NEPAL ELECTRICITY AUTHORITY

(An Undertaking of Government of Nepal)

DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

नेपाल विद्युत प्राधिकरण
Nepal Electricity Authority

TENDER DOCUMENT

for

Procurement of material, equipment, associated accessories and necessary installation services including design, erection, testing, and commissioning of Distribution System Network – Package No. EIB-W5

Package No. EIB-W5 Subprojects: Bajhang, Baitadi, Rukum East and Rolpa Districts

Tender Procedure: Single-Stage Two-Envelope

Issued on:

Invitation for Tenders No.: ***Re-ICB-DCSD-2081/82-DSUEP-EIB-W5***

Contract Ref. No.: ***Re-ICB-DCSD-2081/82-DSUEP-EIB-W5***

Employer: ***Nepal Electricity Authority***

Country: ***Nepal***

Volume II of III

(Technical Specification and Technical Data Sheet for 11 kV Lines, Distribution Transformers and Low-Tension lines)

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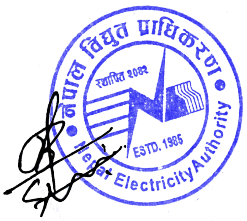
This section contains the general clauses to be applied in all contracts. These Conditions are subject to the variations and additions set out in Section 8 (Special Conditions of Contract).

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1 SCOPE OF SUPPLY OF PLANT AND SERVICES

1.1 General Information

The electricity distribution system of Nepal is being developed side by side with development of generation projects. The provinces of the country have varying degrees of electrification with some having better coverage than others. Sudurpaschim Province has the one of the least coverage in terms of central electricity grid distribution, whereas Lumbini Province also demands considerable upgrade in existing electrical infrastructures. To redress this situation, the government of Nepal has initiated a project to extend supply lines to the western and far western areas as a part of its program "to achieve affordable electricity for all by 2022". Nepal Electricity Authority (NEA) via. the Government of Nepal have received funds from the European Investment Bank (EIB) toward the cost of financing the proposed project entitled Distribution System Upgrade and Expansion Project (DSUEP).

The electricity supply-demand gap in the country persists, due to the following reasons:

- Increasing but insufficient generation capacity
- Seasonal fluctuation of hydro generation, which accounts for 94% of the total installed generation capacity in Nepal
- Inadequate and outdated transmission and distribution (T&D) systems

The electricity supply has been growing significantly, with large investments in new generation capacities and increasing electricity imports from neighboring country. However, upgrading and expansion of T&D networks have not kept pace with the supply growth. As a result, Nepal experiences high system losses and excessive voltage drops, due to the overloading and extended feeder lengths of the existing networks. Sizeable investments are needed to relieve the T&D bottlenecks in Nepal so as to ensure efficient and reliable delivery of electricity to consumers.

The objectives of DSUEP is to expand and upgrade the distribution capacity of electrical grid in number of districts in Lumbini Province and Sudurpaschim Province. This package of the project serves as Technical Specifications for Design, Supply, Installation, Testing and Commissioning of number of sub-projects under DSUEP.

1.2 Scope of Work in this Tender

The following table enlists the list of sub-projects, including the district and province of implementation considered by this document.

Table 1 - Summary of sub-projects of DSUEP considered by this document

S.N.	Funding Agency	Sub-project	District	Province
1	EIB	Bajhang	Bajhang	Sudurpaschim
2	EIB	Baitadi	Baitadi	Sudurpaschim
3	EIB	Rukum East	Rukum East	Lumbini
4	EIB	Rolpa	Rolpa	Lumbini

The Scope of works constitutes 11 kV lines, Low Tension lines and Distribution Transformer installation with accessories as per the specifications and BoQ of the project.

Table 2 - Summary of scope of works is listed below:

S.N.	Sub-Projects	Length of 11 kV lines (ckt km)	Length of LT lines (ckt km)	No. of Distribution Tr. (25/50kVA)
1	Bajhang	192	462	70
2	Baitadi	36	210	34
3	Rukum East	96	210	34
4	Rolpa	36	210	34

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Abbreviations & Acronyms

Acronym	Full form
ABC	Ariel Bunched Cables
AC	Alternating Current
ACSR	Aluminium Conductor Steel Reinforced
BoQ	Bill of Quantity
CAGR	Compounded Average Growth Rate
CSP	Completely Self Protected
CT	Current transformer
DC	Direct Current
DC	Distribution Centre
DSUEP	Distribution System Upgrade and Expansion Project
DT	Distribution Transformer
ESMF	Environmental and Social Management Framework
EIB	European Investment Bank
EUR	Euro
GPS	Global Positional System
GoN	Government of Nepal
GSS	Grid Sub-Station
HT	High Tension
IPP	Independent Power Producers
kV	kilo Volt
kVA	kilo Volt Ampere
kWh	kilo Watt Hours
LILO	Loop-In Loop-Out
LT	Low Tension
LV	Low Voltage

Acronym	Full form
MVA	Mega Volt Ampere
MW	Mega Watt
NEA	Nepal Electricity Authority
NEC	NEA Engineering Company Limited
NPR	Nepalese Rupees
NRs	Nepalese Rupees
PIU	Project Implementation Unit
PSC	Pre-stress Concrete Cement
PSS	Power Sub-Station
RMR	Remote Meter Reading
SAS	Substation Automation System
SCADA	Supervisory Control and Data Acquisition System
SIM	Subscriber Identity Module
TVM	Tri-Vector Meter
USD	US Dollars
VCB	Vacuum Circuit Breaker

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1 GENERAL SPECIFICATIONS

1.1 General

This document enlists the Technical Specifications for HT/LT lines and Distribution Transformers for the sub-projects. Standard requirements of the Installation of HT/LT lines are provided followed by requirements for the distribution transformers. Tender Drawings are provided as part of this volume to assist these specifications.

The 33/11 kV substations will transform the power from 33 kV to lines to distribution system at 11 kV. The details of the lines and transformers are enlisted in the Scope of Supply. Drawings following the technical specs provides SLDs, Schematics of poles, and essential specifications.

Anything mentioned in the Specifications and not shown on the drawings or shown on the drawings and not mentioned in the Specifications shall have the effect as if shown or mentioned in both. In case of difference between the Drawings and Specifications, the Specifications shall prevail. In case of difference between scaled dimensions and figures on drawings, the figures shall prevail.

All components must be insulated for the referenced voltage level and should be rated for higher capacity than the possible current flow through the component.

1.2 Technical Documents

1.2.1 General

This Section specifies the general extent definition and quality of the documents which shall be submitted by the Contractor to the Employer.

Technical documents mean all drawings, diagrams, specifications, lists and schedules, operation and maintenance manuals, and technical information of a like nature provided by the Employer to the Contractor or submitted by the Contractor to the Employer under the Contract.

The Contractor shall provide within one month of the Commencement Date a list of all drawings to be submitted to the Employer for approval. The Contractor shall highlight if he requires approval in less than 15 days, the intended date of submission and the date required for drawing approval.

Technical documents provided by the Contractor shall be folded down to DIN Standard size A4 in size. Prints shall be on durable paper, with dark lines on a white background.

The Technical documents shall show the following particulars either on the title page for A4 size or in the lower right-hand corner for A1 to A3 size:

- Name, Logo and address of Employer
- Name, Logo and address of Contractor
- Project title
- Contract number and title
- Title of technical documents (location, item and detail)
- Scale
- Date of technical documents
- Details of electrical supply (where applicable)
- Technical document number
- Revision identification
- Serial number in accordance with drawing classification system Signature of the Contractor's Representative.

Dimensions on all technical documents shall be in the metric system.

A suitably dimensioned blank space shall be provided as an extension of the title block for the recording of the Contractor's reason for submission "FOR APPROVAL" (A) or "FOR INFORMATION" (I) and the Employer's the approval stamp "APPROVED (A)" or "APPROVED AS NOTED (AN)" or "RETURNED FOR CORRECTION (RC)" or APPROVAL NOT REQUIRED (ANR). Alternatively, the approval stamp can be incorporated in the title block. Provision shall be made for revision details (Revision's Number; Revision's date, Revision's Description, Staff (drawn, checked, approved) appointed in the revision to be recorded above the title block.

Unless specified differently elsewhere, a period of fifteen (15) days after the receipt of design information and drawings shall be allowed for approval or comments. One (1) week shall be allowed for return mail.

Claims or extensions of time will not be granted on account of late submission of drawings to the Employer or for delay caused by drawings not approved the Employer and requiring re-submission. Should the Employer deem a longer period of time necessary for checking certain drawings, he shall inform the Contractor to that effect in writing, within fourteen (14) days of receiving such drawings.

One copy of the submitted drawings will be returned to the Contractor with the following status:

- "APPROVED (A)" or;
- "APPROVED AS NOTED (AN)" (authorizing the Contractor to proceed with the contractual works taking account the Notes) or;
- "RETURNED FOR CORRECTION (RC)" or
- FOR INFORMATION (FI).

In every case, these drawings and documents shall be submitted in time to permit modifications to be made without delaying the completion of the works.

The Contractor shall be responsible for any discrepancies, errors or omissions in the drawings and other particulars supplied by him, whether or not such drawings and particulars have been approved by the Employer/Engineer. It shall be understood that the approval of the drawings will not exonerate the Contractor from any responsibility in connection with the Works.

Technical documents, which are returned for correction shall be revised and resubmitted by the Contractor within 10 days for the final approval. All materials ordered or work performed prior to approval of the relevant designs or drawings by the Employer shall be at the Contractor's risk. When the Contractor prepares his Detailed Program of Work, he shall make allowance for and indicate the dates expected for submission and resubmission of technical documents by the Contractor. He shall also indicate the time for comments and for the approval of the technical documents by the Employer/Engineer. All cost for preparation, submittal, modifications and re-submittal of all documents and information required under this Contract shall be included in the contract price.

The Employer reserves the right to request from the Contractor additional documents as may be required for proper understanding and definition of construction and operation, and for other purposes, such as co-ordination. The Contractor shall co-ordinate between the contracts in the exchange of drawings, dimensions, data and all other information required to ensure proper co-ordination of the work. All documents to be supplied shall be submitted in accordance with the agreed program so that any comment and change requested by the Employer could be taken into account before starting manufacturing in the workshop and/or erection or installation at Site.

If the Contractor fails to submit such documents, then the later execution of changes requested by the Employer and the resulting additional cost and/or delays shall be the Contractor's responsibility. The Contractor shall not be released of his responsibility and guarantee after drawings and computations have been approved by the Employer.

The preparation of drawings, stress analysis, computations or other technical documents shall not be sub-let by the Contractor without the written authorization of the Employer. In such a case the Contractor shall still be fully responsible for such drawings, stress analysis, computations and other technical documents as if he made them himself.

On drawings, catalogue sheets or pamphlets of standard work submitted to the Employer the applicable types, paragraphs, data, etc., shall either be marked distinctively or the non-applicable parts shall be crossed out. Documents not marked in such a manner will not be accepted and approved by the Employer.

If required for proper understanding of the documents, additional descriptions/ explanations shall be given on these documents or on separate sheets. All symbols, marks, abbreviations, etc., appearing on any document shall clearly be explained by a legend on the same document or on an attached sheet.

Each device appearing on any document (drawing, diagram, list, etc.) shall be clearly designated. The abbreviation mark used for an individual device shall be identical throughout the complete documentation so as to avoid confusions. All documents shall have a uniform title-block as outlined in the Specifications and agreed by the Employer. Beginning with the very first submittal to the Employer, the Contractor's drawings shall bear a serial number corresponding to a drawing classification plan to be agreed upon by the Contractor and the Employer.

Revised technical documents replacing previously submitted ones should be marked accordingly. The revised part in the Document itself shall also be marked clearly.

This Section and the Conditions of Contract specify the documents to be supplied and the required status, namely "FOR APPROVAL" (A) or "FOR INFORMATION" (I), respectively.

Any comment given by the Employer on an "I" type drawing shall have the same effect as if it were given on an "A" type drawing.

1.2.2 Drawings

A General Drawings

For all larger pieces of the Works the Contractor shall submit binding loading drawings indicating dimensions, weights, axle loads and the intended means of transportation and hoisting. The loading drawings shall be submitted prior to manufacturing.

The Contractor shall submit foundation drawings, showing his requirements on the civil works, including essential and pertinent information required for design and execution of the works. The arrangement, assembly and execution drawings shall show the physical arrangement of equipment, group of equipment in complete relation with each other.

Arrangement/layout drawings shall be prepared and submitted using software which identifies with different layers the various systems of the layout; layers shall be easily identified, and each may be switched on/off when examining the drawing.

The assembly drawings shall indicate the main dimensions, elevations, tolerances, adjustments, clearances, capacities and the reference numbers of the respective shop drawings and part lists.

The Execution Drawings shall include the shop drawings, erection drawings, piping drawings, process diagrams, part lists, etc., showing the dimensions, design and data of all apparatus and equipment to be furnished under this Contract. Execution drawings of standard components not specifically designed for the project need not be submitted if they fulfill the following requirements:

- Proven standard product (e.g., bolts, seals, relays, switches),
- Certified product (e.g., steel cables, ladders),

For all components, however, which do not require the submission of execution drawings, the respective assembly drawings or catalogue sheets and detailed part lists shall be submitted.

All such drawings shall be drawing according to scale.

B Line Drawings

In addition to the loading, arrangement, foundation, assembly and execution drawings, the Contractor shall investigate the Site and design accordingly without any additional cost to the Employer and provide drawings as discussed in this section. Any Omission from both drawing and the specification or any express reference to any detail or work necessary and obviously intended shall not relieve the Contractor of his responsibility to include that detail of work in his supply and price. Typical drawings of the lines are to be submitted with the Tender showing all essential details of construction of the various items of supply.

The following drawings must be prepared by Tenderers and accompany copy of their tender:

- Outline and general arrangements for all basic types of lattice steel structure with tower loading diagrams and loading calculations for normal and broken wire conditions.
- Ditto as above for poles of all types
- Details of types of foundations with volume of earth work, concrete and rebar. Conductor tension clamps and jumper terminals.
- Earth tension clamps and jumper terminals.
- Conductor non-tension joints.
- Suspension Insulator strings and clamps with all fittings.
- Tension Insulator strings and clamps with all fittings.
- Vibration dampers, Arcing horn
- Conductor final tension charts.
- Drawings and/or other data indicating the method of stringing to be adopted.
- Drawing and/or details of Tools and Equipment.

Drawings need to have leading dimensions only. Structure and drawings should have provisional dimensions of principal members and shall indicate the necessary clearance dimensions for structures for still air and maximum swing of insulator strings and jumpers called for in this specification. The conductor tension charts are to show final sags and tensions for a range of equivalent spans between those approximately 70 percent higher and lower than the basic span

given, in still air at maximum, every day and minimum temperature and the tension at minimum temperature at full wind.

The successful Tenderer will be required, at the time of letting of the Contract, to supply additional copies of the above drawings as may be selected by the Employer. These drawings, together with such drawings originally issued with the Tender Documents will then form part of the Contract Document and be signed both by the Employer and the Contractor for identification purposes.

All designs and drawings submitted with the successful Tender shall be considered preliminary only and not to be considered as approved. Prior to commencement of the work, the Contractor shall submit drawings and data to the Engineer for approval. Should the Engineer direct that modifications be made in order to satisfy the requirements of the Specifications, the Contractor shall submit revised drawings for approval. Alteration in the Contract price shall not be allowed by reason of the drawing modifications.

The Contractor shall submit the following drawings and data to the Engineer for approval:

- Survey drawings,
- Pole drawings including Foundation drawings,
- Procedures for pole testing
- Insulator string assembly and fitting drawings
- Line accessories drawings
- Initial sag and tension tables for conductors ADSS cables including details of calculations necessary for stringing
- Drawings and/or catalogues of insulators, hardware and fittings.

  Approval of the Contractor's drawings shall not in any way relieve the Contractor of any part of his obligation to meet all the requirements of the Contract or of the responsibility for the correction of the drawings.

  The line drawings shall have at least the following labels in addition to labels stated elsewhere in this document.

- Name of the Line Section (if applicable)
- Description of Line Section (if applicable)

1.2.3 Electrical, Process and Schematic Diagrams

A General

Diagrams of electrical system, process, shall be prepared by the contractor. For electrical diagrams general reference is made to IEC 61082-1.

B Single Line Diagrams

This is a simplified diagram of the essential electrical Works and their interconnections. A single line only shall represent each circuit. It shall contain all required technical information of the Works represented, e.g., voltage, power, capacity, short-circuit level, ratios, voltage variations, positive and zero sequence impedance's, measuring transformer and protection relay indices, interlocking, kind of switch drive, code designation, etc.

C Circuit Diagrams

The Circuit Diagrams shall show the power circuits in all phases with the main apparatus as well as the measuring and control circuits. It shall show in full the

functioning of part or all installations, Works, or circuits with all required technical information.

Standard Circuit Diagrams are patterns of circuit diagrams, which have been standardized with regard to scope, arrangement, representation, and allocation of Works with the aim of simplification and easy surveillance of electrical circuitry.

D Connection Diagrams

The internal Connection or Wiring Diagrams shall show the wiring connections either within one apparatus or between several apparatuses of one group. They shall contain the single components or apparatuses of one group arranged in the correct physical location including terminals and terminal boards. The connections shall either be represented by lines or, in case of a "wireless" connection diagram, by a wire table.

The external Connection or Interconnection Diagram shall show the external wiring connections between the different units of an installation.

E Block Diagrams

The Block Diagrams shall be used to show in a simplified manner the main inter-relationships between the elements of a system by means of symbols, block symbols and pictures without necessarily showing all the connections. The symbols used for the individual kinds of components shall clearly be explained on the diagram or on an attached legend.

When recommendable, a Block Text Diagram may be prepared, consisting essentially of explanatory texts enclosed in outlines which are linked by lines showing the functional relationships that exist between the various parts of an installation, equipment or circuit.

F Terminal Diagrams

Such diagrams shall be prepared for any type of terminal box, marshalling rack, control cubicle, switchboard, etc., and shall show the terminals (properly numbered) and the internal and/or external conductors (wires or cables) connected to them. The terminal diagram of each individual switchboard, terminal box, panel, etc., shall contain, but not be limited to the following information:

- Terminal number of terminal boards with targets (terminal number and current path) of incoming and outgoing cables and wires
- Cable designation
- Type of cable
- Number and cross-section of conductors
- Assignment of conductors
- Number of spare conductors
- Approx. length of cable and its destination.

G Protection Coordination Diagrams

These diagrams shall show in a graphical manner separately for each power supply circuit:

- A simplified single-line diagram of the circuit with technical data of all instrument transformers and relays,
- Coordinated tripping curves of related protection devices, Setting of the protection devices.

1.2.4 Specifications

A Material or Equipment Specifications

Based on the data of the selected manufacturer material and/or equipment specifications shall be prepared for all principal equipment and installations. The specifications shall state the manufacturer and the relevant technical data, describe the performance (design, construction, material, dimensions, corrosion protection, etc.) of the equipment, and include a parts list.

For standard equipment such as switchgear, control gear, relays, transmitters, indicators, lighting fittings, and the like, catalogues or pamphlets can be submitted as described.

The technical data of equipment shall include as a minimum:

Normal and exceptional permissible ambient conditions (temperatures, humidity), Normal and exceptional operating conditions,

- Rated current and rated output/capacity,
- Rated flow and pressure data for hydraulic devices,
- Adopted materials,
- Rated voltage and ratio or regulation/setting range,
- Maximum service voltage (according to IEC),
- Power frequency and impulse withstand voltages,
- Short-time (1 and 3s) current rating and design fault currents as maximum dynamic (sub-transient), peak and breaking current,
- Ratio, burden and accuracy of measuring transformers and transducers,
- Type and code No. of protection relays and of instantaneous or thermal releases directly attached to circuit breakers and contactors,
- Specific requirements are described in the following sub-clause.

B Cable Specifications

The Cable Specifications shall include the calculation of the de-rating factors for the individual modes of installation at applicable ambient temperatures and grouping of cables. For each cross section the following data shall be provided:

- The rated current carrying capacity,
- The maximum short-circuit capacity,
- The voltage drop,
- Type, insulation system, armouring and sheathing of cable,
- Type, description and catalogue/pamphlet of cable terminations.

Separate specifications shall be prepared for cable trays, conduits, supporting structures and other accessories.

C Measurement and Control Apparatus Specifications

The accuracy of performance with respect to variable ambient conditions and the power supply requirements shall be included.

1.2.5 Lists and Schedules

A Cables Lists

The Cable Lists shall include for each individual cable the following as a minimum:

- Cable number,

- Cable type,
- Rated voltage,
- Number and size of conductors,
- Overall diameter,
- Cable termination at each end,
- Connection point at each end with cubicle/equipment identification and terminal numbers,
- Cable routing.

B Workshop Test Schedules

Individual schedules for workshop testing of equipment and installations (e.g. materials, machines, transformers, switchgears, control equipment, cables, etc.) shall be prepared. The Workshop Test Schedules shall contain at least:

- Equipment to be tested with Substation identification number,
- Manufacturer,
- Intended place and date of test,
- Type of test and method, performance data, tolerances,
- Applicable standards and specifications,
- Testing authority,
- Certification,
- Presence of the Employer,
- Release for shipment,
- Remarks.

C Site Test Schedules

The scope shall be as in above with modifications relevant to site tests.

D List of Spare Parts, Tools and Appliances

All spare parts, tools and appliances included in the scope of work shall be listed separately for each plant component and piece of equipment. The lists shall contain the following:

- Item and Asset identification number,
- Description with exact reference to the respective piece of equipment,
- Manufacturer,
- Model number, order number, or other manufacturer's identification number,
- Technical data,
- Drawing number,
- Quantity,
- Weight,
- Storage requirements.

The lists shall be appropriate to be utilized with a computerized spare part management system.

E List of identification numbers

An asset identification system shall be established. The lists shall contain the used Asset Numbering System in alphanumeric order and for each of them a description (the defined equipment denomination, for example as written on the equipment label) and the location (short definition of outdoor area and level elevation or building/room with elevation and room number).

F Test Procedures for HT and LT line

The following equipment, apparatus and items shall be tested for HT and LT line,

- Towers – All tower types, to be used for the HT and LT Line need to be tested.
- Poles – All pole types, to be used for the HT and LT Line need to be tested.
- Insulators, hardware and fittings
- Ground Electrical Resistance
- Piles

1.2.6 Calculations

Design calculations, diagrams and operating data, etc. shall be submitted to the Employer with all formulae, standards, test results, basic assumptions, etc. used for these calculations. Submission of the calculation results only, i.e. computer printouts only will not be accepted.

The short-circuit calculations shall be performed in accordance with IEC 60909.

These studies shall be performed for all relevant switchgear and equipment configurations.

Based on the prevailing site conditions a lightning protection study shall be performed to define the necessary lightning protection measures for the entire project.

The minimum size of cable connections shall be calculated applying the maximum admissible temperatures and ratings for continuous and short circuit conditions. The results shall be shown in a table containing at least:

- Maximum initial symmetrical short circuit current
- The rated current,
- The breaker setting range,
- The resulting minimum cable cross section,
- The applicable standard cross section.

The transformer ratios and tap changing ranges shall be determined with due consideration of the network requirements and as agreed upon with the Client.

For lines, additional calculations required for Tower design, tower foundations design, pole foundation designs, pole design, earthing design and current rating of each part of the HT and LT line shall be determined as per approved procedure by the Employer.

The detail design of pole, tower or both shall be carried out based on the survey data. The poles shall be as per the drawings, and the Contractor shall carry out detail calculations assuring the validation of the design. Any poles and pole structure essential in addition to those mentioned in the design drawings shall be selected from IS 2713 as far as possible and PSC pole with details. The employer will accept variations supported by detail calculations, and the payment shall be carried out on weight basis.

1.2.7 Instruction Manuals

A Contents

Instruction Manuals shall describe the complete Works and shall give a step by step procedure for any operation likely to be carried out during the life of the Works after the site delivery, including identification, erection, setting to work, testing, commissioning, operation, maintenance, dismantling, repair,

adjustment and reassembly of all parts of the Works. The greatest importance shall be attached to completeness and presentation. Instruction manuals Table of Contents shall be submitted to the Employer within 30 days from the Commencement Date

The "Installation Manuals" shall be provided by the Contractor and shall contain all the information necessary to clearly show the erection procedure that the Contractor intends to adopt. The Manuals shall be submitted to the Employer for approval at least thirty (30) days before the shipment of the relevant equipment in order to have the possibility, in case of disagreement of the Employer, to carry out the necessary modifications in the workshops.

The "Operation and Maintenance Manuals" to be provided by the Contractor shall contain the following information in sufficient detail to enable the Employer to maintain, dismantle, repair, reassemble, adjust and operate the Works with all its equipment and installations:

- Table of Contents
- List of Illustrations
- Introduction
- Detailed Description
- Operating Principles and Characteristics
- Operating Instructions
- Testing and Adjustment
- Maintenance Instructions

B List of Illustrations

The list shall contain in alphanumeric order all drawings, sketches or any kind of illustration required for a proper understanding of the equipment.

C Introduction

The Introduction shall comprise:

- General description of the equipment,
- Brief description of the use of the equipment,
- Definition of technical terms used throughout the manual,
- A complete list of all items in accordance with the Plant Identification System.

D Detailed Description

The Detailed Description shall give complete and precise information on the equipment, all components and ancillaries, their assembling and dismantling. An accurate list stating clearances, tolerances, temperatures, fits, etc. shall be included.

E Operating Principles and Characteristics

The technical operating principles and specific characteristics of the equipment shall be summarized briefly, including among others P & I diagrams, circuit diagrams, sequence diagrams, etc.

F Operating Instructions

The instructions shall be precise and easy to understand, and shall contain the sequence of individual manipulations required for operation. The information shall be presented in such a manner that the contents of this paragraph can be used for instructing personnel in the operation of the equipment. Tables, lists

and graphic presentations should be used whenever possible for making the description readily understandable.

The entire testing and adjustment procedure required for the plant after overhauls and during operation shall be described. The description shall be as illustrative as possible with reference diagrams, as applicable.

G Maintenance Instructions

This section shall be divided into five paragraphs:

- Preventive Maintenance: Indicating the inspections required at regular intervals, the inspection procedure, the routine cleaning and lubricating operations, the regular safety checks and similar steps.
- In addition, a maintenance schedule shall be prepared, listing the required activities in daily, weekly, monthly, quarterly, yearly, or other cycles. This document shall provide brief and yet fully comprehensive information including all references to the applicable detailed maintenance instructions.
- Repair and Adjustment: Describing the inspections, fitting and dismantling of parts, error search, repair and adjustment procedures. An appropriate trouble-shooting list shall be included.
- List of Spare Parts
- List of Tools and Appliances
- List of Suppliers, indicating name and complete address.
- As-built drawings in AutoCAD format software files (dwg or .dxf) on non-rewritable compact laser disks ("CD-R disks") and USB drive.

H Editing

The Employer reserves the right to specify a uniform cover, e.g., loose-leaf binder, for the Operating and Maintenance Manuals. Furthermore, the Contractor shall adapt upon request his drawings (single line diagrams, wiring diagrams, terminal diagrams, etc.) to drawings of Sub-Contractors/Manufacturers/Suppliers in order to facilitate maintenance, surveillance, fault tracing, etc. The Contractor shall not be entitled to claim extra payment for these requirements.

Reference drawings, sketches and illustrations shall not exceed DIN A3 size.

Catalogue sheets, printed specifications, etc., shall be checked and prepared by the Contractor in such a way that the figures, statements and data valid for the delivered sizes and types of equipment are clearly marked. All figures, statements and data not applicable shall be crossed out or deleted. In addition to the agreed number of the MOM hard copies the MOM shall also be provided on CD-ROMs together with a suitable computer, software and A3/A4 printers.

I Revisions and Supplements

The completeness of the manuals shall be checked jointly by the Contractor and the Employer during installation, testing, commissioning and trial operation.

If it becomes evident during the installation, trial operation and guarantee period of the equipment that the Operation and Maintenance Manuals are inadequate or incorrect, the Contractor shall supply immediately the necessary supplements and corrections. This shall be handled in the following manner:

- Deletions

  One sheet of errata, printed on pink paper, shall be issued indicating the pages and date of issue of those pages which are to be deleted and are no longer valid.

- Corrections, Revisions, Replacements

  New sheets shall be issued to replace the wrong pages. Whenever a new sheet is added to the manuals, this sheet shall be given the new date of issue, a revision symbol, an indication "Substituted for ... " and a marking of the corrected/revised items.

- Insertions, Supplements

  Insertions or supplements shall be accompanied by a new Table of Contents, where the latter shall be handled as correction.

  The revisions and supplements requested by the Employer shall be submitted in each case to the Employer for checking.

J Progress Reports

Before the tenth (10th) day of each calendar month the Contractor shall submit copies of the monthly progress reports in a format acceptable to the Employer, detailing the progress of the work during the preceding month. The document shall report on the status of the work during the whole duration of the contract, starting from the commencement date. The report shall contain, but not be limited to, the following information:

- General descriptions of the Works performed during the reporting period on each main activity and include notable problems, which were encountered.
- The percentages of each main work activity completed during the reported month compared with the scheduled program. Appropriate comments shall explain any differences.
- The total overall percentages of erection work completed with reference to the actual construction program. Appropriate comments shall explain any differences.
- A list of all activities of scheduled and actual progress during the reporting period including actual starting dates compared with scheduled starting dates and actual completion dates compared with scheduled completion dates for each activity. Appropriate remarks shall explain any differences.
- A list of activities scheduled to be started within the next period of 90 day, with expected starting and completion dates and expected quantities thereof. If the expected starting and/or completion dates are different from those shown on the actual construction programme, an explanation shall be given.
- A list of local manpower (by trade classification) employed during the reporting period and a statement about labour relations and an explanation of an actual or potential problem.
- A list of local and expatriate supervisory staff (number, name and position) employed during the reporting period.
- Electric power consumption at various feeders.
- A list of the Contractor's equipment and materials presently stored at Site. A list of equipment and materials which arrived at the port of entry and is in the process of being cleared through customs shall also be included.
- A list of equipment and materials delivered at site complete with the list of the detected unconformities/damages upon arrival.
- Progress photographs of significant events. The Employer may ask to include specific photographs if deemed necessary.
- Charts and detailed descriptions of progress, including each stage of design (if any), Contractor's Documents, procurement, manufacture, delivery to

Site, construction, erection, testing: and including these stages for work by each Subcontractor. xiv. Critical path analysis updated to reflect the actual progress of the works. xv. S-curve updated to display actual versus early and late planned progress. xvi. Comparisons of actual and planned progress.

- Main items of temporary facilities constructed during the reporting period.
- Details of any delay affecting activities such as design, material procurement, manufacture, shop tests, shipping, site work/site installation, testing and commissioning.
- For the manufacture of each main item of Plant and Materials, the name of the manufacturer, manufacture location, percentage progress, and the actual or expected dates of:
  - commencement of manufacture,
  - Contractor's inspections,
  - tests, and
  - shipment and arrival at the Site
- A statement detailing the status of progress on the overall program and how to regain any lost time or setbacks, which may have occurred.
- A list of inoperable and/or temporary inoperable equipment and the estimated date when the repair/replacement will be completed and any fire occurred.
- A list of accidents at site involving the hospitalization and/or death of any person and a list of any accidents in which equipment was damaged to the extent it needed repair or became inoperable.
- A statement concerning effectiveness of the security program and a list of major thefts.
- Financial status of the works, including a list of the amount and date of any payments received during the reporting period and the amount of any monthly invoice, which has been submitted but not yet paid.
- A list of quantities of each work, including Temporary Works, performed during the month, and illustrations showing the exact location of work done such as concrete lift schedule.
- A quantity list of the Contractor's construction material consumed or used during the month and accumulated totals thereof and materials now on site.
- A list of claims submitted during the reporting period complete with relevant notices given under sub clauses 2.5 [Employer's Claims] and 20.1 [Contractor's Claims] including the claimed cost and extension of time.
- A statement concerning potential problems and recommendations on how they could be solved.

1.2.8 Submission of Technical Documents

A Numbers to be submitted

All technical documents to be submitted by the Contractor under the Contract, shall be submitted in the following number of copies:

Document		No of Copies to be Submitted to Employer
1	**General Technical Documents:**	
1.1	Draft version for Approval	3H + 2 E

Document		No of Copies to be Submitted to Employer
1.2	Final version after Approval including correction	4H + 2 E
2	**As-built Drawings:**	
2.1	Draft version for Approval	3H + 2 E
2.2	Final version after Approval including corrections	12H + 6 E
3	**Operation and Maintenance**	
3.1	Preliminary version 112 days prior to commencement of Commissioning	3H + 2 E
3.2	Final Draft version for Approval	3H + 2 E
3.3	Final version after Approval including corrections	12H + 6 E
4	**Commissioning Manuals:**	
4.1	Tentative version for Approval	4H + 2 E
4.2	Final version after Approval including corrections	12H + 6 E

Key:

H = Hardcopy (paper or other as appropriate);

E = Electronic copy, with fully open accessibility, editing and user capability, stored on DVD and USB/HDD and other approved electronic mediums.

The 2 Electronic Copy shall be on different storage system (e.g., DVD and USB or USB and HDD, etc.) All such submissions shall include editable type as well (e.g., word files/latex files of reports, pdfs, CAD files or relevant drawing files of specific software etc.)

B Deadlines for Submission

The technical documents to be submitted by the Contractor under the Contract shall be submitted in accordance with the latest deadlines stipulated in the following table. Any changes required in the deadlines shall be reflected in the updated deadlines for submission table, as agreed by the Client and Contractor in writing.

Table 1: Submission of Technical Documents etc. for Approval

1	**Within 28 days after the Commencement Date:**
1.1	Detailed time programmed in accordance with the Conditions of Contract
1.2	90-day Engineering Programme in accordance with the Conditions of Contract, first issue
1.3	Drawing classification plan and drawing cover sheet layout
2	**Within 60 days after the Commencement Date:**
2.1	Principle drawings and schematic diagrams
2.2	List of detailed manufacturing drawings with submission dates
2.3	Electrical power requirements during erection

2.4	Program of performance tests, material and workshop tests to be carried out
2.5	Detailed Quality Assurance scheme for the Site Works
2.6	Site installation drawings and Instruction Manuals Table of Contents
3	**Within 90 days after the Commencement Date:**
3.1	Outline drawings of the equipment
3.2	Stress analysis for main components and any other calculations as required in the Technical Specification
3.3	Foundation drawings including design loads on foundations and details of anchoring and support required
3.4	Assembly drawings of the equipment with details of materials intended to be used
3.5	Electrical, control and protection schematic diagrams
3.6	Schematic diagrams for water, oil and air systems (if present)
3.7	Basic Design, comprising drawings and calculations
3.8	Drawings for pipe routing, air duct and cable rack routing, with dimensions for block-outs
3.9	Detailed information on products for, and application of, shop and site painting
4	**Within 28 days after a request for information by the Engineer:**
4.1	Revised drawings, specifications and data sheets
4.2	Any revised information which has not been approved earlier
5	**Prior to the commencement of manufacture:**
5.1	Detailed manufacturing drawings with all important dimensions, final assembly drawings, automation and control schemes, tubing and piping schemes, cabling and wiring diagrams and block and circuit diagrams intended to aid understanding and to provide full information about the principles of operation
5.2	Performance and stress calculations as the Engineer may require
5.3	Plant design calculations
5.4	Stability and regulation characteristics calculations
5.5	List of sub-orders
5.6	Detailed information (type, make, etc.) on products used for priming and painting of all components
6	**During Manufacture:**
6.1	Progress reports at monthly intervals
6.2	Notices of tests and shop inspections
6.3	Inspection reports
6.4	Certificates of tests and inspections
7	**Not less than 15 days prior to shipment:**
7.1	Loading lists of each consignment

7.2	Instructions for loading, unloading, handling, and precautions for storage on Site
8	**Not less than 60 days prior to the commencement of erection:**
8.1	Erection procedures and instructions (the "Installation Manual")
8.2	All approved drawings
8.3	List indicating special lifting devices and special tools
8.4	Detailed erection program
8.5	Inspection program indicating main activities of inspection, including a site test schedule
9	**Not less than 15 days prior to the commencement of erection:**
9.1	All policies of insurance related to the site work
9.2	90-day Installation Programme in accordance with the Conditions of Contract, first issue
10	**During erection:**
10.1	Progress reports at monthly intervals
10.2	Work logbook reporting on the day-to-day activities, at monthly intervals
11	**Not less than 90 days prior to the commencement of commissioning:**
11.1	Tentative Commissioning Manuals, containing detailed program and description for commissioning tests for each Section
11.2	Preliminary version of Operation and Maintenance Manuals
12	**Not less than 60 days prior to commencement of commissioning:**
12.1	Detailed instructions, conditions and procedure of Test Service Operation
13	**Prior to Taking-Over the Works:**
13.1	Final Commissioning Report and "Commissioning Manual" updated with data added during commissioning
13.2	Draft version of "As-built Drawings" for Approval
13.3	Final Draft version of Operation and Maintenance Manuals for Approval
13.4	Final Operating and Maintenance Manuals
13.5	Final "As-built Drawings"

1.3 Spare Parts, Tools and Appliances

1.3.1 General

A spare part management system shall be implemented by the Contractor. The program will be utilized by the personnel of the Employer under direction of the Contractor. The program shall be capable of controlling the receipt of spare parts at the Site, maintaining stock, and controlling the issue of parts.

The Contractor shall operate the program and be responsible for storing spare parts until the issuance of the Taking-Over and Performance Certificate or equivalent for the last equipment as part of the Contract unless the Employer will accept an earlier transfer.

The spare parts are also liable to the warranty clause and conditions as stipulated under General Conditions and Conditions of Particular Application. The duration for warranty shall commence after handing over of all spare parts to the Employer.

In case of failure of any original part/component of the equipment and where such failures are due to faulty design, material and workmanship, spare parts supplied for such components/parts shall also be replaced without any extra cost to the Employer. Such replaced spare parts shall have the same guarantee period as applicable to the replacement made for the defective original part/component.

All spare parts supplied shall be absolutely interchangeable with each other and with the parts for which they are intended to be replaced. If the Employer observes that such interchangeability is not met to the extent required, he reserves the right to return all such parts which do not fit to the Contractor within the period of 2 years after handing over, who in turn is to supply immediately new spare parts free of charge.

The spare parts shall be treated and packed for long term storage under the climatic conditions prevailing at site. Each spare part shall be clearly marked or labelled on the outside of its packing with its description and tag number.

Packing shall be such that it can be opened and removed for checking during handing over but reused to the maximum possible extent.

The Contractor shall guarantee the long-term availability of spares for five years after taking over. Prior to stopping the production of spare parts for the equipment under this Contract the Contractor shall give at least twelve (12) months advance notice so that the Employer will have the opportunity to order the required quantity of spare parts.

The Contractor shall check and/or test at site, in the presence of the Employer, the spare parts, tools and appliances. Acceptance of any of these items will not take place until the Contractor has submitted the final lists.

1.3.2 General Spare Parts

The quantity of general spare parts specified below shall be included in the Bid Price and the Accepted Contract Amount and shall be consequently supplied under the Contract.

If the same spare parts are listed under General Spare Parts and under Special Spare Parts, the quantity listed under Special Spare Parts shall take priority over the quantity stipulated under General Spare Parts.

General Spare Parts are classified in the following categories:

A Wear and Tear Items

Wear and tear items shall be defined as such, which require replacement several times during the service life of the assembly.

Hence, for a number "**N**" of like and identical assemblies such as workshop equipment, etc., "**X**" sets of the following spare parts shall be delivered, whereas one set shall be defined as the total quantity for one assembly:

- Frequently actuated springs

B Customary Spare Parts

In addition to above, "**X**" sets of the following spare parts shall be furnished:

- Seals, gaskets, and packings
- Thermometers, pressure gauges, flow meters, level indicators (with and without contacts) (if applicable)

- Transducers 4-20 mA for temperature
- Lamps, signal lamps, push buttons and switches
- Fuses, clamps, terminals
- Limit switches, relays
- Springs.

For a number "N" of identical standard valves, "X" spare valves including drives shall be delivered. The following valve types shall be considered as standard:

- Safety valves
- Aeration and venting valves

C Miscellaneous

5% of the corresponding total amount, but at least two pieces of all bolts, screws, nuts, washers, spanner rings and cotters shall be furnished. The quantity may be taken from the surplus handed over to the Employer after completion of the erection.

5% of the respective quantity of painting material, but at least one litre, in new sealed containers, shall be furnished as touch up paint.

The quantity "X" of the General Spare Parts to be furnished is a function of the number "N" of identical or similar assemblies supplied under this Contract. The quantity "X" shall be determined as follows:

Number "N"	Quantity "X"	Remarks
< 3	1	-
< 10	2	-
> 10	N/10+ 1	Rounded up to the next higher integer number

In case identical assemblies are provided in a redundant arrangement, "X = 1" shall be set as quantity irrespective of the number "N" of supplied assemblies.

Parts with the following special properties and/or sizes are not considered as General Spare Parts:

- Bolts, screws, nuts, washers, spanner rings and cotters with a nominal diameter of more than 80 mm
- Valves with a nominal diameter of more than 600 mm
- Main seals for, access doors and openings with 2.40 m in straight length or circumference

1.3.3 Special Spare Parts

Spare parts defined in the Technical Specifications as Special Spare Parts shall be included in the Bid Price and the Accepted Contract Amount and shall be supplied under the Contract. The price for each listed special spare part shall be quoted individually in the Price Sheets.

1.3.4 Recommended Spare Parts

Additional spare parts recommended by the Bidder shall be stated in separate Price Sheets with description, quantity and itemized prices.

The prices for the Recommended Spare Parts shall not be included in the Bid Price.

Orders for additional spare parts recommended by the Bidder shall be optional to the Employer for a period of three years after the Commencement Date.

1.3.5 Tools and Appliances

The Contractor shall furnish the tools and appliances stipulated in the Technical Specifications or otherwise required for assembly, disassembly and maintenance of all equipment supplied under the Contract. The prices for aforesaid items shall be included in the Bid Price and the Accepted Contract Amount.

Tools includes customary or special tools, and appliances includes lifting devices, ropes, etc.

1.4 Design and Manufacture

1.4.1 General

The technical requirements are valid for all parts of the Technical Specifications, with the exception where additional and/or special requirements are specified.

Whenever a Bidder deviates from the Specifications, he shall furnish the data called for in the Technical Data Sheets and give a summary of and the reasons for all deviations in the "List of Technical Deviations from the Specifications". Failure to accomplish this may cause the elimination of his Bid, especially when a major deviation is involved.

All changes to the Contractor's Proposal of any part of the equipment which may become necessary after signing the Contract have to be submitted in writing to the Employer for approval, being sufficiently substantiated and justified.

The parts of the Works shall be designed and arranged so that they can be easily inspected, cleaned, erected and dismantled without involving large scale dismantling of other parts of the Works. They shall be designed and manufactured in accordance with the latest recognized rules of workmanship and modern engineering practice.

All parts of the Works shall be suitable in every respect for continuous operation at maximum output under the climatic and operating conditions prevailing at the Site. Problems of matching at delivery limits of equipment supplied by different partners/subcontractors shall be solved directly by the Contractor and shall be defined in writing.

Suitable lifting and hauling eyes shall be provided where required or where they will be useful for erection and dismantling. Pockets and depressions likely to hold water shall be avoided, and if not avoidable they shall be properly drained.

All design details, layout and construction matters shall be discussed in periodic meetings with the Employer. The first design discussion (pre-design meeting) between the Contractor and the Employer shall take place within thirty (30) calendar days after the signing of the Contract Agreement. Further design and construction meetings shall take place periodically as agreed between the participants until the design work is completed.

1.4.2 Standardization of Equipment

As far as possible, measures shall be taken to standardize parts of the equipment throughout the Works in order to facilitate stock keeping, maintenance, replacement, interchangeability, etc.

The Employer, therefore, reserves the right to request the Contractor to use certain types or makes of equipment and materials. The Contractor shall not be entitled to claim extra payment due to this request. This request shall especially be applicable to small mechanical and electrical equipment such as:

- Thermometers
- Terminals and terminal racks

- Indicating instruments and meters
- Auxiliary relays
- Contactors, fuses
- Control devices

The types or makes to be used shall be decided later by the Employer/Engineer.

1.4.3 Equipment Identification

A Identification Plates

i General

Each important part delivered under this Contract shall be fitted with permanent identification plates in readily visible locations. Whether a part shall be considered as important in this respect shall be decided by the Employer.

The identification plates shall be protected during erection. Damaged or illegible identification plates shall be replaced by new ones. The identification plates of non-corroding, non-deteriorating material shall be inscribed in English (except manufacturer's nameplates of small, standardized components). The inscription shall be printed, punched or engraved, waterproof, oil-proof and wear resistant. Large equipment nameplates shall be of stainless steel. Wording, size and material of all labels and plates shall be subject to the approval of the Employer, except nameplates of small, standardized equipment.

ii Manufacturer's Nameplates

The following data shall be shown in accordance with the relevant standards:

- Manufacturer's name and address
- Equipment's serial number and date of manufacture
- Main design data.

As a general rule, standardized components, such as transformers, instruments, etc., may be delivered with the manufacturer's standard nameplate which shall be completed at the request of the Employer.

iii Function Plates

Each part appearing under a certain symbol or number in functional diagrams, piping diagrams, in the Operation and Maintenance Instructions, etc., shall be equipped with a plate showing the same symbol or number. Reference is given to "Asset Numbering System".

iv Instruction Plates

All plates showing designations or instructions for operation, safety, lubrication, etc., shall have a uniform design.

B Color Codes

The color code for equipment, such as transformers, switchgears, etc., shall be in accordance with the indications of Annex and as agreed upon after award of the Contract.

1.4.4 Workmanship

A General Requirements

For general performance of workmanship reference is given to General Conditions of Contract.

The Contractor shall level and adjust all parts of the equipment on the foundations. After approval is given by the Employer, grouting or concreting will be carried out and verified by the Contractor. The Contractor shall be responsible for ensuring that such work is carried out to his/her satisfaction and that the levels and adjustments made by him are not disturbed by the grouting operation. The Contractor shall be responsible for ensuring that the positions, levels and dimensions of the works are correct according to the drawings, notwithstanding that he may have been assisted by the Employer on said positions, levels and dimensions.

B Finished Surfaces

Where the finish is not indicated or specified, the type of finish shall be that type which is most suitable for the surface to which it applies and shall be consistent with the class of fit required.

Surfaces to be machine-finished shall be indicated on the shop drawings by symbols. Compliance with the specified surface shall be determined by the sense of feel and by visual inspection of the work compared to applicable "Standard Roughness Specimens", or with roughness feeler gauge instruments. The Contractor, at the request of the Employer, shall procure both "Standard Roughness Specimens" and feeler gauge instruments.

C Unfinished Surfaces

As far as practicable, all work shall be laid out to secure proper matching of adjoining unfinished surfaces. Where there is a large discrepancy between adjoining unfinished surfaces, they shall be chipped and ground smooth, or machined to secure proper alignment.

Unfinished surfaces shall be true to the lines and dimensions shown on the drawings and shall be chipped or ground free of all projections and rough spots. Depressions or holes not affecting the strength or usefulness of the parts shall be filled in a manner approved by the Employer.

D Protection of Machined Surfaces

Machine-finished surfaces shall be thoroughly cleaned of foreign matters. Finished surfaces of large parts and other surfaces shall be protected with wooden planks or other suitable means. Unassembled pins or bolts shall be oiled or greased and wrapped with moisture-resistant paper or protected by other approved means.

E Chamfers, Edges and Rounding

The edges of surfaces to be painted shall be rounded (minimum radius 2 mm) or chamfered accordingly. This requirement must be stated in all shop drawings for the relevant parts.

1.4.5 Corrosion Protection

The Contractor's services shall cover the procurement of all materials, and the preparation and application of the painting and other protective coats as specified; all costs shall be included in the Bid Price.

Unless otherwise specified under the Employer's Requirements, painting shall be done in accordance with ISO 12944 "Paints & Varnishes - Corrosion protection of steel structures by protective paint systems (parts 1-8)" or other equivalent standards approved by the Employer.

A Warranty

The guarantee period for all corrosion protection work shall be 3 years, starting from the date of the issue of the "Taking-Over Certificate". This guarantee

period shall be effective regardless of any other guarantee periods for the project or parts of the project, or any "Defects Notification Period" or even "Performance Certificate", issued prior to the elapse of the painting guarantee period.

The Contractor shall perform requested painting repair work at no charge for the Employer if the painting quality guarantee is not met.

B Galvanizing

Unless otherwise specified, all structural steel and all exterior and interior steel surfaces of outdoor equipment, as well as bolts and nuts associated with galvanised parts shall be hot-dip galvanised, electro galvanised, as may be appropriate to the particular case.

Galvanising shall be performed in accordance with DIN ISO 1461 and EN 50341.

i Material

For galvanising, only original blast-furnace raw zinc shall be applied, which shall have a purity not less than 98.5%.

The cover of the zinc coat shall be:

- For bolts, nuts, and all other parts intermittently or permanently submerged in water, approx. 500 g/m^2,

ii Cleaning

All material to be galvanised shall be carefully cleaned of rust, loose scale, dirt, oil, grease, and other foreign matters. Particular care shall be taken to clean slag from welded areas.

In case pieces are of such dimensions that they cannot be dipped in one operation, great care shall be exercised to prevent warping.

Finished compression members of steel structures shall not have lateral variations greater than one-thousandth of the axial length between the points which are to be supported laterally. Finished tension members shall not have lateral variations exceeding 3 mm for each 1.50 m of length. Materials with sharp kinks or bends shall be rejected. All holes in material shall be free of excess spelter after galvanising.

iii Galvanising of Hardware

Bolts, nuts, washers, locknuts and similar hardware shall be galvanized in accordance with the relevant standards. Excess spelter shall be removed by centrifugal spinning.

All plates and shapes which have warped during the galvanising process shall be straightened by re-rolling or pressing. The material shall not be hammered or otherwise straightened in a manner that will injure the protective coating. Materials that have been harmfully bent or warped in the process of fabrication or galvanising shall be rejected.

iv Repair of Galvanising

Material on which galvanising has been damaged shall be re-dipped unless the damage is local and can be repaired by soldering or by applying a galvanising repair compound; in this case, the compound shall be applied in accordance with the manufacturer's instructions.

v Soldering

Soldering shall be done with a soldering iron using 50/50% solder (tin and lead).

Surplus flux or acid shall be washed off promptly and the work shall be performed so as not to damage the adjacent coating or the metal itself. Any member on which the galvanised coating becomes damaged after having been dipped twice shall be rejected.

1.5 Quality Assurance Plan

1.5.1 Scope

The Contractor shall prepare a detailed quality assurance plan for the Project consistent with his ISO 9000 certification. The quality assurance plan shall provide details of all quality assurance procedures as applied to the facilities, any quality control interventions required to be witnessed by the Employer, all references to drawing control, inspection or testing documents, and all quality assurance documents that will be produced during the manufacture, installation and commissioning of the facilities. It shall include but not be confined to, the tests and inspections included in the Specification.

The quality assurance plan shall be issued by the Contractor's duly authorised officer and submitted to the Employer for approval. Following approval, the Contractor may not vary the requirements thereof without the explicit approval of Employer. The Employer may, at any time, audit the quality assurance documents and the implementation of the quality assurance plan.

These quality management requirements shall apply to all activities during design, procurement, manufacturing, inspection, testing, packaging, shipping, storage, site erection and commissioning.

The Contractor shall have sole responsibility for ensuring compliance with each of these requirements as applied to the whole of the Contract Works, and shall ensure that subcontractors implement those quality activities that are appropriate to the extent of their supply.

1.5.2 Document Submittal

In addition to any document submittals required by other parts of the Specification, the Contractor shall forward the following Quality Control documentation to the Employer as indicated.

The Contractor shall submit Quality Manuals, standard QC plans for main items of equipment, installation procedures, and other such documents, within 28 days from the Commencement Date.

These documents will be resubmitted to include the necessary details during the execution of the Contract.

Documents shall be supplied to indicate the following:

- Identification of main items to be supplied, with names of supplier and manufacturer (if different from supplier) and location of place of manufacture.
- Manufacturing programs for each major item of equipment, showing main stages of design, procurement, manufacture, inspection and testing.
- Site erection and commissioning programs, showing all controls, inspections, tests and safety procedures.

1.5.3 Particular Quality Requirements

These particular requirements identify the elements of quality control considered necessary to ensure compliance with the specified Contract requirements and it is these elements that the Employer will examine to verify that compliance has been achieved.

Details of the structure and methods used for establishing and implementing these control elements are not stated, since there are many acceptable ways of achieving a satisfactory system of control. The manufacturer's established structure and methods shall be used whenever these are capable of complying with the Technical Specifications stated in the following clauses.

1.5.4 Organization

The Contractor shall establish an organization for the control of quality, and all personnel so designated shall have defined responsibilities and the authority to identify and evaluate quality problems, and to ensure that adequate remedial actions are implemented.

The Contractor shall ensure that responsibilities are assigned for advising the Contract requirements to subcontractors and manufacturers, and the monitoring of compliance with those requirements.

1.5.5 Planning

The Contractor, immediately after Award of Contract, shall perform a complete review of the Contract and take timely action to ensure that the necessary quality control procedures and provisions are established in accordance with this Specification, purchase order, applicable codes and standards, or other Contract Documents.

Particular care shall be taken to identify any specified requirements that are different from or additional to a manufacturer's normal design or quality control practice, and to initiate the necessary measures to ensure that such additional requirements are implemented satisfactorily.

The Contractor shall prepare a quality plan for the complete Contract Works, and shall require individual manufacturers to prepare detailed quality plans for all main items of equipment. Quality plans shall identify all inspections and tests which are to be carried out, including those necessary to verify compliance with particular specified requirements.

1.5.6 Design Control

The Contractor shall be responsible for control of all design functions for the Contract Works. When design responsibility is shared by subcontractors, the Contractor shall establish interface control measures which co-ordinate the control of the whole design process.

The Contractor shall provide controls to ensure that specified design requirements, codes and standards are correctly incorporated into specifications, drawings, procedures and instructions. All designs and drawings, including those produced by subcontractors, shall be checked and approved by Contractor's personnel, other than the originator.

Drawings and designs submitted for the Employer's approval will not be accepted if there is no evidence of checking by the Contractor, of it the quality of the document's contents clearly indicates that any check carried out was not competent.

1.5.7 Procurement Document Control

The Contractor is responsible for ensuring that all procurement documents issued to subcontractors contain or reference all applicable requirements specified in the Specification which are necessary to enable the Contractor to fulfil those requirements. The Contractor shall also verify that all subcontractors purchase orders onto manufacturers or other suppliers similarly identify all applicable requirements

1.5.8 Document and Change Control

The Contractor shall establish measures to control all documentation that relates to the quality requirements detailed in the Specification. The measures shall ensure that only current issues of documents are used at all manufacturing and control points.

1.5.9 Control of Purchased Material, Equipment and Services

The Contractor shall be responsible for ensuring that all purchased material, equipment and services conform to the Contract requirements.

All purchased material or equipment shall be subjected to inspection control by the Contractor, either on receipt, or before dispatch from the manufacturer's works.

No material or component shall be obtained by the Contractor or his subcontractors from any source which has not been previously audited by a responsible party and designated as an approved supplier. The Employer may, at his discretion, require evidence that such audits have been satisfactorily made and/or evidence of the competence of the designate supplier to meet the necessary quality requirements.

1.5.10 Control of Inspections and Tests

The Contractor shall ensure that all manufacturer's inspections and tests are satisfactorily carried out, in accordance with the planned programme and that the data recorded is acceptable. On completion of manufacture, sufficient inspection and testing shall be carried out to complete the full verification that all equipment conforms to all specified requirements.

1.5.11 Handling, Storage and Delivery

The Contractor shall ensure that adequate and controlled measures are established for cleaning, protection, preservation, packing, handling, storage and shipping, to protect items from damage, deterioration or loss. When the nature of the item indicates the need for special handling equipment, this shall be specified and verified by the Contractor.

The identification, marking and labelling of items of shipping shall comply with contractual requirements, and shall be applied in a manner that will ensure no loss of identity and permit permanent and easy recognition of special handling and storage requirements.

1.5.12 Inspection and Test Status

The Contractor shall ensure that measures are established for all material and items that will prove, at any point of manufacture, that the manufacturer's planned inspections and tests up to that point have been carried out.

1.5.13 Site Installation and Commissioning

The Contractor shall ensure that all Site installation and commissioning controls, inspections and tests, are carried out in accordance with the planned programme, and that data recorded is adequate to permit the Employer to verify that the whole of the Contract Works are in full compliance with all Contract requirements and specifications.

1.5.14 Implementation

In order to achieve the Quality Management Requirements specified above, the Contractor shall designate senior engineers with sufficient authority who will be solely responsible for the Quality Management of the Project. These engineers shall be independent of any other design, manufacturing, inspection, testing and site erection activities associated with this Contract.

One engineer will be responsible for all activities associated with design, procurement, manufacture, inspection, testing, packing and shipping whether undertaken by the Contractor, or by his designated subcontractor or supplier and will be normally resident at the Contractor's Head Office or principal place of work. The other engineer will be responsible for all activities associated with site erection and will be resident at the Contractor's Site Office.

The main responsibilities of the Quality Management engineers are given below:

Head Office

- Production and implementation of all Quality Manuals, Standards and test and inspection programs for all materials ordered. All Q.Ms and Q.Ss and programs shall be submitted for approval to the Employer prior to implementation.
- Verifying/Certification that all design and drawings prior to submission to the Employer are in accordance with the Specification and all relevant Standards/Codes of Practice.
- That all orders placed for materials are in accordance with (1) above, and that only the latest revision of approved drawings is used in the course of manufacture.
- That all manufacturers/suppliers have acceptable Quality Control procedures and that these have been implemented throughout the execution of the work. All Q.Cs shall be submitted for approval to the Employer prior to their implementation.
- That all test and inspections are undertaken to agreed Standards and Codes of Practice and that the test/inspection results meet or exceed the specification requirements.

Site Office

- Production and implementation of all Quality Manuals, Quality Standards and test and inspection programs relating to all site construction, testing, pre-commissioning, commissioning and safety procedures. All Q.Ms and Q.Ss and programs shall be submitted for approval to the Employer prior to implementation.
- That only the latest revision of approved drawings are used during the execution of the work and that no drawings stamped "This Drawing Subject to Approval" is available for use on site.
- That all orders placed for local materials are in accordance with paragraph (1) for Head Office.
- That all work is executed in accordance with the requirements of the Specification and all relevant Standards/Codes of Practice.
- That all tests and inspections are undertaken to agreed Standards/Codes of Practice.

1.6 Electrical Equipment

1.6.1 General

All electrical as well as mechanical works under this Contract shall comply with these Standard Technical Requirements and the Technical Specifications. The equipment shall be of an approved, reliable design providing the highest possible degree of uniformity and interchangeability.

The design and arrangement of equipment and installations shall facilitate erection, installation, testing, operation and maintenance.

All equipment shall be pre-assembled in the manufacturer's workshop to an utmost extent.

Contact between dissimilar metal parts shall be avoided as far as practicable, especially in any fully or partially submerged application. Suitable insulating material such as plastic, neoprene or paint shall be provided where possible to prevent metal to metal contact between dissimilar metals. If it is necessary to use dissimilar metals in contact with each other, the two metals shall be as close as possible to each other in the galvanic series and practical experience shall be submitted to demonstrate their compatibility. Overlapping paint shall be applied where dissimilar metals are welded together.

The whole of the works shall be designed to ensure satisfactory operation. All reasonable precautions shall be taken in the design of equipment and of the works, to ensure the safety of personnel concerned with the operation and maintenance of the works, and of the public. All workmanship shall be of the highest class throughout and the design dimensions and materials of all parts shall be such that the stresses to which they are subjected shall not render them liable to distortion or damage under the most severe conditions encountered in service.

The electrical equipment of any electrical, mechanical or line installation to be provided under this contract according to the Technical Specifications shall, if not stated otherwise therein, fulfil the requirements of this section.

All the electrical equipment including automation and control equipment as specified under the contract shall be provided from the same sub-Contractor. Consequently, the Bidder is requested to consider in his proposal all the technical aspects regarding this equipment as well as to co-ordinate properly for smooth interfaces to avoid unnecessary interfaces between different "Electrical" sub-Contractors within the "Electrical Systems".

The arrangement of the electrical equipment as described in the specifications forming the "Overall Electrical Systems" may be simplified as far as technically possible for logical arrangement and configuration of the electrical equipment, with the particular aim to achieve easy supervision, easy operation and high reliability. Hence, the specification is for the basic quotation and for guidance only, and the Contractor is encouraged to offer alternatively such simple systems with high reliability, in addition to the offer to be given strictly in accordance with the specification.

All components shall be of an approved and reliable design. The highest extent of uniformity and interchangeability shall be reached. The design shall facilitate maintenance and repair of the components.

The equipment shall be pre-assembled to the highest possible extent in the Contractor's or sub-Contractor's workshop, complete with all devices and wired up to common terminal blocks.

The power supply and control cables shall be laid up to their common terminal blocks. Unless otherwise agreed, ratings of main electrical equipment (incoming feeders, bus-ties) as selected or proposed by the Contractor, whether originally specified or not, shall generally include a safety margin of 10% under consideration of the worst case to be met in service. Prior to approval of such basic characteristics, the Contractor shall submit all relevant information such as consumer lists, short circuit calculations, de-rating factors, etc.

Short-circuit calculations shall be evaluated giving full evidence that every electrical component can withstand the maximum stresses under fault conditions, for fault levels and durations obtained under the worst conditions, e.g. upon failure of the

corresponding main protection device and time delayed fault clearing by the back-up protection device.

All equipment shall be suitable for the prevailing climatic conditions.

Outdoor installations shall be protected against solar radiation by means of adequate covers.

The Contractor shall ensure that all the supplied equipment is insensitive to any signals emitted by wireless communication equipment.

All equipment shall be designed to minimize corona or other electrical discharges, to comply with local EMC standards and in accordance with relevant IEC or other internationally recognized standards.

The terms Low Voltage, Medium Voltage, High Voltage. Extra High Voltage (see IEC standard 60038), whenever used; shall refer to the following Voltage ranges:

Hz A.C. Voltage Ranges	kV
Low Voltage (LV)	LV ≤ 1 kV
Medium Voltage (MV)	1kV < MV ≤ 35kV
High Voltage (HV)	35kV <HV ≤ 230 kV
Extra High Voltage (EHV)	>230 kV

1.6.2 Standards and Color Code

Generally, the design, manufacture and testing of all equipment and installations shall strictly comply with the latest edition of the relevant IEC publications valid at the time of contract signature.

In general, the color code for electrical equipment shall be as described in a previous section and in Annex of this chapter.

The manufacturer's painting systems shall be used to the maximum possible extent but shall by all means be subjected to the approval by the Employer. Final coats of equipment shall be matching adjacent installations, complying with architectural requirements.

Every current carrying part of the equipment including conductors, connections and joints shall be capable of carrying their rated current continuously under the site conditions as specified.

1.6.3 Switchgear, Cubicles and Panels

A General Design and Construction Features

Electrical switchboards shall be constructed of braced rolled steel sections, with recessed panels, and supporting structures for mounting of power and control cables. All steelworks shall be made of minimum 1.5 mm thick sheet-steel.

The cubicles shall be of robust and rigid construction, of the self-supporting floor mounted type. They shall be supplied complete with lifting lugs and eye bolts, with all required base frames, anchors, fixing materials, etc. Hinged doors, rear or side covers etc. shall be adequately braced to avoid wobbling.

Cubicles mounted in rooms with computer floors shall have their own supporting structures made of steel profiles, being fixed to the concrete floor.

Wherever necessary, adequate vibration and shock absorbers shall be installed to guarantee the correct operation of instruments and relays.

All panels and cubicles shall be of standard dimensions, having a uniform appearance. The outer look of panels and cubicles should be aesthetically pleasing.

Switchgear installed outdoors shall be of protection class IP 67 and, provided with sun shields.

The construction shall be such that the various components of the switchgear are segregated electrically from each other by suitable insulation barriers and access to the circuit breaker and cable termination part shall be possible without interfering with adjacent components such as relays and instruments. Suitable interlocks shall be provided for preventing access to live parts.

All instruments, relays, control and selector switches, indicating lamps, push-buttons and trip levers shall be flush-mounted, arranged in a logical manner and located at convenient heights on the front side of the switchgear.

Cast resin insulators are permitted within individual cubicles but bushings entering or interconnecting different cubicles (for example busbars) shall be of absolute fire-resistant type (for example porcelain).

The cubicles shall have front access and - if not specified for erection at the wall - rear access for easy cable termination work and for maintenance and repair of the main and auxiliary equipment accommodated in the interior. Means shall be provided to limit the opening angle of doors to about 100°.

The cubicles shall be complete with all locks, cable end boxes, color-coded busbars, internal wiring, and terminal accessories.

Busbars shall be made of high conductivity electrolytic copper suitably protected against corrosion and rigidly supported on approved type of insulators.

Busbars shall be suitably mounted in enclosed compartments running the full length of the distribution boards. Access to the busbars shall be possible only by removing bolted covers.

Opening the back or front door of any circuit-breaker cubicle shall not expose the busbars. Busbar connections lying outside the busbars compartment shall be insulated or shrouded to eliminate hazardous accidental contact while working on other parts of the switchgear.

Means shall be provided for expansion and contraction of the busbars resulting from temperature variations.

All busbars joints and connections shall be smoothed and silver-coated or tinned on the contact surfaces. If appropriate for the intended installation, contact surfaces can also be brightly polished and greased.

All switchgear, busbars and connections shall be capable of withstanding the electrical, mechanical and thermal stresses they may be subjected to under normal or fault conditions.

Clearances between live parts and to earth shall be in accordance with the relevant standards.

Each cubicle shall be provided with devices for earthing the incoming cables, preferably each phase separately. Provision shall also be made for earthing the busbars. Such earthing shall be interlocked with the incoming circuit breaker(s). Safety interlocks shall be provided to prevent earthing of live parts.

An earthing bar with a minimum cross-section of 40×6 mm shall run the full length of the distribution boards. This bar shall be connected to the main earthing system and all metallic parts not forming part of the live circuits and instrument transformer terminals to be earthed shall be connected to it.

The finishing coat shall consist of lacquer of a color agreed upon. The painting shall be scratch-proof and resistant to perspiration from the operator's hands. The painting shall be of such quality that damages during transport or erection can be easily repaired at site.

Each cubicle/panel shall be equipped with a suitable mimic diagram.

All panels/cubicles shall have approx. 10% spare room for mounting of future auxiliary devices.

Piping transporting water, steam or oil is not permitted in the cubicles.

Phase rotation and color markings shall be employed throughout the equipment.

Floor openings below cubicles shall be covered and sealed by the Contractor after cable installation to obtain fire-proof and vermin-proof installations. Gland plates with suitable glands shall be provided in order to obtain the specified IP protection class.

B Switchgear

All circuit breakers, load break switches, and contactors shall be suitably rated and controlled according to the electrical and mechanical performance and duties they are assigned for. They shall be of the continuously rated pattern generously rated to comply with the site conditions and requirements.

Contactors and their associated devices shall be capable to operate without overheating for five minutes with 70% of the rated supply voltage. Means shall be provided to prevent pumping.

Moulded case circuit breakers and miniature circuit breakers may be used if they are properly selected to withstand the maximum short-circuit current.

All Contactor units of the same rating shall be interchangeable.

C Circuit Breakers

Circuit breakers rated 63 A and above shall be of the trip-free type with a driving mechanism composed of a spring loaded, energy storing closing and tripping device and fitted with operation counter.

The LV breakers shall be provided with main and isolating contacts, and with suitable arcing contacts, magnetic arc quenching devices, arc chutes.

The spring release of the closing mechanism shall be operated by means of a DC solenoid coil and a mechanical pull out handle. Tripping shall be effected by means of a DC solenoid shunt trip coil and a mechanical push button. The closing mechanism can alternatively be of the AC operated solenoid coil/latched type.

The MCCBs shall have shunt trip coil and trip-free operating mechanism of the quick-break type. They shall have a thermal overload of 125% of the nominal full load current and instantaneous magnetic trips which operate at currents exceeding 500% of nominal full load currents or 600% of motor full load current whichever is applicable. In order to reduce the fault level of the next coordinated electrical components the breakers shall be of the fault limiting type as required.

MCBs shall be of the fault limiting single-pole or triple-pole type with adequate current ratings. The operating as well as the overload mechanism shall be sealed. The mechanism shall provide positive closing, contact roll and wipe, trip-free action. The contacts shall be of anti-welding, silver tungsten tips fixed on high conductivity copper backings. The contacts of control relays and of higher rated circuit breakers and contactors shall be silver-plated.

D Contactors

LV contactors shall be of the air break type with arc shields according to IEC standards. Butt contacts of the rolling, self-cleaning type shall preferably be utilized and all portions likely to suffer from arcing shall be easily removable.

When closed, the contactors shall withstand the system fault current determined by the next coordinated short circuit tripping device.

E Fuses

The HRC-fuses shall be suitably sized to cope with the connected loads at site conditions.

They shall be of the current limiting type and correspond in their protection range with the associated switchgear or consumer.

Fuses up to 63 A rated current shall be inserted into lever operated fuse isolators so that no special tool is required for their replacement. Devices shall be provided for local and remote indication of the fuse blowing.

F Load Break Switches

The load break switches shall permit manual operation from the front panel but shall also allow mounting of a power drive for local and remote control.

They shall be equipped with a padlocking device, self-cleaning contacts with a high resisting anti-arc case suitable for quick-making and quick-breaking action, and capable to switch safely the specified rated currents.

The load break switches may be combined with the HRC-fuses.

G Push Buttons, Push Buttons Stations

Pushbuttons, which may be of the illuminated or non-illuminated type, shall be shrouded or well recessed in their housings in such a way as to minimize the risk of inadvertent operation.

In instances where "enable" push-buttons are required they shall be electrically interlocked with the normal control such that deliberate operation of the "enable" push-button is required before the normal control can take place.

The color of push-buttons shall be as follows:

- When mounted on push-button stations adjacent to running plant, the stop button shall be colored red and the start button colored green,
- When mounted on the front of the contactor panel, the stop button shall be colored red and the start button colored green,
- When mounted on panels or desks with adjacent indication lights, both buttons shall be colored black, unless required otherwise by the Employer.

Individual push-button stations, unless supplied as weather-proof free-standing enclosures, shall be of the metalclad weather-proof type suitable for wall or bracket mounting with enclosure classification of IP 65. All outdoor mounted push-button stations shall incorporate a protective cover or guard (e.g. toughened glass door) to prevent inadvertent operation.

Control stations shall be clearly labelled showing the duty or drive to which they are applicable. Location of ammeters shall be agreed with the Employer.

Push-buttons used on covered desks, panels etc. may need to be of special types (e.g. miniature, illuminated). The Specifications and requirements for these special pushbuttons shall be agreed with the Employer.

Emergency stop pushbuttons shall be provided adjacent to all machinery with exposed moving parts, couplings etc. to prevent danger and on main and local

control panels. These push-buttons shall have a large "mushroom" head, colored red and incorporate a protective cover or guard to avoid accidental operation. These buttons shall automatically lock in the pressed position, requiring twist or key resetting. Contacts shall be provided to cause tripping of the associated circuit, prevent restart of the circuit and bring up an alarm in the Central Control Room.

Feeder cables for cranes shall be fitted with lockable "Crane Switches" to be installed in good accessible locations.

H Overvoltage Protection

LV switchboards shall be equipped with overvoltage protection devices, such as lightning current arresters or overvoltage arresters. The protection concept shall be elaborated by the Contractor, subject to approval by the Employer.

I Switchgear Control

For local switchboard control, all circuit breakers units shall have:

- One (1) green illuminated push-button for ON,
- One (1) red illuminated push-button for OFF,
- One (1) position indicator of either the semaphore type for circuit breaker, electrically controlled, or indicating lamps, included above.
- One (1) amber- colored indicating lamp for fault indication of local protection equipment (tripping of protection relay or device, blowing of power fuse, tripping of miniature circuit breaker of control circuits). This lamp shall remain lit until cancelled by resetting of the device having caused the fault indication. Facilities shall be provided to repeat the alarms, individually or grouped for remote indication or recording.

Remote controlled incoming and outgoing feeders shall be equipped with key-operated LOCAL - REMOTE selector switches.

The "OFF" control shall be effective at all locations independent of the selector switch position. The "ON" control shall be restricted to the actual selector switch position.

All manual operated equipment shall have mechanical indications clearly indicating the relevant position.

Each bus section of a distribution board shall have a blue- colored signaling lamp indicating that the control supply is "ON". Each cubicle shall have a yellow-colored signaling lamp indicating that the heater is "ON".

Indicating lamps shall be of an approved low consumption type. The hoods covering the lamps shall be made of transparent colored glass mould or any other equivalent heat resistant and break-proof material and shall be either of the screw or any other approved type to facilitate to replacement of the lamps. LED indicating devices are also acceptable; they shall preferably be of the multi-element type. All indication lamp fittings of similar use shall be of the same size and type.

Lamp test facilities shall be provided on each panel. Up to 3 panels, forming an assembly can be fitted with one common lamp-testing device.

Boards other than power distribution boards shall include indicating lamps to signalize:

- Heaters "ON",
- Control voltage "ON",
- TRIP alarm of any interior equipment.

Generally, all signal, monitoring and protection circuits as well as shunt trips of circuit breakers shall be fed by the specified standard DC voltage(s).

AC contactor-operating circuits shall be controlled by AC with the contactor solenoids preferably designed for DC fitted with rectifier bridges. Latched contactors are also acceptable. All aforesaid circuits shall be protected individually by means of miniature circuit breakers with position monitoring. AC control circuits shall be derived from the relevant busbar system protected and monitored by MCBs.

Closing of the circuit breakers and contactors shall be possible between 85% and 110% of the rated control voltage. Holding of contactors shall safely be achieved at 70% of the rated control voltage. Tripping devices shall operate at 50-120% of the rated control voltage in case of mains dependent and at 75-110% in case of separate control voltages (DC system).

J Auxiliary Power Supply

Power supplies for the operation of auxiliary electrical systems shall be provided in accordance with the details given elsewhere in this specification.

All main switchboards, relay panels, control equipment, suites of cubicles etc., shall be provided with duplicate supplies for control and alarm purposes. Such duplicate supplies shall be derived from separate power sources as far as practical and shall operate such as to prevent loss of function for failure in voltage. They shall be monitored to initiate a local and remote voltage failure alarm.

K Small Wiring

All wiring within panels, racks, boards, etc. shall be of stranded copper wires with flame-retardant insulation.

The insulation material may be of fire-resistant PVC, tropical grade or of other approved fire-resistant type. The wiring shall be capable of withstanding, without deterioration, the conditions prevailing at the individual location of installation. The bare ends of stranded wires shall be provided with squeezed sleeves or pins.

The minimum cross-sections shall be as follows:

- 2.5 mm2 for all consumers (such as heaters) and current transformer circuits;
- 1.5 mm2 for control wiring above 60 V service voltage;
- 0.5 mm2 for control wiring below 60 V and telephone wiring;
- 0.2 mm2 approx. in case the applied termination techniques of standard electronic equipment do not permit the use of larger cross-sections.

All secondary wiring shall be arranged and protected to prevent damages by arcing or mechanical effects.

Wiring shall be neatly run, bundled or in rigid PVC plastic wire-ways filled not more than 70%. (f) The ends of every cable core and all secondary panel wiring above 60 V shall be fitted with numbered ferrules of yellow, moisture and oil-resisting insulation material having a gloss finish, with the identification numbers clearly engraved in black being the same as for the relevant terminals. In case different terminal boards are arranged close to each other, the ferrules shall contain the terminal board denomination and the terminal number. The ferrules shall be fitted in such a way that they cannot become detached when the wire is removed from the terminal. All internal wiring shall enter the terminal blocks at one side only.

Wiring shall terminate in one or more terminal blocks, arranged at the side or bottom of each panel or compartment. Internal wiring between instruments or other devices not using the terminal block shall be permitted within the same compartment only.

Terminal blocks shall be numbered consecutively beginning with 1 from left to right or top to bottom and shall consist of single "insertion" type terminals of non-tracking, non-inflammable synthetic plastics lined-up in one row. All terminals shall have two (2) separate pressure clamping plates suitable for connection of incoming or outgoing, stranded and solid conductors, respectively.

Terminals with clamping screws in direct contact with the conductor are not acceptable. The following categories of terminals shall be provided:

- Category - A Terminals for power circuits.
- Category - B Terminals with short-circuit facilities for current transformer circuits.
- Category - C Terminals for measuring and control circuits, where required with bridging facilities to the neighboring terminal.

All terminal blocks shall contain 20% spare terminals of category C. Insulating barriers shall be provided between each pair of power circuits and between the terminal categories. The height and the spacing shall be such as to give adequate protection to the terminals whilst allowing easy access to the same.

L Tests

The workshop tests shall be performed in accordance with applicable standards. For the individual switchgear components (i.e. circuit breaker, load break switch, etc.), the manufacturer's type and routine test certificates shall be supplied.

The following site tests shall be performed:

- Visual inspection;
- Megger test (to include equipment and internal wiring but excluding electronic equipment);
- Functional tests of controls, interlocks, measurements;
- Setting of protection relays: adjustment by means of special testing equipment and operational checks;
- HV tests as required by applicable standards.

1.6.4 Auxiliary Equipment

A Auxiliary Switches

For save and proper functioning each item of plant shall be equipped with the necessary auxiliary switches, contactors and devices for indication, protection, metering, control, interlocking, supervision and other services. All auxiliary switches shall be wired up to terminal blocks on the fixed portion of the plant.

Auxiliary switches and mechanisms shall be mounted in approved accessible positions clear of the operating mechanism and protected in an approved manner. The contacts of auxiliary switches shall be mechanically strong and have a positive wiping action when closing.

B Panel Lighting

Cubicles and panels shall be fitted with fluorescent type, door switch controlled interior lighting and 230 V socket outlets. A LED light providing at least 50 lux shall be installed with limit switch that turns on while opening the panel and cubicle door.

C Instrument Transformers

Current and potential transformers shall be designed and accommodated to suit their particular duties. They shall meet the requirements of the latest IEC standards for metering and protection and be capable of withstanding without any damage or deterioration:

- The continuous thermal current rating of the associated switchgear,
- The maximum short-circuit level of the circuit for a period of 1 sec,
- The applicable test voltages.

D Current Transformers (CTs)

CTs shall comply with IEC 60044 as amended and supplemented by the following requirements.

Separate cores shall be provided for protection, instrumentation and metering purposes, unless otherwise specified.

For measuring current transformers, the following accuracy classes shall apply:

- 0.2 For plant record metering, and for other acceptance testing purposes,
- 0.5 For AVR's,
- For indicating instruments, and for tariff metering of small supplies.

Current transformers used for indication/metering purposes shall be designed to saturate at a value of primary current sufficiently low to protect the secondary circuit from damage at all possible values of primary fault current up to the associated primary short time rating.

All CTs shall be capable of carrying rated primary current with an open-circuited secondary winding for one minute without damage or deterioration. The secondary of CTs shall be earthed with the earth connections easily accessible.

The nominal values of CT and VT secondary windings shall be as stated in Annex. The instrument transformers shall have adequate accuracy, saturation factor and rated burden.

The Contractor shall determine the burdens and accuracy class of the secondary windings taking into consideration the most unfavourable conditions.

Current transformers for protective and protective/indication purposes shall be designed to suit the particular requirements of the associated protection which, in general, shall be in accordance with the recommendation given in IEC 60044.

Class "5P" current transformers shall be used for combined over current and earth fault protection of the inverse time-over current type. The rated accuracy limit with actual burden connected shall be equivalent to the ultimate maximum symmetrical three-phase fault current or earth fault current of the protected circuit. The current transformers shall be capable of meeting the "5P" error classification at rated accuracy limit current over the full range of relay settings.

Current transformers for protection using high impedance relays shall be of the low reactance type and their performance shall be stated either in terms of the Class "X" parameters or in terms of the Class "TPS" parameters (low reactance current transformers are preferred for all types of protection).

The rated VA output of each current transformer shall not be less than the connected burden as installed, taken into account the burden of cable connections.

Current transformers shall be capable of withstanding without damage the peak and rated short-time currents of their associated equipment.

The secondary windings of each set of current transformers shall be earthed at one point only, via a bolted disconnecting link. The current transformer core, where accessible, shall be separately earthed.

When multiple ratio secondary windings are specified, a label shall be provided at the secondary terminals of the current transformer, indicating clearly the connections required for each tap. The connections and the ratio in use shall be indicated on all connection diagrams.

Design magnetisation curves and DC resistance values shall be submitted before manufacture for each current transformer used for protective purposes and shall be subsequently verified by factory routine tests.

For metalclad switchgear, all current transformers shall be located on the outgoing circuit side of the circuit breaker. Current transformers may also be provided on the bus bar side of

the circuit breaker to permit protection zone overlap. The primary conductors of all current transformers shall be readily accessible for primary injection testing on site.

Where current transformers have to be mounted on apparatus provided under other contracts, the Contractor shall be responsible for ensuring compatibility with the other Contractors and for keeping the Employer informed.

The Contractor shall supply manufacturer's test certificates on test and measurements to be performed in accordance with applicable standards.

The CT's and their associated circuits shall be tested on site by the primary injection method.

E Voltage/Potential Transformers (VTs/PTs)

All VTs shall comply with the requirements of IEC 60044 as amended and supplemented by this specification. They shall have outputs 50% in excess of the actual requirement unless otherwise specified.

VTs shall have the following accuracy classes:

- 0.2 for metering and acceptance testing purposes;
- 0.2 for plant record metering and AVRs;
- For indicating instruments, synchronisers and tariff metering of small supplies;
- 3P for protection purposes.

The voltage transformer secondary circuits shall be completed in itself and shall be earthed at one point only; metal cases shall be earthed separately. The transformer core, where accessible shall be earthed separately. All voltage transformers at a particular voltage level shall be earthed in the same manner.

Where it is required to earth the primary neutral of a metal-clad voltage transformer, the neutral earthing connection shall be insulated from the tank and brought out separately from the switchgear earthing connection.

Secondary main protection fuses or miniature circuit breakers shall be provided as close as possible to, preferably mounted on, each voltage transformer and labelled to show their function and phase color. It shall not be necessary to de-energise the primary circuit or remove the voltage transformer of metal-clad switchgear to gain access to the fuses or miniature circuit breaker.

Voltage transformer cores shall not saturate in case 1.732 times normal voltage is applied to each winding.

Magnetisation curves shall be submitted for approval for each type of voltage transformer prior to factory tests.

The standard secondary voltage between phases shall be 110 V (50 Hz systems, to suit primary rated voltage) unless special circumstances dictate otherwise and shall be stated at the time of Biding.

Secondary circuits of different voltage transformers shall not be connected in parallel.

All measuring transformers shall be provided with an equipment label giving type, ratio, class, output, serial number and connections.

The Contractor shall supply manufacturer's test certificates on test and measurements to be performed in accordance with applicable standards.

F Busbars and Electrical Connections

Busbars and connections shall be electrolytic copper, unless otherwise agreed with the Employer.

The busbars, assemblies and connections of HV metal-enclosed or metal-clad switchgear shall be of a type, which does not rely solely on air for insulation purposes. The covering material shall be non-deteriorating at the rated short-time maximum temperature of the busbars and shall have such thickness as is required to withstand rated line to line voltage between bus bar and a conducting object on the exterior of the covering material for a period of not less than 1 minute.

The busbars shall be capable of carrying the full rated current continuously without exceeding the maximum temperature specified in IEC, as applicable, under site ambient conditions.

The busbars and their connections, and insulation materials as appropriate, shall be capable of withstanding, without damage, the thermal and mechanical effects of a through fault current equivalent to the short-time rating of the switchgear.

Devices shall be provided to compensate thermal expansion of the busbars and associated components including the insulating medium.

Busbars shall be contained in separate compartments within the general casing of switchgear. Busbar barriers shall be provided between switchgear equipment to prevent the spreading of ionised gases in the event of a fault.

Access to busbars and the connections directly connected thereto shall be gained only by the removal of covers secured by bolts or screws. Such covers shall be clearly and indelibly marked "BUSBARS".

Busbars shall be extensible at both ends; such extension shall entail the minimum disturbance to bus bar compartments.

Busbars shall be of uniform cross sectional throughout the length of a switchboard.

Bolted connections shall correspond with the applicable DIN standards and have two washers and one spring washer. Bolt terminals of machines (transformers, etc.) shall be equipped with secured nuts, two washers and spring washer; all the above elements shall be of corrosion-proof material or plated accordingly.

Tightening of such bolt connections shall be done with a torque wrench set to values to be given by the Contractor before commencement of erection work.

Flexible joints shall be provided for connecting busbars / busducts with individual equipment such as transformers, switchgear, etc. They shall be sized and rated in line with the respective busbars and shall cope with vibrations, thermal or operational displacements and shall withstand the dynamic short circuit stresses.

G Electrical Insulation

Insulating materials shall be suitably finished so as to prevent deterioration of their qualities under the specified working conditions. Account shall be taken of the IEC 60085 and IEC 60505 recommendations.

Ebonite or synthetic resin bonded laminated material shall be of suitable quality selected from the grades or types in the appropriate IEC, or approved National Standard.

The insulation of all machine windings, solenoids, etc. other than those immersed in oil or compound, shall be of Class "F" materials, unless otherwise specified elsewhere.

All cut or machined surfaces and edges of resin-bonded laminated materials shall be cleaned and then sealed with an approved varnish as soon as possible after cutting.

Hygroscopic types of materials shall not be used for insulation purposes.

Wherever practicable, instrument, apparatus and machine coil windings, including wire wound resistors, with the exception of those immersed in oil or compound, shall be thoroughly dried in a vacuum or by other approved means and shall then be immediately impregnated through to the core with an approved insulating varnish. Varnish with a linseed oil base shall not be used.

No material of a hygroscopic nature shall be used for covering coils. Where inter-leaving between windings in coils is necessary, only the best Manila paper, thoroughly dried, which permits penetration by the insulating varnish or wax, shall be used.

PCB type materials shall not be used anywhere in the equipment or in any component.

Asbestos shall not be used anywhere in the equipment or in any component.

H Protection Devices

The main parts of the plant shall be protected and interlocked so as to prevent mal-operations and other fault occurrences and to maintain safety during all operation phases.

Electric protection relays shall be the standard product of an experienced and reliable protection relay manufacturer. They shall be of the electronic numerical, tropicalized type and be mounted in suitable dust proof and shock-absorbing casings. They shall not be affected by external magnetic fields or any other influence (radio, computer, signals, impulses, etc.) consistent with the place or method of mounting.

The protection relays shall be equipped with all necessary auxiliaries such as tripping units, time relays, trip circuit monitoring and external local/remote resetting device.

Pre-warning alarms shall be initiated as early as possible before the protection system trips, in order to enable the operators to take precautions. Tripping of a protection system as well as the sources of the protective action shall be indicated and recorded as an alarm.

Unless otherwise required for special purposes, protection relays shall remain in the tripped position until the operator resets the relay manually, locally or remotely. The protection and auxiliary relays shall be grouped and mounted on plug-in modules or stationary-mounted on swing frames with separate plugs and sockets to feature easy replacement and testing. The construction shall be sturdy and such that all parts are easily accessible for adjustment. Relays installed in switchboards shall be arranged in compartments separated from the switchgear.

Besides the mechanical-operated flag type indicator, all relays shall have sufficient contacts and/or auxiliary relay contacts to perform all the tripping, inter-tripping, interlocking, indications and alarm functions required. Spare contacts (1 "NO", 1 "NC") shall be provided for later use. The contacts shall be silver-plated or of the seal-in type with the main contacts adjustable.

The relay contact rating shall be for the specified standard voltage and for 200% of the nominal passing current. The relay coil shall be able to operate properly at voltage variations of -25% to +15%.

Relays shall be capable of withstanding at least one million operations without any defect.

Testing of the individual relays shall either be effected by stationary-mounted or portable testing devices.

1.6.5 Cables

A General

The Contractor shall perform all relevant design and engineering for power, control, measuring and communication cable systems and prepare the cable installation drawings comprising cable lists, cable routing, connection diagrams, installation details, etc.;

All cables shall be the standard product of a competent manufacturer;

All cables and accessories shall be suitable for full length installation under the specified site conditions and shall have the highest thermal and mechanical strength, duly selected for the intended purpose. The Contractor shall select the most suitable cable routes and raceways ensuring a minimum of interference with other installations. Unless otherwise approved, no cable joints will be accepted;

The maximum continuous current carrying capacity of each individual cable type and cross-section shall be listed, duly taking into account the site conditions and load reduction factors. The conductor cross-section of each cable shall be adequate for carrying the fault currents determined by the relevant short-circuit protection device when operating under the specified load conditions, without deterioration of the dielectric properties. All the above data together with complementary system fault current calculations (if required) shall form part of the documents to be supplied by the Contractor;

Cables running on or nearby hot surfaces shall be of the Copper Sheathed Mineral Insulated (MICC), Silicone Rubber Insulated (SRI), or other approved type;

Cable conductors shall be of annealed, high conductivity copper with the outer sheath or serving of PVC. Cables to be laid directly in the ground shall be single-wire or tape armoured. Power Cables shall be of XLPE insulation. All other requirement for power cables shall be as per Internationally accepted standards and will be finalized upon approval by Employer/Employer's Engineer.

The PVC used for conductor insulation and cable sheathing shall be of the highest quality, heat resisting, flame retardant type.

The identity of the manufacturer shall be provided throughout the length of the cable by embossing the outer sheath with "name of manufacturer - year of manufacture". The letters and numerals shall be raised and shall consist of upright block characters. The gap between the identification marks shall not be greater than 200 mm.

B LV Power Cables

Power cables shall have either:

- Four conductors of identical cross-section for three-phase consumers up to 20 kW;
- Three conductors of identical cross-section for single-phase consumers up to 7 kW with one conductor being used for protective earth;
- Three conductors for all other consumers in which case the connection to the station earthing system shall be performed separately;
- Three conductors of identical cross-section and one conductor of adequate smaller or identical cross-section for the neutral, for the power supply to all main and sub distribution boards, MCCs.

All cables shall be selected to withstand without damage the prospective short-circuit current in the copper conductor and sheath metal for durations as determined by the next coordinated protection device and a maximum voltage drop of 3%. The minimum cross-section of copper conductors shall be 2.5 mm2.

Power cables shall be of the extruded solid dielectric insulated type with either PVC or XLPE insulation. All conductors shall have colored insulation in accordance with the specified phase colors. Alternatively, colored plastic marking sleeves can be used at cable terminations.

C Control Cables

The control cables shall be of the multicore, PVC-insulated type withstanding without deterioration the conditions at the individual locations of installation. Cables for analogue signals shall have a common screen of metal tape; cores shall be twisted to pairs.

The minimum cross-section of each copper wire of the instrumentation and control cables shall be as follows:

- 1.5 mm2 for all cables above 60 V service voltage;
- 1.5 mm2 for all cables between local boards/boxes to the individual instruments;
- 1.5 mm2 for all thermocouple compensation leads;
- 0.5 mm2 for all Instrumentation and Control (I&C) multicore cables between local boards/boxes and the control room.

For control and electronic circuits, the minimum cross-sections shall be compatible with the power requirements of the individual equipment. In any case, the maximum voltage drop between feeder point and consumer shall not exceed 5% at the worst load and temperature conditions.

Multicore cables with more than 7 cores shall have approx. 10% spare cores for future use. Multi-conductor cables shall be number-coded and/or color-coded or identified by other suitable means. The color coding or any other identification system shall be shown on the circuit and terminal diagrams.

D Cable Laying

As appropriate for the various locations, the cables shall be installed in cable ducts, raceways, conduits, tray systems, cable trenches or shall be directly laid in the ground.

Cables running inside buildings or concrete trenches shall be laid on trays. The trays shall be of adequate strength and size to carry the specified number of cables, providing approx. 25% spare capacity. The design of such trays shall include a safety factor to avoid permanent distortion when supporting erection staff during cable installation. The trays shall be of suitable aluminium alloy or hot-dip galvanised steel standard materials.

In chemically polluted environments, all trays, supports, ladders, etc., shall be of hot-dip galvanised steel elements painted with suitable epoxy-resin paint or provided with a sintered coat of suitable material for protection against such chemical environment. Cable trays shall normally be of the ladder type consisting of bars with rungs evenly spaced (max. 500 mm) according to requirements. Perforated, covered metal trays shall be used in highly polluted or otherwise endangered surroundings. All trays shall be rigidly fixed on supporting steel structures, masonry or galvanised racks. Cable trays arranged one above the other should be at least 300 mm apart in case of power cables and 200 mm in case of control cables.

Cables to be laid on trays or racks shall be properly fixed or clamped. Supports and racks shall be arranged to facilitate removal or replacement of cables.

Cables branched off from general raceways and directed to the relevant equipment shall be suitably protected over their entire length by galvanised steel or heavy-duty rigid or flexible PVC conduits sealed at their ends against ingress of water. Conduits shall be fixed on steel structures, brickwork or be embedded in concrete floors or walls according to field requirements.

Conduits embedded in concrete or block work shall be of heavy-duty rigid or flexible PVC type. Cables to be laid outdoors across roads or in concrete foundations shall run in hard PVC plastic pipes buried in the ground in a depth not less than 600 mm or shall run through prefabricated concrete ducts in suitable depth.

The cross-section area of such ducts shall be utilised to 50% only. Pipe ducts shall terminate in concrete manholes before entering buildings. Manholes and pulling pits shall be provided in suitable intervals to facilitate easy cable installation.

Cables on brick walls or similar civil structures can be laid in conduits (painted galvanised steel conduits within the reach of persons or erection/maintenance devices, PVC conduits in other areas) or in pre-fabricated installation channels made of galvanised sheet metal or plastic.

Non-armoured cables shall be properly protected against mechanical damage when leaving ducts or covered trenches.

Fire-partitions shall be provided when cables are passing through different fire zones (ceilings, floors, walls, etc.) or when entering cubicles and panels. Cable passages into buildings shall be sealed fire- and water-proof. Accessible cable galleries shall have firebarriers at suitable intervals including fire doors, which are normally open and closed automatically in case of fire.

Cables entering watertight structures shall be adequately sealed.

Cables directly buried in the ground shall be laid as follows:

- Cable trenches shall be excavated approx. 1100 mm deep; the width shall be appropriate to the quantity of cables;

- Bottom of trenches shall be covered by a 100 mm layer of fine, clean material (preferably sand);
- Cables shall be laid on this layer of fine material (*);
- Cables shall be covered by a 150 mm layer of fine, clean material (preferably sand);
- Cable protection tiles shall be laid along the cables;
- Trench shall be carefully backfilled with excavation material approx. 200 mm high; the material shall be properly compacted;
- Yellow plastic warning tape(s) shall be laid on top of this layer (*);
- Trench shall be completely backfilled, material compacted and surface reinstated. Excess material shall be removed.

Items marked (*) shall be executed under responsibility of the Electromechanical manufacturer while all other items will be covered by the Civil Works remaining supervision and responsibility for the proper execution of the work under responsibility of the electromechanical manufacturer.

Minor civil works like slotting or chiselling shall be included under these specifications.

The manufacturer shall provide in due course, all required information on cable ducts, trenches, manholes, block-outs, foundations, etc. to be considered by others.

Power and control cables shall be adequately spaced. A distance of approx. 300 mm shall be kept against other services.

The Contractor shall be responsible for any damage on civil or steel constructions caused by him. He shall be responsible for making good such damage to the satisfaction of the involved party.

The pulling, fixing and termination of cables shall be strictly in accordance with the manufacturer's instructions, using the recommended tools and appliances.

The following shall be observed for cable installation in trenches:

- Cable trench covers shall be removed in sections, according to the progress of work;
- Removed covers shall be stored in such a way that they do not create a hazard to people or traffic at site;
- Cables lying in open trenches for more than two weeks shall be protected against sun radiation;
- Open trenches shall be properly secured by red warning tapes on both sides along the trench;
- Any cover, cable or cable tray having been damaged during installation shall be replaced by the responsible sub-Contractor;
- Cable trenches shall be cleaned from dirt, sand, etc., before closing;
- Trenches shall be closed as soon as possible.

E Cable Terminations

For all terminations of wires and cables, the insulation shall be neatly stripped without nicking the strands of the conductors. Cable lugs for power cables shall be of adequate size. Cable glands or clamps shall be fitted in all cases to prevent stresses on conductors or terminals.

Terminations of MV and HV cables with insulation readings of less than 100 MΩ (using a standard 500 or 1000 V "Megger"), 24 hours after making off, will not be accepted.

If space allows some cable slack as loop or other suitable form shall be foreseen at a convenient place nearby the cable termination points.

F Tests

Cables shall be workshop tested in accordance with applicable standards. The minimum scope of tests shall include:

- Dielectric loss factor (Tan Delta) test for 2.25 times rated voltage and constant ambient temperature (MV and HV cables only);
- Dielectric loss factor with increasing temperature (MV and HV cables only);
- Measurement of conductor resistance at 200C room temperature, the measured value shall be adjusted to the actual temperature;
- Measurement of insulation resistance;
- Measurement of insulation, bedding and outer sheathing thickness;
- High voltage impulse test (HV cables only).

On site, power cables shall be tested as follows:

- Measurement of insulation resistance (Megger test);
- HV test (MV and HV cables only);
- For control cables, the voltage drop of critical lengths shall be measured.

1.6.6 Earthing and Lightning Protection System

A General Requirements

All electrical devices, enclosures and equipment made of conducting materials shall be provided with appropriate earthing terminals. If several devices form part of a larger assembly (such as control cabinets, control boards, power distribution boards, etc.), the earth conductors shall be interconnected, terminating in earthing terminals at both ends.

The low voltage distribution network shall be designed as a protective multiple earthing system in which the neutral conductor will be earthed at the transformer star point and carried along to main and sub-distribution boards and the various earthing systems as mentioned below. The metal housing of all equipment shall be connected to this protective multiple earthing system. In the event of a short circuit between live parts and earth, the resulting resistance of the closed circuit shall cause a fault current activating the appropriate protective device.

B Tests

For all earthing systems, continuity tests as well as earth resistance tests (as applicable) shall be executed. In case the required earthing resistances are not obtained, the Contractor shall be obliged to undertake all additional measures without any extra payment, until the values are satisfactory.

1.6.7 Line Components

A General

All workmanship for line construction and complete work shall be of the highest class throughout and the design dimensions and materials of all parts shall be such that the stresses to which they are subjected shall not render them liable to distortion or damage under the most severe conditions encountered in service.

The detailed design shall be such as to facilitate inspection, cleaning, repairs and simplicity of operation & maintenance. All apparatus shall be designed to ensure satisfactory operation under the atmospheric conditions prevailing in the areas where the line is to be built and under such variations of load and voltage as may occur under the working conditions of the system.

The design of all line supports, conductors, insulators and fittings shall be such as to minimize the risk of damage in service of any part of the lines. No welding, plugging or filling of defective parts shall be carried out without the prior sanction in writing of the Employer.

Corresponding parts of equipment liable to renewal shall be interchangeable and the Contractor will be required to demonstrate this feature to the Employer's satisfaction.

Field Works shall be scheduled as per work-site availability without the Employer having to incur additional cost.

The Bidder shall provide a comprehensive list of all tools and erection equipment to be used in the Works. This list shall include for each tool or equipment model number / type, number of years in service, ownership i.e. owned by the Bidder or requires being purchased/hired, etc.

B Equipment and Material

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

Galvanized Steel tubular poles as indicated in Scope of Supply and as approved by the Employer are to be used for the lines.

Covered Aluminium Conductor Steel Reinforced (ACSR) conductors, specifically DOG to be used for 33 kV and 11 kV high tension (HT) lines.

Aerial Bundled Conductors shall be used for Low Tension lines of specified dimension.

Galvanised steel materials to be used for fabrication of cross arms, bracing, stay sets, stay wires, nut bolts, insulator spindles and earth electrodes.

C Transportation and Installation of Line Materials

All line materials regarding the construction of lines are provided by the Contractor and the Contractor must transport all materials from its store to respective site store, established by the Contractor, which includes loading and unloading of materials.

The Contractor must establish the site store at each respective site and transport all the materials from site store to the respective construction site. The site store must be well-managed and accounts must be kept properly.

The contractor must have following tools and equipment in the given numbers for the execution of the contract:

S.N.	Equipment Type and Characteristics	Minimum Number required
1.	5kV Megger	1
2.	Multimeter	1
3.	Hand Vice (Wire Tensioner) for ACSR Conductor	2
4.	Hydraulic Crimping Tools for mid span jointing sleeves for ACSR Conductor	1

All works described herein and other works necessary to complete the job for proper coordination and operation, even if not stated, shall be within the scope of the Contractor's work and the cost of such works shall be considered to be included in the bid price.

Coordination of the supply and installation of lines with other works related to other contractor shall be the responsibility of the Contractor. The Employer will furnish the information needed to coordinate the supply and installation of line works. The Contractor shall have adequate manpower to complete the work within the scheduled time.

1.6.8 Oil and Compound

A Insulating Oil and Compound

The first filling of lubrication oil, insulating oil or compound for any equipment requiring such media shall provide under this contract.

Oil and compound shall comply with the latest approved appropriate standards and shall be delivered in strong, hermetically sealed new drums.

B Oil or Compounded filled Chambers

All joints of oil or compound filled chambers, other than those, which have to be broken, are to be welded, and care is to be taken to ensure that the chambers are oil-tight. Defective welded joints shall not be caulked but be re-welded.

Suitable provision shall be made for the expansion of the filling medium in oil or compound filled chambers and the chambers shall be designed to avoid trapping of air or gases during the filling process.

All wiring in the vicinity of oil-filled chambers shall have oil-resisting insulation of approved quality.

C Oil Level Indicators

Oil level indicators of approved design shall be fitted to all oil containers clearly visible from normal access levels. The indicators shall show the level at all temperatures likely to be experienced in service and shall be marked with the normal level at rated ambient temperature.

1.6.9 Labels and Nameplates

A General

All equipment and apparatus there on shall be clearly labelled in an approved manner. The proposed material of the labels, size, exact label lettering as well as proposals for the arrangement of the labels shall be submitted to the Employer for approval.

The text is to be written in both English and Nepali (Vernacular language) and the translated text in Nepali is to appear above or to the right of the text in the Contract Language. The translations in the local language and label inscriptions shall be submitted for approval.

A laminated text on wooden board shall be held on every major electrical equipment (transformer, Load Break Switch, 11 kV feeders and tap off points, etc.), with a heading and a paragraph regarding the function of the equipment in Nepali.

The text shall contain a heading and a paragraph regarding the function of the equipment in Nepali.

Labels using adhesive backed plastic materials will not be permitted.

B Equipment Labels and Instruction Plates

Labels written in the contract language shall be provided for all instruments, relays, control switches, push buttons, indication lights, breakers, etc. No label is required if the function is indicated on the device. The label shall be fixed close to the devices in such a way that easy identification is possible. Fixing on the dial glass of instruments will not be accepted. The wording shall be the same as used in the engineering documents.

Asset Identification numbers shall clearly define mechanical and electrical equipment and the ID number engraved on labels of appropriate size shall be fixed to such equipment.

Labels shall be made of anodised aluminium or other approved material with black engraved inscriptions, arranged at the top section of the units. Manufacturer's trade labels shall, if desired, appear in the bottom section of the units.

Equipment inside cubicles, panels, boxes, etc., shall be properly labelled with their item number. This number shall be the same as indicated in the associated documents (wiring diagrams, equipment list, etc.).

C Warning Labels

Warning labels shall be made of synthetic resin with letters engraved in the contract and local language.

Details are stated in the Technical Specifications or will be fixed at a later date.

D Labels for Conduits

The material shall be non-corroding and the description embossed with 4 mm letters/figures.

E Labels for Cables

Each completely installed cable shall have permanently attached to each end and at intermediate positions non-corroding labels detailing identification number of the cable, voltage and conductor size. The cable identification numbers shall comply with those stated in the cable lists.

F Rating Plates

Equipment (machines, transformers, etc.) rating plates and other technical data/informative plates shall either be of the enamelled type or be of stainless steel suitably protected after engraving with a transparent paint resistant to aggressive atmosphere and solar radiation.

G Single Line Diagrams

Each switchgear room shall be furnished with a copy of the final as-built single-line diagram detailing all electrical data and denominations, separate for each individual switchgear / distribution board/MCC, placed under glass and frame/wall mounted at an approved location.

H Key System for Electric Boards

Key interlocked switches shall be provided with Yale or other approved locks for locking in the neutral position. Similar locks shall be provided for selector switches for locking the switches in any of the positions.

The locks or padlocks shall be coordinated with an overall key system for the different applications and shall be supplied with a minimum number of three keys. A key cabinet in the control room shall be provided for collecting and storing the keys.

The key system shall employ master keys to override the individual keys. Each key shall have an identification label fixed above the key hanging hook inside the cabinet. Cabinet door keys shall be handled in a similar manner.

1.6.10 Fasteners

All bolts, screws, anchor bolts, with sleeves, nuts, washers, locking devices, etc., required for all equipment of this Contract shall be supplied.

All bolts, studs, screws, nuts, and washers shall be according to the ISO system unless other standards will be considered for specific applications. Threads shall be metric. The Contractor shall indicate the extent to which other standards are proposed. Bolts and nuts shall be hexagonal or socket headed. Sizes smaller than 4 mm shall be used only for instrument and relay internal connections.

Where mild steel bolts and nuts are used, they shall be of the precision cold forged washer faced type if commercially available in the size required. Alternatively, approved hot forged bolts and nuts, machined so that the undersides of bolt head and nut are faced and parallel to one another when assembled, may be used. In the latter case, a suitable fillet shall be machined between the bolt head and shaft. All parts, other than structural steel work, bolted together, shall be spot faced on the back to ensure that nuts and bolt heads bed down satisfactorily. Bolts machined from bar stock shall not be used without approval of the Employer.

All bolting material shall be adequately treated against corrosion before dispatch from the workshop. Mild steel nuts and bolts shall be zinc or cadmium plated. All threads shall be greased carefully during installation except where otherwise specified. Split pins or other approved locking devices generally shall be provided for nuts which may become loose due to vibration, etc.

All bolts, nuts, screws and other devices used to fix, clamp or adjust any parts which are:

- Exposed to water or high humidity, or
- Subjected to frequent adjustment or frequent removal, shall be of corrosion-resistant steel or bronze.

Bolts and nuts shall be of different grades of stainless steel.

To minimize the probability of cold welding between mating surfaces of bolts and nuts, dissimilar materials as close as possible to each other in the galvanic series, or lubricants shall be used.

All bolts or studs which will be subject to high stress and/or temperature shall be of approved high tensile material with nuts of approved material. All bolts and studs larger than 36 mm in diameter, which are not accessible for tightening, and loosening by commercially available pneumatic impact wrenches shall be drilled for heaters or shall have an extension for pretensioning with hydraulic tools.

Washers shall be provided under bolt heads and nuts unless otherwise approved by the Employer. All ferrous nuts and bolts on Works items where dismantling may be required during the life of the Works shall have their threads coated with an approved anti-seize compound.

When in position, all bolts or studs shall project through the corresponding nuts by at least one thread, but this projection shall not exceed three threads, unless more length is required for adjustment. All nuts and set screws shall be securely fastened, to prevent loosening due to vibrations, using spring washers, lock nuts, split pins, self-locking inserts or "Loctite" as appropriate for the purpose and material used.

The Contractor shall supply the net quantities plus 5 % of all permanent bolts, screws and other similar items and materials required for installation at the Site. Any such

rivets, bolts, screws, etc., which are surplus after the installation of the Works has been completed shall become spare parts and shall be wrapped, marked and handed over to the Employer/Engineer.

1.6.11 Instrumentation Equipment

A Design Criteria

i General

The general requirements for electrical equipment shall be considered for Instrumentation equipment. Special reference is made to cabling, wiring and labelling.

All components shall be of an approved and reliable type and design. The highest extent of uniformity and interchangeability shall be reached. The design shall facilitate easy repair and maintenance of the components.

The equipment shall be pre-assembled to the highest extent in the contractor's or subcontractor's workshop, e.g., shop welding of thermometer wells and other connections, wiring of boards, desks, etc., including internal wiring and installation of devices shall be carried out. Fragile instruments shall be removed for transportation to site.

All components shall be suitable for continuous operation under site conditions and compatible with other equipment. Materials for instrumentation and control equipment, including piping material, which is exposed to the measured media, shall be selected accordingly.

All instrumentation and control functions shall be shown on the piping and instrumentation diagrams. The symbols to be used shall be in accordance with ISO standard. The identification system (tag numbers) shall be in accordance with the plant identification system, which is subject to approval by the employer. All measurements and alarms shall be listed in I/O lists of a standard form subject to approval. For remote controls, a schedule of interlocks shall be provided. The features of automatic controls shall be shown in block diagrams.

All local indicating instruments and test connections shall be included in the respective equipment as integral part. Such equipment include distribution transformers, load break switches. Such system shall be suitable to transmit the information of current, voltage, power factor, transformer oil temperature, THD and additional details as required by the Client to the Regional Control Centre via, GSM or any means approved by the Client.

The scope of local indicating instruments and test connections shall enable the operator to properly survey the equipment and shall also allow to adequately carrying out all acceptance and other tests.

ii Standards

In case, the contractor intends to apply standards and regulations other than those specified, he shall provide the employer with four (4) sets of such documents, which shall be complete, unabridged and written in the contract language.

iii Sizes of Measuring Instruments

Meters, instruments and recorders shall be of standard size and selected to guarantee unique appearance of control panels, control desks, etc. The front glasses shall be of the anti-glare type. The scales shall be 90° or 240° type.

The indicating instruments and recorders shall have the following or similar sizes:

- Indicators on local control panels 72 × 72 mm or MV and LV switchgear 144 × 72 mm;
- Indicators on vertical sections of control desks in control room 96 × 48 mm or and on rectifier or converter panels 96 × 96 mm;
- Indicators on horizontal parts of control desks in control room 48 × 48 mm;
- Indicators on control panels in control room 72×72 mm or 144×72 mm or 144×144 mm or 96×48 mm when incorporated in mimic diagrams;
- Recorders144×144 mm (for line and 6-point recorders) 288×288 mm (for 12-point recorders);
- Pressure gauges and other dial type instruments (local) preferably 100 or 160mm diameter.

The control switches, adjusters, etc. installed on panels and desks shall harmonise with the selected indicator sizes.

iv Special Local Conditions

If the prevailing local conditions require special measures, the following shall be observed:

- Local indicators shall be of stainless steel;
- External bolts and screws shall be of non-corrosive material;
- Outdoor Instrumentation and Control (I &C) equipment, exposed to sun, shall be protected against direct sun radiation. This may be achieved by protective enclosures, sun shields, etc.;
- Multi-core I&C cables installed outside the buildings shall be completely protected by means of closed cable trays, flexible conduits, etc. The individual cables from the terminal boxes to the instruments shall be protected as far as practicable.

B Tests

The single components and pre-erected assemblies shall undergo functional and routine tests in the contractor's or sub-contractor's workshop. The ready mounted control and supervisory system shall undergo functional tests on site prior to commissioning of the lines.

Calibration tests shall be made on important pressure gauges and other instruments as required by the employer.

C Temperature Measurements

All wells for capillary type thermometers, resistance temperature sensors and thermocouples shall be of the weld-in type. Wells for thermometers and temperature sensors of the screw-in type shall be restricted to measuring points for lubrication oil, and to such measuring points where welding is not suitable, e.g. at cast iron parts. Shop-welded thermometer wells shall be covered by screw caps for protection during transportation and erection.

Resistance thermometers and thermocouples shall be equipped with water-proof connection heads. Thermometer design shall be such that the connection heads do not get warmer than 80°C and the measuring inserts are easily exchangeable.

The temperature sensors shall be selected in such a way as to minimize the number of different spare inserts.

Resistance thermometers shall generally be of type Pt 100 or Ni 1000. Double resistance thermometers (with two resistors in one insert) should be avoided.

Temperatures to be recorded shall be measured by means of resistance thermometers or thermocouples, which can directly be connected with the recorders.

The use of dial-type contact thermometers shall be restricted to bearing metal, cooling water and oil temperature measuring. In all other cases, thermocouples or resistance thermometers and electric contact modules (monitors) shall be used. Glass thermometers or similar will not be accepted as contact thermometers.

Mercury type measuring and switching devices are not permitted.

D Level Measurements

The liquid level measurements in reservoirs and tanks with atmospheric pressure shall be made by means of pressure transmitter either of the mercury-less-type, by displacement type transmitters or float-disc-transmitters. The errors shall not exceed ±1.0% of the total measuring range. Level switches shall be of the externally mounted float or displacer operated type. The switch shall be of packless construction; there shall be a minimum of moving parts.

E Electrical Measurements

All Electrical instruments shall be of flush mounted design, dust and moisture-proof. Ammeters and voltmeters for AC systems shall have moving iron system of not less than accuracy class 1.5 for connection to the secondary side of instrument transformers. DC measuring instruments shall have moving coil systems of same accuracy. Wattmeter shall have electro-dynamic measuring mechanisms or alternatively a moving coil mechanism if fed by transmitters. Wattmeter shall be suitable for unbalanced systems.

All indicating instruments shall generally withstand without damage a continuous overload of 20% referred to the rated output value of the corresponding instrument transformers. Ammeters shall not be damaged by fault currents within the rating and fault duration time of the associated switchgear via the primaries of their corresponding instrument transformers.

All instruments and apparatus shall be capable of carrying their full load currents without undue heating. All instruments and apparatus shall be rear connected, and the enclosures shall be earthed. Means shall be provided for zero adjustment of instruments without dismantling.

All voltage circuits to instruments shall be protected by fuses in the unearthed phases of the circuit, installed as close as practicable to the instrument transformer terminals, or, where instruments are direct-connected, as close as practicable to the main connection. All power factor indicators shall have the star point of their current coils brought out to a separate terminal which shall be connected to the star point of the current transformer secondary windings.

When more than one measured value is indicated on the same instrument, a measuring point selector switch shall be provided next to the instrument and shall be engraved with a legend specifying each selected measuring point.

All instruments shall be of the flush mounting type and shall be fitted with non-reflecting glass and shall comply in every respect with the requirements of IEC 60051. Except for instruments employed for plant performance tests, all instruments shall have an accuracy class 1.5.

Scales shall be arranged in such a way that the normal working indication is between 5075% of full-scale reading permitting an accurate reading.

Instrument scales shall be subject to approval by the employer. All instruments mounted on the same panel shall be of same style and appearance.

Energy metering equipment shall be of the electronic, programmable type according to IEC 62053. The casings shall be dust and moisture proof and shall fit into the boards to permit reading without opening the corresponding front door.

Energy metering equipment shall be suitable to be connected to the station control system via bus.

F Positions Measurements

Position transmitters of the potentiometer type will not be accepted. Inductive or capacitive type shall be provided.

G Contact Devices

Contacts of level switches, temperature switches, limit switches, and of all other devices shall be of the snap action type Single Pole Double Throw. Contact devices for interlocking systems shall be separate i.e. contact devices serving commonly for interlocking and other purposes will not be accepted.

H Protection System

Electrical/mechanical protection and interlocking systems shall be provided for all plant components and individual systems to ensure safe and reliable plant operation and to limit harm and damage to personnel and equipment to an utmost possible extent.

The primary functions of these facilities shall be to prevent mal-operation, to disconnect selectively faulty sections of the systems prior to influence or damage other equipment, and to maintain operation of systems as far as possible.

I Cabling

All power and control cables for the instrumentation and control systems shall comply with this General Specification.

Shielded cables shall be provided, where required.

Fibre optical cables and co-axial cables (ADSS) shall be in compliance with the Technical Specification.

1.7 Inspection and Tests

1.7.1 General Remarks

The whole of the works, i.e., all materials, elements, aggregates, apparatuses, etc. called for in the Technical Specifications of each lot, while in the process of: (i) manufacture, (ii) erection, and (iii) completion shall be subject to such tests and inspections as required by pertinent standards, as may be the standard practice of the manufacturer and as deemed necessary by the employer to prove compliance with the requirements of the specifications.

Approval of assemblies, tests, inspections, related procedures, etc. and acceptance of pertinent test and inspection certificates, or waiving of inspections or tests, shall in no way relieve the contractor of his contractual obligations for furnishing the works in accordance with the provisions of the specifications.

The Contractor shall be responsible for the conduct of all inspections and tests required to demonstrate during manufacture and on completion that the equipment complies with the requirements of the specifications. The cost associated with all such inspections and tests shall be borne by the Contractor himself.

The contractor shall prepare an inspection and test program including all tests during and after manufacture (except for stock material) which shall form part of the contract, and which shall describe the inspections and tests for each major component and item. Such inspections will be performed by the employer.

Such program shall include a sufficiently detailed manufacturing schedule with all expected dates of inspections and tests, a description of each inspection or test (including the method used) to be performed and the applicable standards. Where the contractor's acceptance standards are proposed, copies of it shall be provided for judgment and approval by the employer.

This program and the related schedule shall be updated by the contractor at two (2) months intervals with clear indication of possibly revised inspection and test dates.

The first submission of such schedule shall be affected not later than forty-five (45) days after the date of commencement.

Written notice of the exact date, time and place of inspection and test to be attended by the employer, as well as all other necessary information shall be given to the employer in writing not later than fifteen (15) days prior to the date of any such inspection and test. It shall also be understood that the contractor (or his sub-contractor) will arrange all facilities for proper and timely execution of the inspection and tests to the employer.

Free unrestricted access to the contractor's factory and shops (including to those of his subcontractors') shall be granted to the employer also and upon reasonable notice by the employer if deemed necessary by same for additional witnessing of assembly work or inspections and tests.

Should an agreed inspection not be carried out as proposed because of lack of preparation, obvious negligence, or material and/or equipment being presented in a state which is clearly not acceptable, such an inspection shall be repeated. The costs for repeated inspections shall be fully borne by the contractor.

The Contractor shall organize all shop tests and inspections, which shall be witnessed by the employer or employer's engineer in such a manner that the total number of these shall not exceed a number to be agreed-on in the contract. For additional tests, which could have more properly scheduled all costs, shall be borne by the Contractor.

Inspection and testing of the equipment shall include all inspections, test checks, procedures, etc., as required to ensure that the equipment supplied meets the requirements of the specifications.

They shall comprise, but not be limited to:

- Chemical analysis of materials;
- Destructive and non-destructive tests of materials;
- Checks and examinations of welds;
- Checks of fits and assemblies;
- Dimensional checks;
- Inspection of paints and coatings (thickness, porosity and adhesion);
- Hydrostatic pressure and tightness tests (if applicable);
- Electrical tests;
- Running tests (including measurements of sound levels);
- Functional tests;
- Performance tests;
- Load and overload tests;
- Acceptance tests;
- Type tests.

The technique, equipment and instrumentation to be used for these tests, checks, inspections, examinations, etc. shall be in accordance with the pertinent and internationally accepted standards, rules or codes, in particular those mentioned in the specification.

If in the employer's opinion instruments, apparatus, devices, etc., used by the contractor (or his sub-contractor) need calibration or re-calibration, then such instruments, apparatuses, devices, etc., shall be calibrated at the contractor's cost by an independent authority or institute subject to approval by the employer.

In addition to the provisions established in the General and Particular Conditions of Contract, regarding general procedures of inspections and tests, terms, definitions and time schedules of inspections and tests, the following stipulations shall apply.

1.7.2 Workshop Inspections and Tests

As far as practicable, quality of materials, workmanship and performance of all items of the work and equipment to be furnished under this contract shall be inspected at the places of manufacture.

Where the contractor desires to use stock material, not manufactured specifically for the work, satisfactory evidence shall be submitted that such material conforms to the requirements of the contract. Tests on these materials may be waived.

Arrangements shall be made for expediting the shop inspection by having all shop assemblies or pieces covering a single shipment ready at one time. Any painting work as well as transport to the site of the equipment shall not be started before the approval of the employer has been obtained.

A Material Tests

Unless otherwise specified, the quality of materials shall generally be verified by:

- Chemical analysis,
- Mechanical tests (Yield point, Tensile strength, Elongation, Notch impact strength, etc.),
- Welding tests (Welding procedure, Welding material, Welding tensile strength, Welding bend test, Welding reversed bend test, etc.),
- Electrical tests (Voltage, Losses, Tan delta, Insulation, Magnetic properties etc.).

Certified mill test reports of plates will be acceptable when they comply with the requirements. Test specimen and samples for analysis shall be plainly marked to indicate the materials they represent.

Casting and forging shall be tested in the rough state in order to detect flaws in good time thus avoiding delays. Magnetic particle inspection of important castings shall cover the whole surface of the castings. Further tests can be conducted after partial machining.

B Checking of Dimensions

The dimensions, especially the clearances and fits (ISO recommendation R286) which are essential for operation and efficiency, shall be carefully checked in an approved manner, such as:

- Fits and clearances of gates, bearings, etc.;
- Dimensions of couplings or connections for assembly with other deliveries from the contractor, sub-contractors or other contractors.

C Workshop Assembly

Equipment shall be shop assembled to a status sufficient to prove that the design and workmanship have been executed in accordance with the

specifications, that the supply is complete and that no work remains to be done at site, which reasonably can or should be done in the workshop.

In addition, in order to minimize site works and possible problems, the contractor shall preassemble, in the workshops, all assemblies, subassemblies and pieces of equipment which may be preassembled and which require a precise fit for field erection. This procedure shall be followed even if components are made by different manufacturers in different workshop and therefore the contractor shall be responsible to timely schedule and coordinate all necessary works.

Shop preassembly shall be done after all shop welding and necessary finishing has been completed.

All the workshop preassemblies shall be witnessed by the Employer/Employer's Engineer and programmes of shop preassembly shall be timely submitted for approval.

Where applicable, each item of the equipment shall be assembled completely prior to painting.

D Functional Tests

Functional tests shall be defined as tests of the function of assemblies, sub-assemblies or parts of the equipment under no load conditions. Functional tests shall be performed on all equipment prior to the execution of operational tests.

E Operational Tests

As far as practicable, operational tests shall be carried out on all equipment, simulating operating conditions.

Parts to be delivered by sub-suppliers shall be tested either at the premises of the sub-supplier or of the contractor, as agreed by the employer.

Before testing, the contractor shall submit a notice containing full information on the tests with detailed tables or graphs on the latest edition of the characteristic values of the equipment to be tested and on the test facilities and equipment.

Testing of the electrical equipment shall be performed in accordance with applicable standards; the tests shall include but not be limited to testing of insulation, temperature rise, loading, overloading and losses.

Operational tests of equipment shall include tests under nominal load and overload conditions.

F Electrical Tests

Electrical equipment shall be tested in accordance with applicable standards and agreed test programs and procedures.

G Type Tests

Upon request by the employer, the contractor shall submit complete type test reports, as defined by the pertinent standards, for all major or important apparatus, equipment or devices. These test reports shall show that such tests have been successfully performed on equivalent apparatus, equipment or devices, appropriately witnessed by an independent institution.

If the employer shall find the incomplete or inconsistent with the provisions of the contract, the employer shall be entitled to ask the contractor, at the contractor's expense, to carry out any of the type tests required in order to prove compliance with the requirements of the contract.

In particular, it must be proven by type tests that all dielectric, thermal and dynamic short circuit stresses as specified in the contract will be met, that the permitted temperature rises will not be exceeded and that the required life times can be achieved.

The test results obtained on equivalent equipment shall be a confirmation of computer calculations if the Contractor wants to use calculations for proving of the guaranteed parameters of the equipment to be supplied.

In addition to that, the following equipment, apparatus and items shall be tested for lines and results provided accordingly.

- Towers – All tower types, to be used for the 11 kV Line, if essential, need to be tested or the Contractor shall produce test certificates for same tower.
- Poles – All poles types, to be used for the 11kV and LT Lines need to be tested.

H Random Sample Tests

These are tests, which are being carried out on random samples of a lot of equipment, parts or material. Choosing of the samples to be tested will be done by the employer and the complete lot of equipment, parts etc. shall be presented for this purpose. The number of samples taken will be either at the discretion of the employer, particularly for small lots, or shall conform to the generally accepted rules and standards of statistical testing.

The whole lot of which the samples have been taken shall be considered satisfactorily if none of the samples tested has failed. Should one only of the samples fail, even only in one test, the following shall apply:

- Small lots: All pieces shall be fully tested.
- Large lots: A second set of samples, identical in number to the first one, shall be chosen and tested. If this set will pass all tests satisfactorily, the lot shall be considered to be accepted. If again one or more samples will fail in one or more tests, either the whole lot shall be rejected or all pieces of the lot shall be fully tested individually. The decision of which of the two alternatives to follow shall be with the employer.

Pieces of lots which have been declared non-acceptable and samples which have failed in test must be marked immediately and must not be presented for test again.

1.7.3 Factory Acceptance Tests (FATs)

FAT shall be performed on equipment and plants in compliance with the Particular Conditions of Contract, the Standard and Technical Specifications, the applicable standards and regulations and the contractor's Quality Assurance Program.

The contractor shall submit detailed FAT programs, procedures and schedules, subject to approval by the employer.

At least the FAT of the following equipment will be witnessed by the Employer.

Electrical Equipment:

- 11 kV switchgear,
- Distribution transformers
- 11 kV equipment,
- LT switchgear,
- HT and LT cable system,

- Electrical protection systems,
- Instrumentation systems,
- Communication and security systems, if present
- ACSR Conductors,
- Pole.
- Insulators, hardware and fittings

The employer will designate the required technical personnel to participate in FAT. The required arrangement will be made by the employer.

Reference is made with respect to details of the facilities, services and items to be provided to these representatives.

At the test place, the contractor shall make available all relevant standards and regulations.

1.7.4 Site Tests

During erection, commissioning and trial operation, the contractor shall perform at suitable intervals all inspections and tests in the presence of the employer in order to prove the orderly execution of the works in accordance with the contract.

Unless otherwise specified, all costs and associated charges for testing at site shall be borne by the contractor. This includes properly calibrated measuring devices and pertinent accessories, which shall be made available by the contractor for the entire duration of the tests. The contractor shall delegate his experts to perform these tests at site.

The employer reserves the right to have re-calibrated the contractor's instruments, to be used or having been used for any tests, by an independent, officially acknowledged institution at the contractor's expenses.

Special tests to be performed at site are specified in the corresponding section of the Technical Specifications.

The Contractor's testing at site shall be complete in every respect to prove the successful performance and operation of all the works and equipment to be supplied and installed under this contract.

In case of disagreement between the employer and the contractor on the test results, an independent expert shall be appointed to whom both parties shall agree. If no amicable settlement can be reached, the arbitration clause of the Conditions of Contract shall be applied.

For the procedures of inspections and tests at site, commissioning, trial operation, acceptance tests, reports and notice to the employer reference is made to the General and Particular Conditions of Contract.

The contractor shall prepare and submit for the employer's approval complete site test procedures and test forms for each test required by the contract and to be witnessed by the employer. Such approval must have been obtained at least one week before the start of such testing and it is suggested that the corresponding submission be given to the employer at least three weeks earlier. The contractor shall bear all costs resulting from non-compliance with this requirement.

A Commissioning and Trial Operation

Immediately upon termination of commissioning of a part or section of the permanent equipment which can operate as an independent unit a "Certificate of Fulfilment of Conditions of Commissioning" shall be issued by the employer.

This document shall be signed by an authorized representative of the Employer and the contractor.

This certificate shall state:

- The supplier of the equipment concerned,
- The quantity and type of equipment concerned,
- The conditions of commissioning,
- The names of the participants,
- The date of commencement of trial operation,
- The list of minor defects, if any.

After the contractor has notified the employer that the plant is ready for the service, the plant may be required to operate at nominal rated output for 72 hours. Thereafter, it shall be required to operate under the operating conditions of the station and within the limits of specified output as may be convenient for the employer, without failure or interruption of any kind, resulting from defect of the plant supplied under the contract, for a period of one calendar month.

During this trial operation, the plant will be operated by the employer's personnel with the responsibility and the assistance of the contractor. The contractor may require minor adjustments to be carried out during the trial operation.

If any failure or interruption occurs in any part of the plant due to, or arising from faulty design, materials or workmanship, sufficient to prevent full use of the plant, the trial operation for one month is to recommence after the contractor has remedied the cause of defect. The onus of proving that any defect is due to causes other than those referred to above shall lie with the contractor.

During the trial operation, the contractor shall make familiar the employer's personnel with the properties, the operation and maintenance of the equipment and its auxiliaries to such extent that thereafter the duties can be assigned to the trained personnel.

The contractor shall not withdraw his personnel from this training without the consent of the employer. In case this period of training should last longer than the agreed period for the trial operation, the contractor shall be paid accordingly upon mutual agreement.

If any defects or irregularities affecting the safety or reliability of the plant should arise during the trial operation, the trial operation shall be interrupted and started again after such defects or irregularities have been corrected by the contractor.

B Acceptance

The acceptance of any part or section of the permanent equipment which can operate as an independent unit shall be performed in accordance with the standards and regulations following the test procedure agreed upon between the employer and the contractor.

Immediately upon termination of any such acceptance of a part or section of the permanent equipment, a "Protocol of Acceptance" shall be issued by the employer.

This document shall be signed by an authorized representative of the Employer and the contractor and shall form an integral part of the later "Certificate of Completion".

This "Protocol" shall state:

- The date of acceptance,
- The quantity and type of equipment concerned,
- Statement of all minor defects and/or irregularities, which have to be corrected by the contractor,
- Confirmation that the guaranteed data have been proven,
- Confirmation that all contractual documents have been submitted,
- Confirmation that the employer's personnel has been familiarized with the equipment and that they will be able to operate and maintain the equipment.

If any test for the verification of the guaranteed data could not be performed for operational reasons beyond the contractor's responsibility, this part of the acceptance shall be stated in the "Protocol of Acceptance" and be postponed for a mutually agreed period.

C Performance and Efficiency Tests

After the satisfactory completion of a trial operation, any specified official performance and efficiency tests of the plant shall be carried out. Similarly, any other tests shall be performed, which the employer consider necessary to demonstrate that the plant is in accordance with the specification requirements and the guaranteed characteristics.

If any equipment is not meeting the guaranteed performance and adequate opportunity for correction has been provided, the guarantee penalties shall be applied as specified.

D Report on Tests

Within one month of completion of the trial operation, the contractor shall submit in triplicate a draft report on works and site tests in two sections. All tests shall be described in detail and shall be accompanied by all the relevant tables, charts and graphs, etc. The draft shall be revised until it shall contain a comprehensive record of all settings and final adjustments made during the commissioning of the plant.

After the final approval of drafts, the final document shall be issued in the general style and format of the Operation and Maintenance (O&M) manuals.

E Final Inspection

Immediately prior to completion of the maintenance period, the employer reserves the right to request the contractor to open up the whole or any part of the plant for inspection. The employer will provide the labour for this task to work under the direct supervision of the contractor. The cost of the supervision and of making good any defects uncovered will be to the cost of the contractor.

1.7.5 Tests Certificates

Three (3) sets of all test records, test certificates, performance curves, tables, etc., of all inspections and tests, whether or not attended by the employer shall be supplied soonest after performance of each inspection or test. After completion of all testing, one (1) information in electronic form (DVD or CD) containing all of the above-mentioned documents shall be supplied.

All test certificates shall be endorsed with sufficient information for identification of the equipment and material to which the certificates refer.

In addition, the following references shall be entered in the top right-hand order:

- Employer's name,

- Project title and lot/chapter of specification,
- Plant name,
- Number of contractor's reference drawings,
- Date.

1.7.6 Participation of the Employer

Engineers and technicians from the Employer shall witness selected factory tests. All the cost shall be borne by the Employer for the FAT.

1.8 Transport and Installation

1.8.1 General

Shipping, transportation, loading, storage, erection and test running shall be performed by or under the responsible direction of the Contractor. An appropriate period for transportation shall be considered.

The general co-ordination of storage and erection work as well as the civil engineering work under the different lots on site will be done by the Engineer. The delivery dates, transportation and erection periods indicated in the Contract Documents shall be strictly adhered to. Changes, which are unavoidable or necessary, will be regulated in accordance with the stipulations laid down in the General Conditions. All parts of the plant shall be protected and insured from the time of manufacturing until commissioning against damage of any kind at the Contractor's expense. Parts which are damaged during transport, storage and erection or trial operation shall be replaced at the Contractor's expense.

1.8.2 Packing

The Contractor shall prepare all equipment, devices and materials for shipment to protect them from damage in transit, and shall be responsible for and make good all damages due to improper preparations, loading or shipment. After the workshop assembly and prior to dismantling for shipment to the Site, all items of machinery and equipment shall be carefully marked to facilitate site erection.

All packages shall be marked as specified and approved by the Employer.

If marking tags have to be used on bundled structural material, the tags shall be made of metal and clamped flat to each bundle. Paper or cloth tags are not acceptable.

Packages shall be marked on all four sides with arrows pointing to the top.

Fragile or perishable materials shall be marked with the appropriate symbol, i.e., "FRAGILE", "HANDLE WITH CARE", "COOL STORAGE" and "REEFER STORAGE" and "USE NO HOOKS".

When required due to length or unbalanced weight, containers or pieces shall have centre of balance indicated by painted stripe extending upward on each side with wording "CENTRE OF BALANCE".

Sling marks shall be shown as required.

Fabricated sections of structures and equipment shall have their respective piece marks permanently stamped into the piece to a minimum depth of 1.0 mm and the stamped areas painted with corrosion protective paint of a different color to the base color. Characters shall be at least 10 mm high.

On vehicles, unboxed earth moving equipment or materials handling equipment, etc., the markings may be shown on a notice suitably fastened to the windshield etc.

These shipping marks are separate from and not to be confused with vehicle or equipment color requirements and equipment identification numbers.

Dismantling shall be done into convenient sections, so that the weights and sizes are suitable for transport to Site and handling on the Site under the special conditions of the Project.

All individual pieces shall be marked with the correct designation shown on the Contractor's detailed drawings and other documents (packing lists, spare part lists in Operating and Maintenance Manuals, etc.).

Marking shall be done preferably by punching the marks into the metal before painting, galvanising, etc., and shall be clearly legible after painting, galvanising etc. In labelling, the Contractor shall endeavour to use as few designations as possible and each part of identical size and detail shall have the same designation, regardless of its final position in the plant.

All parts of the plant shall be packed at the place of manufacture; the packing shall be suitable for shipment by sea and for all special requirements of the transportation to Site. Where necessary, double packing shall be used in order to prevent damage and corrosion during transportation, unloading, reloading or during intermediate storage. All identical members shall be packed together, if reasonably possible, in a form convenient for shipment and handling.

Small items shall be packed in boxes and large items shall be protected, where necessary, by timber, straw and sacking. Drums shall be used for electric cables, steel ropes, steel wires and similar materials. All bolts, nuts, washers, etc. shall be packed in containers. Each container shall include only bolts, nuts or washers of identical size.

All parts shall be suitably protected against corrosion, water, sand, heat, atmospheric conditions, shocks, impact, vibrations, etc. All electrical parts shall be carefully protected from damage by sand, moisture, heat or humid atmospheric conditions by packing them in high-pressure polyethylene foil. Where parts may be affected by vibration, they shall be carefully protected and packed to ensure that no damage will occur while they are being transported and handled.

All packing costs shall be included in the scope of work. The packing materials remain the property of the Employer. A copy of the packing list shall be placed inside each shipping package. A copy of the packing list in a waterproof envelope shall be securely fastened to unpacked pieces or bundles. Packing lists shall indicate the name of the Employer and the Contract number.

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

The following information shall be provided for each package:

- Description of package, i.e., box, crate, drum, bundle etc.
- Package number
- General description of contents corresponding to the invoice
- Equipment number where applicable
- Gross, tare and net weights in kilograms
- Dimensions of package.

Packing lists shall detail complete export marks as indicated in "Packing and Marking Instructions". All members comprising multipart assemblies, e.g., steel framework, etc. shall be marked with distinguishing numbers and/or letters corresponding to those of the approved drawings or material lists. These erection marks, if impressed before painting or galvanising, shall be clearly readable afterwards. Color banding to an approved code shall be employed to identify members of similar shape or type but of differing strengths or grades.

1.8.3 Transport and Storage

The Contractor shall provide means for all unloading and reloading work on arrival of a consignment in the port of entry and on the Site immediately on arrival of any shipment. The Contractor is required to take the necessary steps in order to provide the carriage, special supporting structures for heavy loads, etc.

All parts of the plant shall be brought, as far as possible, to their final place of erection. The Employer will designate areas where the Contractor may store parts of the plant. The Contractor shall at his own expense render such areas suitable for the respective purposes. The required space for these facilities will be provided suitably levelled and compacted on the Site.

The warehouses shall be weatherproof, with good ventilation and solid floors. The floors of the warehouses and storage areas shall be designed to carry the loads imposed on them by the stored parts. The following parts shall be stored inside closed warehouses:

Bolts, pins, packing, tools, insulation materials, electrical parts with electrical devices attached, instruments, welding material and equipment, all small parts and all parts of the plant which already have been finally painted.

If large parts are stored in the open air, they shall be provided with weather-resistant and fire-resistant covers. Electrical parts which are not packed in heavy-duty polyethylene foil and those so packed but whose packing has been damaged shall be kept in suitable places from the moment of storage to the moment of installation. All insulation materials which will be taken from the warehouse for installation, and which are stored temporarily in the station shall be protected from weather or humidity.

1.9 Preparation for Installation

Prior to commencement of installation, the Contractor shall closely inspect the site and all the foundations and other structures on which parts of the plant supplied under this Contract will be installed; he shall check that the foundations conform to the installation drawings.

The result of this check shall be reported to the Employer in due time to allow any errors to be corrected before the commencement of erection. All parts of the plant shall be cleaned carefully of all contamination such as dust, sand, rust, mill scale and other dirt prior to installation.

1.9.1 Contract Interface Points

The Contractor's responsibility for carrying out connections shall be as follows unless otherwise stated in the Technical Specifications:

- This Contract shall include terminating and connecting of all cables supplied under this Contract.
- All associated cabling not included in the Contract will be installed, connected to the terminal boards and tested under the supervision of the Employer, but it will be the responsibility of the Contractor under this Contract to assist the Employer in re-checking all final connections and to ensure the subsequent satisfactory operation of the equipment.

1.9.2 General Notes on Installation Works

All transportation and handling of the equipment from the place of storage to the place of installation shall be carried out by the Contractor. He shall provide all hoisting equipment, staging and scaffolding, winches and wire ropes, slings, tackles and all other appliances and temporary materials. The erection staging and scaffolding shall be provided with coverings and barriers and shall guarantee safe working conditions.

The Contractor shall comply with all applicable and approved safety regulations while carrying out the works on Site and with all reasonable requirements of the Employer. This stipulation shall in no way release the Contractor from any obligation concerning his liability for accidents and damages. He shall be responsible for adequate protection of persons, equipment and materials against injuries and damages resulting from his operations.

The equipment or parts to be installed shall not be overstressed during the process of installation. The Contractor shall be responsible that the installation of all equipment is properly executed to the correct lines and levels and in accordance with the manufacturer's instructions and the Technical Specifications.

The alignment of the equipment shall be done exactly; the tolerances indicated by the Manufacturers or in the drawings shall be kept. Setting of parts to be aligned shall be performed by means of fine measuring instruments. All erection clearances and settings shall be recorded. Copies of these records shall be given to the Employer. After alignment, the parts shall be held firmly in position by means of set pins, fitted bolts, etc.

Anchor bolts, base-plates, anchor rails, etc. to be embedded in the first stage concrete shall be delivered in due time with instructions and/or templates to facilitate the bringing in of such parts into the Civil works.

The Contractor shall provide all necessary anchors and braces to ensure the alignment and stability of the parts to be installed. All temporary anchors and bracings shall take care of all dead load, wind load, seismic and erection stresses, e.g., during concreting, and shall remain in place until they can be removed without endangering the stability of the equipment.

If for installation purposes auxiliary structures have been attached to the equipment, they shall be removed after completion of work and the surface restored to proper condition by grinding and repainting. Special care shall be taken not to damage surfaces of galvanised or specially treated equipment during erection. Care shall be taken to prevent any rust streaks or foreign matters deposited on galvanised or otherwise finished surfaces during storage or transport or after installation.

Glass parts or other parts which can easily be damaged shall be provided with suitable protective sheaths or coverings during installation. Machined or bright surfaces, which are not to receive a coat of paint, shall be protected during storage and erection by a suitable anti-corrosion film.

All portable power tools shall preferably be operated electrically. Special tools, which are supplied for maintenance and repair, can be used for installation. They are to be handed over at the end of the installation work in good condition in accordance with the Employer's instructions.

The carrying out of all the work included in the Contract shall be supervised by a sufficient number of qualified representatives of the Contractor, and full facilities and assistance shall be afforded for the Employer to check the Works. The Contractor shall obtain from the Employer details of the parts, which he proposes to inspect, but such inspection shall in no way exonerate the Contractor from any of his obligations. The Contractor, if requested by the Employer, shall open for inspection before erection any equipment, which has been delivered to the site partly, assembled.

The Contractor shall keep reasonably clean the site on which he erects or stores plant, removing all waste material resulting from the Works as it accumulates and as reasonably directed. On completion of the Works the Site shall be left clean and tidy to the satisfaction of the Employer. Any damage done to buildings, structures, plant or property belonging to the Employer shall be made good at the Contractor's expense.

During erection and commissioning the Contractor shall provide all temporary scaffolding, ladders, platforms with toe boards and hand-rails essential for proper access of workmen and inspectors, cover or rail off dangerous openings or holes in floors, and afford adequate protection against materials falling from a higher level on to personnel below.

The maximum personal safety must be afforded to personnel either directly engaged on this Contract or who in the normal course of their occupations find it necessary to utilise temporary works erected by the Contractor or to frequent the working area.

In each and every case involving a connection between the Plant supplied under this Contract and any other existing plant which may or may not be in service, the Contractor shall make suitable arrangements as regards the time and manner in which the connection is made, subject only to the approval of the Employer who is in charge of the existing plant. Where cases arise involving the operation of the plant or work on plant in operation or whenever required by the Employer, the Contractor must obtain a written "Permit to Work" signed by a person duly authorised by the Employer.

1.9.3 Signs

During the process of local transportation, erection and construction the Contractor shall provide appropriate safety and warning signs for use in prevention of accident; for warning of health hazards and for meeting certain emergencies.

The permanent Works shall be fitted with safety, warning, escape, fire protection signs and plates in compliance with the Standards and Regulations. Construction, material, color, shape, geometry, etc. shall comply with the relevant standards. The signs shall be of weather-resistant, durable material suitable for the condition prevailing on site.

Signs with pictograms should be used where possible. Wording imprinted on the signs shall be in English language as well as in Nepali language and vernacular language.

The positions for the signs shall be chosen so that they are within the field of vision of the persons to whom they apply. The signs shall be permanently attached. Temporary dangerous areas (e.g., construction sites, assembly areas, uncovered pits and trenches etc) shall be marked by movable signs. The safety signs shall be mounted in such a manner that there is no possibility of misunderstanding.

"Information Signs" should supply the necessary information to acquaint personnel with the physical arrangement and structure of site, buildings and equipment, e.g. floor number, load carrying capacities including marking of floor areas, working loads of cranes, lifting gear and lifts, room identification, etc. The routing of underground pipes and cables shall be indicated by substantial marker blocks showing the relevant identification numbers.

In the event of accidents, all necessary information shall be immediately available to those affected. Thus, a sufficient number of signs of appropriate size shall be installed, e.g. escape routes (including marking of floor areas), emergency exists, fire alarms, fire extinguishers, instructions for special fire-extinguishing agents, warnings against fire-extinguishing agents (CO_2), first aid equipment, first aid points, accident reporting points, telephones, etc.

Signs indicating obligatory actions shall be installed wherever certain action is necessary, e.g. "DO NOT OBSTRUCT THE ENTRANCE", "KEEP RIGHT" "KEEP YOUR HEAD HIGH" etc.

Signs should also indicate when the wearing of protective clothing and equipment is necessary and obligatory, e.g. protective goggles, protective clothing, helmets, head guards, breathing equipment, ear protection, etc.

Warning signs shall refer to the existing or possible danger, e.g. flammable substances, explosive substances, corrosive or toxic substances, suspended loads, general danger, width/height restriction, steps, risk of trapping, slipping, falling, collision, holes in floors etc.

In addition to warning signs, appropriate black-yellow strip markings shall be applied where necessary.

Prohibition signs shall be put up at appropriate locations to indicate that certain actions/activities are prohibited, e.g. "NO SMOKING", "NO OPEN FLAMES", "NO DRINKING WATER" etc.

1.9.4 Fire Protection and Fire Fighting

The Contractor shall be responsible for the fire protection of his buildings by providing trained personnel and firefighting equipment. Sufficient firefighting equipment shall be provided on the Site for the full period from the commencement of site works until take-over of the Works. The Contractor shall ensure that both he and his Subcontractors take all precautions to prevent fires occurring.

1.9.5 Cleaning

Throughout the duration of the Contract the Contractor shall maintain the Works in a clean and tidy condition. All material not in use and/or no longer required for the Works, all condemned materials and all rubbish shall be removed from the Site, combustible rubbish shall be removed daily. Upon completion of the Works, the Contractor shall remove all temporary works which he may have constructed for the protection of plant or his convenience while carrying out the works and all equipment and surplus materials and any remaining rubbish which may have accumulated in the execution of the Contract and shall leave the whole area in a clean and tidy condition.

1.10 Annex

1.10.1 Electrical Standard Ratings

A Voltage

i High Tension System/Lines

High Tension Line shall refer to 11 kV and higher.

ii Low Tension System/Lines

400 V, 3-phase AC with N or PEN (TT or TN-C system)

230 V, single-phase AC with PEN (TN-S system)

230 V, 3-phase AC with PE for UPS system, control / communication systems and security lighting (IT system)

220 V DC with PE, primary DC voltage for power/control (IT system).

The electrical equipment as fed by the above-mentioned standard distribution voltages shall not be affected in their specified duty or life expectation while encountering the following system variations, which referred to the rated consumer voltage:

- For normal AC systems 80 % to 115 % (for short duration ≤ 30 s), and 95 % to 105 % continuously.
- For DC systems 85 % to 115 % continuously.

B Neutral Earthing

All transformer neutral points shall be earthed according to the Technical Specifications.

1.10.2 Instrument Transformers

Potential transformer secondary windings shall have a rated voltage of 110/√3 and 110/3V as per the single line diagram.

Current transformer secondary windings shall have a rated current of 1A as per the single line diagram.

1.10.3 Color Code for Electrical Connections

Live parts of electrical connections shall be color coded as follows:

Conductor Coding: Designation / Alphanumeric Symbol / color

A AC network:

- Phase 1: L1 / red
- Phase 2: L2 / yellow
- Phase 3: L3 / blue
- Neutral: N / black

B DC network:

- Positive: L+ / white
- Negative: L- / black
- Neutral: M / blue

C Earth and protective earth conductors:

- Protective earth: PE / green - yellow
- Combined protective earth/neutral: PEN / green-yellow
- Earth E: bare or grey

1.10.4 Color Code for Mimic Diagram and Displays

Mimic diagrams to be arranged on switchgear cubicles, control panels/desks or displayed on monitors, etc. shall be color coded as follows:

Table 2: Color Code for Mimic Diagram and Displays

33 kV	grey	similar to RAL 6013
11 kV	blue	similar to RAL 5015
400 V	black	similar to RAL 9005
110 V DC	violet	similar to RAL 4001

Note: colors shall be finally agreed upon during detailed design.

1.10.5 Display Card for Three Phases

The three phases shall use the following symbols for display wherever applicable, including the incoming/outgoing gantry, bus bars, cable markers, switchgears. The triangle, square and circle shall have equal radius of the circle to which they are inscribed.

Table 3: Display Symbols for Phases

SN	Phase	Symbol
1	R	Triangle
2	Y	Square
3	B	Circle

1.10.6 Required Documents

A General

In compliance with Section Technical Documents of this General Technical Requirements at least the following documents for the equipment shall be supplied to the Engineer for approval (marked A) or for information (marked I).

For identical equipment such documents shall be submitted only once. The drawings shall be submitted shall also be submitted again as As-Built drawings, even if not explicitly mentioned.

B Principal Requirements

The following documents shall be supplied individually or as a whole for equipment/installations wherever applicable.

i Loading Drawings

For all larger pieces requiring special means for transportation, as for example:

- Poles
- Distribution transformers

All documents: I

ii Foundation Drawings

For any equipment requiring a foundation or other civil works provisions: A

iii General Layout Drawings

For the whole line arrangement/ trenches: A

iv Short Circuit Calculations

For the following voltage levels:

- MV systems (33 kV and 11 kV MV distribution systems)
- LV systems

All documents: A

v Insulation Coordination, Lightning and Switching Overvoltage Study

Insulation coordination study A

Lightning and switching over-voltage study A

vi Asset Numbering System

Description of the applied asset numbering system A

Frequently updated lists complete with all system I

vii Basic Documentation

For all equipment/installation the following basic documents shall be provided:

- Specification for rating plates and labels including list of inscriptions A
- Workshop test schedule I
- Site test schedule I
- List of tools and appliances I
- List of spare parts I

viii Overall Diagrams

Single-line overall diagrams A

Three-phase overall diagram with phase sequence and vector groups A

ix Documents for all Equipment and Installation as Applicable

Shop test programs	A
Material test certificates	I
Shop test reports	A
Welding procedures	A
Paint schedules	A
Instrument lists	A
Wiring diagrams	A
Signal and alarm list	A
Installation drawings	A
Erection procedures	A
Site test procedures	A
Commissioning program	A
Commissioning procedures (dry and wet)	A
Operating & maintenance manuals	A
Program for training of Employer's Personnel	A
Site test reports	A

C Specific Documents for Electric Equipment

i Distribution Transformers

Specifications and technical data sheets	A
Voltage ratio and tap-changer calculation	A
Arrangement and dimension drawings	A
Oil specification and technical data sheets	A
Execution drawings for:	
- Magnetic core	I
- Windings	I
- Tap changer	I
- Bushings and terminals	A
- Rating and operation plates	A
- Cooling system	I
Execution drawings for instrumentation systems:	
- Arrangement and dimension drawings	A
- Specifications	A
- Circuit diagrams for Instrumentation	I
- Block and Logic diagrams	A
- Part lists	I
- Terminal diagrams	I

ii Medium Voltage Overhead Lines

Line profile drawings	A
Conductor and earth wire tension/ sag tables	A
Pole, support, and stay anchoring detailed drawings	A

Foundation drawings	I
Details of insulators, conductors, earth wires, fittings, clamps, etc.	I
Installation drawings for load break switches, earthing switches, surge arresters and cable sealing ends with supports	A
Part lists	I

iii Low Voltage Installations

Specifications and technical data sheets	A
Arrangement and dimension drawings for complete distribution boards and for each type of feeder	A
Single-line diagrams	A
Standard circuit diagrams	A
Individual circuit diagrams	A
Part lists	I
Terminal diagrams	I
I/O Lists	A

iv Electrical Protection Systems

Overall and detailed protection single-line diagrams	A
Specifications, technical data sheets, setting and tripping ranges/curves for protection devices	A
CT and VT calculation notes	A
Protection relay setting study	A
Protection co-ordination diagrams, tripping matrix	A

v Communication Systems, wherever applicable

Specifications and technical data sheets	A
Overall schematic diagrams	A
Equipment lists	A
I/O Lists	A
Installation drawings	I

vi Earthing and Lightning Protection Systems

Specifications and technical data sheets	A
Report on test results of specific earthing resistance measurements	I
Overall schematic diagram	A
Installation drawings for buried, and exposed earthing system	I
Installation drawings for lightning protection systems	I
Typical installation details	I

D Specific Documents for HT and LT Line

i Survey

General layout plan of at least 30 m width	
Profile drawings as required as per lines central line, both ends of arms and both ends of the right of way	
Preconstruction Survey – Structural Data Sheet	
Other essential Drawings	
All documents:	A

ii *Towers and Poles*

Design drawings and calculation for each type of tower and leg extension

Detail drawings for each type and leg extension

Bills of materials

Design drawings and calculation for each pole types including clamps

Detail Drawings of each stay types

Bills of materials including weights: total and transport.

All documents: A

iii *Insulators, Fittings and Accessories*

Catalogues and Details of all accessories

Detail drawings for each type of accessories

All documents: A

iv *Conductor and Stringing Charts*

Cross Section of Over Head ACSR Conductor (Covered and Bare)

Cross Section of Underground Cables

Stringing Chart from 30 m to 150 m for each conductor, Single Circuit

Stringing Chart from 30 m to 150 m for each conductor, Double Circuit

Stringing Chart from 30 m to 150 m for each conductor, Single Circuit including ADSS Cable

Stringing Chart from 30 m to 150 m for each conductor, Double Circuit including ADSS Cable

All documents: A

v *Test procedures*

Towers

Poles

Insulators, hardware and fittings

Sub-soil tests

Ground electrical resistance

Piles

Test Reports

All documents: A

vi *Foundations*

Design drawings and calculation for each type of Tower Foundations

Design drawings and calculation for each type of Pole Foundations

Detail Tower Grounding Drawings and Design

Drawings and/or catalogues of insulators, hardware and fittings

Test Reports

Special Foundation Drawings, wherever required.

All documents: A

vii *Reproducible*

Surveys

Details drawings for all towers and poles

Bills of materials and tower/pole schedules

As built Drawings – Structural Data Sheet

All documents: A

Manuals

Instruction manuals and lists of operation and maintenance tools.

All documents: A

1.10.7 Classification of Test Certificates

The classification of test certificates according to DIN EN 10204 is as follows:

CLASSIFICATION OF TEST CERTIFICATES ACCORDING TO DIN EN 10204			
Type	Designation of Test Certificates EN 10204	Contents of Test Certificates	Document validated by
2.1	Declaration of compliance with the order	Statement of compliance with the order	The Manufacturer
2.2	Test report	Statement of compliance with the order, with indication of results of non-specific tests	The Manufacturer
3.1	Inspection certificate 3.1	Statement of compliance with the order, with indication of results of specific inspection	The Manufacturer's authorized inspector independent of the manufacturing department
3.2	Inspection certificate 3.2	Confirmation of compliance with the order with indication of results of specific inspection	The Manufacturer's authorized inspector independent of the manufacturing department and either the purchaser's authorized inspection representative or the inspector designated by the official regulations

1.10.8 Equipment Designation System Application Guide

A Introduction

i General

This **Application Guide** is based on the system planned for implementation in NEA. Any additional attributes required by the Client shall also be submitted by the Contractor. This section presents the review of the specifications and implementation modality developed by NEA. The document first describes the physical system architecture. Then the attributes to be collected are checked although it needs further study, the attributes are proposed as,

- Substation Attributes – 33/11 kV substations only
- Feeder Attributes – 33 kV, 11 kV and LT feeder with numbering system
- Transformer Attributes – Substation Power Transformer and Distribution Transformer
- Pole Attributes – Pole Structure instead of single pole numbering
- Meter Attributes – One user possible for a meter
- User Attributes – More than one meter possible per user

The attributes should be interlinked with each other. The collected data should be easily retrievable. The collection process should be such that, it should present as minimum error during data collection, as far as possible. The key features and functions for the system is mentioned in the following section:

Particular Project Applications

The tables shall be currently completed with relevant details and kept up-to-date by one responsible person for the whole project (to avoid double-definitions or other confusions).

The completed/revised Guide versions shall be regularly distributed to all parties concerned and in the as-built form finally included in the Operation Manual.

ii Asset Numbering System

A suitable asset identification system should be planned/carried out, like a barcode sticker, QR code etc. to the equipment for identification. It is suggested to make use of standards.

ISO 3166 — Codes for the representation of names of countries and their subdivisions

This provides division up to Provincial Levels, That could be helpful instead of using DCs name as eventually, distribution system needs to be as per the Local Municipality Level.

Methodology, Instead of using a plate, propose to use water resistant adhesive in water resistant plastic; Use of bar code and at least one QR code and pasting it all round the pole and wherever required.

In addition to these, the pole arrangement is suited with much detailed numbering system, For example, Structures could be designated with letter as follows in North American System,

S Suspension

T Tension

A Angle

or the following could be used

L Light --- Up to 2 degree

M Medium --- Up to 15 degree

H Heavy --- Up to 30 degree

and similar terms...

We could use further code for

D Dead End

Similarly, number of circuits can be represented as,

DC Double Circuit

SC Single Circuit

This is with consideration that the poles are designated with 2 letters.

And in addition to these, voltage system can be specified

0 Single Phase line

4 3 Phase line

1 11 kV line

3 33 kV line

So, A 30DDC or 3-0D-DC would be a 400 V type 3 phase, Double Circuit Dead End Structure. Work on this would allow to identify such features directly from the pole code. This is proposed to be done than simply numbering a pole based on a Distribution Centre, which owns it. The DC could just be represented by a code number. Similarly, the composite nature of pole, feeder and other functions can be

designated as a code and at last a number say 4 digits would be enough for feeder length up to 250 km with 32 pole structures per km.

250 * 32 = 9600 i.e., we can assign a four digit numbering system at end of a pole in a feeder;

The number can be updated if the pole is switched to other feeder in future. Software arrangement can be made on that.

So, a pole code could simply be

A-123-456-0-AB-SC-1234

A	Asset Type, Max 26 types of assets
123	DC Code, Max 999 DCs
456	Feeder Code, Max 999 feeders per DC
0	Line voltage type, composite with which voltage levels; Max 9 type
AB	Pole function, Suspension, Dead End, Tension, etc.
SC	Single Circuit, Double Circuit or Special Type with 11 kV double LT single, etc.
1234	Pole Number in that particular Feeder, Maximum 9999 poles per feeder

B Substation Attributes

The Contractor shall need to prepare substation attributes as follows and rather present direct relations to feeders and transformers. The feeders and transformers codes need to be determined based on ease of understanding. It is proposed to have the CT and PT information in feeder and transformer data.

For	Substation Attribute
1	Substation Code
2	No. of Transformers
3	Transformer Codes - Multiple
4	No. of Feeders
5	Feeder Codes - Multiple
6	Photos
7	Substation Layout
8	Substation SLD

C Feeder Attributes

For the current backbone information, it is proposed to have conductor types and feeder capacity. The causes of tripping, min and max load is suggested to update later in real time system.

S.N.	Feeder Attribute
1	Feeder Code
2	Voltage Level
3	Conductor Type

S.N.	Feeder Attribute
4	Substation Code
5	Feeder Capacity
6	Feeder Length
7	Feeder Meter Code
8	Photos
9	No. of Sub-Feeders
10	Sub-Feeder Codes
11	Feeder Map Imagery

D Transformer Attributes

It is proposed to have a similar dataset for Substation and Distribution Transformer, which will however be in separate headings.

S.N.	Transformer Attribute
1	Transformer Code
2	Manufacturing Company Name
3	Transformer Capacity
4	Voltage level
5	Number of Phases
6	Transformer Ownership
7	Earthing Wire
	Transformer HV Neutral Earthing
	Transformer LV Neutral Earthing
	Frame Earthing
	Lightning Arrestor Earthing
8	Silica Pot
9	Type of Connection
10	Feeder Code
11	Pole Code (For Distribution Transformer)/Substation Code (For Substation Transformer)
12	Manufacture Date
13	Installation Date
14	Photo
16	Location: Local Name

S.N.	Transformer Attribute
17	Oil level in Conservator Tank (To be Updated during transformer data updating by NEA engineer)
18	MCCB rating (For Distribution Transformer)/Circuit Breaker Info (For Substation Transformer)
19	Last Inspection/Maintenance Date

E Pole Attributes

The pole attributes could be for pole setup rather than a single pole, which can then be applied to any kind of structures including towers in Distribution Level. The pole setup could thus be numbered with poles in the setup numbered as A, B and so on. This eases the process for numbering poles with transformers as well as in 3 pole arrangement for distribution lines.

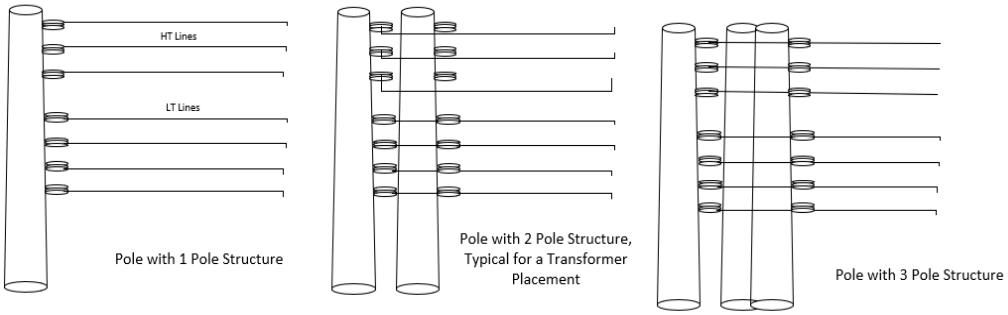


Figure 1-1: Pole Setups for numbering the Poles.

S.N.	Pole Attribute
1	Substation Code
2	Feeder Code
3	Transformer Code
4	Pole Structure Code
5	Number of Poles
6	Pole Type
7	Pole Dimension
8	Photo
9	Number of Feeder Lines
	Type X Conductor Type
	Type X Conductor Size
	Number of Circuits
10	Total Number of Outgoing Feeder Lines
11	Total Number of Service Connection
12	Additional Cables on Pole
13	TV Cable
14	ISP Cable

S.N.	Pole Attribute
15	Sub-Feeder Code
16	Service Connection (Meter) Code
17	Pole Function (Suspension, Angle, Tension, etc.)

F Meter Attributes

It is suggested to differentiate the Meter and User Attributes, as one user can have multiple meters.

S.N.	Meter Attribute
1	Meter Code/Number
2	Meter Capacity
3	Approved Load
4	Meter Connection
5	Connected Phase
6	CT Ratio
7	PT Ratio
8	Pole Connected to
9	Consumer Code
10	Meter Type
11	Photo
12	Meter Manufacturer
13	Meter Purchase/Approved Date of NEA (Which FY meter

G Consumer Attributes

It is suggested to differentiate

S.N.	Meter Attribute
1	Consumer Code
2	Consumer Name
3	Address
4	No. of Meters
	Meter Code(s)
5	Photo of recognizing ID

1.10.9 Painting Schedules

A Painting Schedules for Electrical Components

Equipment	Inside/ Outside	Surface Preparation	PRIMER COATS				TOP-COATS				Remarks
			Type	Application	Number	Dry Thickness per Coat (µm)	Type	Application	Number	Dry Thickness per Coat (µm)	
Transformer Tanks		Z	A	1	2	25	D	1	2	25	
Transformer Radiators		Y, X	K H	5 5	1 1	60 25	D D	1 1	1 1	30 30	
HV Switchgear		Y, X	E	4	1	25	D	3	1	30	
MV Switchgear		Y, X	E	4	1	25	D	3	1	30	
LV Switchgear		Y, X	E	4	1	25	D	3	1	30	
Panels & Cubicles	I O	Y, X	E E F	4 4	1 1	25 25	G G	1 2	1 2	30 25	

Legend

LEGEND:

Surface Preparation:

Z = Sand blasting grade to SIS or DIN

Y = Rust + dust removal by acid solution

X = Phosphating and passivating

Type of Coating

A = Resin primer

B = Phosphate zinc primer

C = Zinc chromate primer

D = Resin enamel

E = Acrylic emulsion enamel

F = Lacquer putty

G = Lacquer enamel

H = Phenol-alkyd resin

K = Chlorinated rubber-alkyd resin

L = Rubber chloride enamel

Application

1 = Spray coating

2 = Air spray coating

3 = Airless spray coating

4 = Electrostatic powder coating

5 = Flow coating

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2 PRECONSTRUCTION SURVEY

2.1 General

The Contractor shall carry out the following works as part of pre-construction survey.

- Pre-construction Survey of 11 kV lines and Underground Cable, if available.
- Pre-construction Survey of LT lines.
- Pre-construction Survey of LILO/Tap off Point and Tapping Bay Substation

The pre-construction survey will follow the Development of Design report of lines and distribution transformers including tapping arrangement locations. The reports will constitute all the detail submissions mentioned in general specifications, along with ones presented here.

2.2 Structural Data Sheet of 11 kV and LT Line

A structure data sheet (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. Abbreviations used in the SDS shall be defined as follows:

Table 1: Typical Abbreviations for 11 kV and LT Lines – Consider Drawings for more details

S.N.	Particular	Description	Code
1	Circuit Type	Single Circuit	SC
		Double Circuit	DC
2	Pole Type	Steel Telescopic Pole	STTP
		Steel Lattice Tower	SLT
3	Conductor/ Cable Type	11 kV 400 mm2 XLPE Power Cable, 1C	XLPE,400,11, 1C
		11 kV 400 mm2 XLPE Power Cable, 3C	XLPE,400,11, 3C
		ACSR 'WOLF' Conductor	WOLF
4	Pole Frame Type (11 kV and LT Line)	Single Pole Single Arm	SPSA
		Single Pole Double Arm	SPDA
		H-structure	HS
		Three Pole or Four Pole Structure	MP
		Single Pole Double Dead End Structure	SPDDE
		Tap-Off structure (TO)	TO
		Dead End Structure (DE)	DE
5	Stay Type	Single stay	S
		Double Stay	D
		Flying type stay	F
6	Load Break Switch	Load Break Switch	LBS
7	Angle of Deflection	Angle of line deflection in degree	BA

Note:

a) nformation 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).

The SDS shall be submitted in soft copy in kmz, ESRI shape file (.shp), .csv and .txt format.

The format for SDS shall be as provided at end of this chapter.

2.3 Survey Works of 11 kV Line and LT line

The survey works shall be carried out as per industry standard for recci and transverse survey. The detail survey procedure shall be as approved by the Client. The Contractor shall submit the following documents after the survey works.

- Survey drawings, including:
  - Route maps.
  - Centerline plans and profiles of each line pole spotting drawings.
  - Soils survey map identifying foundation type selected for each individual pole.

2.4 Typical Format for Structural Data Sheet of 11 kV and 400 V Line

Nepal Electricity Authority

Structure Data Sheet (SDS) of 11 kV and 400 V Line

Province: Distribution Centre:

District: Name of the Project:

Municipality: Contract No:

Ward No: Contractor:

Tole: Authorized Signature:

SN	Pole No		Lat	Long	Span	Circuit Type	BA	Pole Type	Pole Frame							Stay			Conductor /Cable	Switch	Remarks
	From	To							SPSA	SADA	HS	MP	SPDDE	TO	DE	S	D	F			
1																					
2																					
3																					
4																					

...

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Section 6: Employer's Requirements

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3 STANDARD PRACTICES FOR HT AND LT LINES

3.1 General installation practices

These Standard Specifications, together with the Construction Standards, shall govern the performance of the Works and shall be the basis for inspection and acceptance of the Work by the Client. The Standard Specifications and the Construction Standards shall be considered as mutually inclusive, and the conditions stated in each shall supplement the other as appropriate. All Standard Specifications shall be followed at all times by the Contractor unless specifically accepted in writing by the Client, or unless some aspects of the work covered by these General Specifications are not required by the Scope of Work. The Construction Standard Guidelines – Drawings are prepared in detail for tender level in use for both single and double circuit along with ADSS Cables. The Contractor refer to these specific drawings for complete construction purposes.

3.1.1 Route of Circuits

To the greatest extent practicable, all overhead circuits should be located along streets or travelled ways ordained by the Local Government or required authority as public property, except as required for Service drops and circuits to individual consumers. 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 Client. The Client shall obtain any required permits for occupancy of public or private Right-of-Way.

3.1.2 Survey and Staking

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.

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. 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. 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.

All distances between structures, and other necessary measurements of length, shall be measured to accuracy, of 0.1 meter 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 meter by means acceptable to the Client.

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 Client at the time of completion of the Works. The format of proposed survey notes shall be submitted to the Client for approval.

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 Client.

3.1.3 Technical Documentation

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 Client prior to acceptance by the Client of such documentation. All technical documentation shall be prepared in the English language.

Documentation shall be prepared using the following mediums:

a) Mylar material, with a minimum thickness of 0.127 millimeters, shall be used to produce the base Structure Data Sheet, As-Built Drawings and other drawings specified by the Client.

b) Standard drafting vellum shall be used to produce small area plotting, profiles of line-sections and center-line plotting necessary for the development of Structure Data Sheets and As-built Drawings.

Structure Data Sheets (SDS) shall be prepared in accordance with the F1 format contained above. Structure Data Sheets shall be prepared by the Contractor showing his proposed construction details for erection of facilities in accordance with the Construction Standards. The SDS shall be prepared after the center-line survey and staking is completed, for any line section designated by Client, and shall be submitted to Client for approval prior to any construction of the facilities shown in SDS. Submission of SDS for approval shall be in the form of A3 photocopy in clearly legible copy. Any unclear or illegible form entry or reproduction shall be rejected. Client 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 Client representative. The SDS and As Built Plan are intended as permanent records for Client. Any construction performed prior to the Contractor's receipt of approved SDS from Client shall be completely at the Contractor's risk, and Client shall have the right to require any correction due to the un-approved construction activities.

As-Built Drawings shall be prepared by the Contractor in the general format provided by the Client. Drawing size shall be approximately 841 x 597 mm overall and the scale shall be 1:10,000, 1:2,000. The Client shall provide any available environmental background data for inclusion on the various drawings and the Contractor shall record (in ink) all facilities as-built.

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

3.1.4 Material Storage

The Contractor shall procure all materials and equipment stated in the Bill of quantities. The Contractor shall provide all labour, 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 Client reclaimed after demolition of existing facilities if any shall be transported to the Client warehouse and unloaded in the same manner.

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 Client, at the Contractor's cost.

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 Client 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. C cable reels shall be placed on Wood pallets, wood lagging, or well-graveled 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 Client. 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.

3.1.5 Excavations

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.

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.

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) centimeters 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.

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 Client, 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.

3.1.6 Safety

The Contractor shall take all measures required to safeguard the public, 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.

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.

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.

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.

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.

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

3.1.7 Tests

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 Client.

The Contractor shall megger all circuits installed with a motor-driven megger or equivalent instrument. All circuits installed with a motor-driven megger to demonstrate the acceptable insulation characteristics of the line prior to energization

and Provisional Acceptance. Overhead circuits shall be tested at 2500/1000 volts AC and 33 kV overhead circuits shall be tested at 5000 volts AC.

The Contractor shall megger all transformers with a motor-driven megger prior to installation. All tests specified shall be conducted during suitable atmospheric conditions under the supervision and witness of the Client. All test results shall be documented and signed by both parties.

3.1.8 Demolition

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 Client and the Contractor shall deliver all salvaged materials to the Client warehouse, or as specifically directed by the Employer.

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.

All conductor materials removed shall be returned to the Client. Methods of conductor removal shall be specified by the Client. 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.

Care shall be taken in removing, handling, and transporting cutouts, and surge arresters to minimize porcelain damage. Transformers removed from service shall be delivered to the Client warehouse or as specifically directed by the Employer. Care shall be taken in removing, lifting, and transporting transformers.

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

3.1.9 Cleanup

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

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.

3.1.10 Tree Cutting and Trimming

Any tree cutting or tree trimming authorized and directed shall be accomplished by the Contractor under the direct supervision of Client. All cutting shall be removed by the Contractor with disposition of cutting as specified by Project Implementation Unit.

3.1.11 Interruptions to Existing Service

The Contractor shall arrange for interruptions of service to existing lines with Client. Every effort shall be made to limit such interruptions to the minimum. If it is possible

to maintain service to a section of line by constructing temporary facilities approved by Client, the Contractor shall detail man hours and classification of personnel required to construct such facilities and submit to Client for approval prior to any work being performed.

3.1.12 Pole Setting

Pole holes shall be dug large enough in diameter to admit a tamping bar all around the periphery of the pole and shall have a uniform dimension as per the type of pole used at the top and bottom. Poles shall be planted in the ground to the depth specified in Table 2. Before planting a pole, the bottom of the hole made for planting the pole, shall be cleaned of free soil and firmly tamped, to prevent the hole from settling. The stability of a pole, particularly a pole without stay, is greatly influenced by the size of the pole hole, the nature of the soil and the care exercised in back filling and tamping. Two active hand tampers and one slow shovel shall result in good compaction. Poles shall be set to stand perpendicular except at terminals, angles and other points of excessive strain where they shall be given a rake not to exceed 10 centimeters against the direction of strain. Poles located at the sides of banks or other locations, where washouts may occur, shall be protected by suitable cribbing, or shall be referred to the Engineer for recommended action.

After the pole is in position and the hole is back filled and tamped, soil shall be piled and packed firmly around the pole. Pole setting shall be inspected prior to acceptance and any back fills that have sunk shall be refilled. Poles located in shallow riverbeds shall be protected by gabions as designated by the Employer. Gabions should be approximately 2 meters x 1-meter x meter. Four such gabions are required for each pole. Set pole and pour 860 mm diameter foundation and level areas around pole and set gabions in pattern shown in CSG-06. It is important to lace adjacent gabions together along the perimeter of all contact surfaces. Fill gabions with hard, durable, clean stone, 100 mm to 200 mm in size in three layers. Install two connecting wires at each layer. Lace gabion lids securely and make certain that all edges are closed. Fill void between pole and gabion with hard, durable, clean rock 200 mm minimum size.

3.1.13 Pole Framing

Pole and structures shall generally be framed in accordance with these standards and the construction structure data sheets. Where special framing requirements are necessary, the Employer shall provide framing instructions for the specific structure. Each cross-arm shall be attached to the pole by a pole clamp or by machined bolts of sufficient length to pass completely through the holes provided on the pole and cross-arms and receive their full complement of nuts. Bolts of proper length shall be used. Excess nuts shall not be used to make use of a bolt which would otherwise be too long. The end of a machined bolt projecting more than 3 centimeters beyond the nut shall be cut off to a length of 2 centimeters beyond the nut. Each bolt, when installed, shall have its full complement of nuts.

3.1.14 Stays

Stay leads specified in construction documents are defined as the horizontal distance from the center line of the pole at ground line to the point where the anchor rod should enter the ground assuming the ground to be level. For the correction in stay leads for uneven ground see Construction Standard Guidelines – relevant Drawings. The Engineer, upon request, may designate the actual location of stay anchor rods on slope of hills. The stay stake indicates the point where the anchor rod enters the ground. The anchor hole shall be dug accordingly. The attachment of one stay shall not overlap that of another stay when two or more stays are carried to a pole or anchor. Each shall be entirely independent of the other. This does not prevent the use of multiple eye rods for nuts designed for such use.

All stays to be installed on a pole line shall be placed and drawn reasonably tight before the conductors are tensioned. After the conductors are tensioned and sagged to their final position, the stays shall be carefully inspected to see that each is carrying its share of the load on the pole as intended. If multiple stays are not carrying equal strain, the slack stay shall be pulled up until it is sharing load as intended. Stay anchors must be installed full depth and set to pull against undisturbed soil to develop full tension. An anchor not properly installed will move and allow movement of the top of the pole, thus slacking the conductors. Stay anchors installed in soft or unstable earth shall be placed at specified depth and back filled with 5 cm. maximum size crushed stone placed to a depth of 1 meter from the bottom of the pole.

3.1.15 Stay Insulators

Stay insulators shall be installed on all stays in accordance with the construction drawings.

3.1.16 Field Modifications

During the erection work at the field there may be necessity to modify galvanized steel hardware and may have to be drilled, reamed, filed or cut. Under such a condition the area of the steel exposed, after these modifications, shall be coated with a zinc-rich paint to protect the steel from corrosion.

3.1.17 Sagging

Conductors shall be sagged in accordance with the sag chart specified by these specifications. The importance of careful sagging of conductors cannot be over emphasized. Conductors have definite characteristic that control their behaviour resulting from changes of temperature, wind speed and additional load due to ice or wet snow. Conductors must not be sagged too tightly (less than specified sag) as unspecified extra tensions may result in failure of conductor structure. Conductors sagged too loosely (more than specified sag) may contact adjacent conductors' hardware or any structure. Excess sag can reduce clearance beneath the line with the ground to the point of danger.

3.1.18 Sag Charts

Unless otherwise noted, all sag charts are calculated on the basis of 35 kg/sqm wind pressure Sag is always measured vertically, without wind, when conductors are being installed or re-sagged. Unless otherwise specified by the Employer for a specific condition, initial or stringing sag shall be applied to the installation of all new unstressed conductor. The initial sag is always less than the final sag.

Sags for the various temperatures shall be furnished by the Engineer in a table form for spans not covered by the sag chart. In order to ascertain the sag for a given stringing temperature, select the point corresponding to the proper temperature on the scale on the left-hand side of the sag chart. Lay a straight edge so that it passes through this point and the point of the center scale representing the length of span to be sagged. The straight edge will then indicate the proper stringing sag on the righthand scale. Interpolate if the temperature of span is not exactly the same as designated on the chart. The low voltage neutral conductor shall be sagged with the same sag as the low voltage phase conductor. If the low voltage conductor, as a group, has less design sag than the high voltage phase conductor installed above it, the low voltage conductor, as a group, shall be installed to the same sag as the high voltage conductors installed above.

3.1.19 Stringing

The dynamometers and similar apparatus shall be used for tensioning of conductor to obtain appropriate sagging of conductors. For stringing of conductors of all size

stringing rollers or roller shall be used to support the conductor as it is pulled out and sagged. Stringing rollers shall be used regardless of size of aluminium conductors, bare or covered. Stringing rollers shall be suspended at each insulator support position so that the conductor shall roll smoothly over the roller protecting conductor from any physical damage. Stringing sheaves shall have a diameter at least 20 times the conductor diameter and so finished as to prevent damage of any kind to the conductor as it is pulled through the sheaves.

Conductor drum shall be located at a sufficient distance from the first structure to avoid excessive bending of the conductor over the sheaves and excessive downward loading on the cross-arms. Attention shall be paid to the fact that all sag charts contained herein for ACSR & AAAC conductors are calculated on the basis of non-pre-stressed conductor. For this reason, at no time during the stringing or sagging operation, shall conductors of this type be pulled to sags which are less than those shown by the charts. Special care shall be taken at all times to prevent the conductor from becoming kinked, twisted or abraded in any manner. Where it is necessary to drag conductors on the ground, the conductors shall be protected by covering all stones or other objects which might damage the conductor with boughs or trees or suitable pieces of lumber.

Poles to be used under this Contract Agreement shall be used to maximize the ruling span so as to make optimal utilization of Breaking Load and Crippling Load.

These requirements are especially important when ACSR &AAAC conductor is being handled on river crossing spans. Floats with rollers shall be used to prevent the conductor from dragging along the river bottom. In stringing conductors across highways, the conductors shall be fully protected from passing vehicles by use of temporary guard structures.

3.1.20 Damaged Conductor

Damaged conductors shall be repaired by using a repair sleeve provided that no more than 2 strands of the outer aluminium layer are damaged and further provided that none of the sleeve core strands are damaged. For a conductor damaged in excess of the above conditions, the damaged section of the conductor shall be cut out and a tension splice installed. When cutting out damaged section of conductor, no more than 1 tension splice shall be permitted in a span and no splice be made within 8 meters of an insulator attachment.

3.1.21 Sag Error

Sag error shall not exceed + 40 mm from the sag defined by the sag chart.

3.1.22 Conductor Attachment

Conductors shall be secured to pin insulators with pre-formed conductor ties or with tie wire. Insulator ties, except at jumper supports in structures, shall be made with pre-formed ties when available. Conductors shall be connected to dead end assemblies with tension set.

3.1.23 Line Splices

For Tensioning and Looping Cleaned and polished contact surfaces are necessary to make conductor splices so that it shall remain free from trouble. Great care shall be taken to completely clean the strands of aluminium conductor. The splicing sleeve must be centered over the conductor ends before compressing to make a splice of required strength. The outer strands of aluminium shall be carefully cleaned with a wire brush to remove all foreign matter till the aluminium shines brightly. The cleaning applies to both new and old conductors. Splicing sleeves for aluminium

conductor are supplied by the manufacturer prefilled with inhibitor compound. Splices in line conductors shall be so located that the end of the splicing sleeve is at least 30 cm from the end of a suspension or dead-end clamp. Non-tension loops, such as between dead ends, shall be spliced with a connector when the conductor is of same metal and size.

3.1.24 Connectors

Cleaned and polished contact surfaces are necessary to make electrical connections that will be free from trouble.

Tap connectors are supplied by manufacturers pre-filled with inhibitor compound. Excess inhibitor compound shall not to be removed but it shall be wiped over the connector as a moisture seal. Connectors shall not be covered or taped.

Compression connectors shall be located in such a manner that there shall be at least 30 cm of conductor between the end of the connector and the end of a dead end

Connectors shall be installed on non-tensioned portion of the conductor such as loops in preference to the conductor in the span.

Connectors installed on conductor shall be located in a span adjacent to the crossing rather than the crossing span when practicable.

Aluminium compression connectors, pre-filled with inhibitor compound, shall be compressed on the cleaned area of aluminium conductor. Where necessary, inhibitor compound shall be applied to the cleaned conductor and connector before assembly.

Aluminium compression connectors shall be used for connecting aluminium to aluminium conductors.

3.2 Conductor accessories to be used

3.2.1 Pre-Formed Ties and Grips

Taps for jumpers and services shall not be made over the legs of ties or dead-end grips.

3.2.2 Pin Insulator Ties

Pin insulator ties are of 2 types:

With single top grooves: Single top ties may be used to turn line angles to 7 degrees where single insulators are permitted. Please refer the Construction Standard Guidelines – relevant Insulator Drawings for Details.

With side grooves with specific size of ties for specific conductor in each tie style: Specific usage is dictated by insulator pin loading and use of single insulators. Please refer the Construction Standard Guidelines – relevant Insulator Drawings for Details.

3.2.3 Preformed ties for Stay Wire

Preformed ties for stay wire are furnished as per material list CSG–29, 30. Preformed ties for stay wire are right hand lay. Preformed ties for stay wire may be removed and replaced up to 3 times, when initially installed, to permit adjustment of stay tension.

3.2.4 Application

When applying ties or grips the manufacturer's identification tag and color coding shall be checked to ensure that the tie or grip is the right unit specified for application on the specific conductor or wire strand. Preformed ties for stay wire are furnished with two crossover markings. When applying preformed ties on hardware, the grip shall be installed using the crossover point closest to the loop of the grip.

3.3 Installation practices for ABC cables

3.3.1 General

The insulated neutral messenger supported Aerial Bundle Conductor consists of five XLPE insulated cores (3 phases, one neutral and one street lighting) of hard- drawn stranded aluminium conductors which are laid up together.

Special care should be taken when handling the cable drums, and the unwinding, pulling, stringing and clamping the cables. Precautions should be taken to prevent the bundle from dragging over the ground, ensure adequate protection when crossing fences or any other obstacles to avoid damage to the cable insulation.

3.3.2 Pole preparation

Hardware can be fitted to poles before or after the poles are set up. Hardware can be fixed to poles by means of: Pigtail hot dipped galvanized bolts, nuts and washers or hook hot dipped galvanized bolts, nuts and washers.

3.3.3 Procedure for setting up the line

Before setting up the lines, necessary precautions must be taken such as the suitable staying of line poles to avoid the overstraining of the supports and hardware, which are not designed to resist to dead end line stresses.

Suspension fittings should be used where the line angle is less than 60o. When the line angle exceeds this value double strain assemblies must be used.

Hardware should be fitted to either side of the poles to accommodate angles in the line. In the event of an accident this will allow the cable to swing free and avoid damage.

When ABC lines are installed on a hill a double dead-end assembly is recommended instead of a suspension bracket on the peak of the hill, as the weight of the ABC will load the bracket excessively. On a gradient the cable is pulled from the higher to the lower point.

Following the line adjustment, the strained bundles sections will be kept on stringing blocks during a minimum period of 24 hours before clamping the line and angle suspensions.

3.3.4 Running out preparation

a. Cable laying

The drum is positioned 8-10 m behind the support, used for final adjustment. It is slightly set off (1m) from the pole on the side of the first stringing block, to prevent any friction of the twisted cable against the pole.

In the case of strong gradient, the drum is positioned at the higher point (extremity) on a drum carrier equipped with mechanical breaking device to regulate the running out the cable.

The cable drum (drum carrier) should be positioned to allow the cable to roll off the top of the cable drum and 8-10 meters from the first pole. (such distance is equal to the length of the pole over the ground)

The cable must not drag on the ground during laying operations.

The rotation of the cable drum will be controlled by the operator and if necessary be regulated with a braking system.

Passing the conductors through the stringing blocks and pulling the bundle with a pulling grip performs the pulling

Stringing blocks (wide grooved pulley) shall be hung on poles, by means of a nylon or rope sling in chocker fashion or a special device developed for such application consisting or a pulley and a saddle which includes a bracket and a lashing device.

The pulled extremities must be tied with cable ties to avoid untwisting of the bundle. Pulleys are fitted on supports, just below the pigtail/hook bolts in such a manner that the bundle is near the level of the suspension clamp. This ensures: - easy placement of the bundle in the suspension clamps. - minimum un-tensioning during the installation of the strain clamps.

Stringing blocks or pulleys must not be suspended from the pigtail/hook bolts. These are not designed to support the loads exerted during the pulling.

The pulling of the bundle should be by mechanical means. However, it can be done manually in the case of line section not exceeding 100 meters with maximum spans of 50 meters.

Precautions should be taken to avoid damage to the cable insulation.

b. Link between the pulling rope and the bundle

A pulling rope is threaded through all the pulleys on the route. This rope should be - ø10mm Polyester rope, for a manual pulling - ø12mm Polyamide rope, in case of mechanical pulling

Attach the pulling rope to the ABC by means of a ball bearing swivel and pulling socks set. This set includes:

a galvanized steel sock fixed in permanence to the rope

a galvanized steel sock is slipped over the bundle, selected according to bundle diameter

Prepare adequate protection where cables cross fences of any other structures on route. The foreman verifies that the rope slide normally and that ABC does not suffer any damage by sharp objects. The people in charge of the drum carrier regulate the breaking according to the sag chart instructions given to him. he pulling action should be slow and continuous avoiding unnecessary jerking.

c. Realization of the first terminal pole

No lineman has to remain on poles.

At the last pole of the run, the bundle is clamped with a come-along and tension is provided by a cable/chain hoist linked to the pole by nylon or rope sling.

The recommended tension is obtained by a dynamometer and sagging of conductors shall be made according to the sag chart.

When the required tension/sag has been reached, locate with an adhesive tape where the strain clamp shall be positioned and then proceed to fit the strain clamp on the bundle. Exert an extra load on the bundle in order to facilitate the installation of the strain clamp to the pigtail/ hook bolt.

Fit a cable tie in front and behind the clamp to keep all conductors together.

Release the apparatus and remove the stringing block.

The dead-end assembly consists of: - One pigtail or hook bolt - One dead end clamp for self-supporting bundle - Two cable ties made of polyamide for clamping bundled conductors

d. Realization of the first line section

The tensioning of the first line section shall be made at the first double strain point. For such procedure a chain or cable hoist equipped with a reel is needed.

The loads being more or less equilibrated, no staying is required.

The line adjustment for the fixing of the dead-end clamp on bundle is obtained as follows:

- Proceed simultaneously on the two tensioning devices (one at the termination pole and the other at the double strain assembly) in order to obtain the adjustment of the first line section and the slack bridge needed for the double strain assembly.
- Install the strain clamps by exerting a supplementary traction in order to facilitate the fixing of the clamps on the bolts.
- Release the loading device at the double strain point.
- Remove the equipment (Cable hoist Pulley)
- The others line section is realized in the same manner
- The last line section is realized as the first terminal pole

e. Intermediate poles

Lift the cable from the pulley and fit the bundle into the suspension clamp.

Close the suspension clamp and fit a cable tie on the ABC either side of the suspension clamp

The suspension assembly consists of: - One pigtail or hook bolt - One suspension clamp for self-supporting bundle - Two cable ties

3.3.5 Linesmen tools

Necessary tools required for ABC Cable stringing: -

- Unwinding machine or similar equipment provided with drum braking system
- A ground hoist or winch, strong enough to give an efficient suppleness
- Traction rope having a length and a mechanical resistance sufficient to allow pulling and stringing operations up to ten spans of ABC
- Stringing blocks (one per support) 10 spans
- 11 number of supports
- Hydraulic compression tool (performance motorized since faster easier to use in remote areas)
- Pulling grip for ABC Cables

3.4 Line construction

3.4.1 Arrangement of Conductor

The standard position of 11 kV phase conductors on the cross-arm in the normal triangular configuration looking from the normal source of power supply shall be seen as: Red (R) on top of the pole, Yellow (Y) on right hand end of the cross-arm and Blue (B) on left hand end of the cross arm. Any alternate configuration depending on site conditions and acceptable to NEA shall be complied with. See Construction Standard Guidelines – relevant Drawings for both single and double circuit along with ADSS Cables.

3.4.2 Attachments to poles

Bolt holes are provided on poles for cross-arms, cross-arm braces and stay bolts. See Construction Standard Guidelines – relevant Drawings for both single and double circuit along with ADSS Cables.

3.4.3 Conductor Ties

Pre-formed ties and grips shall be used for attaching conductors to structures when available.

If pre-formed materials are not available, the wire shall be soft conductor so that when made up, the tie wire will bind the conductor tightly. No tie wire shall be used for a second time. Jumpers on structures shall always be made with tie wire. Tie wire shall be of the same metal as that of the bare conductor to which the tie is applied. See Construction Standard Guidelines – relevant Drawings for both single and double circuit along with ADSS Cables.

3.4.4 Spacers for twin bundle conductors

The optimum spacing between sub-conductors for reducing voltage gradient shall be eight to ten times of the diameter of the conductor. Number of spacers to be used per span shall be as per the site conditions.

3.4.5 Conductor Support

The conductor supports on straight lines shall be carried on the top wire groove of the pin insulator. Conductors shall be attached to the side conductor groove of pin insulator on the outside of angles so that transverse conductor tension will tend to hold the conductor in the insulator groove. Conductor ties shall not hold a conductor on the insulator when uplift exists. If uplift is found, it is required to consult with the Employer to determine remedial action to be taken.

See Construction Standard Guidelines – relevant Drawings for both single and double circuit along with ADSS Cables.

3.4.6 Pole Wiring

All taps or connections passing from one level to another on the pole shall, as far as possible, be vertical. Connections shall have sufficient length so that the line conductors are not moved from normal positions and normal movement is not restricted. Connections shall have at least 30 centimeters clearance from other conductors. Any connection carried from one side of the pole to the other side shall be supported on pin insulators. See Construction Standard Guidelines – relevant Drawings for both single and double circuit along with ADSS Cables.

3.4.7 Installation of stays

Where stays are installed on a line angle structure, line of stay shall bisect the outside line angle. The span of stay extending between poles shall not be greater than 50 meters. Anchor and anchor rods shall be set so that the axis of the rod and line of stay shall be straight. The portion of the anchor rod above the ground shall not be bent at an angle to connect a stay wire. If this occurs, anchor and anchor rod shall be reset. The anchor rod shall not be exposed for more than 15 centimeters above the ground after the anchor is set.

If gravel back fill is required to set anchor in soft or unstable soil. Gravel back fill shall be designated as "Local Material". If a stay is installed on a pole where low volt conductor is dead ended or double dead ended and extends past stay, a piece of plastic hose slit along the length shall be placed over the stay wire extending from the upper stay attachment to 200 mm below lowest low voltage conductor.

After installation, the hose shall be wrapped with plastic tape and the hose shall be secured to the upper stay bolt with tie wire. Plastic hose shall be "Local Material".

The successful Bidder shall make preliminary survey of the work site to finalize the type of poles being used. The size / type and quantity of pole clamps may subject to variations as per fiend requirements. See Construction Standard Guidelines – relevant Drawings for both single and double circuit along with ADSS Cables.

Volume II
Section 6: Employer's Requirements

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4 11 KV LINES

4.1 General

11 kV lines are required for distribution of power grid to Low Voltage lines and medium voltage consumers. This section envisions the specifications of 11 kV lines in the scope of DSUEP.

Summary of data on proposed lines is given in the Scope of Services. The reference drawings are provided in the Drawings Section.

4.2 Major items for 11 kV lines

11 kV trunk lines shall have 3-phase, 3-wire configuration. The most common 11 kV line configurations are as follows –

- 3 - phase 11 kV overhead line on MVCC double circuit
- 3 - phase 11 kV overhead line on MVCC single circuit

11-meter-long PSC poles shall be used to construct the 11 kV lines in all locations, expect where the transportation limitations limit the transportation of such poles. In such cases 11-meter-long foldable steel tubular poles shall be used.

Thus, major items for 11 kV lines are as follows –

- 11-meter Steel tubular poles (STP)
- 11-meter PSC poles
- MVCC conductor and its hardware
- 11 kV grade Aerial bunched cables
- Pin Insulators and disc insulators

4.3 Quality Assurance Program

For each items, 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:

a) The structure of the organization;

b) The duties and responsibilities assigned to staff ensuring quality of works;

c) The system for purchasing, taking delivery and verification of materials;

d) The system for ensuring quality of workmanship;

e) The quality assurance arrangement shall conform to relevant requirements of ISO 9001;

f) 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 tests normally carried out on raw materials;

g) List of manufacturing facilities available;

h) List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections;

i) 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.

4.4 Specification of PSC poles

4.4.1 Scope

This specification applies to rectangular 11-meter-long pre-stressed concrete poles for use in electrical power distribution by 11 kV lines.

4.4.2 Materials

a. **Cement**

Cement to be used in the manufacture of pre-stressed concrete poles shall be ordinary or rapid hardening Portland cement confirming to ASTM C150 or EN 197-1.

b. **Aggregates**

Aggregates to be used for the manufacture of pre-stressed concrete poles shall confirm to ASTM C33 (Specification for concrete aggregate). The nominal maximum sizes of aggregates shall in no case exceed 12 mm.

c. **Water**

Water should be free from chlorides, sulphates, other salts and organic matter. Potable water will be generally suitable.

d. **Admixture**

Admixture should not contain Calcium Chloride or other chlorides and salts which are likely to promote corrosion of pre-stressing steel. The admixture shall conform to ASTM C494.

e. **Pres-Stressing Steel**

Pre-stressing steel wires including those used as un-tensioned wires should conform to ISO 6934. The type design is for plain wires of 2.6 mm diameter with a guaranteed ultimate strength of not less than 160 kg/mm². All pre-stressing steel shall be free from splits, harmful scratches, surface flaw, rough, aged and imperfect edges and other defects likely to impair its use in pre-stressed concrete.

4.4.3 Concrete Mix

Concrete mix shall be designed to the requirements laid down for controlled concrete (also called design mix concrete) in ASTM C935 subject to the following special conditions: Minimum works cube strength at 28 days should be at least 420 Kg / cm². The concrete strength at transfer should be at least 250 Kg / cm². The mix should contain at least 380 Kg of cement per cubic meter of concrete. The mix should contain as low water content as is consistent with adequate workability. It becomes necessary to add water to increase the workability the cement content also should be raised in such a way that the original value of water cement ratio is maintained.

4.4.4 Design Requirements

The poles shall be planted directly in the ground with a planting depth as per ASTM C935. Wherever, planting depth is required to be increased beyond the specified limits or alternative arrangements are required to be made on account of ground conditions e.g. water logging etc., the same shall be in the scope of the bidder at no extra cost to owner. The bidder shall furnish necessary design calculations/details of alternative arrangements in this regard. The working load on the poles should correspond to those that are likely to come on the pole during their service life. The factor of safety for all poles shall not be less than 2.0. The average permanent load shall be 40% of the working load.

The F.O.S. against first load shall be 1.0. At average permanent load, permissible tensile stress in concrete shall be 30 kg/cm². At the design value of first crack load,

the modulus of rupture shall not exceed 53.0kg/cm² for M-40. The ultimate moment capacity in the longitudinal direction should be at least one fourth of that in the transverse direction. The maximum compressive stress in concrete at the time of transfer of pre-stress should not exceed 0.8 times the cube strength. The concrete strength at transfer shall not be less than half, the 28 days strength ensured in the design, i.e., 420 x 0.5 = 210 kg / cm².

4.4.5 Dimensions and Reinforcement

The cross-sectional dimensions and the details of pre-stressing wires should conform to the ASTM C935. All pre-stressing wires and reinforcements shall be accurately fixed as shown in drawings and maintained in position during manufacture. The un-tensioned reinforcement as indicated in the drawings should be held in position by the use of stirrups which should go around all the wires. All wires shall be accurately stretched with uniform pre-stressed in each wire. Each wire or group of wires shall be anchored positively during casing. Care should be taken to see that the anchorages do not yield before the concrete attains the necessary strength.

4.4.6 Cover

The cover of concrete measured from the outside of pre-stressing tendon shall be normally 20 mm.

4.4.7 Welding and Lapping of Steel

The high tensile steel wire shall be continuous over the entire length of the tendon. Welding shall not be allowed in any case. However, joining or coupling may be permitted provided the strength of the joint or coupling is not less than the strength of each individual wire.

4.4.8 Compacting

Concrete shall be compacted by spinning, vibrating, shocking or other suitable mechanical means. Hand compacting shall not be permitted.

4.4.9 Curing

The concrete shall be covered with a layer of sacking, canvass, Hessian or similar absorbent material and kept constantly wet up to the time when the strength of concrete is at least equal to the minimum strength of concrete at transfer of pre-stress. Thereafter, the pole may be removed from the mould and watered at intervals to prevent surface cracking of the unit the interval should depend on the atmospheric humidity and temperature. The pre-stressing wires shall be de-tensioned only after the concrete has attained the specified strength at transfer (i.e. 200 or 210 kg/cm² as applicable). The cubes cast for the purpose of determining the strength at transfer should be coursed, a sear as possible, under condition similar to those under which the poles are cured. The transfer stage shall be determined based on the daily tests carried out on concrete cubes till the specified strength indicated above is reached. Thereafter the test on concrete shall be carried out as detailed in ASTM C31 (practice for making and curing concrete test specimens in the field). The manufacturer shall supply, when required by the owner or his representative, result of compressive test conducted in accordance with ASTM C403 (test method for time of setting of concrete mixtures by penetration resistance) on concrete cubes made from the concrete used for the poles. If the manufacturer so desires, the manufacturer shall supply cubes for test purpose and such cubes shall be tested in accordance with ASTM C403.

4.4.10 Lifting Eye-Hooks or Holes

Separate eye-hooks or hoes shall be provided for handling the transport, one each at a distance of 0.15 times the overall length, from either end of the pole. Eye-hooks

provided, should be properly anchored and should be on the face that has the shorter dimension of the cross-section. Holes, if provided for lifting purpose, should be perpendicular to the broad face of the pole.

4.4.11 Holes for Cross Arms etc.

Sufficient number of holes shall be provided in the poles for attachment of cross arms and other equipment.

4.4.12 Stacking & Transportation

Stacking should be done in such a manner that the broad side of the pole is vertical. Each tier in the stack should be supported on timber sleeper located as 0.15 times the overall length, measured from the end. The timber supported in the stack should be aligned in vertical line.

4.4.13 Earthing

Earthing shall be provided by having length of 6 SWG GI wire embedded in Concrete during manufacture and the ends of the wires left projecting from the pole to a length of 100mm at 250 mm from top and 1000 mm below ground level.

Earth wire shall not be allowed to come in contract with the pre-stressing wires.

4.5 Specification of Steel tubular poles

4.5.1 Scope

This Specification covers the design, fabrication, testing and supply of 11m and 8-meter-long steel tubular poles commonly used in 11 kV and 0.4 kV overhead electric lines.

4.5.2 General

The steel pole shall be fabricated in several lengths and strengths as specified in Table 1 contained herein. The steel tubular poles must be manufactured by a company approved to quality standard ISO 9001:2000. The ISO 9001 certification number, the name of the authorized approving authority with the contact address and telephone and fax numbers shall also be stated. The Bidder shall enclose a copy of the ISO 9001 certificate with the bid. All such poles shall be as per IS 2713.

4.5.3 Description

The steel poles shall be of swaged design and shall consist of three (3) separate lengths of steel tubing swaged at two joints to fabricate the poles. However, there are some numbers of poles as mentioned in the price and delivery schedule which shall be of folding type. The quantities of such folding poles shall be intimated at the time of contract.

The steel tubing used in pole fabrication shall be of steel of any approved process possessing a minimum tensile strength of 42 kg/sq. mm and a chemical composition of not more than 0.06% sulphur and not more than 0.06% phosphorous.

The tubing diameter and tubing wall thickness shown in table below for each length of pole are the minimum size to be used in fabricating each length of pole. It shall be the responsibility of the Bidder to determine the adequacy of the component tubing shown for the load to be sustained. However, in no case the tubing diameter and wall thickness for any component tube be less than the value shown in the table.

Tubular poles shall be made of welded tubes, swaged and joined together. The upper edge of each joint shall be chamfered at an angle of about 45-degree. The steel pole

shall be composed of three sections of diminishing diameters and minimum diameter thickness and lengths of pole shall be as shown in the table. All tubes forming parts of the above supports shall be made from hot insulated seamless or continuously welded steel in accordance with BS 6323 or equivalent applicable Standards.

The entire section of the poles shall be galvanized with minimum coating of weight not less than 460-gm/-sq. m internally and externally. Each pole shall be provided with a steel top plate 3-mm minimum thickness welded to the end of the section. The top plate shall not project beyond the perimeter of the top section. Each pole shall also be provided with a welded base plate welded to the bottom of the pole. The pole shall, be drilled in accordance with the drilling patterns as defined in the Figure. All the holes shall be of 18 mm dia. However, the manufacturer must get approval of the drilling pattern before manufacturing the poles. Each pole shall be marked with the appropriate length as shown in Figure.

The folding type of poles shall be fabricated in such a way that the section pieces can be carried to the site and fitted on the site itself. The pole section on top shall have a flange and the section under it shall overlap to a length of 25 cm as shown in the diagram. The poles shall be drilled in such a way that the section in top could be securely fixed the section under it by two bolts of 5/8" x 7" at 90 degree each other. Two such joints form a complete pole of three sections as shown in Fig 2 and 3.

The size of the base plate shall be as per governing standard but it has to be welded during fabrication of pole.

Poles Specifications – As per IS 2713

IS Designation	410 SP-74	410 SP-69	410 SP- 52	410 SP-44	410 SP-31	410 SP-13
Overall Length	14.5 m	13 m	11 m	10 m	9 m	8 m
Planting Depth:	2 m	2 m	1.8 m	1.8 m	1.5 m	1.5 m
Pole Designation:	410 SP74	410 SP69	410 SP52	410 SP44	410 SP31	410 SP13
Section Length:						
Top (h1)	4.0 m	3.6 m	2.7 m	2.4 m	2.0 m	1.75 m
Middle (h2)	4.0 m	3.6 m	2.7 m	2.4 m	2.0 m	1.75 m
Bottom (h3)	6.5 m	5.8 m	5.6 m	5.2 m	5.0 m	4.50 m
Outside Diameter:						
Top (h1)	139.7 mm	139.7 mm	114.3 mm	114.3 mm	114.3 mm	88.9 mm
Middle (h2)	165.1 mm	165.1 mm	139.7 mm	139.7 mm	139.7 mm	114.3 mm
Bottom (h3)	193.7 mm	193.7 mm	165.1 mm	165.1 mm	165.1 mm	139.7 mm
Thickness:						
Top (h1)	4.50 mm	4.50 mm	3.65 mm	3.65 mm	3.65 mm	3.25 mm
Middle (h2)	5.40 mm	5.40 mm	4.50 mm	4.50 mm	4.50 mm	3.65 mm
Bottom (h3)	5.90 mm	5.90 mm	4.50 mm	4.85 mm	4.50 mm	4.50 mm
Crippling load	561 kgf	456 kgf	307 kgf	373 kgf	367 kgf	301 kgf
Approximate weight (Excluding the weight of Galvanization, Base Plate and Cap)	336 kg	302 kg	175 kg	168 kg	147 kg	101 kg
Application of Load from top of pole	0.6 m	0.6 m	0.6 m	0.6 m	0.3 m	0.3 m

4.5.4 Tolerance

The following tolerances shall be maintained:

a) Tolerance of diameter: ± 1%

b) Tolerance on weight: ± 2.5%

c) Tolerance on thickness: ± 5%

d) Tolerance on length: ± 20 mm on any section;
± 20 mm on overall length.

e) Straightness: The finished poles shall not be out of straightness by more than 1/600 of the height.

f) If the offered lot has negative tolerances on thickness and weight but within the acceptable limit, the poles shall be accepted but the cost of double of the

reduced weight shall be deducted from the payment.

4.5.5 Marking

Each pole shall be clearly marked with the following engraving on the finished pole at a position approximately 3.6m from the butt end:

a) "Property of NEA"

b) Name and trademark of the Manufacturer

c) Manufacturing Year

d) Contract Identification No.

Each pole shall be clearly marked with the following with indelible permanent paint on the finished pole at a position below the above engraving:

a) IS designation with length of the pole in meters

b) Year and month of manufacturing "YYYY-MM"

c) Horizontal line throughout the circumference at a height of $1/6^{th}$ of the pole length from the butt end with equally spaced five arrows pointing towards butt end for indication of the planting depth.

4.5.6 Tests

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 NEA.

a) Tensile test and chemical analysis for sulphur and phosphorous

b) Deflection test

c) Permanent set test

d) Drop test

Number of poles selected for conducting tensile test and chemical analysis for sulphur and phosphorous shall be as given below:

Lot Size	No. of poles
Up to 500	1
501 to 1000	2
1001 to 2000	3
2001 to 3000	4
3001 and above	5

Number of poles selected or conducting deflection test, permanent set test and drop test shall be as given below:

Lot Size	No. of poles
Up to 500	5
501 to 1000	8
1001 to 2000	13
2001 to 3000	18

Lot Size	No. of poles
3001 and above	20

The deflection test, permanent set test and drop test shall be conducted in succession on each of the poles selected.

Deflection Test

Each pole shall be rigidly supported for a distance from the butt end equal to the depth which it is to be planted in the ground. It shall then be loaded as cantilever and the appropriate deflection load of Table applied at right angles of the axis of pole 30 cm from the top of the poles up to 9 m (overall) and 60 cm from the top for poles over 9 m (overall). For convenience in testing, the pole may be fixed horizontally and the load applied vertically. The temporary deflection due to the applied load at the point of application of load shall not exceed 157.5 mm.

Permanent Set Test

This test shall be carried out immediately after the deflection test. After application of proper load specified in Table 1 the permanent set measured from the zero position after the release of the appropriate applied load at the point of application of the load shall not exceed 13 mm.

Drop Test

The test shall be made in the case of swaged poles. The pole shall be dropped vertically with the butt end (bottom end) downwards, three times in succession from a height of 2 m on to a hardwood block 150 mm thick laid on concrete foundation. The pole shall not show any signs of telescoping or loosening of joints.

Should of any of the poles selected fail to pass any of the tests specified above, two further poles shall be selected for testing from the same lot in respect of each failure. Should both these additional poles fail, the test material represented by the test samples shall be deemed as not complying with these specifications.

4.6 Specification of 11 kV Covered Conductor (MVCC)

4.6.1 Scope

This Specification covers the design, manufacture, factory test and supply and delivery of Hardware and accessories of 11000 V XLPE Covered All Aluminum Alloy Conductor for use as overhead distribution feeders suitable on 3-phase AC System conforming to EN 50397-1: 2006 with up-to-date amendments.

4.6.2 Composition and Description of the Conductor

a. The conductor shall be of multi-strand round uncompact hard drawn aluminium alloy conforming to the specified standards

b. The properties of conductors of various sizes shall be as below:

S. No.	Description	Unit	55 mm^2	100 mm^2
1	Actual Area	mm^2	55	100
2	Stranding & wire diameter	mm	7/3.15	4/4.26
3	Approximate overall diameter	mm	9.45	12.78
4	Approximate weight	Kg/km	149.20	272.86

5	Maximum calculated DC resistance at 20°C	Ω/km	0.6210	0.3390
6	Approximate calculated breaking load	kN	16.03	29.26
7	Current Rating	Amps	234	325

Tolerance shall be as per the relevant standards.

c. Freedom from Defects

The wire shall be smooth and free from all imperfections such as spills, splits, slag inclusion, diameter marks scratches, fittings, blow holes, projections, looseness, overlapping of strands, chipping of aluminium layers etc. And all such other defects which may hamper the mechanical and electrical properties of the conductor. Special care should be taken to keep away dirt, grit etc. during stranding.

d. Joints in Wires

There shall be no joint in any wire of a stranded conductor containing seven wire, except those made in the base rod or wire before final drawing.

e. Stranding

The wires used in the construction of a stranded conductor shall, before stranding satisfy all the relevant requirements of this standard.

The lay ratio of the different layers shall be between 10 and 14.

In all constructions, the successive layers shall have opposite directions of lay, the outer most layer being right handed. The wires in each layer shall be evenly and closely stranded.

f. Filling (Water Blocking)

The stranded conductor shall be longitudinally water tight by means of a water blocking material incorporated during the extrusion process. The use of grease / water swellable tape / water swellable powder etc. is not permitted. The water blocking material shall be stable at maximum operating conductor temperature of 90°C.

The water blocking compound shall be compatible with the conductor material as well as the semi conducting polymer screen layer above it and not adversely affect its electrical or mechanical properties

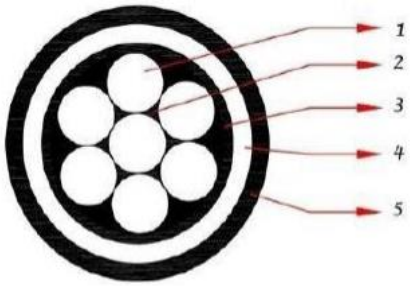
g. Insulation

The insulation shall be dual layered with the inner layer being XLPE with a nominal thickness of 1.2 mm and the outer layer being a suitable XLPE which is UV resistant, non-tracking and erosion resistant with a nominal wall thickness of 1.1 mm. The minimum combined insulation thickness of both layers should be 2.2 mm.

The Conductor manufacturing and stranding process shall incorporate the longitudinal water blocking. The semi-conduction screen, inner insulation and outer insulation shall be extruded in one step i.e. triple extrusion to ensure a good, permanent bond between the three layers and also with the conductor.

It shall be possible to remove the Semi Conducting Screen, Inner and Outer Insulation Layers without damage to the conductor.

The following figure shows the cross section of an AAAC XLPE covered conductor.



S. No.	Description	Unit	Nominal Thickness
1	Aluminium Alloy wire	mm^2	As per requirement
2	Extruded longitudinal water blocking layer	mm	As required to make water block arrangement
3	Extruded Semi-conductive layer	mm	0.3
4	Inner insulation of XLPE, without carbon black	mm	1.2
5	Outer insulation with UV & Track resistant XLPE	mm	1.1

The XLPE material shall be of Borealis, Austria/ BASF, Germany/Du Pont, USA/Sumito Chemicals, Japan or DOW Chemicals, USA make. In case of other make, the bidder shall submit the certification from Independent Internationally Recognized Agency/ies to substantiate the equivalency to the above referred make. Failure to furnish the equivalency certification will result in the offer being rejected

4.6.3 Tests

The tests shall be carried out confirming to the EN 50397 and as per the following:

a. **Type Tests**

The Bidder shall submit the type test reports along with the Bid. The Covered Conductors shall be type tested conforming to EN 50397-1:2006 or IEC Standard, and certified copies of the type test certificates shall be furnished with the offer. The report shall be issued by a recognized independent testing authority. 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. The cable shall be subjected to the following type tests but not limited to:

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.

b. **Routine Tests**

The manufactured conductor shall be tested in full compliance with the governing standard including following routine tests but not limited to:

Test on wire before stranding

a) Wire diameter
b) Ultimate tensile strength
c) Wrapping test
d) Resistivity test

Test on finished covered conductor

a) Inter-strand conductivity test
b) Thickness of covering
c) Static water blocking test
d) Stripping test
e) Spark test

4.6.4 Packing and Marking

a. The conductors shall be wound in reels or drums conforming to the latest versions of IS: 10418 (amended up to date).

b. **End Sealing**

Heat Shrinkable end caps with sealant shall be used for effectively sealing the end terminals of the covered conductor. The inner diameter range of cap shall be such that it shall tightly fit to the covered conductors to prevent moisture ingress.

c. **Packing**

The gross mass of packing and the normal length for various conductors shall be as given in the following table:

Conductor size in mm^2	Gross Mass in kg	Standard length (m/drum)
55 (7/3.15 mm)	750	1000
100 (7/4.26 mm)	1000	1000

d. **Marking**

The following particulars shall be properly legible embossed/printing on the covered conductor for identification in interval not more than 1 meters throughout the length of the cable. Font size of letters to be minimum 5 mm. The covered conductor with poor and illegible embossing/printing shall be liable for rejection.

a) Manufacturer's Name and Brand Name of Trade Mark
b) Voltage Grade
c) Size of conductor
d) Successive length
e) Type of insulation
f) DSUEP EIB W5.

The following information be marked on each package i.e. cable drum

a) Manufacturer's Name and Brand Name of Trade Mark
b) Year of Manufacture
c) Nominal Cross-sectional area of the cable conductor
d) Type of cable and voltage grade
e) Length of the Cable
f) Direction of rotation of drum (by means of an arrow)
g) Approximate gross weight in kg/km
h) Drum or identification number
i) Contract Identification No.

4.7 Specification of 11 kV Aerial bunched cables

4.7.1 Scope

This Specification covers the design, manufacture, factory test and supply of 6.35 / 11 (12) kV 50, 35 and 25 sq mm three-core cross-linked polyethylene (XLPE) insulated, PVC outer sheathed with high tensile galvanized steel strand messenger wire based aerial bundled conductors (ABC).

4.7.2 Description

The cable shall be manufactured and tested in accordance with UK ESI Standard 43 - 14:"Aerial Bundled Conductors XLPE Insulated for HV Overhead Distribution", or BS - 7870 (Part V) or latest revision thereof or any recognized international standards that ensure at least a substantially equal quality to the standards mentioned above.

The High Voltage ABC Cable manufacturing company shall have been accredited with ISO 9001:2000 (design included) quality certification. The High Voltage ABC shall be supported with high tensile galvanized steel strand bare messenger wire of 50 sq mm.

The conductor shall consist of compact round stranded aluminum wires. The conductor shall be insulated by extruded black cross-linked polyethylene (XLPE) material. The complete cable shall consist of three equal-size 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 four conductors.

The insulation of the cable shall be extruded cross-linked polyethylene (XLPE) complying with appropriate test requirements specified in Section 3 of IEC publication 60502. The minimum thickness of insulation shall not fall below the specified nominal value by more than 10%+0.1 mm.

The conductor shielding shall be non-metallic and shall consist of a layer of extruded semi-conducting compound. The insulation shielding shall consist of a non-metallic semi-conducting part in combination with a metallic part. The non-metallic part shall be applied directly upon the insulation of each core and shall consist of a layer of extruded semi-conducting compound. The metallic part shall be applied over the individual cores and shall consist of copper tape, in the thickness about 0.1 mm. A suitable binding tape shall be applied over the copper tape. The outer covering of the R phase of the cable shall be embossed with the name of the manufacturer, name of the Purchaser " NEA-DSUEP", the cross sections, type of insulation followed by "Electric Cable: 6.35 / 11 kV" at the spacing of 5 meters. Every 2 meters of outer covering of the cable shall also be embossed with length of the cable.

The sheath shall consist of PVC compound complying with ST2 specified in IEC Publication 60502. The minimum thickness of the sheath shall conform to the table furnished at the end of this specification. The average thickness of the sheath shall be not less than the specified nominal value. The minimum thickness of the sheath shall not fall below the nominal value by more than (15 % + 0.1 mm).

4.7.3 Phase Identification

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.

4.7.4 Type tests

The Bidder shall submit the type test reports 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 latest equivalent 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. The ABC shall be subjected to the following type tests:

a) Mechanical strength of the conductors

b) Insulation resistance

c) Dielectric test

d) Impulse withstands

e) Resistance of each phase of the conductor at 20°C

f) A.C voltage test

4.7.5 Routine tests

The tests shall be made on the completed cables at the manufacturer's plant in accordance with governing standards including following tests:

a) Verification of diameters of conductor and insulated conductor, and thickness of insulation, and so on

b) Breaking load test

c) High voltage test

d) Conductor resistance at 20°C

e) Dielectric strength

f) Insulation resistance

4.7.6 Packaging

Each reel of the conductors furnished shall contain only one (1) length of conductor.

All conductors shall be furnished on non-returnable seasoned wooden reels or steel suitably protected against corrosion. All timber shall be treated to provide protection against rot and insects. 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 un-loading, storage in tropics, hauling and field erection of conductor without distortion or disintegration. The treatment process shall not have deleterious effect on the cable. 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.

All reels shall be legibly marked in paint with the following information:

a) Type of conductor

b) Size of conductor

c) Voltage

d) Length in meters

e) Net weight of conductor and Drum Separately

f) Direction of rolling

The standard length of the completed conductor in each reel shall be 0.5 km.

4.7.7 Dimensional and Electrical Data

The dimensional and electrical data for single-core cable is given below:

S.N.	Description	50 sq mm	35 sq mm	25 sq mm
1	Number of cores	3 phases with messenger wire		
2	Nominal sectional area of conductor (mm^2)	50	35	25
3	Nominal conductor diameter (mm)	8.4	7.3	6.2
4	Nominal thickness of XLPE insulation (mm)	3.6	3.6	3.6
5	Metallic screening approx. thickness of copper tape (mm)	0.045	0.045	0.045
6	Nominal thickness of PVC outer sheath (mm)	2.0	2.0	2.0
7	Diameter of power core (mm)	22.6	21.5	20.4
8	Nominal cross-section area of messenger wires (mm^2)	35	35	35
9	No. of messenger wires (No.)	1	1	1
10	Overall diameter (mm) of messenger wire	7.8	7.8	7.8
11	Minimum breaking load (kN) of messenger wire	41	41	41
12	Material of messenger wire	High tensile galvanized steel strand		
13	Approx. weight (kg/km)	1940	1760	1590
14	Max. conductor dc resistance at 20°C (ohm/km)	0.641	0.868	1.200
15	Continuous current carrying capacity in air at 50°C (Amps)	140	115	95

4.8 Specification of Porcelain Insulators

4.8.1 Scope

This Specification covers the fabrication and supply of porcelain insulators, as herein specified, for use on overhead power line construction.

4.8.2 Description

All porcelain insulators shall be fabricated and tested in accordance with the Standards referenced or other national or international standards, for each type of insulator.

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 manufacturer of the insulator must have been accredited with ISO 9001:2000 with design and manufacturing quality certification.

4.8.3 General requirements

All surfaces shall be clean, smooth, without cuts, abrasions or projections. No part shall be subjected to excessive localized pressure. The insulator and metal parts shall be so designed and manufactured that it shall avoid local corona formation and not generate any radio interference beyond specified limit under the operating conditions.

a. **Toughened Glass Insulators (Not Applicable)**

The glass used for insulators shall be heat strengthened soda lime glass and shall be smooth and free from defects and blemishes which might adversely affect the life of the insulator. The glass shall be completely non-porous, and its impact strength shall be at least 35 Nm. The co-efficient of thermal expansion of the glass shall be between 8 and 9 x 10^{-6} mm / ^{o}C.

b. **Porcelain Insulators**

The Porcelain shall be sound, free from defects, thoroughly vitrified and smoothly glazed. The glaze shall cover all the porcelain parts of the insulator except those areas which serve as supports during firing or are left unglazed for the purpose of assembly.

The surface of the insulator shall be non-porous, smooth, uniform and moisture proof. It shall be unaffected by weather, ozone, acidic and/or alkali deposits. Further, the insulator surface shall be free from excessive dust, carbon, cement or other pollutants when supplied.

The design of the insulator 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. Cement used in the construction of the insulator shall not cause fracture by expansion or loosening by contraction. Proper care shall be taken to locate the individual parts correctly during cementing. The cement shall not give rise to chemical reaction with metal fittings, and its thickness shall be uniform.

4.8.4 Tolerances

The tolerances on all dimensions e.g. diameter, length and creepage distance shall be allowed as follows in line with IEC 61109 –

- ± (0.04d + 1.5) mm when d ≤ 300 mm
- ± (0.025d+6) mm when d > 300 mm

Where, 'd' being the dimensions in millimeters for diameter, length or creepage distance as the case maybe. However, no negative tolerance shall be applicable to creepage distance.

4.8.5 Service Condition

The insulators to be supplied against this specification shall be suitable for satisfactory continuous operation under the following topical condition –

- Max. ambient temperature: 50ºC
- Min. ambient temperature: -5ºC, up to -25 ºC in some regions
- Relative humidity: 10 % to 100 %
- Average number of rainy days: 100 / annum
- Max. annual Rainfall: 1500 mm
- Max. Wind Pressure: 150 Kg/ sq. Meter
- Max. Wind Velocity: 50 Km/ hour
- Max. Altitude above MSL: 1000 Meter
- Seismic level: 0.3 g (Horizontal acceleration)
- Average Thunderstorm: 45 Days per annum
- Climatic condition: Moderately hot and humid tropical climate, conductive to rust and fungus growth. Pollution level is low - moderate.

4.8.6 System parameters

Nominal system voltage:	11 kV
Highest system voltage:	12 kV
Power frequency:	50 Hz
Number of Phases:	3
System earthing:	11 kV solidly earthed

4.8.7 Pin Insulator

The pin insulator shall be manufactured and tested in accordance with IEC 60815 or IS: 731-1971 or the latest version thereof or any other national or international standards that ensures the insulators of at least equal to or better quality than the standard mentioned above, will also be acceptable.

The insulator pin shall be furnished with a spring washer, stainless steel split lock and nut assembled on the insulator pin. The lead thread shall be compatible with the insulator pin specified in these documents. The insulator pin shall be fabricated and tested in accordance with the IS 731-1971, IS 2486, IEC 60815.

The pin insulator shall have following ratings and features:

Particulars	11 kV pin insulator
Highest System Voltage	12 kV
Rated Voltage	11 kV
Creepage Distance (min)	230 mm
Wet Power Frequency Withstand Voltage	35 kV

Particulars	11 kV pin insulator
Impulse Withstand Voltage	75 kV
Puncture Power Frequency Voltage (min)	105 kV
Visible Discharge Voltage (Effective)	9 kV
G.I. Pin Head	Small IS Ref. S165P
Total Length	315 mm
Stalk Length	165 mm
Shank Length	150 mm
Minimum Failing Load	5 kN
Applicable Standard	IS 731-1971, IS 2486 (Part II), IEC 60815

4.8.1 Disc Insulator

The disc insulator shall be manufactured and tested in accordance with IEC 60815 or IS: 731-1971 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 meet or exceed the following ratings and features:

Particulars	11 kV Disc Insulator
Highest System Voltage	12 kV
Rated Voltage	11 kV
Porcelain Diameter (min)	255 mm
Spacing	145 mm
Creepage Distance (min)	280 mm
Power Frequency Puncture Withstand Voltage	1.3 x Actual wet flashover voltage
Wet Power Frequency Withstand Voltage	35 kV
Impulse Withstand Voltage	75 kV
Puncture Power Frequency Voltage (min)	105 kV
Visible Discharge Voltage (Effective)	9 kV
Mechanical Strength	45 kN
Ball and Socket Size	16 mm B
Applicable Standard	IS 731-1971, IS 2486, IEC 60815

4.8.8 Stay Insulator

The stay insulator shall be manufactured and tested in accordance with IS: 5300-1969 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 stay insulator shall meet or exceed following ratings and features:

General requirements

Particulars	11 kV Stay Insulator (Type II)
Highest System Voltage	12 kV
Rated Voltage	11 kV
Creepage Distance (min)	41 mm
Minimum Failing Load	44 kN
Power Frequency Puncture Withstand Voltage, 1 minute	
Dry	18 kV
Wet	8 kV
IS Designation	A

4.8.9 Pins for porcelain type insulators

Pins shall be made with drop forged steel. They shall be in one single piece and duly hot dip galvanized. They shall not contain parts or pieces joined together welded, shrink fitted or by any other process from more than one piece of materials. The pins shall be of high tensile steel, drop forged and heat-treated.

Galvanizing shall be by the hot dip process with a heavy coating of zinc of very high purity. The bidder shall specify the grade composition and mechanical properties of steel used. The pin shall be of such design that it will not yield or distort under the specified mechanical load.

4.8.10 Glass core for insulators using glass rod (Not applicable)

The core shall be a glass-fiber reinforced epoxy resin rod of high strength (FRP rod). Glass fibers and resin shall be optimized in the FRP rod. Glass fibers shall be Boron free electrically corrosion resistant (ECR) glass fiber or Boron free E-Glass and shall exhibit both high electrical integrity and high resistance to acid corrosion. The matrix of the FRP rod shall be Hydrolysis resistant. The FRP rod shall be manufactured through Pultrusion process. The FRP rod shall be void free. The FRP rod shall be covered by a seamless sheath of a silicone elastomeric compound or silicone alloy compound of a thickness of 3mm minimum. It shall be one-piece housing using Injection Molding Principle to cover the core. The elastomer housing shall be designed to provide the necessary creepage distance and protection against environmental influences. The housing shall conform to the requirements of IEC 61109/92-93 with latest amendments.

4.8.11 Material & workmanship

All the raw materials to be used in the manufacture of insulators shall be subject to strict raw material quality control and two-stage testing / quality control during

manufacturing to ensure the quality of the final end-product. Manufacturing shall conform to the best engineering practices adopted in the field of extra high voltage transmission. Bidders shall therefore offer insulators as are guaranteed by them for satisfactory performance on transmission lines.

The design, manufacturing process and material control at various stages be such as to give maximum working load, highest mobility, best resistance to corrosion, good finish and elimination of sharp edges. The design of the insulator shells shall be such that stresses due to expansion and contraction in any part of the insulator shall not lead to deterioration.

All ferrous parts shall be hot dip galvanized to give a minimum average coating of zinc equivalent to 610 gm/sqm or 87µm thickness and shall be in accordance with the requirement of ISO 752:2004. The zinc used for galvanizing shall be of purity 99.5% as per ISO 752:2004. The zinc coating shall be uniform, adherent, smooth, reasonably bright continuous and free from imperfections such as flux, ash rust stains, bulky white deposits and blisters. The galvanized metal parts shall be guaranteed to withstand at least four successive dips each lasting for one (1) minute duration under the standard Preece test. The galvanizing shall be carried out only after any machining.

Porcelain insulators

Shells with cracks shall be eliminated by temperature cycle test followed by mallet test. Shells shall be dried under controlled conditions of humidity and temperature.

All metal surfaces shall be perfectly smooth with no projecting part or irregularities, which may cause corona. All load bearing surfaces shall be smooth and even so as to distribute the loading stress uniformly. Pins shall not show any microscopically visible cracks, inclusions and voids.

4.8.12 Galvanizing

All ferrous components except or those made of stainless steel shall be hot dip galvanized. The threads of nuts and tapped holes, when cut after galvanizing shall be well oiled and greased. The galvanizing shall conform to BS EN ISO 1461 or any other equivalent national of international standards.

4.8.13 Finish

All insulator pins shall be reasonably smooth on all surfaces and free of sharp projections.

4.8.14 Tests

a. Type Tests

- Dry lightning impulse withstand voltage test;
- Wet power frequency withstand voltage test.
- Visual examination test
- Checking of threads on head
- Galvanizing test
- Mechanical test

b. Acceptance Tests

- Checking of threads on head
- Galvanizing test
- Mechanical test

c. Routine Tests

- Visual examination
- Verification of dimensions
- Temperature cycle test
- Mechanical tests
- Puncture test
- Porosity test

4.8.15 Marking

Each insulator shall be legibly and indelibly marked to show the following:

a. Name or trademark of manufacturer.

b. Year of manufacture.

c. Name of the Purchaser as follows: "NEA-DSUEP"

d. Minimum failing load in Newton (for pin and disc insulators only)

Markings on porcelain shall be printed and shall be applied before firing.

4.9 Specification of disc insulator fittings

4.9.1 Scope

This specification covers the fabrication and supply of tension type disc insulator fittings.

4.9.2 Description

The disc insulator fittings shall be supplied with ball and socket couplings (socket eye, ball eye/ball clevis etc.), twisted straps, and bolted type tension clamps. Number of U-bolts in tension set shall be 3 (three). Tension clamp shall be suitable for ACSR conductor, diameter ranging from 5 mm. to 16.5 mm. The ultimate strength of disc insulator fittings shall be more than 45 kN.

All parts of different fittings, which provide for interconnection, shall be made such that sufficient clearance is provided at the connection point to ensure free movement of insulator assembly.

The twisted strap shall be suitable for 50×100×50 mm. cross arm. Size of the holes for bolt, which anchors twisted strap with cross arm shall be suitable for insulator pins specified in SPECIFICATION: SP-11.0 and width of the twisted strap shall be designed accordingly. Diameter of nuts and bolts of strap shall be equal to shank diameter of insulator pins. Nuts and bolts shall also be provided with spring washer and split pin.

Unless otherwise specified in this specification, disc insulator fittings shall be in accordance with IEC: 60383 or any other equivalent national or international standards. The manufacturer of the disc insulator fittings must have been accredited with ISO 9001:2000 with design and manufacturing quality certification.

4.9.3 Material

The tension clamp shall be made of the aluminium alloy type. Other accessories like ball eye/ball clevis, socket eye, nuts, and bolts shall be made of hot rolled steel and obtained preferably by process of forging. 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 stainless steel.

All forging and castings shall be of good finish and free from flaws and other defects. The edges on the outside of fittings, such as at the eye, socket and holes, shall be rounded.

4.9.4 Galvanizing

All ferrous fittings and the parts other than those of aluminium alloy and stainless steel, shall be hot dip galvanized in accordance with EN ISO 1461 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.

4.9.5 Tests

The disc insulator fittings shall comply with the following tests as per IEC 60168 or any other equivalent national or international standards.

a. **Type Test**

- Verification of Dimensions
- Visual Examination Test
- Slip Strength Test
- Mechanical Test
- Electrical Resistance Test
- Heating Cycle Test
- Galvanizing Test

b. **Acceptance Tests**

- Verification of dimensions
- Galvanizing Test
- Mechanical Tests

c. **Routine Tests**

- Visual Examination Tests
- Routine Mechanical Test

4.9.6 Marking

The tension clamp shall be marked on it following:

- Name or trademark of manufacturer
- Name of the Purchaser as follows: " DSUEP EIB W5"

4.10 Specification of 11 kV Covered Conductor (MVCC) Hardware and accessories

4.10.1 Scope

This Specification covers the design, manufacture, factory test and supply and delivery of Hardware and accessories for All Aluminium Alloy Stranded XLPE Covered Conductor for use on 11000 V overhead distribution feeders suitable on 3-phase AC System conforming to EN 50397-1: 2006 and EN 50397-2 with up-to-date amendments (or equivalent standard).

4.10.2 Description

The specifications mentioned below are indicative. Bidder shall furnish the dimensional details for each accessory supported by brochures, manuals etc. of its standard product. The hardware and accessories suitable for XLPE conductor are specified below:

Description	Application
1. Tension/Anchoring Assembly (TA)	For fitting on to a pole for tensioning at the beginning or end of a length of covered conductor, or for anchoring at a major deviation in direction of line. The Tension assembly consists of one wedge type tension / anchoring clamp and one Tracking protection IPC.
2. Polymeric Cable Ties for Pin Insulator	For supporting and aligning covered conductor at an intermediate pole in a length, with small angle of deviation. The Tie hold the covered conductor in its position on top of the pin insulator.
3. Insulation Piercing Connectors (IPC)	For making tap-off / Branch Connection / Earthing Connection etc. to the Covered Conductor. To ensure the electrical characteristics within the required limits, while ensuring necessary insulation protection against tracking and water penetration on covered conductor.
a. For Bare to Covered Interconnection (IPC – Type 1)	For main (bare) to main (Covered Conductor) networking connection.
b. For Networking / Branching / Looping (IPC – Type 2)	For main (Covered Conductor) to main (covered Conductor) networking or branching of covered conductor to another covered conductor or Branch Cable or Looping for transformer junctions.
c. IPC with Aluminium Bail for Earthing (IPC – Type 3)	For temporary earthing provision from covered conductor for maintenance purpose.
4. Straight-Through Jointing and Heat Shrinkable End Cap	For joining end to end of covered conductors and to protect the conductor from moisture
5. Power Arc Devices	Used on straight line crossarm for a power arc protection without insulator damage for covered conductors.

4.10.3 Tension/Anchoring Assembly (TA)

a. **General**

Tension/Anchoring assemblies are used to firmly hold the XLPE Covered Conductor to a concrete or steel pole and transmit the mechanical tension at the end of a run and at a major change in direction of over 20 degrees.

The assembly shall consist of an Aluminum alloy corrosion resistant body, rigid sling ("bail") of galvanized steel with Tracking IPC, self-adjusting plastic wedges which shall anchor/hold the cable, and socket eye for connecting it with disc insulator.

Tension/Anchoring assembly shall be suitable and complete for disc insulator and its fittings as mentioned above.

The conceptual drawing is shown in Volume II, Part C - Drawings.

b. **Technical Requirement**

Tension/Anchoring Clamp

The following key criterion to be followed for the design of Tension/Anchoring Clamp:

- There shall be no losable part (except Tracking IPC and bail) in the process of clamping arrangement.
- Locking mechanism should be wedge type self-locking. Wedges are to be made of high strength, climatic resistance Engineering Plastic with glass fiber ensuring the right tightening of the wedges. There should be no metal teeth inside the wedges to avoid any damage to the outside sheath of the cover.
- The Tension clamp shall be equipped with all aluminum tracking insulation piercing connector to ensure same potential level and wedges to be attached to connector for smooth travel and ensuring no damage to conductor.

The fittings shall be able to withstand the specific minimum failure load (SMFL) and shall not damage the covering. SMFL is the minimum load specified by the purchaser or declared by the supplier at which mechanical failure will not take place.

Rigid Sling (Bail) of Anchor Assembly

The Anchoring assembly shall be supplied with a Galvanized steel rod to connect the Tension Clamp to the Insulator through socket eye.

The Rigid Bail forming part of clamp should have sufficient distance between bracket and body of clamp and shall have sufficient mechanical strength to withstand the mechanical test for the complete assembly tests in this specification.

Flexible bail is not acceptable due to the reason to withstand the load.

Rigid Bail should be fitted with provision to remove from the clamp to have easy installation.

Wedge Type Tension Clamp for Anchoring Assembly

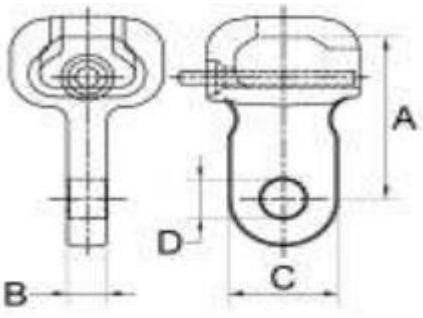
Wedge type clamps shall be used for clamping the Covered Conductor without damaging the insulation and shall be capable of clamping an uncut Covered Conductor so that it can continue without break to the connecting point or next span.

The clamp shall be of aluminum with fully insulating type of mechanical and weather resisting thermoplastic wedges.

No tools shall be needed for fitting the Covered Conductor into the clamp.

Socket Eye

The Socket eye shall be of steel, forged, hot dip galvanized according to IEC. The sizes shall be suitable for disc insulator as mentioned above with ball eye of 16 mm. The dimension and drawing shall be as below:



Dimensions in mm				Ball Eye	kN	kA 1s	Approx. Weight (kg)
A	B	C	D				
71	19	45	20	16	130	14	0.69

c. **Drawing**

The bidder shall furnish along with the bid the outline drawing of the assemblies together with insulators and hardware fittings all complete. The General Arrangement Diagrams and Drawings are provided in Volume II, Part C – Drawings.

d. **Marking**

Each clamp shall be legibly and indelibly marked to show the following.

a) Name & Trade mark of the manufacturer

b) Month & Year of manufacturing

c) Minimum Failing Load (in KN)

e) "Contract No" marking

e. **Testing Requirements**

After the mass production, the Type Test and Acceptance Test as per the relevant standards shall be carried out from an internationally recognized ISO/IEC 17025 certified independent test laboratory accredited to ILAC/IAF.

The following tests are intended to establish design characteristics as per EN 50397-2 and NFC 33-041.

S.N.	Test	Type test	Acceptance Test	Routine test
1.	Visual examination	☑	☑	☑
2.	Dimensional verification	☑	☑	☑
3.	Mechanical tests			
3.1	Tensile test at ambient temperature	☑	☑	
3.2	Tensile test at low temperature	☑		
3.3	Tensile test at high temperature	☑		
3.4	Slippage test at ambient temperature	☑	☑	

S.N.	Test	Type test	Acceptance Test	Routine test
4.	Environmental tests			
4.1	Corrosion test	☑		
4.2	Climate ageing test	☑		
5.	Check for permanent marking	☑	☑	☑

4.10.4 Polymeric Cable Ties for Porcelain Pin Insulator

a. **Technical Requirements**

The ties shall be designed suitably to hold the XLPE Covered Conductor in its position on top of the porcelain pin insulator and shall confirm to EN 50397-2. The Ties shall be helical type to ensure tracking resistance and to avoid any insulation damage to covered conductor due abrasion while mechanical or wind induced vibration.

The helical ties should be manufactured as plastic coated metallic ties to ensure same potential at all point of contacts, which retain good physical characteristics without deteriorating in function from the effects of severe weather conditions and industrial fumes.

b. **Testing Requirements**

After the mass production, the Type Test and Acceptance Test as per the relevant standards shall be carried out from an internationally recognized ISO/IEC 17025 certified independent test laboratory accredited to ILAC/IAF.

The following tests are intended to establish design characteristics as per EN 50397-2.

S.N.	Test	Type test	Acceptance Test	Routine test
1.	Visual examination	☑	☑	☑
2.	Dimensional verification	☑	☑	☑
3.	Mechanical tests			
3.1	Failure Load Tests	☑	☑	☑
3.2	Slip Load Tests	☑	☑	☑
3.3	Lift / Side Load Tests	☑	☑	☑
3.4	Thermal Tests under load	☑		
4.	Environmental tests			
4.1	Corrosion test	☑		
4.2	Climate ageing test	☑		
4.3	Resistance against tracking in heavy polluted areas	☑		
5.	Check for permanent marking	☑	☑	☑

c. **Drawing**

The bidder shall furnish along with the bid the outline drawing of the ties together with insulators and hardware fittings all complete. The General Arrangement Diagrams and Drawings are provided in Volume II, Part C – Drawings.

d. **Marking**

Each tie shall be legibly and indelibly marked to show the following.

a) Name & Trade mark of the manufacturer

b) Month & Year of manufacturing

c) "Contract No" marking

4.10.5 Insulation Piercing Connectors (IPC) for Covered Conductor

a. **General**

Insulation Piercing Connectors (IPC) are used for making Tee / Tap-off / connections to a XLPE covered conductor / Bare Overhead Line.

Insulation Piercing Connectors are designed to make a connection between the uncut main conductor and a branch cable conductor without having to strip either cable to expose the conductor. Instead, the tightening action of the IPC will first pierce the Insulation, then make good electrical contact between the main and branch conductor while simultaneously insulating and sealing the connection.

IPCs shall ensure the electrical characteristics within the required limits, while ensuring necessary insulation protection against tracking and water penetration on covered conductor.

The IPCs shall be of the following type (s) depending on the application:

Type – 1 for main (Bare) to main (Covered Conductor) network connection

Type – 2 for main (Covered Conductor) to main (Covered Conductor) networking.

Branching of Covered Conductor to another Covered Conductor or Branch Cable.

Looping for Transformer junctions.

Type – 3 IPC with Aluminium Bail for temporary Earthing Provision from Covered Conductor for maintenance purpose.

b. **Technical Requirements**

The connector bodies shall be made entirely of mechanical and weather resistant plastic insulation material made of weather & UV resistant reinforced polymer and no metallic part outside the housing is acceptable except for the tightening bolt or nuts.

The contact plates should be made of tinned copper/aluminium alloy.

Connector teeth should be factory greased & sealed to retard water or moisture ingress & corrosion.

The Insulation material should be made of weather & UV resistant reinforced polymer.

The outer metallic part should have potential free tightening bolts to allow safe installation on live lines.

Any metallic part that is exposed must be free from potential during or after connector installation.

Screws or nuts assigned for fitting with IPC (Insulating Piercing connector), must be fitted with torque limiting shear heads to prevent over tightening or under tightening. While the minimum and maximum torque values are to be specified by Manufacturer.

The IPC must perform piercing and connection on Main and Branch cable simultaneously using single bolt for tightening as multiple bolts do not ensure even tightening. The shear bolt/nut shall be suitable for tightening with a hexagonal socket of 13 mm or 17mm.

The IPCs shall be water proof and the water tightness shall be ensured by appropriate elastomer materials and not by grease, gel or paste alone. Grease can be applied to protect the contact blade alone and shall not be visible on the outer surface of the connector. Connector should not be dipped in grease.

The connector shall have a rigid removable end cap which can be slide fitted onto the main connector body on either right or left by the installer (depending on site requirement) for sealing the cut end of the branch cable. Once the connector is fitted, it should not be possible to remove the cap without removing the connector.

All the metallic parts of the connector should be corrosion resistant and there should not be any appreciable change in contact resistance & temperature after overloads & load cycling and should conform to the long duration tests specified in this standard.

c. **Testing Requirements**

After the mass production, the Type Test and Acceptance Test as per the relevant standards shall be carried out from an internationally recognized ISO/IEC 17025 certified independent test laboratory accredited to ILAC/IAF.

The following tests are intended to establish design characteristics as per EN 50397-2.

S.N.	Test	Type test	Acceptance Test	Routine test
1.	Visual examination	☑	☑	☑
2.	Dimensional verification	☑	☑	☑
3.	Voltage and Water Tightness Test	☑	☑	☑
4.	Mechanical tests	☑	☑	☑
5.	Corrosion test	☑		
6.	Climate ageing test	☑		
7.	Electrical Ageing Test	☑		
8.	Check for permanent marking	☑	☑	☑

d. **Drawing**

The bidder shall furnish along with the bid the outline drawing of the IPCs together with Covered Conductor all complete. The General Arrangement Diagrams and Drawings are provided in Volume II – Part C – Drawings.

e. **Marking and Packaging**

Each IPCs shall be packed in an air-tight plastic. In a hard-box, max 24 nos. of IPC shall be packed. Each IPCs and Each hard-box shall be legibly and indelibly marked to show the following.

a) Name & Trademark of the manufacturer

b) Month & Year of manufacturing

c) "Contract No" marking

4.10.6 Straight-Through Jointing and End Cap

a. **Straight-through Jointing**

The Sleeves shall be pre-insulated automatic tension jointing type. The automatic tension jointing sleeves shall be made of Aluminum.

The sleeve shall be wedge type and need No tool for fixing.

Insulation shall be provided by an Anti-UV black shrinkable tube.

The testing shall be done in accordance to EN50397-2

b. **End Cap**

The Insulated End Cap with sealant shall be suitable for effectively sealing the end terminal of the covered conductors. The inner diameter range of the cap shall be such that it shall tightly fit to the covered conductors to prevent entry of moisture.

4.10.7 Power Arc Devices

a. **General**

Power arc devices are used on straight line crossarm for a power arc protection for covered conductor. To avoid damage to the insulator, the arc must be ignited in the arc gap so that the short circuit occurs through the crossarm and trips the circuit breakers. This leads the short-circuit current to the crossarm, tripping the circuit breakers. The arc gap is designed to withstand stresses caused by high-current short-circuits (I_k = 10 kA / 1s). Power arc devices can be installed on either side of the insulator due to not being dependent on the direction of the power feed. Installation can also be done to different sides of the pole. Power arc devices shall be used with tension and suspension insulators.

b. **Technical Requirement**

The device is suitable for horizontal, covered conductor, suspension crossarm that are equipped with pin insulators. It can be used in straight lines and also at line angles that are allowed for the crossarm. Nominal insulator covering thickness of the conductor may vary from 1.7 to 2.5 mm. The arc gap is designed to withstand stresses caused by high-current short circuits (I_k = 10 kA/1s). The arc gap shall be adjustable and it will be 90 mm for 11kV line.

The insulator covering of the conductor need not to be removed as the connector is insulation piercing type. Tightening torque for connector screws is 40 Nm.

The arching Horn Assembly protection device consists of:

- Two arcing horns with adjustable distance "L" directly mounted on the insulator terminals.
- A covered conductor with clamp on the horn side.
- An insulation piercing connector on the main cable side.

Aluminum Material shall be corrosion resistant aluminium alloy, tensile strength

300 N/mm2.

Screws shall be hot dip galvanized and washer should be stainless steel.

The device should have Aluminium thread having diameter as 25 mm^2.

The connector is watertight by silicone greased teeth.

It should be tested in accordance to EN 50397-2 standard.

The weight of each piece shall be 1.6 kg and each package shall be consisting of 3 pieces.

c. Testing Requirements for Arc Protection Devices

Type tests as per EN 50397-2 shall be conducted from an internationally recognized ISO/IEC 17025 certified accredited independent test laboratory accredited to ILAC/IAF.

The following tests are intended to establish design characteristics as per EN 50397 – 2.

S.N.	Test	Type test	Acceptance Test	Routine test
1.	Visual examination	☑	☑	☑
2.	Dimensional verification	☑	☑	☑
3.	Check for Marking	☑	☑	☑
4.	Mechanical tests	☑	☑	☑
5.	Short Circuit Test	☑		

4.11 Specification of 11 kV Load Break Switch

4.11.1 Scope

This specification covers the design, manufacture, assembly, shop test, supply, delivery, installation works and field test of operation for both manned and unmanned substation/ line branches operation mode Load Break Switch.

This specification also covers requirement for outdoor pole mounted Load break switch (LBS) with capability of being integrated with any SCADA system using intelligent electronic devices (IED). The load break switch shall be designed for pole mounted or substation installation. All of the unit's protection, control and metering functions shall be electronically controlled within an integrated, modularized control unit. The load break should be capable of effectively extinguishing the arc by injecting the air through the pressurized chamber. Use of SF6 gas for either insulation or arc extinguishing is not permissible due to its harmful greenhouse effects.

The Load Break Switch shall have arrangement for operation remotely, locally, and automatically and same shall apply for all other 11 kV components. The Load Break Switch shall be normally installed in the line from where the line is tapping or branching.

4.11.2 General

The LBS shall be suitable for use on non-effectively earthed and effectively earthed networks and under the system conditions and service conditions as follows:

1	Rated Voltage	kV	11
2	Highest System Voltage	kV	12
3	Rated Normal Current	A	400/630
4	No. of Poles		3
5	Switch Type		Air Break Load Break Switch
6	Operating Condition		Tilting Type, Vertical Break, Outdoor Type
7	Applicable Standard		IEC 62271-103
8	Altitude		Up to 3000 m
	Temperature		-10°C to +55°C
9	1 min power frequency (Across / Phase-Earth)	kV	40 / 36
10	Lightning Impulse withstand voltage (1.2/50 us) (Across / Phase-Earth)	kV	105 / 95
11	Rated Frequency	Hz	50
12	Rated Short-time withstand current	kA, s	16 for 3 seconds
13	Short Circuit Making Current (TDma)	kA peak	40
14	Cable charging Current	A rms	16
15	Mainly Active Load Breaking Current (TD load 2 and TD Load 1)	A	400/630
16	Closed Loop distribution circuit current	A	400/630
17	Breaking/Interruption Medium		Air

18	Isolating Medium		Air / Solid State
19	Insulator Type		Polymer
20	Minimum Phase to Phase distance	mm	375
21	Minimum Isolating Distance (when in open position)	mm	275
22	Creepage Distance (Minimum)	mm	450
23	Operating Mechanism		Motorized and Manual
24	Mounting of Motor / Motor Operating Mechanism		On the Pole with the switch
25	Closing Time	ms	< 750
26	Opening Time	ms	< 750
27	Suitable for SCADA		Yes
28	Padlocking facilities		Yes

4.11.3 Construction

The R, Y, B three-phase of the load break switch is installed on one great sectional galvanized square steel base, joint together with one integrative drive axis interphase to ensure for closing and opening three poles synchronously.

The arching chamber should be maintenance-free, which should operate at the time of closing and opening. Being the heart of the load break switch, it should be capable of extinguishing the arc formed when operated on full load. There shall not be any requirement of external energy for holding the position CLOSE or OPEN. The use of HV/LV solenoids is not acceptable.

Oil / SF6 is not acceptable for interruption or insulation purposes. The unit shall be designed for M1 class for mechanical endurance.

Provisions shall be included for electrical close, and electrical and manual trip. Each pole of the LBS shall be identical to allow complete replacement of any individual pole, without disassembly or replacement of the other poles. All parts must be field replaceable. The LBS shall be suitable for mounting on channel on D.P. Structure.

There should be no connecting rods / operating rods / down pipe which connects the switch mechanism to the control box located below. The motor and gears should be fitted with the switch on the pole with only wires coming down for connection with the control box.

Each phase should have 3 insulators, 2 for fixed contacts and pads and 1 for operation of the moving contact.

The fixed contact, moving contact and terminal pads must be made of hard drawn electrolytic copper. The current density for fixed contact, moving contact and terminal pads must be minimum 2.0A/sqmm.

4.11.4 Mechanism

The load break switch should compose of a disconnect blade, an arc extinguishing chamber in air and an operating mechanism. The arc extinguishing chamber should be made of insulating material with the merits of high electric performance, arc endurance and high strength. The chamber should have a built-in spring with fast acting mechanism which ensures breaking of load current, hence being free from operating speed of the user. The arching gap and disconnect gap of the load break switch should be parallel in the course of opening and closing.

This load break switch should be operate-able by a manual linking rod or motor operating mechanism. There should be a visible gap of switch after opening to produce functions of isolation and protection. The blade of the switch should use press spring to assure enough connection pressure to the contact. By use of the spring the operation should be made convenient, the blade stable and the reliability of opening-closing operation should be guaranteed. The switch should open or close under rated load current and not require any secondary protection device.

The load break switch should work on the principle of extinguishing the arc by a blast of compressed air produced by the switch itself while opening the main moving contact tube.

4.11.5 Solid Dielectric Insulation

The phase to phase shall be minimum 375 mm and adequate for meeting the dielectric requirements. The creepage distance of insulators shall be minimum 450 mm to ensure the safety even in worst case failures of the quenching device. Use of boots or screw on bushings to meet Creepage is not acceptable.

The switch will go through high vibrations due to fast operations and the high creepage will give added safety.

The distance between poles when the switch is open should take into consideration of the case when the chamber does not operate.

4.11.6 Adding SCADA compatibility

The load break switch should be capable of being integrated with SCADA functions using an IED (Intelligent Electronic Devices). The load break switch should be capable of reporting switch ON/OFF status and should be capable of being operated (OPEN/CLOSE) by GPRS function.

4.11.7 Control equipment

Control cabinet

The control cabinet of the LBS should be capable of locally and remotely operating the LBS. It should be capable of sending the status of ON/OFF to the control room at the substation through wire/cable.

The control cabinet should take an input of 220 VAC/110 VDC which is used to operate the motor and send a logical 1 or 0 to the control room indicating ON/OFF respectively.

The control for the LBS shall be capable to be integrated with a highend SCADA compatible numerical relay which has inbuilt UPS and power control electronics cabinets that houses equipment for protection and control and shall be mounted independently of the LBS.

The cabinet of the LBS should be capable of shall be adequately sealed and dust protected and shall be internally treated to prevent moisture condensation. The degree of protection shall be suitable for Outdoor installation. The cabinet must be made of stainless steel. Mild Steel or Aluminium will not be acceptable.

The door of the cabinet shall be fitted with a robust fastening arrangement that is capable of being secured by a padlock.

The control must have Open and Close pushbuttons.

4.11.8 Tests

a. **Type tests**

The load break switch shall have been type tested in accordance with, and found to comply with, the requirements of IEC 62271-103 for the following, and the

appropriate values shall be stated in the tender documentation:

- Dielectric Tests (BIL and Power frequency).
- Measurement of resistance of the main circuit
- Short-time withstand current test.
- Temperature rise test
- Mechanical operations.
- Cable Charging and Line Charging Test
- Mainly Active Load Test
- Closed Loop Current Test

The control cabinet and associated electronics shall have been type tested in accordance with IEC 60259.

All insulators shall have been type tested in accordance with IEC 62231.

Type Test records in the form of validated copies of test certificates issued by an NABL approved / International accredited testing authority shall be submitted with the tender documentation.

Only the tests conducted at NABL approved laboratory or an accredited international laboratory shall be accepted.

b. Routine/Acceptance tests

Routine tests, as required in the relevant standards, shall be carried out as a normal requirement of the contract and, unless otherwise agreed upon, shall be witnessed by the purchaser or by his appointed representative. No additional charge shall be levied for such tests or for the production or presentation of documentation related to routine tests.

Duplicate copies of routine test certificates shall be supplied together with the equipment when the latter is delivered to the final destination stated in the order.

Mechanical Operating Test:

During these tests, which are performed without voltage or current in the main circuit, it shall be verified, in particular, that the switches open and close correctly when their operating devices are energized or under pressure. It shall also be verified that operation will not cause any damage to the switches. The arrangement of the switch shall comply with specifications for the mechanical operation type tests, refer to 6.102.1 of IEC62271-103. A switch having a power operating device shall be subjected to the following tests:

- at specified maximum supply voltage and/or maximum pressure of compressed gas supply: five operating cycles;
- at specified minimum supply voltage and/or minimum pressure of compressed gas supply: five operating cycles;
- if a switch can be manually operated besides its normal electric or pneumatic operating device: five manual operating cycles.

A manually operated switch shall be subjected to the following test: 10 operating cycles. During these tests, no adjustment shall be made and the operation shall be faultless. It shall be verified that the position indication is operating correctly when the switches open and close.

Volume II
Section 6: Employer's Requirements

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5 DISTRIBUTION TRANSFORMERS

5.1 Standard installation practices

5.1.1 Activities

Test the transformer with the right size of megger with respect to the primary and secondary voltage system, transport the transformer, lightning arresters, drop-out sets and distribution panel board, mount transformer on elevated platform, install LV cable between transformer LV terminals and protection panels, install all LV cables between protection panels and outgoing LV overhead lines, including cable and jumper connections, connect LV neutral earth terminal with earth lead.

5.1.2 Erection

Distribution panel-board material and equipment ratings shall be determined by the kVA rating of the transformer and number of 400/230 volt out going distribution circuits.

Where outgoing distribution circuits are installed, pole moment loading must be balanced by another outgoing distribution circuits in the opposite direction or by installation of stays. Three separate rods shall be used to earth the transformer structure.

a. One for surge arresters and equipment

b. Second for transformer body/equipment

c. Another for the neutral of transformer low voltage winding

Each earth rod shall be driven at a minimum distance of 2 meters from the adjacent pole resulting in a minimum distance of 6 meters between the two ground rods.

Ground conductor lead shall be stranded steel wire. 6. 1/2" banding material shall be used to strap grounding conductors to pole(s) at one (1) meter intervals.

Compression connectors and PG clamp shall be used to make all electrical connections. Conductor shall be terminated on main breaker and neutral bus with cable socket of proper size. If a sufficient number of connectors are not provided with the main breaker, the Contractor shall provide the remaining number required as local material.

Distribution Panel Board installation includes MCCB fitting and necessary connections with transformers and outgoing feeders as well as the data instrumentation system. There shall be adequate location for installation of Capacitor Bank in the panel.

5.2 Major items for Distribution transformers

Major items are to be used in DT installation are –

A. Distribution transformers 25, 50, 100, 200 and 300 kVA

B. Surge arresters

C. Drop-out fuse

D. Distribution Panel Board

E. Moulded Case Circuit Breaker (MCCB)

Specifications of each item is discussed in detail in the following sections.

5.3 Specification of 3-phase Distribution Transformers

5.3.1 Scope

These specifications cover design, engineering, manufacture, assembly stage testing, inspection and testing before supply and delivery at site of oil immersed naturally cooled, three phase, 50 Hz, 11 kV CRGO core, Copper conductor outdoor type Distribution Transformers.

The transformers shall be guaranteed for 3 years from the date of supply and acceptance.

It is not the intent to specify completely herein all the details of the design and construction of material. However, the material shall conform in all respects to high standards of engineering, design and workmanship and shall be capable of performing in continuous commercial operation in a manner acceptable to the Employer, who will interpret the meanings of drawings and specification and shall have the power to reject any work or material which in his judgment is not in accordance therewith. The material offered shall be complete with all components necessary for its effective and trouble-free operation. Such components shall be deemed to be within the scope of Contractor's supply irrespective of whether those are specifically brought out in this specification and / or the commercial order or not.

The transformer and accessories shall be designed to facilitate operation, inspection, maintenance and repairs. The design shall incorporate every precaution and provision for the safety of equipment as well as staff engaged in operation and maintenance of equipment.

All outdoor apparatus, including bushing insulators with their mountings, shall be designed so as to avoid any accumulation of water.

5.3.2 Service Condition

The transformers shall be designed and constructed for outdoor installation with three phase 50 Hz, 11 kV system in which the neutral is effectively earthed, suitable for service under supply voltage fluctuation of ±10% and frequency fluctuation of ±5%; and for satisfactory continuous operation under the following conditions:

Particulars	Rating
Ambient temperature	- 5°C to + 50°C
Average daily ambient air temperature	35°C
Location	Various locations in Nepal
Relative humidity	Up to 96 %
Altitude	up to 2500 m above mean sea level
Seismic level (Horizontal acceleration.)	0.30 g
Max. wind pressure (Kg./Sq. m)	200
Max. wind speed (m/sec)	50
Isokeraunic level (days per year)	59

The equipment shall be for use in moderately hot and humid tropical climate, conducive to rust and fungus growth.

5.3.3 Standards and Quality Certification

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 equivalent to IEC Standards. In particular:

- IEC 60076 Power transformers / Distribution Transformer
- IEC 60137 Insulating Bushings for alternating voltages above 1 kV
- IEC 60156 Insulating liquids - breakdown voltage at power frequency - test method
- ASTM B-49 Specification for Copper wire rod
- IEC 60296 Specification for uninhibited mineral insulating oils - DT 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 & switching impulse testing of power transformers & reactors
- IEC 60733 Determination of water in insulating oils.
- IEC 5493 Protective coating of iron and steel structures against corrosion.

The manufacturer of the offered transformers must have been accredited with valid ISO9000 quality certification with design in its scope of registration. The Tenderer shall have in-house facility to manufacture and testing of the Transformers of offered design.

5.3.4 Tank

The tank shall be conservator type. Alternatively, the supplier may offer the tank of hermetically sealed corrugated type with bolted cover utilizing a non-breathing gas cushion or other provision to absorb the oil expansion. It 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 weather proof, hot-oil resistant, resilient gasket in between for complete oil tightness.

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 and shall submit the calculation sheet in this regard.

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 be less than 3.2 mm. The thickness of tank-bottom & cover shall not be less than 4.0 mm. The thickness of CRCA sheet used for corrugation panel shall not be less than 1.2 mm. The tank shall be capable of withstanding, without leakage or permanent deformation, a pressure 25% greater than the maximum operating pressure. Each transformer shall be provided with earthing terminal with clamp type connector.

The internal clearance of tank shall be such that it shall facilitate easy lifting of core with coils from the tank without dismantling LV bushings.

The top cover of the tank shall be slightly sloping to drain rain water.

The tank plate and the lifting lugs shall be of such strength that the complete transformer filled with oil may be lifted by means of lifting shackle/hook type.

Tank and its top cover shall be embossed with "NEA/DSUEP-EIB-W5".

The tanks shall be tested for leakage test at a pressure of 0.25 kg/sq. cm measured at the top of tank.

5.3.5 Oil Preservation System

The transformer shall be of completely oil filled type.

In case of offer of transformer with conservator;

a. The conservator vessel shall have a capacity between highest and lowest level of not less than 7.5% of the total cold coil volume of the transformer.

b. Oil gauge shall be fixed to the conservator. A drain plug and a filling hole shall also be provided. The cover of main tank shall be provided with an air release plug to enable air trapped within to be released, unless the conservator is so located as to eliminate the possibility of air being trapped within the main tank.

c. The inside diameter of the pipe connecting the conservator to the main tank shall be within 30-40 mm and it shall be projected into the conservator so that its end is approximately 20 mm above the bottom of the conservator so as to create a sump for collection of impurities. The minimum oil level shall be above the sump level.

d. To overcome the oil leakages, side plate of conservator tank shall be welded. Bolting with gasket will not be allowable.

e. Breather shall be screwed type. It shall have die-cast aluminum body & further, inside container for silica gel shall be of tin sheet. Inverted U-shape pipe shall be used for connection of breather. The dehydrating agent shall be silica gel. The moisture absorption shall be indicated a change in the color of the silica gel crystal to be easily observed from a distance of 6m. Volume of breather shall be suitable for 500g of silica gel for transformer up to 200 kVA and 1 kg for above transformer. The make and design of breather shall be subject to approval of the Employer.

f. Individual breather shall be packed in a cotton bag and be bound with individual transformer in a clear visible position.

g. The position of the silica gel breather shall be such that maintenance can be carried out without the need to de-energize the transformer.

5.3.6 Painting

a. General

All paints shall be applied in accordance with the paint manufacturer's recommendations. Particular attention shall be paid to the following:

i. Proper storage to avoid exposure as well as extremes of temperature.

ii. Surface preparation prior to painting.

iii. Mixing and thinning

iv. Application of paints and the recommended limit on time intervals between coats.

v. Shelf life for storage.

All paints, when applied in a normal full coat, shall be free from runs, sags, wrinkles, patchiness, brush marks or other defects.

All primers shall be well marked into the surface, particularly in areas where painting is evident, and the first priming coat shall be applied as soon as possible after clearing. The paint shall be applied by airless spray according to

manufacturer's recommendations. However, where ever airless spray is not possible, conventional spray be used with prior approval of Employer.

The Supplier shall, prior to protect nameplates, lettering gauges. Sight glasses, light fittings and similar such items.

b. Cleaning and Surface preparation

After all machining, forming and welding has been completed, all steel work surfaces shall be thoroughly cleaned of rust, scale, welding slag or spatter and other contamination prior to any painting.

Steel surfaces shall be prepared by Sand / Shot blast cleaning or chemical cleaning by Seven Tank process including Phosphating to the appropriate quality.

The pressure and volume of the compressed air supply for blast cleaning shall meet the work requirements and shall be sufficiently free from all water contamination to ensure that the cleaning process is not impaired.

Chipping, scraping and steel wire brushing using manual or power-driven tools cannot remove firmly adherent mill-scale shall only be used where blast cleaning is impractical. Manufacturer shall explain such areas in his technical offer clearly.

c. Protective Coating

As soon as all items have been cleaned and within 4 hours of the subsequent drying, they shall be given suitable anti-corrosion protection.

d. Paint Material

Following are the types of paint that may be suitably used for the items to be painted at shop and supply of matching paint to site –

i. Oil resistant paint for inside surface.

ii. For external surface one coat of Thermo Setting paint or 1 coat of Zinc chromate primer followed by 2 coats of Polyurethane base paint. These paints can be either air drying or stoving.

iii. The color for the finishing paint shall be light grey or as approved by Employer.

e. Painting procedure

All painting shall be carried out in conformity with both specification and with the paint manufacturer's recommendation. All paints in any one particular system, whether shop or site applied, shall originate from one paint manufacturer.

Particular attention shall be paid to the manufacturer's instructions on storage, mixing, thinning and pot life. The paint shall only be applied in the manner detailed by the manufacturer e.g. brush, roller, conventional or airless spray and shall be applied under the manufacturer's recommended condition. Minimum and maximum time intervals between coats shall be closely followed.

All prepared steel surfaces should be primed before visible re-rusting occurs or within 4 hours, whichever is sooner. Chemical treated steel surfaces shall be primed as soon as the surface is dry and while the surface is still warm.

Where the quality of film is impaired by excess film thickness (wrinkling, mud cracking or general softness) the Supplier shall remove the unsatisfactory paint coating and apply another. As a general rule, dry film thickness should not exceed the specified minimum dry film thickness by more than 25%. In all instances where two or more coats of the same paint are specified, such coatings may or may not be of contrasting colours.

Paint applied to items that are not be painted shall be removed at supplier's expense, leaving the surface clean, unstained and undamaged.

f. Damaged paintwork

Any damage occurring to any part of a painting scheme shall be made good to the same standard of corrosion protection and appearance as that originally employed.

Any damaged paint work shall be made good as follows –

i. The damaged area, together with an area extending 25 mm around its boundary, shall be cleaned down to bare metal.

ii. A priming coat shall be immediately applied, followed by a full paint finish equal to that originally applied and extending 50 mm around the perimeter of the original damage.

iii. The repainted surface shall present a smooth surface. This shall be obtained by carefully chamfering the paint edges before and after priming.

g. Dry Film Thickness

To the maximum extent practicable the coats shall be applied as a continuous film of uniform thickness and free of pores. Overspray, skips, runs, sags and drips should be avoided. The different coast may or may not be of the same color.

Each coat of paint shall be allowed to harden before the next is applied as per manufacturer's recommendation.

Particular attention must be paid to full film thickness at edges.

The requirements for the dry film thickness (DFT) of paint and the materials to be used shall be as given below:

S. No.	Paint Type	Area to be painted	No. of Coats	Total Dry film thickness (min.)
1	Thermo setting paint	Inside outside	01 01	30 microns 60 microns
2	Liquid Paint Zinc chromate (primer) Polyurethane (Finish Coat) Hot Oil Paint / Varnish	 Outside Outside Inside	 01 02 01	 30 microns 25 microns each 35/10 microns

h. Tests

The painted surface shall be tested for paint thickness.

The painted surface shall pass the Cross-Hatch Adhesion Test, Salt spray test and hardness test as per the relevant ASTM standards.

Note: Supplier shall guarantee the painting performance requirement for a period of not less than 5 years.

5.3.7 Core

The transformer shall be core type. The cores shall be constructed with high grade, low loss, high permeability, non-ageing, cold rolled grain oriented (CRGO) silicon steel of maximum thickness 0.27 mm. No other core materials shall be entertained.

The core design shall avoid the presence of pockets which would prevent the complete emptying of the tank through the drain valve. The core materials offered

to be checked for its correctness before core coil assembly. For this, the Employer may ask for core and coil inspection before its tanking.

The laminations shall be free of all burrs and sharp projections. Each sheet shall have an insulating coating resistant to the action of hot oil.

The insulation structure for the core to bolts and core to clamp plates shall be such as to withstand 2000 V DC voltage for one minute.

The completed core and coil shall be so assembled that the axis and the plane of the outer surface of the core assemble shall not deviate from the vertical plane by more than 25mm.

All steel sections used for supporting the core shall be thoroughly shot or sand blasted, after cutting, drilling and welding.

The finally assembled core with all the clamping structures shall be free from deformation and shall not vibrate during operation.

The core clamping structure shall be designed to minimize eddy current loss.

The framework and clamping arrangements shall be securely earthed.

The core shall be carefully assembled and rigidly clamped to ensure adequate mechanical strength.

Oil ducts shall be provided, where necessary, to ensure adequate cooling inside the core. The welding structure and major insulation shall not obstruct the free flow of oil through such ducts.

The design of magnetic circuit shall be such as to avoid static discharges, development of short circuit paths within itself or to the earth clamping structure and production of flux component at right angle to the plane of the lamination, which may cause local heating. The supporting framework of the cores shall be so designed as to avoid the presence of pockets, which would prevent complete emptying of the tank through the drain valve or cause trapping of air during filling.

The construction is to be of boltless core type. The core shall be provided with lugs suitable for lifting the complete core and coil assembly. The core and coil assembly shall be so fixed in the tank that shifting will not occur during transport or short circuits.

Transformer Serial Number shall have to be punched on the Core-Yoke frame.

5.3.8 Internal Earthing

All internal metal parts of the transformer, with the exception of individual laminations and their individual clamping plates shall be earthed.

The top clamping structure shall be connected to the tank by a copper strap. The bottom clamping structure shall be earthed by one or more the following methods:

a. By connection through vertical tie-rods to the top structure.

b. By direct metal to metal contact with the tank base.

c. By a connection to the structure on the same side of the core as the main earth connection to the tank.

The magnetic circuit shall be connected to the clamping structure at one point only and this shall be brought out of the top cover of the transformer tank through a suitably rated insulator. A disconnecting link shall be provided on transformer tank to facilitate disconnections from ground for IR measurement purpose.

Coil clamping rings of metal at earth potential shall be connected to the adjacent core clamping structure on the same side as the main earth connections.

5.3.9 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 shall 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 so that vibration during short circuit is not passed on to the windings.

Winding shall be subjected to a shrinking and seasoning process, so that no further shrinkage occurs during service. Adjustable devices shall be provided for taking up possible shrinkage in service.

All low voltage windings for use in the circular coil concentric winding shall be wound on a performed insulating cylinder for mechanical protection of the winding in handling and placing around the core.

Winding shall not contain sharp bends which might damage the insulation or produce high dielectric stresses. No strip conductor wound on edge shall have width exceeding six times the thickness.

The winding insulation shall be free from insulating compounds which are liable to soften, ooze out, shrink or collapse. It shall be non-catalytic and chemically inert in hot transformer oil during normal service.

The stacks of windings are to receive adequate shrinkage treatment.

The windings and connections are to be braced to withstand shocks during transport, switching, short circuit or other transient conditions.

Permanent current carrying joints in the windings and leads shall be welded or brazed. Clamping bolts for current carrying parts inside oil shall be made of oil resistant material which shall not be affected by acidity in the oil steel bolts, if used, shall be suitably treated.

Terminals of all windings shall be brought out of the tank through bushings for external connections.

The windings shall be uniformly insulated and the LV neutral points shall be insulated for full voltage.

The completed core and coil assemble shall be dried in vacuum at not more than 0.5mm of mercury absolute pressure and shall be immediately impregnated with oil after the drying process to ensure the elimination of air and moisture within the insulation. Vacuum may be applied in either vacuum over or in the transformer tank.

The winding shall be so designed that all coil assembles of identical voltage ratings shall be interchangeable and field repairs to the winding can be made readily without special equipment. The coils shall have high dielectric strength.

Coils shall be made of continuous smooth high conductivity E.C. Grade (A) copper materials, shaped and braced to provide for expansion and contraction due to temperature changes.

Adequate barriers shall be provided between coils and core and between high and low voltage coil. End turn shall have additional protection against abnormal line disturbances.

The insulation of winding shall be designed to withstand voltage stress arising from surge in transmission lines due to atmospheric or transient conditions caused by switching etc.

Magnitude of impulse surges transferred from HV to LV windings by electro-magnetic induction and capacitance coupling shall be limited to BIL of LV winding.

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

5.3.10 Permissible Flux Density and Over Fluxing

Flux density at rated voltage and frequency shall not exceed 1.6 Tesla. The no-load current at rated voltage and at 112.5% voltage shall not exceed the values given below without any positive tolerance.

- At 100% rated voltage: 1% of rated full load current
- At 112.5% rated voltage: max 2% of rated full load current

The Manufacturer 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.

The Manufacturer shall submit the details of core type (product code) along with the B-H curve showing losses per unit.

The test for magnetic balance shall be carried out by connecting the LV phase by phase to rated phase voltage and by measuring a_n, b_n, c_n voltage.

The transformer shall be capable of operating at 10% over voltage and at frequency of 48.5 Hz without saturation.

5.3.11 Current Density

Current density for any part of the winding shall not exceed 2.4 Amp/mm^2.

5.3.12 Short Circuit Capacity

The transformer shall be designed and constructed to withstand, the mechanical and thermal stress produced by short-circuit current which is limited only by the impedance of the transformer only, as per IEC.

5.3.13 Tap Changer

An externally operated tap changer for transformers 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.

5.3.14 Insulating Oil

The transformers shall be supplied complete with first filling of transformer oil up to maximum permissible level. The quantity of oil required for the first filling of the transformer and its full specification shall be stated in the Tender. The complete first filling shall be of new oil free from inhibitors and additives up to maximum permissible level for the supplied Transformer. The price of transformer shall include the cost of Transformer Oil required for initial filling.

The insulating oil for the transformer shall be of EHV grade, generally conforming to IEC: 60296/ BS: 148/ REC: 39/ 1993 or latest version of IS: 335/ 1983 or other standards whichever is more stringent. No inhibitors shall be used in the oil. If an anti-oxidant inhibitor is recommended, its use shall be subject to the Employer's approval.

The design and materials used in the construction of the transformer shall be such as

to reduce the risk of the development of acidity in the oil.

The insulating oil shall be refined mineral oil. Necessary quantity of oil for the transformer shall be furnished by the contractor. The characteristics of the oil shall be as follows –

S.N.	Characteristic	Specified value
1	Electric strength (breakdown voltage) - Unfiltered	30 kV (rms) (min)
2	Electric strength (breakdown voltage) - Filtered	50 kV (rms) (min)
3	Dielectric dissipation factor (tan delta) at 90°C	0.002 (max)
4	Specific resistance (resistivity) at 27°C	1500 x 10^{12} ohm-cm
5	Specific resistance (resistivity) at 90°C	35 x 10^{12} ohm-cm
6	Flash point (PM closed)	140°C
7	Interfacial tension at 27°C	0.04 N/m (min)
8	Neutralization value (total acidity)	0.03 Mg KOH/g
9	Water content	35 PPM (max)

Test report for each batch of oil shall be submitted.

5.3.15 Bushings

The porcelain portion of HV and LV bushings shall be of standard make and confirm to IEC 60137, "Specification for High voltage porcelain bushings". Creepage distance of the bushing insulator shall be 290 mm or more for 12 kV transformer.

The bushings shall be of reputed make supplied by the manufactures that are having manufacturing and testing facilities for manufacture of HT insulators

Bushings shall be of the outdoor type and easily replaceable. They shall be sufficiently robust to withstand normal transport and erection hazards.

The bushing rods and nuts shall be made of brass material 12 mm diameter for both HV & LV. The bushings shall be fixed to the transformers on top with straight pockets and in the same plane. The tests as per IEC 60137 shall be conducted on the transformer bushings.

All bushings shall have a minimum creepage distance of 25 mm / kV. For 11 kV, 17.5 kV class bushings shall be used and for 0.4/0.23 kV, 1.1 kV class bushings shall be used.

Dimensions of the bushings of the voltage class shall conform to IEC 60137.

Brazing of all interconnections; jumpers from winding to bushing shall have cross section larger than the winding conductor.

In the case of LV bushing, the internal bushing shall be made of tough insulating material like epoxy and shall have embedded stem and a strong coupling connection (screwed) properly secured with a split pin/screw type locking arrangement shall be used between stem of the internal and external bushings.

The LV bushings shall be so located that even under the hottest conditions the level of the transformer oil shall be below the opening meant for fixing the LV bushings. The LV jumpers and bushing material shall be selected and designed for this condition.

The design of the internal bushing for LV shall be such as to provide adequate ea

clearance and creepage distance as stipulated in the standards specified. All other tests as per relevant standards shall be applicable.

The terminal arrangement shall not require a separate oil chamber not connected to oil in the main tank.

5.3.16 Terminal connectors

The LV bushing and HV bushing stems shall be provided with suitable detachable terminal connectors so as to connect the jumper without disturbing the bushing stem.

High voltage phase windings shall be marked both in the terminal boards inside the tank and on the outside with capital letters 1U, 1V, 1W and low voltage winding for the same phase marked by corresponding small letters 2u, 2v, 2w. The neutral point terminal shall be indicated by the letter 2n.

The high voltage bushings shall be provided with a bi-metallic clamp-type terminal connector suitable to receive 35-120 mm^2 AAAC or ACSR or cables directly without any bi-metallic action.

The low voltage bushings shall have clamp-type bi-metallic terminal lugs 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 clamp-type bi-metallic terminal lug for terminating together an earth-wire and an aluminum conductor of neutral circuit of the LV system.

The non-ferrous threaded terminals are to be supplied with one 16 mm bolt, one conic spring washer, one matching flat washer, one nut and one lock nut for each hole in the terminal plate.

5.3.17 Lightning Arrester

The polymer-housed lightning arresters of gapless metal-oxide type (Disconnector type) of high surge capacity of 9 kV (V_{rms}), 10 kA (8/20 micro wave shape) for 11 kV class transformers conforming to IEC 60099 shall be mounted on the HV bushings of transformer, clamped securely to the tank, to protect the transformer and associated line equipment from the occasional high voltage surges resulting from lighting or switching operations. The earthing terminal of the lightening arresters shall be grounded separately.

Lightning arrester shall be enclosed in HV Cable Terminal Box for the transformer where HV/LV terminations are made through cables.

The Lightning Arrester shall have following minimum technical requirements –

S.N.	Characteristic	Specified value
1	Nominal Voltage (System Voltage)	11 kV
2	Rated voltage	12 kV
3	Continuous Operating Voltage	9 kV rms
4	Standard nominal discharge current (8 / 20 |js)	10 kA
5	Line discharge Class	1
6	High current impulse (4/10js) – Peak	100 kA
7	Steep current (1/20js) maximum	40 kV

S.N.	Characteristic	Specified value
8	Maximum residual voltage at 10 kA for (8/20js)	35 kV
9	Switching impulse (30-100/60-200js) maximum residual voltage - peak	30 kV
10	One second TOV withstand capability	>1.15 x 12 kV
11	Type of housing Insulator	Polymeric
12	Lighting impulse (1.2/50js) voltage – peak	75 kV (Peak)
13	Power frequency withstand voltage (wet)	28 kV (rms)
14	Total creepage distance	320 mm and increase as per altitude requirement
15	Energy absorption capability	Not less than 3.2 KJ / k

The Lightning 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.

The manufacturer of Lightning Arrester shall possess ISO 9001: 2000 Quality Assurance Certification for the design & manufacture of Lightning Arrester for the plant where the manufacture of Lightning Arrester is done. A copy of the ISO Certificate certified as true copy of the original by the manufacturer shall be furnished along with the offer. Manufacturer shall have a minimum of 10 years' experience in manufacture of 12 kV Metal Oxide Gapless Arresters. The manufacturer shall submit proof documents such as supply records, the name and particular of the Employers, quantity sold, and the year of sale.

The Lightning Arrester shall directly be purchased from the manufacturer and a copy of bill shall be given to inspecting officer at the time of inspection. The manufacturer shall submit the type test reports as per IEC 600 99-4 with certified drawings, Oscillograms and approved drawing from ILAC / IAF approved laboratory along with the offer.

5.3.18 Tests

Tests shall be performed in accordance with IEC standards. In the absence of necessary procedures in IEC standards for any of the specified tests, such tests shall be conducted as per the provisions stipulated in other equivalent International Standards.

a. Type Tests

The Tenderer shall submit, along with the Tender, type test reports (detail) on the following tests performed on identical units.

i. Temperature rise tests

ii. Dielectric Type test

- Impulse voltage tests
- Lightning voltage tests
- Separate source AC withstand voltage test
- Short/Long duration induced AC voltage test

iii. Noise Level Measurement

iv. Short Circuit Test

The type test certificates shall be furnished for each type of transformer offered which, in addition to other required data, 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 Tenderer and the values given in the type test reports. The test of the transformer shall have been conducted by an independent laboratory accredited by International Laboratory Accreditation Corporation (ILAC) or International Accreditation Forum (IAF) or government accreditation agency.

If the type test is to be re-conduct as per EQC, the Tenderer/Manufacturer shall have to conduct it after mass production of the first lot at the Tenderer's cost in a Short-Circuit Testing Liaison (STL) - Accredited Laboratory in the presence of Employer's representatives. After successful type test only, the lot will be accepted.

The Supplier shall furnish calculations in accordance with the relevant standard to demonstrate the thermal ability of the transformers to withstand short circuit forces.

b. Routine Tests

The following tests shall be performed on each unit of transformer by the manufacturer before dispatch and submit the test-reports to the Employer.

i. Applied voltage test

ii. Induced voltage test

iii. No load loss and excitation current test

iv. Impedance voltage and load loss tests

v. Winding resistance measurement

vi. Ratio tests

vii. Polarity and phase relation tests

viii. Leakage tests

ix. Insulation resistance tests

x. Separate source power frequency voltage withstand test

xi. Dielectric breakdown strength of oil

The Tenderers are required to furnish the details of testing facilities available at the manufacturer's premises for conducting the tests listed above. The testing laboratory of the manufacturer must be accredited by International Laboratory Accreditation Corporation (ILAC) or International Accreditation Forum (IAF).

c. Tests to be witnessed by the Employer

The Employer's representative(s) shall witness at the manufacturer's plant in following stages:

i. In the first stage, after award of the contract and prior to mass production, the manufacturer shall design & manufacture the prototype of Distribution Transformers and carry out type test on identical unit of offered design of each capacity of transformer in one of the following testing laboratories in the presence of representative appointed by the Employer at no extra cost

to the Client/Employer:

- ASTA Certification Services (UK) or National Metrological Laboratory in UK, accredited to Western European Legal Metrology Corporation.
- CESI (Centro Electrotecnico Sperimentale Italiano S.P.A) or National Metrological Laboratory in Italy, accredited to Western European Legal Metrology Corporation,
- ESEF (Ensemble Des Stations D' Essais a' Grande Puissance Francaises) or National Metrological Laboratory in France, accredited to Western European Legal Metrology Corporation,
- B.V. KEMA (KEMA) or National Metrological Laboratory in Netherlands, accredited to Western European Legal Metrology Corporation,
- National Metrological Laboratory in Japan, accredited to National Laboratory Accreditation System in Japan,
- National Metrological Laboratory, accredited to American Association for Laboratory Accreditation,
- The type test from other internationally recognized independent meter test laboratory, such as PTB, Germany; PTP, Austria; NMI, Holland; Falcon Test Lab and UK, Ofgem (formerly known as 'Offer"), Ireland.

All the type tests shall be concluded within 120 days after the award of Contract. The suppliers shall be allowed to mass production only after satisfactory result of Type Test.

ii. Second 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 the NEA, in this regard, 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 inspection, a few assembled cores shall be examined to ensure that the CRGO laminations are as per the specification and tests as per standard shall be carried out on CRGO lamination. The winding materials and tanks shall be examined to ensure that they are as per the specification. 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 inspection 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 on minimum 5% quantity of offered lot shall be sent by the supplier along with Routine Test Certificates as specified.

In addition to above the Employer's representative(s) shall also witness the

following test on maximum 5 number of each type (rating) of transformer:

- Temperature-rise test,
- Dielectric type-test
- Dimensional verification
- Verification of weight of individual components and total weight

The sample 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. Testing after Delivery of Goods: The Supplier 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 which shall be the Final Test for acceptance of Transformers.

- Temperature rise test on at least one transformer of each rating.
- No Load Loss and Load Loss test on 100 (hundred) % of transformers

Cost for such tests (per unit and respective ratings of distribution transformer) shall be included in the cost of transformers and shall be paid by the Contractor. The cost for testing shall be as published in the NEA Citizen Charter and shall prevail.

Inspection by the Representatives shall not relieve the Manufacturer of his obligation of furnishing equipment in accordance with the specifications.

d. Dispute on quality of Goods:

The Employer has all the rights to conduct the test including type tests, at his own cost by an independent agency whenever there is dispute regarding the quality of supply or interpretation of test results. In the event of failure of transformers in such tests, the expenses incurred in testing shall be to the supplier's account as already mentioned above in case of Testing after Delivery of Goods.

The Employer at its discretion can open one of the randomly selected Transformer from one or each rating to verify the internal details of the transformer like conductor size, conductor material used, core lamination thickness etc. If there is any deviation found in the same from the technical data sheet and/or from the type tested design (within tolerance for dimensions as per IEC standards), the Employer has the discretion to reject the entire lot of the transformers without any notice to manufacturer with financial implications entirely on manufacturer for replacement with a right material.

5.3.19 Performance and Productivity of the Goods

The transformer no-load and load loss shall not exceed the following prescribed values. If the guaranteed no load and load losses exceed the values prescribed below, the Tender shall be rejected.

Rating	No Load Loss at rated voltage and frequency at 75°C (watts)	Load Loss at rated full load current, voltage and frequency at 75°C (watts)
300 kVA	550	3000
200 kVA	365	2100
100 kVA	220	1210

Rating	No Load Loss at rated voltage and frequency at 75°C (watts)	Load Loss at rated full load current, voltage and frequency at 75°C (watts)
50 kVA	120	750
25 kVA	75	460

When evaluating the individual Tender received from various Tenderers, the loss of Distribution transformers shall be capitalized and evaluated Tender Price shall be calculated as below:

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

where,

P_E Evaluated price

P_b Tender 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 No Load and Load Loss capitalization rate shall be:

K_{NL}	Value of no-load loss	USD 4,684 / kW
K_L	Value of load loss	USD 618 / kW

The Tenderer shall furnish guaranteed no load and full load loss value at rated full load capacity of the transformers along with the Tender for all rating of Distribution Transformers. In case of loss capitalization, no tolerance shall be permitted for the guaranteed value. Failure to furnish the guaranteed No Load and Full Load Loss of each rating of distribution transformer, the Losses shall be assumed as per the Specification.

During loss capitalization, no tolerance shall be permitted for the guaranteed value.

After receipt of goods at the delivery point and during warranty period, the Employer reserves the right to conduct any kind of test on any transformers chosen by the Employer in the presence of Supplier's representative at reputed national/international testing laboratory. The costs involved in organizing and conducting such tests shall be borne by the Employer.

5.3.20 Penalty for Non-performance

If the No Load and Load loss distribution transformers as measured during test exceed the values guaranteed in the Tender, then for each kilowatt of losses in excess of the losses guaranteed, an amount at the rates of twice the rates specified above for no-load losses (i.e.; USD 9368.00) and load-losses (i.e.; USD 1236.00) shall be deducted from the Contract Price of the Contractor. No tolerance shall be permitted on the quoted guaranteed value while applying penalty for exceeded loss value.

The performance figures quoted on Functional Guarantee of the Proposed Facilities Form FUNC shall be guaranteed and shall become a part of the Contract. The Distribution transformers will be rejected, if the measured component loss (individual no load and load loss) exceeds the guaranteed value by over 15% or the total losses (no load loss plus load loss) exceeds by over 10%. No tolerance shall be permitted o the quoted guaranteed value.

If at any stage it is established that the type test report submitted by the Contractor is not satisfactory, discrepant or ambiguous, then NEA reserves the right to ask the Contractor to conduct the type test on the rating/s of transformers chosen by the NEA in the presence of their representative at reputed national/international testing laboratory. The costs involved in organizing and conducting such tests shall be borne by the Contractor.

5.3.21 General specifications

The General Specifications of the distribution transformer shall be as below:

S.N.	Particulars	Rating
1	Type	-Three Phase,11/0.4 kV
2	Rated power	As specified in the Price Schedule
3	Rated Voltage - Primary - Secondary	 11 kV 400/230 V
4	Max. System Voltage - Primary - Secondary	 12 kV 440/253 V
5	Rated Frequency	50 Hz
6	Connection - Primary - Secondary	 Delta Grd. Wye
7	Cooling System	ONAN
8	Vector group	Dyn 11
9	Rated impedance voltage	3.5 - 4.5%
10	BIL for windings and bushings for primary side	75 kV
11	Withstand voltage, 50 Hz, 60 Sec. - Primary - Secondary	 28 kV 3 kV
12	Mounting	Pole
13	Insulation levels (IEC 76)	LI 75 AC 28/AC 3
14	Insulation temperature class (IEC 76)	A
15	Maximum allowable noise level at 3 metre hemispherical radius	<44 dB
16	Applicable standards	These Specifications and IEC

5.3.22 Quality Assurance Program

Along with the Tender the Tenderer 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:

a. The structure of the organization;

b. The duties and responsibilities assigned to staff ensuring quality of works;

c. The system for purchasing, taking delivery and verification of materials;

d. The system for ensuring quality of workmanship;

e. The quality assurance arrangement shall conform to relevant requirements of ISO9001;

f. 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 tests normally carried out on raw materials;

g. List of manufacturing facilities available;

h. List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections;

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.

5.4 Specification of surge arresters

5.4.1 Scope

The surge arresters shall be suitable for use on a three-phase, wye-connected, uni-grounded (solid grounding), 11 kV, 50 Hz distribution circuits at an altitude up to 2000 meters, and ambient temperatures ranging from -5 deg. C to 45 deg. C.

The surge arrester housing shall be of polymer type, manufactured using industry recognized polymeric material having superior insulating properties necessary for outdoor installations. The housing shall display in an indelible manner: Arrester type, voltage rating, and year of manufacture.

The surge arresters shall be of gapless metal-oxide type. It shall have line terminals and ground lead terminals accommodating copper or aluminium conductor sizes from 13.3 mm sq. through 53.49 mm sq. Each arrester shall be provided with nut and wire clamp as the line terminal and ground terminal accessory hardware. The surge arresters shall be furnished with necessary mounting bracket and accessories necessary for steel channel (100 x 50 x 50 x 6 mm) cross-arm mounting. It must be manufactured by a company approved to quality standard ISO 9001. The ISO 9001 certification number, the name of the authorized approving authority with the contact address and telephone and fax numbers shall also be stated. The Tenderer shall enclose a verified copy of the ISO 9001 certificate with the Tender.

5.4.2 Ratings

The surge arresters shall have the following characteristics:

S.N.	Particulars	Rating
1	Voltage rating (Ur)	9 kV rms
2	Nominal system voltage	11 kV rms
3	Maximum system voltage	12 kV rms
4	System frequency	50 Hz
5	Nominal discharge current	10 kA
6	Creepage distance (terminal to base)	320 mm and as required by the altitude of installation.
7	Minimum power-frequency withstand – Wet	50 kV rms
8	Minimum power-frequency withstand – Dry	70 kV rms
9	Impulse withstand (1.2/50µsec)	95 kV crest
10	Max discharge (residual) voltage at 10 kA lighting impulse	29 kV crest
11	Steep current residual voltage	32 kV crest
12	Pressure relief class B – High current	for 0.2s 20 kA
13	Pressure relief class B – Low current	for 0.5s 0.8 kA

5.5 Specification of Drop-out fuse

5.5.1 Scope

The specification covers technical requirements of design, manufacture, fabrication, testing, packing, supply and delivery of outdoor, open, drop out expulsion type fuse cutouts complete with fuse carriers, stickers and mounting brackets suitable for installation in 50Hz, 11kV distribution system for protection of H.T. lines and transformer.

It is not the intent to specify completely herein all the details of design and construction of 11KV D.O. fuse with Porcelain Insulators. However, 11KV D.O. fuses will confirm in all respects to high standards of engineering design and workmanship and shall be capable of performing in continuous commercial operation up to the manufacturer's guarantee in a manner acceptable to the Employer, who will interpret the meanings of drawings and specifications and shall have the power to reject any material, which in his judgment not in accordance with the specifications / drawings. The offered 11KV D.O. fuses shall be complete with all components necessary for its effective and trouble-free operation along with associated equipment such components shall be deemed to be within the scope of supplier's supply, irrespective of whether these are bought out specifically in the specification and / or in order or not. Also, similar parts particularly removable shall be interchangeable.

The drop out fuse shall be suitable for use on three-phase, wye-connected, uni-grounded, 50 Hz distribution circuits at an altitude up to 2500 meters. The drop out fuse shall be tested in full compliance with ANSI C 37.41-1981, ANSI C 37.42 or IEC 60282-2. The drop out fuse shall incorporate wet-process glazed porcelain insulators. The insulator shall display in an indelible manner: manufacture, type and voltage rating. The fuse holder shall accommodate a non-expendable cap or an expendable cap determined by interrupting rating. The drop out fuse shall be furnished with a galvanized steel-mounting bracket that may be adapted for steel channel (100x50x50x6mm) cross arm mounting. The drop out fuse shall have clamp type terminals to accept copper or aluminium conductors ranging from 25 sq mm to 150 sq mm. The drop out fuse must be manufactured by a company approved to quality standard ISO 9001 (including design in the scope of registration). The ISO 9001 certification number, name of authorized approving authority with contact address, telephone and fax numbers shall also be stated. The Tenderer shall enclose a verified copy of ISO 9001certificate with the Tender.

5.5.2 Ratings

Drop out fuse shall have the following electrical characteristics:

S. N.	Particulars	Rating
1	Type of DO Fuse	Expulsion, Class A
2	Rated/Service Voltage	12/11 kV
3	Rated Frequency	50 Hz
4	No. of Phases	3
5	Rated Continuous Current	100 A
6	Insulation Level	

S. N.	Particulars	Rating
	a. Dry Impulse withstand (1.2 kV/50µs) voltage (positive & negative polarity) (Peak) - To Earth and between poles - Across the isolating distance of the fuse base	 75 kV 85 kV
	b. Wet 1 min. power frequency withstand voltage (rms) - To Earth and between poles - Across the isolating distance of the fuse base	 28 kV 32 kV
7	Total Creepage distance (min)	320 mm and increase as per altitude
8	Interrupting capacity	10 kA
9	Temperature rise limit (copper contacts)	65°C
10	Temperature rise limit (terminals)	50°C
11	Fuse holder rating	100 A to 300 A
12	Mounting angle to vertical plane	15-20°
13	Length of the fuse barrel	285±2 mm
14	Tensile Strength	10 kN

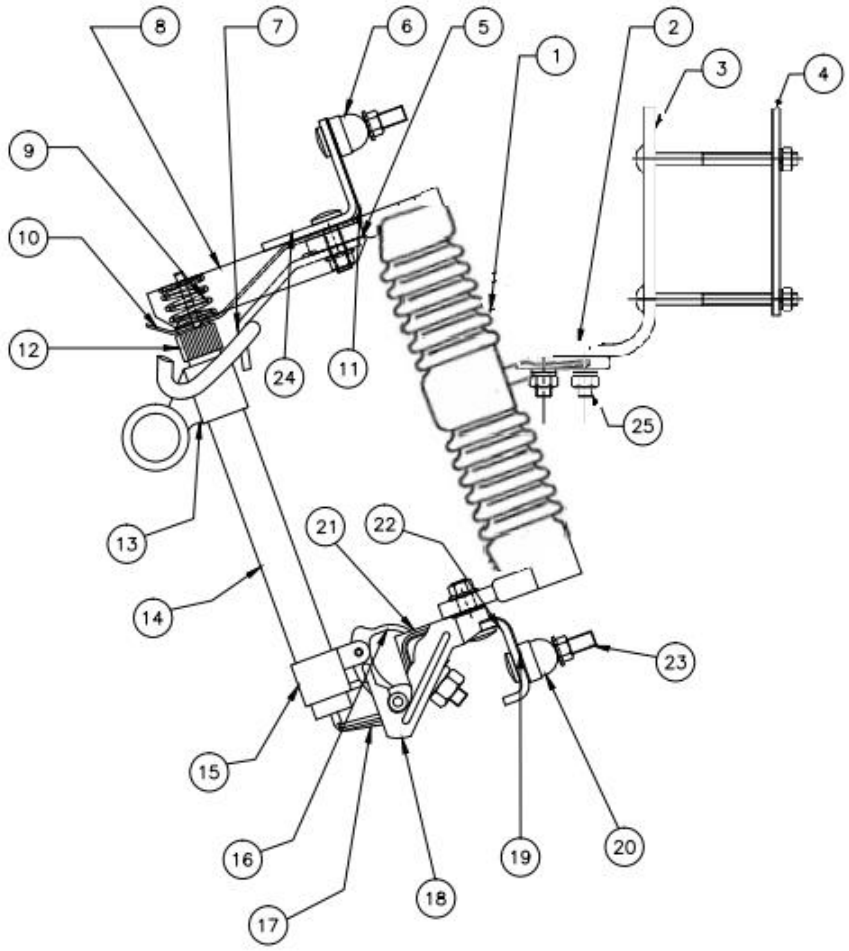
5.5.3 Construction details

a. General

i. The Drop-out fuse Cutouts shall be of Class A as per IEC 60282-2. It shall be suitable for use in outdoor circuits under tropical conditions stipulated in Clause 2 above. The D.O. Fuse cutout shall be complying with the minimum technical requirements stipulated above.

ii. A complete set of D. O. Fuse cutout shall consist of three units of D. O. one in each phase.

iii. The General Arrangement Diagrams and Drawings are as below:



Item	Qty	Description	Material	Item	Qty	Description	Material
1	1	Insulator	Porcelain	14	1	Fuse Holder Tube	Epoxy Fiber Glass
2	1	Fixing Rod	Galvanized Steel	15	1	Lower Tube Holder	Brass
3	1	Mounting Bracket	Galvanized Steel	16	1	Crankshaft	Silver plated Brass
4	1	Back Plate	Galvanized Steel	17	1	Trigger	Stainless Steel
5	1	Upper Contact Support	Galvanized Steel	18	1	Crankshaft Support/Lower Housing	Brass
6	1	Upper Connector	Tin Plated Brass	19	1	Lower Contact Plate	Silver Plated Copper
7	1	Hook and Support Plate	Galvanized Steel	20	1	Lower Connector	Tin Plated Brass
8	1	Upper Housing	M.S. hot dip galvanized	21	2	Lower Contact	Silver Plated Copper
9	1	Spring	Stainless Steel	22	1	Lower Terminal Support	Galvanized Steel
10	1	Upper Contact	Silver plated copper	23	2	Bolt for Groove Connector	Galvanized Steel
11	1	Upper Contact Terminal Plate	Silver plated copper	24	1	Upper Terminal Support	Galvanized Steel
12	1	Contact Cap/Nut	Silver plated brass	25	2	M10 Carriage Bolt with plain & Spring Washer	Galvanized Steel
13	1	Upper Tube Holder	Brass				

b. Operation

i. It shall not be possible to close the fuse carrier without the top cap fitted. The Drop-out fuse Cutouts shall be designed and constructed such that on closing the fuse carrier-fuse link no additional stress shall be applied to the fuse link which could cause it to fail.

ii. The fuse carriers shall be interchangeable between D. O. units of same voltage class from different manufacturers.

iii. The D. O. units shall be able to mount on a single channel iron cross arm (100 mm x 50 mm x 6 mm) at an angle of 15 to 20° to the vertical plane. The whole unit shall be complete with long mounting bracket, bolts, nuts & washers.

iv. Lifting rings of 25 mm nominal internal diameter shall be provided on the bottom end and on the top of the fuse tube to enable the removal and replacement of the fuse tube using a standard operating rod fitted with a hook-link stick.

v. The fuse carrier shall drop-out immediately following the blowing of the fuse.

c. Fuse Base

i. The Drop-out fuse Cutouts shall be designed with a solid core, bird proof, one piece Porcelain Insulator with 320 mm minimum creepage distance and, it shall be robust enough to withstand shocks due to frequent operations.

ii. The porcelain insulator shall be as per IEC 60383.

iii. The top and bottom assemblies with the middle clamping hardware, shall be fitted suitably through riveting so as to provide a strong clamping arrangement in suitable position.

iv. The assembly shall have the enough mechanical strength as per the requirement.

v. The top and bottom current carrying parts (contact and contact terminal plate) shall be made of copper and shall be silver plated for corrosion resistance efficient current flow. The top contact shall have a socket cavity for latching and holding firmly the fuse carrier.

vi. The top contact shall be actuated by a strong stain-less steel spring which keeps it under sufficient pressure to maintain a firm contact with the fuse carrier during all operating conditions. The spring shall also provide flexibility and absorbs most of the stresses when the fuse carrier is pushed into the closing position.

vii. The current carrying parts of the assembly shall be protected from water and dust formation by a hot dip galvanized steel top cover. The size of the top cover shall be 150 mm x 85 mm x 35 mm with thickness of 2 mm.

viii. The top contact assembly shall have a robust galvanized steel hook to align and guide the fuse carrier in to the socket latch even when the fuse carrier is closed at an off-center angle.

ix. The top assembly shall be robust enough to absorb bulk of the forces during the fuse carrier closing and opening operations and shall not over stress the spring contact. It shall also prohibit accidental opening of the fuse carrier due to vibrations or impact.

x. The bottom assembly shall have hinge contacts made from highly conductive, anti-corrosive silver-plated brass. It shall accommodate and make a firm contact with the fuse carrier bottom assembly. The fuse carrier shall be placed easily in or lifted from the hinges without any maneuvering. The fuse carrier shall be prevented from slipping out of the self-locking hinges during all operating conditions and only when the fuse carrier has reached its fully open position then only it can be removed from the hinge support.

xi. The material for other parts shall be as per drawings.

d. Fuse Carrier

i. Fuse carrier shall be made of high strength fiber-glass filament wound tube or suitable insulating material and it shall be protected from weather and environment by an ultraviolet resistant coating. Inside liner of the fuse tube shall be constructed of a synthetic arc quenching material. The tube shall have high bursting strength to sustain high pressure of the gases during fault interruption. The inside diameter of the fuse tube shall be 17.5 mm and outer diameter shall be 22 mm.

ii. The fuse carrier top contact shall have a solid replaceable cap made from highly conductive, anti-corrosive silver-plated brass to provide a low resistance current path from the fuse base top contact to the fuse link.

iii. 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.

iv. 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.

v. The upper stationary contact shall be capable of absorbing the shock when the fuse carrier is pushed into the closed position and shall not allow the fuse link to be damaged.

vi. The fuse carrier bottom assembly shall be made of silver-plated brass casting to efficiently transfer current to fuse base. It shall make smooth contact with the fuse base bottom assembly during closing operation.

vii. The upper stationary contact assembly shall be provided with a safety latch and the hinge at lower stationary contact shall be so designed to prevent fuse carrier from dropping due to vibration.

viii. The lower contact shall be capable of absorbing the shock when the fuse carrier is pushed into the closed position and shall not allow the fuse link to be damaged.

ix. The lower contact shall keep the fuse link in the center of the fuse carrier and keep it tensioned under all operating conditions.

x. The Asymmetrical breaking current ratings shall be permanently marked on the upper metal part.

xi. The material for other parts shall be as per drawings.

e. Terminals

i. The lower and upper terminal/connector for receiving aluminum conductors of diameter from 5 mm to 16 mm, shall made from tin plated brass while the terminal support and bolt for groove connector shall be made from galvanized steel.

ii. 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.

f. Galvanizing

i. All 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 ISO 1461.

g. Mounting Bracket GI

i. The D. O. Fuse unit shall be provided with suitable mounting bracket, bolts, nuts & washers of appropriate size to mount these units on a single channel iron cross arm (100 mm x 50 mm x 6 mm).

ii. It shall provide the necessary clearance from the support.

iii. Mounting arrangement shall be made of high strength galvanized steel flat and shall be robust enough to sustain the various stresses encountered during all operating conditions of the cutout.

5.5.4 Tests

a. Tests shall be performed in accordance with IEC standards mentioned in Clause 4. In the absence of necessary procedures in IEC standards for any of the specified tests, such tests shall be conducted as per the provisions stipulated in other equivalent International Standards.

b. Type Test

The type test reports consisting of all the tests as per the relevant standards shall be submitted along with the Tender. The type test shall have been carried out in an internationally recognized ISO/IEC 17025 certified independent test laboratory accredited to ILAC/IAF.

c. Routine Test

The routine shall be carried out in accordance with relevant standards mentioned above.

The following tests shall be carried out by the manufacturer on each unit to check the essential requirements:

i. Visual Inspection

ii. Verification of all dimensions

iii. Power frequency voltage dry test

The Manufacturer shall maintain the register for routine tests and shall submit it to the Representative of the Employer before Acceptance Tests.

d. Acceptance Tests

The Acceptance Test shall be carried out in a lab of manufacturer.

The followings tests shall be carried out as the Acceptance Test:

i. Nameplate Marking and Dimensional Verification

ii. Creepage Distance Verification

iii. Dielectric Tests

iv. Mechanical Tests (For Fuse base and Fuse Links)

v. Breaking Tests on minimum one sample

vi. Galvanize test on all galvanized steel

vii. Physical Operation Test i.e. ON-OFF observations

e. Tests to be witnessed by the Employer

Pre-Dispatch Inspection

Equipment shall be subject to inspection by a duly authorized representative of the Employer.

Inspection may be made at any stage of manufacturer at the option of the Employer.

After the mass production, the Manufacturer/Supplier shall intimate the Employer with a list of independent laboratories accredited by ILAC/IAF, so that representatives from the Employer could be deputed. The appointed representatives shall select samples as required. The following tests shall be carried out at the selected laboratory in the presence of appointed representatives.

i. Dielectric Tests

ii. Temperature Rise Tests

iii. Mechanical Tests (For Fuse base and Fuse Links)

iv. Breaking Tests

v. Electric strength of 25 kV when tested edgewise in oil at 90°C (Fiber glass tube)

vi. Insulation resistance of minimum 10 MΩ at 500 V DC after emersion in water (Fiber tube)

vii. Tests for time-current characteristics

viii. Physical Operation Test i.e., ON-OFF observations

ix. Pull out test for embedded components of the Fuse base (porcelain) in addition to other tests mentioned in IEC 60383

x. Creepage Distance and Dimensional Verification

Sampling for the test shall be done as per relevant standards.

Inspection by the Representatives shall not relieve the Manufacturer of his obligation of furnishing equipment in accordance with the specifications.

Material shall be dispatched after dispatch clearance certificate is issued by the Employer.

5.6 Specification of Distribution panel board

5.6.1 Scope

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 manufacturer of panel boards must have been accredited with ISO 9001 quality certification. 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.

5.6.2 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.

5.6.3 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 undersurfaces.

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.

5.6.4 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.

5.6.5 MCCB Standoffs

The standoffs shall be shaped and dimensioned to accommodate the MCCBs as required by Tender Packages. The standoffs shall be precisely located.

5.6.6 Cable Standoffs

The cable standoffs shall be properly shaped and dimensioned. The standoff s[illegible]

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.

5.6.7 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.

5.6.8 Cable entrance fittings & 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 Tender 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.

5.6.9 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.

5.6.10 Pole mounting bracket

The panel board shall be provided with two (2) pole mounting brackets. The size of poles will be confirmed by the Project before manufacturing.

5.6.11 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.

5.6.12 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. 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.

5.7 Specification of Moulded Case Circuit Breaker (MCCB)

Each Distribution Panel Board shall be provided with a MCCB installed inside as described below:

S. No.	Transformer Capacity kVA	Full Current	MCCB with TMTU
1	11/0.4 kV, 3-phase, 25 kVA	36 A	40 A TP
2	11/0.4 kV, 3-phase, 50 kVA	72 A	75 A TP

10% extra no. of MCCBs of each rating shall be provided as spares.

Design, Manufacture, Testing, Installation and Performance shall be in accordance to the latest editions of IEC 60947-1, IEC 60947-2 & IEC 60947-3 and IEC / EN 60068-2-27. The offered MCCBs shall meet EMC in accordance with IEC 61326 including amendment, safety requirements of IEC 1010-1.

The moulded-case circuit breaker (MCCB) shall be of fixed type version suitable for vertical mounting and of current limiting type.

The power contacts shall be insulated in an enclosure made of a thermosetting material from other functions such as the operating mechanism, the case, the trip unit and auxiliaries.

All poles shall operate simultaneously for circuit breaker opening, closing and tripping.

The specification of MCCB shall be as follows:

Type	MCCB with Thermal Magnetic Tripping Unit (TMTU)
Rated Operation voltage:	415 V/230 V AC
Maximum voltage ($U_{e,max}$):	690 V
Rated insulation voltage:	≥ 800 V AC
Rated impulse withstands voltage	≥ 8 kV
Rated frequency	50-60
Number of poles	DP/TP
Rated continuous current	as per the ratings of MCCB
Rated service short circuit breaking capacity	16 kA or higher
Operating Mechanism	Quick make, quick break, Manual ON/OFF, automatic and manual trip, mechanically trip free, Indicator for "ON-TRIP-OFF" position. Must be equipped with "push to Trip" button in front of Breaker. Shunt Trip function shall also be provided.
Trip	The trip unit must have adjustable overload and instantaneous short-circuit Protection.
Operating Device	Spring Charge type
Auxiliary Contacts	Shall be provided for feedback of MCCB status
Shock Resistance	MCCBs shall be insensitive to vibrations and meet requirements on mechanical & electromechanical vibration strength according to IEC/EN60068. Also, suitable for shock resistance without tripping up to 10g.
Mechanical Life Operation	> 15000
Electrical Life Operations	> 3000

The manufacturer shall be ABB/Siemens/Schneider/GE/L&T/Hyundai/Mitsubishi/Legrand or equivalent. In case of equivalent make~~,~~ the manufacturer shall have been shortlisted as an approved vendor in any government entity and the type test as per standards for each rating of MCCB shall be carried out by the manufacturer free of cost in one of the lab as mentioned in 5.3.18 c i in presence of Employer's representatives.

The following tests on MCCB shall be carried out at the manufacturer's works as **Acceptance/ Routine Test:**

- Overall dimensions checking
- Insulation resistance tests
- High voltage test at 2500 V, 50 Hz AC for one minute
- Other tests as per IEC
- Temperature rise test for completely assembly i.e. Distribution panel board with MCCB

Volume II
Section 6: Employer's Requirements

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6 LT LINES

LT lines are required to connect the end consumer to secondary side of distribution transformers. Typically, LT lines are provided to extend 400 volts from distribution transformers located at central location of a load center, such as the market square.

6.1 Major items for LT distribution

Major items are to be used in LT installation are:

A. LT AB cables

B. LT XLPE Power Cables

C. Hardware for LT AB cables

Specifications of each item is discussed in detail in the following sections.

6.2 Standard specification of LT Aerial Bunched Cables

The Specification covers design, manufacture, testing before dispatch, transportation, supply and delivery of 1100 V Aerial Bundled Conductors (ABC) having XLPE insulated, stranded compact circular aluminum conductors twisted over an XLPE insulated aluminum alloy Neutral cum messenger wire for use as overhead distribution feeders suitable for use on 3-phase/1-phase AC System conforming to IS-14255/1995 with up-to-date amendments (or equivalent standard).

6.2.1 General Requirements

Aerial bundled conductors for use in low voltage overhead lines shall be designed to withstand all mechanical, electrical and thermal stresses under steady state and transient operating conditions.

All materials used in manufacturing of conductors shall be new, unused and of finest quality. All materials should comply with the requirements/tests as per applicable standards. The Employer will verify the documentary evidence of the purchase and use of various raw materials used for the manufacture of the supplied cable.

6.2.2 Composition and Description of the Cable

The Aerial bundled conductors shall comprise three single-core power cables twisted around an XLPE insulated aluminum alloy Neutral cum messenger wire in case of three phase and one single-core power cable twisted around an XLPE insulated aluminum alloy Neutral cum messenger wire in case of single-phase system. The messenger wire will carry the overall weight of cable.

6.2.3 Conductors

The conductor shall be of H2 (sizes of 50 mm^2 and below) or H4 (all sizes above 50 mm^2) grade Aluminum – Governed by IS 8130 / 1984 with latest amendment if any (or equivalent standard). The neutral cum messenger wire shall be of heat-treated aluminum magnesium-silicon alloy wires containing approximate 0.5% magnesium and 0.5% silicon conforming to IS-398 (Part-IV)/1984 with up-to-date amendments (or equivalent standard). The stranded conductor shall be clean & reasonably uniform in size and shape and its surface shall be free from sharp edges. Not more than two joints shall be allowed in any of the wires forming every complete length of conductor and no joint shall be within 300 mm of any other joint in the same layer. The joint shall be brazed, silver soldered or electric or gas welded. No joint shall be made in the conductor, once it has been stranded.

The conductor shall generally confirm to IS 14255 – 1995 and IS 7079 (P-I)/1988 with latest amendment if any (or equivalent standard).

The conductor shall suitably compact and outer diameter shall be within the specified limits as per applicable standard of ABC cable (IS 14255/1995 or equivalent standard).

The Tensile strength of Aluminum wire used in conductor shall not be less than 90N/mm^2.

6.2.4 Insulation

The Conductor (with protective barrier, wherever applier) shall be provided with cross linked polyethylene (XLPE) applied by extrusion conforming to the standard specification as per IS 14255/95 (or equivalent standard).

The insulation material shall be cross-linked by a dry process. A cross-linking process using steam curing will not be permitted. The insulation should have minimum thickness as specified. No tolerance on the negative side shall be acceptable. The insulation compound shall be clean with low levels of contamination. Upper surface of cable insulation should be Ultra Violet Ray Resistant and color of insulation shall be black.

The make of XLPE compound shall be from among DuPont (USA), Hanwha (Korea), Borealis (Austria), BASF (Germany), Sumito Chemicals (Japan).

6.2.5 Core Identification

The Phase Conductors shall be insulated with black weather resistant, XLPE suitable for 1100 V insulation. The Phase Conductor shall be provided with one, two and three ridges for quick identification. The individual cores thus formed shall then be laid up around insulated messenger wire. The insulated messenger wire shall have four ridges as per IS 14255:1995 (or equivalent standard).

6.2.6 Laying Up

Three Power Cores having Ridges one, two and three should be twisted over insulated messenger wire with right hand direction of lay. This will from the Aerial Bundled Cable. Lay ratio shall be as specified in IS: 14255/1995.

6.2.7 Tests

Type Tests

Type Test reports of all sizes of Aerial Bundled Cables as specified in relevant IEC, IS & IEE conducted from independent test laboratory accredited ILAC/IAF shall be furnished along with the Tender.

The type test reports shall contain details of following tests as per IS 8130-1984 and IS 10810 (or equivalent standard).

i. Tests on Phase Conductor
   a) Tensile Test
   b) Wrapping Test
   c) Resistance Test

ii. Tests on Messenger Conductor
   a) Breaking Load
   b) Elongation Test
   c) Resistance Test

iii. Physical Test for XLPE insulation
   a) Tensile Strength and Elongation at break
   b) Ageing in air oven
   c) Hot Set Test
   d) Shrinkage Test
   e) Water Absorption (Gravimetric) test
   f) Carbon Black
      - Content
      - Dispersion

iv. Test for thickness of Insulation
   a) Breaking Load
   b) Elongation Test
   c) Resistance Test

v. Insulation performance (Volume resistivity) Test

vi. High Voltage Test

Prior to the mass production of the first lot, at its own cost the Manufacturer/Contractor shall carry out the type test as per the relevant standards on identical unit of each item selected by the representatives of NEA from one of the lab as mentioned in clause 5.3.18 c i of 6-B1-5 in the presence of representatives from NEA.

Routine Tests

The following tests as well as other routine tests as per relevant standard shall be carried out on all sizes and drums of cables by the manufacturer and the test report shall be submitted to the inspectors at the time of pre-dispatch inspection test.

i. Conductor Resistance Test

ii. High Voltage Test at room temperature

Acceptance Tests

All the acceptance tests as per IS-7098 Part-1/1988, IS 14255/1995 or equivalent IEC standards with up-to-date amendments shall be carried out in the presence of the Employer's representative. The Contractor shall clearly state as to what testing facilities are available in the works of the manufacturer and whether the facilities are adequate to carry out routine and acceptance tests as mentioned in the relevant standards. All the testing facilities shall be provided to Employer's representative for witnessing the acceptance tests in any internationally accredited laboratories or by national board. The following minimum tests shall be included under routine/acceptance tests.

i. Tensile Test

ii. Wrapping Test

iii. Breaking Load Test for messenger Conductor

iv. Elongation test for messenger Conductor

v. Conductor Resistance Test

vi. Test for thickness of insulation

vii. Tensile Strength and Elongation at Break Test

viii. Hot Set Test for XLPE Insulation

ix. Insulation Resistance Test

x. High Voltage Test

xi. Bending Test on complete cable

6.2.8 Packing and Marking

The Cable shall be supplied on suitable sized wooden non-returnable drum of robust construction for each length of Cables as per IS 10418 (or equivalent standard). A layer of water proof paper shall be applied to the surface of the drums and over the outer cable layer. A clear spare at least 40 mm shall be left between the Cable and Logging. Wood preservative shall be applied to the entire drum. Packing shall be sturdy to protect the Cable from any injury during transportation handling and storage. Both Cable ends shall be sealed with PVC/Rubber Caps to eliminate ingress of moisture. Each Cable drum shall have the following information stenciled on it:

i. Manufacturer's Name and Brand Name

ii. Year of Manufacture

iii. Nominal Cross-sectional area of the cable conductor

iv. Type of cable and voltage grade

v. Length of the Cable

vi. Number of the cores

vii. Color of outer sheath

viii. Cable Code

ix. Direction of rotation of drum (by means of an arrow)

x. Approximate gross weight in kg/km

xi. Name of Employer

xii. Contract No.

Each drum of the conductors furnished shall contain only one (1) length of conductor.

The Standard length of the conductor in each drum shall be as per the table below:

Conductor Size (sq. mm)	95 (3+1	50 (3+1)	25 (3+1)	25 (1+1)
Normal Length of the Conductor (m)	500	1000	2000	2000

All whole bundled cable while rolling in the drum shall be passed through the jet printing station to be printed with Cumulative length of AB Cable. The cable shall have the following identification in interval not more than 2 meters. Font size of letters to be minimum 5 mm.

i. Manufacturer's Name and Brand Name

ii. Voltage Grade

iii. Type of Cable i.e. LV ABC

iv. Size of conductor i.e. 25 + 25, 3Cx25 + 25, 3Cx50 + 35, 3Cx95 + 70

v. Year and month of manufacturing

vi. Type of insulation

vii. Contract No.

6.2.9 Verification of Length of Conductor

The Length of AB Cable is the total length of bundled cable not individual conductor. The length of bundled cable shall be jet printed as mentioned above.

The Employer shall ascertain the length of cable at Manufacturer's works and at the receiving store centers by measuring the actual length by length measuring machine.

used for the purpose. The Contractor/Manufacturer should ensure that length measuring machine is available for measurement of the length by the inspecting officer.

All ends of the cable shall be sealed by the Contractor/Manufacturer and seals will be contained in the drum and not exposed out of drum.

The declared length will be measured between manufacturer's seals at both ends of the cable.

The weight of the cable will also be checked for ensuring correct lay and length.

For the verification of the length of the cable, 10% of total lot (in Drums) should be selected at the works. The physical verification of the length of the conductor should be carried out for maximum up to 5 (five) drums. If there are any more drums left for verification, then weight of each verified drum should be carried out and average weight may be calculated.

Then the weight of each of all the remaining selected drums may be taken and if these weights are matching with the average weight, then that particular lot may be accepted otherwise rejected.

Verification of length of conductor will also be carried out at each stores center for two drums out of each lot. If the average length is found correct or more, the lot will be accepted. If the average length is found to be less than the declared, the percentage of such short length will be applied for reduction for the entire quantity supplied in the lot at respective stores for acceptance.

In case of dispute, joint inspection along with the representative of the Contractor/Manufacturer shall be carried out after giving 10 (ten) days' notice to the Contractor/Manufacturer to remain present at stores center for the purpose. If the representative fails to attend on stipulated date for joint inspection, the decision of the consignee shall be final and binding.

6.2.10 Technical Particulars

The standard technical characteristics of the aerial bundled conductor shall be as follow:

AB Cable Type	Minimum Number of Strands		Minimum thickness of Insulation (mm)		Max. DC resistance at 20° (Ω/km)		Minimum Tensile Strength of Messenger (kN)	Approx. Overall Diameter of Cable (mm)	Approx. Weight of Cable (kg/km)
	Phase	Messenger	Phase	Messenger	Phase	Messenger			
3x95+70	19	7	1.6	1.5	0.320	0.492	19.7	42.7	1237
3x50+35	7	7	1.5	1.2	0.641	0.986	9.8	32.3	692
3x25+25	7	7	1.2	1.2	1.2	1.38	7.0	25	390
2x25	7	7	1.2	1.2	1.2	1.38	7.0	22.4	195

6.2.11 Quality Assurance

The manufacturer shall possess ISO 9001 Quality Assurance Certification for the manufacture of LV ABC Cable for the plant where the manufacture of LV ABC Cable is done. The Tenderer shall furnish a copy of the ISO certificate certified as true copy of the original by the manufacturer, along with the offer.

Along with the Bid the Tenderer shall furnish quality assurance program of the manufacturer which included 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 9001;

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 tests normally carried out on raw materials;

vii. List of manufacturing facilities available with supporting documents;

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.

6.3 Specification of LT XLPE power cables

6.3.1 Scope

The specification covers design, manufacturing, testing, packing, supply & delivery of 1100 volts grade, LT Cable, multiple core, Cross linked Polyethylene (XLPE), FRLS, insulated, PVC sheathed, armoured power cables for effectively earthed systems.

6.3.2 Sizes

i. Single Core – 10, 16, 35, 50, 95, 120, 150, 185, 240, 300, 400, 500 & 630 mm^2
ii. Two Core – 10, 16, 35, 50, 95, 120, 150, 185, 240, 300, 400, 500 & 630 mm^2
iii. Three Core - 16, 35, 50, 95, 120, 150, 185, 240, 300, 400, 500 & 630 mm^2
iv. Three and half core - 35, 50, 95, 120, 150, 185,240, 300, 400, 500 & 630 mm^2
v. Four Core - 35, 50, 95, 120, 150, 185, 240, 300, 400, 500 & 630 mm^2

6.3.3 Standards

BS-5468	Cross-linked polyethylene insulation of electric cables
IEC-60540	Test methods for insulations and sheaths of electric cables
IEC-60228/3-2004	Conductor for insulated cables
IEC-60502-1/2004	Power cables with extruded insulation and their accessories for rated voltages from 1kV(Um=1.2kV),up to 30kV(Um=36kV)-Part 1:Cables for rated voltages of 1kV (Um=1,2kV) and 3kVIUm=3.6kVl
ASTM G53/DIN 56687	UV testing of XLPE insulation

6.3.4 Design, construction and technical parameters

a. General

All materials used in manufacturing of cable shall be new, unused and of finest quality. All materials should comply with the requirements/tests as per applicable IEC specification, and any other relevant International standards.

b. Conductor

The conductor of the cable shall be made from high conductivity, Electrolytic H4 Grade, stranded aluminum to form compacted and circular /shaped conductor having resistance within limits as specified in relevant IEC or equivalent with latest amendments.

Before stranding, the conductor shall be circular in cross section, uniform in quality, solid, smooth and free from scale, sharp edges and other defects. Conductor shall conform to the standards for permissible number of joints in any one of the single wires forming every complete length of conductor, for location of joints in same layer of conductors and for method of making such joints. No joint shall be made in any conductor after it is stranded.

c. Insulation

The insulation shall be suitable for LT system voltage and the insulating material shall be cross linked Poly Ethylene (XLPE), and applied by extrusion process as per IEC and its latest amendments. The insulating material shall have excellent electrical properties with regard to resistivity, dielectric constant and loss factor and shall have high tensile strength and resistance to abrasion. This shall not deteriorate at elevated temperatures or when immersed in water. The

insulation shall be preferably fire resistant and resistant to chemicals like acids, alkalis, oils and ozone.

The insulation properties shall be stable under thermal conditions arising out of continuous operation at conductor temperature of 90°C rising momentarily to 250°C under short circuit conditions. It shall be free from any foreign material or porosity visible to the unaided eye. The insulation shall be so applied that it fits closely on the conductor and it shall be possible to remove it without damaging the conductor. The average thickness of insulation shall not be less than the nominal value as specified in relevant IEC with latest amendments.

Tolerance on insulation thickness shall be as per relevant IEC. The insulation shall withstand mechanical and thermal stress under both steady state and transient operating conditions.

d. Core identification (for multiple core cables)

Individual core of multi-core cables shall be colour coded and/or numbered for proper identification. All cores insulation shall be black colored. For cores identifications, a XLPE colored line (1mm width X 0.5 mm height) shall be extruded over the insulation.

- Red line shall represent R phase
- Yellow line shall represent Y phase
- Blue line shall represent B phase
- For Neutral: as core already black, extruded line not required over the insulation.

In 2 core cables, phase core shall be red colored extruded line. The manufacture's name along with the order no. shall be printed (noncontact type) on the outer sheath.

e. Fillers and Laying up of cores (for multiple core cables)

In multi core cables, the cores shall be laid together with a suitable right hand lay. The interstices shall be filled with non-hygroscopic material. Further, the compounds used with fillers shall be such as to have no deleterious effect on other components of the cable and to be stable at cable temperatures.

f. Inner sheath (common covering)

The laid-up cores shall be provided with inner sheath applied by extrusion process. It shall be ensured that the shape is as circular as possible. It shall be applied to fit closely on to the laid-up cores and shall be possible to remove easily without causing any damage to the underlying insulated cores. The thickness of the inner sheath shall be as per relevant IEC. No tolerance on the negative side shall be acceptable.

g. Armoring

The armour of cables shall consist of either galvanized round steel wires or galvanized steel strips. The armoring shall be applied such that the minimum area of coverage shall be 90 % and the gap between any two armour strips/ wire shall not be more than the width of strip/ diameter of armour wire. The galvanized steel strips/wire shall comply with the requirements of IEC with latest amendments. In case of Single core cable armouring shall be of Non-magnetic material with dimensions of the galvanized steel strip/wire shall be as per relevant IEC with latest amendments. No tolerance on the negative side shall be acceptable. The direction of lay of the armour shall be left hand. When one or more layers of proofed plastic tape are applied over the laid-up cores as

binder, the thickness of such tapes shall not be construed as part of the extruded inner sheath.

The dimensions of armour round wires shall be as per IEC 60502. The joints in armour wire shall be made by brazing or welding and the surface irregularities shall be removed. A joint in any wire shall be at least 300mm from the nearest joint in any other armour wire in the completed cable. The single core cable shall not have any GI wire armour.

h. Outer Sheath

The outer sheath shall consist of extruded tough outer sheath of PVC compound insulation over the armouring. The colour of the outer sheath shall be black. The outer sheath shall be applied by extrusion process, it shall be tightly applied –

i. Over the insulation ·in case of un-armoured single core cables

ii. Over the armouring in case of armoured cables

6.3.5 Operation

Cable shall be suitable for operation under voltage and frequency variation as per Latest Indian Electricity rule Cable shall be suitable for laying in air, in duct or buried underground directly or through trenchless boring Cable shall have heat & moisture resistance properties. These shall be of type & design with proven record on distribution network service

6.3.6 Tests

a. Type tests

All the cable types and sizes i.e., items offered should have been fully type tested as per IEC with amendments at any internationally accredited third-party testing lab. The tenderer shall furnish one set of authenticated copy of type test reports along with the offer. These type tests must have been conducted within last five years prior' to date of Bid opening. For any change between design/type of already type tested and the design I type offered against this specification, the Employer reserves the right to demand repetition of type tests without any extra cost. For each type and size, the type test shall be got carried out independently.

The Employer also reserves the right to have tests carried out at his own cost from an independent agency, whenever there is a dispute regarding the quality of supply.

The type test certificates type tests as per IEC shall be furnished invariably with the offer.

a) Tests on conductor
   - Tensile test
   - Wrapping test
   - Resistance test

b) Tests for armouring strips / wires

c) Tests for thickness of insulation (eccentricity) and sheath

d) Physical tests for insulation
   - Tensile strength and elongation at break
   - Ageing in air oven
   - Hot set
   - Shrinkage test

- Water absorption test (gravimetric)

e) Physical tests for outer sheath
   - Tensile strength and elongation at break
   - Ageing in air oven
   - Shrinkage test
   - Hot deformation
   - Loss of mass in air oven
   - Heat shock
   - Thermal stability
   - Carbon black content of polythene sheath

f) Insulation resistance test (volume resistivity)

g) High voltage test

h) Flammability test

i) FRLS Tests –

The following FRLS tests are to be conducted as per the referred standard
- HCL gas evolution test (IEC - 754.1)
- Oxygen Index (ASTM-D-2863)
- Temperature Index (ASTM-D-2863)
- Smoke density test (ASTM-D-2863)
- Flammability test (IEC-332. 1)
- Swedish Chimney test (SS-424 14 75)
- Ladder Test (IEEE-383)

b. Special instructions

The first lot offered shall not be less than 10% of ordered quantity of each size of LT XLPE ARMORED CABLE. One sample from the 1st Lot of LT XLPE ARMORED Cable of each size as received in Employer's store shall be selected and sealed by the inspecting officer nominated by Employers for getting it type tested at any internationally accredited testing laboratory. The charges incurred towards type test of the material received in NEA stores shall be borne by Contractor/Manufacturer.

In case sample from first lot fails then –

a) Contractor/Manufacturer shall have to replace the full quantity of the respective inspected lot supplied to various stores and lying unused at stores

b) Sample from next lot shall be selected again for type test. All test charges incurred towards type test of the material for second time shall be borne by the Contractor/Manufacturer. In case sample again fails in the type test then further supplies shall not be accepted.

c. Factory acceptance tests

The acceptance tests shall be carried out as per IEC on the selected samples –

a) Tensile test (for aluminum)

b) Wrapping test (for aluminum)

c) Conductor resistance test

d) Test for thickness of insulation and sheath

e) Hot set test for insulation

f) Tensile strength and elongation at break test for insulation and sheath

g) High voltage test

h) Insulation resistance (volume resistivity) test

All the acceptance tests shall be carried out by the Contractor, in the presence of Employer's representative at the works. The firm shall give at least 15 days advance notice to the Employer to enable him to depute the engineer for witnessing the tests. The test certificates for acceptance tests witnessed by inspecting officer / engineer shall be submitted for approval before dispatch of material.

d. Routine tests

The following shall constitute the routine tests. The Inspector may also inspect the routine tests at the time of inspection

a) Conductor resistance test

b) High-voltage test for 5 minutes

6.3.7 Quality Assurance Program

Along with the Bid the Tenderer 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:

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 tests 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;

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.

6.3.8 Identification mark

The outer sheath of the cable shall bear following identification parameters embossed at intervals of length of one meter of cable, throughout the cable:

i. Name of manufacturer

ii. Year of manufacture

iii. Voltage grade

iv. Size of cable

v. Cable code

vi. Name of Employer "NEA-DSUEP-EIB"
vii. Successive length
viii. Marking for FRLS cable

6.3.9 Packing and forwarding

The cable shall be wound on non-returnable wooden drums as per IEC and packed in drums suitable for vertical I horizontal transport, as the case may be and shall be suitable to withstand rough handling during transport and outer storage. The outer surface of the drum shall be painted with white aluminum paint. Similarly, the inside surface of drum shall have the protective layer of varnish / paint.

The wooden drums shall be reinforced with steel bends and strips for better protection.

Length

The cable shall be supplied in standard drum length as per detail below:

Size (sq.mm)	1C (meter)	2C (meter)	3C (meter)	3.5C & 4C (meter)
0 – 16	2000	1500	1000	1000
Above 16 up to 50	1500	1000	1000	1000
Above 50 up to 150	1000	750	750	750
Above 150 up to 300	750	500	500	500
Above 300	500	300	300	300

The ends of the cable shall be sealed by means of non- hygroscopic heat shrinkable sealing material.

The following information be stenciled on the drum with either water proof ink or oil paint:

i. Reference of IEC standard
ii. Manufacturer's name or trademark
iii. Type of cable and voltage grade
iv. No. of cores
v. Nominal cross-sectional area of conductor
vi. Cable code
vii. Length of cable on the drum
viii. Gross weight
ix. Direction of rotation of drum (by means of an arrow)
x. Position of outer end of cable
xi. Year of manufacture
xii. Reference of Tender No. I P.O. No. date
xiii. Property of "NEA-DSUEP-EIB"
xiv. Name of consignee and the destination

The firm shall be responsible for any damage to the cables during transit due to improper and inadequate packing. Wherever necessary, proper arrangement for lifting, such as lifting hooks, shall be provided. Any cable found short inside the

packing cases shall be supplied by the Contractor/Manufacturer, without any extra cost.

Each consignment shall be accompanied by a detailed packing list, containing the following information –

i. Name of consignee
ii. Details of consignment
iii. Destination
iv. Total weight of consignment
v. Handling and unpacking instruction
vi. Bill of materials, indicating contents of each package

6.3.10 Inspection

The inspection may be carried out by the Employer at any stage of manufacture. The successful tenderer shall grant free access to the Employer's representative at reasonable time, when the work is in progress.

Inspection and acceptance, of any cables under this specification by the Employer, shall not relieve the Contractor/Manufacturer of his obligation of supplying cable in accordance with the specification and shall not prevent subsequent rejection, if the cables are not found as per the technical specifications.

The Contractor/Manufacturer shall keep the Employer informed in advance about the programme of manufacturing of cables so that arrangement can be made for inspection.

The Employer reserves the right to insist for witnessing the acceptance / routine tests of the bought-out items.

At least 5% of total numbers of drums subject to minimum of 2 in each lot put up for inspection shall be selected at random to ascertain the length/workmanship of cable by the following method –

At the work of the manufacture, the cable shall be transferred from one drum to another for checking any manufacturing defects in the cable drum selected for conducting acceptance tests, at the same time measuring its length with the help of pulley & cyclometer graduated in presence of inspector. The difference in the measured length thus obtained from the declared length by the Contractor/Manufacturer in the packing list shall be applied to all the drums if the cable is found short during checking the sample lot (s).

The Contractor/Manufacturer shall present the latest Calibration Certificate(s) of testing instruments / equipment to be used for the testing of the material covered in the Purchase Order to the authorized inspecting officer / inspecting agency of the Employer. The testing instruments I meters /apparatus etc. should be got calibrated by the Contractor/Manufacturer from time to time from an independent testing laboratory I house having valid accreditation from National Accreditation Board for testing and calibrating laboratories for the testing equipment or from original manufacturers having traceability to NABL /NPL. The calibration certificate(s) should not in any case be older than one year at the time of presenting the same to the inspecting officer I inspecting agency of the Employer. The testing instruments I equipment should be duly sealed by the Calibrating Agency and mention thereof shall be indicated in the calibration certificate(s).

6.3.11 Technical particulars

400V Single Core., two core, three Core, 3. 5 core and four core, XLPE insulated Armoured Power Cables with aluminium conductor for earthed systems –

a. Continuous current rating

Nominal cross-sectional area of conductor (mm^2)	Continuous current rating for Three core (A)		Continuous current rating for single core (A)		Continuous current rating for two core cables (A)	
	In ground	In air	In ground	In air	In ground	In air
10	57	53	59	57	57	53
16	78	70	76	73	78	70
35	116	117	117	140	116	117
50	140	140	138	170	140	140
95	200	221	204	255	200	221
120	225	258	230	300	225	258
150	255	294	265	342	255	294
185	285	339	295	335	285	335
240	325	402	340	450	325	402
300	370	460	390	519	370	461
400	435	542	450	605	435	542
500	481	624	500	700	481	624
630	537	723	555	809	537	723

Nominal cross-sectional area of conductor (sq. mm)	Continuous current rating for 3.5 core (Amp)		Continuous current rating for two core cables (Amp)	
	In ground	In air	In ground	In air
35	116	117	116	117
50	140	140	140	140
95	200	221	200	221
120	225	258	225	258
150	255	294	255	294
185	285	339	285	339
240	325	402	325	402
300	370	461	370	460
400	435	542	435	542
500	481	624	481	624
630	537	723	537	723

- Depth of laying: 900 mm
- Ambient Air temp: 40°C
- Ground Temp: 30°C
- Thermal resistivity of soil: 150 deg. C cm/w
- While designing overall system suitable derating factor shall be take into account as per the site condition

b. Single core armoured cables - dimensional details

Nominal area of conductor (sq.mm)	Nominal thickness of insulation (mm)	Minimum thickness of outer sheath (mm)
35	1.2	1.24
50	1.3	1.24
95	1.4	1.40
120	1.5	1.40
150	1.7	1.40
185	1.9	1.40
240	2.0	1.40
300	2.2	1.56
400	2.4	1.56
500	2.6	1.56
630	2.8	1.72

c. Two core armoured cables - dimensional details

Nominal area of conductor (sq.mm)	Nominal thickness of insulation (mm)	Minimum thickness of inner sheath (mm)	Minimum thickness of outer sheath (mm)
10	0.70	0.3	1.24
16	0.70	0.3	1.40
35	0.90	0.3	1.40
50	1.00	0.3	1.40
95	1.10	0.4	1.56
120	1.20	0.4	1.56
150	1.40	0.5	1.72
185	1.60	0.5	1.88
240	1.70	0.5	2,04
300	1.80	0.6	2.20
400	2.00	0.7	2.36
500	2.20	0.7	2.68
630	2.40	0.7	2.84

d. Three core armoured cables - dimensional details

Nominal area of conductor (sq.mm)	Nominal thickness of insulation (mm)	Minimum thickness of inner sheath (mm)	Minimum thickness of outer sheath (mm)
35	0.90	0.3	1.40
50	1.00	0.3	1.40
95	1.10	0.4	1.56
120	1.20	0.4	1.56
150	1.40	0.5	1.72
185	1.60	0.5	1.88
240	1.70	0.6	2,20

Nominal area of conductor (sq.mm)	Nominal thickness of insulation (mm)	Minimum thickness of inner sheath (mm)	Minimum thickness of outer sheath (mm)
300	1.80	0.6	2.20
400	2.00	0.7	2.52
500	2.20	0.7	2.68
630	2.40	0.7	2.84

e. Three and Half core armoured cables

Nominal area of conductor (sq.mm)	Nominal thickness of insulation (mm)	Minimum thickness of inner sheath (mm)	Minimum thickness of outer sheath (mm)
35	0.90	0.3	1.40
50	1.00	0.3	1.40
95	1.10	0.4	1.56
120	1.20	0.4	1.72
150	1.40	0.5	1.72
185	1.60	0.5	1.88
240	1.70	0.6	2,20
300	1.80	0.6	2.20
400	2.00	0.7	2.52
500	2.20	0.7	2.68
630	2.40	0.7	3.00

f. Four core armoured cables

Nominal area of conductor (sq.mm)	Nominal thickness of insulation (mm)	Minimum thickness of inner sheath (mm)	Minimum thickness of outer sheath (mm)
16	0.70	0.3	1.40
25	0.90	0.3	1.40
35	0.90	0.3	1.40
50	1.00	0.3	1.40
95	1.10	0.4	1.56
120	1.20	0.5	1.72
150	1.40	0.5	1.88
185	1.60	0.5	2.04
240	1.70	0.6	2.36
300	1.80	0.7	2.36
400	2.00	0.7	2.68
500	2.20	0.7	2.84
630	2.40	0.7	3.00

g. Conductor resistance and Short Circuit Current Carrying Capacity (common for 1C and 3C& 3.5C)

Nominal area of conductor (sq.mm)	Maximum DC resistance at 20°C (Ohms/ km)	Short Circuit current for conductor (kA/ sec)
35	1.2000	2.35
35	0.8680	3.29
50	0.6410	4.70
95	0.3200	8.93
120	0.2530	11.28
150	0.2060	14.10
185	0.1640	17.39
240	0.1250	22.56
300	0.1000	28.20
400	0.0778	37.60
500	0.0605	47.00
630	0.0469	59.22

h. General requirements

S.N.	Description	Unit	Requirement
1	Voltage grade		1.1 kV
2	System Voltage		415 V
3	Type of cable		Aluminium conductor, XLPE insulated, PVC inner sheath, Round GI wire armored cables and PVC outer sheathed cables
4	Material of conductor		Stranded compacted circular Aluminium conductor
5	Conductor		H2 / H4 grade Aluminum conductor
6	Insulation		XLPE insulation
7	Inner sheath		PVC Compound Type ST2
8	Armour		Galvanized steel wire
9	Outer sheath		PVC Compound Type ST2
10	Standard length of cable drum with tolerance	M	500 ± 5 %

A	Size of cable	mm²	2C 10	2 C 16	2C 25	2C 50	4Cx25	4Cx50	4Cx95	4Cx150
1	Conductor									
a	No. of cores	Nos.	2	2	2	2	4	4	4	4
b	Maximum DC resistance of conductor at 20°C	Ω / km	3.080	1.910	1.200	0.641	1.200	0.641	0.320	0.206
c	Short circuit capacity for one second	kA	0.94	1.50	2.35	4.70	2.35	4.70	8.93	14.1
d	Continuous current rating at 40°C	Amp	67	88	117	176	96	142	221	292
e	Minimum number of wires in the conductor	Nos.	7	6	6	6	6	6	15	15
f	Shape of conductor		Non-compacted	Stranded Compacted Circular or shaped			Stranded compacted circular			
2	Insulation		2C 10	2 C 16	2C 25	2C 50				
a	Nominal thickness	mm	0.7	0.7	0.9	1.0	0.9	1.0	1.1	1.4
b	Minimum thickness	mm	0.55	0.55	0.75	0.80	0.75	0.80	0.90	1.20
3	Inner sheath		2C 10	2 C 16	2C 25	2C 50				
a	Type		Pressurized Extruded				Extruded			
b	Minimum thickness (at any point)	mm	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.5
4	Armour									
a	Type of armour		GI wire							
b	Nominal diameter	mm	1.4	1.4	1.6	1.6	1.60	1.60	2.00	2.50
c	Tolerance	mm	± 0.040	± 0.045	± 0.045	± 0.045	±0.045	±0.045	±0.050	±0.065
d	No. of wires	Nos.	Total numbers shall be such that these are closely laid over inner sheath with a gap of less than the diameter of single wire in between the interstices							
e	Type of Zinc coating		Medium							
f	Mass of Zinc coating	gtm	95	95	95	95	95	95	105	110
g	Number of dips		1 dip in 1 minute							
5	Outer Sheath									
a	Minimum thickness (at any point)	Mm	1.24	1.40	1.40	1.40	1.40	1.56	1.72	2.04

6.4 Standard specification of Hardware for LT Aerial Bunched Cables

The Specification covers the design, manufacture, testing before dispatch, supply and delivery of hardware and accessories of 1100 V Aerial Bundled Conductors (ABC) having XLPE insulated, stranded compact circular aluminium conductors twisted over an XLPE insulated aluminium alloy Neutral cum messenger wire for use as overhead distribution feeders suitable for use on 3-phase AC System conforming to IS-14255/1995 with up to date amendments (or equivalent standard).

6.4.1 Standards

The design, performance and test requirements shall confirm to this specification and the following standards. However, in case of any conflict, the requirements of this specification shall prevail.

a. NFC 33-040 Suspension Equipment

b. NFC 33-041 Anchoring Devices

c. NFC 33-003 Corrosion Resistance

d. NFC 20-540 Climatic Ageing

e. NFC 33-004 Electrical Ageing Test

The material shall also be compatible with the cables of sizes & dimensions as defined in the Cable Specifications for the cables with which they are intended to be used, and this specification.

For all accessories, the qualification test shall be carried out in an internationally recognized ISO/IEC 17025 certified independent test laboratory accredited to ILAC/IAF and scope of accreditation certificate for the respective standard needs to be submitted along with the tender for technical evaluation.

6.4.2 Description

The specifications mentioned below are indicative. Tenderer shall furnish the dimensional details for each accessory supported by brochures, manuals etc. of its standard product.

a. Suspension Assembly for Insulated Neutral cum Messenger (SA)

i. General

It is required for supporting a length of ABC at an intermediate pole in a length, with small angle of deviation.

It shall consist of one suspension clamp, one aluminium alloy pole bracket, stainless steel strap of 1.5 m with two buckles for 50% of SA and 16 mm galvanized steel bolt for remaining SA for fixing the pole brackets.

ii. Technical Requirement

The clamp should be designed to hang L.T. AB cable 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. There shall not be any losable part in the process of clamping arrangement.

The clamp and the link made of Polymer should provide an additional insulation between the cable and the pole. The clamps and movable links should be made of weather and UV resistant glass fiber reinforced polymer.

Clamps should be fixed with pole by eye hook / bracket. Bracket shall be

made of corrosion resistant aluminium alloy. Ultimate tensile strength of the clamp should not be less than 16 KN for 70-95 sq.mm insulated messenger wire and 12 KN for 25-54 sq.mm insulated messenger wire.

Suspension Assembly is used for supporting an ABC by installation on the messenger at an intermediate point of support such as a pole. It can accommodate small angles of deviation up to 30°.

Each Suspension Assembly shall consist of:

- One number Suspension Bracket.
- One number moveable (articulated) connecting link.
- One number Suspension Clamp.

Suspension Assemblies shall be supplied in sets to ensure compatibility of the materials against corrosion or wear of rotating/moving parts.

iii. Suspension Bracket of SA

The Suspension Bracket shall be made from single piece aluminium alloy suitable for attachment to a pole by either.

- 16 mm galvanized steel bolt(s).
- Two stainless steel straps of 20 x 0.7 mm.

The Suspension Bracket shall be provided with an upper bulge to prevent the clamp from turning over on the Bracket for more than 45° from the horizontal or to within less than 60 mm from the pole / fixing structure.

The Suspension Bracket should be so designed to ensure that the articulated link cannot slip out of it.

Suspension Brackets shall be designed to withstand a load applied at the anchoring point of the movable link as per table below without deformation of more than 10 mm or breakdown at 33O below horizontal (there should be no longitudinal component of load parallel to the plane of fixing).

Conductor Size		Normal rating (kg)	Load (N)
Sq.mm.	Diameter (mm)		
25-50	8-15	1,500	12,000
70-95	13-17	2,000	15,000

iv. Movable (Articulated) Link of SA

Movable Links are used between the Suspension Bracket and Suspension Clamp to allow a degree of movement and flexibility between the two.

Moveable Links should be made fully of insulating type of mechanical and weather resistant thermoplastic. A metallic wear resistant ring should however be fitted at point of contact between the Suspension Bracket and the movable link.

The Movable link should be unloosably fitted to the Bracket and the Clamp.

v. Suspension Clamp of SA

Suspension Clamps are used for locking the messenger of the ABC bundle without damaging the insulation or allowing the messenger to become dismounted from the fitting.

The Suspension Clamp shall accommodate messenger wires from 25 to 95 sq.mm. The Suspension Clamp shall be made fully of insulating type of mechanically strong and weather resistant plastic. There shall be no metal parts/pin inside the clamp. Bolts should not be used for clamping / locking the messenger in the Clamp. There shall be no losable parts in the Suspension clamp.

The Suspension Clamp should be un-loosely fitted to the rest of the Suspension Assembly. The suspension clamp shall be self-tightening and capable of holding without slippage the load specified in the table below.

Conductor Size		Rating (kg)	T start (1 minute) (Newton)	T final (1 minute) (Newton)
Sq.mm.	Dia. (mm)			
25-50	8-15	1,500	9,600	12,000
70-95	13-17	2,000	12,800	16,000

vi. Drawing

The tenderer shall furnish along with the bid the outline drawing of the assemblies together with hardware fittings all complete. The General Arrangement Diagrams and Drawings are provided in the specification.

vii. Marking

Each clamp shall be legibly and indelibly marked to show the following.

- Name & Trade mark of the manufacturer
- Month & Year of manufacturing
- Minimum Failing Load (in kN)
- "Contract No" marking

viii. Testing Requirements

After the mass production, Acceptance Test as per the relevant standards shall be carried out from an internationally recognized ISO/IEC 17025 certified independent test laboratory accredited to ILAC/IAF.

The following tests as per the standard are intended to establish performance Characteristics of Suspension Assembly and categorized:

S. No.	Test	Type Test	Acceptance Test	Routine Test
1	Visual		☑	☑
2	Dimensional	☑	☑	☑
3	Mechanical and Slip Strength Test	☑	☑	☑
4	Mechanical Strength of Bracket & SS Strap with Buckle	☑	☑	☑
5	Voltage Test	☑	☑	
6	Corrosion Test	☑		
7	Climatic Ageing Test	☑		

b. Anchoring Assembly for Insulated Neutral cum Messenger (AA)

i. General

It is used for fitting onto a pole for anchoring the end of a length of ABC, or for a major change in direction. It shall consist of one wedge type anchoring clamp, one aluminium alloy pole bracket, stainless steel strap of 1.5 m with two buckles for 50% of AA and 16 mm galvanized steel bolt(s) for remaining AA for fixing the pole brackets.

ii. Technical Requirement

The clamp should consist of an Aluminium alloy corrosion resistant castled body, bail of stainless steel and self-adjusting plastic wedges which shall anchor/hold the neutral messenger without damaging the insulation. There shall not be any losable part in the process of clamping arrangement.

The clamp body should be made of corrosion resistant Aluminium alloy, bail should be of stainless steel and wedges should be self-adjusting weather and UV resistant polymer.

Ultimate tensile strength of the clamp should not be less than 15 KN for 50-70 sq.mm insulated messenger wire, 15 KN for 50-54 sq.mm and 10 KN for 25-35 sq.mm insulated messenger wire. Anchoring assemblies are used to firmly attach the messenger of ABC to a support and transmit the mechanical tension.

- at the end of a run or to the supporting structures
- at a major change in direction.

Each Anchoring Assembly shall include.

- One number tension bracket.
- One number wedge type tension clamp
- Flexible Rope for fixing tension clamp to bracket.

Anchoring assemblies shall be supplied in sets to ensure compatibility of the materials against corrosion or wear of moving parts.

iii. Tension Bracket of AA

The tension bracket shall be made out of a single piece of Aluminium alloy suitable for attachment to a pole either by

- 16 mm galvanized steel bolt (s).
- Two stainless Steel straps of 20 x 0.7 mm.

The tension bracket should be designed to ensure the Flexible rope cannot slip out at any angle.

The tension bracket should be rated and tested for the loads specified in table below. The load shall be applied at an angle of 45° from the normal to the surface of mounting of the bracket.

Conductor Size (Sq.mm.)	Rating	Load for deformation <10mm (Newton)	Load for deformation <30mm & no-break (Newton)
25-35	1500 Kg	12,000	15,000
70-95	1500 Kg	12,000	15,000

iv. Flexible Rope of AA

The Anchoring assembly shall be supplied with a stainless-steel flexible Rope to connect the Tension Clamp to the Tension Bracket. The rope should have sufficient flexibility to ease the torsional movement of the ABC System. The Rope should be pre-fitted with compression type end fittings to secure the tension clamp.

A wear resistant moveable saddle should be un-loosely fitted on the Rope to prevent abrasion at the point of fitting into the tension bracket.

The Rope should have sufficient mechanical strength to withstand the mechanical test for the complete assembly tests in this specification.

v. Wedge Type Tension Clamp of AA

Wedge type clamps shall be used for clamping the messenger without damaging the insulation. The clamp shall be capable of clamping an uncut messenger so that it can continue without break to the connecting point or next span.

The clamp shall be fully insulating type of mechanical and weather resisting thermoplastic. No bolts or loose parts are allowed as part of the Clamping system. No tools shall be needed for fitting the messenger into the clamp.

The clamp shall be self-tightening and capable of holding without slippage the load specified in the table below.

Conductor Size		Rating (kg)	T start (1 minute) (Newton)	T final (1 minute) (Newton)
Sq.mm.	Dia. (mm)			
25-35	8-11	1,000	8,000	10,000
50-54	8-11	1,500	12,000	15,000
70-95	13.5-16	2,000	16,000	20,000

After fitting the insulated messenger in the clamp, load T start will be held for 1 minute & then load increased to T final at rate between 5000 ± 7,500 N/m. In each case there shall be no breakdown of any part of clamp and slippage of messenger in relation to the clamp.

vi. Drawing

The tenderer shall furnish along with the bid the outline drawing of the assemblies together with hardware fittings all complete. The General Arrangement Diagrams and Drawings are provided in this specification.

vii. Marking

Each clamp shall be legibly and indelibly marked to show the following.

- Name & Trade mark of the manufacturer
- Month & Year of manufacturing
- Minimum Failing Load (in kN)
- "Contract No" marking

viii. Testing Requirements

After the mass production, the Acceptance Test as per the relevant standards shall be carried out from an internationally recognized ISO/IEC 17025 certified independent test laboratory accredited to ILAC/IAF

The following tests as per standard are intended to establish performance Characteristics of Anchoring Assembly and categorized:

S. No.	Test	Type	Acceptance	Routine
1	Visual		☑	☑
2	Dimensional	☑	☑	☑
3	Mechanical and Slip Strength Test	☑	☑	☑
4	Mechanical Strength of Bracket & SS Strap with Buckle	☑	☑	☑
5	Voltage Test	☑	☑	
6	Corrosion Test	☑		
7	Climatic Ageing Test	☑		

c. Straight-Through Jointing and Accessories

i. Straight-through Jointing for phase core

The straight through joint shall be suitable to connect at the end of one drum of the cable/part of cable (3-phase core) to continue the drawing of the cable from other drum. It shall be mid-span inline straight through joints. The straight through joint shall be supplied with suitable mechanical connector, proper stress control, adequate insulation and sufficient environmental sealing.

The straight through joint shall be of heat shrinkable dual wall tube with extruded insulation and semiconducting layers.

The straight through joint shall be provided with complete accessories and pole mounting necessary for fixing it to the 8 m – 11 m steel tubular / concrete poles.

The Sleeves shall be made of Aluminum, insulated with an Anti-UP black thermoplastic tube hermetically sealed two ends with 2 flexible rings.

Strip length, hexagonal crimping die reference and size shall be marked on the outer surface of plastic sleeve.

ii. Straight-through Jointing for neutral cum messenger wire

The jointing sleeve shall be suitable to connect insulated neutral cum messenger wire at the end of one drum of the cable/part of cable to continue the drawing of the cable from other drum. The joint shall afford the whole load of ABC and shall be designed to have the full rate breaking strength of the alloy on which they are fitted. The straight through joint shall be supplied with suitable mechanical connector, proper stress control, adequate insulation and sufficient environmental sealing.

The straight through joint shall be of dual wall tube with extruded insulation and semiconducting layers.

The straight through joint shall be provided with complete accessories and pole mounting necessary for fixing it to the 8 m – 11 m steel tubular / concrete poles. The Sleeves shall be made of Aluminum, insulated with an Anti-UP black thermoplastic tube hermetically sealed two ends with 2 flexible rings.

Strip length, hexagonal crimping die reference and size shall be marked on the outer surface of plastic sleeve.

After the mass production, the Acceptance Test as per the relevant standards shall be carried out from an internationally recognized ISO/IEC 17025 certified independent test laboratory accredited to ILAC/IAF

The following tests as per the standard are intended to establish performance Characteristics of Suspension Assembly and categorized:

S.N.	Test	Type test	Acceptance Test	Routine test
1.	Visual examination	☑	☑	☑
2.	Dimensional verification	☑	☑	☑
3.	Voltage and Water Tightness Test	☑	☑	☑
4.	Mechanical tests	☑	☑	☑
5.	Corrosion test	☑		
6.	Climate ageing test	☑		
7.	Electrical Ageing Test	☑		
8.	Check for permanent marking	☑	☑	☑

iii. Heat Shrinkable End Cap

The Insulated End Cap with sealant shall be suitable for effectively sealing the end terminal of the AB conductor. The inner diameter range of the cap shall be such that it shall tightly fit to the covered conductors to prevent entry of moisture.

iv. Stainless Steel Straps

Stainless steel strap should be of size width 20mm ± 0.2 and thickness 0.7mm ± 0.05 mm and shall have a tensile strength of 7.5 kN min., elongation 30% min, finish 2B.

The stainless-steel material shall be of high mechanical strength, corrosion and wear resistant as per ASTM SS 202 or equivalent.

Tensile strength of strap is to be min 7.5 kN to be tested on a loop with buckle. Number of loops for mounting the bracket on pole to be allocated as per load requirement for dead-end and suspension clamp specified in this specification.

The SS Strap should be engraved with the name of the Manufacturer, the date of manufacturing and length at a distance of approximately 250 mm.

Stainless steel straps to be supplied as a roll of 50 meters in a plastic dispensable case for easy handling.

v. Stainless Steel Buckles

Stainless steel buckles are to be made of SS 304 to suit above said strap and shall be used to tension & fix it. It should have a slot width of not less than 20.5 mm x 1.5 mm.

Stainless Steel buckles are to be supplied in bags of 100 Nos.

6.4.3 Quality Assurance Program

Along with the Bid the Tenderer 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.

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 tests 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;

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.

Volume II

Section 4: Tender Forms

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B2	Technical Data Schedule

Technical Data Schedule shall be submitted along with Technical Proposal

Name of Tenderer _____

Signature of Tenderer _____

Volume II

Section 4: Tender Forms

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Name of Tenderer _____

Signature of Tenderer _____

Nepal Electricity Authority

Distribution and Consumer Services Directorate

Distribution System Upgrade and Expansion Project

Technical Data Sheet

To be filled separately for each equipment and manufacturers; Employer's Requirement are subjected to variation as per altitude of installation and climatic condition. The site specific requirement shall be understood after incorporating Altitude Correction Factor as per IEC Standard.

S.N.	Description	Unit	Employer's Requirement	Bid Offer
A1	**Steel Tubular Pole and Accessories**			
1	**General**			
	Manufacturer			
	Country of Origin			
	Years of Manufacturing Experience			
	Applicable standard			
	Type			
2	**Steel Lattice Tower**		For use in Special Cases	
	Manufacturer			
	Country of Origin			
	Years of Manufacturing Experience			
	Applicable Standard for Steel			
	Are the poles fully Galvanized?	yes/no	Yes	
	Applicable Standard for Galvanization		EN ISO 1461 or IS:4736 or an equivalent international standard	
	Overall Length	m		
	Design span or normal ruling span of Towers	m	350	
	Wind span and weight span of Conductor		1.5 times of Span	
	Design Working Load	kg		
	Factor of Safety		2	
	Minimum Breaking Load	kg		
	Overall Height	m		

Name of Tenderer _____

Signature of Tenderer _____

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Center to center between 2 tower legs	M		
	Tower width at Ground Level	M		
	Maximum width of tower(Foundation width per leg)	M		
	Wind zone	4	4, 5; As per IS 802	
	Circuit on Towers		Single or double	
	Angle of Deviation		As per site condition	
	Phase to Phase Clearance - Horizontal	m	2.75	
	Phase to Phase Clearance - Vertical	m	1.75	
	Insulator Types		Disc	
	Conductor		ACSR DOG/ ACSR WOLF	
	Complete Earthing set as per specification provided	yes/no	yes	
3	**Steel Tubular Pole**			
	Manufacturer			
	Country of Origin			
	Years of Manufacturing Experience			
	Reference Standard		IS 2713	
	Pole Designation (as per IS 2713)		410 SP-52, 410 SP-13, as required (available in IS 2713)	

Name of Tenderer _____

Signature of Tenderer _____

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Length of Poles	m	9, 10, 11, 12, 13, 14.5	
	Are the poles fully Galvanized?	yes/no	Yes	
	Applicable Standard for Galvanization		ISO 1461 or IS:4736 or an equivalent international standard	
	Approximate Weight (excluding the weight of galvanization, base plate and pole cap)	kg	As per IS 2713	
	Planting Depth	m	As per Drawings	
4	**Steel Cross Arm Channel and Angle Braces**		To be completed for all types of components	
	Manufacturer			
	Country of Origin			
	Reference Standard		IS: 2062-2011 and IS 808 -1989	
	Dimensions		Adhering to Drawings and Detail Design by Contractor	
	Is the cross arm and angles fabricated from hot-rolled steel sections?	yes/no	Yes	
5	**Pole Clamps, Steel Bolts and Nuts**			
	Manufacturer			
	Country of Origin			

Name of Tenderer _____

Signature of Tenderer _____

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To be filled separately for each equipment and manufacturers; Employer's Requirement are subjected to variation as per altitude of installation and climatic condition. The site specific requirement shall be understood after incorporating Altitude Correction Factor as per IEC Standard.

S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Reference Standard		IS: 2062-2011 and IS 808 -1989	
	Dimensions		Adhering to Drawings and Detail Design by Contractor and as required on the location of the Poles	
	Is the cross arm and angles fabricated from hot-rolled steel sections?	yes/no	Yes	
6	**Information to be Submitted with the Tender**			
	Layout and dimension drawings showing the main dimensions and physical arrangement of major components with detailed descriptions and leaflets shall be submitted for:			
	ISO 9001 (including design) holder	yes/no	yes	
	ISO 9001 certificate submitted	yes/no	yes	
	Type test certificate submitted	yes/no	yes	
	Submitted for the required ratings	yes/no		
	Type test certified by			
	User's certificate submitted	yes/no	yes	
	Has exported to third country	yes/no	yes	
	Copies of relevant standards attached	yes/no	yes	
	Outline Drawings and associated GA attached	yes/no	yes	

Name of Tenderer _____

Signature of Tenderer _____

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To be filled separately for each equipment and manufacturers; Employer's Requirement are subjected to variation as per altitude of installation and climatic condition. The site specific requirement shall be understood after incorporating Altitude Correction Factor as per IEC Standard.

S.N.	Description	Unit	Employer's Requirement	Bid Offer
7	**Informative Data, To be filled separately for each equipment**			
	Manufacturer			
	Place of manufacturing			
	Dimension (W x D x H)	mm		
	Weight	kg		
	Shipping Data			
	Weight of heaviest package	kg		
	Dimension of largest package (W x D x H)	mm		

Name of Tenderer _____

Signature of Tenderer _____

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To be filled separately for each equipment and manufacturers; Employer's Requirement are subjected to variation as per altitude of installation and climatic condition. The site specific requirement shall be understood after incorporating Altitude Correction Factor as per IEC Standard.

S.N.	Description	Unit	Employer's Requirement	Bid Offer
A2	**PSC Pole and Accessories**			
1	**General**			
	Manufacturer			
	Country of Origin			
	Years of Manufacturing Experience			
	Applicable standard			
	Type			
2	**PSC Poles**			
	Manufacturer			
	Country of Origin			
	Years of Manufacturing Experience			
	Governing Standard		IS 1678, ISO 6734, IS 1785	
	Length of PSC Pole			
	Approximate Weight of the Pole			
	Dimensions			
	Top Width			
	Bottom Width			
	Pole Thickness			
	Working Load			
	Ultimate Load			
	Concrete Grade		M40	
	Pre-Stressing wire			
	Governing Standard		IS 1785	
	Diameter	mm	7.9 mm (7/2.6mm)	
	No. of Tensioned Wire			
	No. of Stirrups		12	
	Cement specifications			
	Make			
	Grade			

Name of Tenderer _____

Signature of Tenderer _____

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To be filled separately for each equipment and manufacturers; Employer's Requirement are subjected to variation as per altitude of installation and climatic condition. The site specific requirement shall be understood after incorporating Altitude Correction Factor as per IEC Standard.

S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Is Nepal Standard Certified?	yes/no	yes	
	Concrete quantity per pole			
	Steel quantity per pole			
	Planting Depth		Adhering to Drawings and Detail Design by Contractor	
3	**Steel Cross Arm Channel and Angle Braces**		To be completed for all types of components	
	Manufacturer			
	Country of Origin			
	Reference Standard		IS: 226-1975 and IS 808 -1964	
	Dimensions		Adhering to Drawings and Detail Design by Contractor	
	Is the cross arm and angles fabricated from hot-rolled steel sections?	yes/no	Yes	
		yes/no		
4	**Pole Clamps, Steel Bolts and Nuts**			
	Manufacturer			
	Country of Origin			
	Reference Standard		IS: 2062-2011 and IS 808 -1989	

Name of Tenderer _____

Signature of Tenderer _____

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To be filled separately for each equipment and manufacturers; Employer's Requirement are subjected to variation as per altitude of installation and climatic condition. The site specific requirement shall be understood after incorporating Altitude Correction Factor as per IEC Standard.

S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Dimensions		Adhering to Drawings and Detail Design by Contractor and as required on the location of the Poles	
	Is the cross arm and angles fabricated from hot-rolled steel sections?	yes/no	Yes	
5	**Information to be Submitted with the Tender**			
	Layout and dimension drawings showing the main dimensions and physical arrangement of major components with detailed descriptions and leaflets shall be submitted for:			
	ISO 9001 (including design) holder	yes/no	yes	
	ISO 9001 certificate submitted	yes/no	yes	
	Type test certificate submitted	yes/no	yes	
	Submitted for the required ratings	yes/no		
	Type test certified by			
	User's certificate submitted	yes/no	yes	
	Has exported to third country	yes/no	yes	
	Copies of relevant standards attached	yes/no	yes	
	Outline Drawings and associated GA attached	yes/no	yes	
6	**Informative Data, To be filled separately for each equipment**			
	Manufacturer			

Name of Tenderer _____

Signature of Tenderer _____

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Technical Data Sheet

To be filled separately for each equipment and manufacturers; Employer's Requirement are subjected to variation as per altitude of installation and climatic condition. The site specific requirement shall be understood after incorporating Altitude Correction Factor as per IEC Standard.

S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Place of manufacturing			
	Dimension (W x D x H)	mm		
	Weight	kg		
	Shipping Data			
	Weight of heaviest package	kg		
	Dimension of largest package (W x D x H)	mm		

Name of Tenderer _____

Signature of Tenderer _____

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To be filled separately for each equipment and manufacturers; Employer's Requirement are subjected to variation as per altitude of installation and climatic condition. The site specific requirement shall be understood after incorporating Altitude Correction Factor as per IEC Standard.

S.N.	Description	Unit	Employer's Requirement	Bid Offer
A3	**MVCC and Hardware**			
1	**General**			
	Manufacturer			
	Country of Origin			
	Years of Manufacturing Experience			
	Applicable standard			
	Type			
2	**Medium Voltage Covered Conductor**			
	Manufacturer's Name & Address			
	List of Standard Applicable		En 50397-1: 2006	
	Rated Voltage, ≥ 11 kV			
	Conductors			
	a. Material		All Almunium Alloy	
	b. Actual Area (mm2)	sq. mm	55/100/150	
	c. Stranding & wire diameter (Nos / mm)			
	d. Approximate overall diameter (mm)			
	e. Approximate weight (kg/km)			
	f. Maximum Calculated D.C. resistance at 20°C (Ω/km)		As per Standard	
	g. Approximate calculated breaking load (kN)			
	h. Reactance per km (Ω/km)			
	i. Current Rating (Amps)			
	j. Lay ratio			
	k. Direction of lay			
	Wire (strand) used in the construction of conductors			
	a. Nominal Diameter (mm)			

Name of Tenderer _____

Signature of Tenderer _____

Nepal Electricity Authority

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Distribution System Upgrade and Expansion Project

Technical Data Sheet

To be filled separately for each equipment and manufacturers; Employer's Requirement are subjected to variation as per altitude of installation and climatic condition. The site specific requirement shall be understood after incorporating Altitude Correction Factor as per IEC Standard.

S.N.	Description	Unit	Employer's Requirement	Bid Offer
	b. Maximum Diameter (mm)			
	c. Cross-section area of nominal diameter wire (mm2)			
	d. Weight (kg/km)			
	e. Maximum Calculated D.C. resistance at 20°C (Ω/km)			
	f. Minimum breaking load after stranding (kN)			
	Insulation (Semi-conduction screen)			
	a. Material			
	Insulation (Inner layer)			
	a. Material			
	b. Nominal thickness (mm)			
	c. Carbon Content (%)			
	Insulation (Outer layer)			
	a. Material			
	b. Nominal thickness (mm)	mm		
	c. Carbon Content (%)	%		
	Combined insulation i.e. both layers	yes/no		
	a. Minimum thickness			
	b. Min. Tensile strength of insulation (N/mm2)			
	c. Elongation (min)			
	d. Volume resistivity			
	i. At room temperature of 27 °C (Ω-cm)			
	ii. At 70°C (Ω-cm)			
	e. Hot set			
	i. Max. Elongation under load (%)			
	ii. Max. Permanent elongation (%)			

Name of Tenderer _____

Signature of Tenderer _____

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	f. High Voltage water immersion Test (4 kV AC for 5 minutes)			
	Covered Conductor			
	a. Minimum Breaking Strength (kN)			
	b. Short time current rating: 1 sec (kA)			
	c. Maximum conductor operating temperature			
	i. Continuous operation (°C)			
	ii. Emergency operation (°C)			
	iii. Short circuit operation; 5 sec (°C)			
	d. Overall diameter (mm)			
	e. Approximate weight of complete cable (kg/km)			
	f. Maximum DC resistance of conductor at 20 °C (Ω/km)			
	h. Reactance per km (Ω/km)			
	Size of cable drum			
	Approximate Length of conductor per drum (km ± %)			
3	**Tension/Anchoring Assembly**			
	Name of Supplier			
	Standards			
	Type of Design			
	Weight			
	Cable Range			
	50 sq mm cable	mm	Φ13-16 mm	
	100 sq mm cable	mm	Φ17-19 mm	
	150 sq mm cable	mm		
	Material			
	Ultimate Tensile Strength			

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	50 sq mm cable	kN	20	
	100 sq mm cable	kN	30	
	150 sq mm cable	kN		
	Installation (with/without disassembly)		Ready to use (without disassembling)	
	Marking			
	Dimensions			
4	**Polymeric Cable Ties**			
	Name of Supplier			
	Standards			
	Length			
	Weight			
	Cable Range		50 mm2 cable (Φ13-16 mm); 100 mm2 cable (Φ17-19 mm)	
	Material			
	Installation (with/without disassembly)		Ready to use (without disassembling)	
	Marking			
5	**IPC**			
	Name of Supplier			
	Standards			
	Type of IPC		Type – 1: Bare to Covered Conductor	
			Type – 2: Covered to Covered Conductor	
			Type – 3: Tapping Connector	

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Are torque limiting shear heads provided to tightening bolts?		Yes	
	Tightening Torque			
	Torque for establishing connection between main and Tap (Nm)		70% of minimum torque specified	
	Cable Range		50 mm2 cable (Φ13-16 mm)	
			100 mm2 cable (Φ17-19 mm)	
	Marking			
6	**Straight-through Jointing**			
	Name of Supplier			
	Type No			
	Size Range		50 mm2 cable (Φ13-16 mm)	
			100 mm2 cable (Φ17-19 mm)	
	Is any metallic part carrying potential in operation exposed during installation?		No	
	Installation		Crimping by Hexagonal Compression	
7	**Information to be Submitted with the Tender**			
	Layout and dimension drawings showing the main dimensions and physical arrangement of major components with detailed descriptions and leaflets shall be submitted for:			

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	ISO 9001 (including design) holder	yes/no	yes	
	ISO 9001 certificate submitted	yes/no	yes	
	Type test certificate submitted	yes/no	yes	
	Submitted for the required ratings	yes/no		
	Type test certified by			
	User's certificate submitted	yes/no	yes	
	Has exported to third country	yes/no	yes	
	Copies of relevant standards attached	yes/no	yes	
	Outline Drawings and associated GA attached	yes/no	yes	
8	**Informative Data, To be filled separately for each equipment**			
	Manufacturer			
	Place of manufacturing			
	Dimension (W x D x H)	mm		
	Weight	kg		
	Shipping Data			
	Weight of heaviest package	kg		
	Dimension of largest package (W x D x H)	mm		

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
A4	**Insulators**			
1	**Pin Insulator**			
	Manufacturer			
	Country of Origin			
	Years of Manufacturing Experience			
	Model No.			
	Applicable Standards		IS 731-1971, IS 2486, IEC 60815	
	Marking as per specifications	yes/no	Yes	
	Highest system voltage	kV	12	
	Rated voltage	kV	11	
	Creepage distance (minimum)	mm		
	Wet power frequency withstand voltage	kV		
	Impulse withstand voltage	kV		
	Puncture power frequency voltage (minimum)	kV		
	Visible discharge voltage (Effective)	kV		
	Cantilever strength	kN		
	GI pin head		Small S165P or Large	
2	**Disc Insulator**			
	Manufacturer			
	Country of Origin			
	Years of Manufacturing Experience			
	Model No.			
	Applicable Standards		IS 731-1971, IS 2486, IEC 60815	
	Marking as per specifications	yes/no	Yes	
	Highest system Voltage	kV	12	

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Rated Voltage	kV	11	
	Porcelain Diameter (minimum)	mm		
	Spacing	mm		
	Creepage Distance (minimum)	mm		
	Power Frequency Puncture withstand Voltage			
	Wet Power Frequency Withstand Voltage	kV		
	Impulse Withstand Voltage	kV		
	Puncture Power Frequency Voltage (minimum)	kV		
	Visible Discharge Voltage	kV		
	Mechanical Strength	kN		
	Ball and Socket Size			
	Applicable Standard for Special Characteristics		IS: 3188-1980	
3	**Disc Insulator Fittings**			
	Manufacturer			
	Country of Origin	yes/no		
	Years of Manufacturing Experience			
	Model No.			
	Applicable Standard		IS: 2486	
	Steel Classification		As per specification	
	Ferrous parts are galvanized As per IS 2629 – 1985?	yes/no	Yes	
	Thickness of Galvanizatiioin	micron		
	Cotter Pins are Stainless Steel?	yes/no	Yes	
	Ultimate Strength of Fittings	kN		
4	**Insulator Pins**			

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Manufacturer			
	Country of Origin			
	Years of Manufacturing Experience			
	Model No.			
	Applicable Standard		IS: 2486	
	Type of steel used		Hot rolled steel	
	Head type		Small S165P	
	Total length	mm	315	
	Stalk length	mm	165	
	Shank length	mm	150	
	Minimum failing load	kN	5	
5	**Pin Insulator Tie**			
	Manufacturer			
	Country of Origin			
	Years of Manufacturing Experience			
	Model No.			
	Material Description furnished?	yes/no	yes	
	Aluminum clad steel wire			
	Bidder Certitifies that all items offered are suitable for use with ACSR "DOG" and "WOLF" conductors?	yes/no	yes	
	Bidder Certitifies that all items offered are suitable for use with insulators specified in specifications?	yes/no	yes	
	Holding Rating of Top tie for "DOG"	kg		
	Holding Rating of Double support Top tie for "DOG"	kg		

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Holding Rating of Side tie for "DOG"	kg		
	Holding Rating of Double support Side tie for "DOG"	kg		
	Holding Rating of Top tie for "WOLF"	kg		
	Holding Rating of Double support Top tie for "WOLF"	kg		
	Holding Rating of Side tie for "WOLF"	kg		
	Holding Rating of Double support Side tie for "WOLF""	kg		
6	**Steel Wire Strand Grip**			
	Manufacturer			
	Country of Origin			
	Years of Manufacturing Experience			
	Model No.			
	Material Description furnished?	yes/no	yes	
	Bidder Certitifies that steel strand grip offered is suitable for use with insulator; stay set and stay wire specified in specifications?	yes/no	yes	
	Holding Rating of Grip for 7/8 SWG	kg		
	Holding Rating of Grip for 7/8 SWG	kg		
7	**Shackle Insulators**			
	Manufacturer			
	Catalog/Dimensional drawings		Yes	
	Governing Standards		Yes	

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Copies of Standards Attached:		Yes	
	If not IS Standards, are standards used equivalent?		Yes	
	Copies of alternate standards attached?		Yes	
	Ratings:			
	Highest system Voltage	kV	1	
	Rated Voltage	kV	0.5	
	Power frequency withstand voltage, 1 min			
	Dry	kV	23	
	Wet	kV	10	
	Power Frequency Puncture withstand Voltage, 1 min	kV	1.3xActual dry	
	flashover voltage			
	Leakage distance	mm	65 min.	
	Mechanical Strength	kN	11.5	
	IS Type		1	
	Approximate Weight	kg		
	mandatorily			
8	**Information to be Submitted with the Tender**			
	Layout and dimension drawings showing the main dimensions and physical arrangement of major components with detailed descriptions and leaflets shall be submitted for:			
	ISO 9001 (including design) holder	yes/no	yes	
	ISO 9001 certificate submitted	yes/no	yes	
	Type test certificate submitted	yes/no	yes	
	Submitted for the required ratings	yes/no		

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Type test certified by			
	User's certificate submitted	yes/no	yes	
	Has exported to third country	yes/no	yes	
	Copies of relevant standards attached	yes/no	yes	
	Outline Drawings and associated GA attached	yes/no	yes	
9	**Informative Data, To be filled separately for each equipment**			
	Manufacturer			
	Place of manufacturing			
	Dimension (W x D x H)	mm		
	Weight	kg		
	Shipping Data			
	Weight of heaviest package	kg		
	Dimension of largest package (W x D x H)	mm		

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
A5	**Stays**			
1	**Stay**			
	Manufacturer			
	Country of Origin			
	Years of Manufacturing Experience			
	Model No.			
	Applicable Standards			
	Marking as per specifications	yes/no	Yes	
	Length of stay rod	m	2.44	
	Diameter of stay rod	mm	19	
	Ultimate tensile strength of stay rod and turn-buckle	kg/sq cm	4200	
	Minimum breaking load	kg	**6433**	
	Length of threaded portion	mm	300	
	Thimble shape		Suitable for Stay wire of 7/10, 7/8, 19/8 and as per approved design	
	Thimble section		18 SWG min.	
	Stay plate section	mm	300 x 300 x 6	
	Eyebolt length	mm	300	
	Eyebolt diameter	mm	16	
2	**Stay Wire**			
	Manufacturer			
	Country of Origin			
	Years of Manufacturing Experience			
	Applicable Standard		IS 2141-2000	
	Applicable Standard for galvanization		IS 4826-1979, BS 183-1972	

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Steel Wire Size	(Nos of wire/ SWG)	7/10, 7/8, 19/8 or as per approved design	
	No. of Wire	Nos	7, 19 or as per approved design	
	Diameter of Each wire	mm	As per SWG	
	Strand Diameter (Overall)	mm		
	Overall Cross Sectional Area	sq mm		
	Steel Quality		Gr. 700	
	Minimum Tensile Strength of Steel	N/sq mm	700	
	Ultimate Tensile Strength	N/sq mm		
	Min. Breaking load of single wire	kN	3.71	
	Min. Breaking load of strand	kN	26	
	Approximate Weight	kg/km		
	Minimum weight of Wire in each reel	kg	100	
	Left hand Lay	yes/no	Yes	
	Minimum Weight of Zinc Coating	g/sq mm	As per IS 4826-1979, BS 183-1972	
3	**Stay Insulator**			
	Manufacturer	yes/no		
	Country of Origin			
	Years of Manufacturing Experience			
	Model No.			
	Applicable Standard		IS: 5300-1969	
	Marking as per specification?	yes/no	Yes	
	IS Designation		C	
	Length	mm	140	
	Diameter	Mm	85	

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Cable Hole Diameter	mm	25	
	Creepage Distance (minimum)	mm	57	
	Minimum failing load	kN	88	
	Power Frequency Withstand Voltage			
	Dry	kV	27	
	Wet	kV	13	
4	**Information to be Submitted with the Tender**			
	Layout and dimension drawings showing the main dimensions and physical arrangement of major components with detailed descriptions and leaflets shall be submitted for:			
	ISO 9001 (including design) holder	yes/no	yes	
	ISO 9001 certificate submitted	yes/no	yes	
	Type test certificate submitted	yes/no	yes	
	Submitted for the required ratings	yes/no		
	Type test certified by			
	User's certificate submitted	yes/no	yes	
	Has exported to third country	yes/no	yes	
	Copies of relevant standards attached	yes/no	yes	
	Outline Drawings and associated GA attached	yes/no	yes	
5	**Informative Data, To be filled separately for each equipment**			
	Manufacturer			
	Place of manufacturing			
	Dimension (W x D x H)	mm		

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Weight	kg		
	Shipping Data			
	Weight of heaviest package	kg		
	Dimension of largest package (W x D x H)	mm		

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
A	**Distribution Transformer**			
1	**General**			
	Manufacturer			
	Place of manufacture/ testing			
	Applicable Standards		IEC 60076	
	Type		Three Phase	
	Winding material		Copper	
	Primary Winding BIL	kV	75	
	Primary Bushing BIL	kV	75	
	Accessories listed below furnished?			
	a) Lower oil filter valve		Yes	
	b) Liquid level gauge		Magnetic-type, readable from the ground level	
	c) Lifting lugs		Yes/No	
	d) Name Plate		Yes/No	
	e) Tank earthing terminal		Suitable for grounding cable with # 6 SWG solid/stranded copper	
	f) Lightning Arrester	yes/no	Yes	
	g) HV Fuses	yes/no	Yes	
	MCCB			
	(i) Overload Protection	yes/no	Yes	
	(ii) Short-circuit Protection	yes/no	Yes	
	(iii) Provision for auxiliary contacts	yes/no	Yes	
2	**Design Information**			
	a) Rated kVA	kVA	25, 50, 100, 200, 300	

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	b) Number of phases		Three for 3- ø	
	c) Frequency (Hz)		50	
	d) Voltage ratio at no load (kV)	kV	11/0.4 for 3-ø	
	e) Winding connections		Dyn11 (for 3-ø)	
	f) Core Material used and Grade		CRGO	
	g) Magnetising current at normal ratio:			
	(i) HV (A)			
	(ii) LV (A)			
	h) Maximum flux density in core iron at normal voltage and frequency based on the net section of iron:			
	(i) Cores (T)	T	1.6	
	(ii) Yokes (T)	T	1.6	
	i) Type of winding:			
	(i) HV (A)	A		
	(ii) LV (A)	A		
	j) Maximum current density in winding at rated power:			
	(i) HV (A/mm2)	A/sq mm	2.5	
	(ii) LV (A/mm2)	A/sq mm	2.5	
	k) Type of insulation used for:	yes/no		
	(i) HV winding			
	(ii) LV winding			
	l) No load loss at normal voltage ratio and 75oC (Watt)			
	m) Load loss at rated current and at 75oC (Watt)			

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	n) Regulation at 75oC and rated power as a percentage of normal voltage:			
	(i) at 1 p.f. (%)			
	(ii) at 0.8 p.f. (%)			
	o) Impedance voltage at 75oC and rated power:			
	(i) at normal tapping (%)			
	(ii) at -5% tapping (%)			
	(iii) at +5% tapping (%)			
	p) Efficiency at:			
	(i) 1 p.f. 125% load and rated current (%)			
	(ii) 1 p.f. 100% load and rated current (%)			
	(iii) 1 p.f. 75% load and rated current (%)			
	(iv) 1 p.f. 50% load and rated current (%)			
	(v) 1 p.f. 25% load and rated current (%)			
	q) Load at which maximum efficiency will occur (kVA)			
	r) Maximum Efficiency (%)			
	s) Temperature rise at rated kVA by thermometer in oil (oC)			
	t) Temperature rise at rated kVA by resistance of windings (oC)			
	u) Permissible overload (%)			
	v) Transformer insulating oil specification:			

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	(i) Total volume of insulating oil at 20oC (litre)			
	(ii) Effective expansion capacity of conservator in litre as well as percentage			
	w) Approximate weight and dimensions:			
	(i) Weight of core (kg)			
	(ii) Weight of winding (kg)			
	(iii) Weight of tank and fittings (kg)			
	(iv) Weight of oil (kg)			
	(v) Total weight (kg)			
	x) Radiator details:			
	(i) No of radiators per transformer (No.)			
	(ii) No of fins per radiator (No.)			
	(iii) Width of each fin (mm)			
	(iv) Thickness of radiator (mm)			
	y) Tank Dimensions:			
	(i) Length (mm)			
	(ii) Breadth (mm)			
	(iii) Height (mm)			
	(iv) Tank Sheet Thickness (sides x bottom x top) (mm)			
	z) Approximate dimensions including fittings:			
	(i) Overall length (mm)			
	(ii) Overall width (mm)			
	(iii) Overall height (mm)			
	aa) Winding resistance value at 75oC			

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	(i) Per phase resistance of HV winding			
	(ii) Per phase resistance of HV winding			
3	**Testing Facilities available in the Lab of the Manufacturer**		Include Name of Test Equipment/Facility, Date of Calibration and Calibrated by	
	Applied voltage test			
	Induced voltage test			
	No load loss and excitation current test			
	Impedance voltage and load loss tests			
	Resistance measurement			
	Ratio tests			
	Polarity and phase relation tests			
	Leakage tests			
	Insulation resistance tests			
	(i) Temperature rise test			
	(ii) Dielectric Type test			
	(iii) Tank pressure test			
4	**MCCB and LVCT Information**			
	IP class of Distribution Box		IP 54	
	Name of Manufacturer			
	MCCB:		ABB/Siemens/Schneider/GE/L&T/Hyundai/Mitsubishi/Legrand or equiv.	

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	LVCT:		ABB/Siemens/Schneider/GE/L&T/Hyundai/Mitsubishi/Legrand or equiv.	
	If MCCB and LVCT are of other company, then will a type test shall be carried out free of cost in a third party lab accredited by ILAC/IAF?		Yes	
5	**Remote Data Logging System**			
	IP class of Enclosure Box		IP 67	
	Over Current Protection		Available	
	Surge Current Protection		Available	
	Positioning System		GPS	
	Data Connection System		GPRS/3G	
	Temperature Sensor		Available	
	Oil level Sensor		Available	
	Current Transformer		Available with 0.2 Class for Metering	
	Potential Transformer		Available with 0.2 Class for Metering	
	Voltage Measurement		Xformer Secondary and MCCB Outputs	
	Current Measurement		Xfomer Secondary	
6	**Information to be Submitted with the Tender**			
	Dimension drawing showing the main dimensions nd physical arrangements of major components			
	Detailed descriptions or leaflets of:			

Name of Tenderer _____

Signature of Tenderer _____

Nepal Electricity Authority

Distribution and Consumer Services Directorate

Distribution System Upgrade and Expansion Project

Technical Data Sheet

To be filled separately for each equipment and manufacturers; Employer's Requirement are subjected to variation as per altitude of installation and climatic condition. The site specific requirement shall be understood after incorporating Altitude Correction Factor as per IEC Standard.

S.N.	Description	Unit	Employer's Requirement	Bid Offer
	- Arrangement and insulation of windings			
	- Core and tank			
	- Measuring/ monitoring instruments			
	- Transformer auxiliaries			
	ISO 9001 (including design) holder	yes/no	yes	
	ISO 9001 certificate submitted	yes/no	yes	
	Type test certificate submitted	yes/no	yes	
	Submitted for the required rating	yes/no		
	Type test certified by			
	User's certificate submitted	yes/no	yes	
	Has exported to third country	yes/no	yes	
	Copies of relevant standards attached	yes/no	yes	
	Outline Drawings and associated GA attached	yes/no	yes	
7	**Informative Data**			
	Manufacturer			
	Place of Manufacturing			
	Main Dimensions (W x D x H)	m		
	Main Dimensions for transportation (W x D x H)	m		
	Weight of the transformer inclusive of oil and accessories	t		
	Oil weight	t		
	Weight for transportation	t		
	Maximum permitted acceleration during transport			
	Lengthwise (x)	m/s^2		
	Crosswise (y)	m/s^2		

Name of Tenderer _____

Signature of Tenderer _____

Nepal Electricity Authority
Distribution and Consumer Services Directorate
Distribution System Upgrade and Expansion Project
Technical Data Sheet
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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Vertical (z)	m/s^2		

Name of Tenderer _____

Signature of Tenderer _____

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
B2	**11 kV Switchgear**			
1	**Drop Out Fuse**			
	Name and Address of Manufacturer			
	Applicable Standard		IEC 60282	
	Type of DO Fuse		Expulsion, Class A	
	Rated Voltage	kV	12	
	Service Voltage	kV	11	
	Rated Frequency	Hz	50	
	No. of D.O. Fuse unit per set	Nos	3	
	Rated Continuous Current	A	100	
	Switching Voltage (max)	kV		
	Dry Impulse withstand (1.2 kV/50μs) voltage (positive & negative polarity) (Peak)			
	i. Across the isolating distance of the fuse base	kV	85	
	ii. To Earth and between poles	kV	75	
	Wet 1 min. power frequency withstand voltage (rms)			
	i. Across the isolating distance of the fuse base	kV	32	
	ii. To Earth and between poles	kV	28	
	Total Creepage distance (min)	mm	320	
	Interrupting rating			
	i. Symmetrical interrupting rating (min) rms	kA	8	
	ii. Asymmetrical interrupting rating (min) rms	kA	9.6	
	iii. X/R Ratio			
	Temperature Rise Limit (in Air)			

Name of Tenderer _____

Signature of Tenderer _____

Nepal Electricity Authority

Distribution and Consumer Services Directorate

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	i. Copper contacts silver faced	° C	65	
	ii. Terminals	° C	50	
	iii. Spring: The temperature shall not such a value that elasticity of the Metal is changed.			
	Mounting angle (to vertical plane)	° (deg)		
	Length of the Fuse barrel	mm	285 ± 2	
	Diameter of the Fuse barrel	mm		
	Tensile Strength	kN	10	
	Thickness of Galvanization		As per IEC	
	Mounting Bracket GI 'L' shape with two bolts	mm	200 x 200	
	Approximate weight			
	i. Porcelain Fuse Base (with embedded parts)	Kg		
	ii. Lower and Upper metal portion of Fuse Base	Kg		
	iii. Fuse Carrier	Kg		
	iv. Upper and Lower metal portion of fuse carrier	kg		
	Declaration to carry out Type Test after mass production in the third-party lab as per Clause 9.	Y/N	Yes	
2	**Lightning Arrester**			
	Name and Address of Manufacturer			
	Applicable Standard			
	Type of Lightning Arrester	yes/no	Gapless Metal-Oxide Polymeric	
	Rated Voltage	kV (rms)	12	

Name of Tenderer _____

Signature of Tenderer _____

Nepal Electricity Authority

Distribution and Consumer Services Directorate

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Technical Data Sheet

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Continuous Operating Voltage	kV (rms)	9	
	Rated Frequency	Hz	50	
	No. of L. A. unit per set	Nos	3	
	Nominal discharge current, 8/20 μs	kA (rms)	10	
	Energy Absorption Capacity	kJ/kV	>6	
	Long duration discharge class	Class		
	High Current Impulse (4/10μs) – Peak	kA	100	
	Steep Current maximum impulse residual voltage (1/20μs)	kV	40	
	Impulse Residual Voltage - Peak			
	i. Maximum Residual Voltage at 10 kA for 8/20μs	kV	35	
	ii. Switching impulse (30-100/60-200μs) maximum residual voltage	kV	30	
	One second TOV withstand capability	kV	> 1.15 x 12	
	Type of Housing Insulator		Polymeric	
	Insulation withstand level			
	i. Lighting Impulse (1.2/50 μs) voltage – peak	kV	75	
	ii. Power Frequency withstand voltage (wet)	kV	28	
	Total Creepage distance (min)	mm	320	
	Energy Absorption Capability (with 4/10 wave)	kJ/kV	> 3.2	
	Insulating Bracket			
	i. Power Frequency withstand voltage	kV	20	
	ii. Cantilever strength	Nm		

Name of Tenderer _____

Signature of Tenderer _____

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Approximate Weight of a Unit	kg		
	Declaration to carry out Type Test after mass production in the third-party lab as per Clause 9.	Y/N	Yes	
3	**Load Break Switch**			
	Name and address of Manufacturer			
	Country of Origin			
	Applicable Standards			
	Type of Design			
	Basic Ratings			
	a. Maximum system voltage		12	
	b. Rated continuous current		200/400/530/630/800/1250	
	c. Rated frequency		50 Hz	
	d. Rated short time withstand current		20 kA	
	e. Rated peak withstand current		25 kA	
	Breaking Medium		Air	
	Making and Breaking Capacity			
	a. Mainly active load current			
	b. Number of load-break operations			
	c. Short circuit making current (peak)			
	d. Number of making operations			
	e. Cable charging current			
	f. Line charging current			
	Rated Power frequency withstand voltage	kV	28	
	Impulse withstand voltage, kV	kV	50	

Name of Tenderer _____

Signature of Tenderer _____

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Other ratings and Specifications			
	a. Internal arc test			
	b. Arc Extinction medium		As per IEC	
	c. Insulation medium			
	d. Creepage distance	mm	As per IEC	
	Protection level (IP)			
	a. Leak proof tank		IP 67	
	b. Mechanism		IP 45	
	c. Control box		IP 55	
	Operation Performance			
	a. Closing/Opening Time			
	b. Mechanical Operations		10000	
	c. Operating temperature	deg C	-5 to +40	
	Gas Pressure			
	a. Nominal Pressure (atm at 20°C)			
	b. Bursting Pressure (atm)			
	c. Minimum Gas Pressure (atm)			
	d. Leakage rate (cc/sec)			
	Weight (approx.)			
	Cable/Conductor Range	sq mm	25 - 150	
	Enclosure Material		Stainless steel	
	Installation (with/without disassembly)		Ready to use (without disassembling)	
	Marking			
	Dimensions			
4	**Information to be Submitted with the Tender**			

Name of Tenderer _____

Signature of Tenderer _____

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Dimension drawing showing the main dimensions nd physical arrangements of major components			
	ISO 9001 (including design) holder	yes/no	yes	
	ISO 9001 certificate submitted	yes/no	yes	
	Type test certificate submitted	yes/no	yes	
	Submitted for the required rating	yes/no		
	Type test certified by			
	User's certificate submitted	yes/no	yes	
	Has exported to third country	yes/no	yes	
	Copies of relevant standards attached	yes/no	yes	
	Outline Drawings and associated GA attached	yes/no	yes	
5	**Informative Data**			
	Manufacturer			
	Place of Manufacturing			
	Main Dimensions (W x D x H)	m		
	Main Dimensions for transportation (W x D x H)	m		
	Weight of the transformer inclusive of oil and accessories	t		
	Oil weight	t		
	Weight for transportation	t		
	Maximum permitted acceleration during transport			
	Lengthwise (x)	m/s^2		
	Crosswise (y)	m/s^2		
	Vertical (z)	m/s^2		

Name of Tenderer _____

Signature of Tenderer _____

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
B3	**CABLES**			
1	**11 kV XLPE Cables**			
	Manufacturer			
	Country of Origin			
	Years of Manufacturing Experience			
	Model No.			
	Applicable standard		IEC 60502, IEC 60228	
	Cable Type Designation			
	Rated Voltage	kV	11	
	Maximum System Voltage	kV	12	
	Rated Voltage between conductor and screen	kV	6	
	Rated Voltage between two conductors	kV	10	
	Power Frequency Withstand Voltage	kV	28	
	Impulse Withstand Voltage (BIL)	kV	75	
	Conductor			
	Conductor Material		EC Grade Aluminum or EC Grade Annealed Copper	
	Cross section of the Conductor	sq. mm.		
	Is Conductor Stranded?	(yes/no)	yes	
	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		

Name of Tenderer _____

Signature of Tenderer _____

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	iv) Class of Stranding			
	Number of Cores		One/Three/As per SLD	
	Insulation			
	Insulation material and Type Designation		XLPE	
	XLPE Compound manufacturer			
	Minimum thickness of insulation	mm	3.4	
	Minimum volume resistivity at 27 deg. C, 70 deg. C and 90 deg. C	Ohm-cm		
	Sheath			
	Material for inner sheath, type of sheathing and Type Designation			
	Minimum thickness of inner sheath	mm		
	Material for outer sheath, type of sheathing and Type Designation			
	Minimum thickness of outer sheath	mm		
	Armor			
	Material			
	Shape			
	Dimension	mm		
	Conductor Screen			
	Material			
	Thickness	mm		
	Insulation Screen	yes/no		
	Material			
	Thickness	mm		
	Metallic Layer/Screen			
	Type			
	Material			
	Thickness	mm		
	Overall Diameter of the Cable	mm		

Name of Tenderer _____

Signature of Tenderer _____

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Geometric Mean Radius (GMR) of the Cable/Conductor	mm		
	Minimum Bending Radius	mm		
	Insulation Resistance at 27 deg. C	Ohm/km		
	Capacitive Reactance	Ohm/km		
	Inductive Reactance	Ohm/km		
	Conductor Temperature rise during			
	Normal Operation	deg. C	90	
	Short Circuit	deg. C	250	
	Continuous Current Carrying Capacity			
	Continuous Current Carrying Capacity in air and Corresponding assumptions/Conditions of installation	A		
	Continuous Current Carrying Capacity under ambient temperature	A		
	Continuous Current Carrying Capacity under Cable laid in Covered cable trenches	A		
	Continuous Current Carrying Capacity under 3-6 Cables per tray touching each other in Covered cable trenches	A		

Name of Tenderer _____

Signature of Tenderer _____

Nepal Electricity Authority

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Continuous Current Carrying Capacity under ambient temperature for Cable laid in ground	A		
	Short circuit current			
	Short circuit current for 0.1 sec	kA		
	Short circuit current for 1.0 sec (minimum kA)	kA	25	
	Short circuit current for armor 1.0 sec (minimum kA)	kA		
	Minimum tensile strength of insulation	kg/sq. cm		
	Minimum elongation at break	%		
	Minimum tensile strength of sheath	kg/sq. cm		
	Minimum elongation at break	%		
	Minimum tensile strength of armor	kg/sq. cm		
	Minimum elongation at break	%		
	Weight of Cable per km	kg/km		
	Standard length of Cable per drum	m	min. 500m	
	Net weight of cable in drum	kg		
	Method of Core identification			
	For Cables up to Five Cores			
	For Cable with more than Five Cores			
	Details of Anti Termite Covering			
	Longitudinal water tight	yes/no	yes	
	Fire Retardant	yes/no	yes	
	Moisture Resistant	yes/no	yes	
	Please indicate in YES or NO whether the following tests have been carried out			

Name of Tenderer _____

Signature of Tenderer _____

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Ageing Test	yes/no	yes	
	Loss of Mass Test	yes/no	yes	
	Cold Impact Test	yes/no	yes	
	Heat Shock Test	yes/no	yes	
	Fire Retardant Test	yes/no	yes	
	Delivery of equipment following award of contract and approval of drawing			
	ISO 9001 holder (including design)	yes/no	yes	
	ISO 9001 certificate submitted	yes/no	yes	
	Type test certificate submitted	yes/no	yes	
	Submitted for the required ratings	yes/no		
	Type test certified by			
	User's certificate submitted	yes/no	yes	
	Has exported to third country	yes/no	yes	
	Copies of relevant standards attached	yes/no	yes	
	Outline Drawings and associated GA attached	yes/no	yes	
	Details of Marking on Outer Sheath			
2	**1100 V LV Power Cables**			
	Manufacturer			
	Type of designation			
	Standards		IEC	
	Rated voltage	V	1100	
	Continuous permissible current (in air)	A		
	Maximum temperature of conductor during			
	- continuous operation	°C	90	
	- short circuit duty for 1 s	°C	250	

Name of Tenderer _____

Signature of Tenderer _____

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Conductor material		EC Grade Annealed Copper	
	Insulation material		Polyethylene	
	Sheath material			
	Shield material			
	Armour material			
	Number of cores	pcs		
	Conductor cross section	mm2		
	Test voltages			
	- power frequency withstand	kV		
	- direct current	kV		
	Nominal bending radius	mm		
	Outer cable diameter	mm		
	Standard Length of Cable Drum	m	min. 500	
	Resistance of 1 m	ohm/m		
	Reactance of 1 m	ohm/m		
	Insulation Resistance at 27 deg. C	ohm		
3	**Control Cables**			
	Manufacturer			
	Type of designation			
	Standards		IEC	
	Rated voltage	V	1100	
	Test voltage	kV		
	Conductor material		EC grade annealed Copper	
	Conductor insulation material			
	Shield material			
	Shield Insulation material			
	Cable sheath material			
	Number of cores	pcs		
	Conductor cross section	sq. mm		
	Minimum bending radius	mm		

Name of Tenderer _____

Signature of Tenderer _____

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Outer cable diameter	mm		
	Resistance of 1 m	ohm/m		
	Reactance of 1 m	ohm/m		
4	**Communication Cables**			
	Manufacturer			
	Type of designation			
	Standard		IEC	
	Conductor material		EC grade annealed Copper	
	Conductor diameter	mm		
5	**Cable Trays an Accessories**			
	Manufacturer			
	Type of designation			
	Material			
	Type of corrosion protection			
6	**Cable Termination Kit**		To be submitted separately for all kits	
	Manufacturer			
	Applicable standard			
	Type			
	Insulation level			
	Maximum design voltage			
	Impulse withstand voltage(BIL)			
	Fire resistance treated	yes/no	yes	
	Smoke resistance treated	yes/no	yes	
	Stress relief performed	yes/no	yes	
	Installation Instruction attached	yes/no	yes	
	List of Installation Accessories Supplied			

Name of Tenderer _____

Signature of Tenderer _____

Volume II

Section 6: Employer's Requirements

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B	Specifications
C	Drawings
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Volume II

Section 6: Employer's Requirements

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NEPAL ELECTRICITY AUTHORITY
DISTRIBUTION AND CONSUMER SERVICES
TECHNICAL AND COMMERCIAL SERVICES DEPARTMENT

GUIDE LINES OF CONSTRUCTION STANDARD

2007 FERBURY

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1. Design Criteria

1.1 Codes and Standards

The applicable codes and standards of the following international and national standards institutions were used as guidance in the design and specification of materials for the works:

ANSI	American National Standards Institutions
ASTM	American Society for Testing and Materials
BS	British Standards Institute
ICEA	Insulated Cable Engineers Association (IPCEA)
IEC	International Electro technical Commissions
IEEE	Institute of Electrical and Electronic Engineer
ISI	Indian Standards Institute
JIS	Japanese Industrial Standards
NSI	Nepal Standard Institute

Rules and regulations of Nepal Government and NEA

NESC	National Electrical Safety Code

1.2 Electrical Criteria

1.2.1 Sub-Transmission Circuits

The standard sub-transmission line for distribution system is 33 kV, 3-phase, 3 wire, 50 Hz overhead system. The lines are extended from 132/33 kV or 66/33 kV substations up to the 33/11 kV substations. The primary side is delta connected while the secondary side is star connected and neutral is grounded with no intentional impedance (solidly grounded).

1.2.2 Primary Circuits

The standard primary distribution system is 11 kV 3-phase, 3-wire, 50 Hertz unigrounded system. The source transformer for each level of system voltage is connected in delta/star and the neutral is grounded with no intentional impedance (solidly grounded).

1.2.3 Secondary Circuits

The standard secondary system is 400/230 volt, 3-phase, 4 wire with neutral point of the source transformer grounded with no intentional impedance (solidly grounded).

1.2.4 **Consumer Services**

1.2.4.1 230 volt, 1-phase with service drops of 6 sq. mm or 25 sq. mm concentric neutral cable with whole current meters of 1-phase, 2 wire having base current of 5, 10 ampere and so on based on current ratings. The meters are protected by the appropriate rating of MCB installed on load side.

1.2.4.2 400 volt, 3-phase with service drops cable of size as per consumer's load requirement. The meters are 3-phase, 4 wire whole current type having base current rating of 5, 10, 15 and 30 ampere.

Similarly, CT operated demand meter, 3-phase, 4 wire having 5 A of CT secondary current.

1.2.4.3 11kV and 33 kV, 3-phase, instrument transformer operated (CT, CT & PT), 3-phase 4 wire solid state energy meters with proper size of control cables.

1.2.5 **Voltage Regulation**

1.2.5.1 The voltage level at the point of consumer is the reference for system design and operation, and the limits of regulation for each level of the distribution system must be configured to accommodate service voltage within the range adopted.

1.2.5.2 The range of service voltage is designated at $\pm$ 5% of nominal 400/230-volt service voltage:

Maximum	-	420/242 volts
Minimum	-	380/219 volts

1.2.5.3 Based on the reference service voltage, the following values of voltage regulation, at the points farthest from the supply point should not be exceeded under normal operation conditions:

33 kV Circuit	-	5%
11 kV Circuit	-	5%
Transformers	-	3%
400/230 Volt Circuits	-	4%
Service Drops	-	1%

1.2.6 **Power Factor**

The system power factor shall be maintained in the range of 0.95 – 0.80 lagging.

1.2.7 Insulation Requirements

1.2.7.1 Insulation for the high voltage system must withstand normal operating voltages and switching surge voltages without flashover or failure. Sufficient basic impulse level (BIL) must also be provided so that the system can be protected by suitable lightning arresters. Further, insulators and bushings, in air, must have adequate creepage distance to minimize 50-Hertz leakage current. At altitudes over 1000 meters or in contaminated areas, extra creepage distance shall be provided.

1.2.7.2 The system shall be designed to meet those insulation parameters using appropriate IEC or other equivalent standards for material and equipment.

- ❖ Basic Impulse Level (BIL)
  - Distribution Class 170 KV (for 33 kV)
  - Distribution Class 95 KV (for 11 kV)
- ❖ Switching Surge Voltage.
  - Approximately three times normal line to ground voltage.
- ❖ Minimum Leakage distance
  - Approximately 25.4 mm/1000 volt, 160 mm for 6.35 kV line to ground.(11 kV line to line voltage) and 484 mm for 33 kV
- ❖ Extra insulation will be provided at line angles and dead ends to preclude flashover due to increased value of surge voltage caused by reflections.
- ❖ Sections of the system that require increase leakage distance will be considered on the individual basis. Increased leakage distance will be based on latest IEC or IS guidelines.

1.2.8 Conductors

1.2.8.1 Sub-Transmission Line

NEA designated standard conductors to be used for the construction of 33 kV sub-transmission line is 100 mm sq (DOG conductor) unless specifically required.

1.2.8.2 Primary Distribution line

1.2.8.2.1 Overhead primary distribution line with bare conductor

NEA designated standard 100 mm sq (DOG) and 50 mm sq (RABBIT) ACSR conductors shall be used for construction of primary distribution line depending upon the load requirement, line length and voltage drop consideration. The 30 mm sq (WEASEL) ACSR conductor can also be used at the line end of 11 kV lines where the load is very small and there will be no possibility of extension of 11 kV line in future.

1.2.8.2.2 Overhead primary distribution line with ABC conductor

Use of 11 kV ABC (Aerial Bundled Cable) is preferred for the areas where tree clearance poses a serious problem and narrow streets in city area where it is difficult to get sufficient clearance for bare conductor. Though, it is much costlier than bare conductor overhead line, it is considerably cheaper as compared to underground cable. So, 11 kV ABC cable can be used where safety and reliability are main dominant factor. According to the load requirement the size of the cable shall be 95 mm sq, 70 mm sq and 35 mm sq.

1.2.8.2.3 Underground cable

Underground cable is mostly used at road crossings and where the overhead line could not be constructed due to safety or aesthetic reason. Cross linked polyethylene (XLPE) cables are generally used because XLPE cables have higher current rating, better short circuit and overload withstand capability and are more rugged and flexible in use. These cables are also used in 33/11 kV substations. Depending upon the load requirement the sizes of 70 mm sq, 120 mm sq, 180 mm sq and 240 mm sq three core XLPE cables are used.

1.2.8.3 Low Voltage 400/230 V Distribution

1.2.8.3.1 Overhead low voltage distribution line with bare conductor

NEA's present practice is to use the bare ACSR conductor for the low voltage distribution. Such open wire systems have lower reactance, require less pole space and present a neater appearance, however, it requires additional items in the materials inventory of NEA. It is strongly recommended that only following combination of conductors are used for the L.V. System:

- 100 mm sq Dog phase conductor w/50 mm sq. Rabbit neutral.
- 50 mm sq Rabbit phase conductor w/30 mm sq. Weasel neutral.

Two wire 230 V low voltage lines are used where load densities are very small and at locations that will not require future extensions. "Weasel" 30 sq mm. ACSR conductor is proposed for two wire 230-volt lines. As the temptation to extend two-wire system results in unbalanced transformer loads and causes excessive voltage drop the two wire 230 V low voltage line should be discouraged.

1.2.8.3.2 Overhead low voltage distribution line with ABC conductor

The LV distribution using aerial bundled conductor (ABC) have been introduced in NEA under different projects on a limited scale and have proved to be successful in terms of reducing losses and improving reliability.

With ABC cable the frequency of outages due to short circuits and earth fault is greatly reduced which results in more revenue. The short circuit problem attributable to uneven sagging and clashing on long spans is eliminated. ABC can run through with tree areas without adverse effect.

Safety is enhanced as the total system, including connectors and neutral is insulated thereby increasing the safety to power utility personnel and the public.

There are two types of ABC system in use these days:

- **Four Core System**

In this system, use are made of four equal insulated conductors, that share the tensile load equally, having a size range of 25mmsq, 50 mm sq and 95 mm sq. They are made of aluminum with a relatively high tensile strength. Therefore, the breaking load of the cable is relatively high too. Insulation of the cores is typically made of XLPE. The cable can also be provided with one or two insulated conductors for street lighting.

- **Insulated/Uninsulated Neutral Messenger Wire System**

The system comprises of three separately insulated aluminum phase conductors with an insulated/uninsulated aluminum alloy neutral conductor/messenger wire. The three phase cores are wound around the neutral to form a "bundle" and the total line tension is applied to only the neutral conductor/messenger. The cores are insulated with extruded cross-linked polyethylene and marked to identify phases and neutral. The pitch of laying is such as to allow easy separation of conductors for making connections but also to maintain bundle cohesion at line angles. Connectors for mains and service taps are insulated and suitable for live line application. The connectors are provided with contact teeth to penetrate conductor insulation without the need for stripping.

Recommended Size for Phase and Neutral

Bundled conductors are generally manufactured in the following standard range of sizes:

❖ **Four Core System**

Size of phase conductor	Current Rating at 80^0C (A)
4x25	105
4x35	125
4x50	150
4x70	185
4x95	225
4x120	260

❖ **Insulated/Uninsulated Neutral Messenger Wire System**

Size of phase conductor	Neutral Conductor (mm sq)	Current Rating at 20^0C (A)
3x25	25	86
3x35	25	107
3x50	35	131
3x70	50	166
3x95	70	193
3x120	70	222

1.2.8.3.3 Low Loss LT Distribution System

To reduce the losses, use shall be made of pole mounted single phase transformer with necessary accessories. The consumers shall be directly fed from the transformer using distribution board attached near the transformer. The size of service cable shall be selected as per load requirement and energy meter shall also be mounted on pole itself.

1.2.9 Grounding

1.2.9.1 NEA Distribution system grounding practice is to ground the neutral point (star point) and the body of the source transformer.

1.2.9.2 Ground terminals of surge arresters are grounded by a conductor of 8 SWG copper wire run through insulated pipe. Surge arrester grounding is separated from transformer grounds by a minimum distance of 5 meters.

1.2.9.3 The 400/230 volt circuits carry a neutral conductor which is grounded at the source transformer.

1.2.9. 4 All grounds are made with a driven ground rod or plate preferably by means of a 25 mm diameter GI pipe driven 2.5 to 3.0 meter into the ground. The ohmic resistance of the ground should be as low as possible and should not exceed 10 ohms.

1.2.10 Sectionalizing and Switching

1.2.10.1 The application of sectionalizing is largely a matter of operating experience and procedures, priorities and budget limitations.

Since, NEA operating personnel are not equipped or trained for live line work, sectionalizing is most important from a normal operating standpoint.

The following guidelines are suggested for sectionalizing/switching applications.

1.2.10.2 Main feeder exits at Substations

Since, transfer bus schemes are not used in NEA substations, it is recommended that it shall be established outside the station for interconnection when more than one circuit exit is involved. This will allow the transfer of load to alternate circuits when breaker /cable maintenance is required on one circuit. Ground operated load break switches should be used at all normally open tie points between feeders.

1.2.10.3 Main Feeder Sectionalizing

Hook operated, single phase disconnects shall be located at selected points on the system to facilitate isolating line sections for maintenance. Locations should be selected on the basis of number of transformers in the line section (suggest

maximum of five), the type of load (hospitals, police, fire stations communications facilities etc.) and line length.

1.2.10.4 **Lateral Tap Lines**

Long tap lines serving important loads which are tapped off the main feeders should be considered for the application of coordinated automatic sectionalizing devices (reclosers). Generally, no more than two reclosers should be connected in series. In no case, automatic sectionalizing devices should be installed in circuits which can be looped.

1.2.10.5 Long Tap lines and Short Tap Lines exposed to unusual hazards, should be fitted with single phase hook operated disconnects at the sources end. Unusual hazards would include tree areas, river crossings, high traffic impact areas etc.

1.2.10.6 The use of fused cutouts in three phase tap lines or feeders should be discouraged. Disconnecting switch or load break switch with solid blades may be used as line disconnects for lightly loaded taps.

1.2.11 **Lightning Protection**

1.2.11.1 Metal oxide surge arresters are proposed, suitable for operation up to 1000 meters altitude. A ground (earth) lead disconnector is proposed so that failed arresters are disconnected from the system.

1.2.11.2 Arresters shall be applied to each phase of the following equipment:

1.2.11.2.1 **Transformers** connected to line side of transformer cutouts. Ground lead to be solidly connected to driven ground rod.

1.2.11.2.2 **Cable Terminations** connected as close to point of overhead line lead-cable terminal (at the point of connection of overhead line and cable) as possible. Ground lead should be connected to cable insulation shield with a short jumper and further connected to a driven ground rod.

1.2.11.2.3 **Capacitor Banks**- connected to line side of capacitor cutout. Ground (earth) lead to be solidly grounded to capacitor frame and driven ground rod.

1.2.11.2.4 **Line Reclosers**- connected to line and load sides of automatic reclosers. Ground lead to be solidly grounded to a driven rod.

1.2.11.2.5 **Normal open Switches** - connected to both sides of normally open switches. Ground lead to be solidly grounded to a driven rod.

1.2.12 Meter and Metering

The majority of consumers in our system come under domestic category and the energy meter used for them are of single phase type. Three phase meters are required for industrial, agriculture and commercial consumers. The following table lists the types of meters that are being used:

1.2.12.1 Single Phase, 2-Wire, Single Element

Number of elements	**One**	**One**
Accuracy class	**2**	**2**
Voltage	**230 V**	**230 V**
Frequency	**50 Hz**	**50 Hz**
Base current I_b	**5 A**	**10 A**
Rated max current (I_{max})	**30 A**	**60 A**
Overload capacity	**600%**	**600%**
Reference temperature	**20^0 C**	**20^0 C**
Terminal connection	**Symmetrical**	**Symmetrical**

1.2.12.2 Three Phase, 4-Wire, Three Elements

Number of elements	**3**	**3**	**3**	**3**
Accuracy class	**2**	**2**	**2**	**2**
Voltage	**400/230 V**	**400/230 V**	**400/230 V**	**400/230 V**
Frequency	**50 Hz**	**50 Hz**	**50 Hz**	**50 Hz**
Base current I_b	**5 A**	**10 A**	**15 A**	**30 A**
Rated max current (I_{max})	**20 A**	**40 A**	**60 A**	**120 A**
Overload capacity	**400%**	**400%**	**400%**	**400%**
Reference temperature	**20^0 C**	**20^0 C**	**20^0 C**	**20^0 C**

1.2.12.3 Solid State Electronic Energy Meter (TOD Meter), 3 Phase, 3 Wire and 4 Wire

Type	**3 phase 3 wire and 4 wire**
Rating	**3 phase 3 wire and 4 wire**
Accuracy class	**0.5 or Better**
Voltage	**100-400 V (phase to phase)**
CT ratio secondary current	**5A**
Rated max current (I_{max})	**1.2 x I_b**
Short time over current for 1sec	**20 x I_b**
Temperature	**-5 to $+55^0$ C**
Standard	**IEC 687 or latest version**
Certification	**ISO 9001**
Dynamic operating range	**0% to +15% of rated voltage, 1% to 120% of Full load**
Burden	**Current coil: 0.5 VA/phase, Pressure coil: 2 W/phase**
Data display	**7 or 8 digit LCD, digital type, non destructive read out**
Memory	**Non Volatile Memory (NVM)**

1.2.12.4

For those consumers having installed transformer capacity of 200 kVA and more, HT metering unit (with Current Transformer & Potential Transformer), and for less than that capacity LT metering (with Current Transformer only) are required. The demand meter is to be installed to all the consumers having approved load of 50 kVA and more. The capacity of potential and current transformer shall depend

on the voltage level and approved load. The TOD meter shall be provided to the consumers having connection to 11 kV or higher voltage supplies.

1.2.13 Street Lighting

Street lighting is to be provided as prescribed by NEA. A separate conductor/insulated cable shall be solely strung for the said purpose and an energy meter shall be provided to record the energy consumption.

It is mandatory that streetlights be controlled by one point photo control switch rather than a manual switch system. Photo control switches are more effective and avoid need for additional manpower for switching the street lights.

1.3. Material Criteria

1.3.1 Service Conditions

1.3.1.1 Material and equipment will be installed outdoors at an altitude below 1500 meters in a region between North Latitude 26 degrees, 15 minute and 30 degree, 30 minute.

1.3.1.2 The annual climatic cycle of the zone consists of dry and wet season of nine (9) and three (3) months respectively.

1.3.1.3 The annual average temperature is 32 degree Celsius. The maximum ambient temperature is 40 degree Celsius and minimum ambient temperature is 0 degree Celsius.

1.3.2. Line Clearances

Clearances of wires and cables to ground, roadways, rails, water surfaces, buildings, bridges and miscellaneous structure are tabulated in table 1.3.3.1A and 1.3.3.1B.

1.3.3 Structure Clearances

1.3.3.1 The minimum vertical clearances at support between line conductors.

Conductors usually at upper level of support (Open supply line conductors and cables) of voltage level:	400/230V	11kV	33 kV
Conductors usually at lower level of support (Open supply line conductors and cables) of following voltage level:	Vertical Clearance in mm		
400/230V	410	410	1020
11kV	-	410	1020
33 kV	-	-	1020

1.3.3.2 Horizontal clearance between two conductors on the same supporting structure shall not be less than.

33 kV	548mm
11kV	323 mm
400/230V	323 mm

Horizontal clearances based on sags may be calculated by
Clearance = 0.0076 m/kV + 0.368√S
Where S = sag in meter

However, calculated clearance shall not be less than 548 mm for 33 kV conductors, 323 mm for 11 kV conductors or 300 mm for 400/230 volt conductors.

TABLE 1.3.3.2 A

Vertical clearance (in meters) of wires, conductors, and above ground, roadways, rails or water surfaces:

Crossings	**400/230 V**	**11 kV**	**33 kV**
Railroad Tracks	8.2	8.5	8.5
Roads, streets, alleys, non-residential drive-way, parking lots and other areas subject to truck traffic	5.5	6.1	6.7
Residential drives, areas not subject to truck traffic	4.6	6.1	6.7
Other lands traversed by Vehicles-cultivated, orchards, grazing, forest	5.5	6.1	6.7
Spaces and ways subject to pedestrians or restricted traffic only	4.6	4.6	5.2

Water Areas	**400/230 V**	**11 kV**	**33 kV**
Less than 10 Hectares	5.5	6.1	6.1
8 to 80 hectares	7.9	8.5	8.5
80 to 800 hectares	9.8	10.4	10.4
Above 800 hectares	11.5	12	12

Parallel to	**400/230 V**	**11 kV**	**33 kV**
Roads, streets, alleys	5.5	6.1	6.1
Rural trails where vehicles Passing under line is unlikely	4.6	5.5	5.5

NOTE: *Clearances stated above are for span lengths not longer than 105 meters. If spans exceed 105 meters in length the clearances listed above shall be increased 0.03 meters for each 10 meter of excess of span length over 105 meters.*

TABLE 1.3.3.2 B

Clearance of wires, conductors and cables passing by but not attached to buildings bridges and other installations.

Crossings	**400/230 V**	**11 kV**	**33 kV**
Buildings-Horizontal:			
To walls, projections ,windows, Balconies and areas accessible to pedestrians	1.5	1.5	3
Buildings-Vertical:			
Over or under roof projection not accessible to pedestrians	3	3	3.7
Over or under balconies or roof accessible to pedestrians	4.6	4.6	5.2

Signs, Chimneys, Radio/ T.V. Antennas, Tanks, etc.	**400/230 V**	**11 kV**	**33 kV**
Horizontal:	1.5	1.5	3
Vertical – over/under	1.5	2.45	3

Bridges	**400/230 V**	**11 kV**	**33 kV**
Over-not attached	3	3	3.7
Over – attached	0.9	1.2	-

Beside, Under, or Within Structure	**400/230 V**	**11 kV**	**33 kV**
Attached	0.9	1.2	-
Not attached	1.2	1.5	-

1.3.3.3 Vertical distance between conductors carried on different supporting structures shall be:

Conductors usually at upper level of support (Open supply line conductors and cables) of voltage level:	Communication	400/230V	11kV	33 kV
Conductors usually at lower level of support (Open supply line conductors and cables) of following voltage level:	Vertical Clearance in mm			
Communication	600	1200	1800	1800
400/230 V	-	600	600	1200
11 kV	-	-	600	1200
33 kV	-	-	-	1200

1.3.4 **Structure Loadings**

Loadings imposed on all structures shall be determined by calculations employing the followings factors;

1.3.4.1 Wind loading of 35 kilograms/sq. meter on all conductors attached to the structure and circular surfaces shall be applied in a direction transverse to the line.

1.3.4.2 Wind loading of 100 kilograms/sq. meter on all flat structural surfaces shall be applied in a direction transverse to the line.

1.3.4.3 A safety factor of 2.0 shall be applied to wind loading.

1.3.4.4 Angle loading of conductors imposed by line angles shall be calculated by the formula:

Angle Tension = 2 x T x Sin (A/2)

Where T = Maximum conductor tension

Where A = Break angle in degrees

Angle loads of all conductors shall be included in the calculations.

1.3.4.5 Dead end loads shall be taken to equal the sum of the maximum tension, as sagged, of each conductor.

1.3.4.6 If the sum of combined wind, angle, and /or deadend loadings exceeds the un-stayed strength of a structure, stays shall be installed to counteract the pole top load, and the structure shall be treated as a strut.

1.3.4.7 Safety factor for 1.1 shall be applied to all guys (stays).

2.0 Technical Implementation

2.1 Poles

The selection of different sizes of poles depends upon the clearance required from the ground level. The places of rail, road crossings etc. where more ground clearance is needed, the pole of greater length is required and route along the field, forest, aside the road where more ground clearance not required shorter pole shall be used.

However, NEA has specified the general requirements for all poles which is to be used as follows:

2.1.1 All poles carrying 33 kV circuits shall be of 11 meters in length.

2.1.2 All poles carrying 11 kV circuits shall be of 11 meters, 10 meters and 9 meters in length. The 11& 10 meters poles shall be used for HT and composite line and 9 meter poles shall be used mainly in rural areas for 11 kV line.

2.1.3 All poles carrying 400/230 volt circuits are to be 8 and 9 meters in length. The 9 m poles shall be used in urban area & road crossing and 8m poles shall be used in semi urban and rural areas.

2.1.4 In hilly areas telescopic and folded steel tubular poles shall be used whereas in plain area both PSC and steel tubular poles shall be used. Treated wooden poles shall be used for L.T line and not recommended for 11 kV as well as 33 kV circuits.

2.1.5 All the poles shall have hole patterns as per Specifications and the poles shall be planted directly in the ground with a planting depth of about 1/6th of the pole length.

2.2 **Stays**

2.2.1 The selection of proper type of stay set and wire depend upon the load/ type of structures and angle of deviation of line. However, the general requirements of the stay sets for the different applications are as follows:

Description	**Type 1**	**Type II**
Length of stay rod, m.	2.44	1.8
Diameter of stay rod, mm.	19	16
Ultimate tensile strength of stay rod and tightner (min.), kg/sq. mm.	4200	4200
Minimum breaking load, kg.	10,454	7,272
Length of threaded portion, mm.	300	300
Thimble shape	Suitable for preformed for 7/8 SWG stay wire	Suitable for preformed for 7/12 SWG stay wire
Thimble section Min., SWG	18	18
Stay plate section, mm.	600x600x6	300x300x6
Eyebolt length, mm./1	300	300
Galvanization	**IS: 2629-1985**	

2.2.1.1 The stay set of type I is used for 33 kV and type II is used for 11 kV and LT applications.

2.2.1.3 Generally staying requirements will be served for 33 kV line by the use of 7/8 SWG stranded Galvanized steel wire strand with an ultimate tensile strength of 6400kg for a safety factor of 2.5. 7/10 SWG stranded Galvanized steel wire strand with an ultimate tensile strength of 3625kg is used for 11 kV and 7/12 SWG stranded Galvanized steel wire strand with an ultimate tensile strength of 2300kg is used for LT line.

2.3 Insulator

Four (4) types of insulator are required for the construction use, as listed hereafter. Certain physical attribution is required for insulators to insure coordination with other materials as assemblies. Such required attributes are delineated in the materials specification.

2.3.1 Pin Insulators

Highest System Voltage	12 kV	36 kV
Rated Voltage	11 kV	33 kV
Creepage Distance (min)	265 mm	680 mm
Wet Power Frequency Withstand Voltage	35 kV	80 kV
Impulse Withstand Voltage	75 kV	110 kV
Puncture Power Frequency Voltage (min)	105 kV	185 kV
Visible Discharge Voltage (effective)	9 kV	27 kV
Cantilever Strength Cantilever Strength	5 kN	10 kN
G.I. Pin Head	Small IS Ref.S165P	Large Thimble Type IS 2486 Part-II

The pin insulator shall be manufactured and tested in accordance with IS 731-1971 or equivalent national or international standard.

2.3.2 Disc Insulator

For tension locations where the line is sectionalized/at heavier deviation angle/dead end, disc type of insulators are used. 3 Nos. of 11 kV disc insulators in series are required for 33 kV and one No. for 11 kV applications.

Highest system Voltage	12 kV
Rate Voltage	11 kV
Porcelain Diameter (min)	255 mm
Spacing	145 mm
Creepage Distance (min)	280 mm
Power Frequency Puncture Withstand Voltage	1.3 x Actual dry flashover voltage
Wet Power frequency Withstand Voltage	35 kV
Impulse Withstand Voltage	75 kV
Puncture Power Frequency Voltage (min)	100 kV
Visible Discharge Voltage	9 kV
Mechanical Strength	45 kN
Ball and Socket Size	16 mm B

Applicable Standard for Special Characteristics IS: 3188-1980
The disc insulators shall be manufactured and tested in accordance with IS 731-1971 or equivalent national or international standard.

2.3.3 Stay Insulators

The stay insulator shall be manufactured and tested in accordance with IS: 5300-1969 or equivalent national or international standard.

	Type 1	Type 2
Highest System Voltage	400/230V	12/36 kV
Rated Voltage	11 kV	11/33 kV
Creepage Distance (min)	41 mm	57 mm
Minimum Failing Load	> 44 kN	> 88 kN
Power Frequency Withstand Voltage, 1 minute;		
Dry	18 kV	27 kV
Wet	8 kV	13 kV
IS Designation	A	C

Note: ***Two insulators of type 2 shall be used in series for 33 kV applications.***

2.3.4 Shackle Insulators

The shackle insulators shall be used for 400/230 volt lines for tension as well as tangent locations. Two types of insulators have been standardized to be used depending upon the conductor size. GS straps are used on tension locations to fix the insulators with the cross arm.

	Type A	Type B
Highest System Voltage	1 kV	1 kV
Rated Voltage	500V	500V
Power Frequency Withstand Voltage, 1 minute;		
Dry	23 kV	23 kV
Wet	10 kV	10 kV
Power Frequency Puncture Withstand Voltage, 1 minute	1.3xactual dry flashover voltage	
Leakage Distance (min)	75 mm	63 mm
Mechanical Strength	16 kN	11.5 kN
IS Type	2	1

The shackle insulator shall be manufactured and tested in accordance with IS: 1445 1977 or equivalent national or international standard.

2.4 Pole Hardware

2.4.1 Cross arms fabricated of galvanized hot-rolled channels & angles shall be utilized for construction of 11 kV and 33 kV lines and they shall be pre drilled for attachment of materials components. The general dimensional requirements of cross arm are as follows:

S.NO.	Description	Type	Dimension in mm.
1.	**11 kV, Single Pole, Triangular** • Pole Top • Standard	 Channel Channel	 100x50x6.4x5x300 100x50x6.4x5x1200
2.	**11 kV, Single Pole, Offset** • Offset • Bracing Member	 Channel Angle	 100x50x6.4x5x1700 40x40x5x877
3.	**11 kV, Double Pole** • Standard • Bracing Member • Bracing Member	 Channel Angle Angle	 100x50x6.4x5x2390 40x40x5x2071 40x40x5x2719
4.	**33 kV, Double Pole** • Standard • Bracing Member • Bracing Member	 Channel Angle Angle	 100x50x7.5x5x3300 40x40x5x2868 40x40x5x2416
5.	**33 kV, Single Pole, Triangular** • Pole Top • Standard	 Channel Channel	 100x50x7.5x5x300 100x50x7.5x5x1900
6.	**Lightening Arrester and Cut-out Support (at Transformer Platform)** • Support	 Channel	 100x50x6.4x5x2348

The transformer platform shall be fabricated from hot-rolled channels, angles and steel members. The platform shall be designed in such a manner that it provides support for a transformer of a minimum of 1500 kg in weight with a minimum safety factor of 2.0.

2.4.2 Bolts and nuts of sizes as per the requirements shall be used for the attachments of cross arms, stay dead-end assemblies, and secondary clevises to the poles. The nominal diameter of the bolts shall be 16 mm for fixing of cross arm and 13 mm for bracings.

2.5 Conductor

2.5.1 The following conductors shall be used for sub transmission circuit, primary and secondary circuit:

- **33kV lines**

  ACSR 6/4.72mm+7/1.57mm (100 mm sq ACSR, DOG)

- **11kV lines**

  ACSR 6/4.72mm+7/1.57mm (100 mm sq ACSR, DOG)
  ACSR7/3.35mm (50mm sq ACSR, RABBIT)

- **LT lines**

  ACSR 6/4.72mm+7/1.57mm (100 mm sq ACSR, DOG)
  ACSR7/3.35mm (50mm sq ACSR, RABBIT)
  ACSR7/2.59mm (30mm sq ACSR, WEASEL)

2.5.2 The basic span shall be maintained between 70 meter to 85 meter for 33 kV & 11 kV and 40 meter to 55 meter for composite and LT circuit.

2.5.3 33 kV and 11 kV circuit shall be constructed with triangular configuration and LT line in vertical configuration.

2.6 Conductor Accessories

2.6.1 Compression fittings shall be used for making all line service conductor connections. Performed conductor ties and dead-end grips shall be used for attaching conductors to insulators and for termination of conductors. Use of these materials are considered to be the best method of achieving uniform results in connections without higher levels of skill required for the work force.

2.6.2 Compression fittings of the tension and non-tension type will be employed in a range of sizes to join the conductors.

2.7 Distribution Transformers

The distribution transformers are used to step down the 33kV and 11kV voltage to 400/230 V. The 3-phase, 50 Hertz, oil-immersed, natural-cooled transformers suitable for outdoor installation and having kVA rating of 25, 50,100,150 & 200 shall be used for distribution of electricity. However, the higher kVA rating of distribution transformer may be required at some locations in the metropolitan cities where there is large density of load. In rural areas, single-phase distribution transformer of 5 kVA, 15-kVA and 25 kVA rating may be used. The use of 33/0.4 kV transformer in distribution system shall be discouraged.

2.8 Protective Devices

2.8.1 Surge arresters and fused cutouts shall be provided for the protection of all distribution transformers and surge arresters shall be employed to protect all apparatus. Surge arresters will also be applied at normally open points in the loop to mitigate traveling waves.

2.8.2 The Zinc Oxide type of surge arrester having ground lead disconnect feature incorporated shall be used for the lightning protection; 30 kV class, for 33 kV and 9 kV class, for 11 kV voltage level.

2.8.3 The circuit distribution cutouts of 36 kV and 12 kV class with 100-amp fuse holder and having symmetrical current interruption rating of 12.5kA shall be used for 33 & 11 kV respectively.

2.8.4 The secondary of all the distribution transformers shall be protected with MCCB of suitable ratings.

2.9 Energy Meters

All the consumers shall be provided with energy meters and it shall be bottom connected. The type of meter and metering shall be as mentioned in 1.2.12 above.

3.0 33/ 11kV SUB-STATION

33 kV lines emanating from 220/132/33kV or 66/33kV sub- stations are extended up to the 33/11kV sub-stations. These sub-stations are planned at the load centers from where 11 kV feeders emanate for feeding 11/0.4 kV distribution transformers. The site of 33/11 kV substation is to be at the load centers but at the same time it has to be convenient from the point of view of approach and free from obstruction. The place should have minimum amenities for the staff.

The substation is to be properly planned so that it caters the future load growth at least for 15 years without any further augmentation, kW-km is within permissible limits and maintenance is easy and economical. There should be enough clearance and space for incoming and outgoing feeders and future expansion.

3.1 Sub-Station Equipments

3.1.1 Bus-Bars

The strain type bus-bars in over-head system shall be used. In this system, wires are strung between two supporting structures with help of disc insulators. The stringing tension should be limited to 500 to 900 kg depending upon the size of conductor used. The conductor normally used for 33 kV bus-bars shall be ACSR or AAC Conductor, the size being as per load requirement of area sub-station. The bus bars and connections are so placed that a minimum of 4 m ground clearance is maintained.

3.1.2 **Circuit Breakers**

Circuit breakers are used for making or breaking a contact in the supply system, but mainly its duty is to break the supply of a faulty system so that it gets isolated from the healthy system.

3.1.2.1 Outdoor vacuum circuit breaker shall be used for 33kV applications. It shall be mounted on individual structures in a fixed position in such a way that adequate section clearances are always available from its live parts.

3.1.2.2 The rupturing capacity for 33kV VCB is generally 630 MVA. However, higher rupturing capacity may be required if fault level is higher.

3.1.2.4 Indoor metal clad vacuum circuit breaker (withdrawal type) shall be used for 12 kV applicable. The fault interrupting capacity of the breaker shall be 25 kA at 11kV for solidly grounded system.

3.1.2.5 The rated current capacity of breaker for incomer and bus coupler shall be 1200 A and that for outgoing feeder 630 A.

3.1.3 **Disconnecting Switches**

3.1.3.1 Disconnecting Switches shall be used for transfer of loads from one bus to another and also to isolate equipment for maintenance.

3.1.3.2 The disconnecting switches with grounding switch shall be able to carry the rated current 800A continuously and rated short time current of 20 kA for three seconds.

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

3.1.3.4 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.

3.1.4 **Instrument transformers**

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

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

3.1.4.3 33 kV Current Transformer Outdoor, oil immersed shall have rated burden 50 VA, accuracy class 5P/20 for protection and 0.5 for metering.

3.1.4.4 33 kV Voltage Transformer Outdoor, oil immersed shall have rated burden for each winding 100 VA, accuracy class 3P for protection and 0.5 for metering

3.1.4.5 The Current Transformers of 11 kV shall be Epoxy Resin insulated block type. Current Transformers shall have rated burden 30 VA, accuracy class 5P/20 for protection and 0.5 for metering.

3.1.4.6 The Voltage Transformer of 11 kV shall be Epoxy Resin insulated block type. Current have rated burden for each winding 100 VA, accuracy class 3P for protection and 0.5 for metering.

3.1.4.7 The current transformers may have ratings according to the capacity of transformer and load of 33 kV or 11 kV feeders. The secondary is usually rated at 5 amperes.

3.1.4.8 The primary voltage of Voltage Transformer shall be 33 kV or 11 kV but the secondary voltage is 110 volt.

3.1.5 Power Transformers

3.1.5.1 The power transformers are used to step down voltage from 33 kV to 11kV.The primary side of the power transformer is delta connected while the secondary side is star connected.

3.1.5.2 The power transformer shall be oil immersed; ONAN, outdoor type, three phase, and 50 hertz with capacities of 1.5 MVA, 3.0 MVA or 6/8 MVA depending upon load density.

3.1.5.3 The Transformer should be capable of operating continuously at its rated output without exceeding the temperature rise limits

3.1.5.4 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.

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

- The voltage varying ± 10% of rated Voltage.
- The Frequency varying ± 5% of rated Frequency.

3.1.6 Lightning Protections

3.1.6.1 Lightning arrestors are provided on power as well as distribution transformers or at important locations at the substations where the lines are terminated or from where the lines are extended.

3.1.6.2 The rated voltage of 33 kV lightning arrester side shall be 30kV. The break-down insulation level of the L.A. shall be 200 kV and discharge current rating shall be 10kA

3.1.6.3 The rated voltage of 11 kV lightning arrester side shall be 9 kV. The break-down insulation level of the L.A. shall be 200 kV and discharge current rating shall be 5kA.

3.1.7 **Power and control Cables**

3.1.7.1 The low voltage cables shall be 1100V grade polyethylene insulated, armored and PVC sheathed. Low voltage power cables shall be suitable for grounded neutral with phase to phase voltage level of 400V and phase to neutral voltage of 230 V AC system and 110V DC system.

3.1.7.2 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.

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

3.1.8 **Battery and Battery Charger**

3.1.8.1 For 33/11 kV Sub-station, the maintenance free battery and suitable battery charger for 110V DC system complete with all necessaries for efficient and trouble-free operation shall be provided. The minimum capacity shall be not less than 240 AH.

3.1.8.2 The Maintenance free Battery shall be rated for supplying total DC load of the each substation. The duration of the load shall be ninety (90) minutes.

3.1.8.3 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.

3.1.8.4 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 variations on the AC side. Cooling shall be by means of natural convection.

3.1.8.5 The minimum rating of the battery charger shall be not less than 75 amperes.

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

3.1.8.7 The instruments, switches and lamps shall be flush or semi flush mounted on the front panel

3.1.9 **Earthing system**

Pipe earthing or rod earthing is provided for sub-station.

3.1.9.1 Provision of adequate earthing in a sub- station is an extremely important for the safety of the operating personnel as well as proper operation of the system and protective device.

3.1.9.2 The resistance to ground should be as low as possible. It should not exceed 1 ohm and in exceptional cases up to 2 ohm for small sub- station.

3.1.9.3 The step and touch potentials should be within safe limit.

3.1.9.4 An earthing network is made by connecting all the earthing in a mesh.

3.1.9.5 The neutral point of each system should have two independent earths.

3.1.9.6 Lightning arrestor should have independent earth electrode.

3.1.10 **Metering and relays**

3.1.10.1 Ammeter and voltmeters are connected through the secondary of C.T and P.T

3.1.10.2 The protective relay system (Over current and earth fault relays) is also connected through the secondary of 5 ampere of C.T and 110 volt of PT.

3.1.10.3 33 kV lines, 11 kV incoming feeder and 11 kV outgoing feeders are also provided with energy meters.

3.1.10.4 11 kV protection system consists of earth fault and over current relays.

4.0 **Construction Standards**

The Construction Standards provide construction directives construction drawings, and associated bill of materials described herein.

The Construction Standards document is designed to be used for ongoing 33 kV and 11 kV constructions in Nepal. Accordingly, it is formulated in sections, and each section is arranged to permit future inclusion of construction directives for future structures, materials and procedures which NEA may implement.

5.0 **Norms standardized by Nepal Electricity Authority for Rural Electrification /Line Extension Program:**

- ❖ Maximum Allowable Distance (from Substation) for 33 kV Line: 60 Km
- ❖ Maximum Allowable Distance (from Substation) for 11 kV line: 20 Km
- ❖ Maximum Allowable Distance (from transformer) for LT Line: 2 Km
- ❖ Conductor size to be used in 33 kV Line: 100 sq.mm ACSR
- ❖ Conductor size to be used in 11 kV Line: 50 & 100 sq.mm ACSR
- ❖ Maximum Allowable Voltage Drop in 33 kV & 11 kV Line: ± 5%

6.0 **KVA-KM Factor (for different conductors) to be used to calculate % voltage drop:**

Conductor	R/Km	X/Km	Cosø	Sinø	Rcosø+X sinø	Voltage (kV)	KVA-KM Factor
100sq.mm Dog	0.3507	0.363	0.85	0.526	0.489033	33	22268.436
100sq.mm Dog	0.3507	0.363	0.85	0.526	0.489033	11	2474.271
50 sq.mm Rabbit	0.675	0.382	0.85	0.526	0.774682	11	1561.931
30 sq.mm Weasel	1.1	0.409	0.85	0.526	1.150134	11	1052.051

% Voltage Drop = (KVA* Km) / (KVA-KM Factor)

NEPAL ELECTRICITY AUTHORITY
DISTRIBUTION AND CONSUMER SERVICES
TECHNICAL AND COMMERCIAL SERVICES DEPARTMENT

DRAWINGS
OF
CONSTRUCTION STANDARD

2007 FERBURY

CONTENT

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8. LOW VOLTAGE DISTRIBUTION SYSTEM

8.1	D-BRACKET FOR LV LINE SUPPORT IN POLE	CSLV-G-01
8.2	H.T METERING UNIT TOWER SET	CSLV-G-02
8.3	STEEL METER BOX FOR 3 PHASE METER	CSLV-G-03
8.4	SERVICE CONNECTION (INSULATED WIRES)	CSLV-G-04
8.5	CONNECTION ARRANGMENT OF CT OPERATED METER FOR LT	CSLV-G-05
8.6	CONNECTION ARRANGMENT OF CT OPERATED METER FOR HT	CSLV-G-06
8.7	O/H 400/230 V INTERMEDIATE SUPPORT (0 DEG DEVIATION)	CSLV-CC-01
8.8	O/H 400/230 V INTERMEDIATE ANGLE SUPPORT (15 TO 60 DEG DEVIATION)	CSLV-CC-02
8.9	O/H 400/230 V INTERMEDIATE ANGLE SUPPORT (DEVIATION UP TO 30 DEG)	CSLV-CC-03
8.10	O/H 400/230 V THREE OR FOUR WAY ARRANGEMENT (DEVIATION OVER 30 DEG)	CSLV-CC-04
8.11	O/H 400/230 V INTERMEDIATE ANGLE SUPPORT WITH TEE-OFF CONNECTION	CSLV-CC-05
8.12	LV O/H POLE WITH D-BRACKET	CSLV-CC-06
8.13	ABC -SUSPENSION TYPE A USING STEEL TELESCOPIC POLE	CSLV-ABC-01
8.14	ABC- SUSPENSION TYPE WITH AN ANCHOR FOR DEAD-TYPE B USING STEEL TELESCOPIC POLE	CSLV-ABC-02
8.15	ABC -FOUR ANCHOR DEAD-TYPE C USING STEEL TELESCOPIC POLE	CSLV-ABC-03
8.16	ABC -ONE SUSPENSION WITH TWO ANCHORS DEAD END TYPE E USING STEEL TELESCOPIC POLE	CSLV-ABC-04
8.17	ABC -SINGLE ANCHOR DEAD END TYPE F USING STEEL TELESCOPIC POLE	CSLV-ABC-05
8.18	ABC -SUSPENSION TYPE A USING PSC POLE	CSLV-ABC-06
8.19	ABC- SUSPENSION TYPE WITH AN ANCHOR FOR DEAD-TYPE B USING PSC POLE	CSLV-ABC-07
8.20	ABC -FOUR ANCHOR DEAD-TYPE C USING PSC POLE	CSLV-ABC-08
8.21	ABC -ONE SUSPENSION WITH TWO ANCHORS DEAD END TYPE E USING PSC POLE	CSLV-ABC-09
8.22	ABC -SINGLE ANCHOR DEAD END TYPE F USING PSC POLE	CSLV-ABC-10
8.23	SUSPENSION CLAMP	CSLV-ABC-11
8.24	CONCEPTUAL ANCHOR CLAM FOR ABC CABLES	CSLV-ABC-12
8.25	PIG TAIL WITH ADJUSTABLE EYE AND DOUBLE EYE FITTING	CSLV-ABC-13

8.26	SEMICIRCULAR CLAMP FORTELESCOPIC POLE	CSLV-ABC-14
8.27	GROUNDING SYSTEM	CSLV-GR-01
8.28	DISTRIBUTION TRANSFORMER STATION GROUNDING SYSTEM	CSLV-GR-02
8.29	DETALS OF GROUNDING ELECTRODE	CSLV-GR-03
8.30	TYPICAL PLATE AND PIPE EARTHING	CSLV-GR-04

1 INTRODUCTION

These Construction Standards shall be applicable for the distribution lines of 33 kV, 11 kV and 400/230 kV categories. The standards consist of the following items:

2 CLEARANCES

These Construction Standards cover the minimum vertical Clearances required between the power lines and the ground as well as the minimum horizontal clearances ground as well as the minimum horizontal clearances between the power Lines and buildings, trees, etc.

3 LEGENDS

In order to facilitate understanding as well as aid in communication a set of legends described in the Construction standard.

4 SAG CHARTS

For the proper stringing of ACSR conductors, the sag charts described in the Construction Standards shall be utilized for different design conditions.

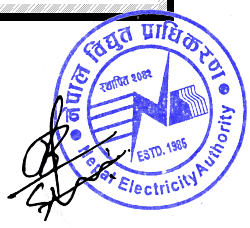
5 LINE MATERIALS

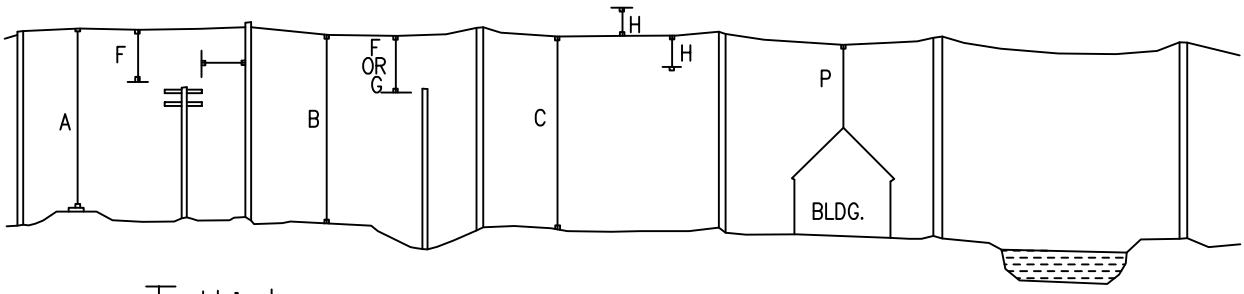
Line Materials are covered in the Construction Standards. The Construction details viz. hole patterns for pole, cross arms, etc. are shown whereas the materials aspects are covered in the respective specifications.

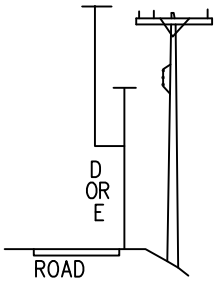
6 ASSEMBLIES

Pole and structures shall be framed in accordance with the assemblies presented in the Construction Standards. Where special assemblies are necessary, the Engineer shall provide framing instruction for the specific structure.

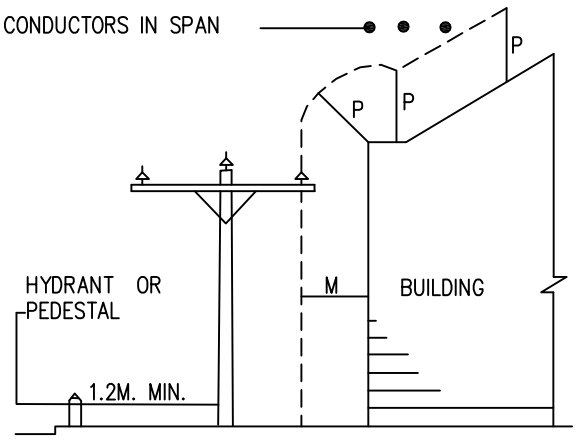
CLEARANCE AND SYMBOLS







POLES ADJACENT TO ROADS



MINIMMUM CLEARANCE FROM BUILDINGS

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

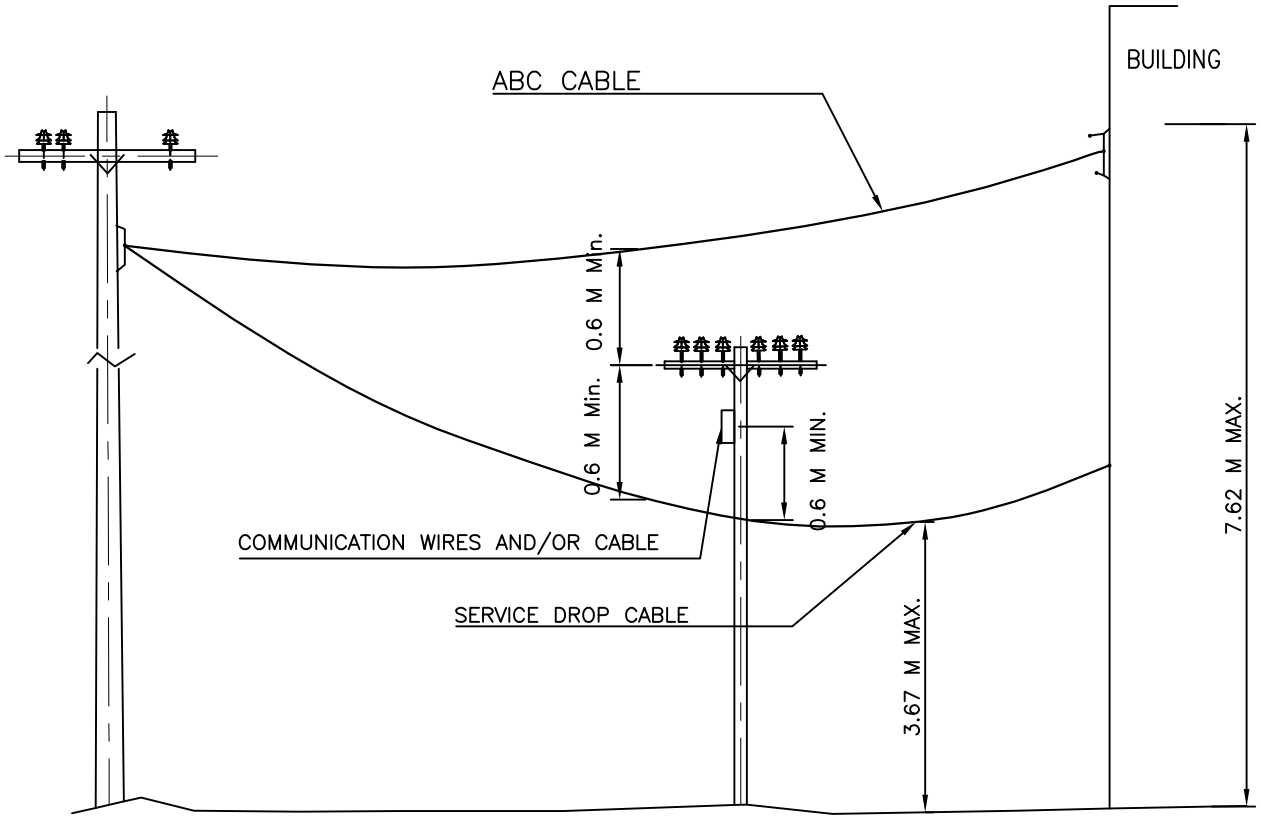
CLEARANCE M ALSO SPECIFIED HORIZONTAL CLEARANCE FROM BALCONIES.

	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

CONDUCTORS AT HIGHER LEVEL / CONDUCTORS AT LOWER LEVEL		SERVICE DROP 0 – 650 V	OPEN SUPPLY WIRES 0 – 650V	OPEN SUPPLY WIRES 651 – 11000 V	OPEN SUPPLY WIRES 33000 V	STAYS AND SUPPLY CABLES ON GROUNDED MESSENGER
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 WIRES 0 – 650 V.	—	1.30	1.80	2.70	0.60
	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.

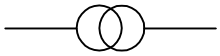
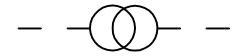
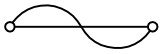
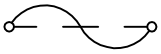
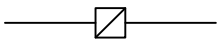
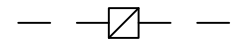
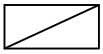
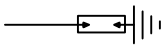
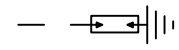
Drawing **CSG-CLR-01**	**Conductor Clearance**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services



SERVICE DROP — Install service over communication facilities where practical and attach to ploe when available; otherwise cross under communication facilities; with proper clearance.

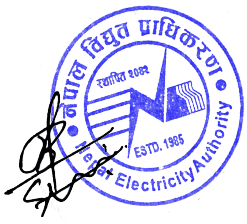
SERVICE DROP (0–600V) CROSSING OVER	CLEARANCE
DRIVEWAY TO RESIDENCE GARAGE OF OVER PARKING LOT EXCLUDING TRACKS	3.67 M.
DRIVEWAY AND COMMERCIAL PARKING LOT OR AREA SUBJECT TO TRUCK TRAFFIC	4.57 M.

Drawing CSG-CLR-02	**Conductor Clearance**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

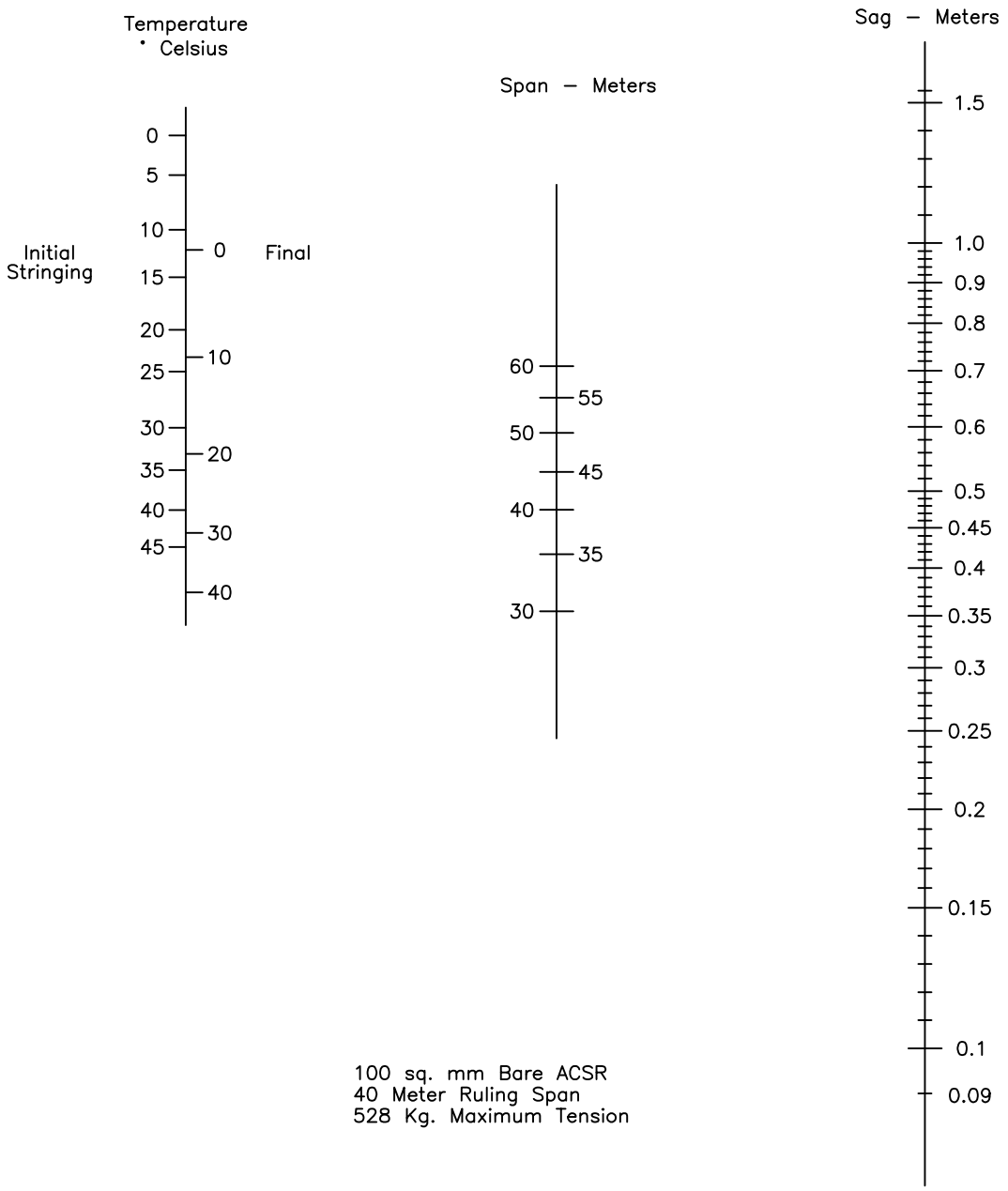
SN	ELECTRIC SYMBOLS	EXISTING	PROPOSED
1	33 kV Line		
2	11 kV Line		
3	0.4 kV Line		
4	Transformer		
5	Fuse Cutout		
6	Disconnecting Switch		
7	Load Break Switch		
8	Auto Reclosure		
9	Substation		
10	Lighting Arrester		
11	Pole Telescopic with Stay		
12	Pole P.S.C. with Stay		
13	Tapping Point		

Drawing **CSG-SYM-01**	**Electrical Symbols**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

SAG CHART

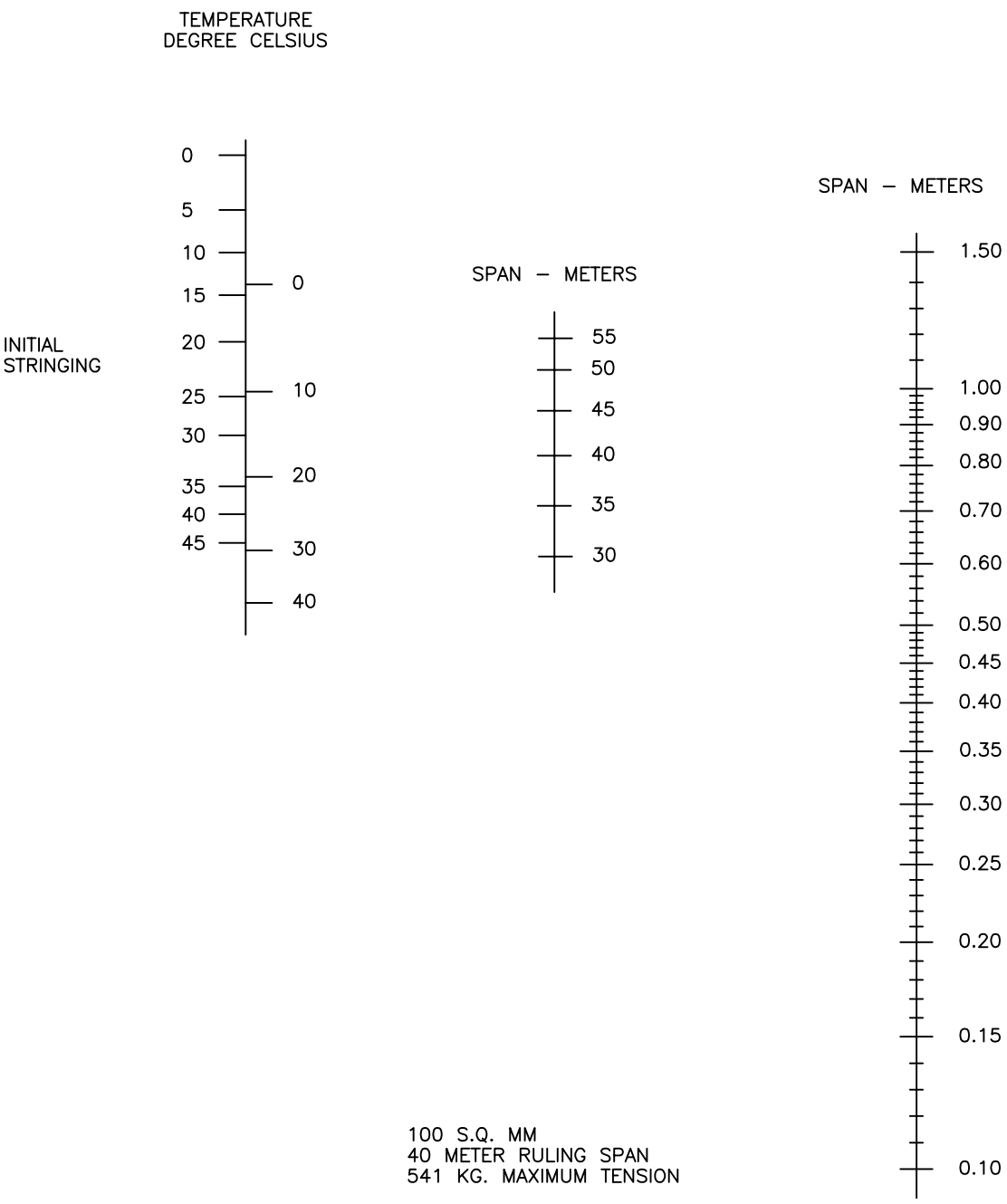


SAG CHART

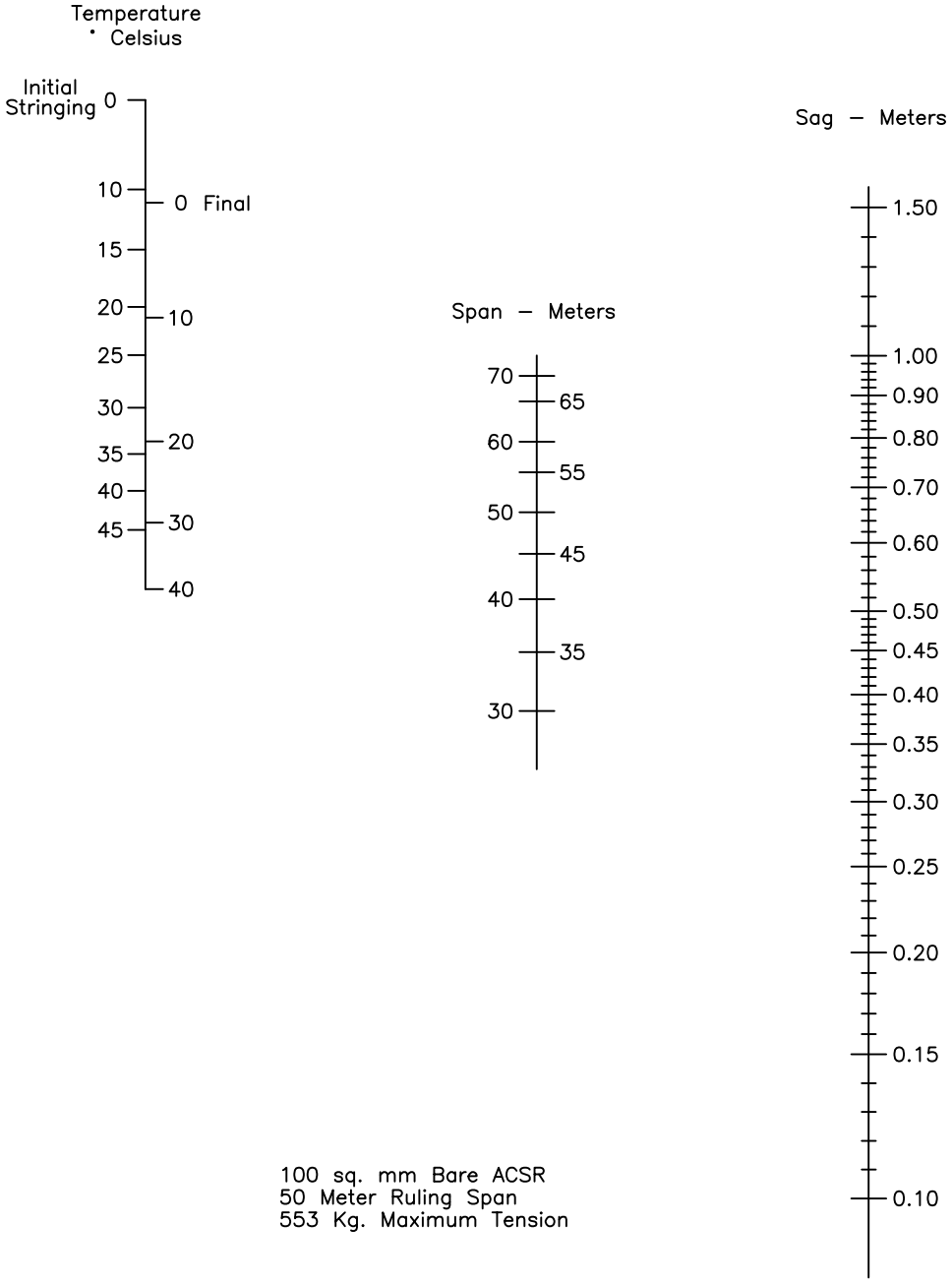


100 sq. mm Bare ACSR
40 Meter Ruling Span
528 Kg. Maximum Tension

Drawing **CSG-SAG-01**	**Sag Chart** **100 sq. mm ACSR**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

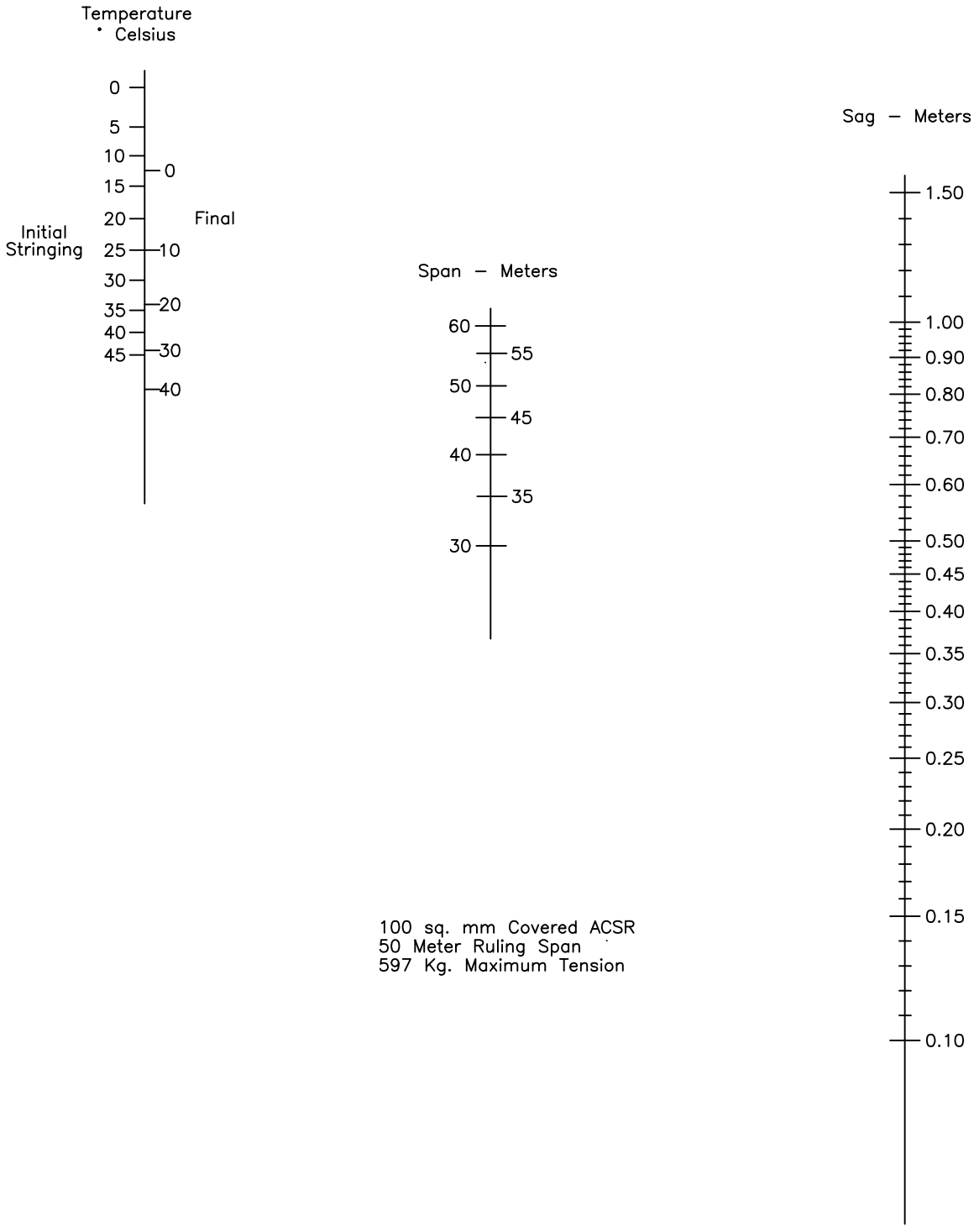


Drawing **CSG-SAG-02**	**Sag Chart** **100 sq. mm ACSR**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services



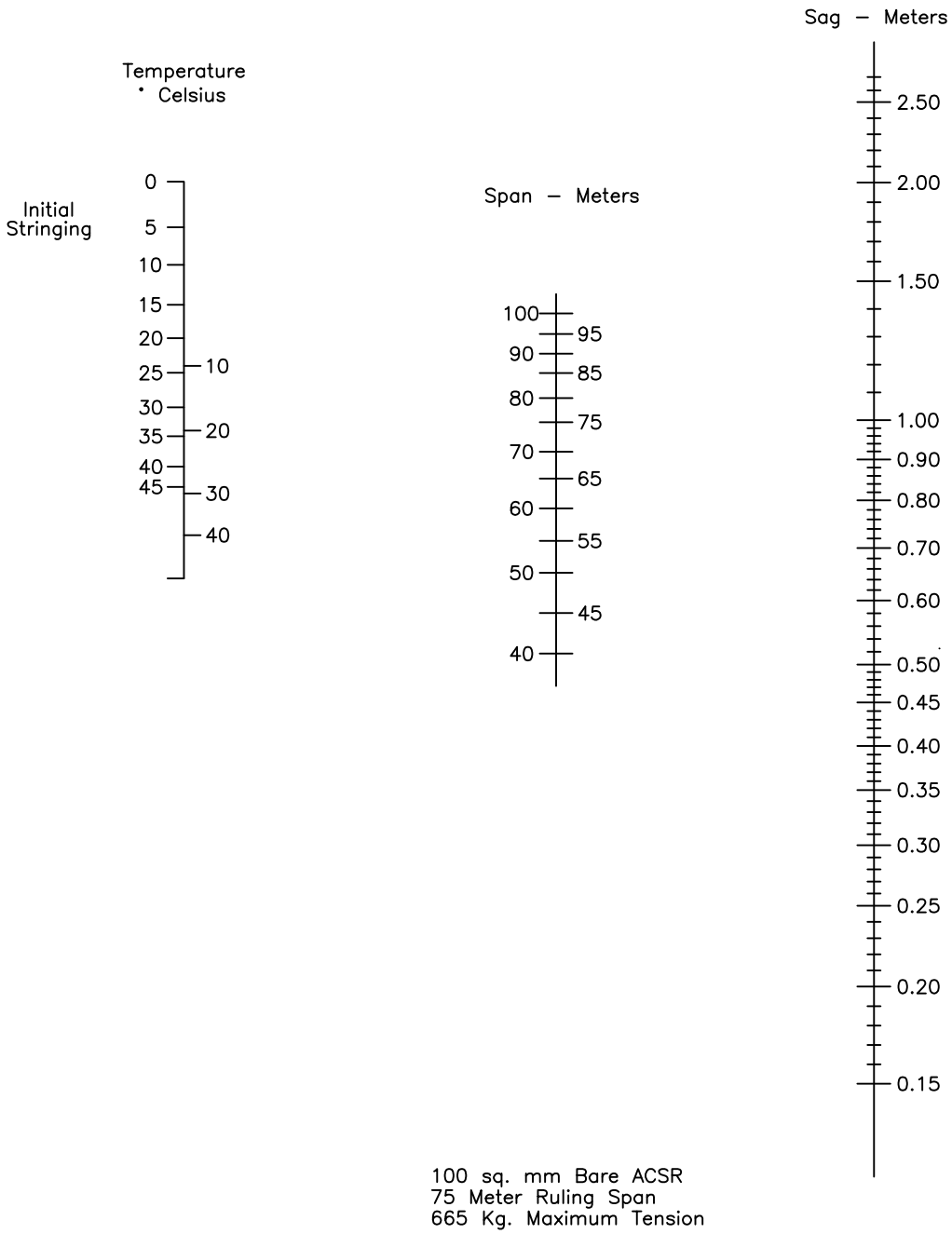
100 sq. mm Bare ACSR
50 Meter Ruling Span
553 Kg. Maximum Tension

Drawing **CSG-SAG-03**	**Sag Chart** **100 sq. mm ACSR**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services



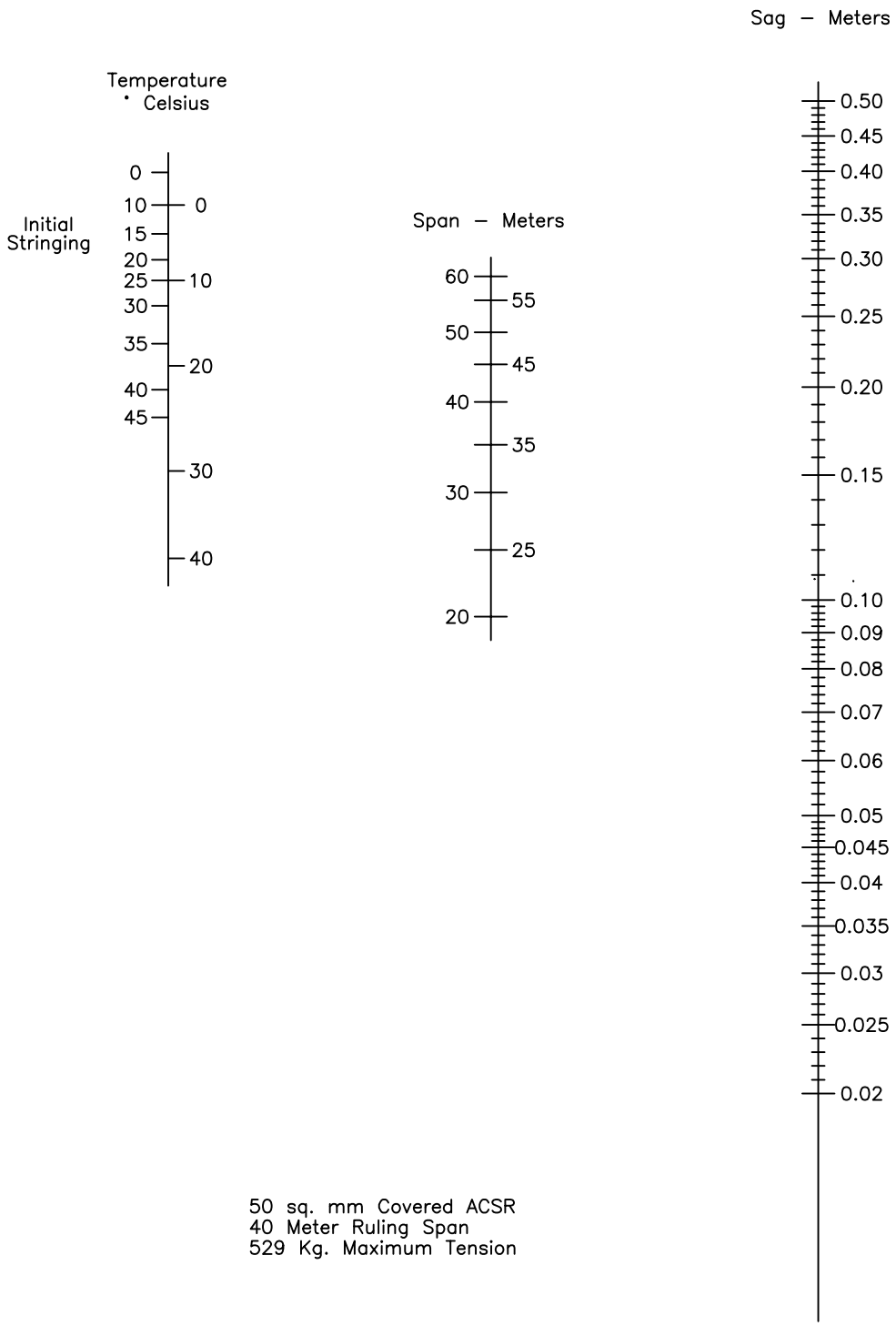
100 sq. mm Covered ACSR
50 Meter Ruling Span
597 Kg. Maximum Tension

Drawing	Sag Chart	NEPAL ELECTRICITY AUTHORITY
CSG-SAG-04	**100 sq. mm ACSR**	**Technical Services / Commercial Department**
		Distribution and Consumer Services



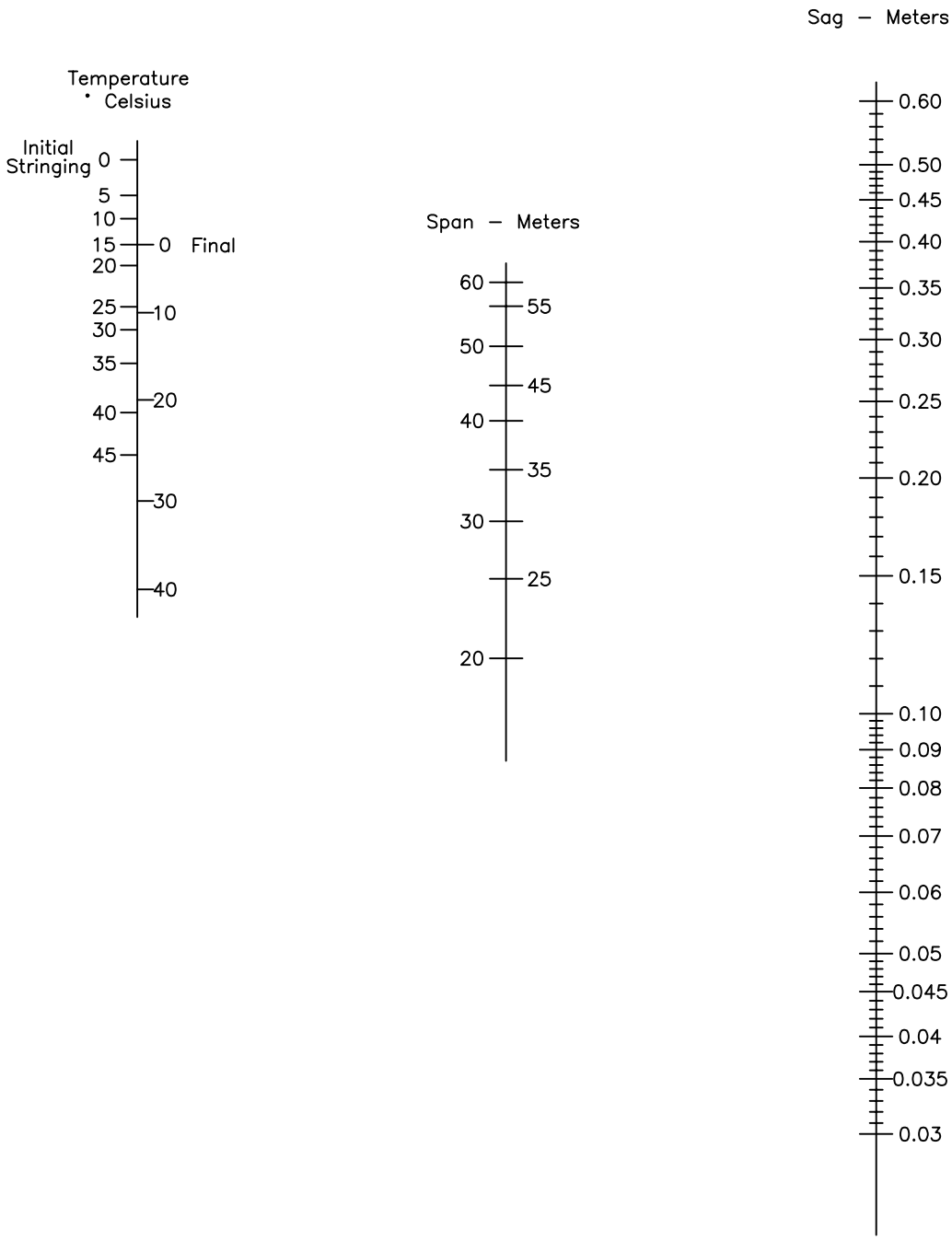
100 sq. mm Bare ACSR
75 Meter Ruling Span
665 Kg. Maximum Tension

Drawing **CSG-SAG-05**	**Sag Chart** **100 sq. mm ACSR**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services



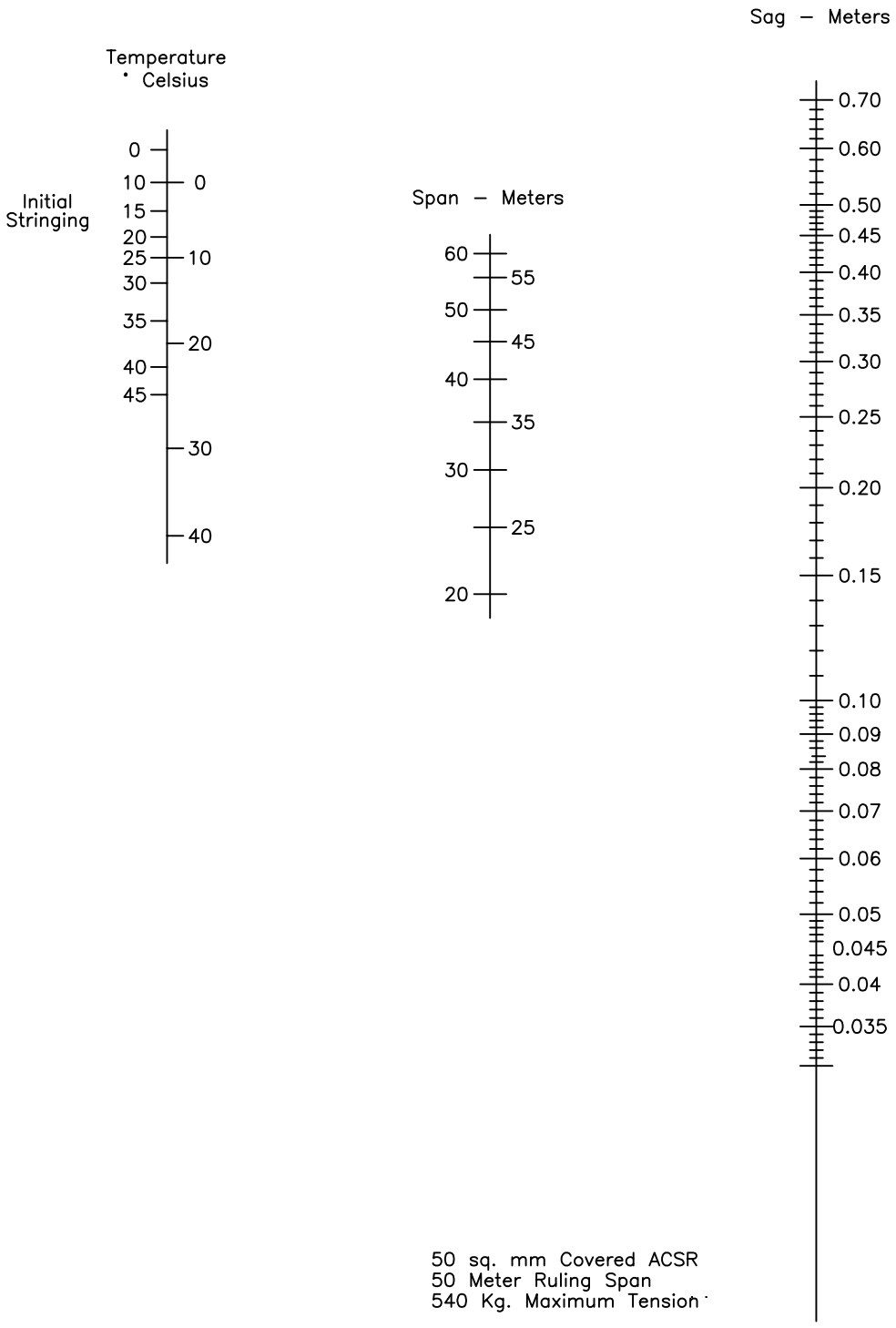
50 sq. mm Covered ACSR
40 Meter Ruling Span
529 Kg. Maximum Tension

Drawing **CSG-SAG-06**	**Sag Chart** **50 sq. mm ACSR**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

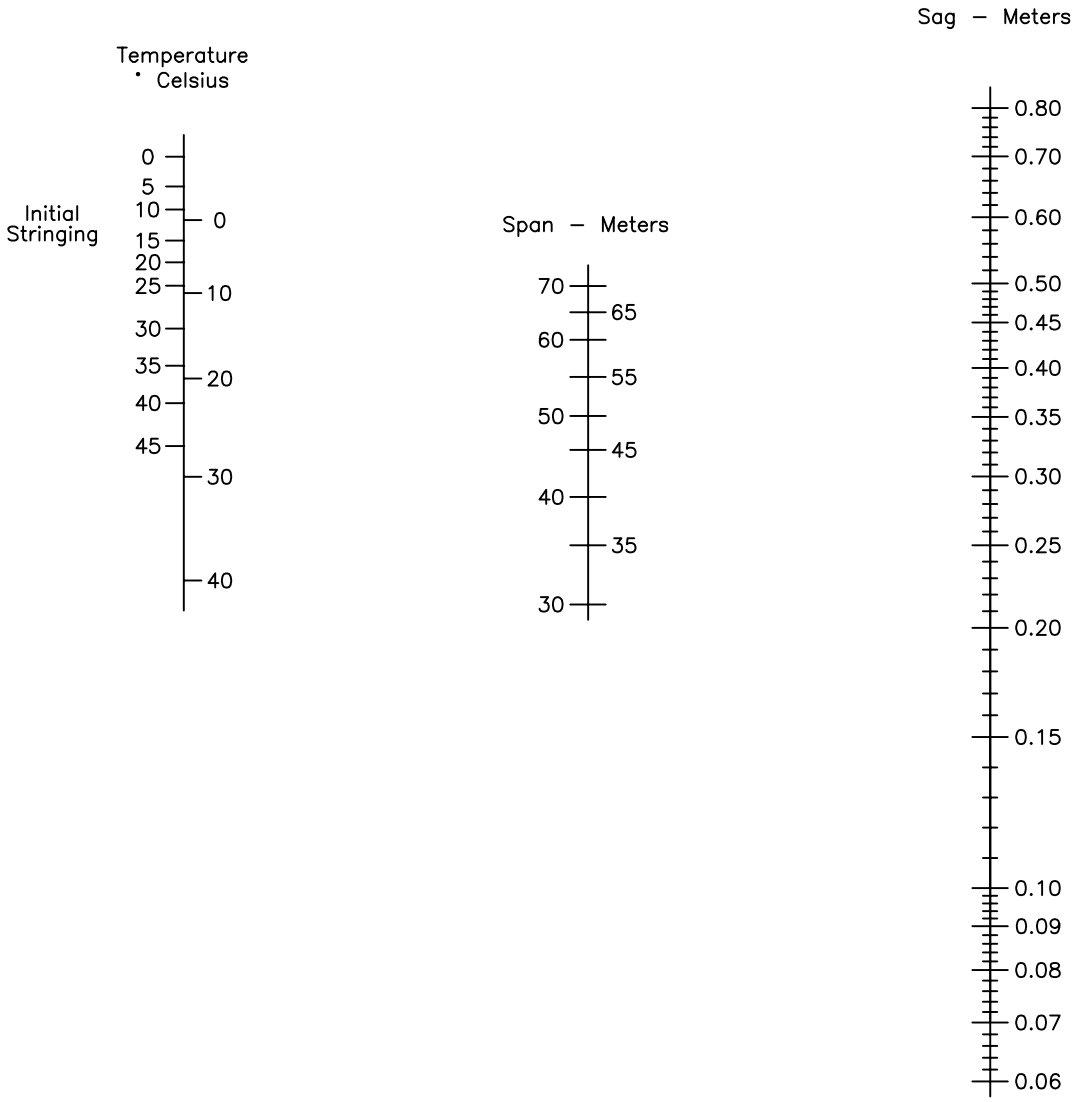


50 sq. mm Bare ACSR
40 Meter Ruling Span
540 Kg. Maximum Tension

Drawing **CSG-SAG-07**	**Sag Chart** **50 sq. mm ACSR**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

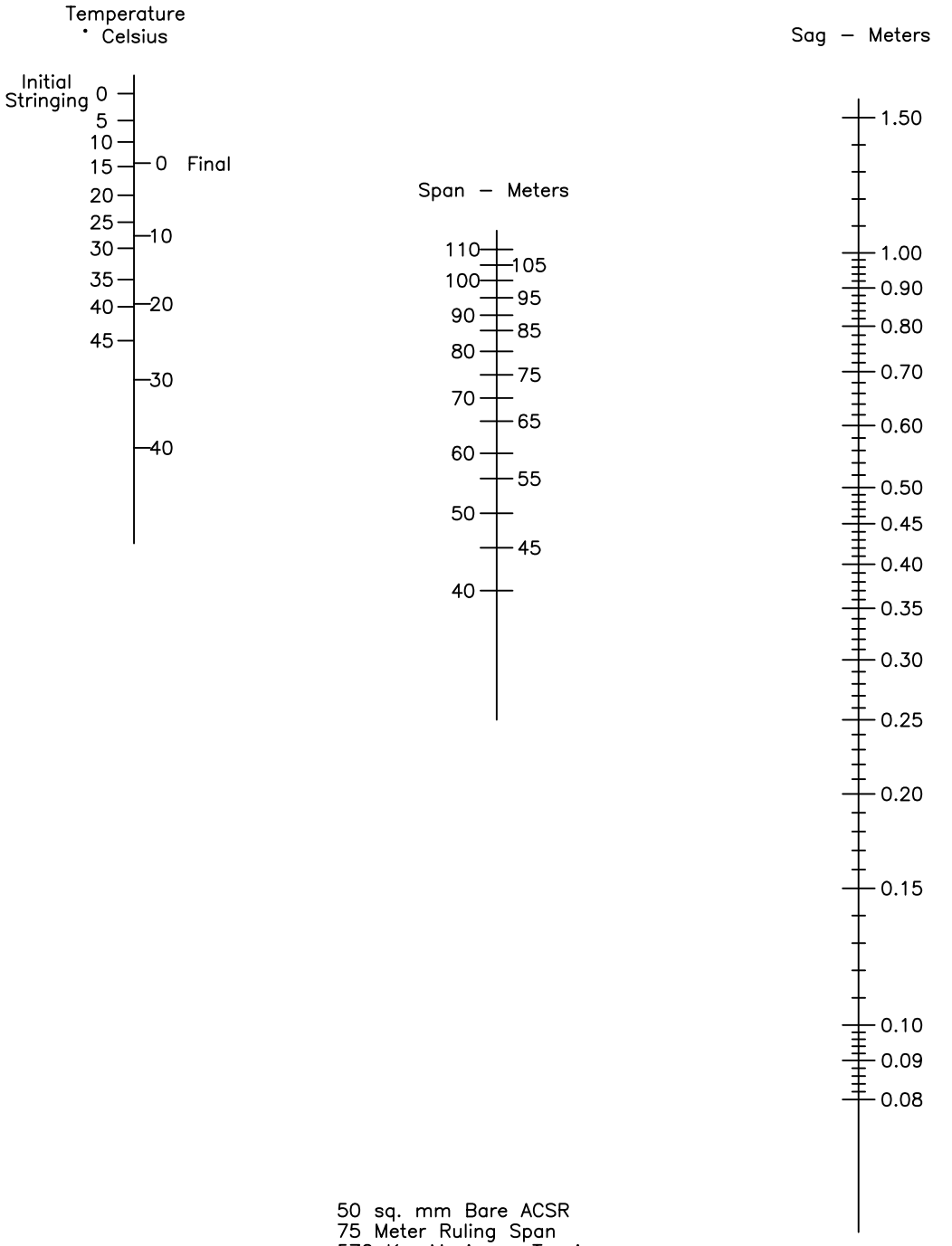


Drawing **CSG-SAG-08**	**Sag Chart** **50 sq. mm ACSR**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services



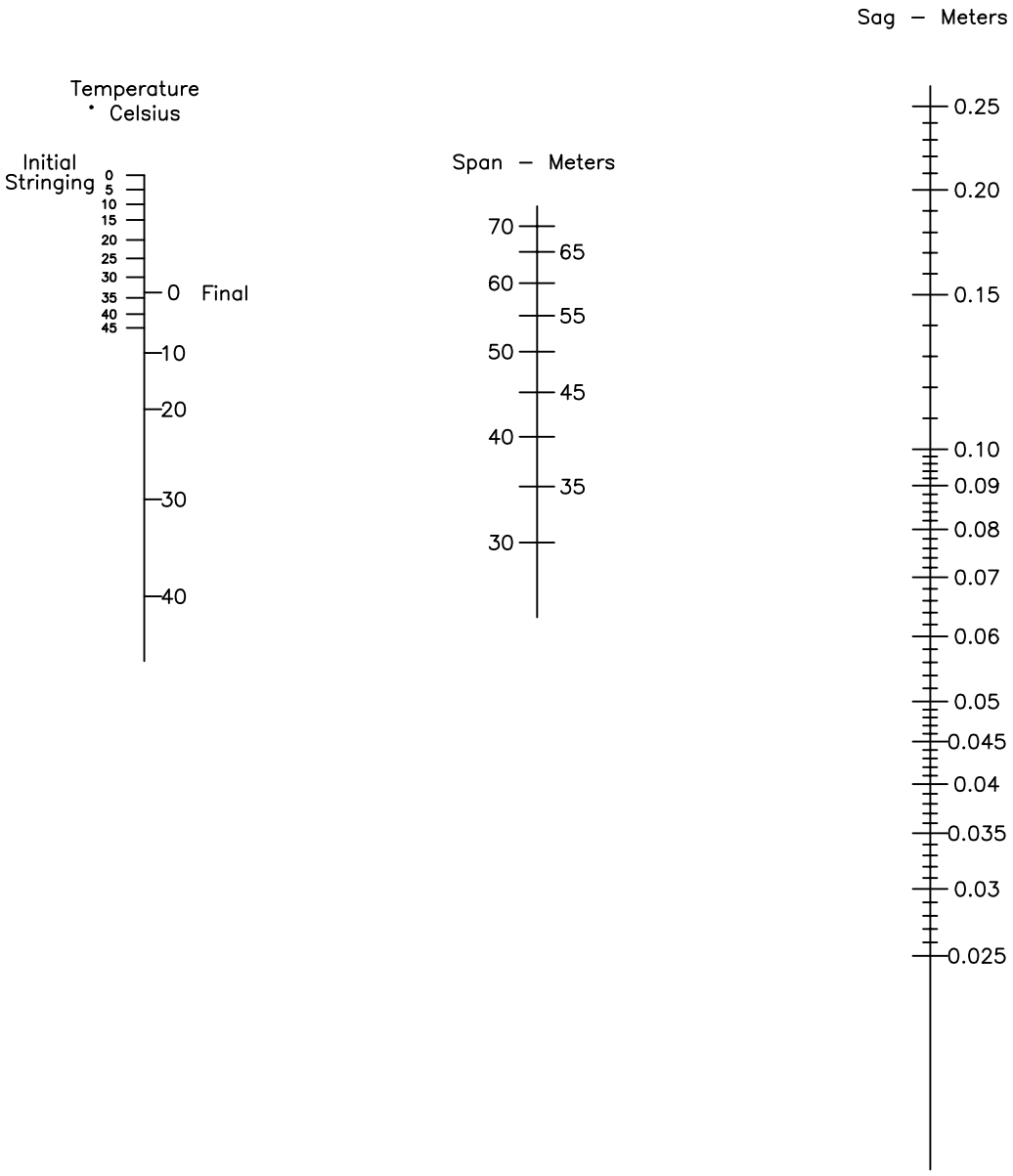
50 sq. mm Bare ACSR
50 Meter Ruling Span
555 Kg. Maximum Tension

Drawing **CSG-SAG-09**	**Sag Chart** **50 sq. mm ACSR**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services



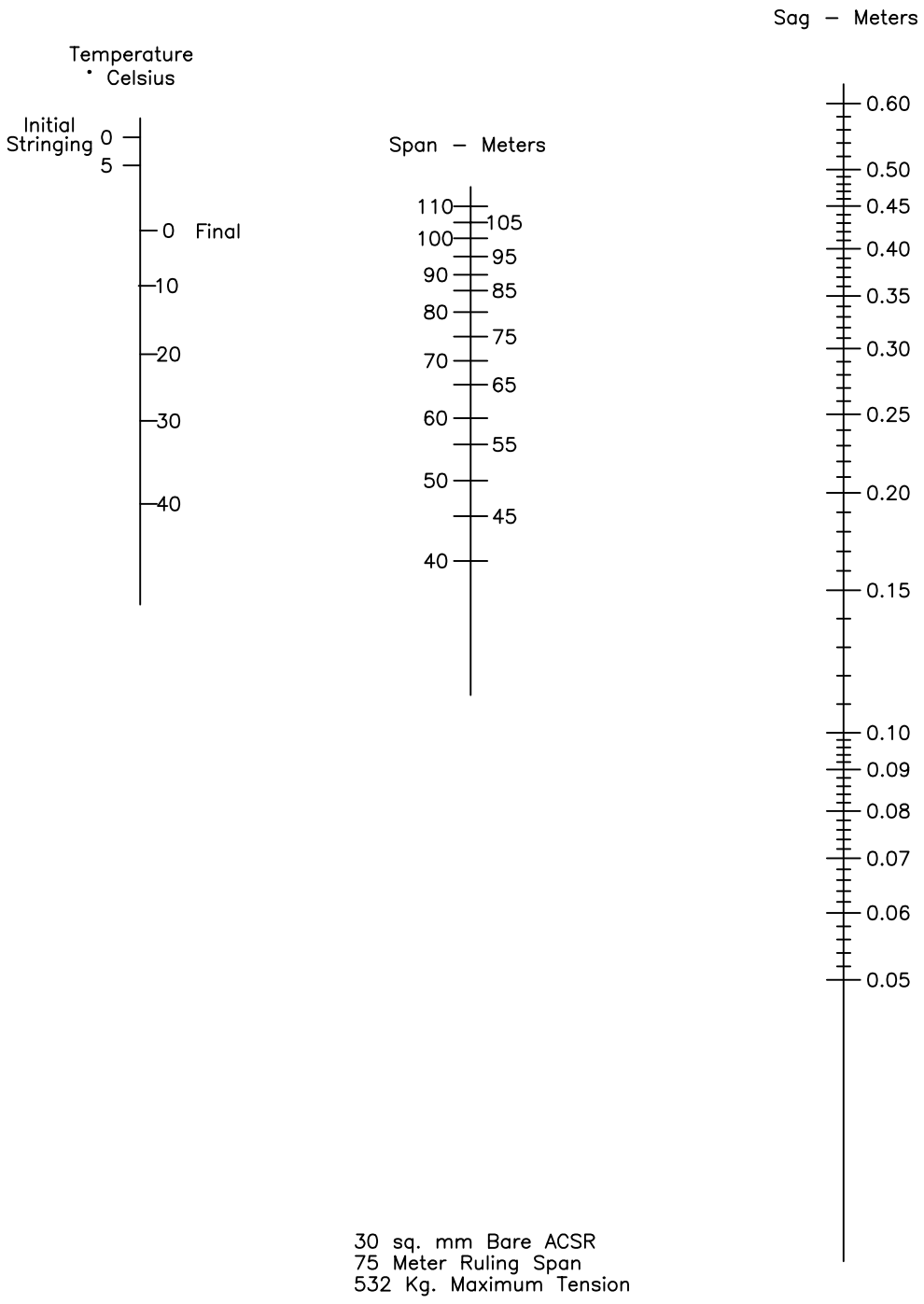
50 sq. mm Bare ACSR
75 Meter Ruling Span
572 Kg. Maximum Tension

Drawing **CSG-SAG-10**	**Sag Chart** **50 sq. mm ACSR**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services



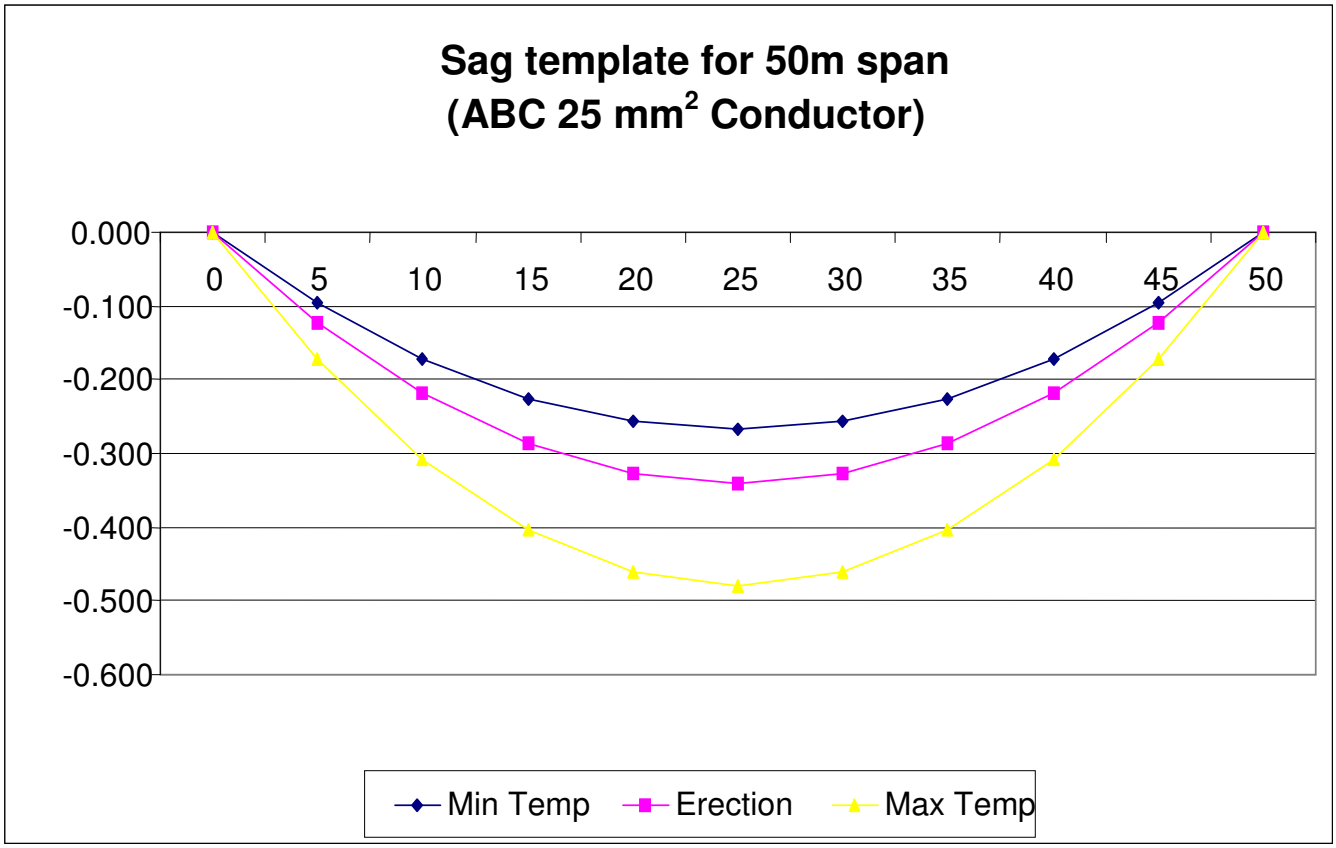
30 sq. mm Bare ACSR
50 Meter Ruling Span
517 Kg. Maximum Tension

Drawing **CSG-SAG-11**	**Sag Chart** **30 sq. mm ACSR**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services



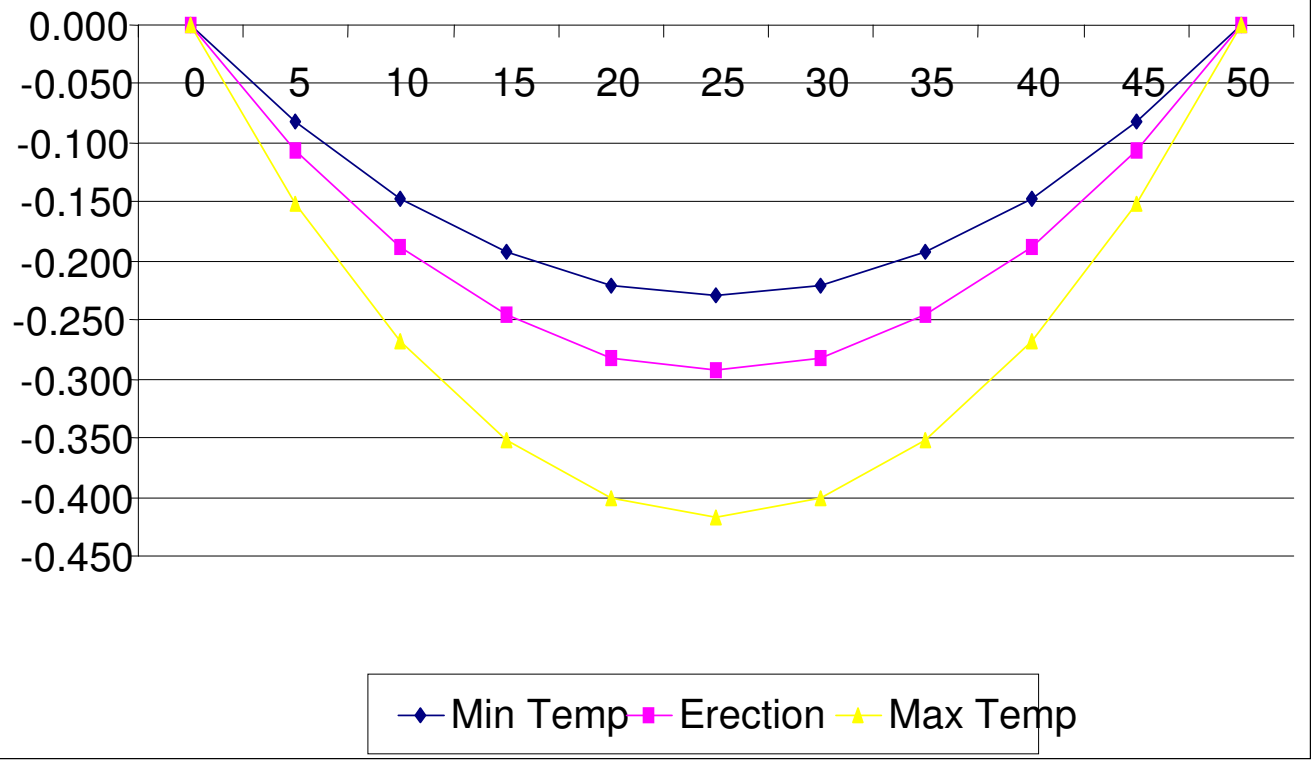
30 sq. mm Bare ACSR
75 Meter Ruling Span
532 Kg. Maximum Tension

Drawing **CSG-SAG-12**	**Sag Chart** **30 sq. mm ACSR**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services



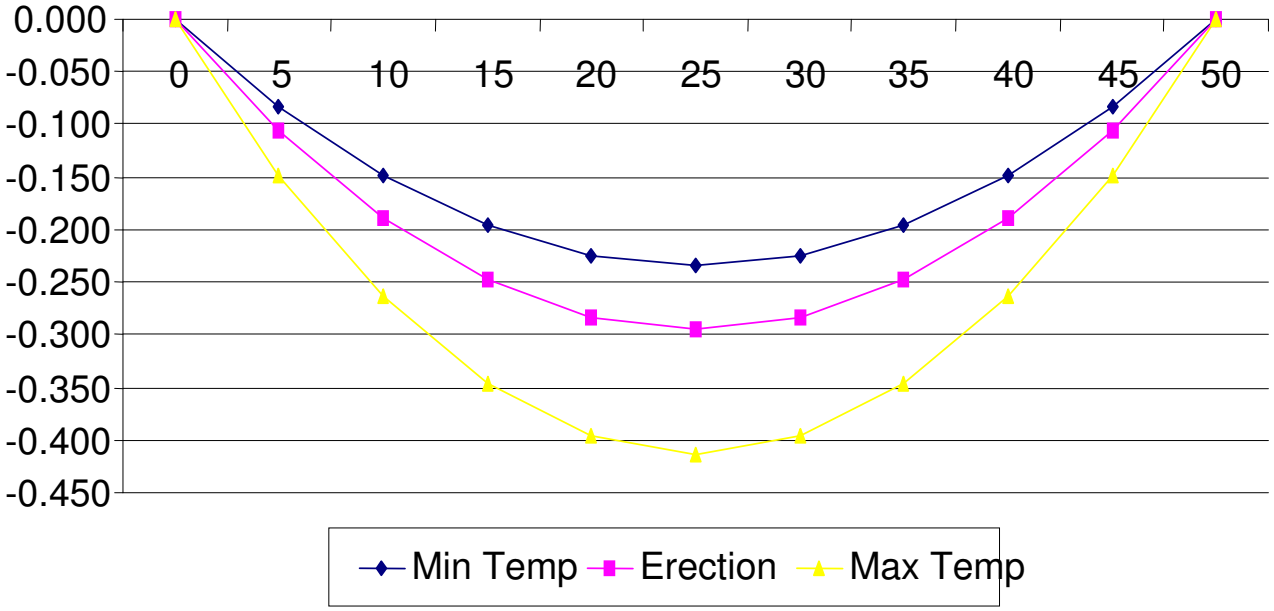
Drawing **CSG-SAG-13**	**ABC-SAG CHART** **25 SQ MM**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

Sag template for 50m span
(ABC 50 mm^2 Conductor)



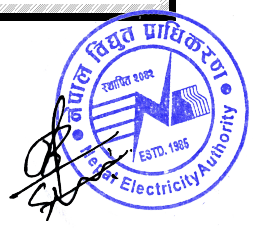
Drawing **CSG-SAG-14**	**ABC-SAG CHART** **50 SQ MM**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

Sag template for 50m span
(ABC 95mm^2 Conductor)



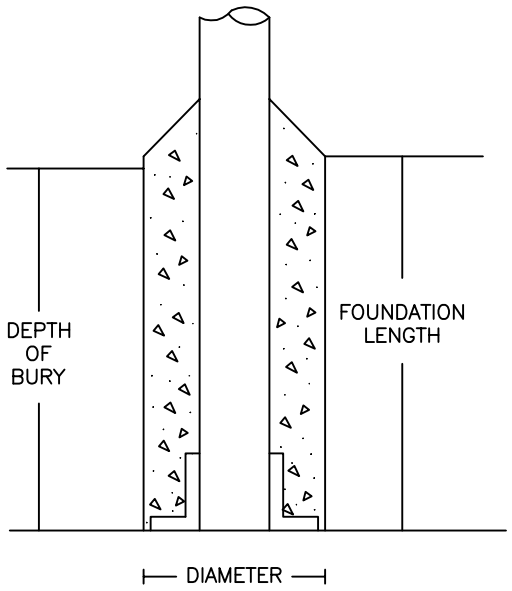
Drawing **CSG-SAG-15**	**ABC-SAG CHART** **95 SQ MM**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

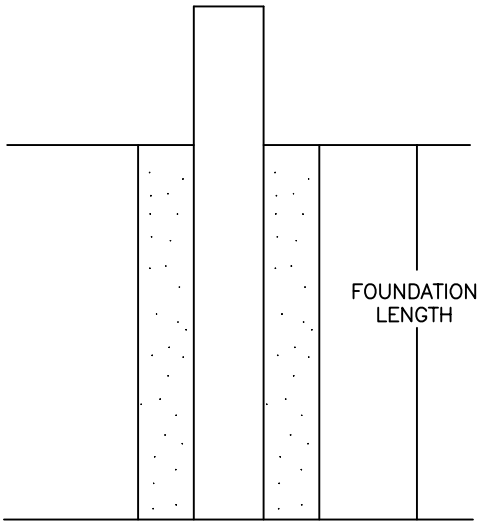
GENERAL


नेपाल विद्युत प्राधिकरण
स्थापित २०१२
ESTD. 1985
Nepal Electricity Authority

PLOE LENGTH (m.)	DEPTH OF BURIAL (m.)	FOUNDATION LENGTH (m.)	SOIL CLASS – Kg./Sq. mm.						
			0.5	0.75	1.0	2.0	3.0	4.0	5.0
			FOUNDATION DIAMETER – mm.						
9	1.5	1.6	1050	860	750	530	430	N/R	N/R
11	1.8	1.9	1080	880	760	540	440	N/R	N/R

N/R = NOT REQUIRED





FUNDATION FOR STEEL TUBULAR
AND CONCRETE POLES

FOUNDATION

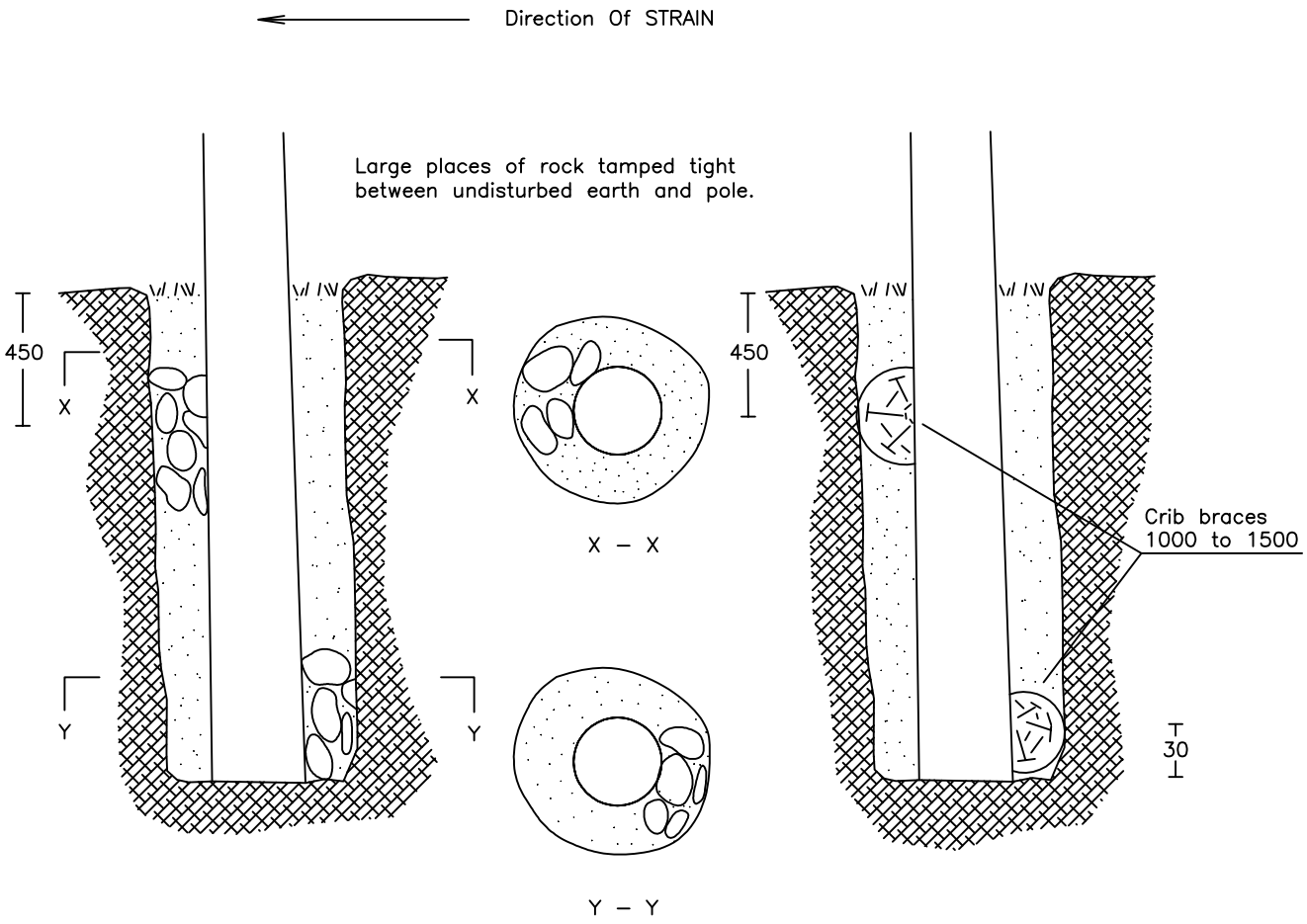
CONCRETE TO BE USED FOR FOUNDATIONS:

1 PART CEMENT
2 PART SAND
3 PART AGGREGATE

BY VOLUME

WATER – CEMENT RATIO:
32 LITERS – 50Kg. APPROX.

Drawing CSG-POLE-01	**Pole Setting**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

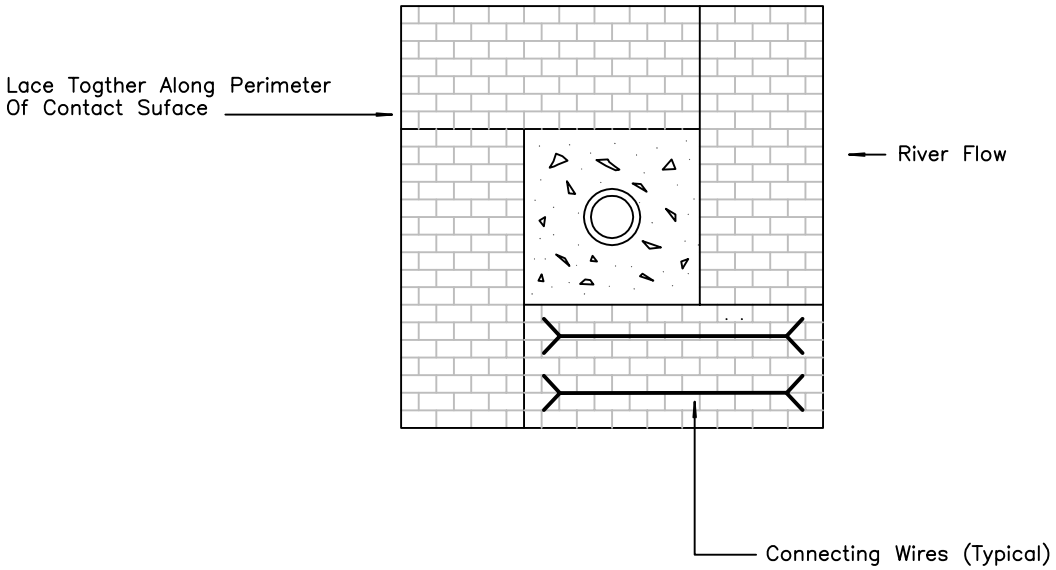


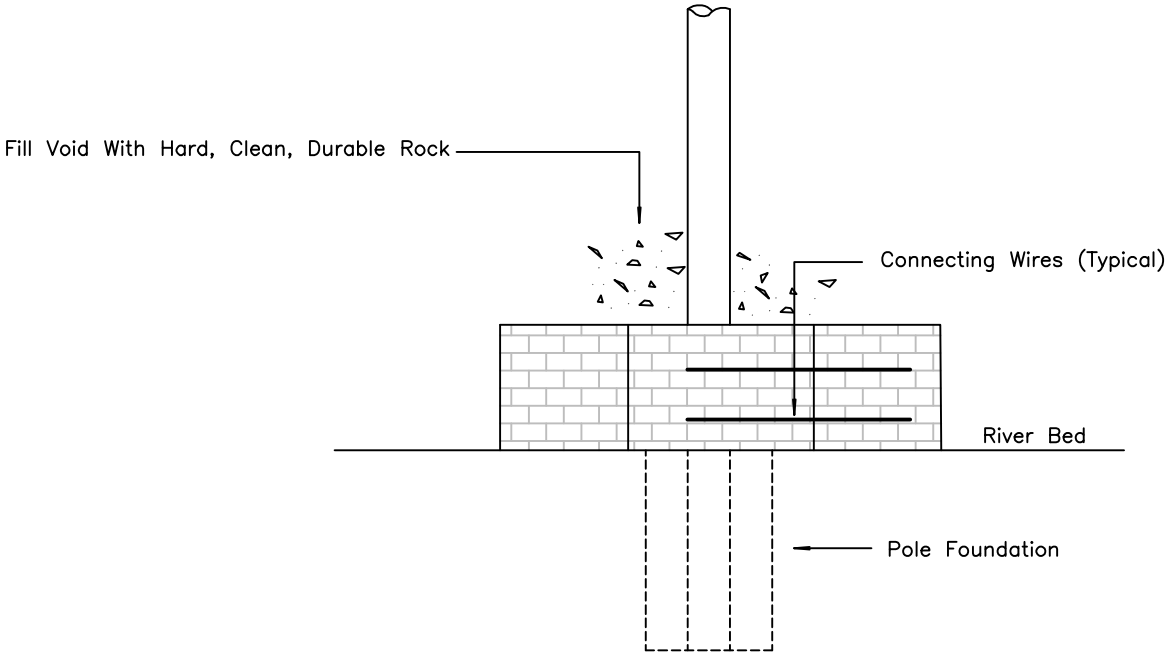
For use where ground is soild or compact.

For use where ground is soft

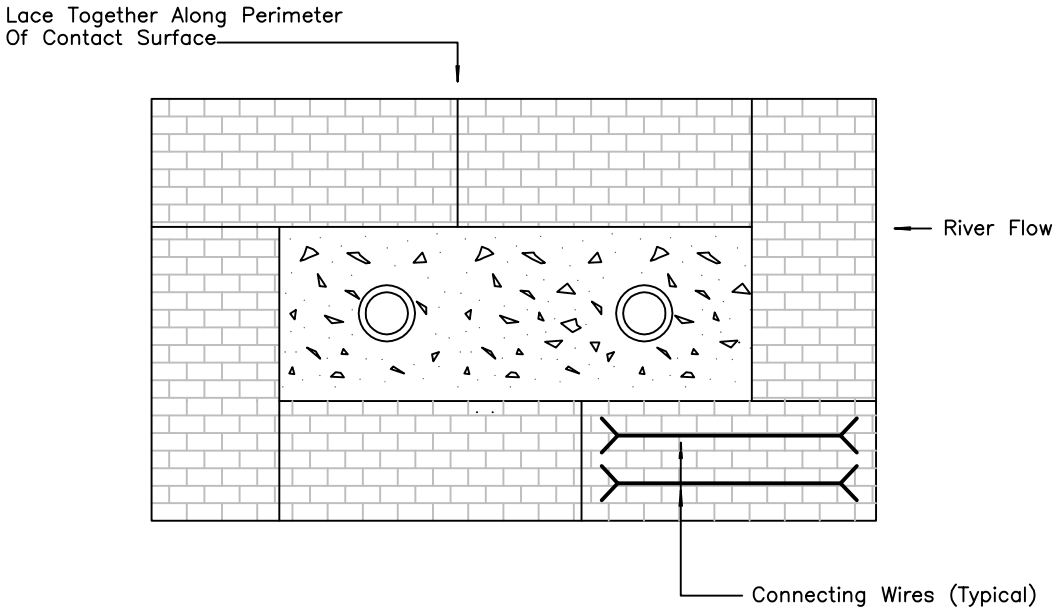
NOTE:
CRIBBING FOR POLES WITHOUT CONCRETE FUNDATIONS.

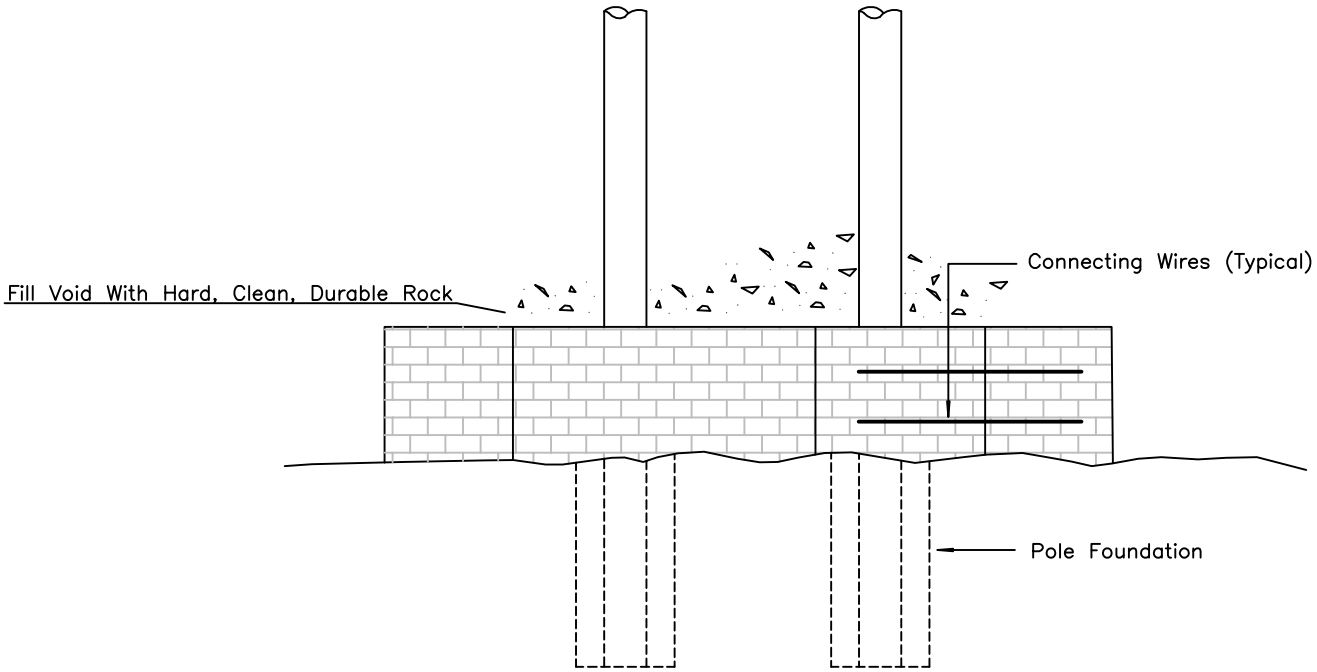
Drawing CSG-POLE-02	**Pole Burial**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services



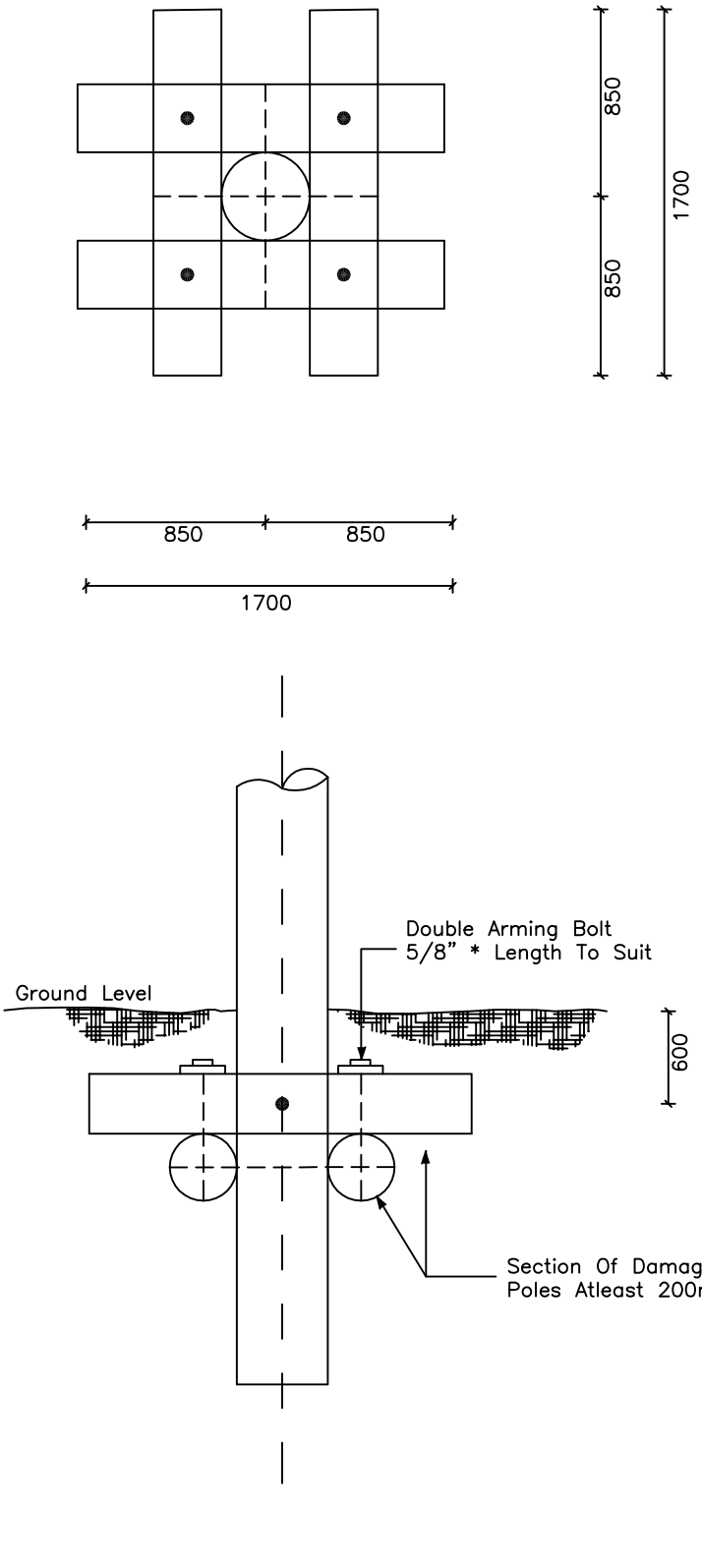


Drawing **CSG-POLE-03**	**Pole Protection in Shallow River Beds**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

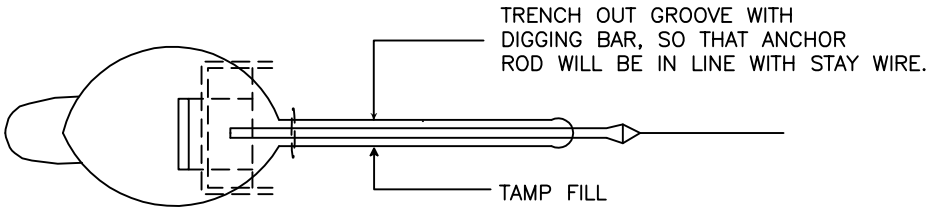


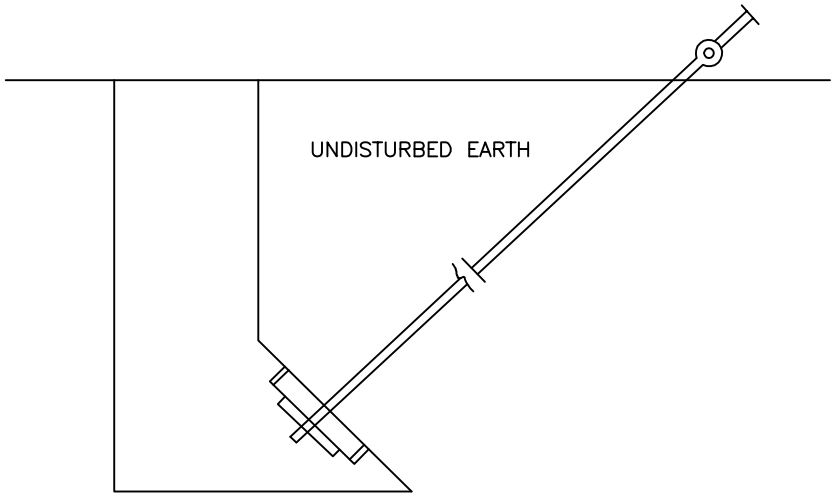


Drawing **CSG-POLE-04**	**Pole Protection in Shallow River Beds**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services



Drawing **CSG-POLE-05**	**Pole Bog Shoe**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services





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.

Drawing **CSG-STAY-01**	**Stays and Anchors**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

Refer Drawing No: CSG-Stay-02

S.No.	QTY.	UNIT	MATERIAL (HT-STAY)	MATERIAL (LT-STAY)	QTY.
1	1	NO	STAY PLATE (MS 600 X 600 MM X 6MM)	STAY PLATE (MS 300 X 300 MM X 6MM)	1
2	1	NO	STAY ROD 19MM	STAY ROD 16 MM	1
3	1	Set	TURN BUCKLE	TURN BUCKLE	1
4	1	NO	STAY INSULATOR	STAY INSULATOR	1
5	4	SET	PREFORM WIRE COMPATIBLE FOR STAY WIRE OF SIZE 7/4 mm	PREFORM WIRE COMPATIBLE FOR STAY WIRE OF SIZE 7/2.6 mm	4
6	12	M	7/4 mm SWG STAY WIRE	7/2.6 mm SWG STAY WIRE	9
7	2	Set	BOLT AND WASHER	BOLT AND WASHERS	2
8	2	NOS	THIMBLE	THIMBLE	2
9	1	NO	DOUBLE EYE (TWISTED)	DOUBLE EYE (TWISTED)	1

CONSTRUCTION STANDARDS
HT AND LT STAY- TYPE A
TELESCOPIC POLE

NEPAL ELECTRICITY AUTHORITY
Technical Service/ Commercial Department
Distribution and Consumer Services

Refer Drawing No: CSG-Stay-02

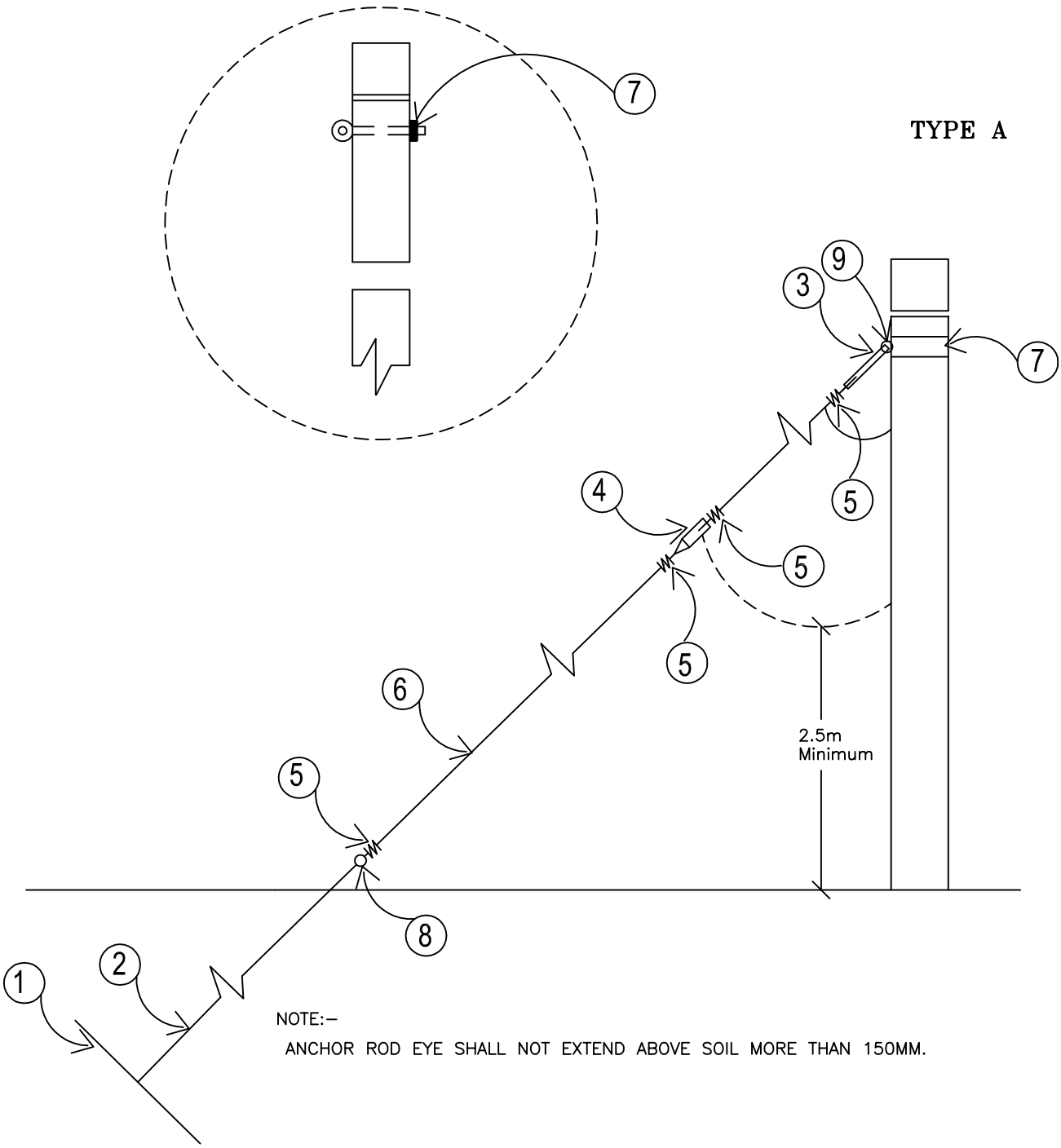
S.No.	QTY.	UNIT	MATERIAL (HT-STAY)	MATERIAL (LT-STAY)	QTY.
1	1	NO	STAY PLATE (MS 600 X 600 MM X 6 MM)	STAY PLATE (MS 3300 X 300 MM X 6MM)	1
2	1	NO	STAY ROD 19MM	STAY ROD 16 MM	1
3	2	Set	TURN BUCKLE	TURN BUCKLE	2
4	2	NO	STAY INSULATOR	STAY INSULATOR	2
5	4	SET	PREFORM WIRE COMPATIBLE FOR STAY WIRE OF SIZE 7/4 mm	PREFORM WIRE COMPATIBLE FOR STAY WIRE OF SIZE 7/2.6 mm	4
6	12	M	7/4 mm SWG STAY WIRE	7/2.6 mm SWG STAY WIRE	9
7	1	Set	EYE BOLT AND WASHER	EYE BOLT AND WASHERS	1
8	2	NOS	THIMBLE	THIMBLE	2

CONSTRUCTION STANDARDS
HT AND LT STAY- TYPE A
PSC POLE

NEPAL ELECTRICITY AUTHORITY
Technical Service/ Commercial Department
Distribution and Consumer Services

PSC POLE

TYPE A



NOTE:–

ANCHOR ROD EYE SHALL NOT EXTEND ABOVE SOIL MORE THAN 150MM.

Drawing	Stays and Anchors	NEPAL ELECTRICITY AUTHORITY
CSG-STAY-02	**HT and LT Stay - Type A**	**Technical Services / Commercial Department**
		Distribution and Consumer Services

Refer Drawing No:CSG-Stay-03

S.No.	QTY.	UNIT	MATERIAL (HT-STAY)	MATERIAL (LT-STAY)	QTY.
1	1	NO	STAY PLATE (MS 600 X 600 MM X 6 MM)	STAY PLATE (MS 300 X 300 MM X 6 MM)	1
2	1	NO	STAY ROD 19MM	STAY ROD 16 MM	1
3	2	Set	TURN BUCKLE	TURN BUCKLE	2
4	2	NO	STAY INSULATOR	STAY INSULATOR	2
5	8	SET	PREFORM WIRE COMPATIBLE FOR STAY WIRE OF SIZE 7/4 mm	PREFORM WIRE COMPATIBLE FOR STAY WIRE OF SIZE 7/2.6 mm	8
6	24	M	7/4 mm SWG STAY WIRE	7/2.6 mm SWG STAY WIRE	18
7	2	Set	EYE BOLT AND WASHER	EYE BOLT AND WASHERS	2
8	4	NOS	THIMBLE	THIMBLE	4

CONSTRUCTION STANDARDS **HT AND LT STAY- TYPE B** **PSC POLE**	**NEPAL ELECTRICITY AUTHORITY** **Technical Service/ Commercial Department** **Distribution and Consumer Services**

Refer Drawing No: CSG-Stay-03

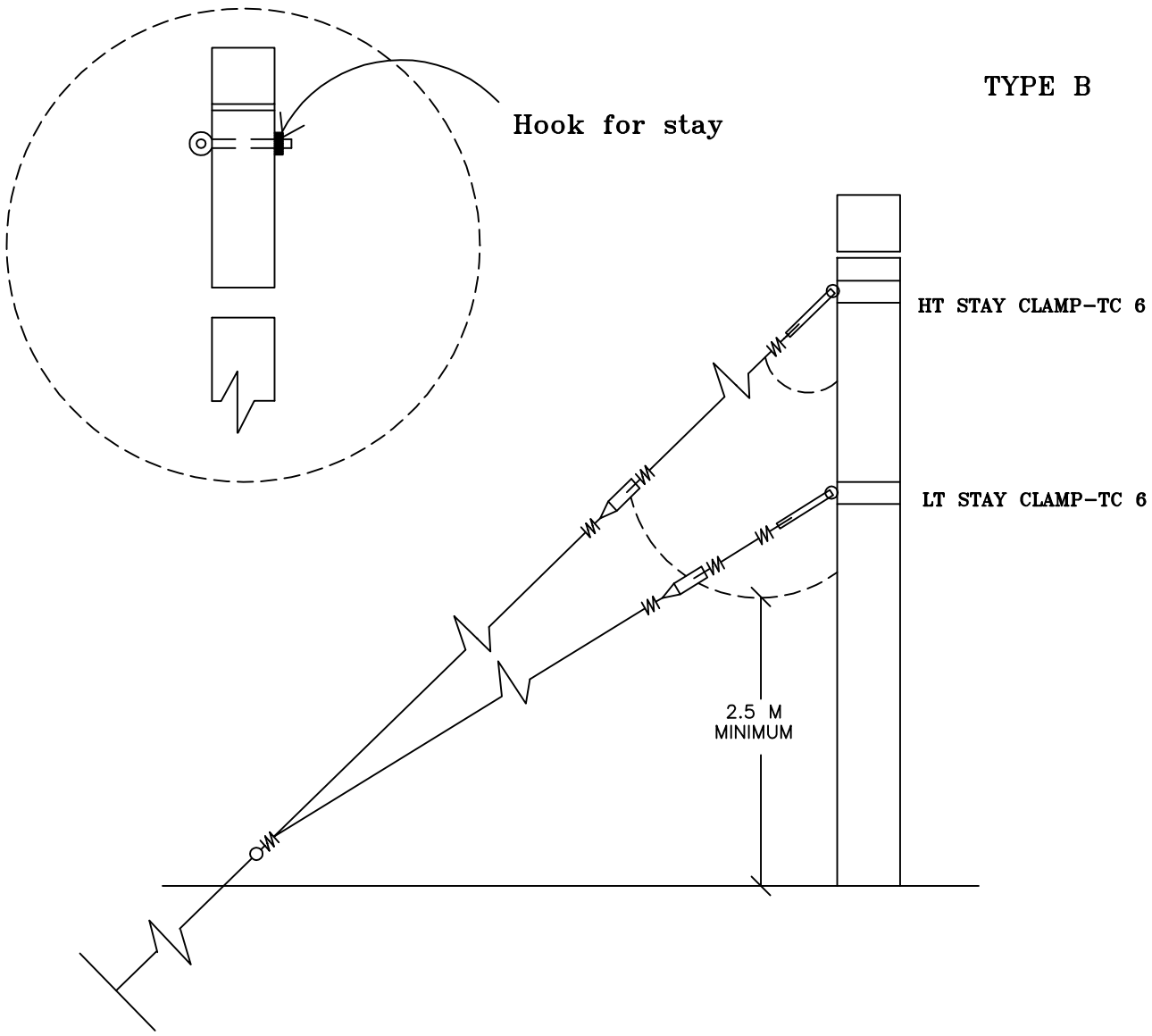
S.No.	QTY.	UNIT	MATERIAL (HT-STAY)	MATERIAL (LT-STAY)	QTY.
1	1	NO	STAY PLATE (MS 600 X 600 MM X 6 MM)	STAY PLATE (MS 300 X 300 MM X 6MM)	1
2	1	NO	STAY ROD 19MM	STAY ROD 16 MM	1
3	2	Set	TURN BUCKLE	TURN BUCKLE	2
4	2	NO	STAY INSULATOR	STAY INSULATOR	2
5	8	SET	PREFORM WIRE COMPATIBLE FOR STAY WIRE OF SIZE 7/4 mm	PREFORM WIRE COMPATIBLE FOR STAY WIRE OF SIZE 7/2.6 mm	8
6	24	M	7/4 mm SWG STAY WIRE	7/2.6 mm SWG STAY WIRE	18
7	2	Set	POLE CLAMP WITH NUT BOLT AND WASHER	POLE CLAMP WITH NUT BOLT AND WASHER	2
8	4	NOS	THIMBLE	THIMBLE	4
9	2	NO	DOUBLE EYE (TWISTED)	DOUBLE EYE (TWISTED)	2

CONSTRUCTION STANDARDS
HT AND LT STAY- TYPE B
TELESCOPIC POLE

NEPAL ELECTRICITY AUTHORITY
Technical Service/ Commercial Department
Distribution and Consumer Services

PSC POLE

TYPE B



NOTE:
STAY ROD EYE SHALL NOT EXTEND ABOVE SOIL MORE THAN 150mm.

Drawing	Stays and Anchors	NEPAL ELECTRICITY AUTHORITY
CSG-STAY-03	**HT and LT Stay - Type B**	**Technical Services / Commercial Department**
		Distribution and Consumer Services

Refer Drawing No: CSG-Stay-04

S.No.	QTY.	UNIT	MATERIAL (HT-STAY)	MATERIAL (LT-STAY)	QTY.
1	1	NO	STAY PLATE (MS 600 X 600 MM X 6 MM)	STAY PLATE (MS 300 X 300 MM X 6 MM)	1
2	1	NO	STAY ROD 19MM	STAY ROD 16 MM	1
3	2	Set	TURN BUCKLE	TURN BUCKLE	2
4	2	NO	STAY INSULATOR	STAY INSULATOR	2
5	8	SET	PREFORM WIRE COMPATIBLE FOR STAY WIRE OF SIZE 7/4 mm	PREFORM WIRE COMPATIBLE FOR STAY WIRE OF SIZE 7/2.6 mm	8
6	50	M	7/4 mm SWG STAY WIRE	7/2.6 mm SWG STAY WIRE	50
7	3	Set	EYE BOLT(16 X 203) MM AND WASHER	EYE BOLT(16 X 203) MM AND WASHERS	3
8	4	NOS	THIMBLE	THIMBLE	4

CONSTRUCTION STANDARDS

HT AND LT STAY- TYPE C

PSC POLE

NEPAL ELECTRICITY AUTHORITY

Technical Service/ Commercial Department

Distribution and Consumer Services

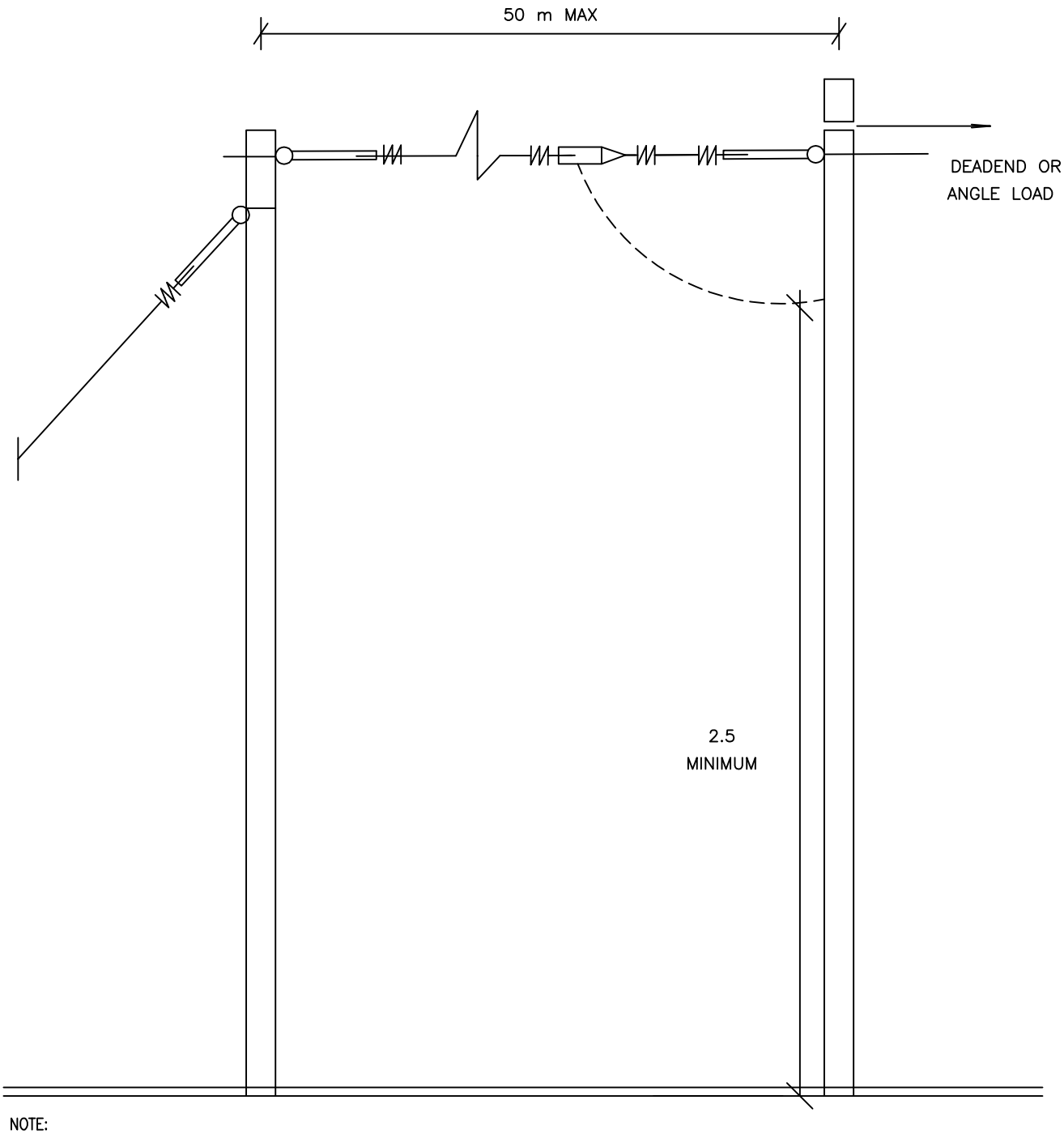
Refer Drawing No: CSG-Stay-04

S.No.	QTY.	UNIT	MATERIAL (HT-STAY)	MATERIAL (LT-STAY)	QTY.
1	1	NO	STAY PLATE (MS 600 X 600 MM X 6 MM)	STAY PLATE (MS 300 X 300 MM X 6 MM)	1
2	1	NO	STAY ROD 19MM	STAY ROD 16 MM	1
3	2	Set	TURN BUCKLE	TURN BUCKLE	2
4	2	NO	STAY INSULATOR	STAY INSULATOR	2
5	8	SET	PREFORM WIRE COMPATIBLE FOR STAY WIRE OF SIZE 7/4 mm	PREFORM WIRE COMPATIBLE FOR STAY WIRE OF SIZE 7/2.6 mm	8
6	40	M	7/4 mm SWG STAY WIRE	7/2.6 mm SWG STAY WIRE	40
7	2	Set	POLE CLAMP WITH NUT BOLT AND WASHER	POLE CLAMP WITH NUT BOLT AND WASHER	2
8	4	NOS	THIMBLE	THIMBLE	4
9	2	NO	DOUBLE EYE (TWISTED)	DOUBLE EYE (TWISTED)	2

CONSTRUCTION STANDARDS
HT AND LT STAY- TYPE C
TELESCOPIC POLE

NEPAL ELECTRICITY AUTHORITY
Technical Service/ Commercial Department
Distribution and Consumer Services

TYPE C



NOTE:

SPAN OF STAY SHALL BE LIMITED TO A MAXIMUM LENGTH OF 50 METERS.

Drawing	Stays and Anchors	NEPAL ELECTRICITY AUTHORITY
CSG-STAY-04	**HT and LT Stay - Type C**	**Technical Services / Commercial Department**
		Distribution and Consumer Services

NOTES

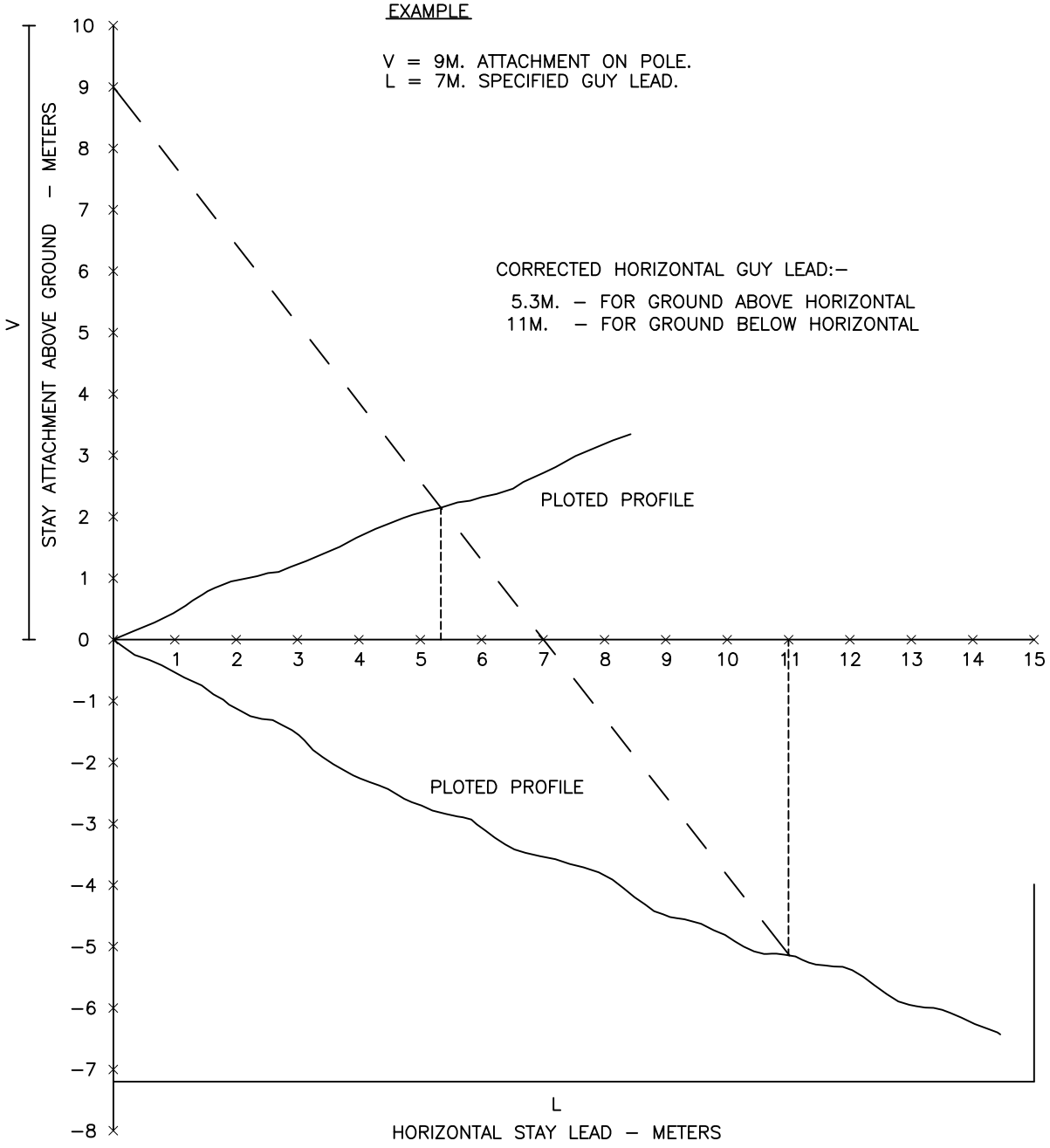
A. PLOT APPROXIMATE GROUND LINE PROFILE UNDER PROPOSED STAY.

B. SELECT A POINT ON VERTICAL SCALE "V" CORESPONDING TO GUY ATTACH– MENT 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.

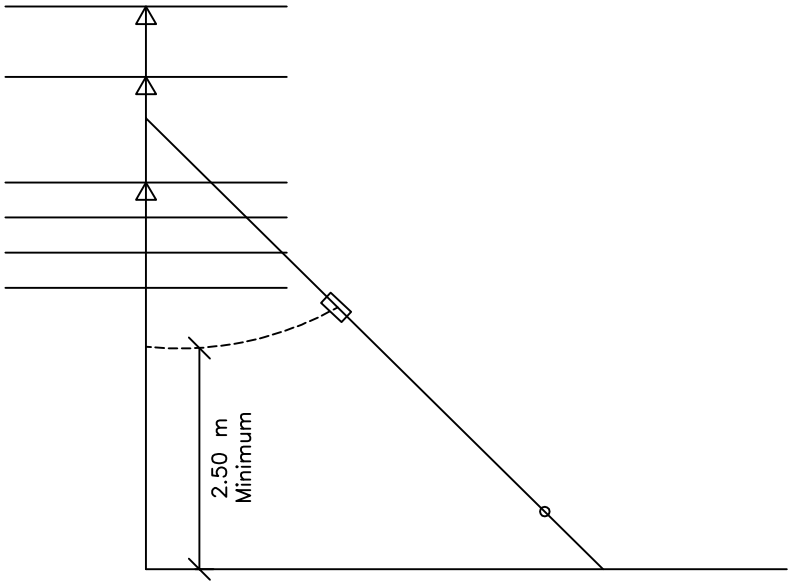
C. PROJECT POINT WHERE STRAIGHT EDGE INTERSECTS GROUND LINE PROFILE VERTICALLY TO HORIZONTAL SCALE "L" AND READ CORRECTED HORIZONTAL STAY LEAD.

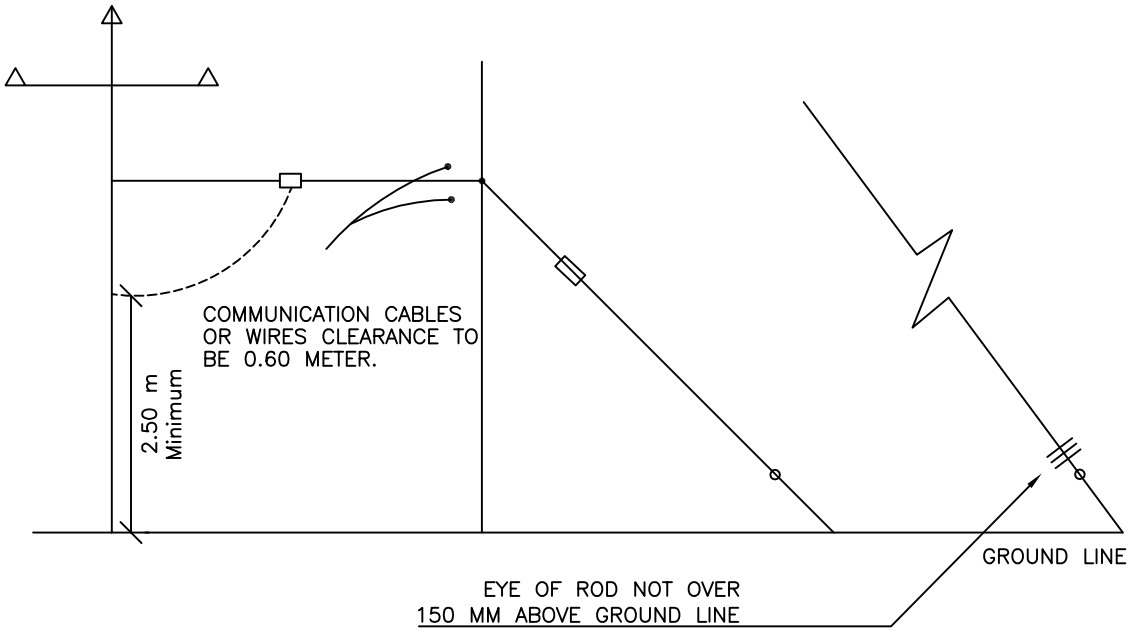
EXAMPLE

V = 9M. ATTACHMENT ON POLE.
L = 7M. SPECIFIED GUY LEAD.

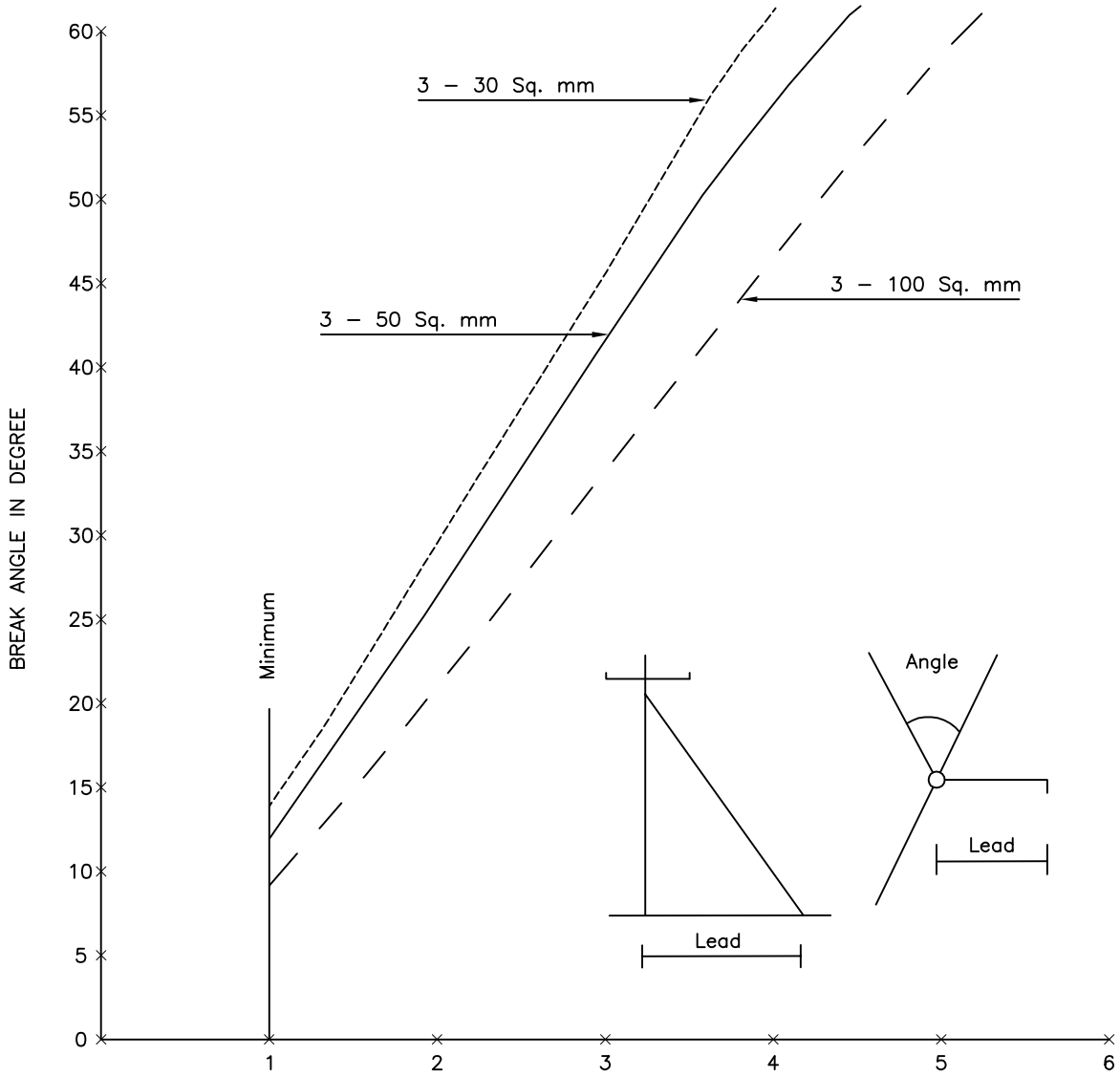


Drawing		
CSG-STAY-05	**Stays and Anchors** **Stay Lead Correction Graph**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services



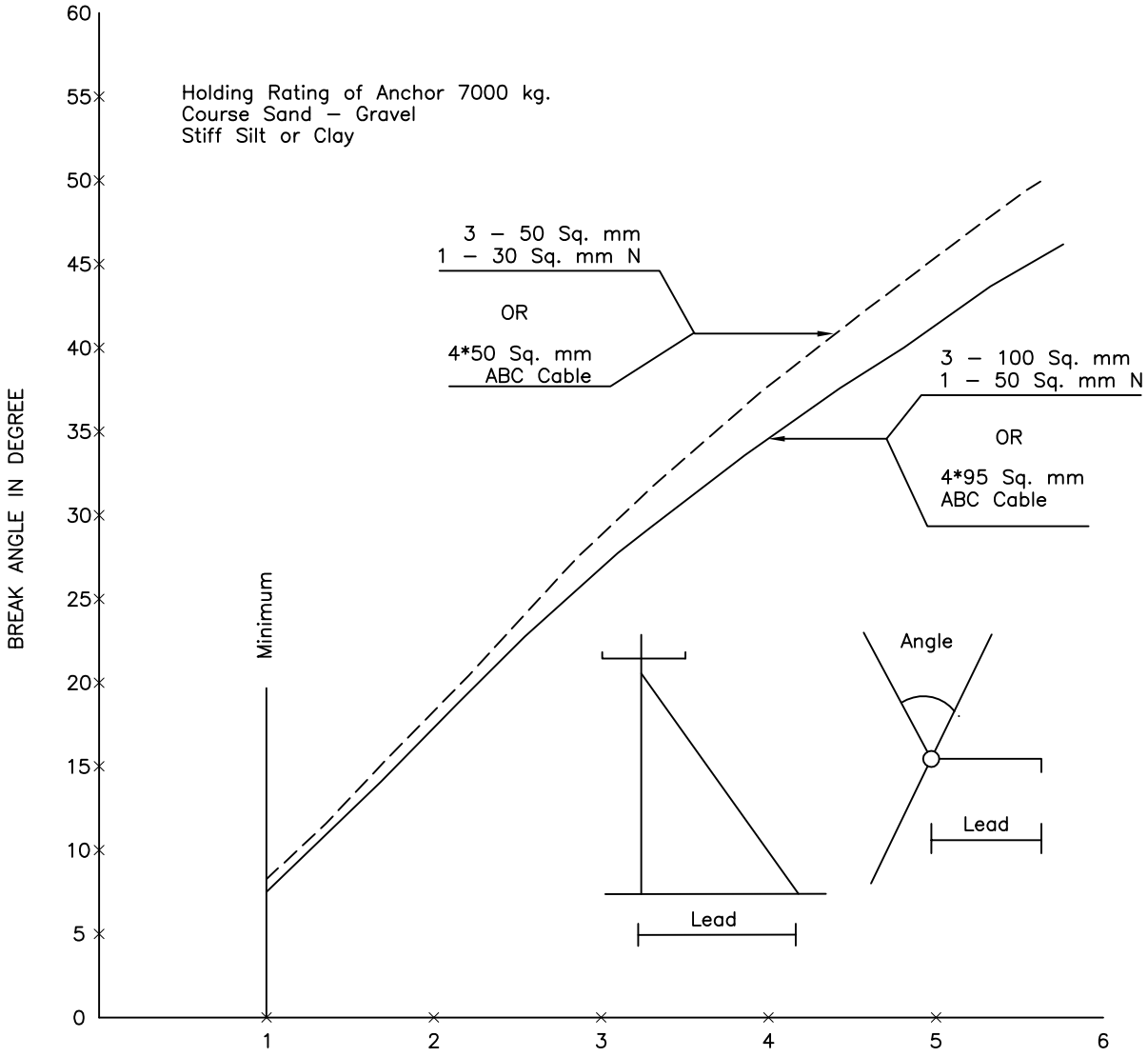


Drawing **CSG-STAY-06**	**Stays and Anchors**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services



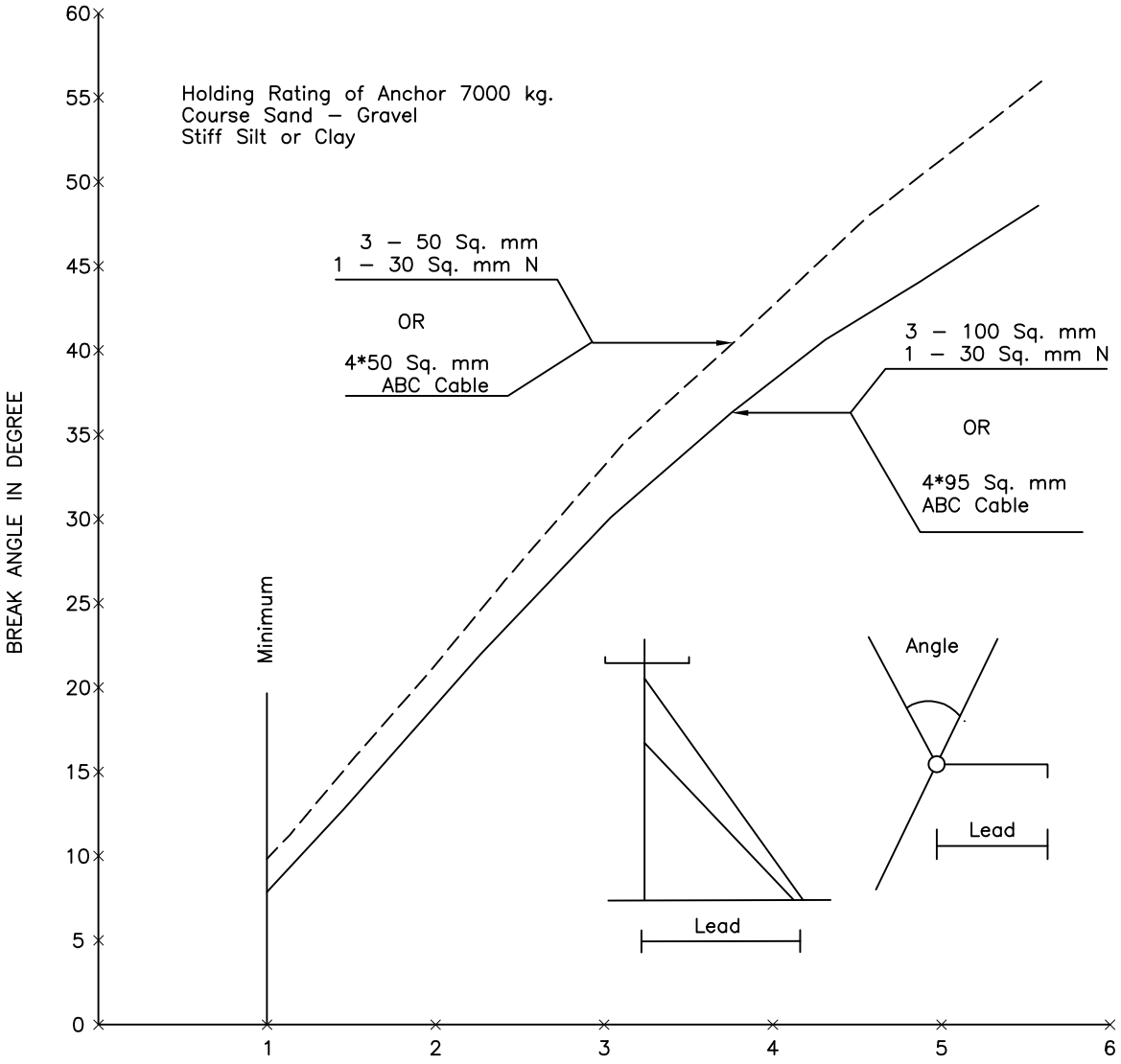
33/11 kV ONLY – 11/10 METER POLES
70 METER SPANS MAXIMUM

Drawing	**Minimum Lead for Side**	NEPAL ELECTRICITY AUTHORITY
CSG-STAY-07	**Angle Stays**	**Technical Services / Commercial Department**
		Distribution and Consumer Services



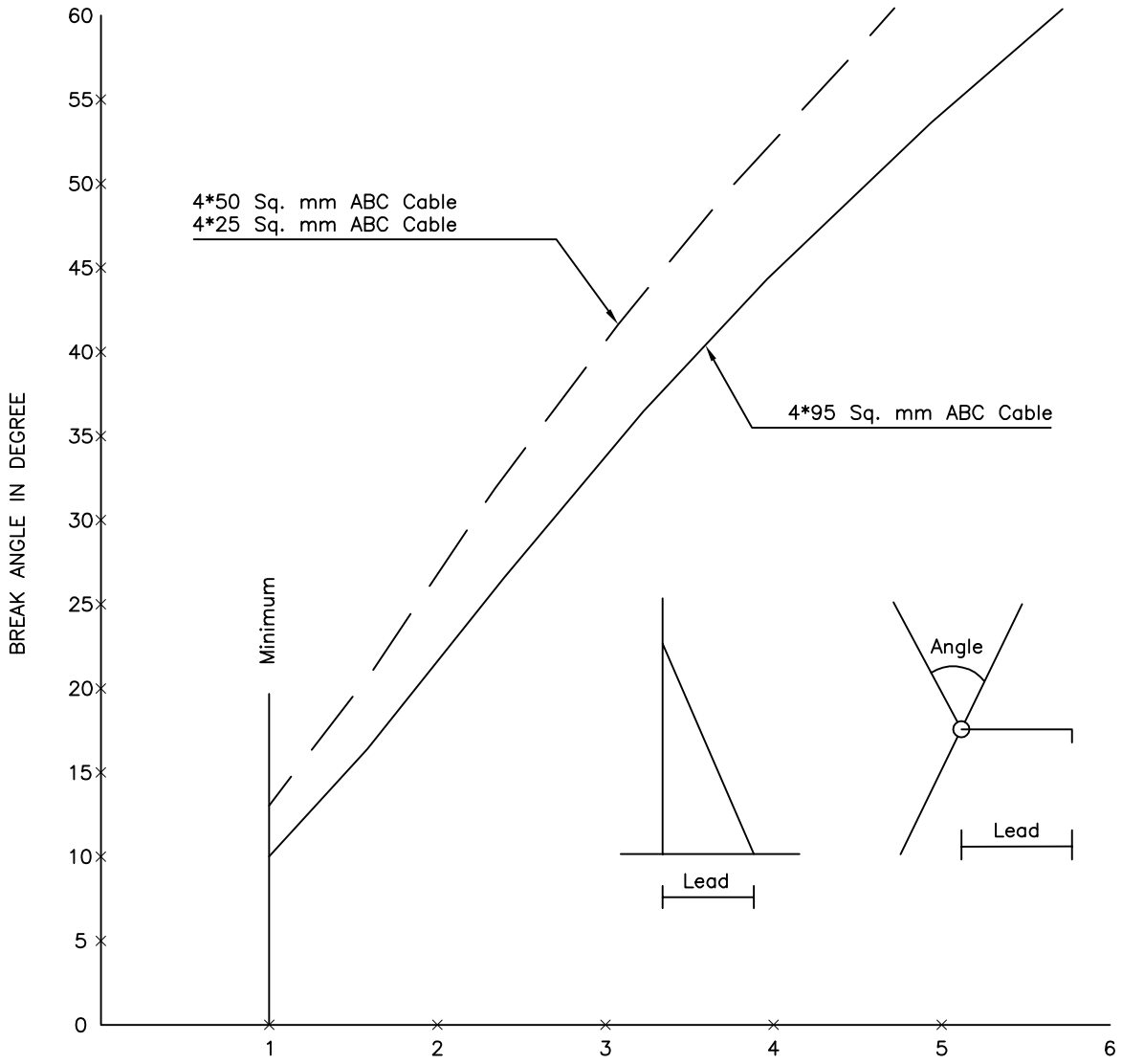
33, 11 AND 0.4 – COMPOSITE – 11/10 METER POLE
50 METER SPAN MAXIMUM
3 – 100 S.Q. MM

Drawing	**Minimum Lead for Side**	NEPAL ELECTRICITY AUTHORITY
CSG-STAY-08	**Angle Stays**	**Technical Services / Commercial Department**
		Distribution and Consumer Services



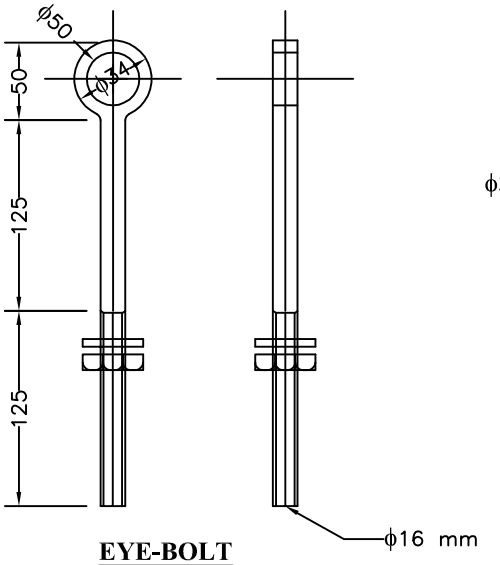
33, 11 AND 0.4 kV –COMPOSITE – 11/10 METER POLE
50 METER SPAN MAXIMUM
3 – 50 S.Q. MM
1 – 30 S.Q. MM

Drawing **CSG-STAY-09**	**Minimum Lead for Side Angle Stays**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

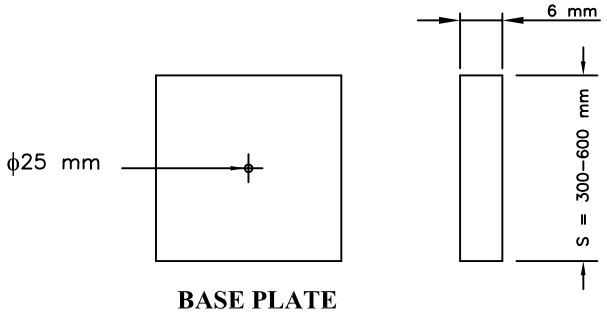


400/230V ONLY – 8 METER POLES
50 METER SPANS MAXIMUM

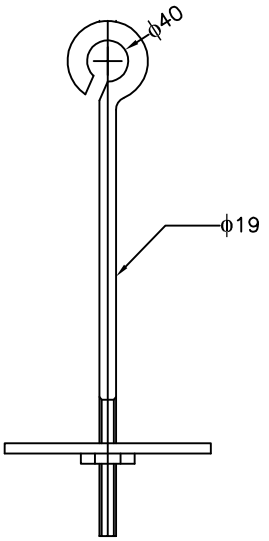
Drawing **CSG-STAY-10**	**Minimum Lead for Side Angle Stays**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services



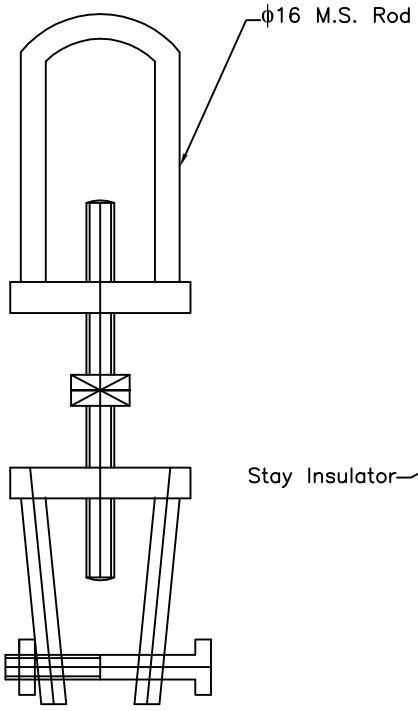
EYE-BOLT



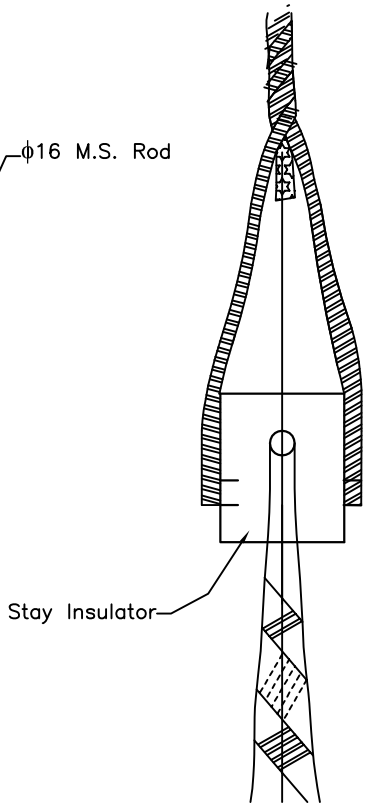
BASE PLATE



STAY ROD



TURN BUCKLE



PREFORMED WIRE ASSEMBLY WITH STAY INSULATOR

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	

Drawing **CSG-STAY-11**	**Hardware for Stay Set**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

Refer Drawing No: CSG-Ties-01and 02

S.No.	SPECIFICATION	DESIGNATION	11 kV PIN INSULATOR TIE	33 kV PIN INSULATOR TIE
1	**TOP TIE**			
A	100 sq.mm.	TT-1	RED	RED
B	50 sq.mm.	TT-2	YELLOW	YELLOW
C	30 sq.mm.	TT-3	BLUE	
2	**SIDE TIE**			
A	100 sq.mm.	ST-1	GREEN	GREEN
B	50 sq.mm.	ST-2	BLACK	BLACK
C	30 sq.mm.	ST-3	PINK	
3	**DOUBLE PIN TOP TIE**			
A	100 sq.mm.	DTT-1	RED	
B	50 sq.mm.	DTT-2	YELLOW	
C	30 sq.mm.	DTT-3	BLUE	

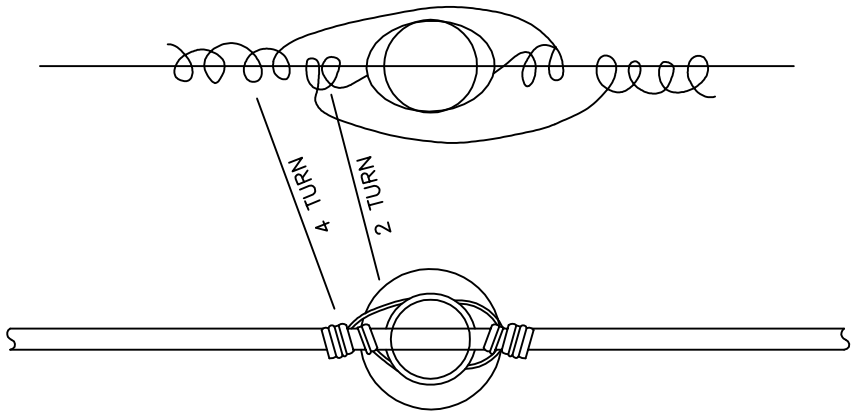
S.No.	SPECIFICATION	DESIGNATION	COLOURE CODE
	STAY WIRE		
A	7/4 mm	GS-1	RED
B	7/2.6 mm	GS-2	BLUE

CONSTRUCTION STANDARDS
PREFORMED INSULATOR TIES

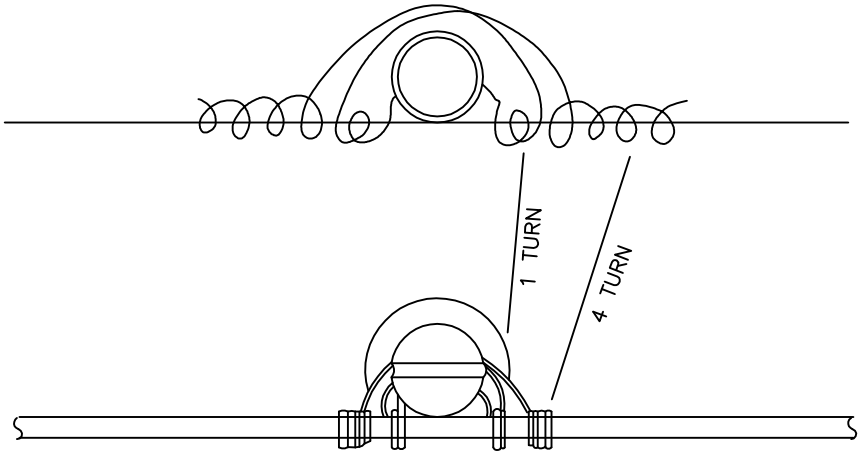
NEPAL ELECTRICITY AUTHORITY
Technical Service/ Commercial Department
Distribution and Consumer Services

JUMPER TIES

TOP GROOVE



SIDE GROOVE

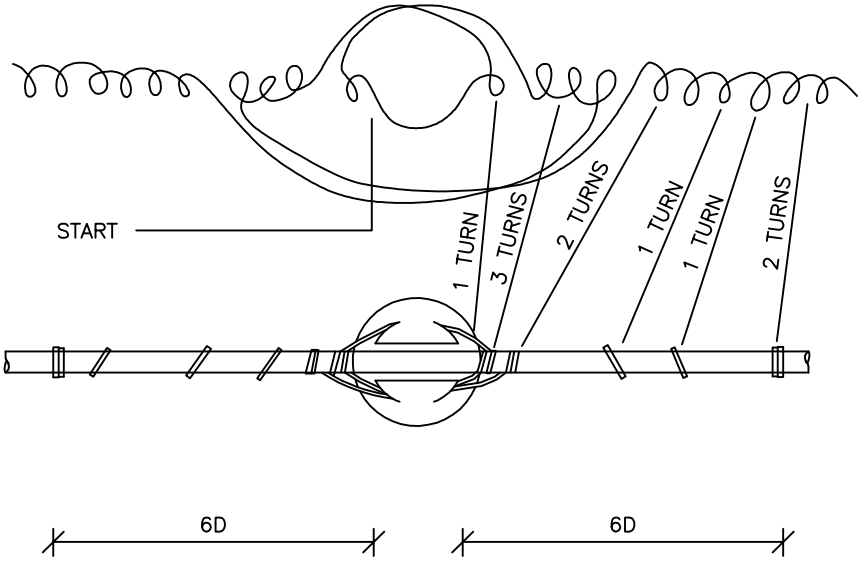


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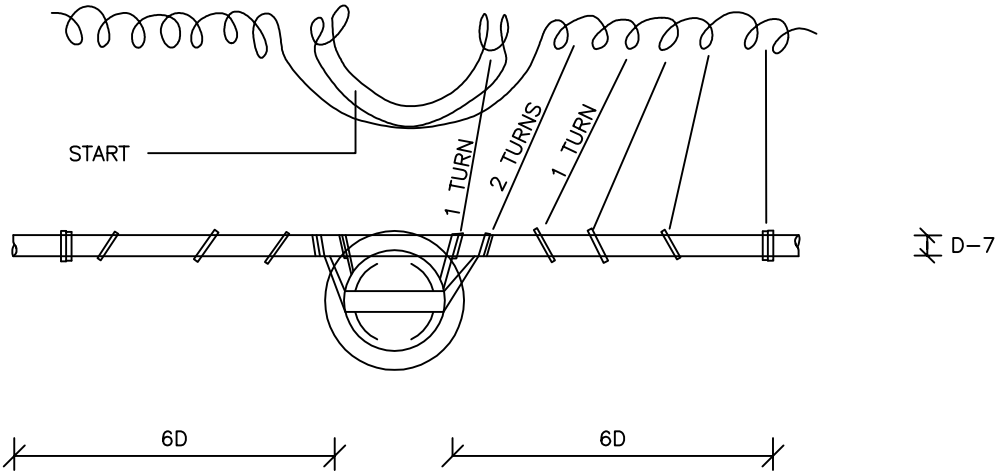
1. TIE WIRE ASSEMBLY SHOULD BE AS TIGHT AS CAN BE WRAPPED.
2. TURNS MAY BE IN EITHER DIRECTION, AS LONG AS ONE–HALF THE TURNS OPPOSE THE OTHER HALF TO PREVENT LOOSENING OF THE TIE.
3. USE ONLY FOR SECURING JUMPERS ON STRUCTURES.

Drawing **CSG-TIES-01**	**Insulator Ties**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

TOP GROOVE



SIDE GROOVE



NOTE
1. HAND TIES TO BE USED ONLY WHEN PREFORMED TIES NOT AVAILABLE.
2. CLINCH LAST TWO TURNS TIGHT WITH PLIERS.
3. SOFT DRAWN – TIE WIRE, TO BE USED FOR ALL TIES.

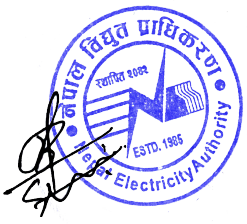
Drawing **CSG-TIES-02**	**Insulator Ties**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

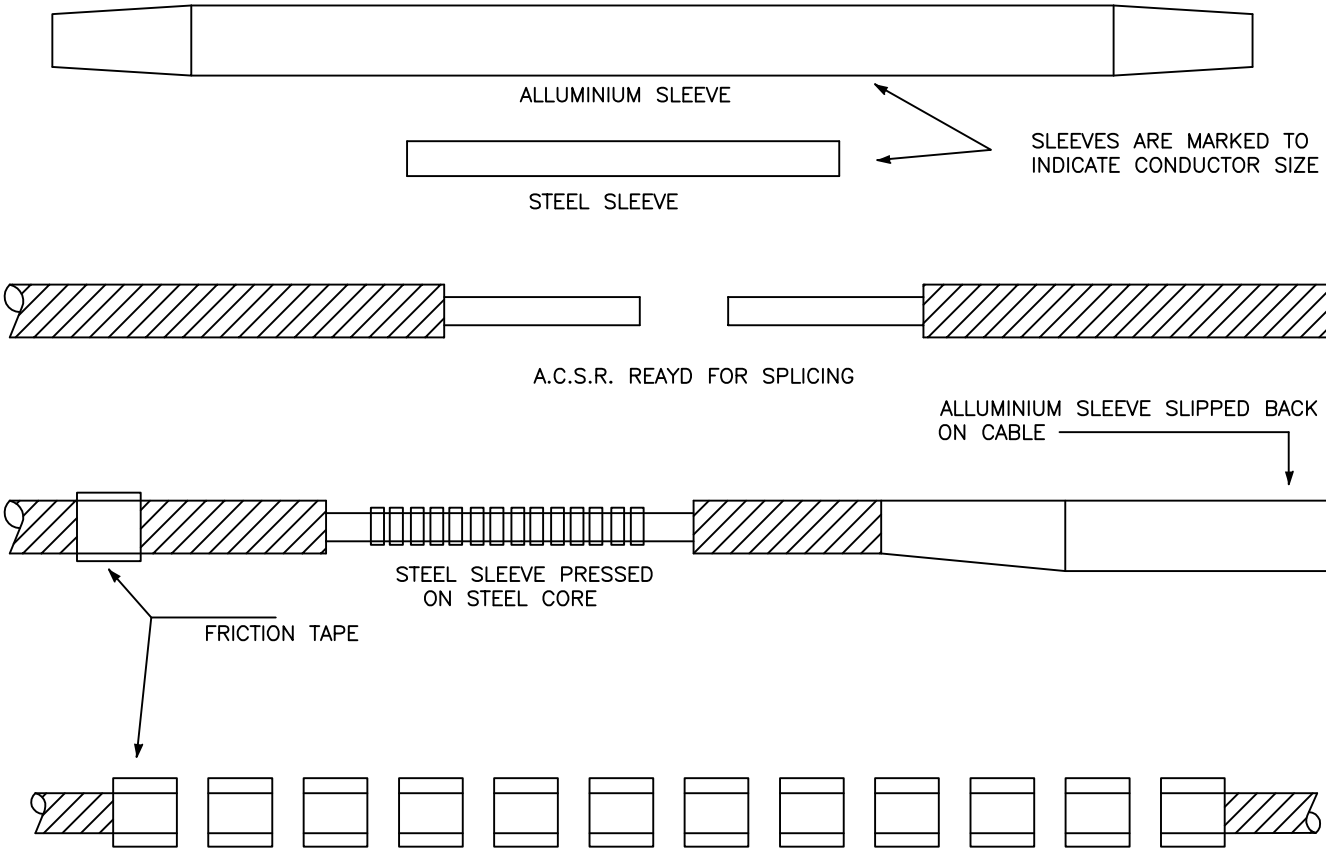
Refer Drawing No: CSG-Splice-01

S.No.	SPECIFICATION	DESIGNATION
A.	**TENSION CONNECTOR**	
1	DOG	A-1T
2	RABBIT	A-2T
3	WEASEL	A-3T
B.	**REPAIR CONNECTOR**	
1	DOG	A-1R
2	RABBIT	A-2R
3	WEASEL	A-3R

CONSTRUCTION STANDARDS
ACSR CONNECTOR

NEPAL ELECTRICITY AUTHORITY
Technical Service/ Commercial Department
Distribution and Consumer Services





1. SELECT PROPER SPLICE FOR THE CONDUCTOR TO BE SPLICED. INSURE BORES OF INNER AND THE SLEEVES ARE CLEAN.
2. INSERT PROPER DIE IN THE COMPRESSION TOOL.
3. CUT END OF CONDUCTOR SQUARE AND SLIP OUTER ALUMINUM SLEEVE OF SPLICE ON ONE END OF THE CONDUCTOR.
4. CUT BACK AND REMOVE ALUMINUM STRAND AT CONDUCTOR END A DISTANCE OF 1/2 THE LENGTH OF THE INNER STEEL SLEEVES PLUS 10 MM.
5. INSERT STEEL CORE WIRES IN THE STEEL SLEEVES AND PRESS WITH INNER GROOVE OF TOOL. PRESS ENTIRE LENGTH OF SLEEVE STARTING AT THE MIDDLE AND WORKING TOWARD THE ENDS LEAVE ABOUT 1.5 MM SPACE BETWEEN
6. STRAIGHTEN STEEL SLEEVE BY HAMMERING CAREFULLY ANAINST A SUITABLE BLOCK.
7. PLACE A PIECE OF FRICTION TAPE ON THE CABLE TO MARK THE POSITION OF THE END OF THE ALUMINUM SLEEVE SUCH THAT IT WILL BE CENTERED ON THE SPLICE.
8. CLEAN CONDUCTOR BY WIREBRUSHING,PAINT THE STEEL SLEEVE AND THE ADJACENT CABLE THAT WILL BE COVERED BY THE ALUMINUM SLEEVE WITH A SUITABLE CORROSION INHIBITOR.
9. SLIP THE ALUMINIUM SLEEVE IN PLACE AND PRESS WITH THE OUTER GROOVE OF TOOL USING THE SAME PROCEDURE AS WITH THE STEEL SLEEVE.
10. STRAIGHTEN ENTIRE SPLICE BY HAMMERING CAREFULLY AGAINST A SUITABLE BLOCK.

Drawing **CSG-SPL-01**	**Tension Splicing Instructions**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

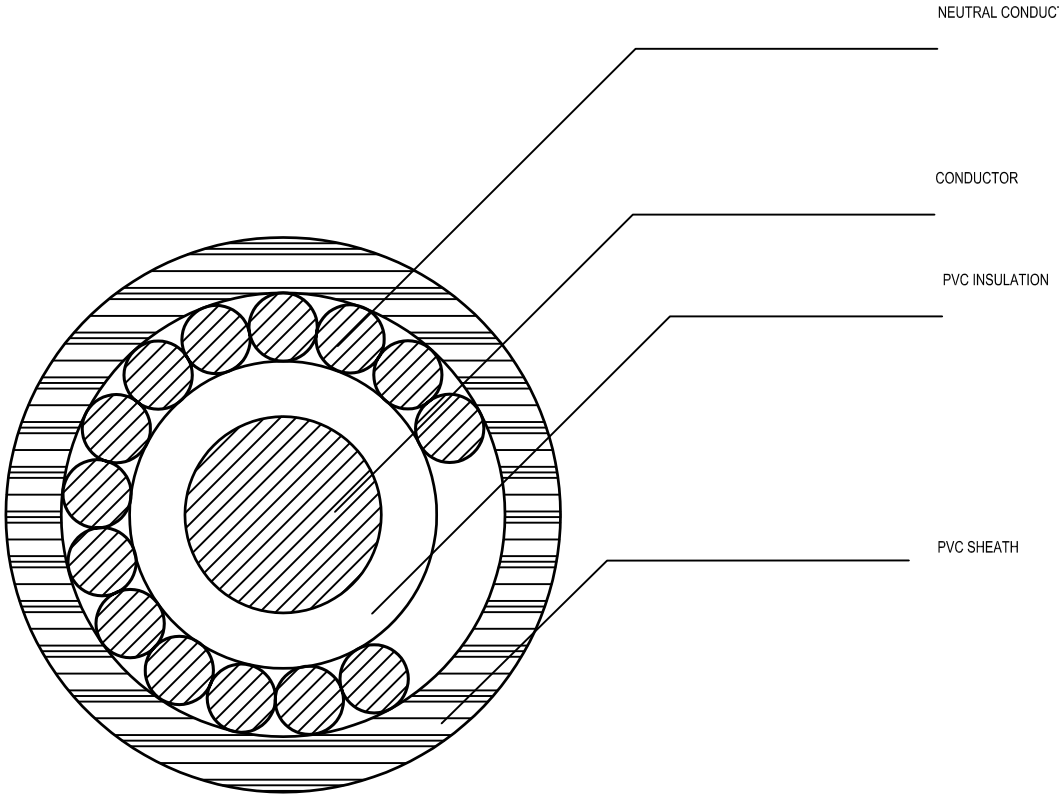
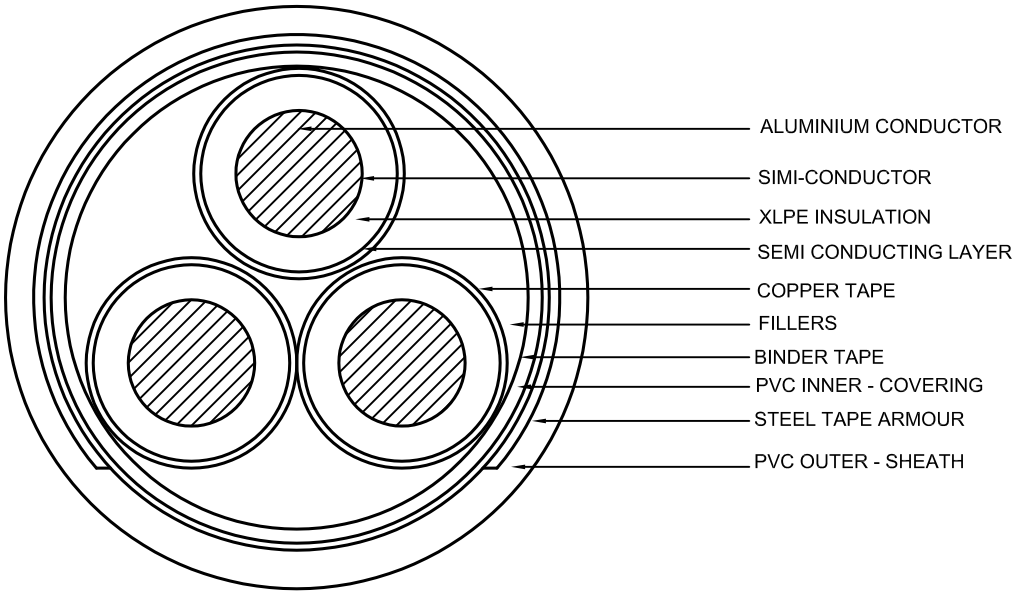


TABLE		
CROSS-SECTION AREA MM 2	6	25
DIAMETER MM	2.896	5.69
PVC INSULATION THICKNESS MM.	1.02	1.27
CONCENTRIC NEUTRAL		
NO-STRANDS	21	23
STRAND DIA. MM.	0.7366	1.2192
PVC SHEATH THICKNESS MM.	1.56	1.56
CABLE OD MM.	8.95	13.21

Drawing **CSG-CABL-01**	**Concentric Cable Cross Section**	NEPAL ELECTRICITY AUTHORITY **Technical Services/ Commercial Department** Distribution and Consumer Services

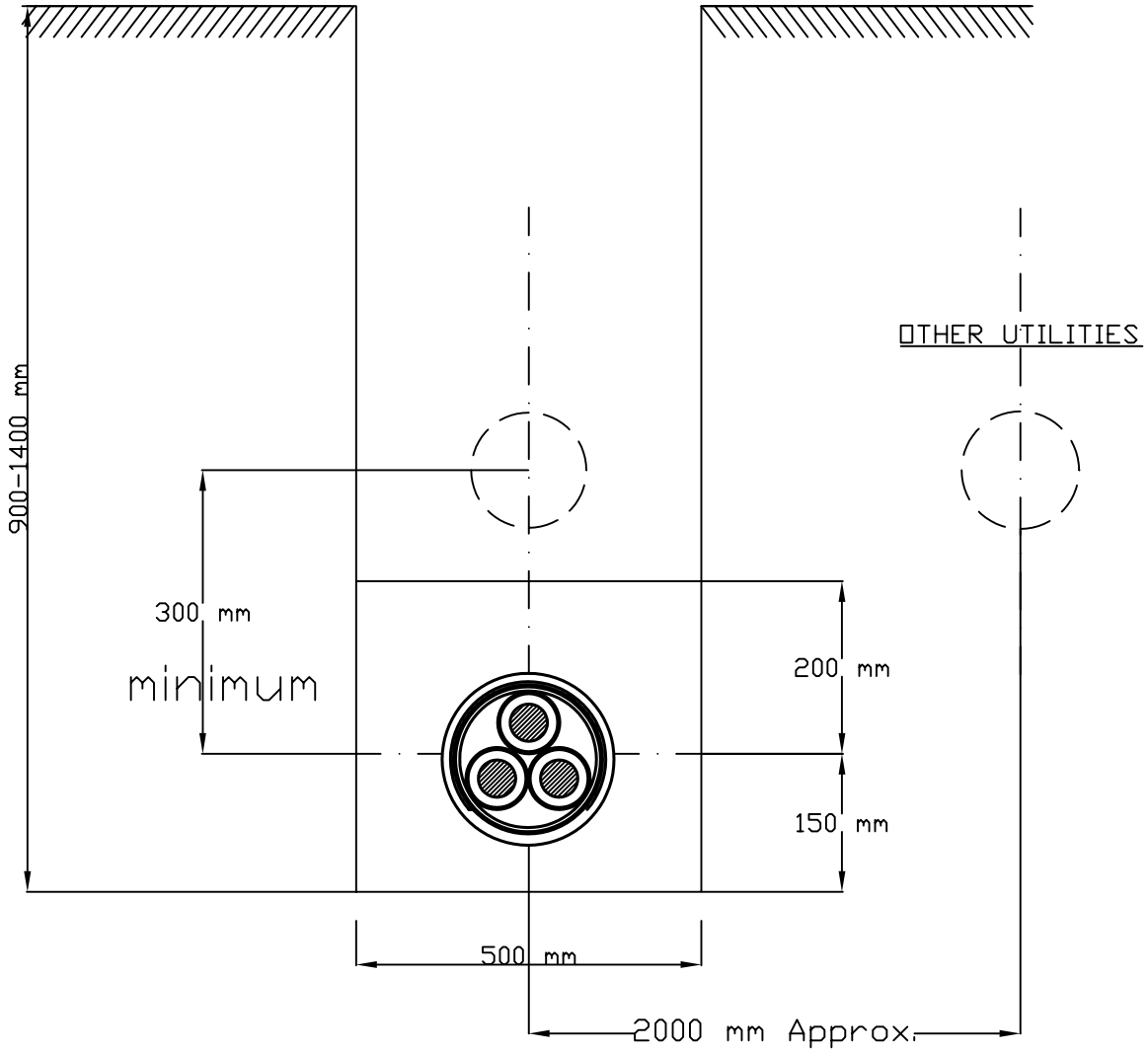


Drawing **CSG-CABL-02**	**XLPE Cable-Cross Section**	NEPAL ELECTRICITY AUTHORITY **Technical Services/ Commercial Department** Distribution and Consumer Services

UNDERGROUND CABLE

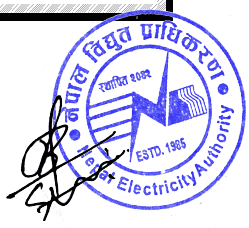
CONSTRUCTION NOTES

CABLES SHALL BE LAID LOOSELY IN THE TRENCH AND IN PARALLEL.
CABLE SHALL NOT CROSS OR LAY ON TOP OF ONE ANOTHER.
BACKFILL SHALL BE CLEAN AND FREE OF STONES AND SHARP OBJECTS 150 MM BELOW AND 200 MM ABOVE THE CABLE.
IF TELEPHONE IS PERMITTED IN THE SAME TRENCH IT MUST MAINTAIN A SEPARATION OF 300 MM ABOVE THE CABLE.
OTHER UTILITIES SUCH AS GAS, WATER, SEWER ETC, IF PARALLEL TO DIRECT BURIED ELECTRIC CABLES, SHOULD MAINTAIN A HORIZONTAL SEPARATION OF 2000 MM.

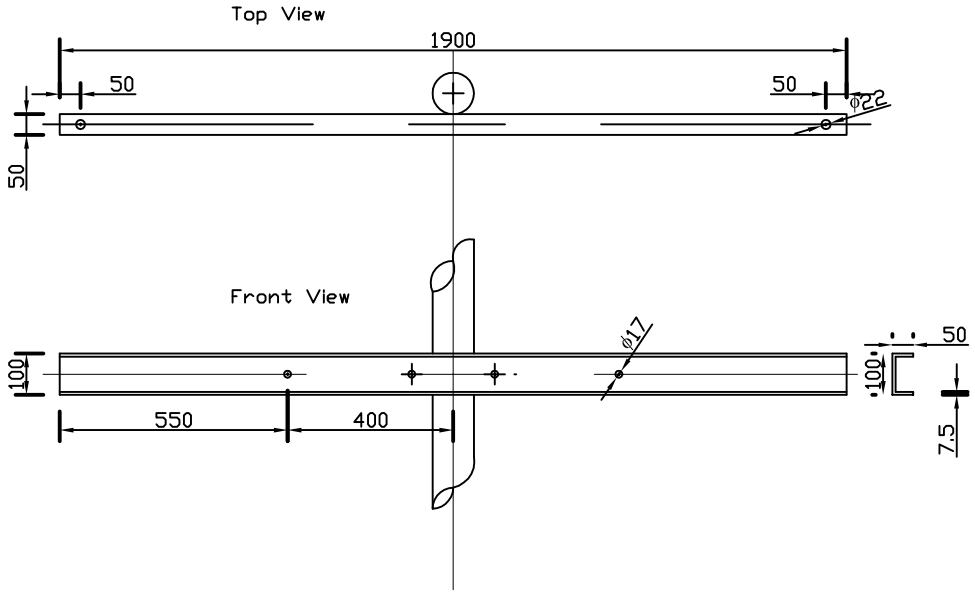


Drawing **CSG-CABL-03**	**11 kV XLPE Underground Cable Laying General Instruction**	NEPAL ELECTRICITY AUTHORITY **Technical Services/ Commercial Department** Distribution and Consumer Services

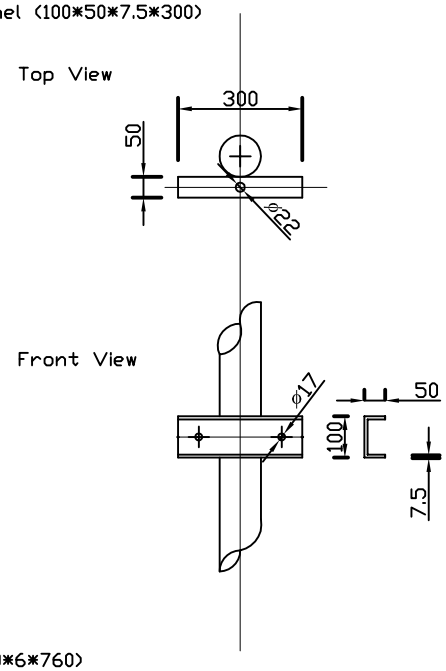
33 kV SUB TRANSMISSION SYSTEM



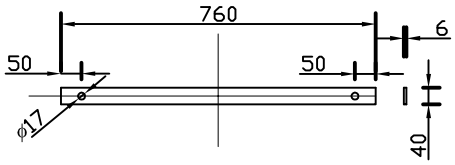
Standard Crossarm Channel (100*50*7.5*1900)



Pole Top Crossarm Channel (100*50*7.5*300)



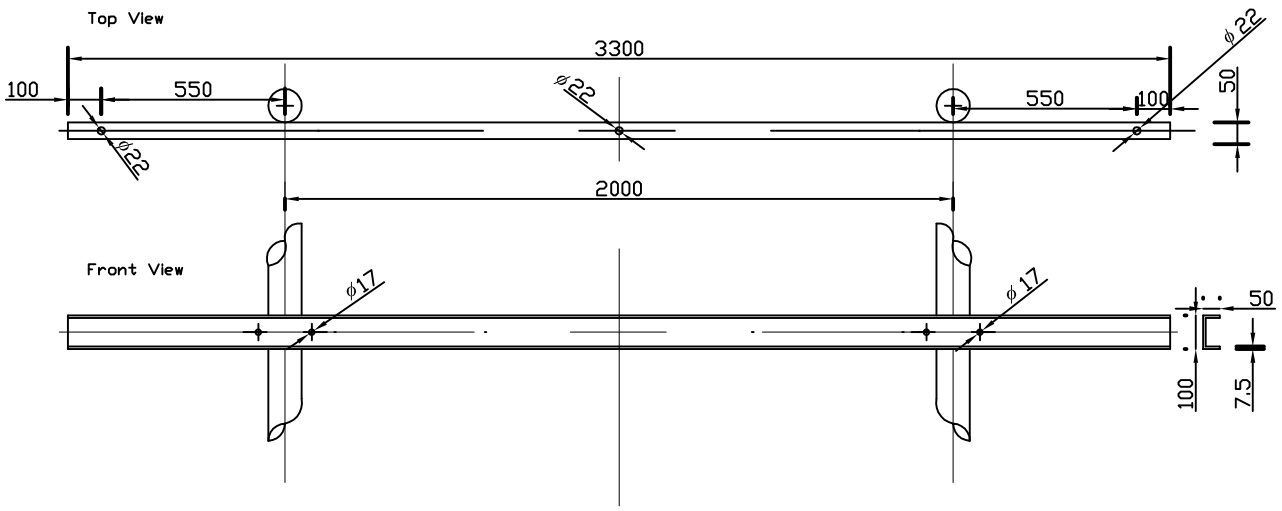
Flat Crossarm Brace (40*6*760)



Location of holes should be confirmed prior to manufacture

Drawing **CS33-LM-01**	**CrossArm & Bracing for** **33 kV Single Pole Structure**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

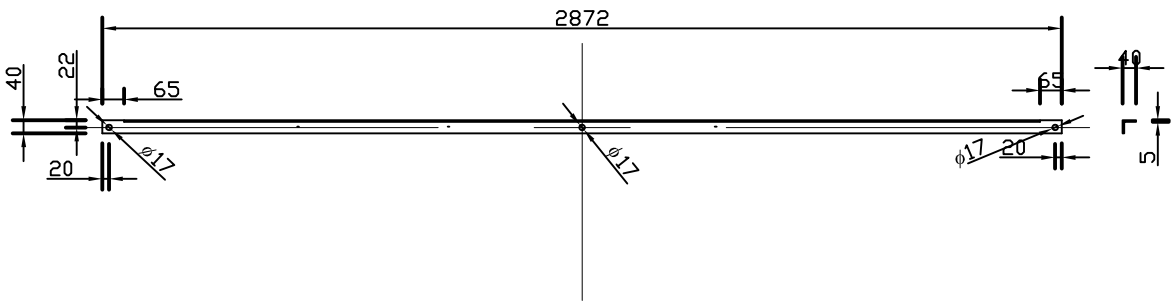
Standard Crossarm Channel (100*50*7.5*3300)



Bracing Angle (40*40*5*2416)

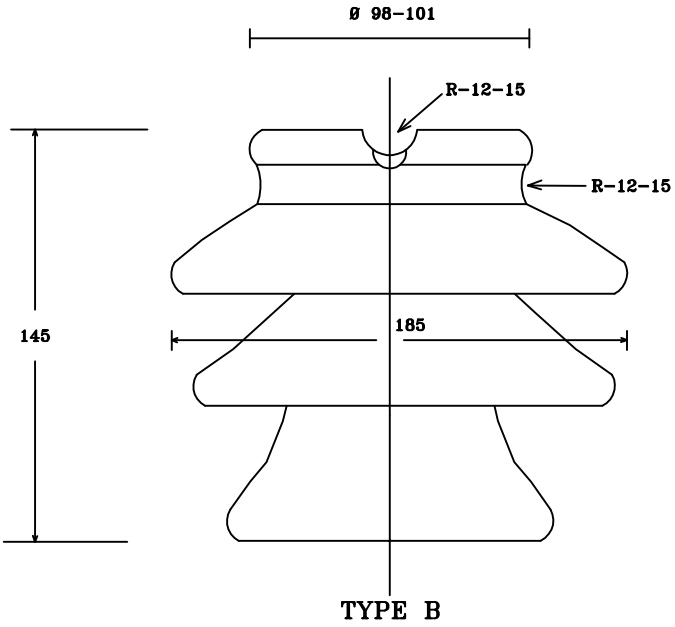


Cross Bracing Angle (40*40*5*2872)



Location of holes should be confirmed prior to manufacture

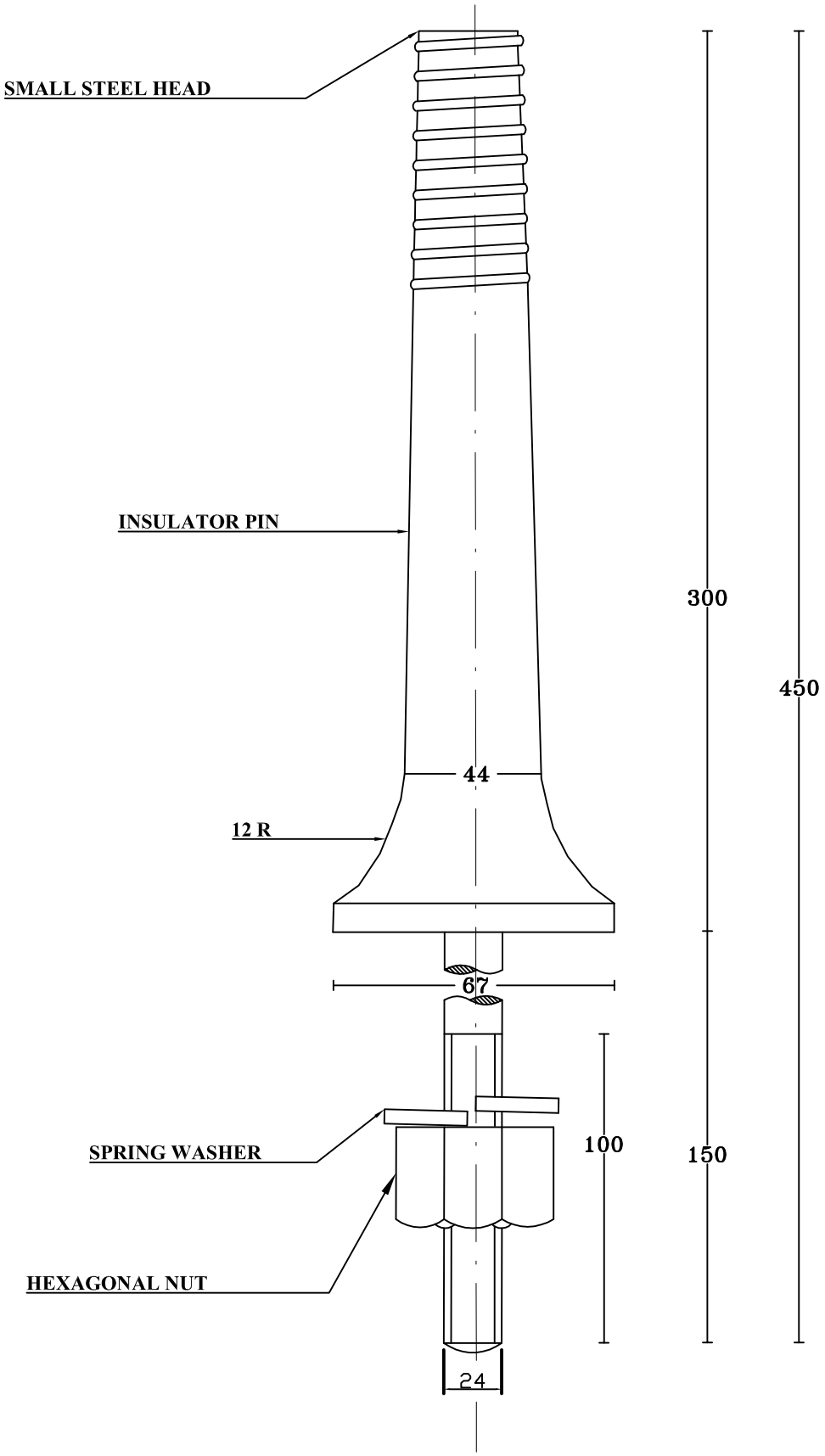
Drawing **CS33-LM-02**	**CrossArm & Bracing for** **33 kV Double Pole Structure** **(H - Structure)**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services



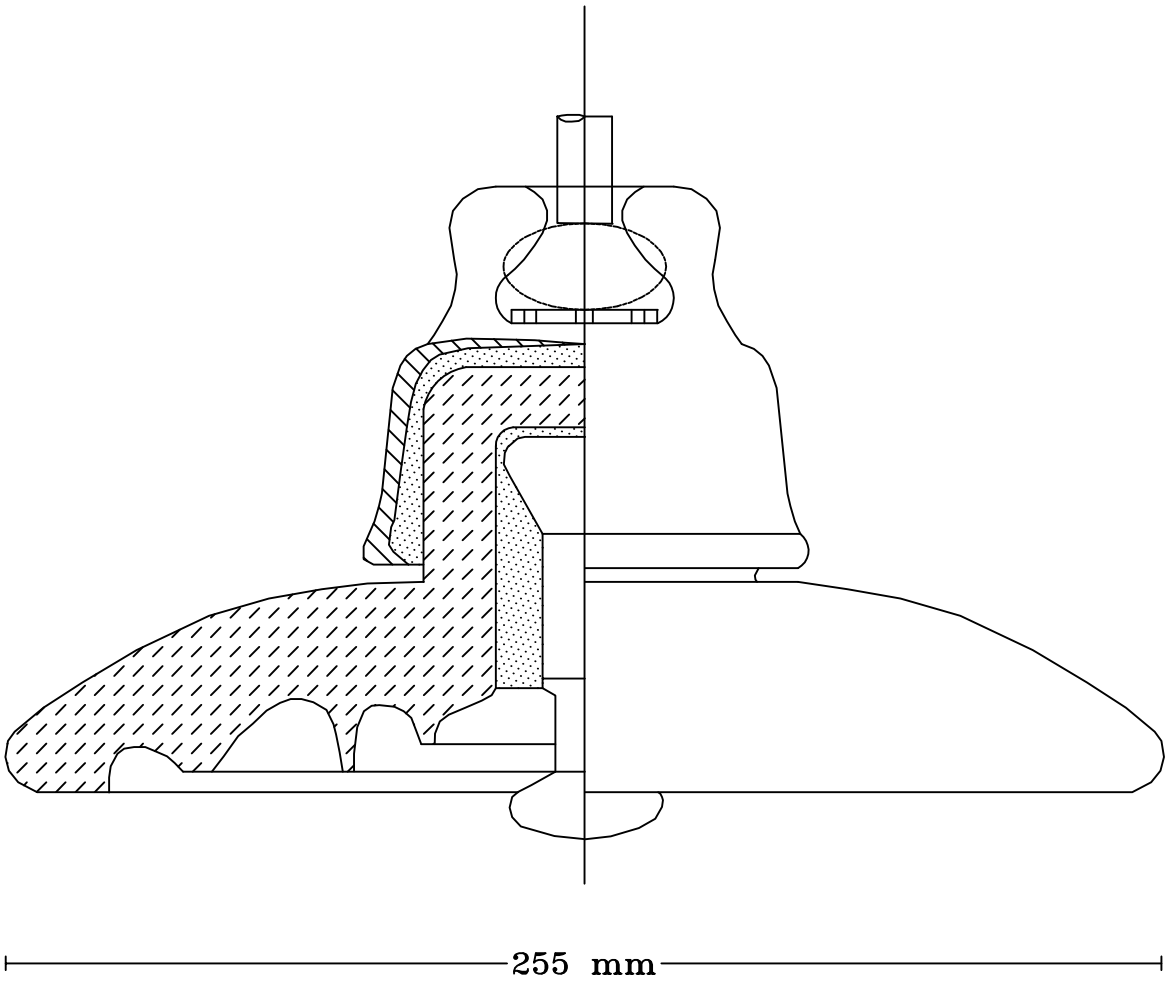
TYPE B

Applicable Standrd IS : 731

Drawing **CS33-LM-03**	**33 kV Pin Insulator**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services



Drawing **CS33-LM-04**	**33 kV Insulator Pin**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

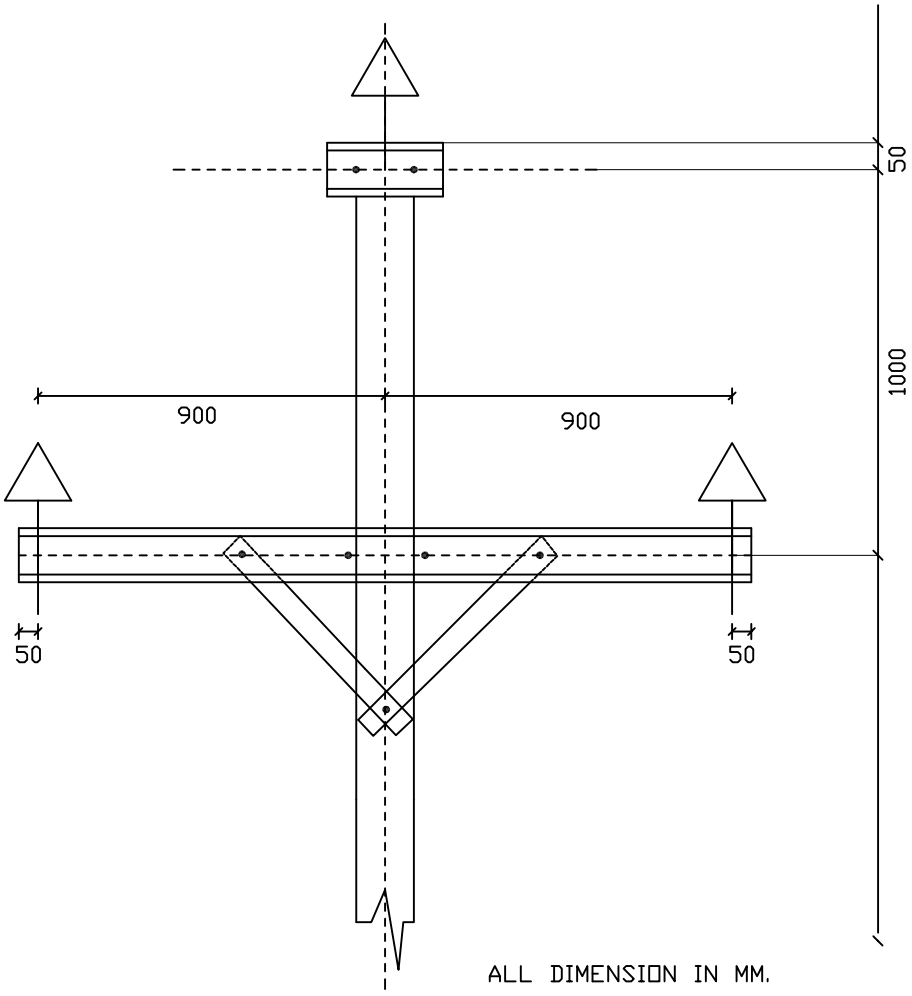


Applicable Standard IS : 731 & IS : 3188

A Set of 3 Disc Insulators Shall be Used for 33 kV

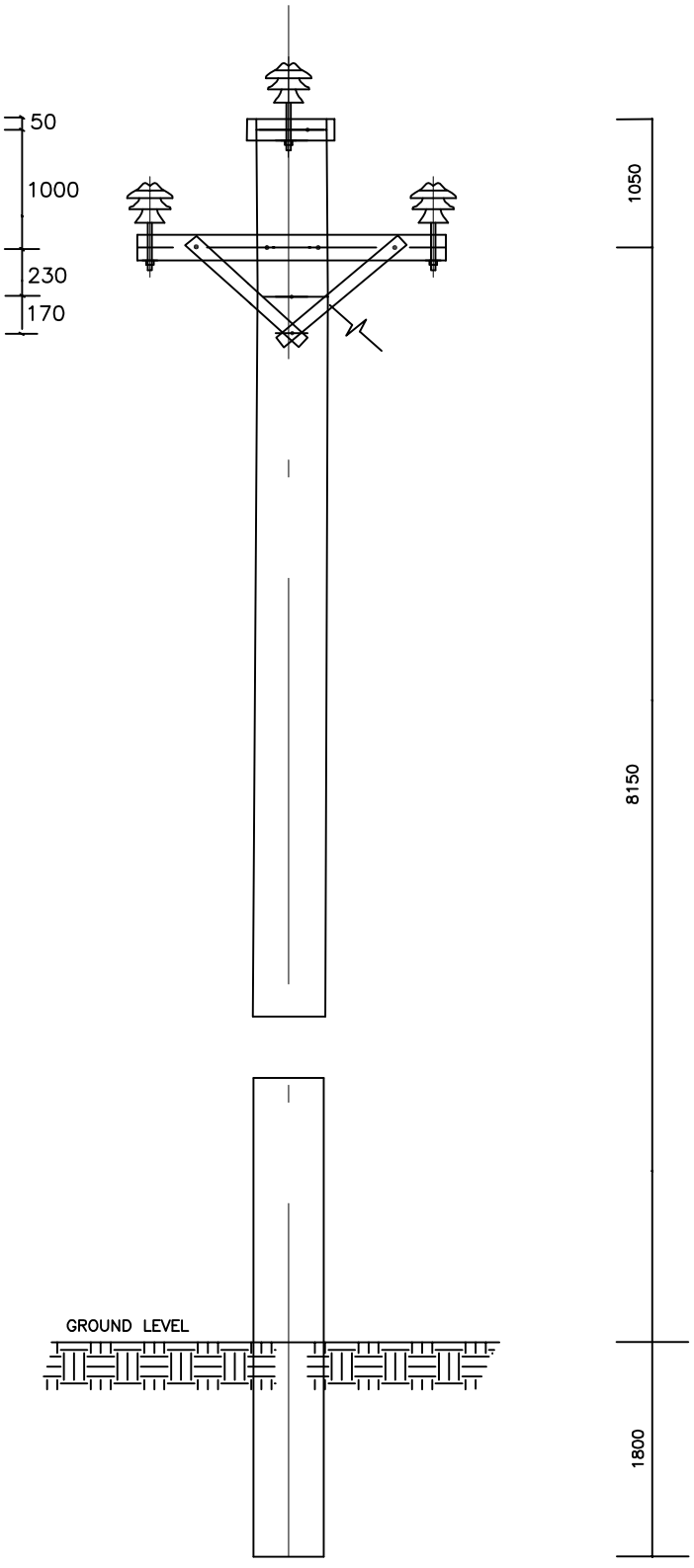
Drawing **CS33-LM-05**	**Disc Insulator**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

33 kV CONDUCTOR POSITIONS



ALL DIMENSION IN MM.

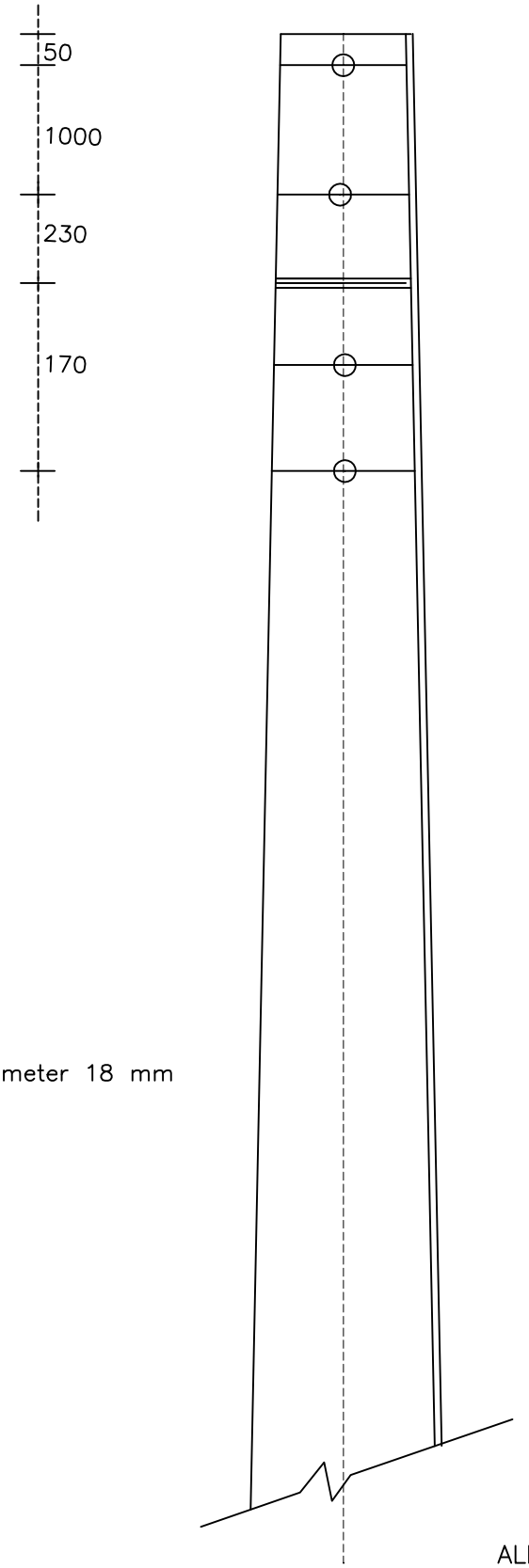
Drawing **CS33-LM-06**	**33 kV Conductor Positions**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services



ALL DIMENSION ARE IN MM

Drawing **CS33-PSCP-01**	**33 kV, 11 m PSC Pole** **Hole Details**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

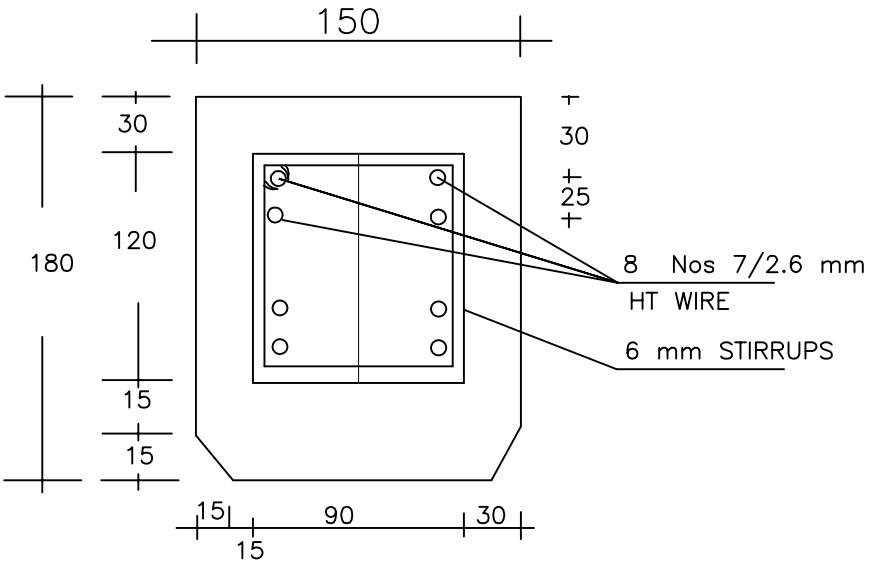
Pre–Stressed Concrete (PSC) Pole



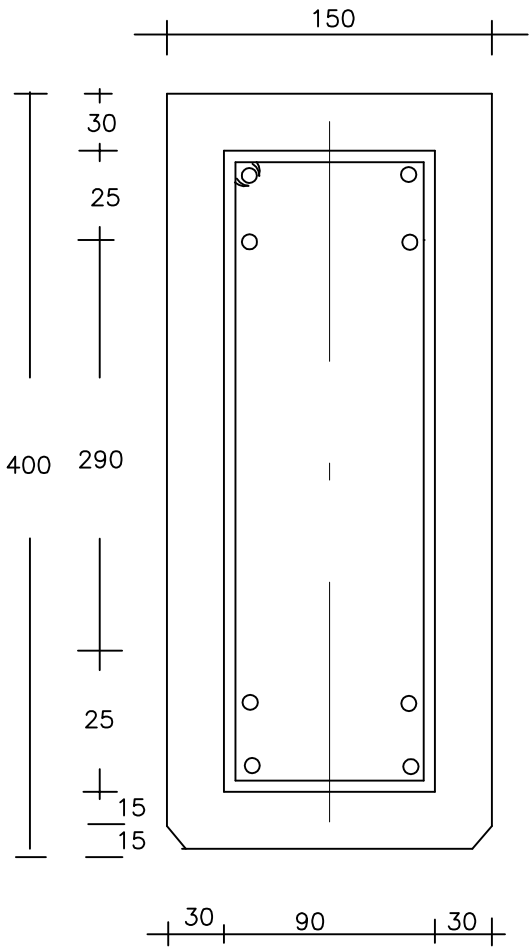
Hole Diameter 18 mm

ALL DIMENSIONS ARE IN MM

Drawing **CS33-PSCP-02**	**33 kV, 11 m PSC Pole** **Hole Pattern**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services



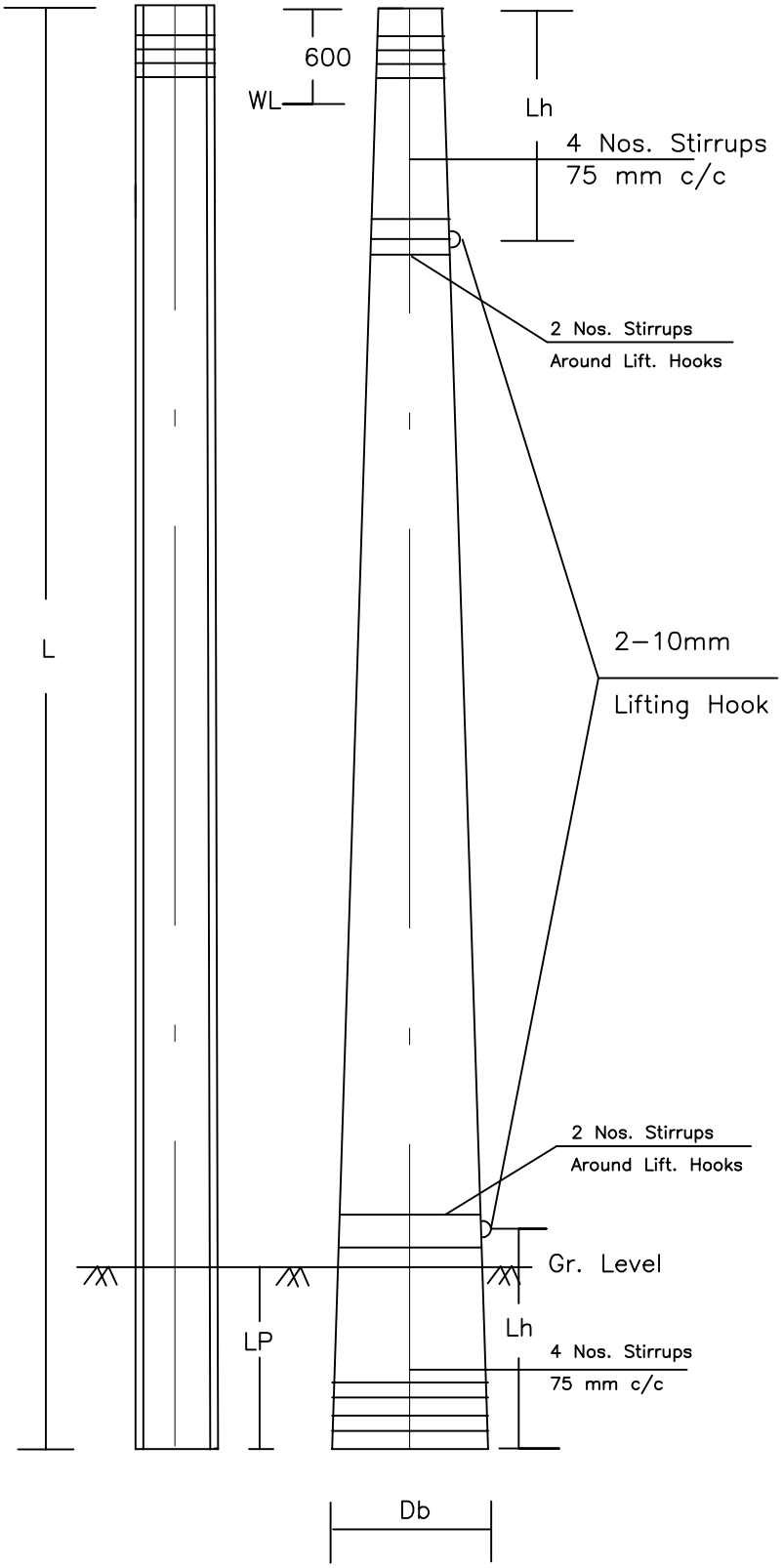
TOP SECTION



BOTTOM SECTION

ALL DIMENSION mm

Drawing **CS33-PSCP-03**	**33 kV, 11 m PSC Pole** **Bottom Section**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services



TECHNICAL PARTICULARS

ITEM	11 m Pole
L(m)	11
Wl(kg)	350
W(mm)	150
Dt(mm)	180
Db(mm)	400
Lp(mm)	1800
Lh(mm)	2000
HT Wires (Nos.)	8
HT Wires Size (No/mm)	7/2.6
Concrete Cu.m.	0.4785
W(kg)	1150

NOTES

1– All dimension are in mm.

2– Grade of Concrete M 400(Min).

3– Load Factor 2.5.

4– Release strength 250 kg/sq.cm(Min).

5– Chamfer 15mm shall be provided at bottom edge.

6– 12 Nos. stirrups(6mm MS) shall be provided with 4 nos. at each end, two nos. on sides of lifting hooks as shown.

7– Stirrups provided for end splitting tensile strength.

8– Hooks locations made equidistant from ends for operational convinience.

9– Dimensional Tolerances.

Length _+ 15mm

Width _+ 3mm

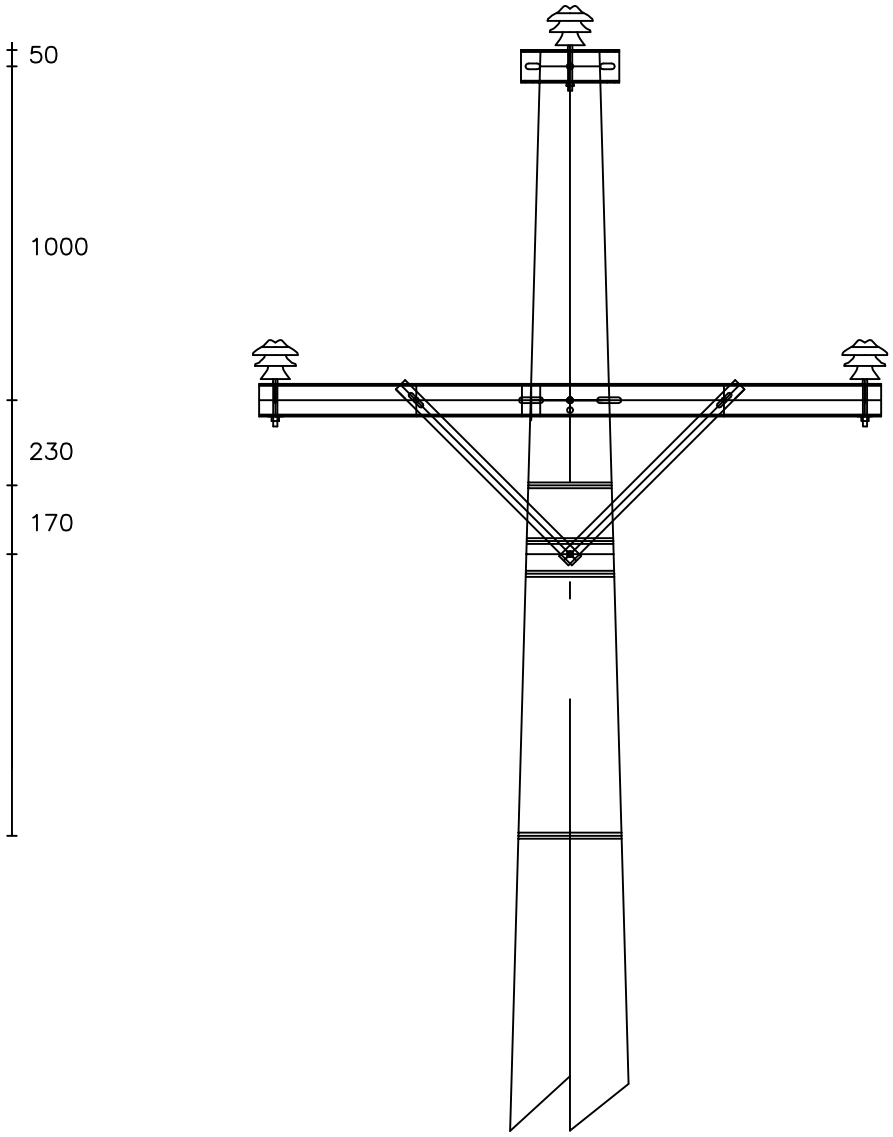
Drawing CS33-PSCP-04	**33 kV, 11 m PSC Pole** **Pole Details**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

Refer Drawing No:CS33-PSCP-05

S.No.	QTY.	UNIT	MATERIAL
1	3	NOS	PIN INSULATOR
2	3	NOS	INSULATOR PIN
3	3	NOS	PREFORM PIN TIES (TOP TIES)
4	1	NOS	STEEL CROSSARM CHANNEL (100x 50x7.5x300) mm.
5	1	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS (PC1)
6	1	NOS	STEEL CROSSARM CHANNEL (100x 50x7.5x1900) mm.
7	1	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS (PC4)
8	2	NOS	FLAT CROSSARM BRACE(40x 6.0x760) mm
9	2	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (12 x51) mm
10	1	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (16 x203) mm
11	1	NOS	POLE PSC 11m

CONSTRUCTION STANDARDS
33 kV SINGLE ARM STRUCTURE
PSC POLE

NEPAL ELECTRICITY AUTHORITY
Technical Service/ Commercial Department
Distribution and Consumer Services



ALL DIMENSION ARE IN MM

Drawing **CS33-PSCP-05**	**33 kV, 11 m PSC Single Pole** **No Deviation (0 - 7 deg.)**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

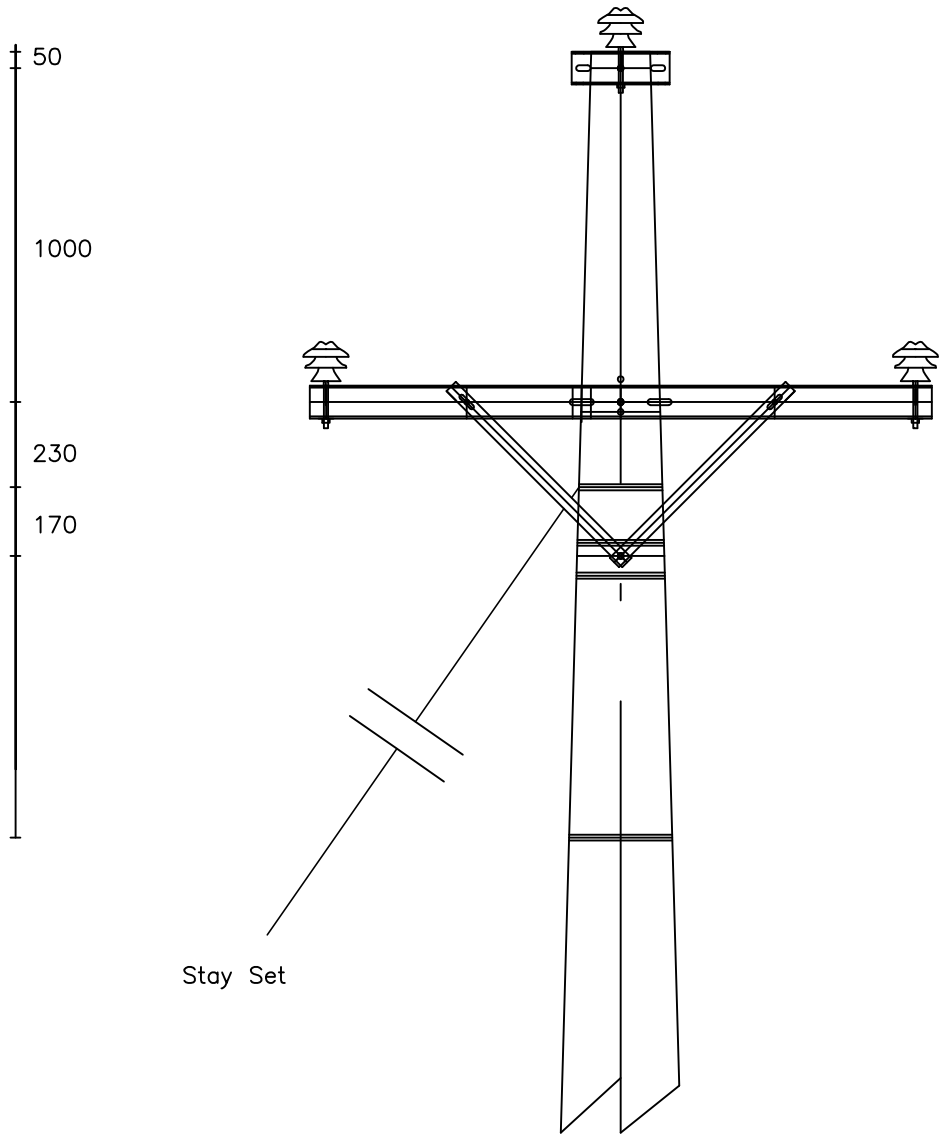
Refer Drawing No: CS33-PSCP-06

S.No.	QTY.	UNIT	MATERIAL
1	3	NOS	PIN INSULATOR
2	3	NOS	INSULATOR PIN
3	3	NOS	PREFORM PIN TIES (TOP TIES)
4	1	NOS	STEEL CROSSARM CHANNEL (100x 50x7.5x300) mm.
5	1	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS (PC1)
6	1	NOS	STEEL CROSSARM CHANNEL (100x 50x7.5x1900) mm.
7	1	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS (PC4)
8	2	NOS	FLAT CROSSARM BRACE(40x 6.0x760) mm
9	2	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (12 x51) mm
10	1	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (16 x203) mm
11	1	LOT	HT STAY SET (AS REQUIRED)
12	1	NOS	POLE PSC 11m

CONSTRUCTION STANDARDS

33 kV SINGLE ARM STRUCTURE
PSC POLE ,LOW ANGLE 8^0 TO 15^0

NEPAL ELECTRICITY AUTHORITY
Technical Service/ Commercial Department
Distribution and Consumer Services



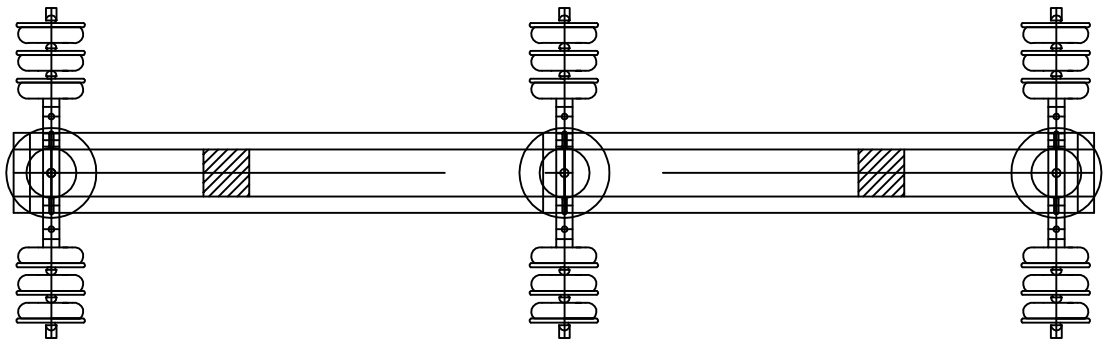
Drawing **CS33-PSCP-06**	**33 kV, 11 m PSC Single Pole** **Low Angle (8 - 15 deg.)**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

Refer Drawing No:CS33PSCP-07

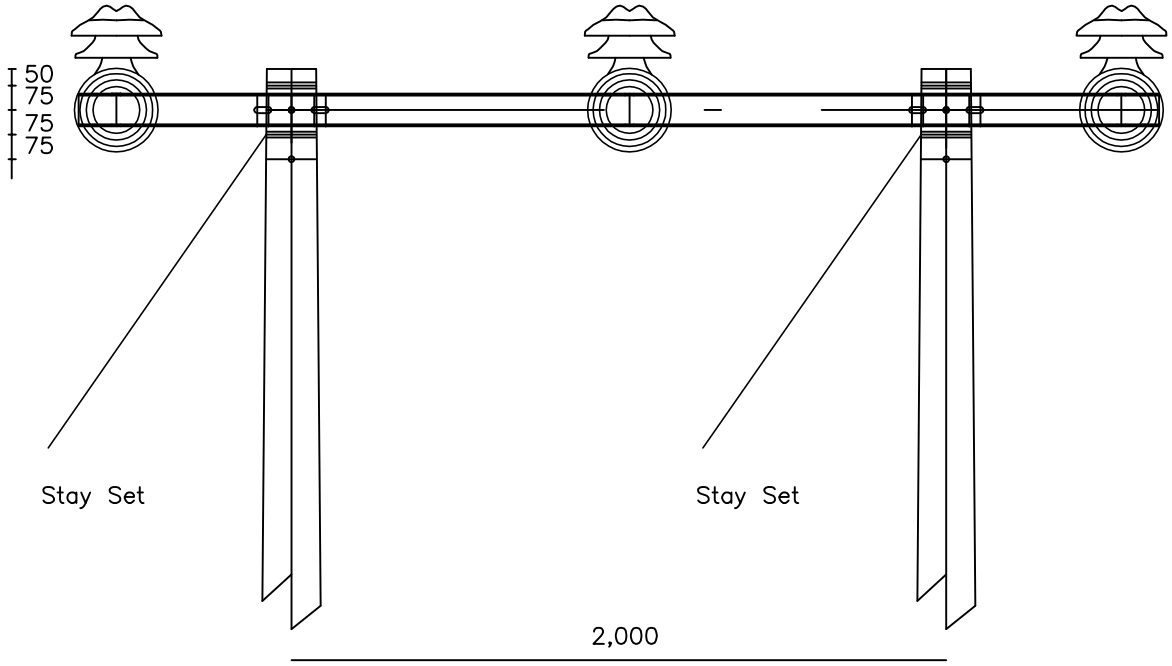
S.No.	QTY.	UNIT	MATERIAL
1	3	NOS	PIN INSULATOR
2	3	NOS	INSULATOR PIN
3	3	NOS	PREFORM PIN TIES (TOP TIES)
4	6	SET	DISC INSULATOR (A SET OF THREE)
5	6	SET	BRACK STRAP
6	6	SET	TENSION SET WITH BALL AND SOCKET EYE
7	6	SET	PG CLAMP
8	2	NOS	STEEL CROSSARM CHANNEL (100x 50x7.5x3300) mm.
9	6	NOS	STRAP FOR INSULATOR STRING (33 kV) (50x 6x404) mm
10	12	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (12 x51) mm
11	4	SET	DOUBLE ARMING BOLTS WITH SUITABLE NUTS AND WASHERS (16 x305) mm
12	1	LOT	HT STAY SET (AS REQUIRED)
13	2	NOS	POLE PSC 11m

CONSTRUCTION STANDARDS
33 kV H- STRUCTURE (PMA)
PSC POLE, 16^0 TO 30^0

NEPAL ELECTRICITY AUTHORITY
Technical Service/ Commercial Department
Distribution and Consumer Services



Top View



Front View

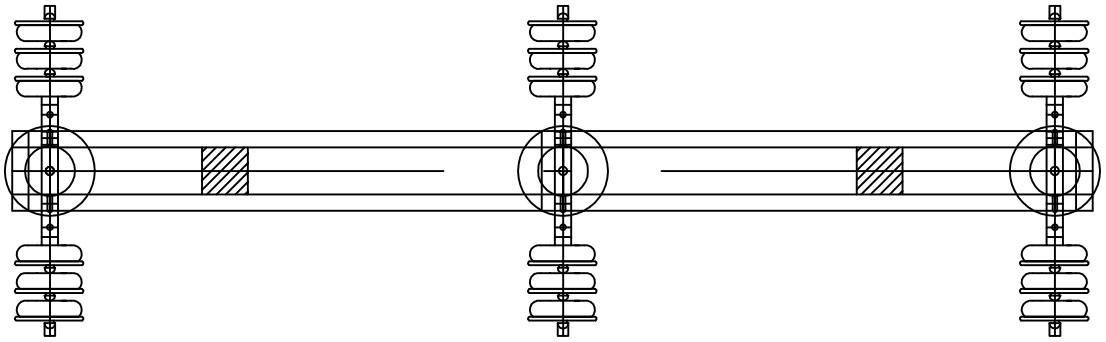
Drawing **CS33-PSCP-07**	**33 kV, 11 m PSC Double Pole Medium Angle (16 - 30 deg.)**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

Refer Drawing No:CS33PSC-08

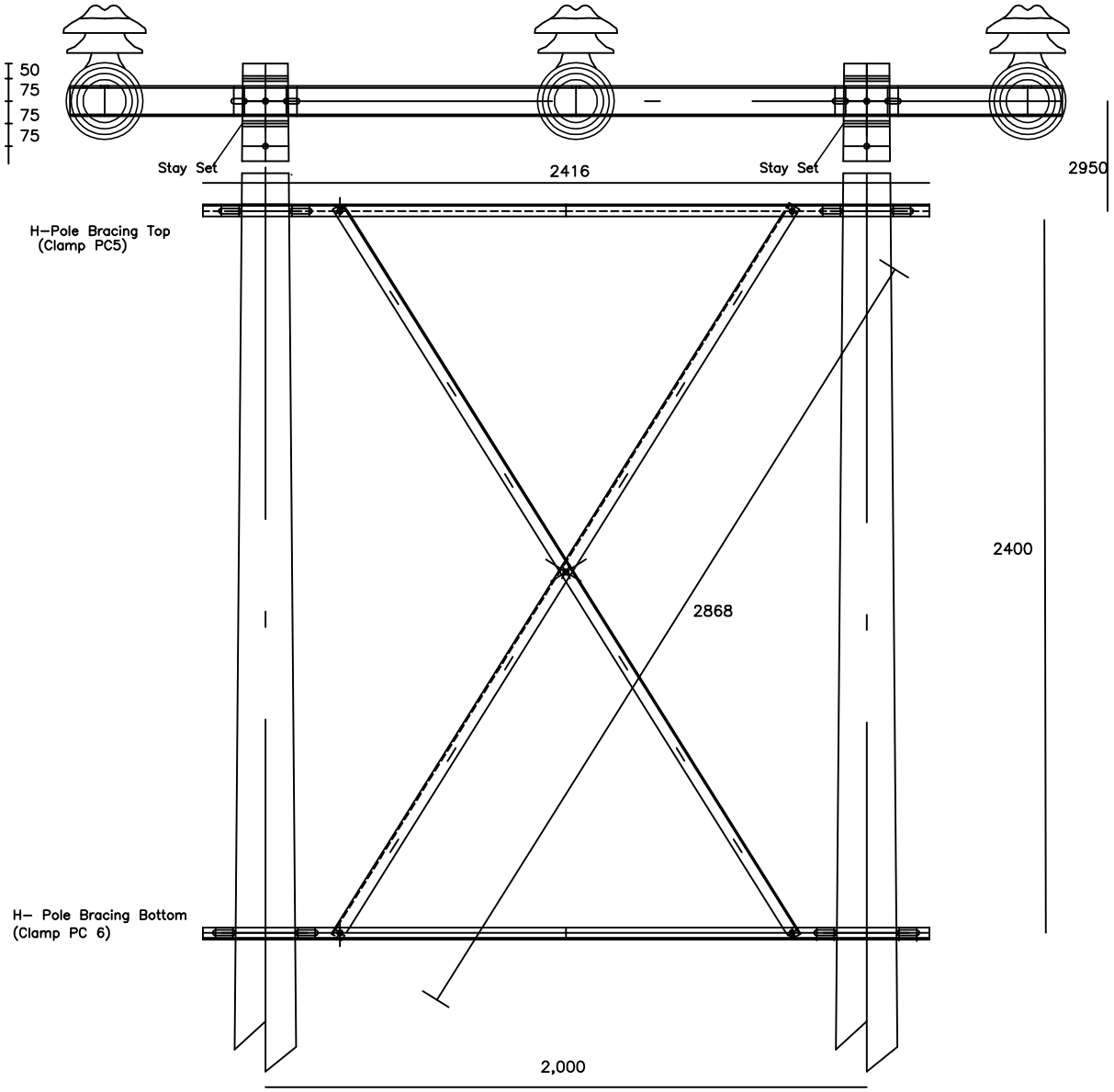
S.No.	QTY.	UNIT	MATERIAL
1	3	NOS	PIN INSULATOR
2	3	NOS	INSULATOR PIN
3	3	NOS	PREFORM PIN TIES (TOP TIES)
4	6	SET	DISC INSULATOR (A SET OF THREE)
5	6	SET	BRACK STRAP
6	6	SET	TENSION SET WITH BALL AND SOCKET EYE
7	6	SET	PG CLAMP
8	2	NOS	STEEL CROSSARM CHANNEL (100x 50x7.5x3300) mm.
9	6	NOS	STRAP FOR INSULATOR STRING (33 kV) (50x 6x404) mm
10	2	NOS	BRACING ANGLE (40x 40x5x2416) mm.
11	2	NOS	CROSS BRACING ANGLE (40x 40x5x2872) mm.
12	17	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (12 x51) mm
13	4	SET	DOUBLE ARMING BOLTS WITH SUITABLE NUTS AND WASHERS (16 x305) mm
14	2	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS ,TOP BRACING (PC5)
15	1	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS,BOTTOM BRACING (PC6)
16	1	LOT	HT STAY SET (AS REQUIRED)
17	2	NOS	POLE PSC 11m

CONSTRUCTION STANDARDS
33 kV H- STRUCTURE (PHA)
PSC POLE , ABOVE 30^0

NEPAL ELECTRICITY AUTHORITY
Technical Service/ Commercial Department
Distribution and Consumer Services



Top View



Front View

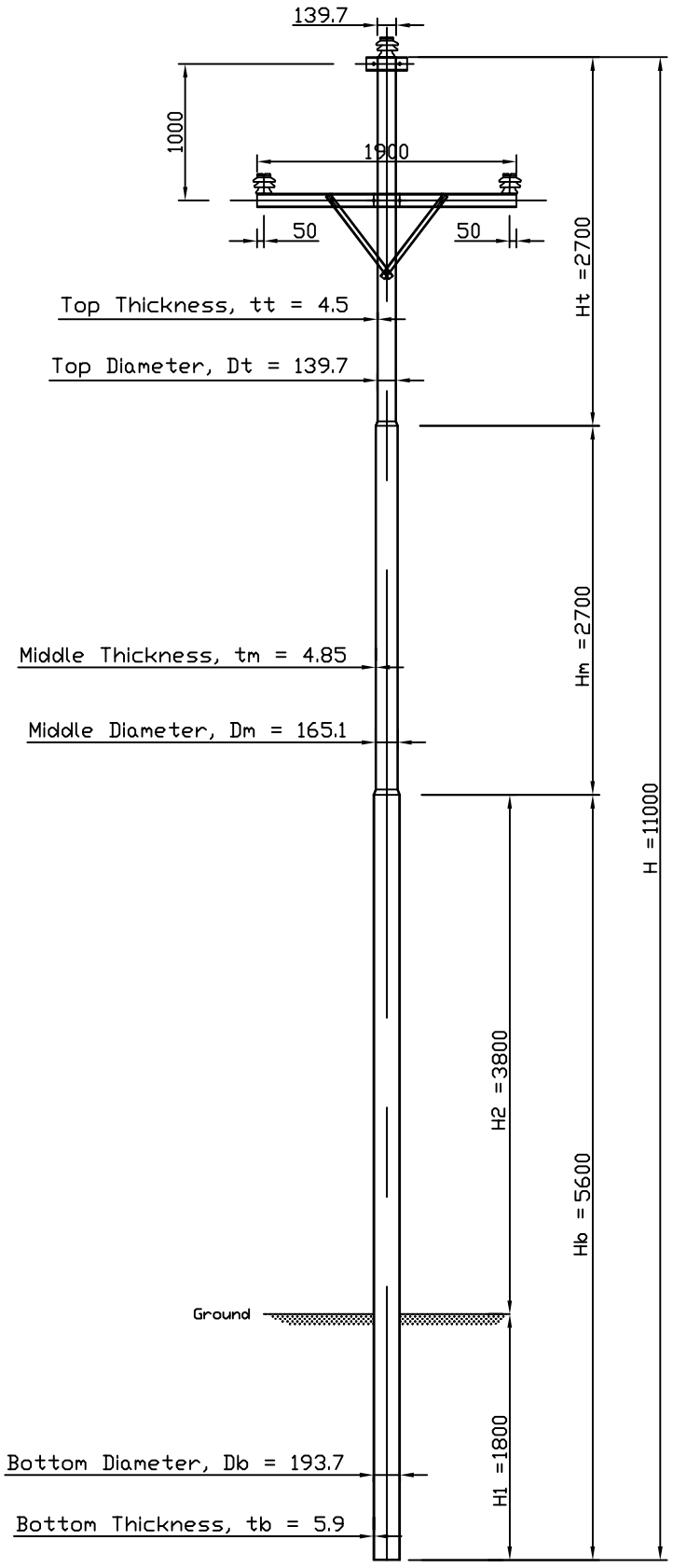
Drawing **CS33-PSCP-08**	**33 kV, 11 m PSC Double Pole** **(H - Structure)** **High Angle (Above 30 deg.)**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

Refer Drawing No: CS33-STP-01

S.No.	QTY.	UNIT	MATERIAL
1	3	NOS	PIN INSULATOR
2	3	NOS	INSULATOR PIN
3	3	NOS	PREFORM PIN TIES (TOP TIES)
4	1	NOS	STEEL CROSSARM CHANNEL (100x 50x7.5x300) mm.
5	1	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS (TC1)
6	1	NOS	STEEL CROSSARM CHANNEL (100x 50x7.5x1900) mm.
7	1	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS (TC4)
8	2	NOS	FLAT CROSSARM BRACE(40x 6.0x760) mm
9	2	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (12 x51) mm
10	1	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (16 x203) mm
11	1	NOS	POLE TUBULAR STEEL 11m

CONSTRUCTION STANDARDS
33 kV SINGLE ARM STRUCTURE
STEEL TUBULAR POLE

NEPAL ELECTRICITY AUTHORITY
Technical Service/ Commercial Department
Distribution and Consumer Services



Pole Details

Description		11 m Pole (H)
Top Segment	H_t	2700
	t_t	4.5
	D_t	139.7
Middle Segment	H_m	2700
	t_m	4.85
	D_m	165.1
Bottom Segment	H_b	5600
	H_1	1800
	H_2	3800
	t_b	5.9
	D_b	193.7

STEEL TUBULAR (ST) POLE

Drawing **CS33-STP-01**	**33 kV, 11 m ST Pole No Deviation (0 - 7 deg.)**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

Refer Drawing No: CS33-STP-02

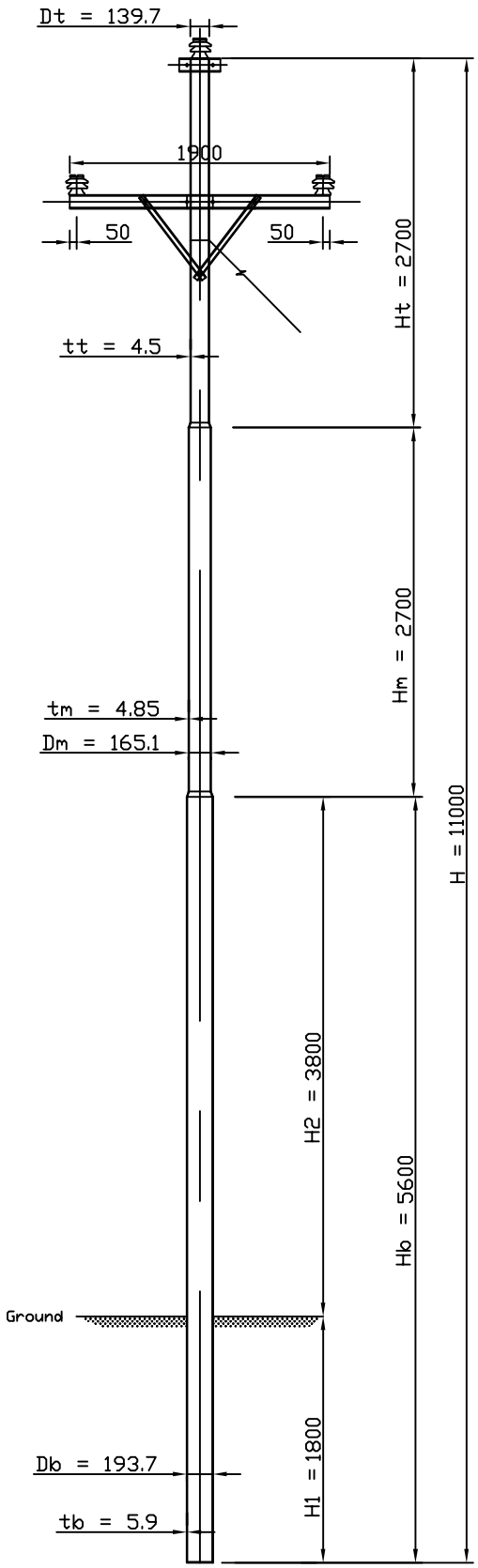
S.No.	QTY.	UNIT	MATERIAL
1	3	NOS	PIN INSULATOR
2	3	NOS	INSULATOR PIN
3	3	NOS	PREFORM PIN TIES (TOP TIES)
4	1	NOS	STEEL CROSSARM CHANNEL (100x 50x7.5x300) mm.
5	1	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS (TC1)
6	1	NOS	STEEL CROSSARM CHANNEL (100x 50x7.5x1900) mm.
7	1	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS (TC4)
8	2	NOS	FLAT CROSSARM BRACE(40x 6.0x760) mm
9	2	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (12 x51) mm
10	1	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (16 x203) mm
11	1	SET	HT STAY SET (AS REQUIRED)
12	1	NOS	POLE TUBULAR STEEL 11m

CONSTRUCTION STANDARDS

33 kV SINGLE ARM STRUCTURE (PLA)
STEEL TUBULAR POLE ,
LOW ANGLE 8^0 TO 15^0

NEPAL ELECTRICITY AUTHORITY

Technical Service/ Commercial Department
Distribution and Consumer Services



Pole Details

Description		11 m Pole (H)
Top Segment	H_t	2700
	t_t	4.5
	D_t	139.7
Middle Segment	H_m	2700
	t_m	4.85
	D_m	165.1
Bottom Segment	H_b	5600
	H_1	1800
	H_2	3800
	t_b	5.9
	D_b	193.7

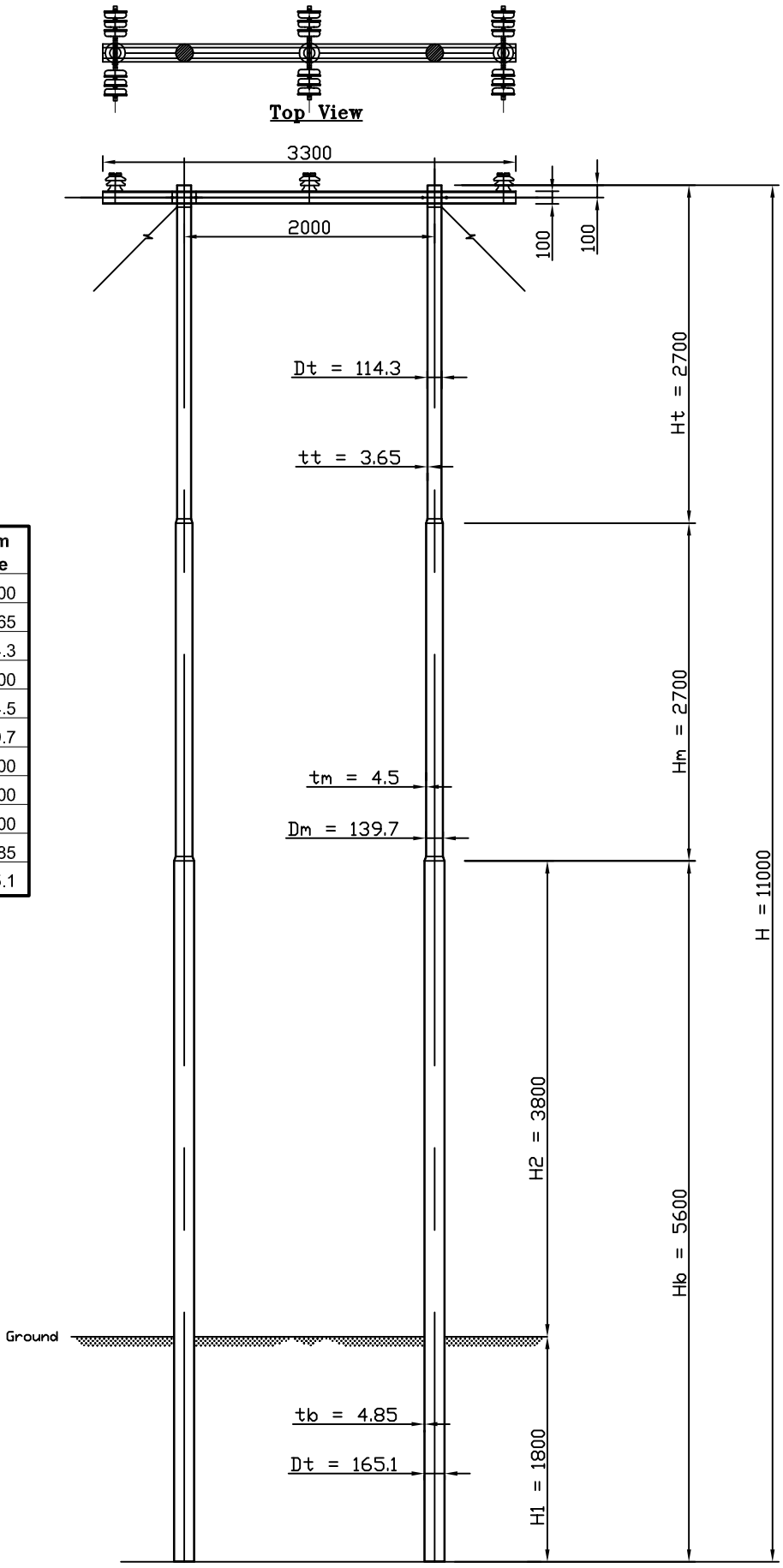
Drawing **CS33-STP-02**	**33 kV, 11 m ST Pole Low Angle (8 - 15 deg.)**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

Refer Drawing No: CS33-STP-03

S.No.	QTY.	UNIT	MATERIAL
1	3	NOS	PIN INSULATOR
2	3	NOS	INSULATOR PIN
3	3	NOS	PREFORM PIN TIES (TOP TIES)
4	6	SET	DISC INSULATOR (A SET OF THREE)
5	6	SET	BRACK STRAP
6	6	SET	TENSION SET WITH BALL AND SOCKET EYE
7	6	SET	PG CLAMP
8	2	NOS	STEEL CROSSARM CHANNEL (100x 50x7.5x3300) mm.
9	6	NOS	STRAP FOR INSULATOR STRING (33 kV) (50x 6x404) mm
10	12	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (12 x51) mm
11	4	SET	DOUBLE ARMING BOLTS WITH SUITABLE NUTS AND WASHERS (16 x305) mm
12	1	LOT	HT STAY SET (AS REQUIRED)
13	2	NOS	POLE TUBULAR STEEL 11m

CONSTRUCTION STANDARDS
33 kV H- STRUCTURE (PMA)
STEEL TUBULAR POLE, 16^0 TO 30^0

NEPAL ELECTRICITY AUTHORITY
Technical Service/ Commercial Department
Distribution and Consumer Services



Pole Details

Description		11 m Pole
	H_t	2700
Top	t_t	3.65
Section	D_t	114.3
	H_m	2700
Middle	t_m	4.5
Section	D_m	139.7
	H_b	5600
Bottom	H_1	1800
Section	H_2	3800
	t_b	4.85
	D_b	165.1

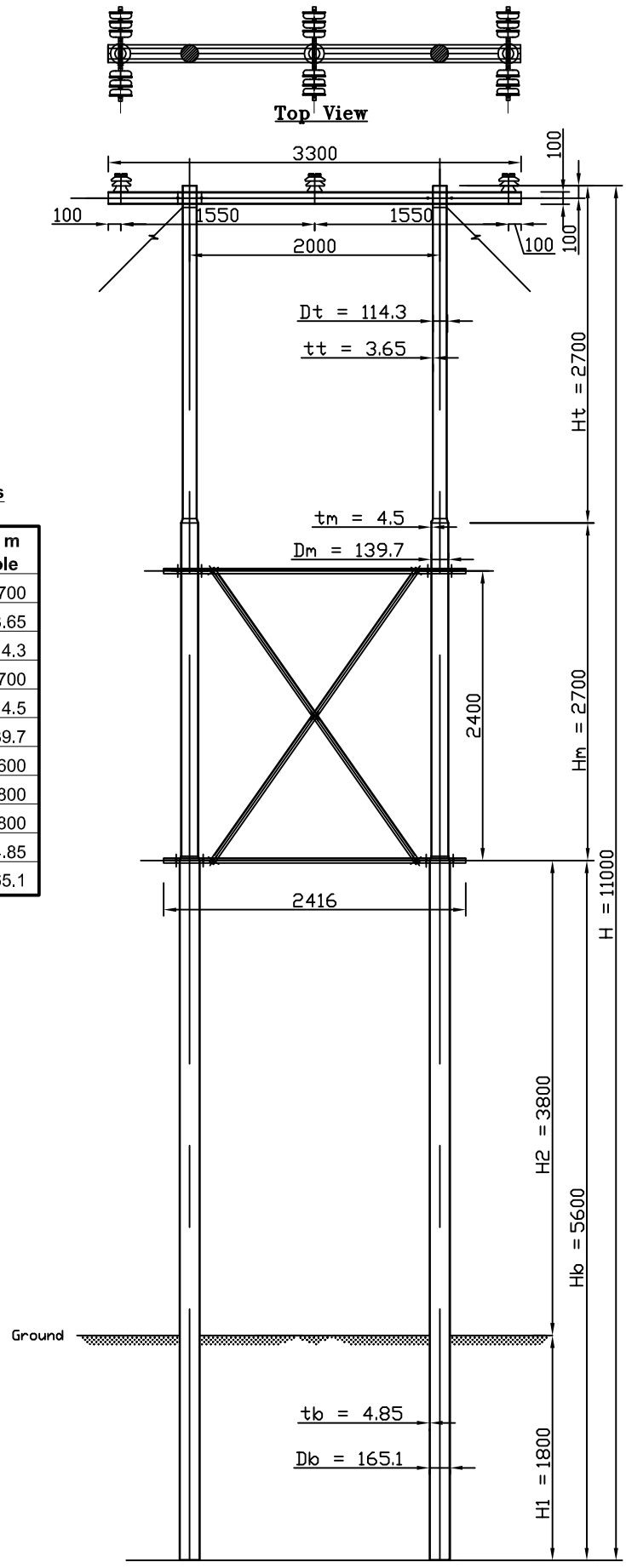
Drawing **CS33-STP-03**	**33 kV, 11 m ST Pole Medium Angle (16 - 30 deg.)**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

Refer Drawing No: CS33-STP-04

S.No.	QTY.	UNIT	MATERIAL
1	3	NOS	PIN INSULATOR
2	3	NOS	INSULATOR PIN
3	3	NOS	PREFORM PIN TIES (TOP TIES)
4	6	SET	DISC INSULATOR (A SET OF THREE)
5	6	SET	BRACK STRAP
6	6	SET	TENSION SET WITH BALL AND SOCKET EYE
7	6	SET	PG CLAMP
8	2	NOS	STEEL CROSSARM CHANNEL (100x 50x7.5x3300) mm.
9	6	NOS	STRAP FOR INSULATOR STRING (33 kV) (50x 6x404) mm
10	2	NOS	BRACING ANGLE (40x 40x5x2416) mm.
11	2	NOS	CROSS BRACING ANGLE (40x 40x5x2872) mm.
12	17	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (12 x51) mm
13	4	SET	DOUBLE ARMING BOLTS WITH SUITABLE NUTS AND WASHERS (16 x305) mm
14	2	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS ,TOP BRACING (PC5)
15	1	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS,BOTTOM BRACING (PC6)
16	1	LOT	HT STAY SET (AS REQUIRED)
17	2	NOS	POLE PSC 11m

CONSTRUCTION STANDARDS
33 kV H- STRUCTURE
STEEL TUBULAR POLE ABOVE 30^0

NEPAL ELECTRICITY AUTHORITY
Technical Service/ Commercial Department
Distribution and Consumer Services

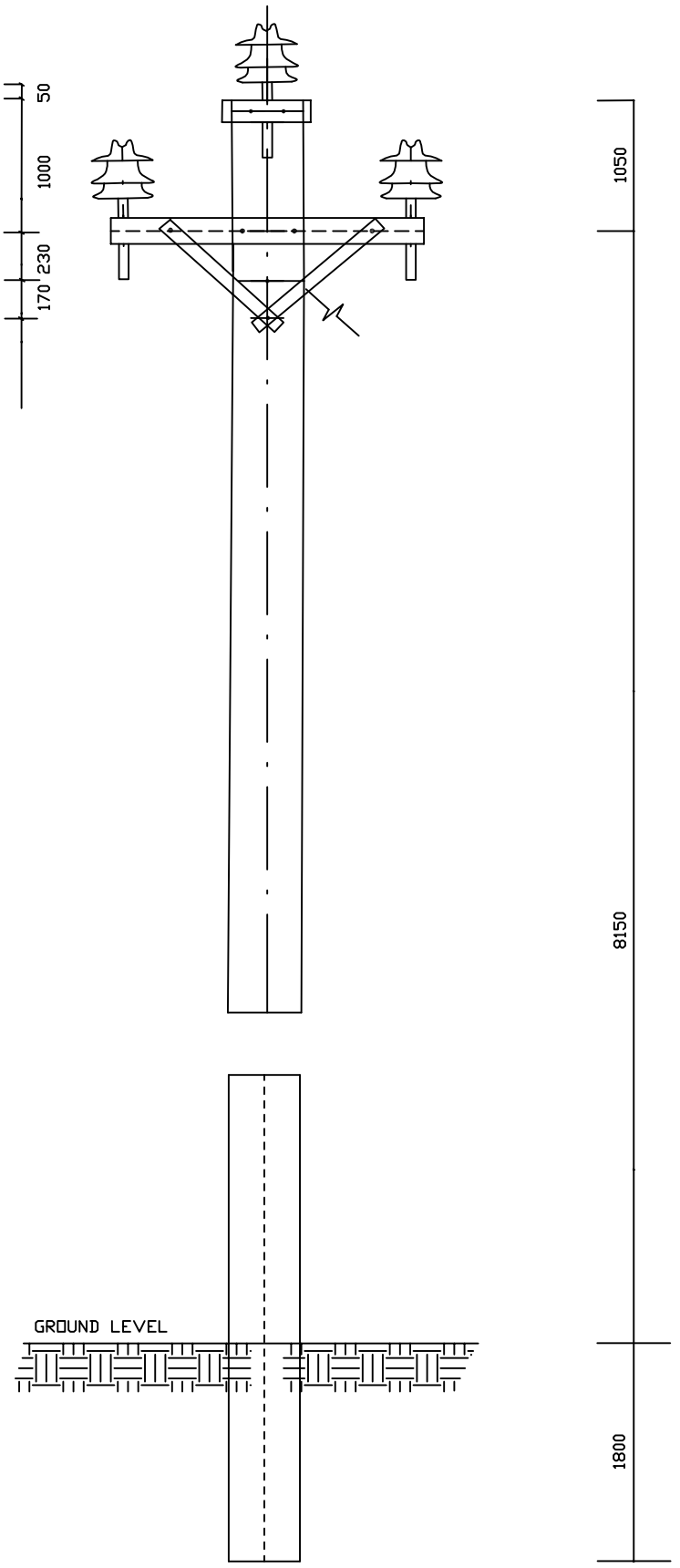


Pole Details

Description		11 m Pole
	H_t	2700
Top	t_t	3.65
Section	D_t	114.3
	H_m	2700
Middle	t_m	4.5
Section	D_m	139.7
	H_b	5600
Bottom	H_1	1800
Section	H_2	3800
	t_b	4.85
	D_b	165.1

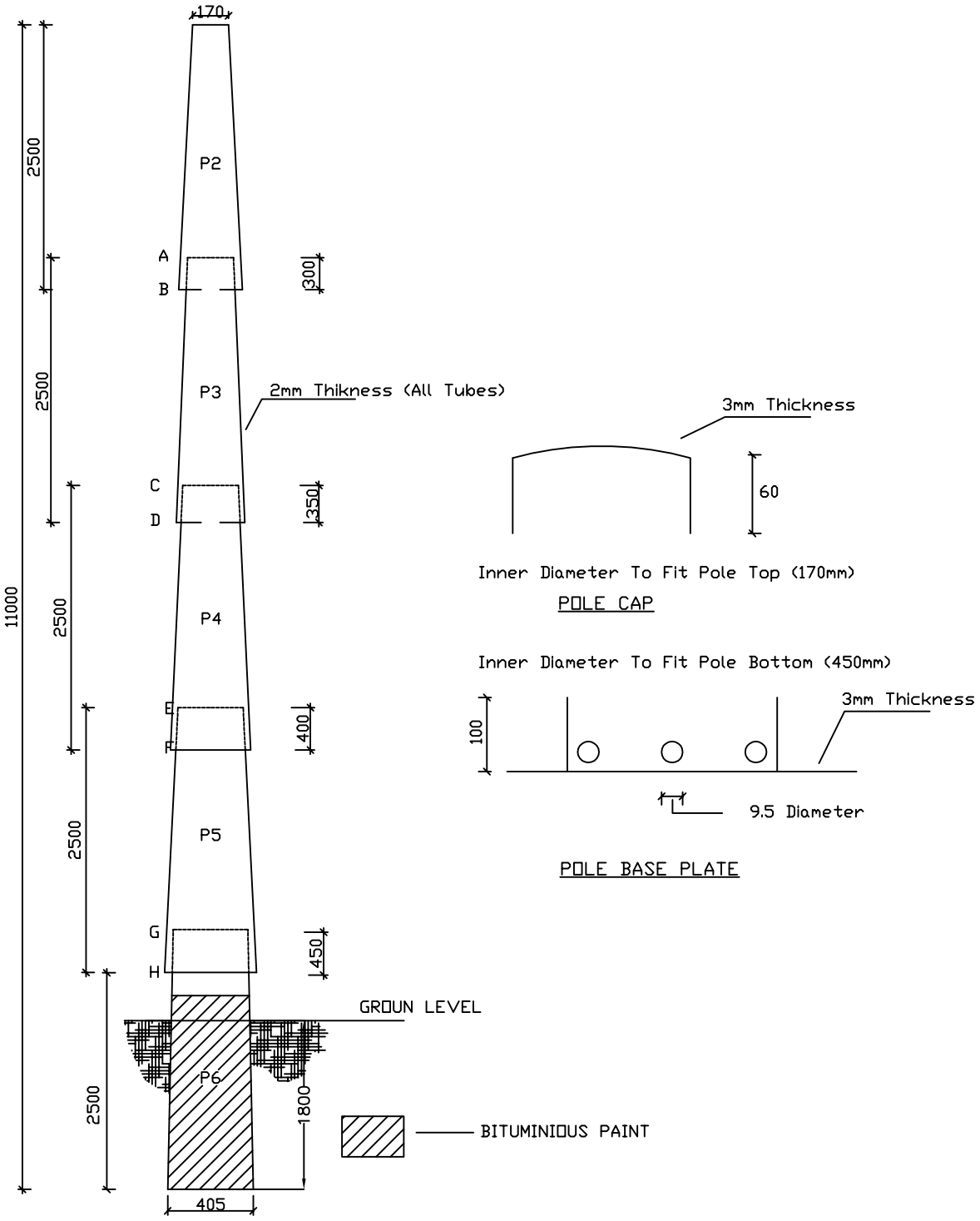
Drawing **CS33-STP-04**	**33 kV, 11 m ST Pole** **High Angle (Above 30 deg.)**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

STEEL TELESCOPIC TUBULAR (STT) POLE



ALL DIMENSION ARE IN MM.

Drawing **CS33-STTP-01**	**33 kV, 11m STT Pole** **Hole Pattern**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services



Inner Diameter To Fit Pole Top (170mm)

POLE CAP

Inner Diameter To Fit Pole Bottom (450mm)

POLE BASE PLATE

ALL DIMENSIONS ARE IN MM.

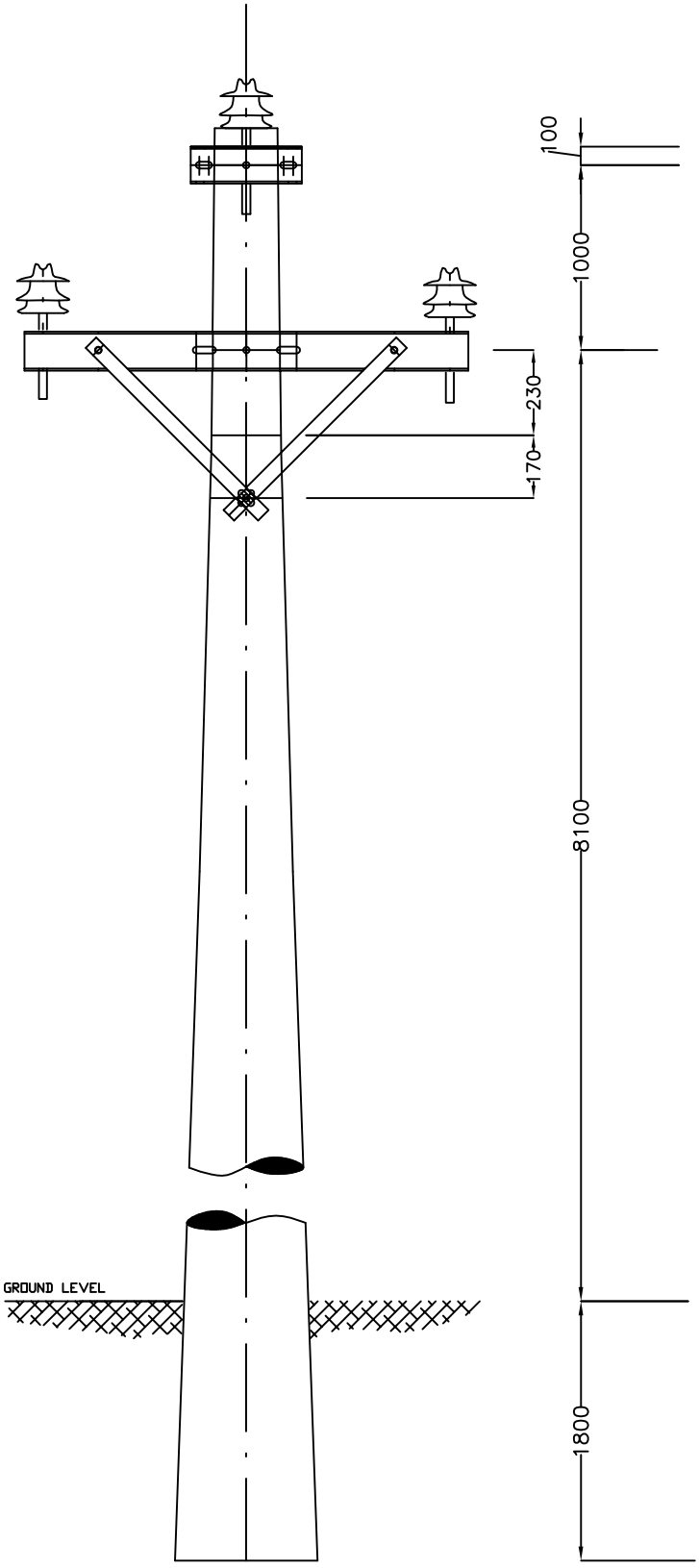
Drawing **CS33-STTP-02**	**33 kV, 11m STT Pole** **Pole Details**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

Refer Drawing No: CS33-STTP-03

S.No.	QTY.	UNIT	MATERIAL
1	3	NOS	PIN INSULATOR
2	3	NOS	INSULATOR PIN
3	3	NOS	PREFORM PIN TIES (TOP TIES)
4	1	NOS	STEEL CROSSARM CHANNEL (100x 50x7.5x300) mm.
5	1	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS (TC1)
6	1	NOS	STEEL CROSSARM CHANNEL (100x 50x7.5x1900) mm.
7	1	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS (TC2)
8	2	NOS	FLAT CROSSARM BRACE(40x 6.0x760) mm
9	2	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (12 x51) mm
10	1	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (16 x305) mm
11	1	NOS	POLE TELESCOPIC 11m

CONSTRUCTION STANDARDS
33 kV SINGLE ARM STRUCTURE
TELESCOPIC POLE

NEPAL ELECTRICITY AUTHORITY
Technical Service/ Commercial Department
Distribution and Consumer Services

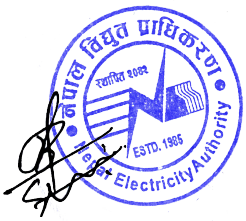


Drawing **CS33-STTP-03**	**33 kV, 11m STT Pole** **Single Arm Structure**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

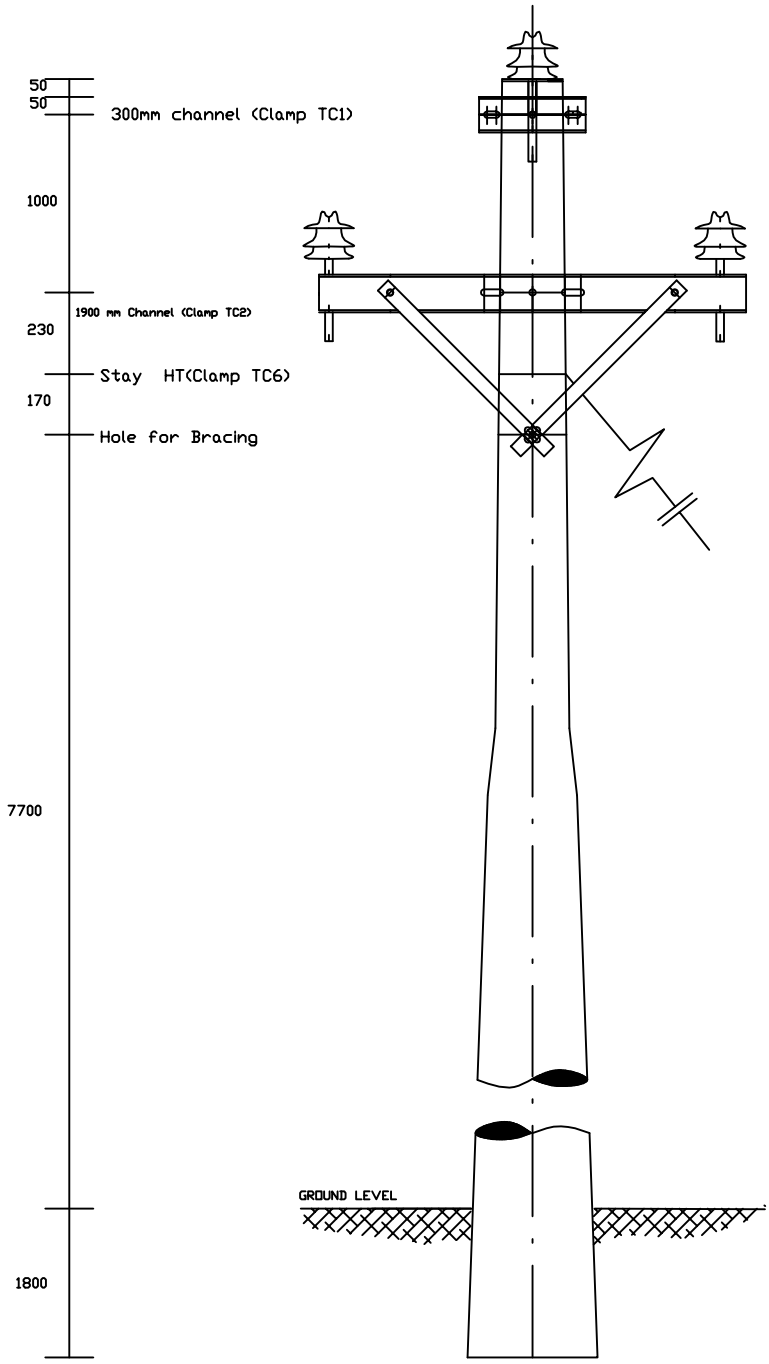
Refer Drawing No: CS33-STTP-04

S.No.	QTY.	UNIT	MATERIAL
1	6	NOS	PIN INSULATOR
2	6	NOS	INSULATOR PIN
3	6	NOS	PREFORM PIN TIES (TOP TIES)
4	2	NOS	STEEL CROSSARM CHANNEL (100x 50x7.5x300) mm.
5	2	NOS	STEEL CROSSARM CHANNEL (100x 50x7.5x1900) mm.
6	4	NOS	FLAT CROSSARM BRACE(40x 6.0x760) mm
7	4	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (12 x51) mm
8	1	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (16 x350) mm
9	4	SET	DOUBLE ARMING BOLTS WITH SUITABLE NUTS AND WASHERS (16 x305) mm
10	1	SET	HT STAY SET (AS REQUIRED)
11	1	NOS	POLE TELESCOPIC 11m

CONSTRUCTION STANDARDS **33 kV DOUBLE ARM STRUCTURE DA TELESCOPIC POLE**	**NEPAL ELECTRICITY AUTHORITY** **Technical Service/ Commercial Department** **Distribution and Consumer Services**



Top view of double arm pole



Drawing **CS33-STTP-04**	**33 kV, 11m STT Pole** **Double Arm Structure**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

Refer Drawing No: CS33-STTP-05

S.No.	QTY.	UNIT	MATERIAL
1	3	SET	DISC INSULATOR
2	3	SET	BRACK STRAP
3	3	SET	TENSION SET WITH BALL AND SOCKET EYE
4	1	NOS	STEEL CROSSARM CHANNEL (100x 50x7.5x300) mm.
5	1	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS (TC1)
6	1	NOS	STEEL CROSSARM CHANNEL (100x 50x7.5x1900) mm.
7	1	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS (TC2)
8	2	NOS	FLAT CROSSARM BRACE(40x 6.0x760) mm
9	2	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (12 x51) mm
10	1	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (16 x305) mm
11	1	SET	HT STAY SET (AS REQUIRED)
12	2	NOS	POLE TELESCOPIC 11m

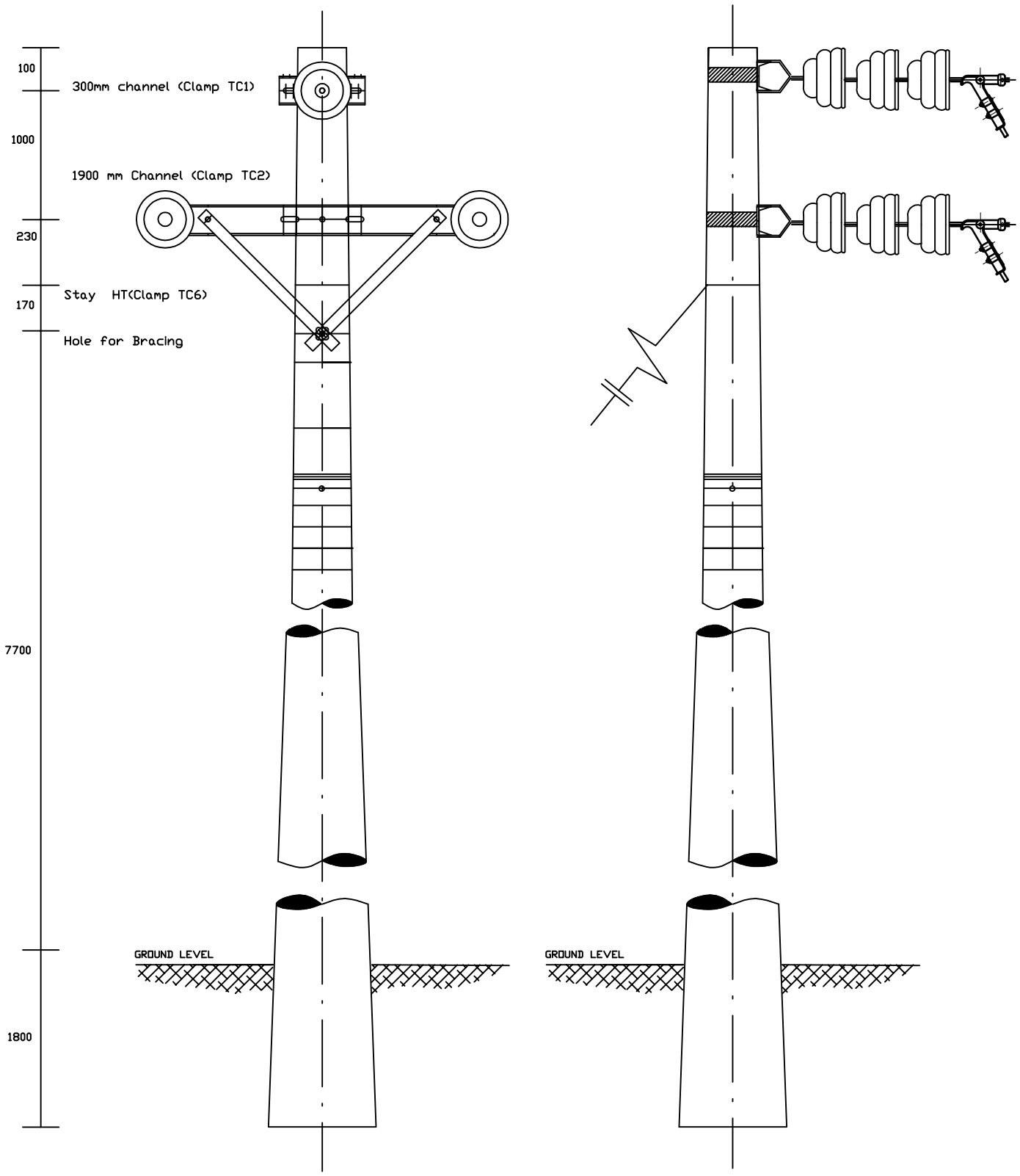
CONSTRUCTION STANDARDS

33 kV SINGLE ARM STRUCTURE DE TELESCOPIC POLE

NEPAL ELECTRICITY AUTHORITY

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Drawing **CS33-STTP-05**	**33 kV, 11m STT Pole** **Dead End Structure**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

Refer Drawing No: CS33-STTP-06

S.No.	QTY.	UNIT	MATERIAL
1	4	NOS	PIN INSULATOR
2	4	NOS	INSULATOR PIN
3	4	NOS	PREFORM PIN TIES (TOP TIES)
4	6	SET	DISC INSULATOR (A SET OF THREE)
5	6	SET	BRACK STRAP
6	6	SET	TENSION SET WITH BALL AND SOCKET EYE
7	6	SET	PG CLAMP
8	2	NOS	STEEL CROSSARM CHANNEL (100x 50x7.5x300) mm.
9	2	NOS	STEEL CROSSARM CHANNEL (100x 50x7.5x1900) mm.
10	4	NOS	FLAT CROSSARM BRACE(40x 6.0x760) mm
11	12	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (12 x51) mm
12	1	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (16 x305) mm
13	4	SET	DOUBLE ARMING BOLTS WITH SUITABLE NUTS AND WASHERS (16 x305) mm
14	4	NOS	STRAP FOR INSULATOR STRING
15	1	SET	HT STAY SET (AS REQUIRED)
16	1	NOS	POLE TELESCOPIC 11m

CONSTRUCTION STANDARDS

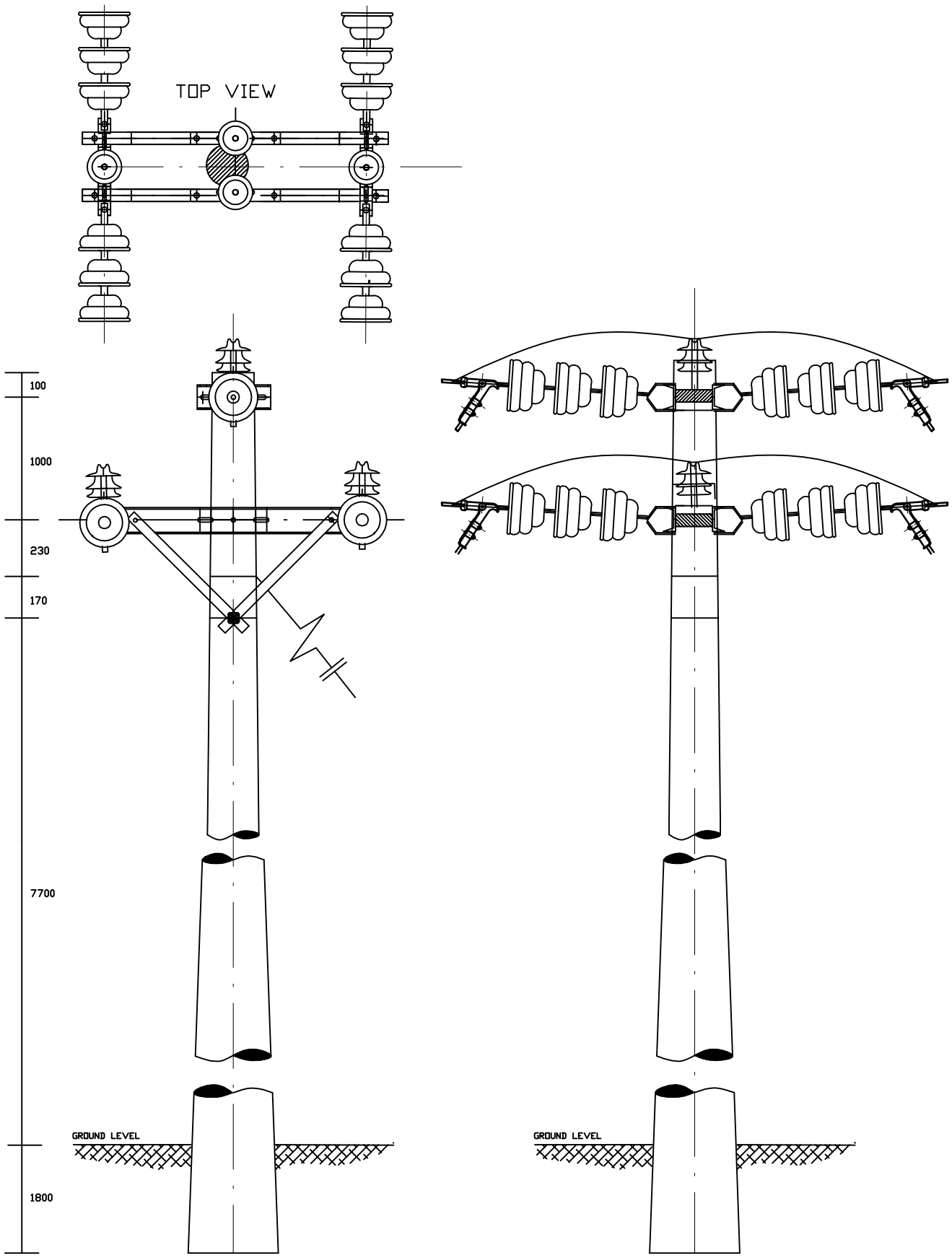
33 kV DOUBLE DEAD END STRUCTURE DDE

TELESCOPIC POLE

NEPAL ELECTRICITY AUTHORITY

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Drawing **CS33-STTP-06**	**33 kV, 11m STT Pole** **Double Arm Dead End Structure**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

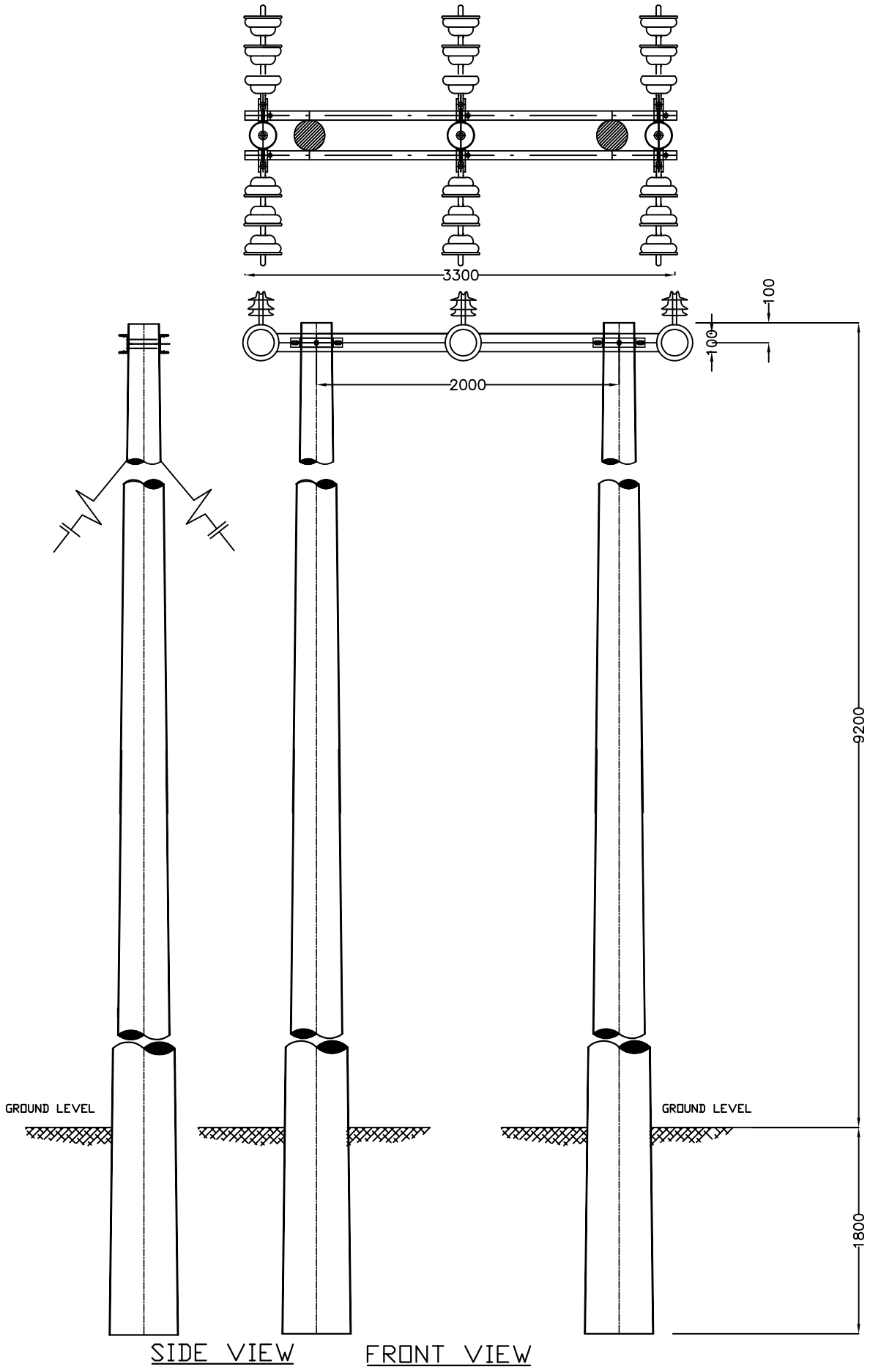
Refer Drawing No: CS33-STTP-07

S.No.	QTY.	UNIT	MATERIAL
1	3	NOS	PIN INSULATOR
2	3	NOS	INSULATOR PIN
3	3	NOS	PREFORM PIN TIES (TOP TIES)
4	6	SET	DISC INSULATOR (A SET OF THREE)
5	6	SET	BRACK STRAP
6	6	SET	TENSION SET WITH BALL AND SOCKET EYE
7	6	SET	PG CLAMP
8	2	NOS	STEEL CROSSARM CHANNEL (100x 50x7.5x3300) mm.
9	6	NOS	STRAP FOR INSULATOR STRING (33 kV) (50x 6x404) mm
10	12	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (12 x51) mm
11	4	SET	DOUBLE ARMING BOLTS WITH SUITABLE NUTS AND WASHERS (16 x305) mm
12	1	LOT	HT STAY SET (AS REQUIRED)
13	2	NOS	POLE TELESCOPIC 11m

CONSTRUCTION STANDARDS
33 kV DOUBLE POLE DOUBLE ARM STRUCTURE
TELESCOPIC POLE

NEPAL ELECTRICITY AUTHORITY
Technical Service/ Commercial Department

Distribution and Consumer Services



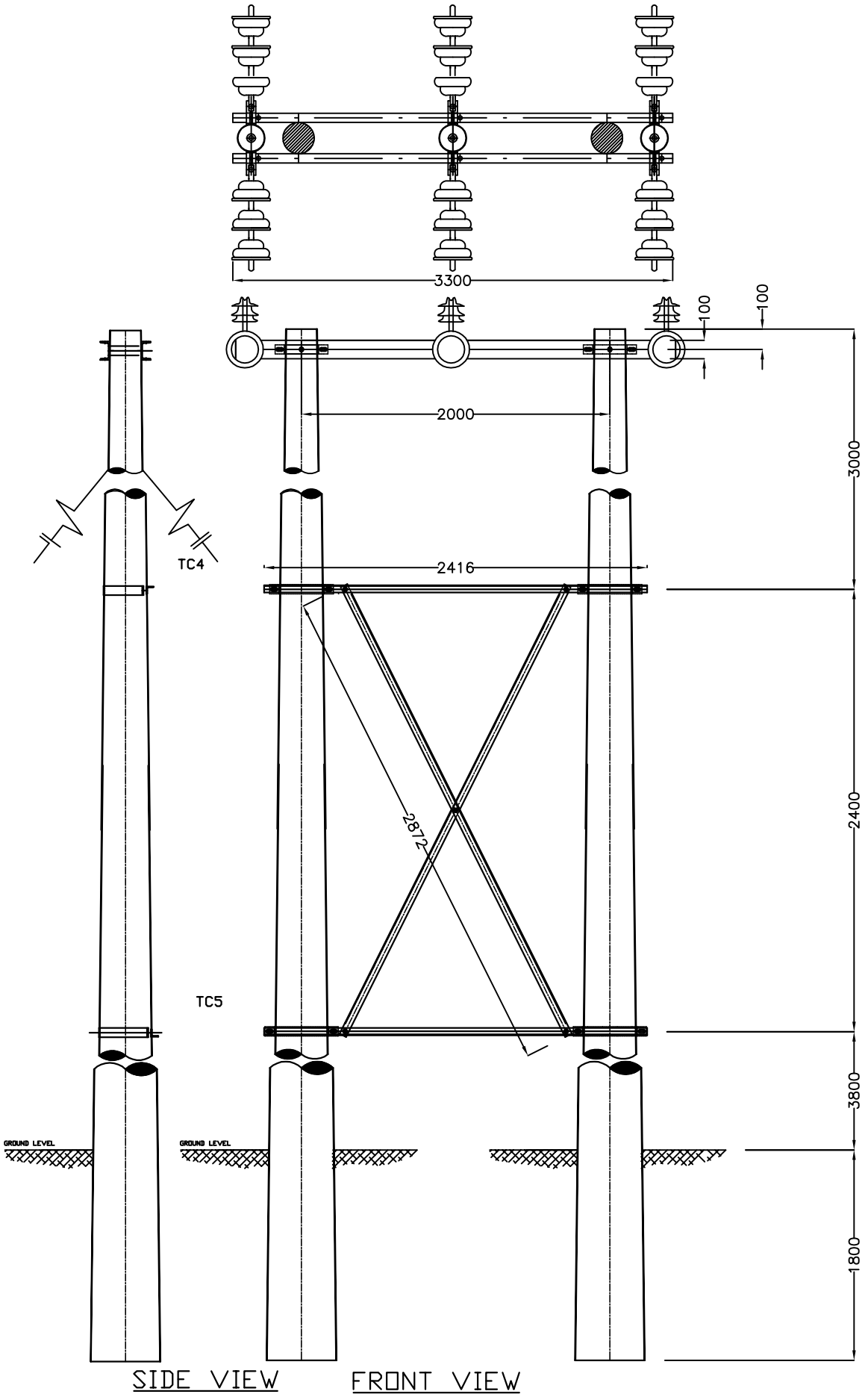
Drawing **CS33-STTP-07**	**33 kV, 11m STT Pole** **Double Pole Double Arm** **Dead End Structure**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

Refer Drawing No: CS33-STTP-08

S.No.	QTY.	UNIT	MATERIAL
1	3	NOS	PIN INSULATOR
2	3	NOS	INSULATOR PIN
3	3	NOS	PREFORM PIN TIES (TOP TIES)
4	6	SET	DISC INSULATOR (A SET OF THREE)
5	6	SET	BRACK STRAP
6	6	SET	TENSION SET WITH BALL AND SOCKET EYE
7	6	SET	PG CLAMP
8	2	NOS	STEEL CROSSARM CHANNEL (100x 50x7.5x3300) mm.
9	6	NOS	STRAP FOR INSULATOR STRING (33 kV) (50x 6x404) mm
10	2	NOS	BRACING ANGLE (40x 40x5x2416) mm.
11	2	NOS	CROSS BRACING ANGLE (40x 40x5x2872) mm.
12	17	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (12 x51) mm
13	4	SET	DOUBLE ARMING BOLTS WITH SUITABLE NUTS AND WASHERS (16 x305) mm
14	2	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS ,TOP BRACING (TC5)
15	1	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS,BOTTOM BRACING (TC6)
12	1	LOT	HT STAY SET (AS REQUIRED)
16	2	NOS	POLE TELESCOPIC 11m

CONSTRUCTION STANDARDS
33 kV H -STRUCTURE
TELESCOPIC POLE

NEPAL ELECTRICITY AUTHORITY
Technical Service/ Commercial Department
Distribution and Consumer Services



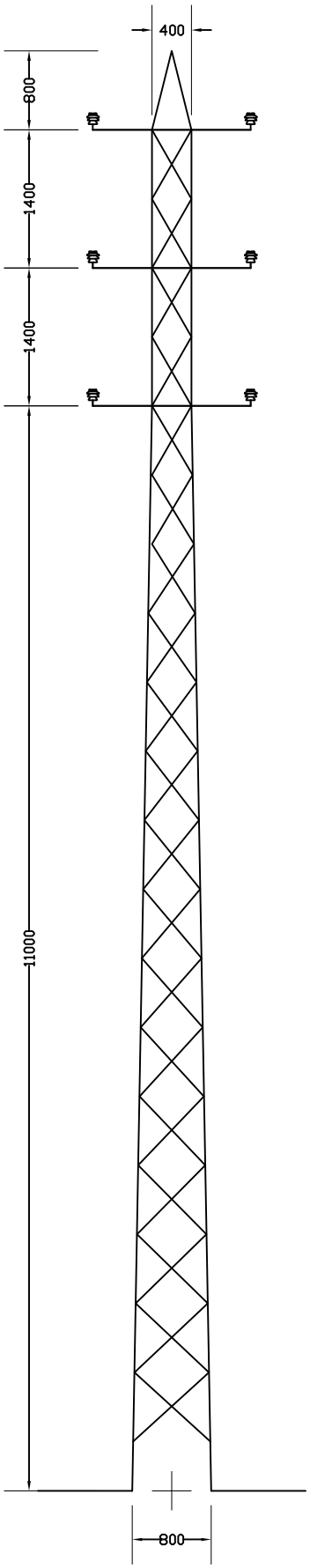
Drawing **CS33-STTP-08**	**33 kV, 11m STT Pole** **Double Pole Double Arm Dead End Structure (H - Structure)**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

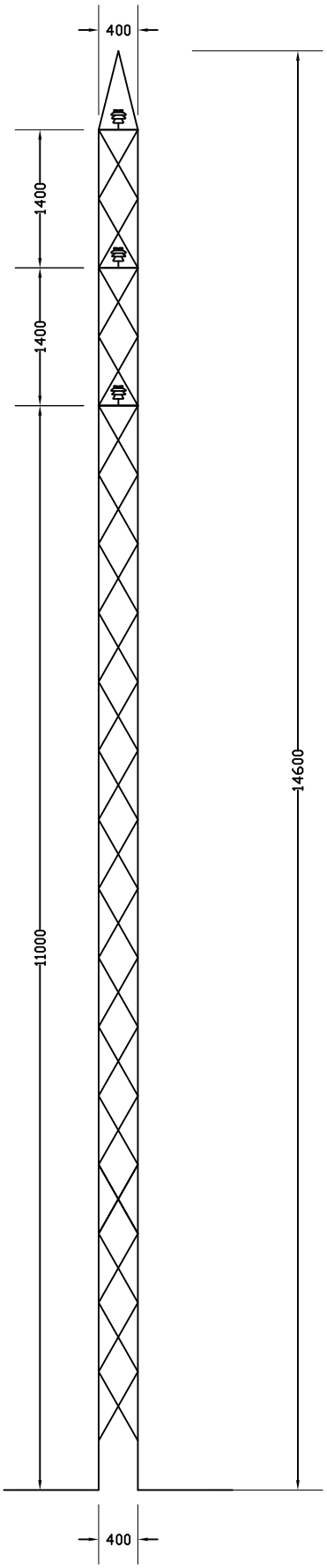
Refer Drawing No: CS33-Twr-01

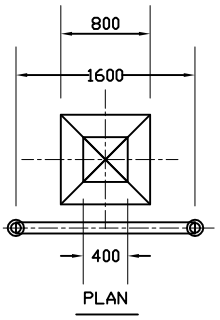
DESIGN CONDITION		
RATED VOLTAGE		33 kV
HORIZONTAL ANGLE		3^0
DESIGN SPAN	BASIC SPAN	130 M
	WIND SPAN	145 M
	WEIGHT SPAN	260 M
POWER CONDUCTOR	CODE NAME	DOG
	SECTIONAL AREA	118.5 MM^2
	DIAMETER	14.15 MM
	WEIGHT	0.394 KG/M
	MAXIMUM WORKING TENSION	1200 KG
INSULATOR	STRING TYPE	SINGLE PIN
	NUMBER OF INSULATOR	1 EA/ PHASE
	WEIGHT	20 KG/ EA
WIND PRESSURE	STEEL STRUCTURE	121 KG / M^2
	WIRE	75 KG / M^2
	INSULATOR	10 KG/ EA

CONSTRUCTION STANDARDS
33 kV LATTICE TOWER

NEPAL ELECTRICITY AUTHORITY
Technical Service/ Commercial Department
Distribution and Consumer Services

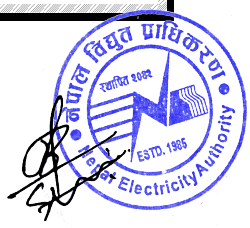


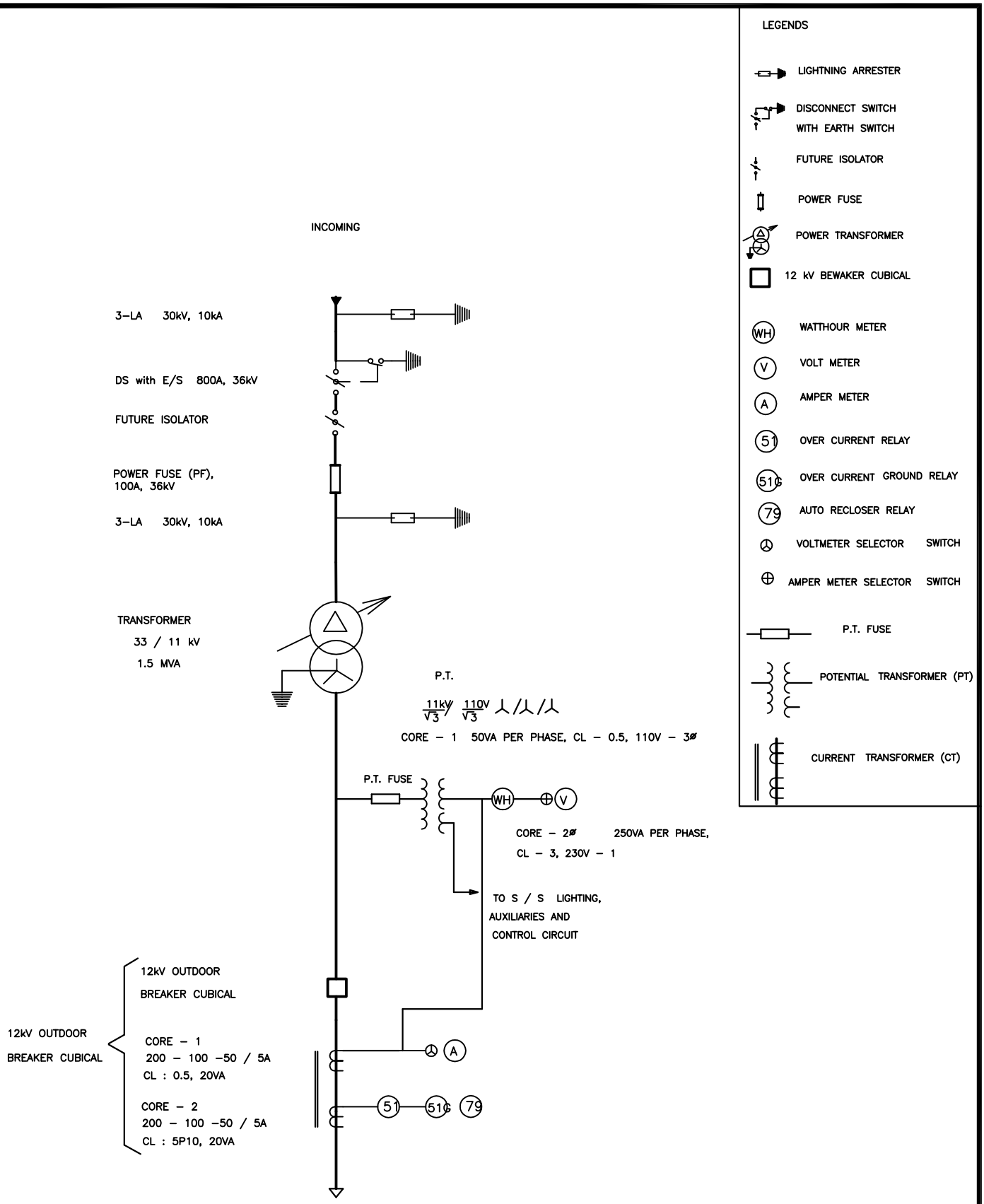




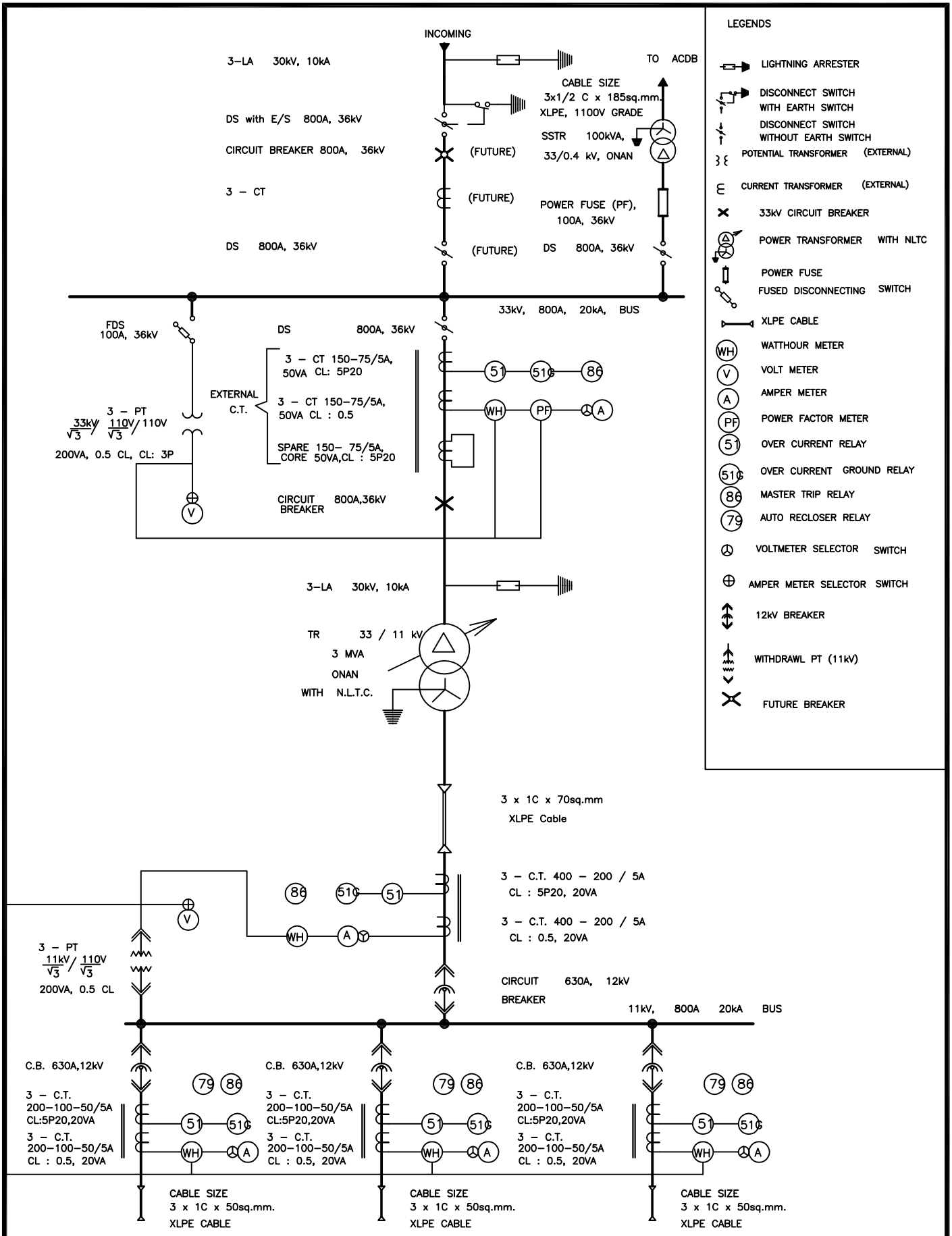
Drawing **CS33-TWR-01**	**33 kV, 14.6 m Tower** **Lattice Steel Structure**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

SUB -STATION

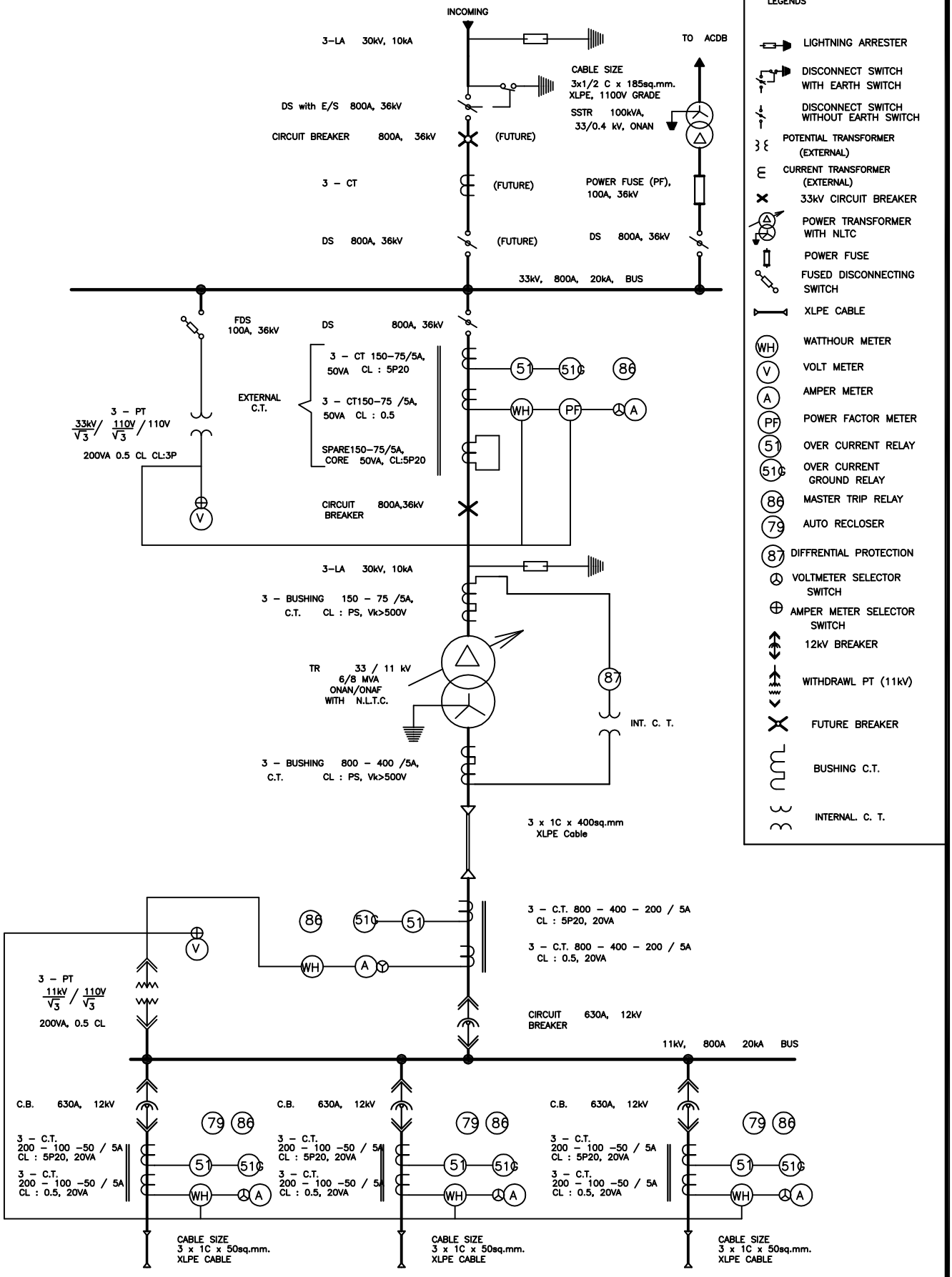




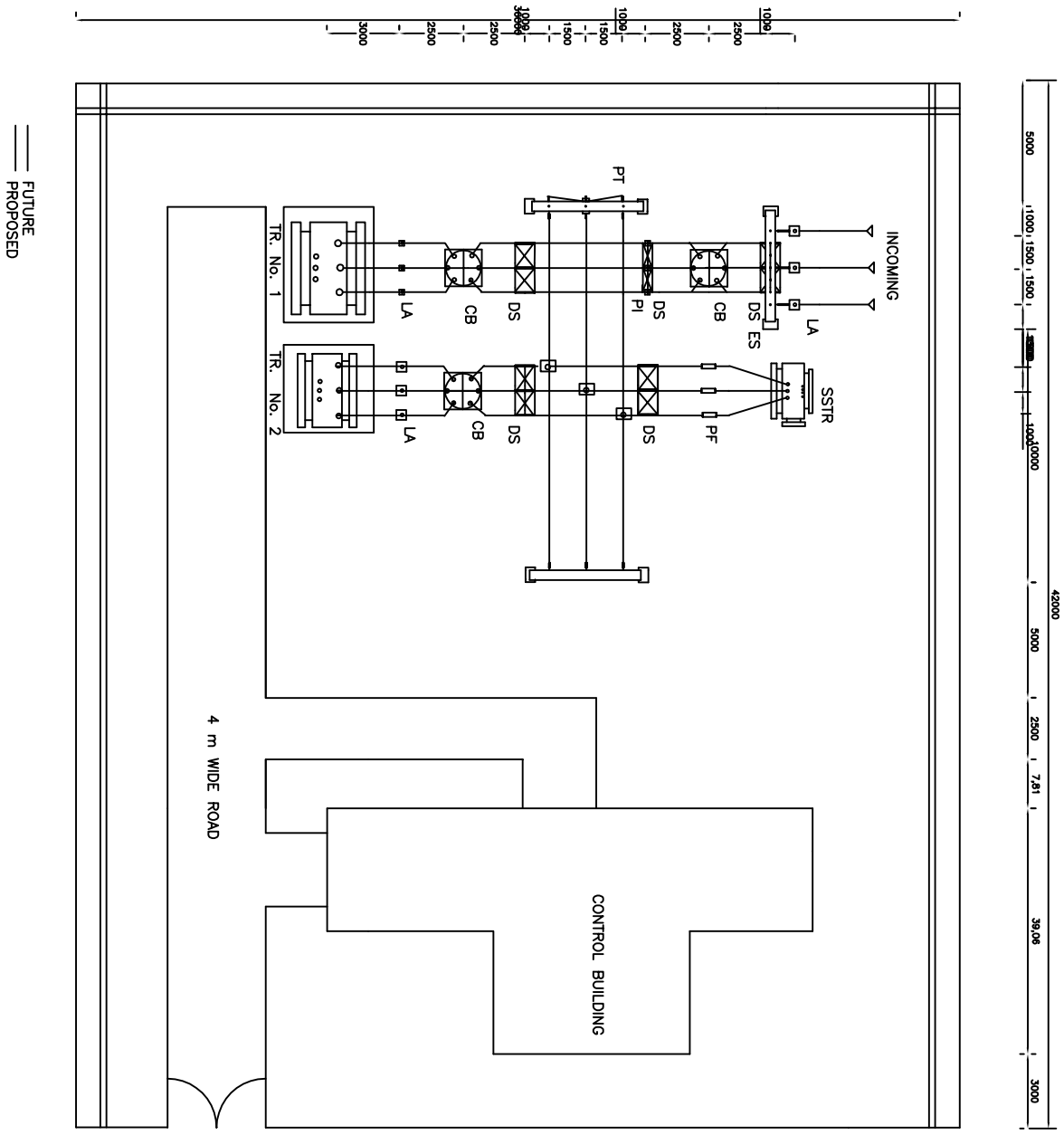
Drawing	Conceptual Single Line Diagram of 33/11 kV, 1.5 MVA S/S	NEPAL ELECTRICITY AUTHORITY
CS33-SS-01		Technical Services / Commercial Department
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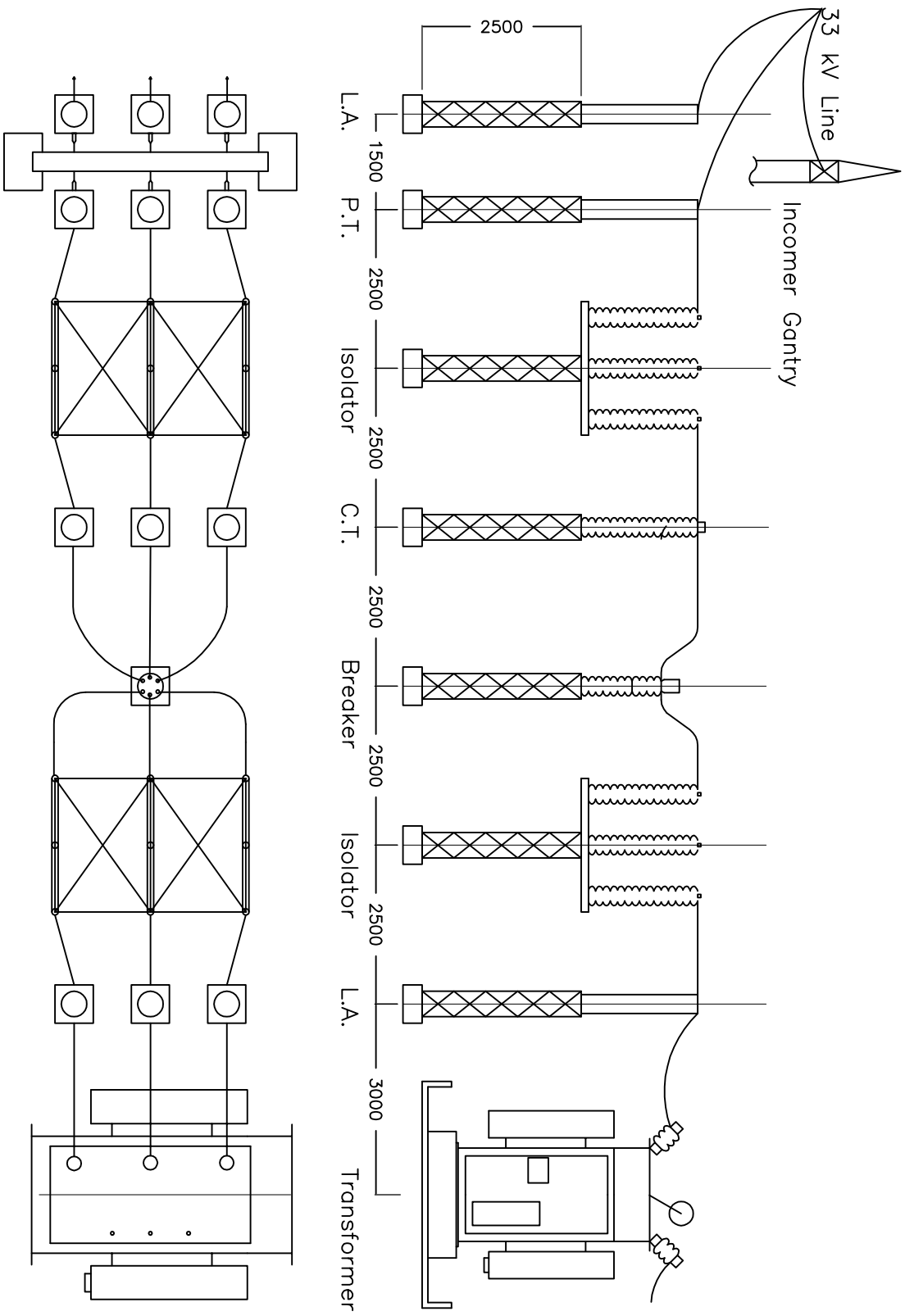
Drawing **CS33-SS-02**	**Conceptual Single Line Diagram of 33/11 kV, 3 MVA S/S**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services



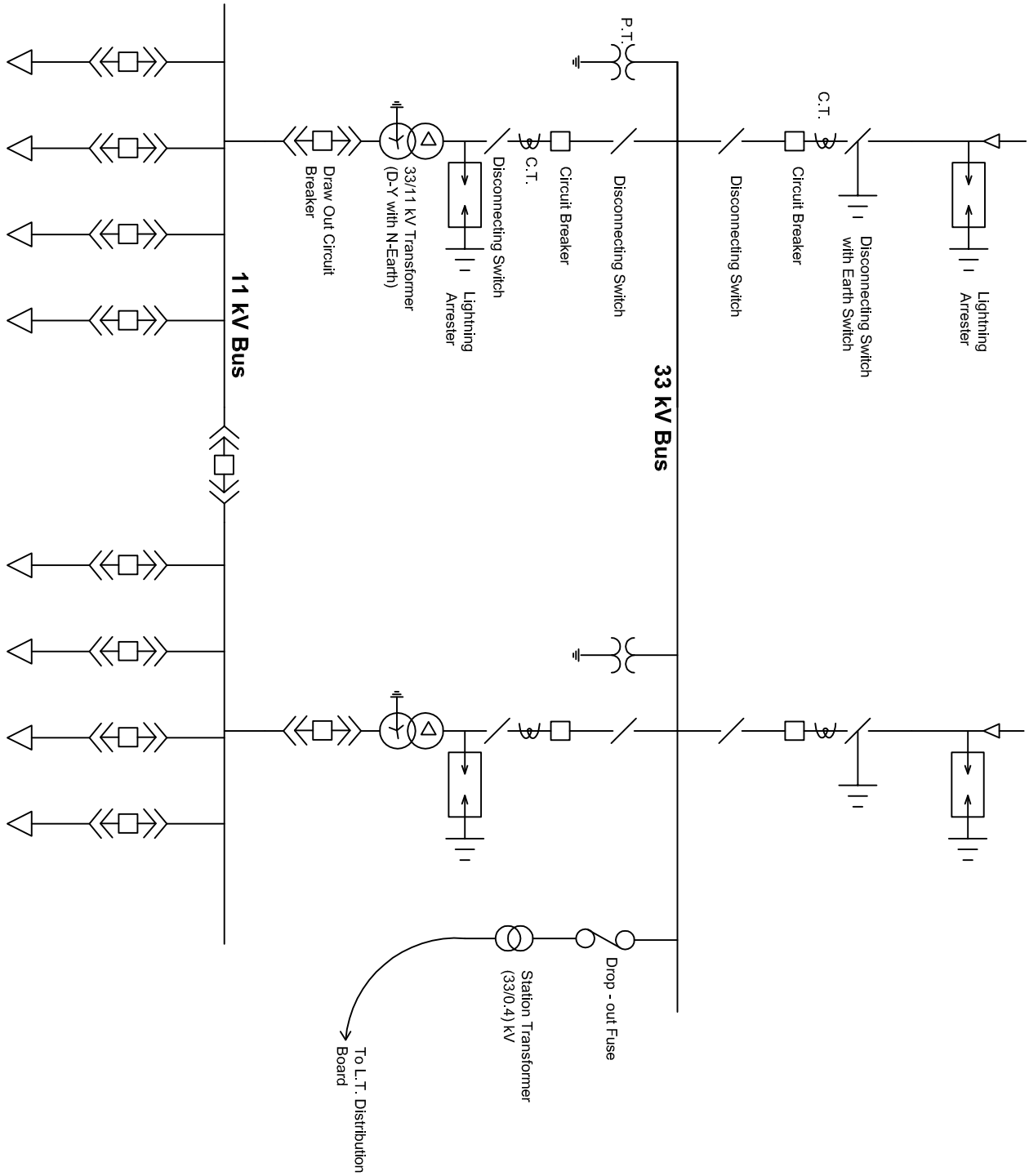
Drawing	Conceptual Single Line Diagram of 33/11 kV, 6/8 MVA S/S	NEPAL ELECTRICITY AUTHORITY
CS33-SS-03		Technical Services / Commercial Department
		Distribution and Consumer Services



Drawing **CS33-SS-04**	**Typical Layout of Substation**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

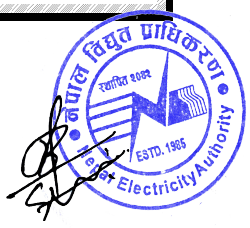


Drawing **CS33-SS-05**	**Typical Layout & Elevation of 33/11 kV S/S**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Service

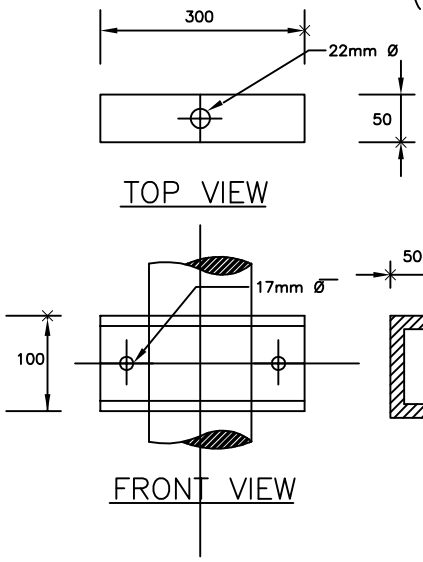


Drawing **CS33-SS-06**	**Conceptual Single Line Diagram of 33/11 kV Conventional S/S**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

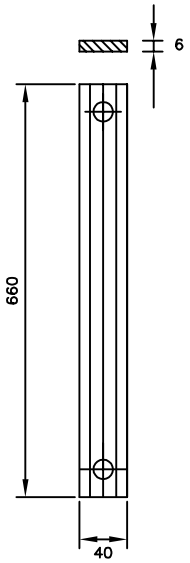
DISTRIBUTION SYSTEM



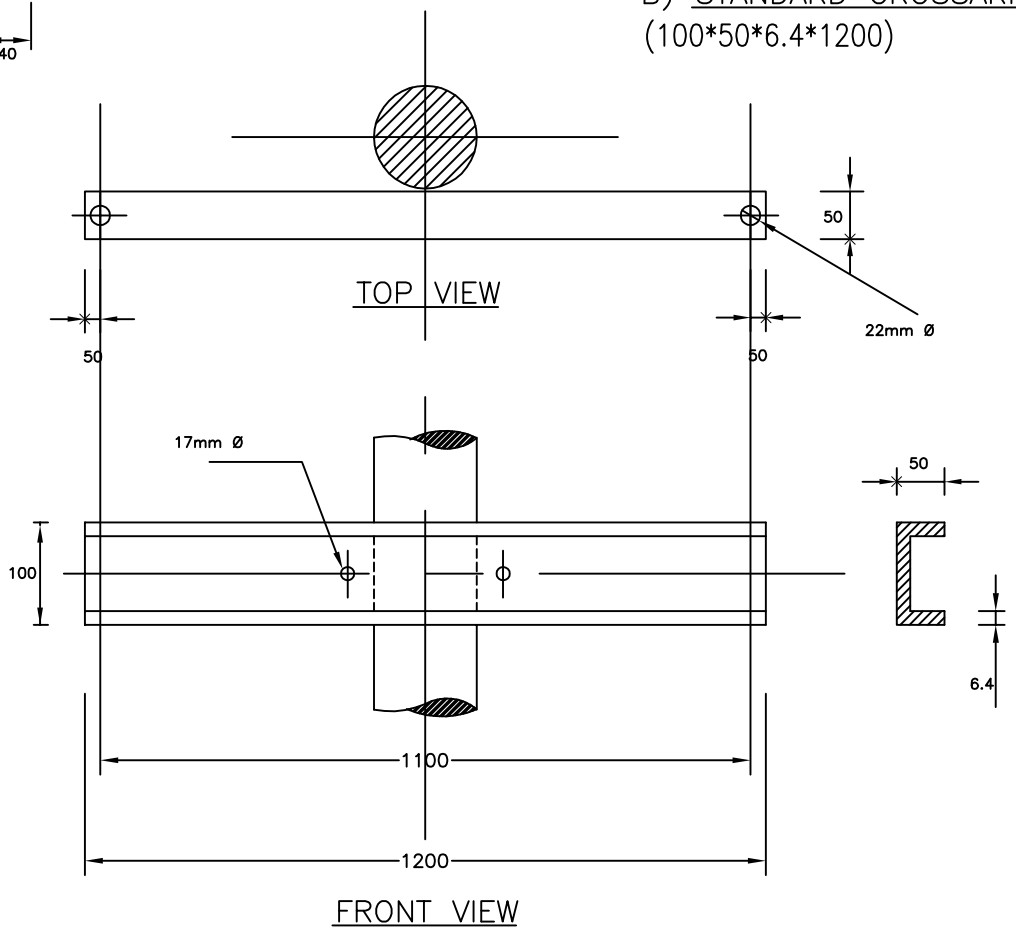
A) POLE TOP CROSSARM
(100*50*6.4*300)



C) FLAT CROSSARM BRACE
(40*6*660)

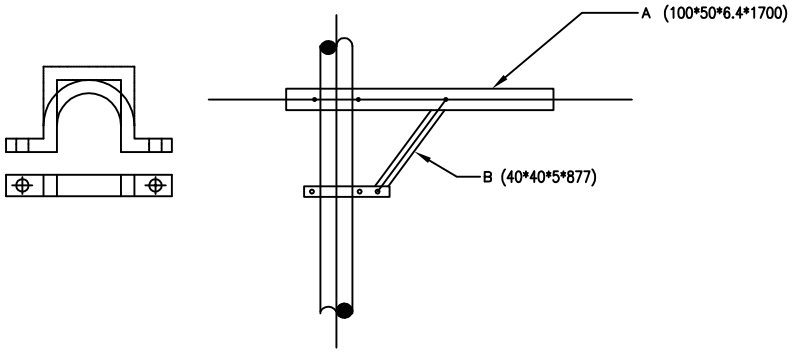


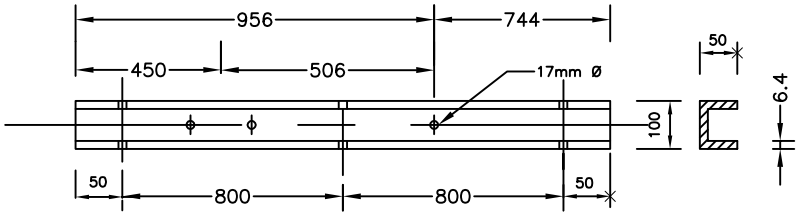
B) STANDARD CROSSARM
(100*50*6.4*1200)



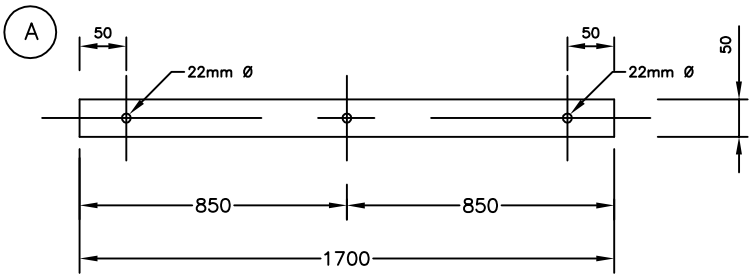
LOCATION OF HOLES TO BE CONFIRMED PRIOR TO MANUFACTURE

Drawing	Standard Crossarm	NEPAL ELECTRICITY AUTHORITY
CS11-LM-01	**11 kV Single Pole Structure**	**Technical Services / Commercial Department**
		Distribution and Consumer Services

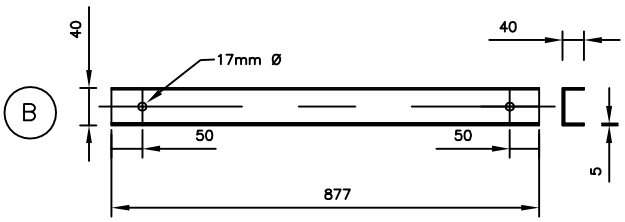




FRONT VIEW



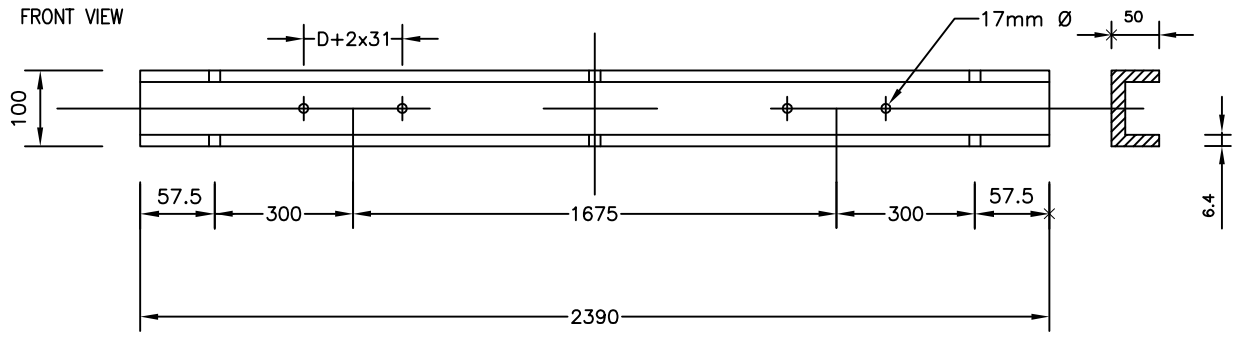
TOP VIEW

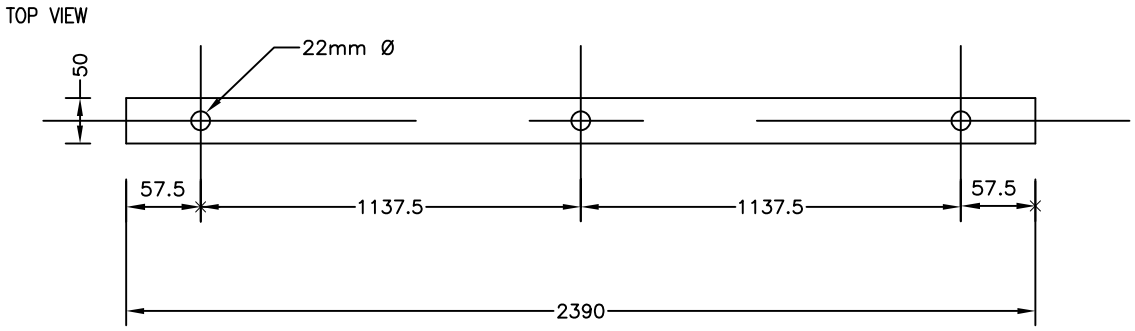


LOCATION OF HOLES TO BE CONFIRMED PRIOR TO MANUFACTURE

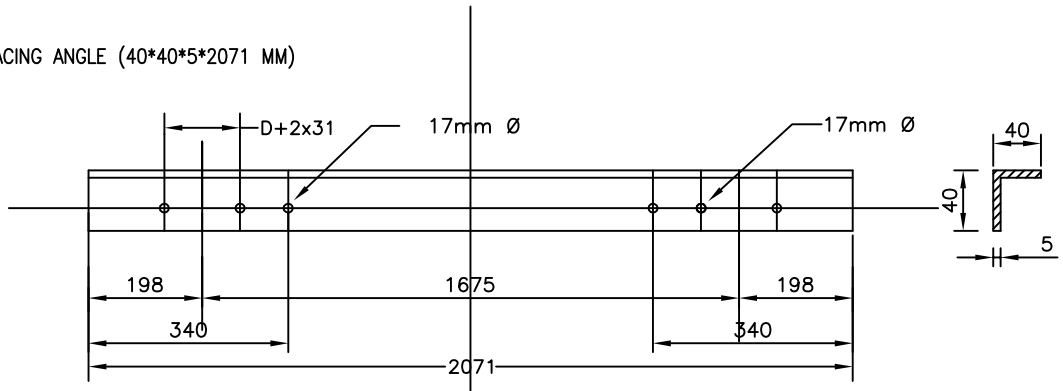
Drawing	Standard Crossarm	NEPAL ELECTRICITY AUTHORITY
CS11-LM-02	**11 kV Single Pole Offset Structure**	**Technical Services / Commercial Department**
		Distribution and Consumer Services

CROSSARM CHANNEL (100*50*6.4*2390 MM)

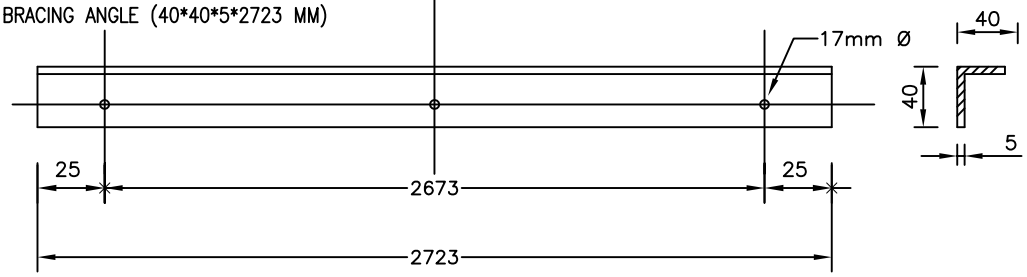




BRACING ANGLE (40*40*5*2071 MM)



CROSS BRACING ANGLE (40*40*5*2723 MM)

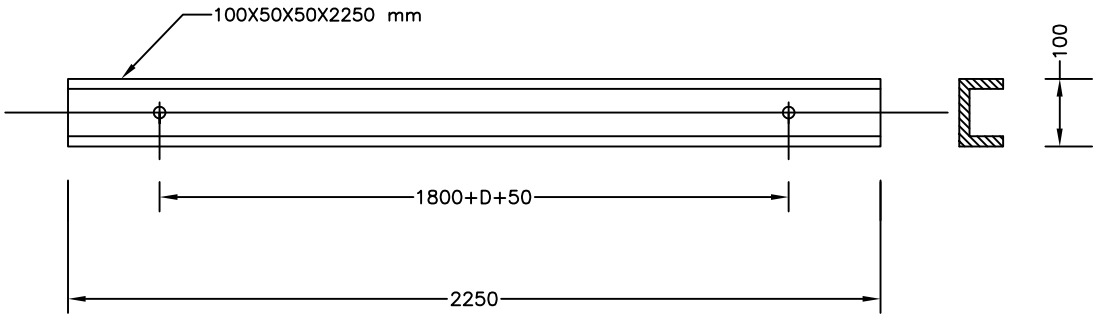


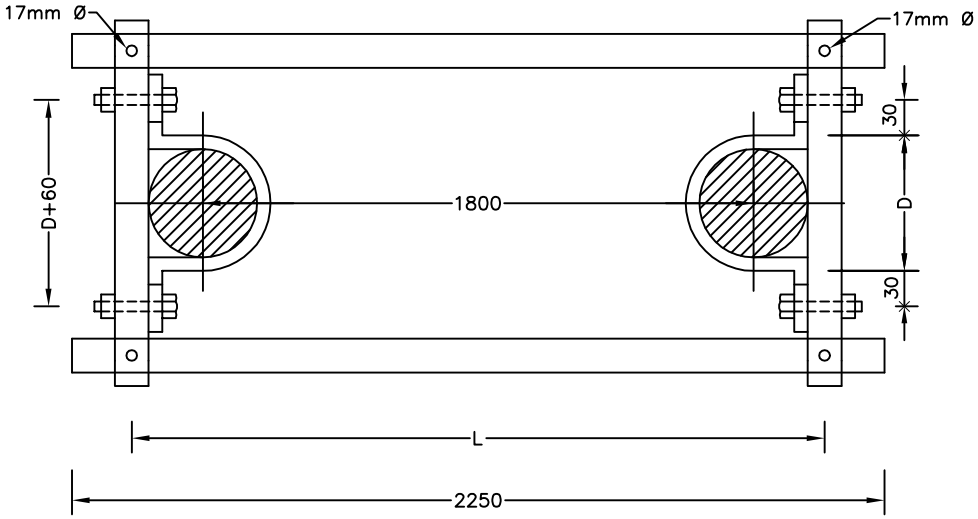
LOCATION OF HOLES TO BE CONFIRMED PRIOR TO MANUFACTURE

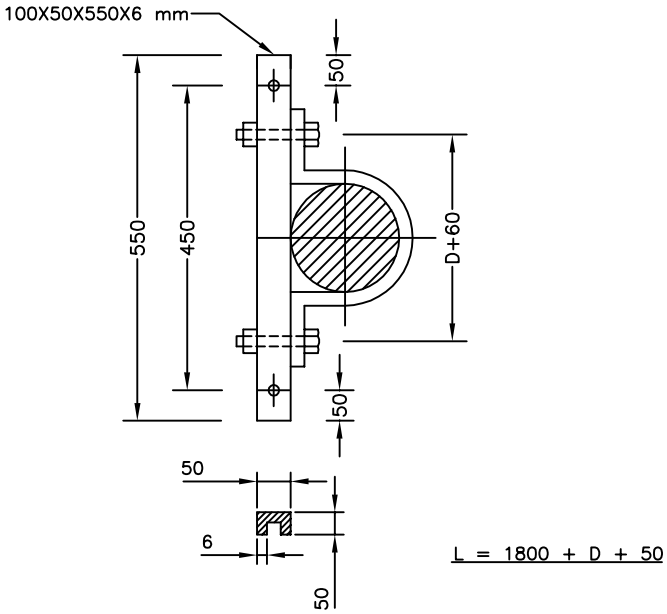
D = DIAMETER OF THE POLL

Drawing	Crossarm & Bracing for	NEPAL ELECTRICITY AUTHORITY
CS11-LM-03	**11 kV Double Pole (H-Structure)**	**Technical Services / Commercial Department**
		Distribution and Consumer Services

ESTD. 1985 Electricity Authority



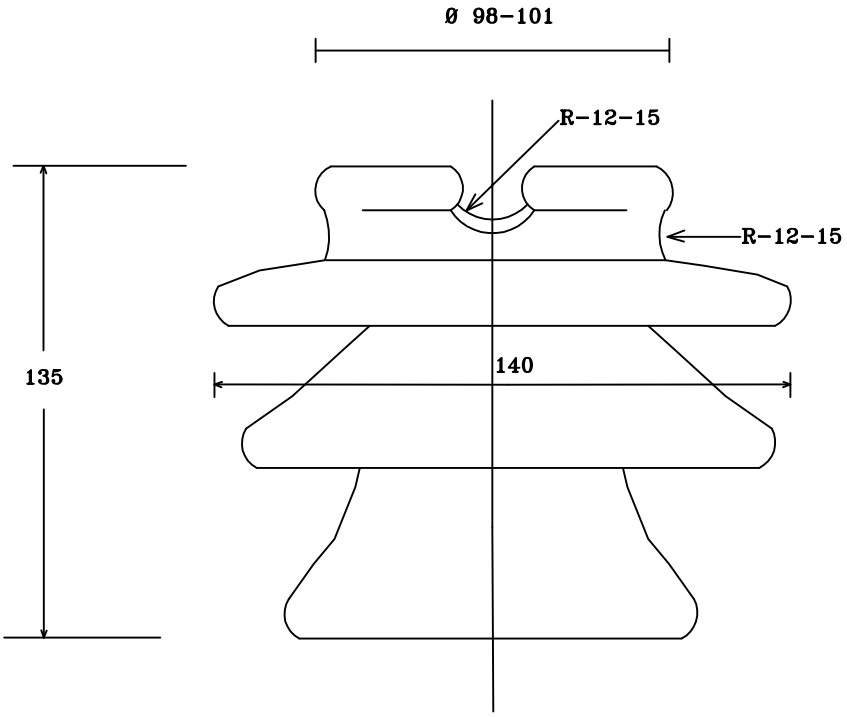




L = 1800 + D + 50

D = DIAMETER OF THE POLE

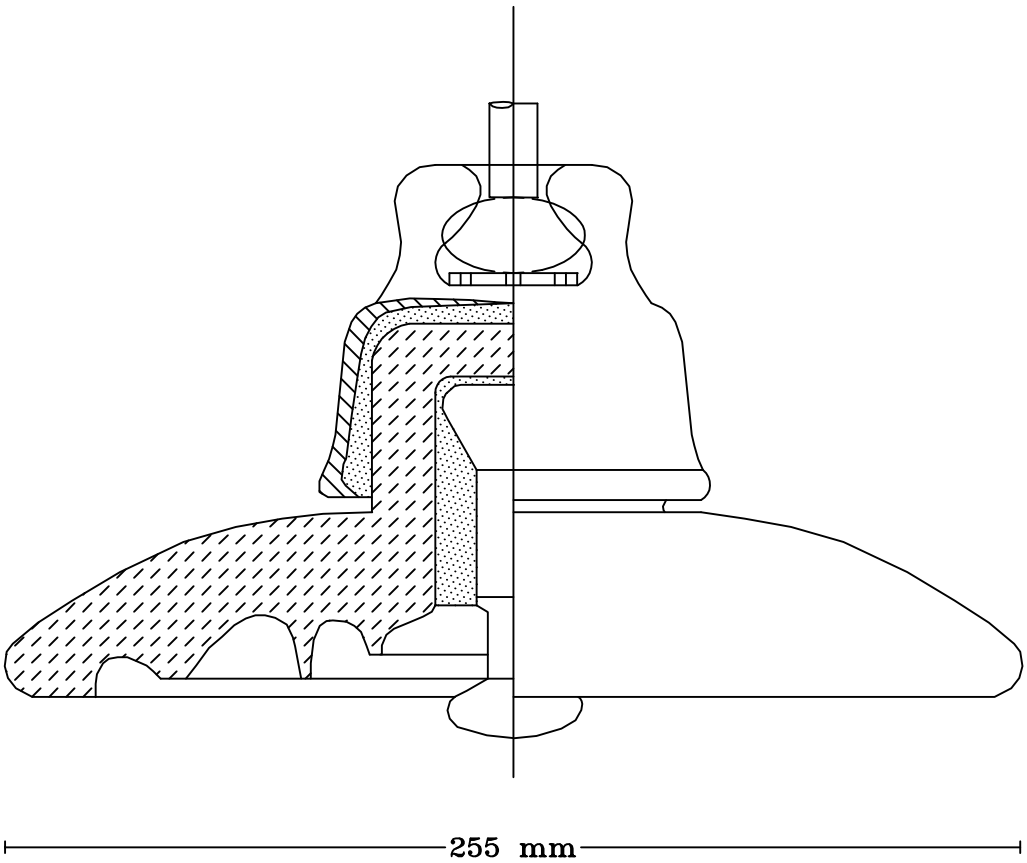
Drawing		
CS11-LM-04	**Transformer Platform**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services



TYPE A

Applicable Standard IS : 731

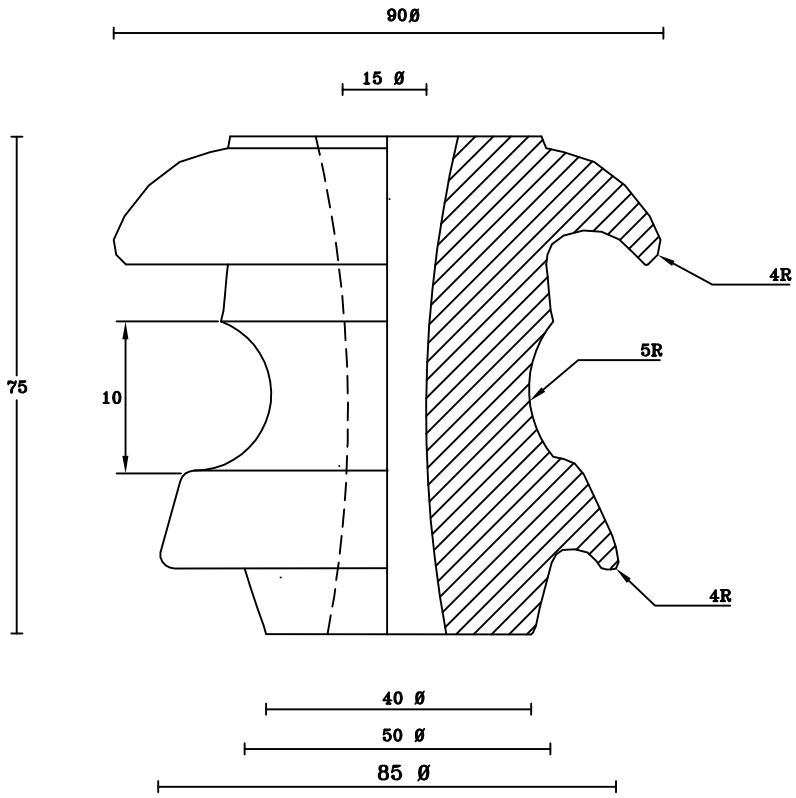
Drawing **CS11-LM-05**	**11 kV Pin Insulator**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services



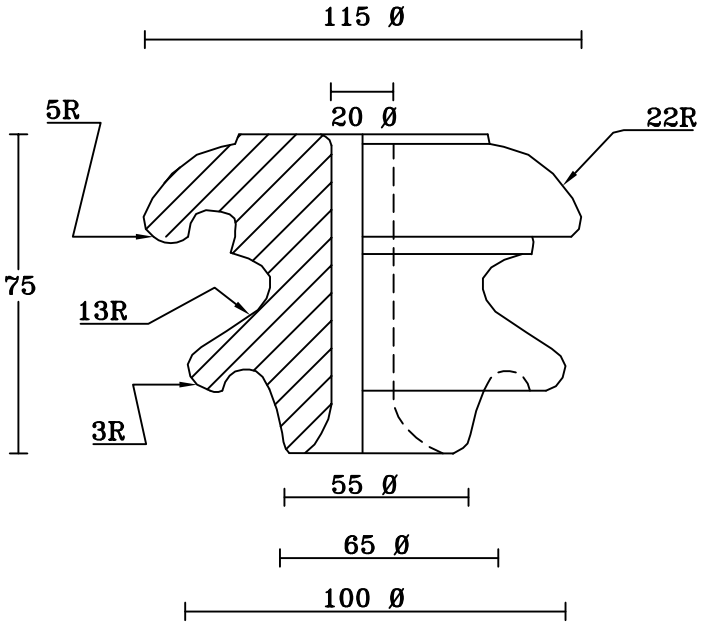
Applicable Standard IS : 731 & IS : 3188

Drawing		
CS11-LM-06	**Disc Insulator**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

Shackle Insulator



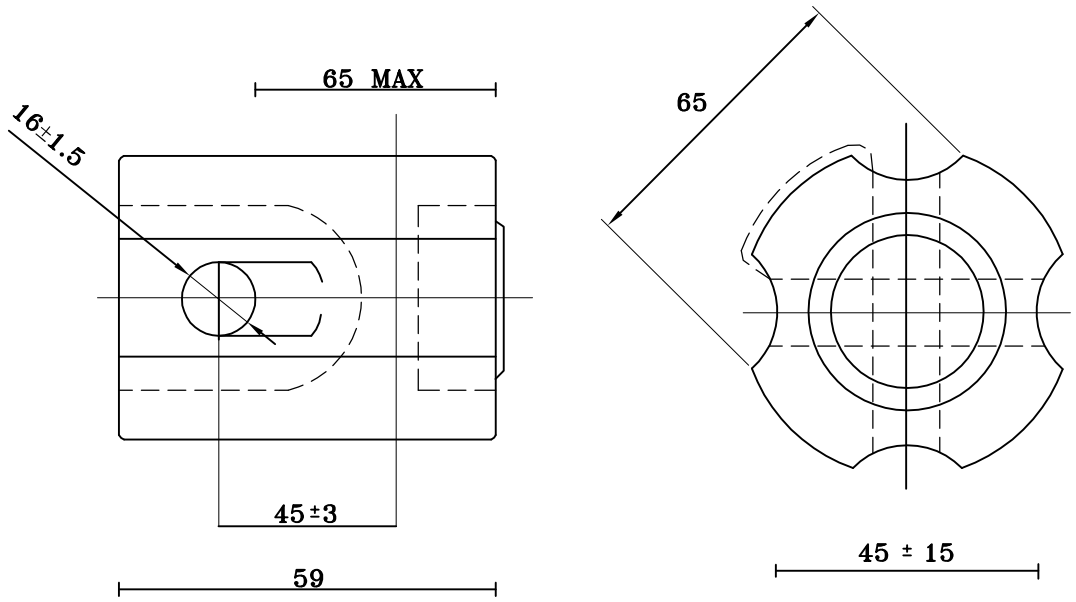
TYPE -B



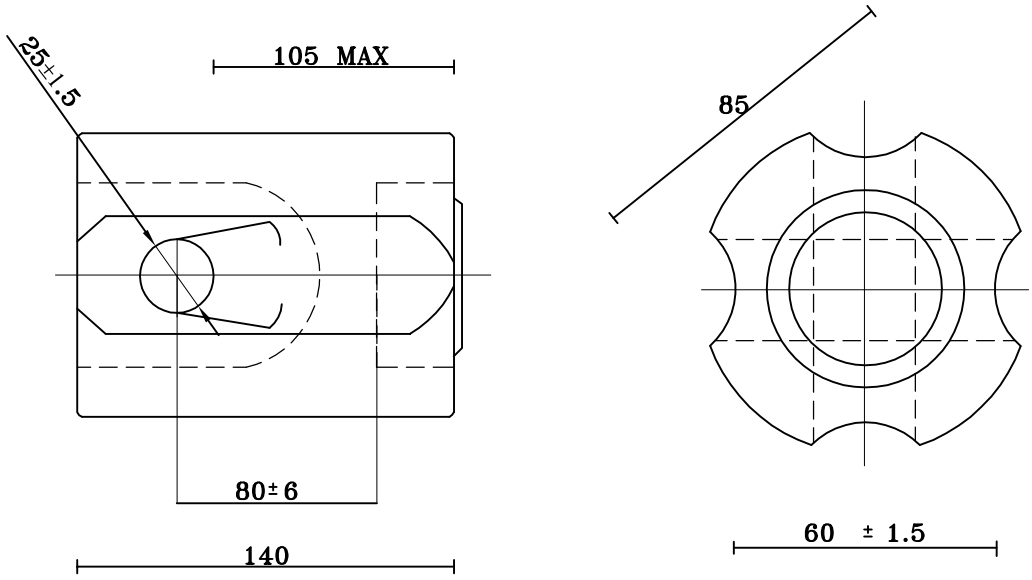
TYPE -A

Applicable Standard IS : 1445

Drawing		
CS11-LM-07	**Shackle Insulator**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services



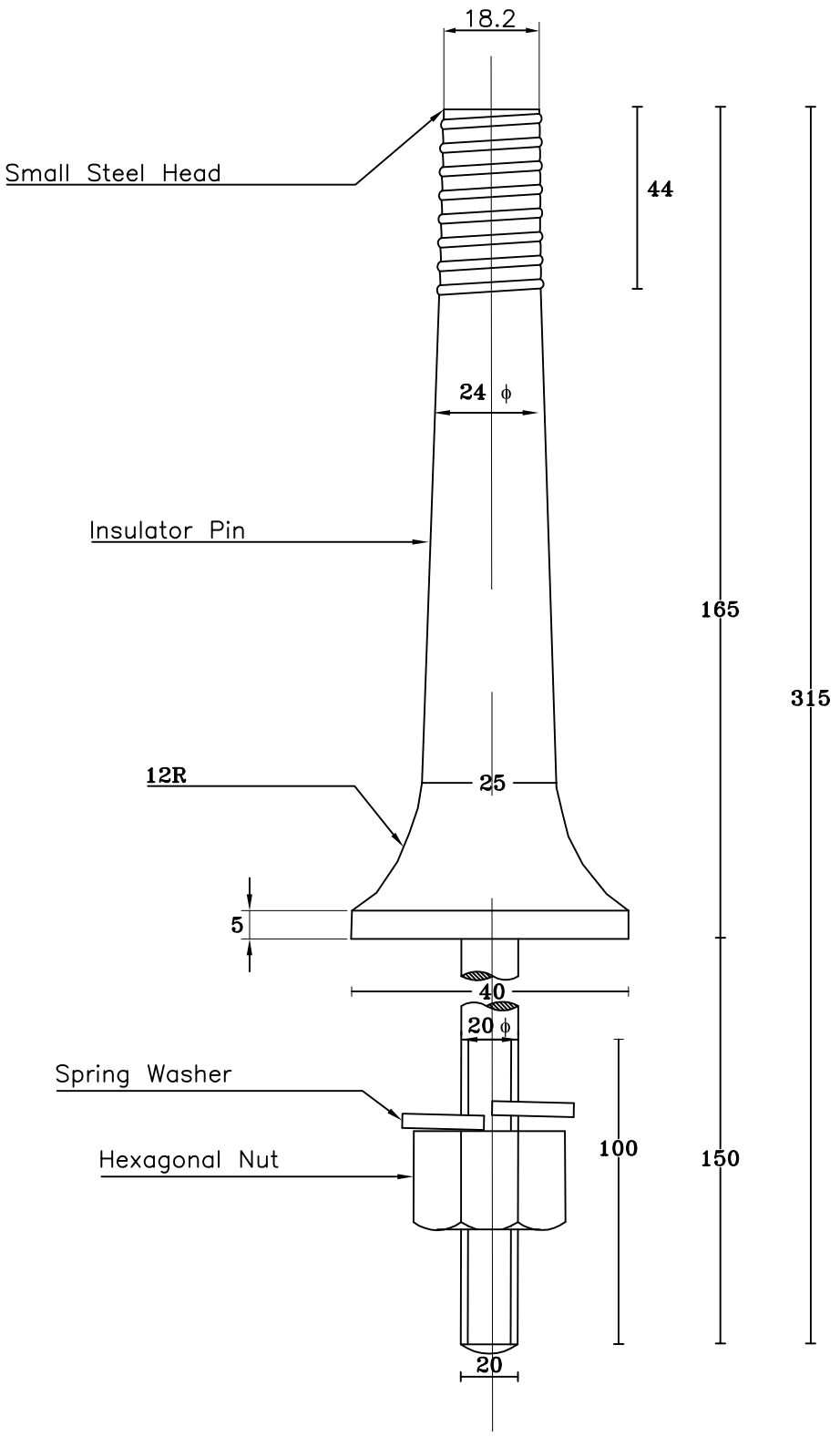
TYPE – 2



TYPE – 1

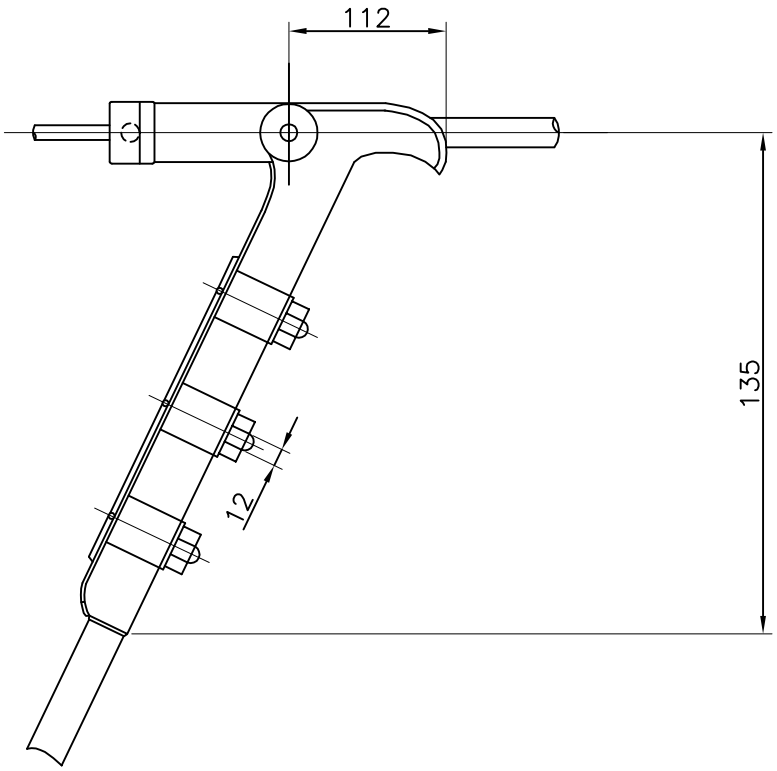
Applicable Standard IS : 5300

Drawing **CS11-LM-08**	**Stay Insulator**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

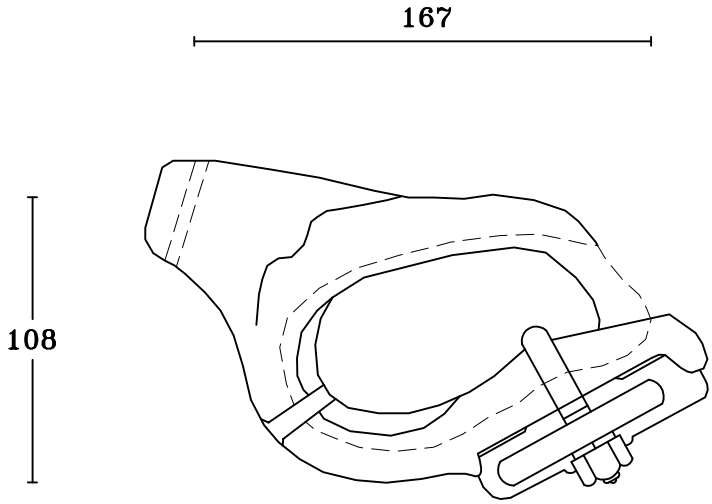


TYPE SI 65 P IS:2486 (PART II)

Drawing		
CS11-LM-09	**Insulator Pin**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services



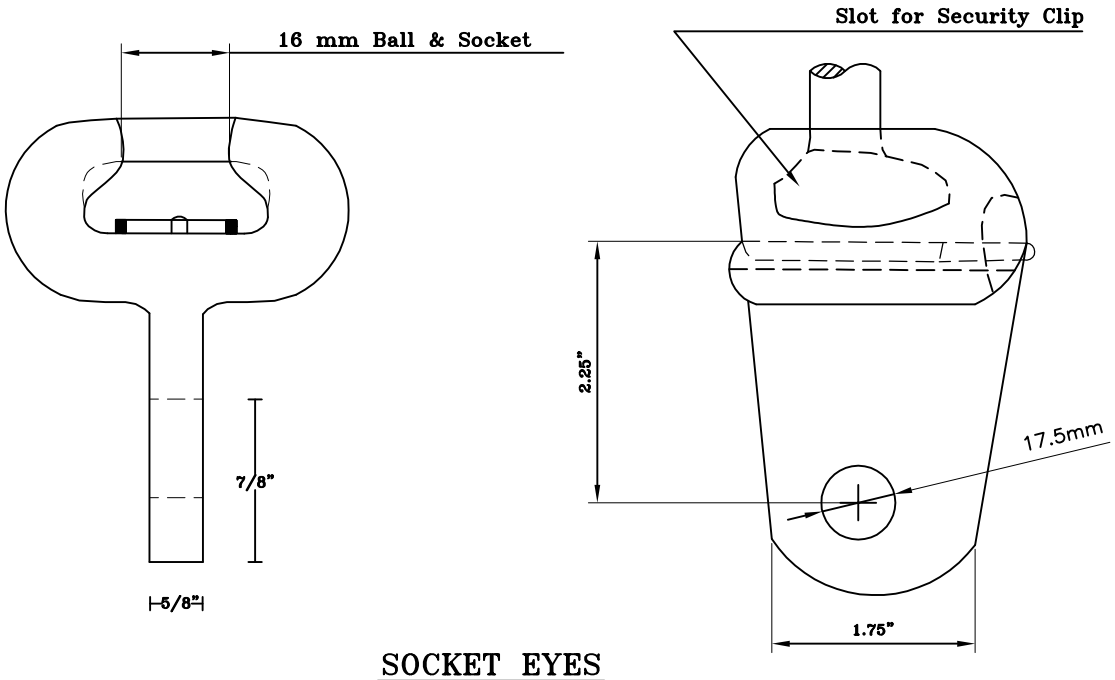
TYPE A (Straight Type)



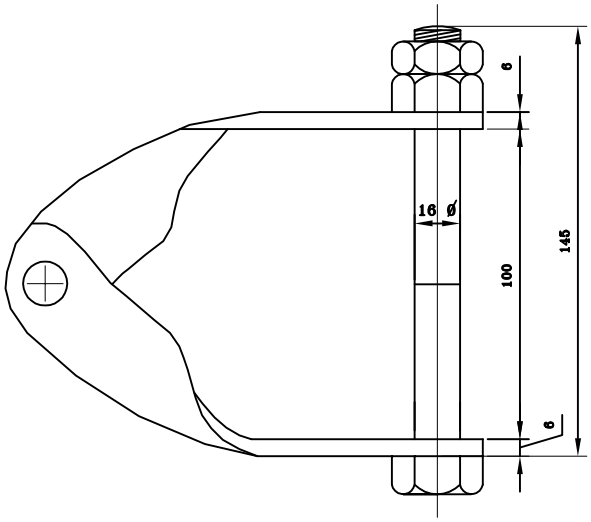
Double 'U' bolt

TYPE B (Snail Type)

Drawing **CS11-LM-10**	**Tension Clamp**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

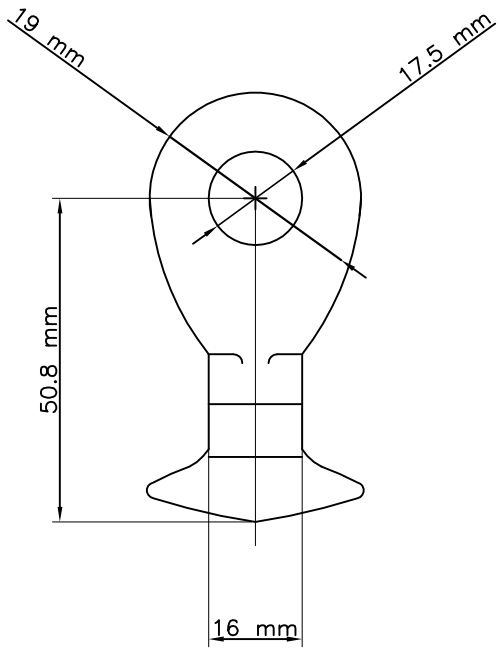


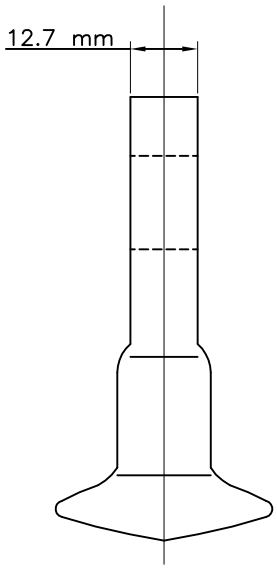
SOCKET EYES



BACK STRAP

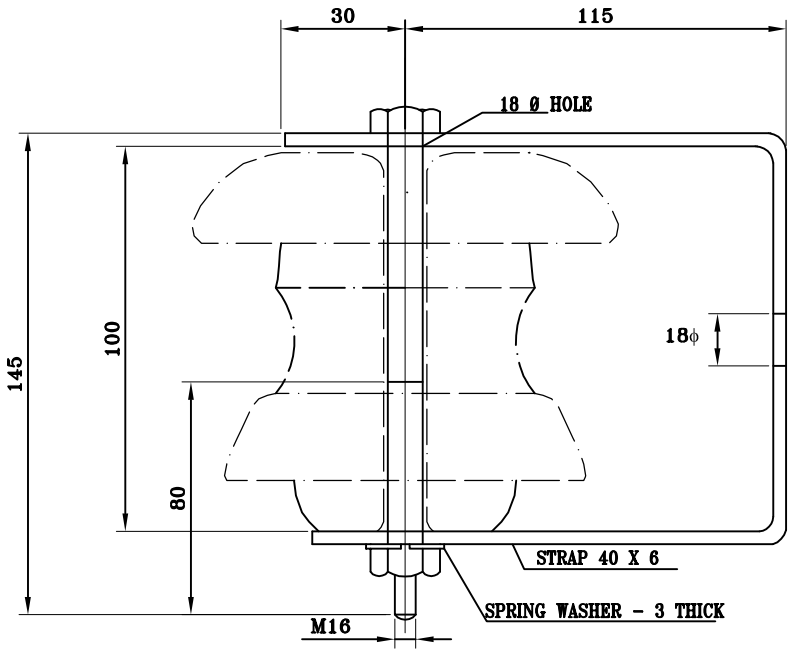
Drawing **CS11-LM-11**	**Hardwares for Tension Set**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services





BALL EYES

Drawing **CS11-LM-12**	**Hardwares for Tension Set**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

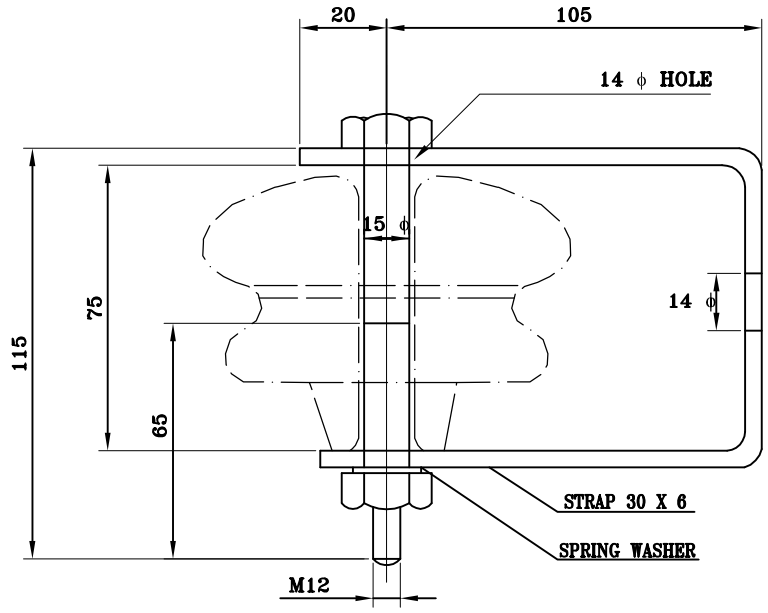


TYPE A

1	STRAP - 40 X 6	1
2	BOLT - 160 X 145	1
3	SPRING WASHER - 3 THICK	1
4	HEXAGONAL NUT	1

NOTES :-

1. ALL FITTINGS HOT DIP GALVANISED
2. FITTINGS AS PER IS 7935 - 1975

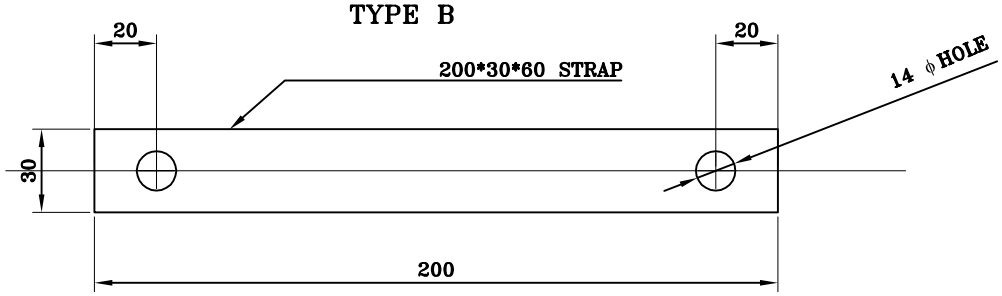


TYPE B

1	STRAP - 30 X 6	1
2	BOLT - 120 X 115	1
3	SPRING WASHER - 3 THICK	1
4	HEXAGONAL NUT	1

NOTES :-

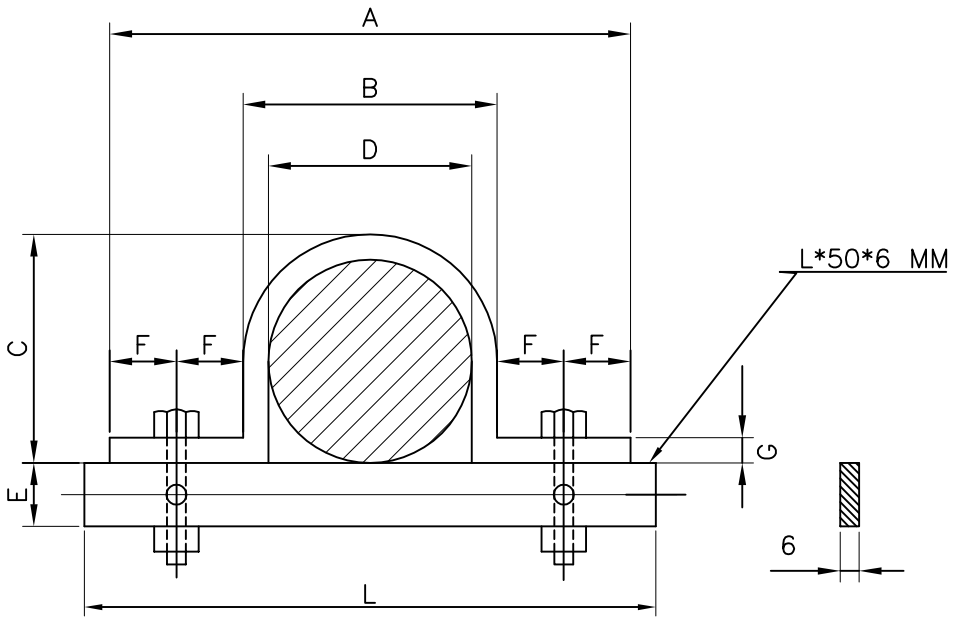
1. ALL FITTINGS HOT DIP GALVANISED
2. FITTINGS AS PER IS 7935 - 1975



EXTENSION STRAP

ALL DIMENSIONS AS PER 1S 7935 - 1975

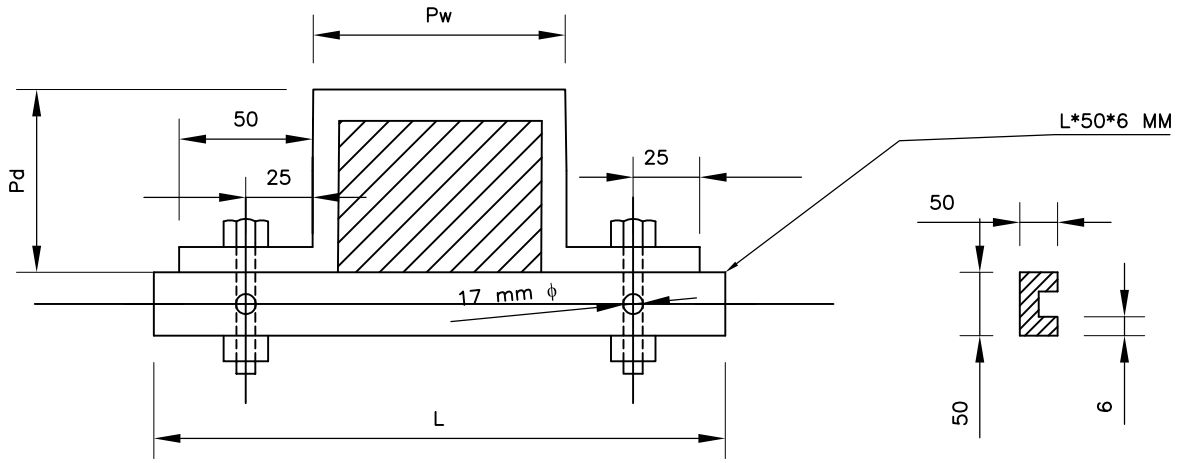
Drawing **CS11-LM-13**	**Shackle Insulator Fittings** **(D-Iron)**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services



D (Pole Dia.)	A	B	C	E	F	G
88.9	200.9	100.9	94.9	50	25	6
114.3	226.3	126.3	120.3	50	25	6
139.7	251.7	151.7	145.7	50	25	6
165.1	277.1	177.1	171.1	50	25	6

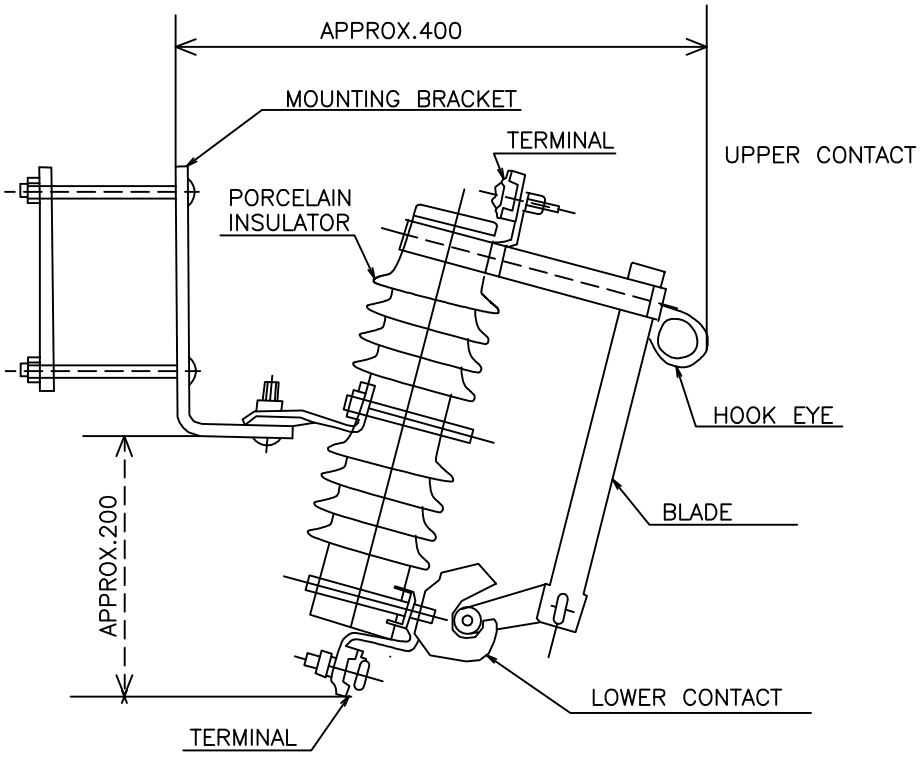
ALL DIMENSIONS ARE IN MM

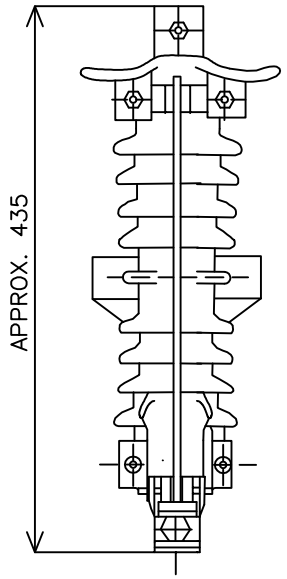
Drawing **CS11-LM-14**	**Pole Clamp**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services



Pw : WIDTH OF THE CONCRETE POLE
Pd : DEPTH OF THE CONCRETE POLE

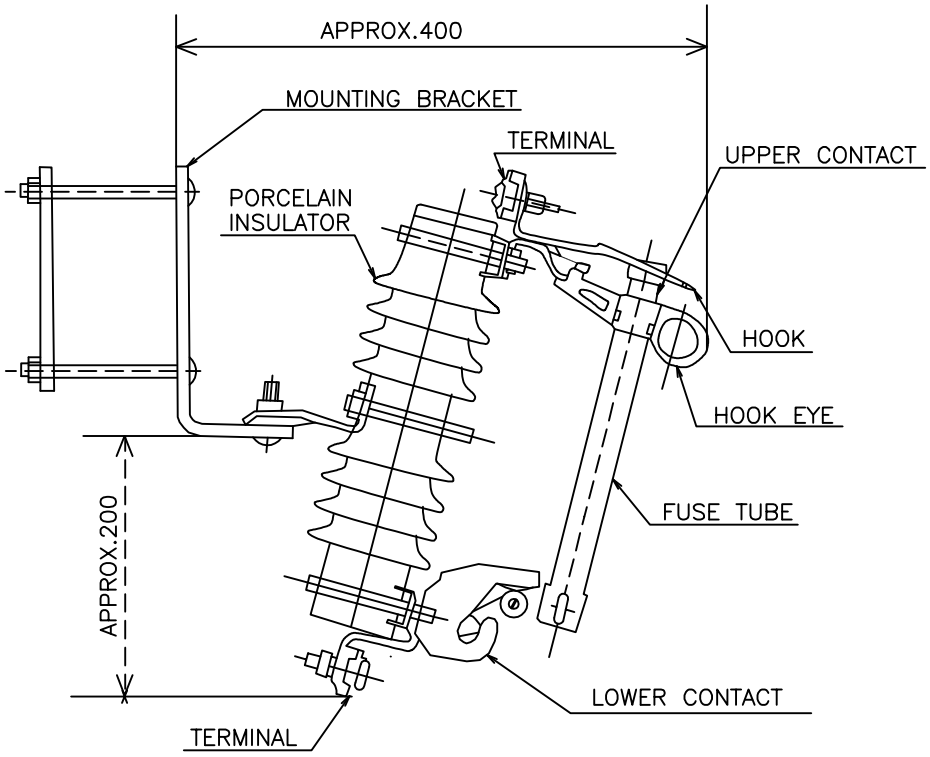
Drawing **CS11-LM-15**	**Pole Clamp**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

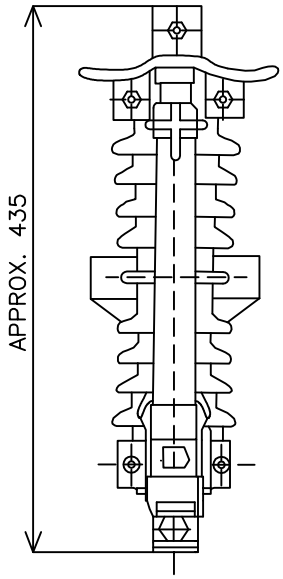




Terminal : Bolted Type Suitable for copper wire 8mm Porcelian color : Brown/white

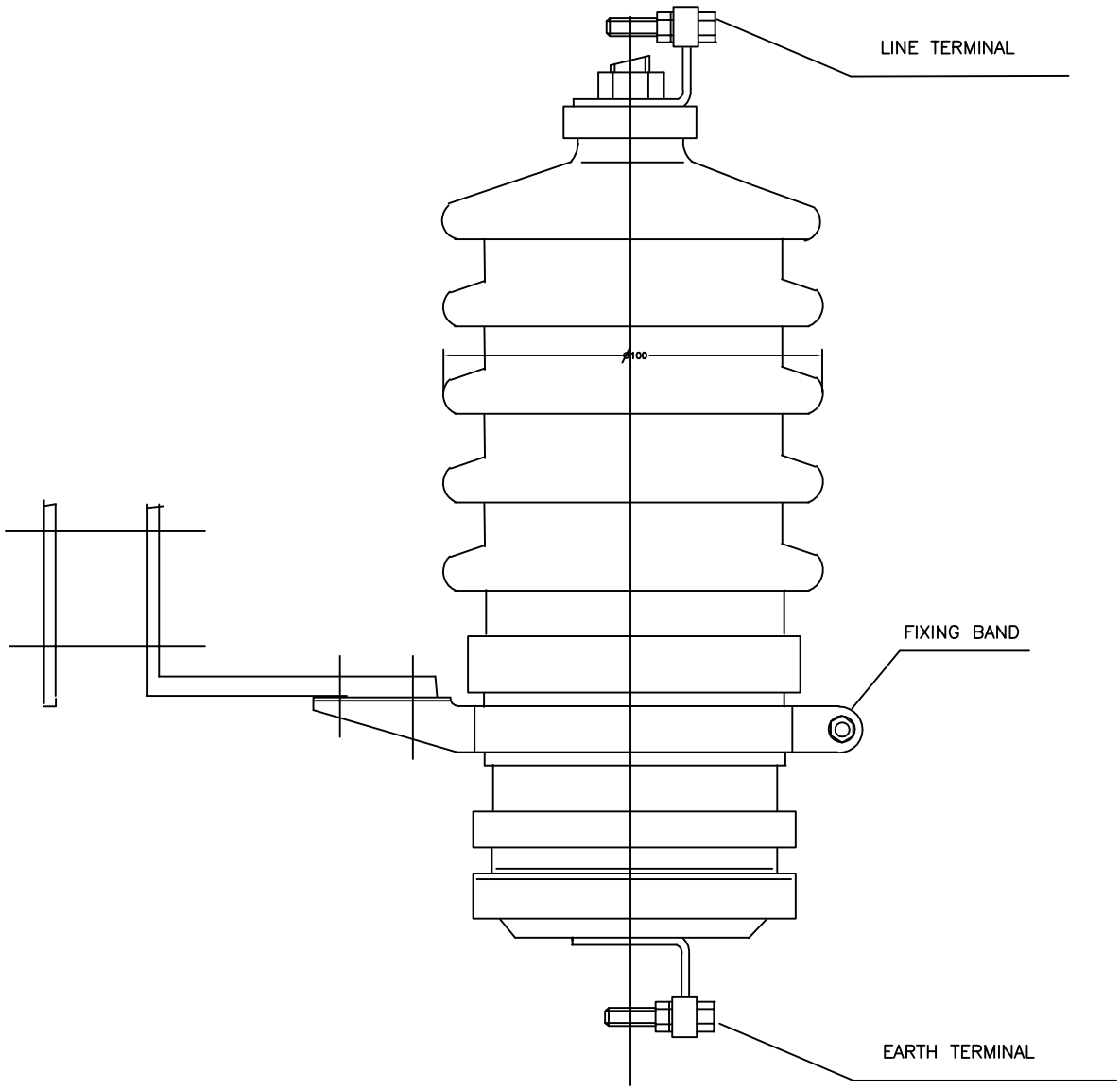
Drawing **CS11-LM-16**	**Disconnet Switch**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services



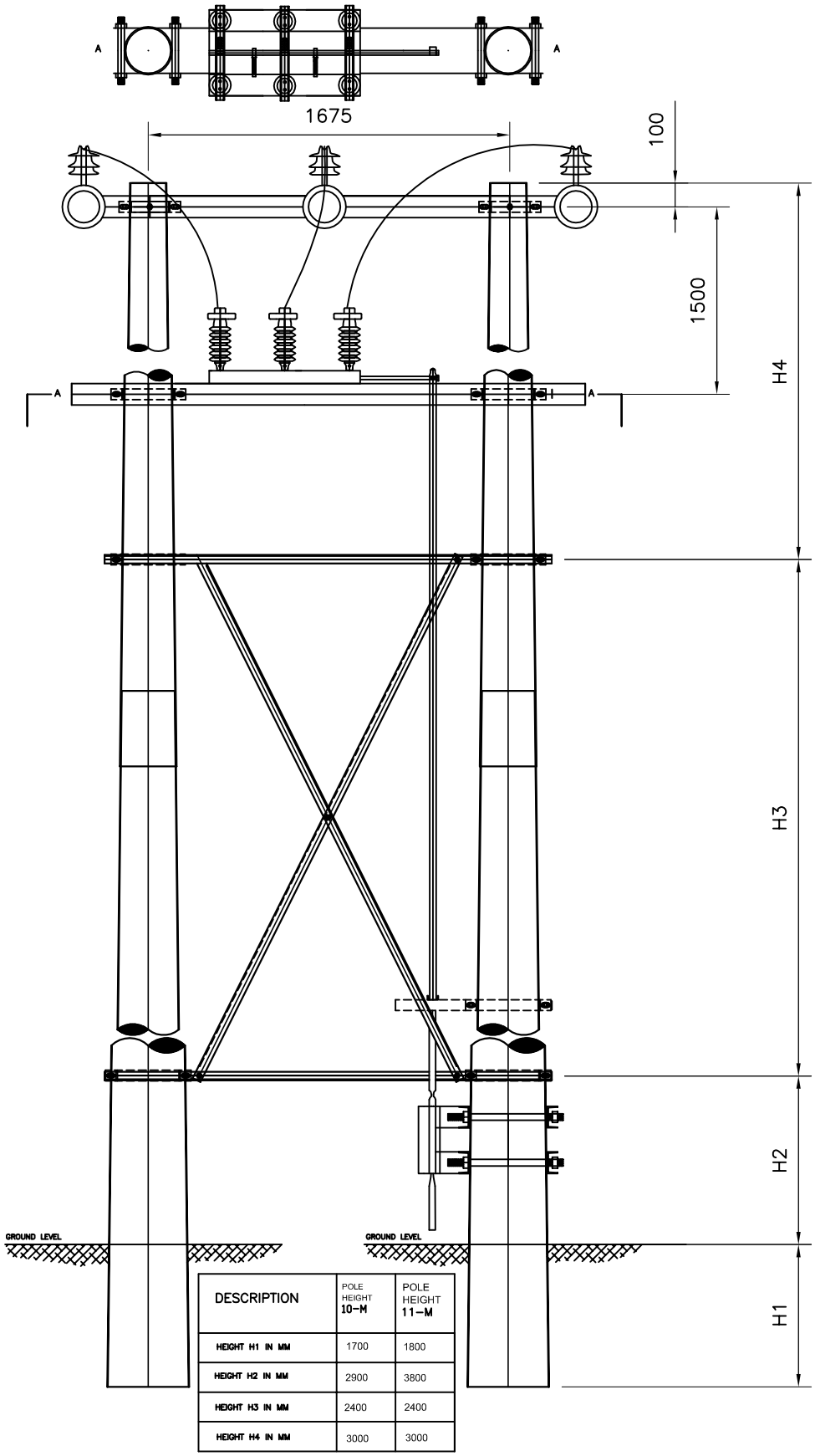


Terminal : Bolted Type Suitable for copper wire 8mm Porcelian color : Brown/white

Drawing **CS11-LM-17**	**Cut Out Switch**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

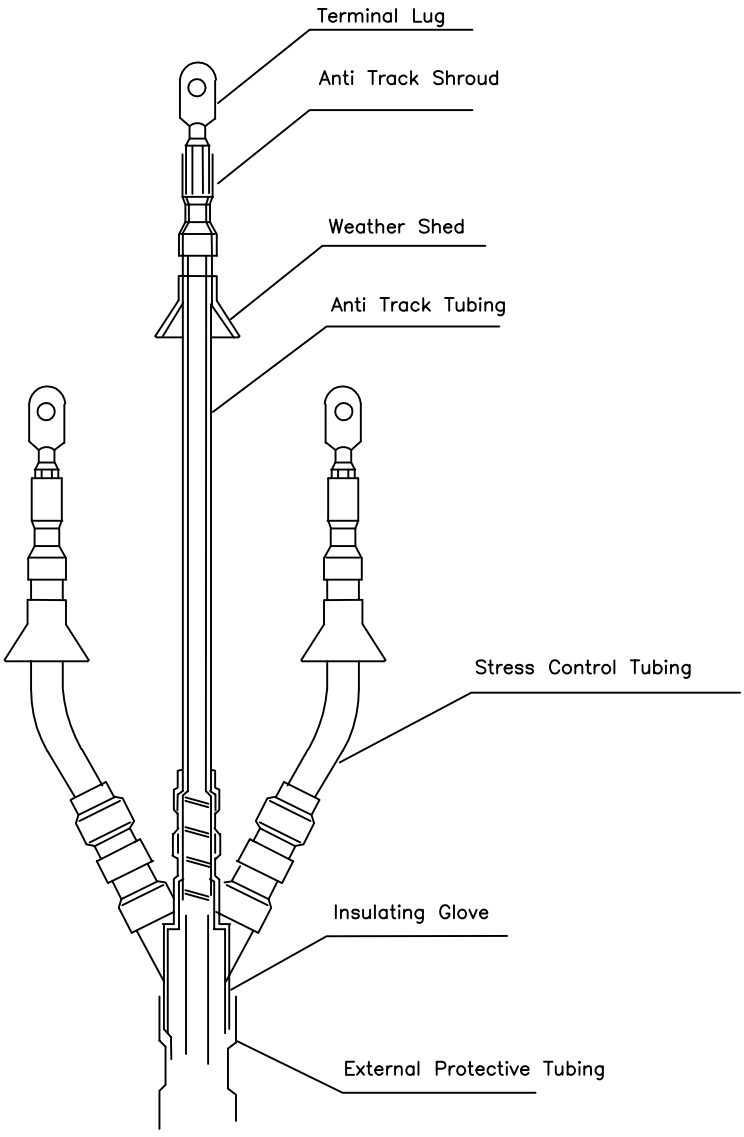


Drawing **CS11-LM-18**	**Lightning Arrester**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services



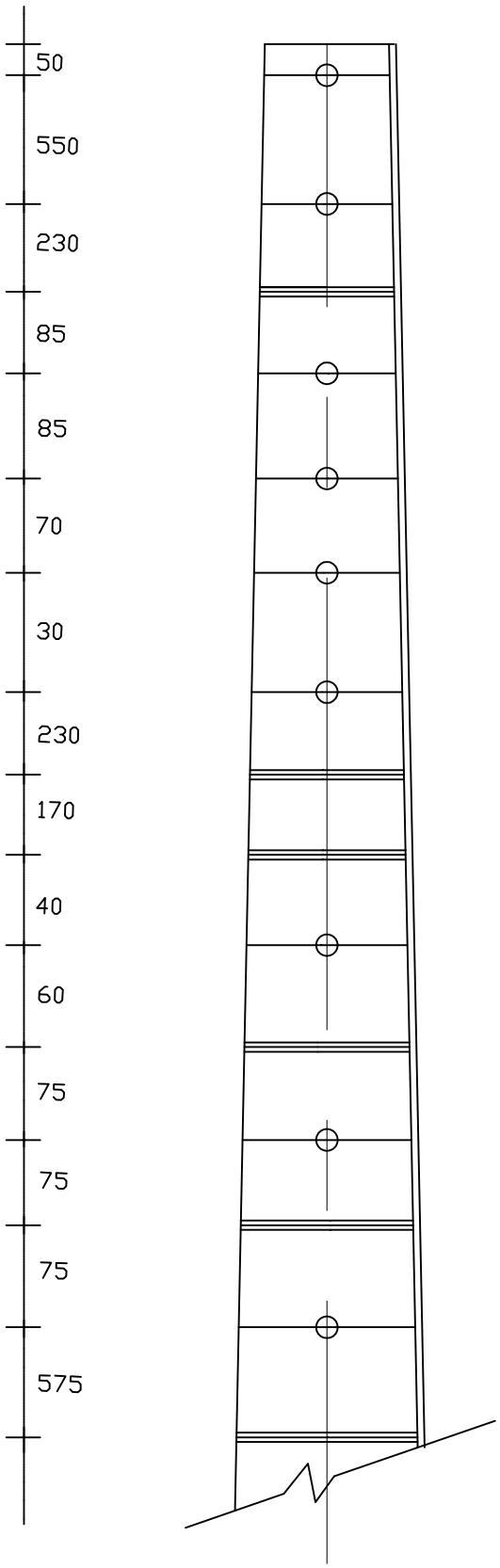
DESCRIPTION	POLE HEIGHT 10-M	POLE HEIGHT 11-M
HEIGHT H1 IN MM	1700	1800
HEIGHT H2 IN MM	2900	3800
HEIGHT H3 IN MM	2400	2400
HEIGHT H4 IN MM	3000	3000

Drawing **CS11-LM-19**	**10/11 m Pole Mounting Disconnet Switch**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services



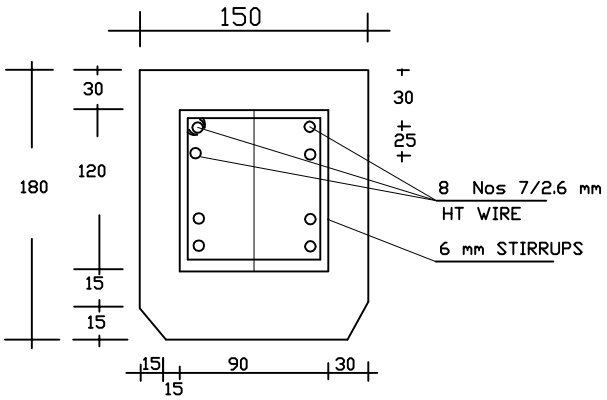
Drawing **CS11-LM-20**	**Outdoor Heat Shrinkable Cable Termination Kit**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

10 / 11 M Pre-Stressed Concrete (PSC) Pole

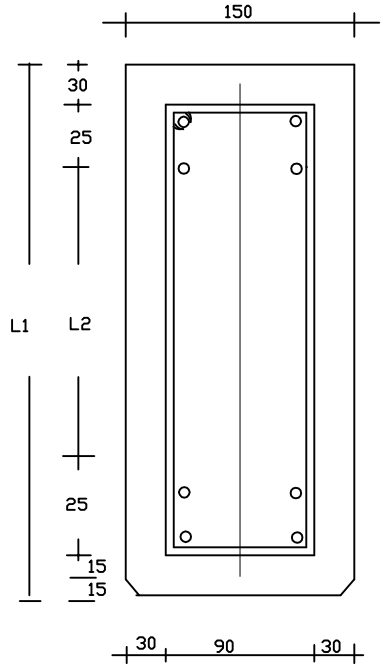


Hole Diameter 18 mm

Drawing **CS11-PSCP-01**	**11 kV, 10/11 m PSC Pole** **Hole Patterns**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services



TOP SECTION

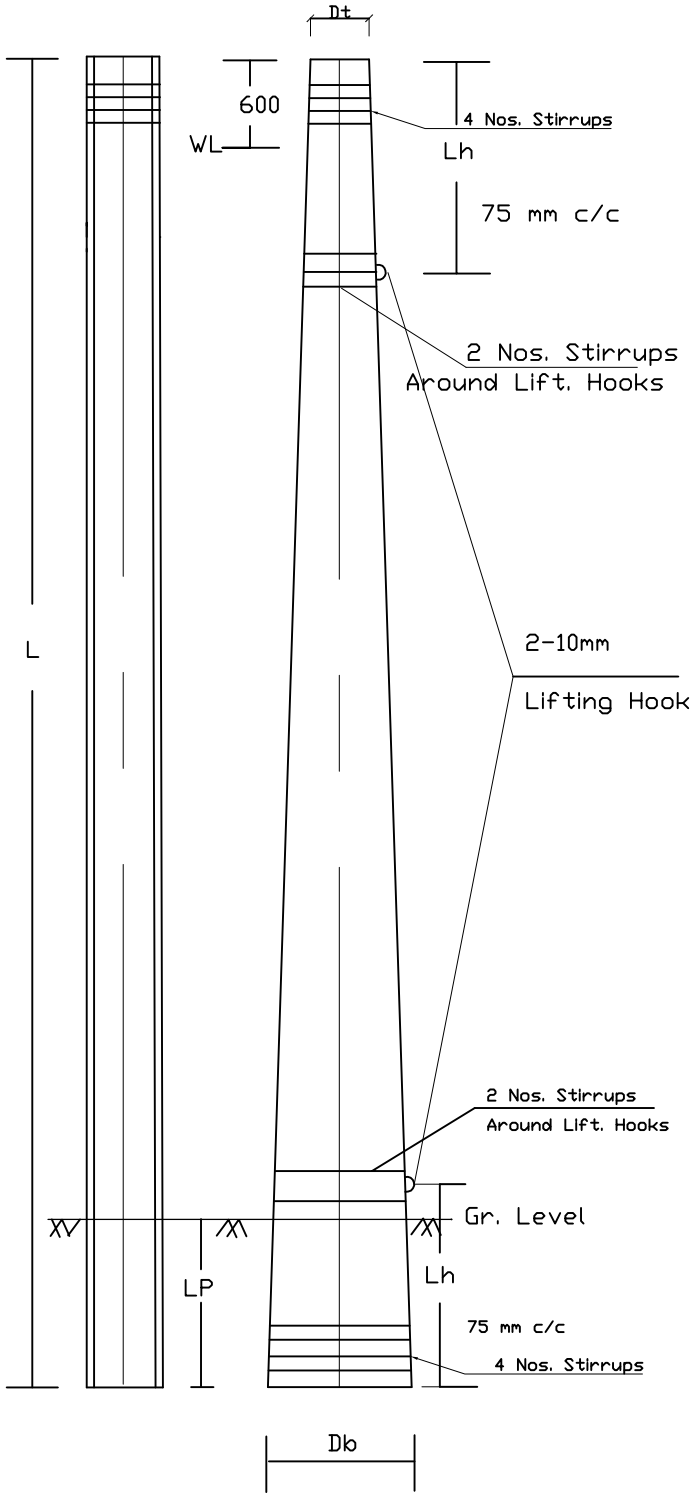


BOTTOM SECTION

Description	10 m Pole	11 m Pole
L1 mm	380	400
L2 mm	270	290

10 m / 11 m Pole

Drawing **CS11-PSCP-02**	**11kV, 10/11 m PSC Pole** **Bottom Section**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services



TECHNICAL PARTICULARS

ITEM	10 m Pole	11 m Pole
L(m)	10	11
Wl(kg)	200	350
W(mm)	140	150
Dt(mm)	150	180
Db(mm)	380	400
Lp(mm)	1700	1800
Lh(mm)	1750	2000
HT Wires (Nos.)	6	8
HT Wires Size (No/mm)	7/2.6	7/2.6
Concrete Cu.m.	0.2835	0.4785
W(kg)	680.4	1150.0

NOTES

1- All dimension are in mm.
2- Grade of Concrete M 400(Min).
3- Load Factor 2.5.
4- Release strength 250 kg/sq.cm(Min).
5- Chamfer 15mm shall be provided at bottom edge.
6- 12 Nos. stirrups(6mm MS) shall be provided with 4 nos. at each end, two nos. on sides of lifting hooks as shown.
7- Stirrups provided for end splitting tensile strength.
8- Hooks locations made equidistant from ends for operational convinience.
9- Dimensional Tolerances.
Length ± 15mm
Width ± 3mm

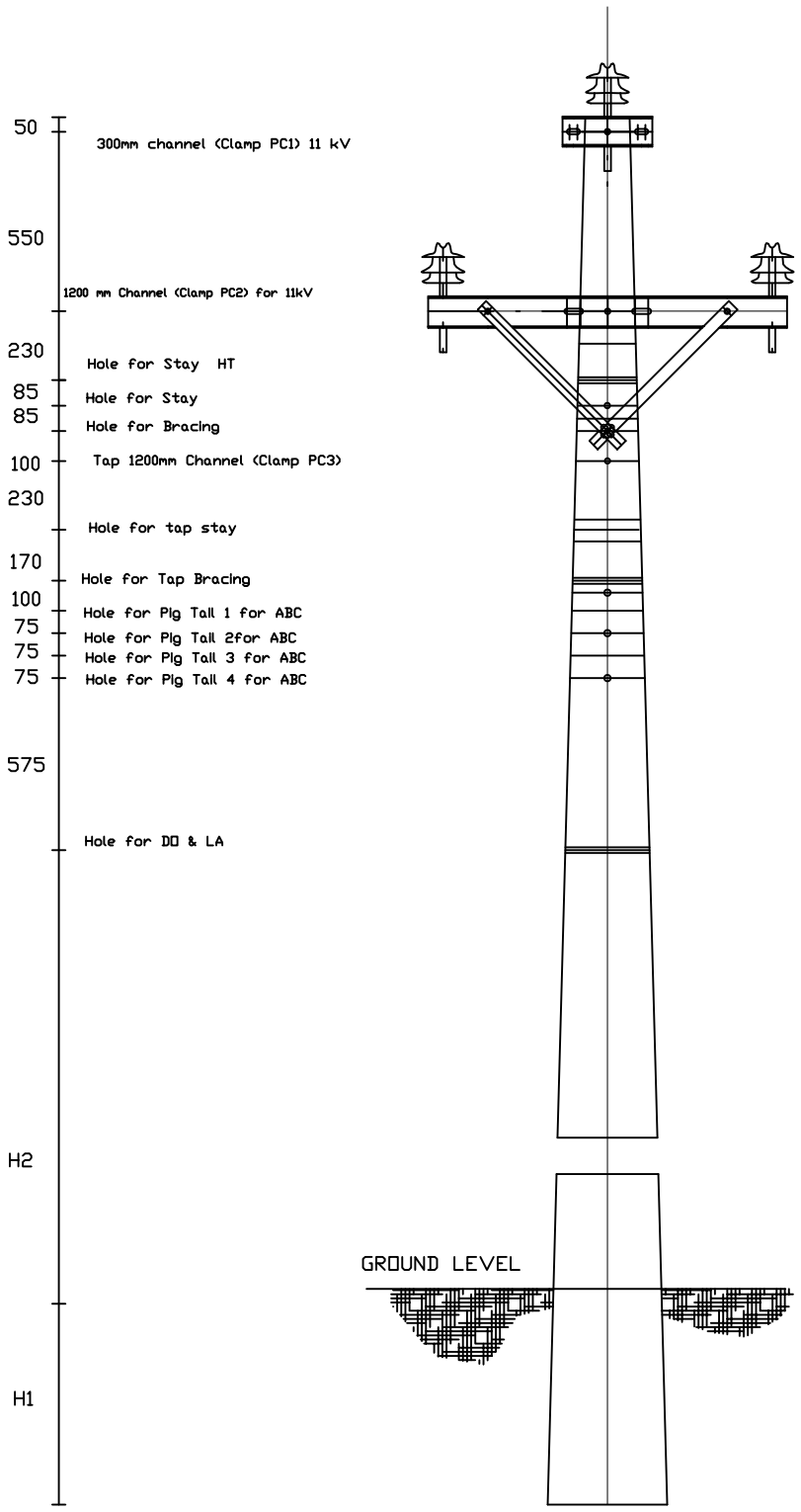
Drawing	11kV, 10/11 m PSC Pole	NEPAL ELECTRICITY AUTHORITY
CS11-PSCP-03	**Pole Details**	**Technical Services / Commercial Department**
		Distribution and Consumer Services

Refer Drawing No: CS11-PSCP-04

S.No.	QTY.	UNIT	MATERIAL
1	3	NOS	PIN INSULATOR
2	3	NOS	INSULATOR PIN
3	3	NOS	PREFORM PIN TIES (TOP TIES)
4	1	NOS	STEEL CROSSARM CHANNEL (100x 50x6.4x300) mm.
5	1	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS (PC1)
6	1	NOS	STEEL CROSSARM CHANNEL (100x 50x6.4x1200) mm.
7	1	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS (PC2)
8	2	NOS	FLAT CROSSARM BRACE(40x 6.0x660) mm
9	2	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (12 x51) mm
10	1	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (16 x203) mm
11	1	NOS	POLE PSC 10 m /11m

CONSTRUCTION STANDARDS
11 kV SINGLE ARM STRUCTURE (SA)
PSC POLE

NEPAL ELECTRICITY AUTHORITY
Technical Service/ Commercial Department
Distribution and Consumer Services



DESCRIPTION	POLE HEIGHT 10-M	POLE HEIGHT 11-M
HEIGHT H1 IN MM	1700	1800
HEIGHT H2 IN MM	5900	6800
POLE WIDTH AT TOP 'WT' IN MM	180	180
POLE WIDTH AT BOTTOM 'WB' IN MM	380	400
POLE DEPTH 'D'	150	150

ALL DIMENSIONS ARE IN MM

Drawing	11kV, 10/11 m PSC Pole	NEPAL ELECTRICITY AUTHORITY
CS11-PSCP-04	Single Arm Structure	Technical Services / Commercial Department
		Distribution and Consumer Services

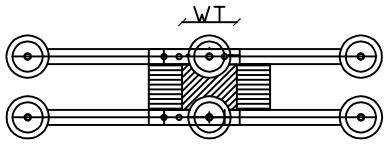
Refer Drawing No: CS11-PSCP-05

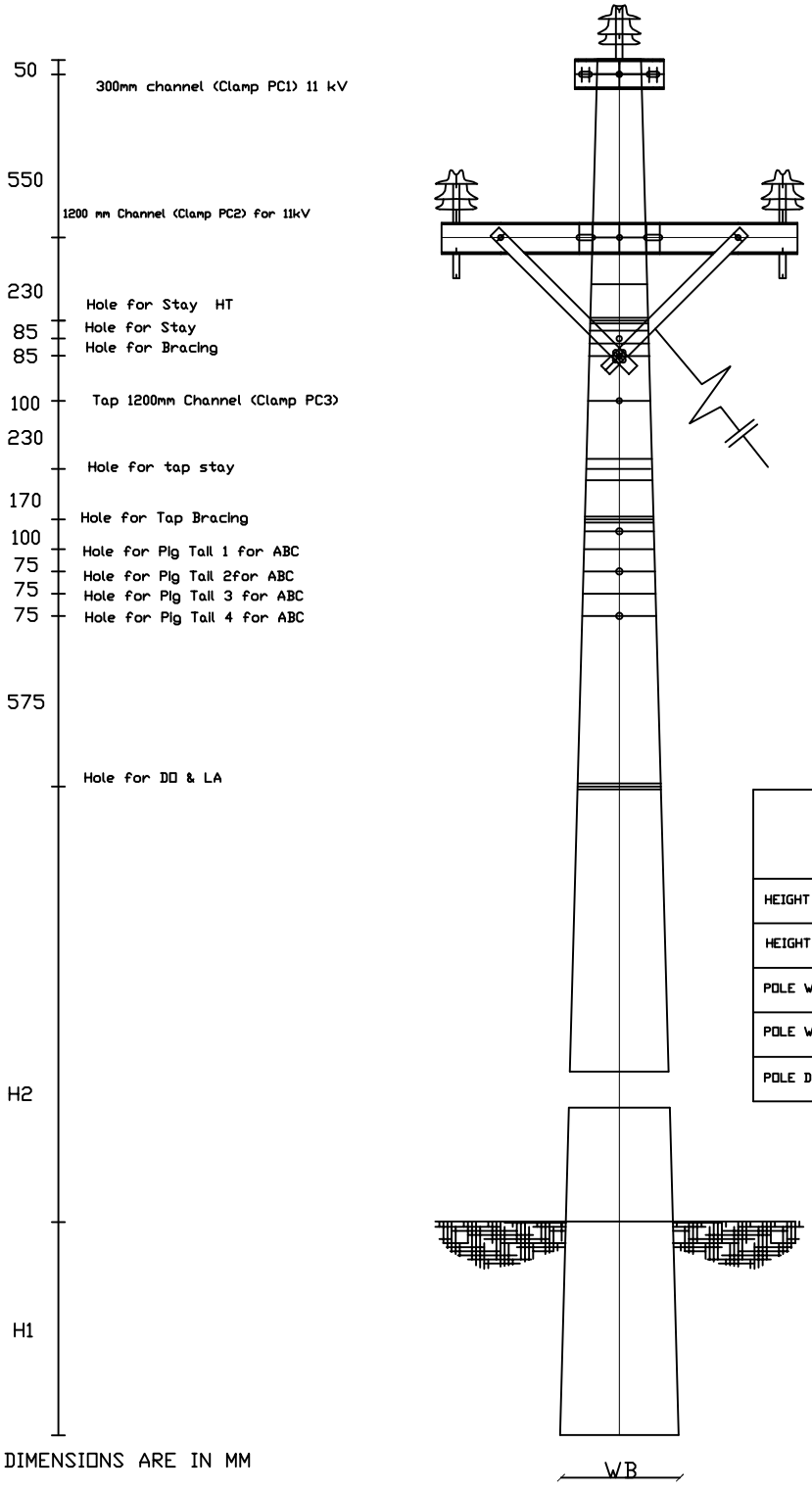
S.No.	QTY.	UNIT	MATERIAL
1	6	NOS	PIN INSULATOR
2	6	NOS	INSULATOR PIN
3	6	NOS	PREFORM PIN TIES (TOP TIES)
4	2	NOS	STEEL CROSSARM CHANNEL (100 x 50 x 6.4 x 300) mm.
5	2	NOS	STEEL CROSSARM CHANNEL (100 x 50 x 6.4 x 1200) mm.
6	4	NOS	FLAT CROSSARM BRACE (40x 6.0 x 660) mm
7	4	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (12 x 51) mm
8	1	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (16 x 203) mm
9	4	SET	DOUBLE ARMING BOLTS WITH NUTS AND WASHERS(16 x 305) mm
10	1	LOT	HT STAY SET (AS REQUIRED)
11	1	NOS	POLE PSC 10 m / 11m

CONSTRUCTION STANDARDS
11 kV DOUBLE ARM STRUCTURE (DA)
PSC POLE

NEPAL ELECTRICITY AUTHORITY
Technical Service/ Commercial Department
Distribution and Consumer Services

Top view of double arm pole





DESCRIPTION	POLE HEIGHT 10-M	POLE HEIGHT 11-M
HEIGHT H1 IN MM	1700	1800
HEIGHT H2 IN MM	5900	6800
POLE WIDTH AT TOP 'WT' IN MM	180	180
POLE WIDTH AT BOTTOM 'WB' IN MM	380	400
POLE DEPTH 'D'	150	150

ALL DIMENSIONS ARE IN MM

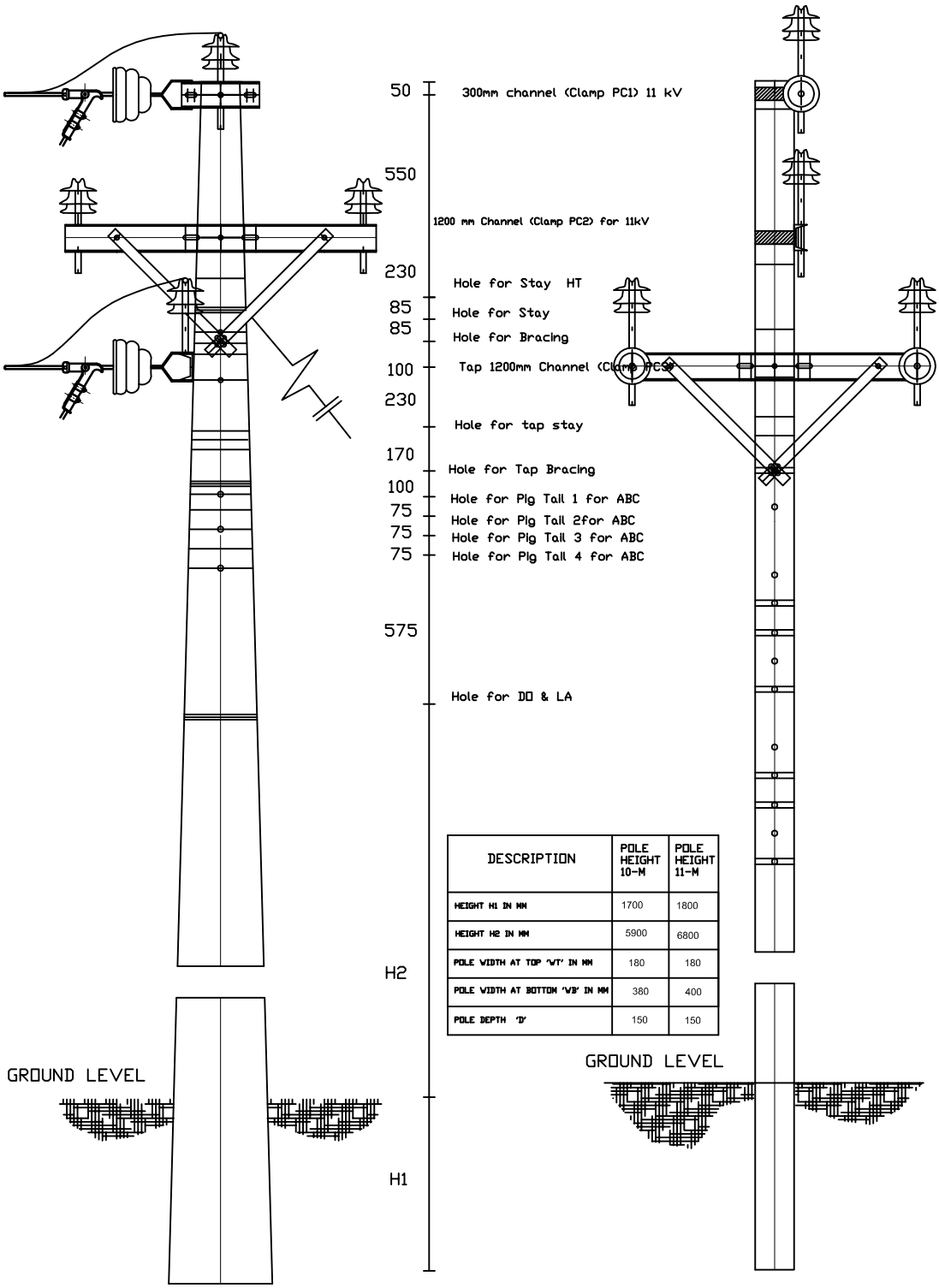
Drawing	11 kV, 10/11 m PSC Pole	NEPAL ELECTRICITY AUTHORITY
CS11-PSCP-05	**Double Arm Structure**	**Technical Services / Commercial Department**
		Distribution and Consumer Services

Refer Drawing No: CS11-PSCP-06

S.No.	QTY.	UNIT	MATERIAL
1	5	NOS	PIN INSULATOR
2	5	NOS	INSULATOR PIN
3	5	NOS	PREFORM PIN TIES (TOP TIES)
4	3	SET	DISC INSULATOR
5	3	SET	BRACK STRAP
6	3	SET	TENSION SET WITH BALL AND SOCKET EYE
7	6	NOS	PG CLAMP
8	1	NOS	STEEL CROSSARM CHANNEL (100x 50x 6.4 x 300) mm.
9	1	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS (PC1)
10	2	NOS	STEEL CROSSARM CHANNEL (100 x 50 x 6.4 x 1200) mm.
11	1	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS (PC2)
12	1	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS (PC3)
13	4	NOS	FLAT CROSSARM BRACE (40x 6.0 x 660) mm
14	4	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (12 x 51) mm
15	1	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (16 x 203) mm
16	1	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (16 x 305) mm
17	1	LOT	HT STAY SET (TYPE AS REQUIRED)
18	1	NOS	POLE PSC 10 m / 11 m

CONSTRUCTION STANDARDS
11 kV TAP OFF STRUCTURE (TO)
PSC POLE

NEPAL ELECTRICITY AUTHORITY
Technical Service/ Commercial Department
Distribution and Consumer Services



DESCRIPTION	POLE HEIGHT 10-M	POLE HEIGHT 11-M
HEIGHT H1 IN MM	1700	1800
HEIGHT H2 IN MM	5900	6800
POLE WIDTH AT TOP 'WT' IN MM	180	180
POLE WIDTH AT BOTTOM 'WB' IN MM	380	400
POLE DEPTH 'D'	150	150

ALL DIMENSIONS ARE IN MM

Drawing **CS11-PSCP-06**	**11 kV, 10/11 m PSC Pole** **Tap Off Structure**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

Refer Drawing No: CS11-PSCP-07

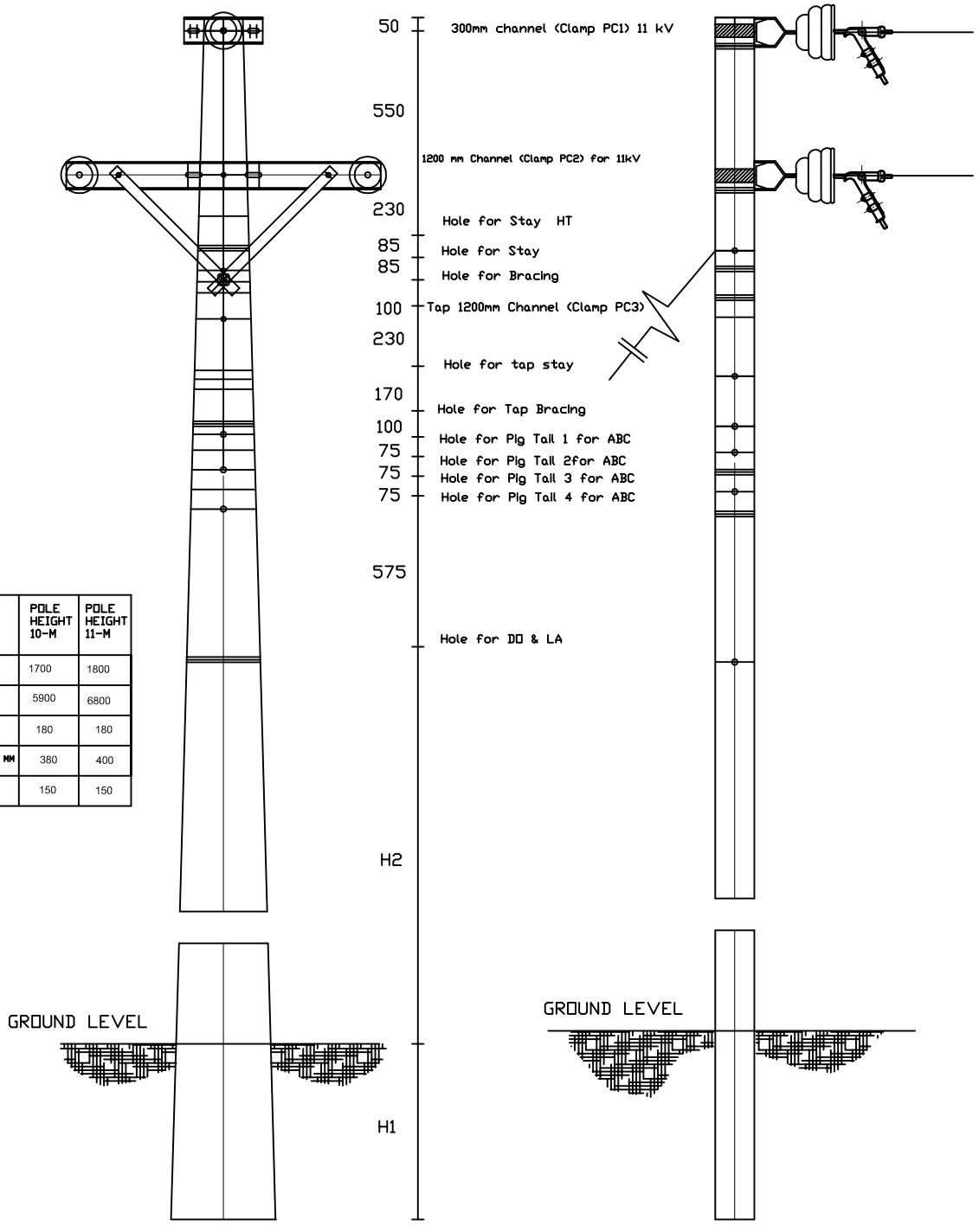
S.No.	QTY.	UNIT	MATERIAL
1	3	NOS	DISC INSULATOR
2	3	SET	BRACK STRAP
3	3	SET	TENSION SET WITH BALL AND SOCKET EYE
4	1	NOS	STEEL CROSSARM CHANNEL (100x 50x 6.4 x 300) mm.
5	1	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS (PC1)
6	1	NOS	STEEL CROSSARM CHANNEL (100 x 50 x 6.4 x 1200) mm.
7	1	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS (PC2)
8	2	NOS	FLAT CROSSARM BRACE (40x 6.0 x 660) mm
9	2	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (12 x 51) mm
10	1	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (16 x 203) mm
11	1	LOT	HT STAY SET (TYPE AS REQUIRED)
12	1	NOS	POLE PSC 10 m / 11 m

CONSTRUCTION STANDARDS

11 kV DEAD END STRUCTURE (DE)
PSC POLE

NEPAL ELECTRICITY AUTHORITY

Technical Service/ Commercial Department
Distribution and Consumer Services



DESCRIPTION	POLE HEIGHT 10-M	POLE HEIGHT 11-M
HEIGHT H1 IN MM	1700	1800
HEIGHT H2 IN MM	5900	6800
POLE WIDTH AT TOP 'WT' IN MM	180	180
POLE WIDTH AT BOTTOM 'WB' IN MM	380	400
POLE DEPTH 'D'	150	150

ALL DIMENSIONS ARE IN MM

Drawing		
CS11-PSCP-07	**11 kV, 10/11 m PSC Pole Dead End Structure**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

Refer Drawing No: CS11-PSCP-08

S.No.	QTY.	UNIT	MATERIAL
1	4	NOS	PIN INSULATOR
2	4	NOS	INSULATOR PIN
3	4	NOS	PREFORM PIN TIES (TOP TIES)
4	6	NOS	DISC INSULATOR
5	6	SET	BRACK STRAP
6	6	SET	TENSION SET WITH BALL AND SOCKET EYE
7	6	NOS	PG CLAMP
8	2	NOS	STEEL CROSSARM CHANNEL (100x 50x 6.4 x 300) mm.
9	2	NOS	STEEL CROSSARM CHANNEL (100 x 50 x 6.4 x 1200) mm.
10	4	NOS	FLAT CROSSARM BRACE (40x 6.0 x 660) mm
11	12	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (12 x 51) mm
12	1	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (16 x 203) mm
13	4	SET	DOUBLE ARMING BOLTS WITH SUITABLE NUTS AND WASHERS (16 x305) mm
14	4	NOS	STRAP FOR INSULATOR STRING (50 x 6 x 396) mm
15	1	LOT	HT STAY SET (TYPE AS REQUIRED)
16	1	NOS	POLE PSC 10 m / 11 m

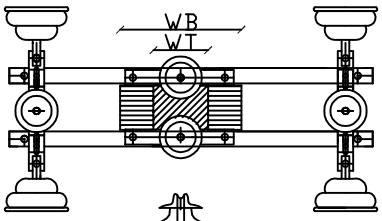
CONSTRUCTION STANDARDS

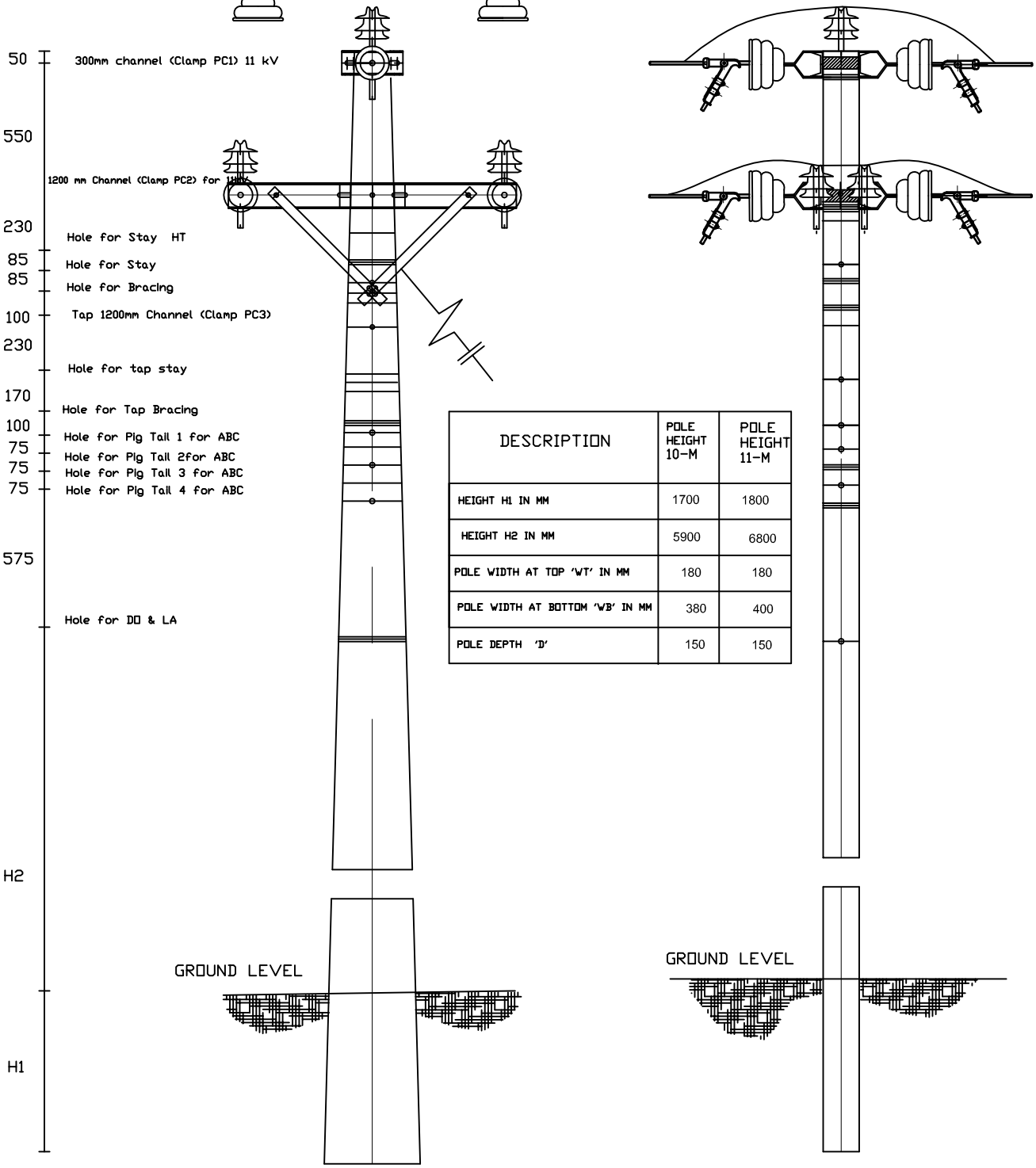
11 kV DOUBLE DEAD END STRUCTURE (DDE) PSC POLE

NEPAL ELECTRICITY AUTHORITY

Technical Service/ Commercial Department
Distribution and Consumer Services

TOP VIEW





DESCRIPTION	POLE HEIGHT 10-M	POLE HEIGHT 11-M
HEIGHT H1 IN MM	1700	1800
HEIGHT H2 IN MM	5900	6800
POLE WIDTH AT TOP 'WT' IN MM	180	180
POLE WIDTH AT BOTTOM 'WB' IN MM	380	400
POLE DEPTH 'D'	150	150

ALL DIMENSIONS ARE IN MM

Drawing	11 kV, 10/11 m PSC Pole	NEPAL ELECTRICITY AUTHORITY
CS11-PSCP-08	**Double Dead End Structure**	**Technical Services / Commercial Department**
		Distribution and Consumer Services

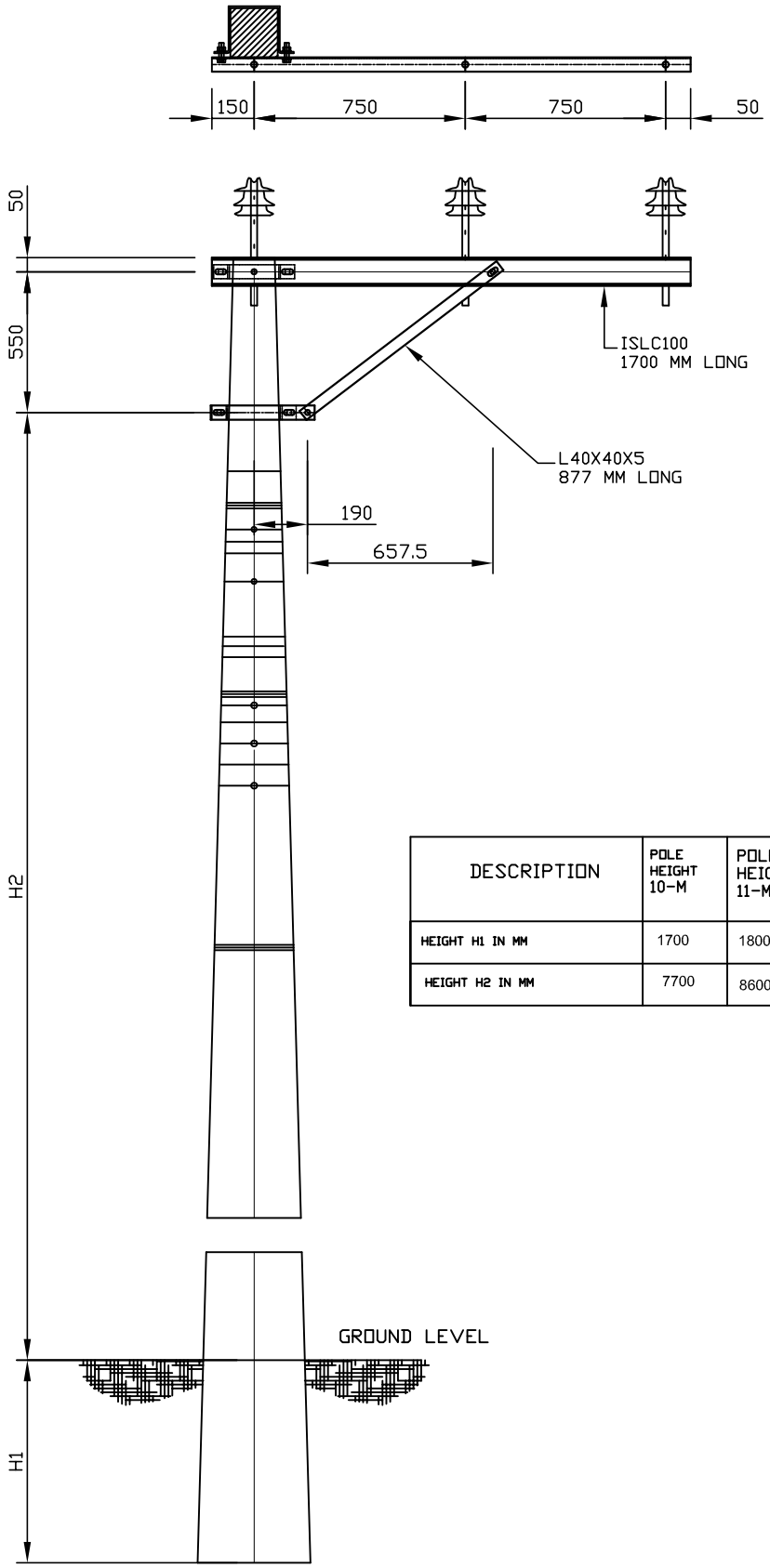
Refer Drawing No: CS11-PSCP-09

S.No.	QTY.	UNIT	MATERIAL
1	3	NOS	PIN INSULATOR
2	3	NOS	INSULATOR PIN
3	3	NOS	PREFORM PIN TIES (TOP TIES)
4	1	NOS	STEEL CROSSARM CHANNEL (100 x 50 x 6.4 x 1700) mm.
5	1	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS (PC1)
6	1	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS (PC2)
7	1	NOS	BRACING CROSSARM ANGLE (40 x 40 x 5 x 877) mm.
8	2	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (12 x 51) mm
9	1	NOS	POLE PSC 10 m / 11m

CONSTRUCTION STANDARDS
11 kV OFFSET STRUCTURE
PSC POLE

NEPAL ELECTRICITY AUTHORITY
Technical Service/ Commercial Department
Distribution and Consumer Services

TOP VIEW



DESCRIPTION	POLE HEIGHT 10-M	POLE HEIGHT 11-M
HEIGHT H1 IN MM	1700	1800
HEIGHT H2 IN MM	7700	8600

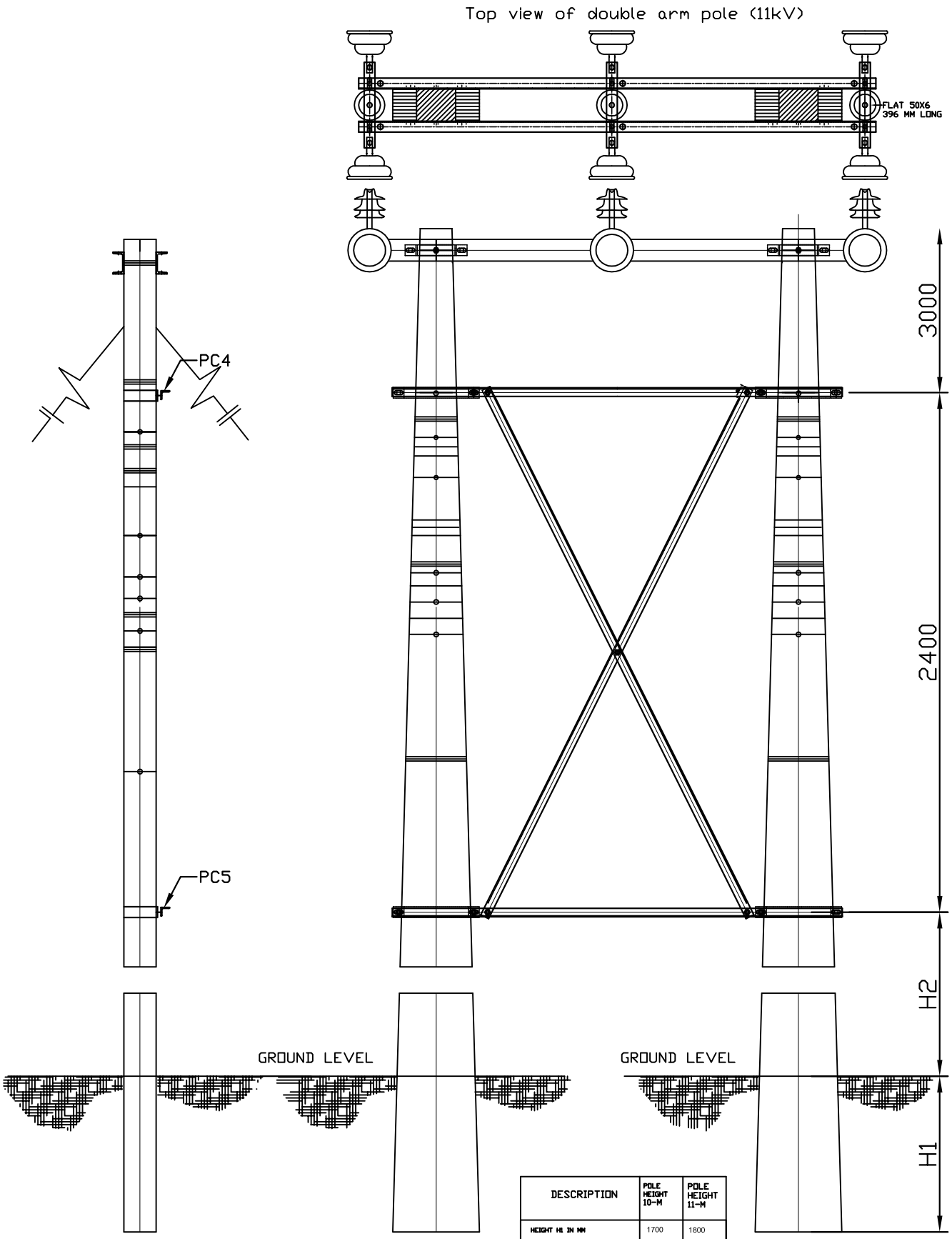
Drawing **CS11-PSCP-09**	**11 kV, 10/11 m PSC Pole** **Offset Pole Structure**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

Refer Drawing No: CS11-PSCP-10

S.No.	QTY.	UNIT	MATERIAL
1	3	NOS	PIN INSULATOR
2	3	NOS	INSULATOR PIN
3	3	NOS	PREFORM PIN TIES (TOP TIES)
4	6	NOS	DISC INSULATOR
5	6	SET	BRACK STRAP
6	6	SET	TENSION SET WITH BALL AND SOCKET EYE
7	6	NOS	PG CLAMP
8	2	NOS	STEEL CROSSARM CHANNEL (100x 50x 6.4 x 2390) mm.
9	2	NOS	BRACING ANGLE (40 x 40 x 5 x 2071) mm.
10	2	NOS	CROSSARM BRACING ANGLE (40 x 40 x 5.0 x 2723) mm
11	17	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (12 x 51) mm
12	2	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS (PC4)
13	2	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS (PC5)
14	4	SET	DOUBLE ARMING BOLTS WITH SUITABLE NUTS AND WASHERS (16 x305) mm
15	6	NOS	STRAP FOR INSULATOR STRING (50 x 6 x 396) mm
16	5	SET	HT STAY SET (TYPE AS REQUIRED)
17	2	NOS	POLE PSC 10 m / 11 m

CONSTRUCTION STANDARDS
11 kV H- STRUCTURE (HS)
PSC POLE

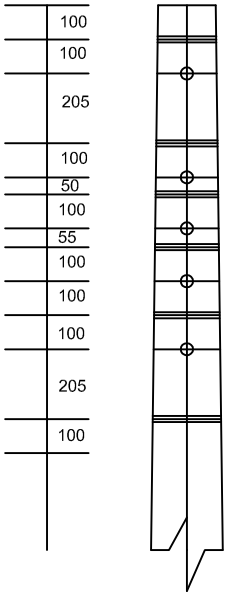
NEPAL ELECTRICITY AUTHORITY
Technical Service/ Commercial Department
Distribution and Consumer Services



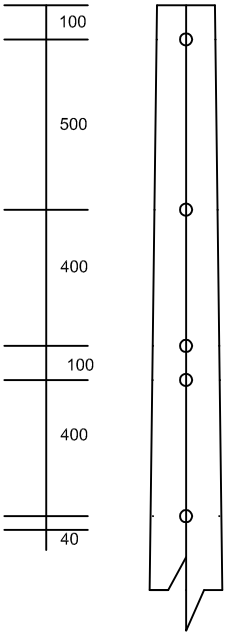
DESCRIPTION	POLE HEIGHT 10-M	POLE HEIGHT 11-M
HEIGHT H1 IN MM	1700	1800
HEIGHT H2 IN MM	2900	3800
POLE WIDTH AT TOP 'WT' IN MM	180	180
POLE WIDTH AT BOTTOM 'WB' IN MM	380	400
POLE DEPTH 'D'	150	150

Drawing **CS11-PSCP-10**	**11 kV, 10/11 m PSC Pole** **H - Structure**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

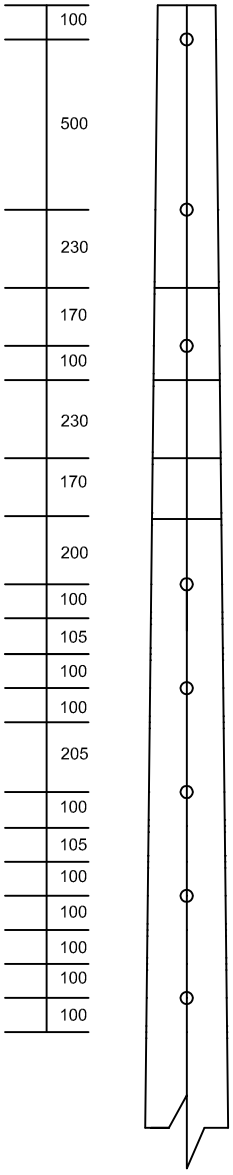
Steel Telescopic Tubular (STT) Pole



9 Meter STTP



10 Meter STTP

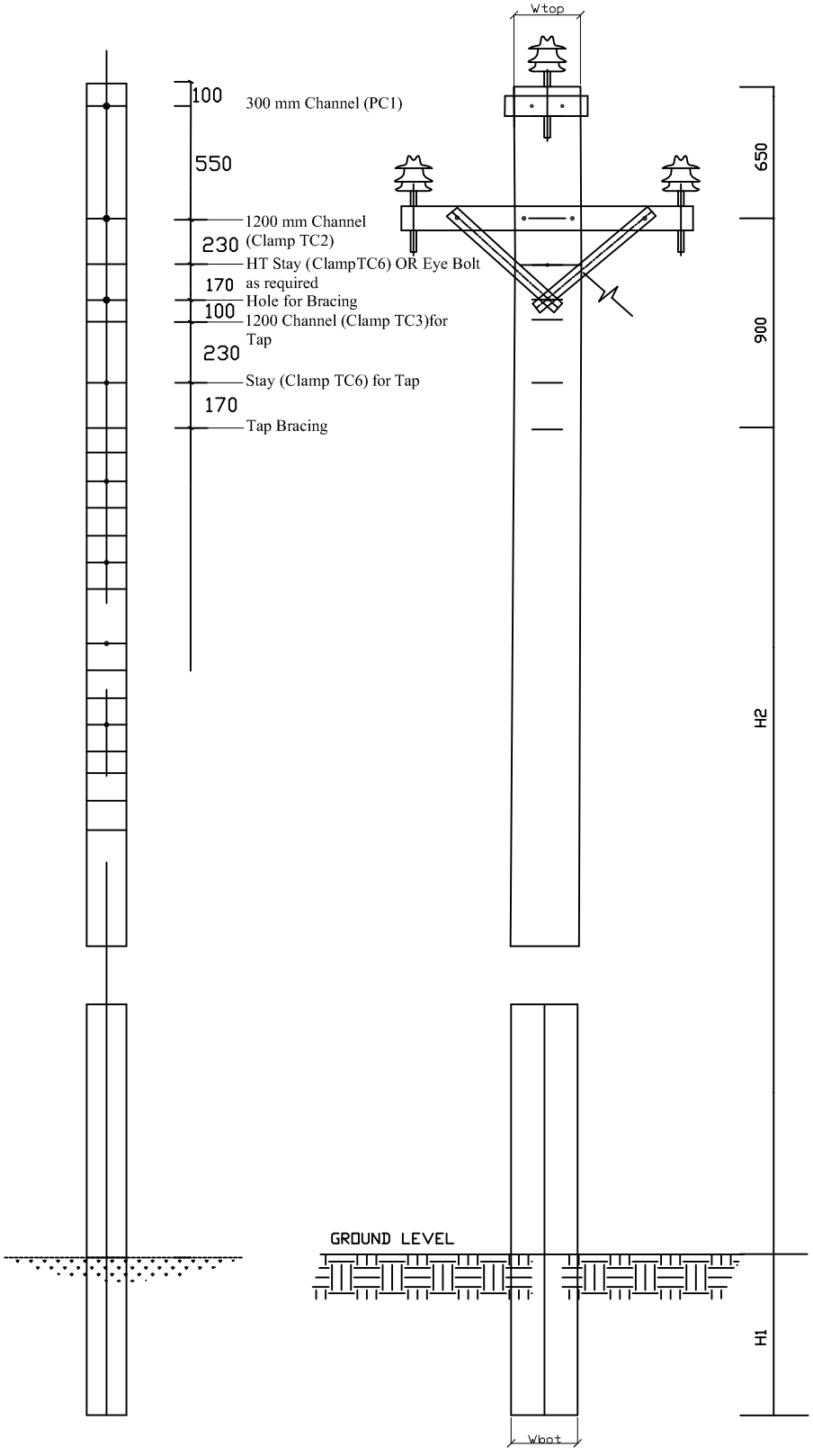


11 Meter STTP

Hole diameter for 9,10 & 11m pole is 18 mm

Note: All dimensions are in mm

Drawing	11kV, 10/11 m STT Pole	NEPAL ELECTRICITY AUTHORITY
CS11-STTP-01	Hole Pattern	Technical Services / Commercial Department
		Distribution and Consumer Services



Description	10 m Pole	11 m Pole
H1 mm	1700	1800
H2 mm	6750	7650
Wtop mm	180	180
Wbot mm	380	400

ALL DIMENSIONS ARE IN MM

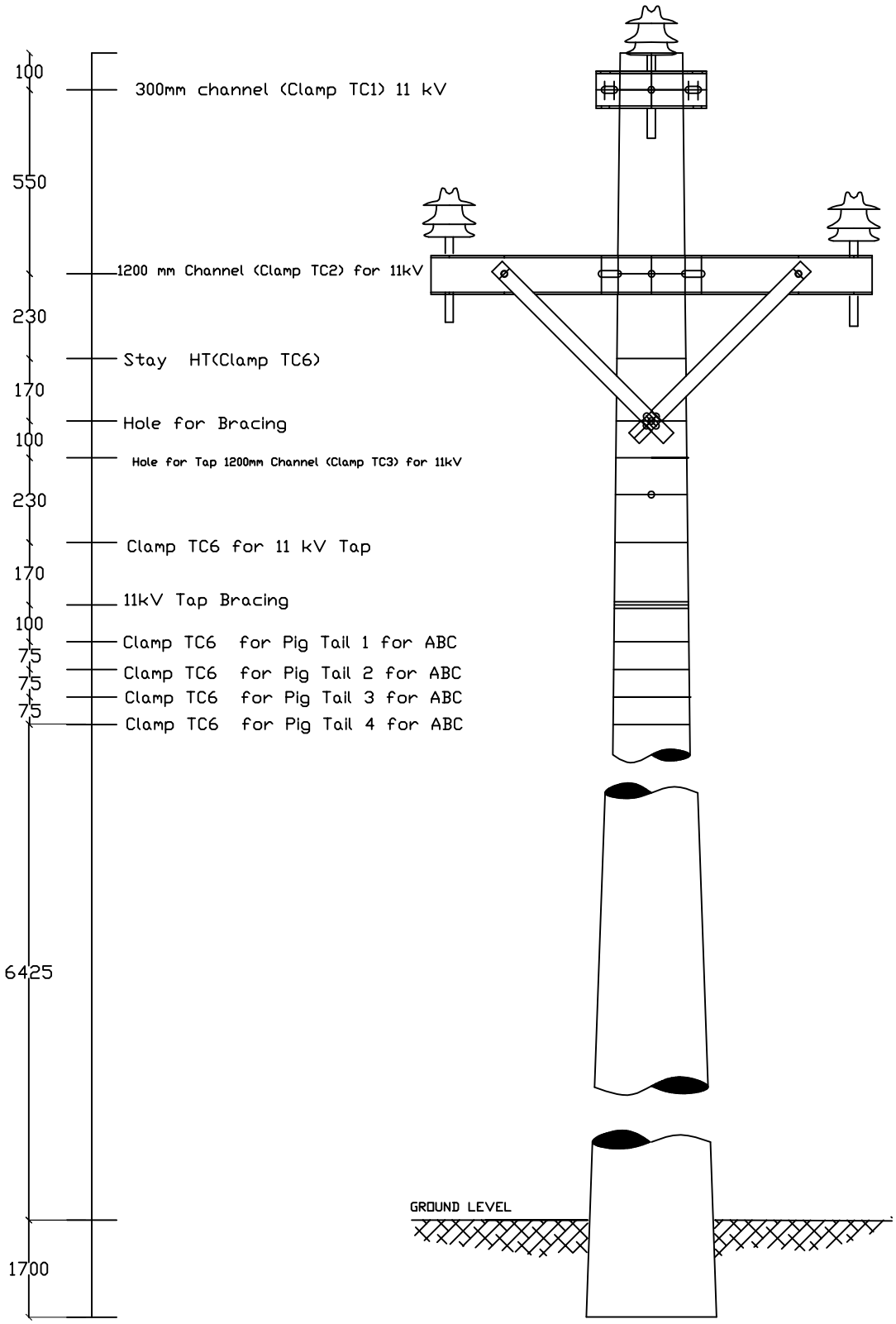
Drawing	11kV, 10/11 m STT Pole	NEPAL ELECTRICITY AUTHORITY
CS11-STTP-02	**Hole Details**	**Technical Services / Commercial Department**
		Distribution and Consumer Services

Refer Drawing No: CS11-STTP- 03 AND 09

S.No.	QTY.	UNIT	MATERIAL
1	3	NOS	PIN INSULATOR
2	3	NOS	INSULATOR PIN
3	3	NOS	PREFORM PIN TIES (TOP TIES)
4	1	NOS	STEEL CROSSARM CHANNEL (100x 50x6.4x300) mm.
5	1	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS (TC1)
6	1	NOS	STEEL CROSSARM CHANNEL (100x 50x6.4x1200) mm.
7	1	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS (TC2)
8	2	NOS	FLAT CROSSARM BRACE(40x 6.0x660) mm
9	2	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (12 x51) mm
10	1	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (16 x305) mm
11	1	NOS	POLE TELESCOPIC 10 m /11m

CONSTRUCTION STANDARDS
11 kV SINGLE ARM STRUCTURE (SA)
TELESCOPIC POLE

NEPAL ELECTRICITY AUTHORITY
Technical Service/ Commercial Department
Distribution and Consumer Services



Drawing **CS11-STTP-03**	**11kV, 10 m STT Pole** **Single Arm Structure**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

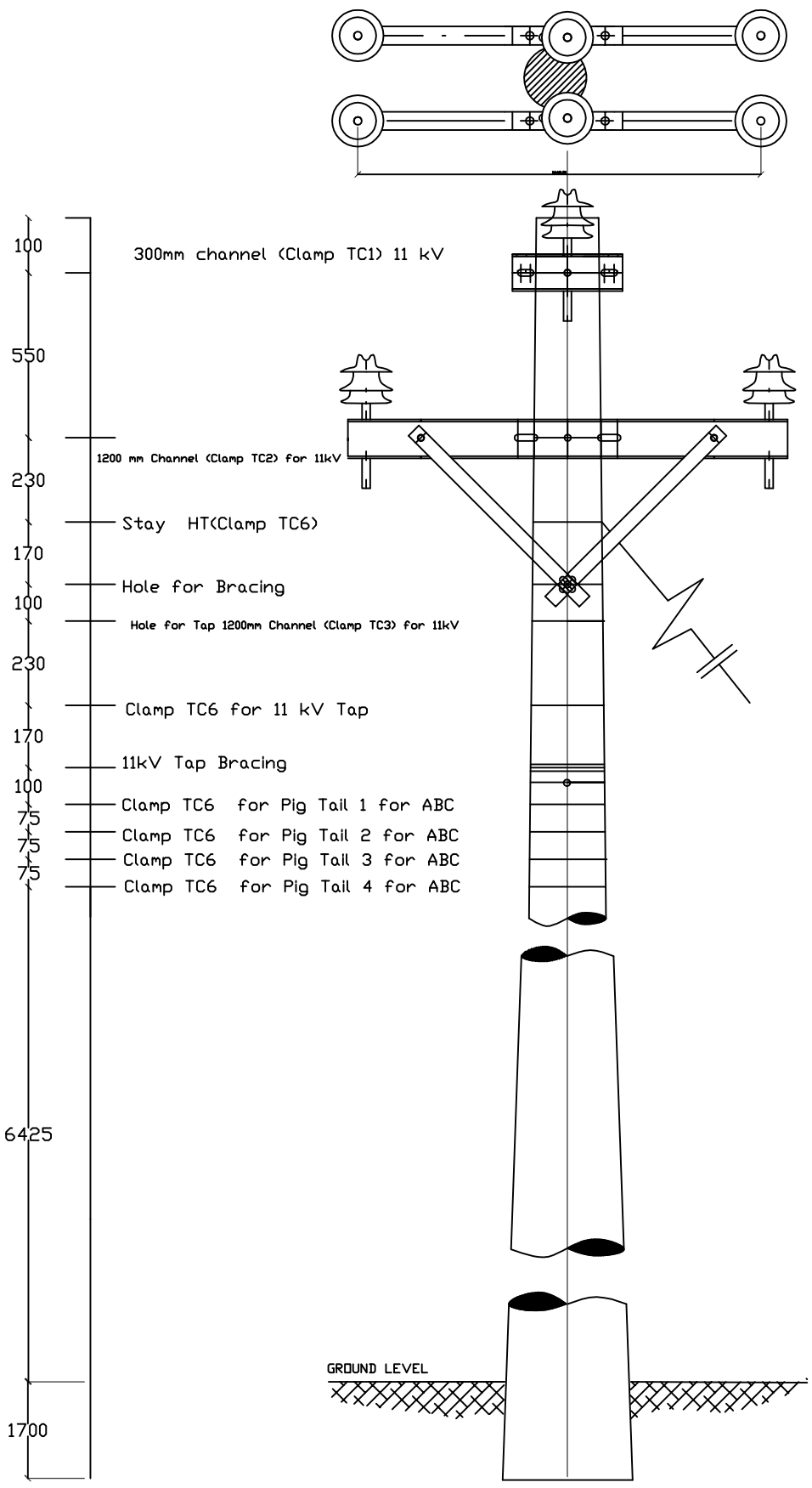
Refer Drawing No: CS11-STTP- 04 AND 10

S.No.	QTY.	UNIT	MATERIAL
1	6	NOS	PIN INSULATOR
2	6	NOS	INSULATOR PIN
3	6	NOS	PREFORM PIN TIES (TOP TIES)
4	2	NOS	STEEL CROSSARM CHANNEL (100 x 50 x 6.4 x 300) mm.
5	2	NOS	STEEL CROSSARM CHANNEL (100 x 50 x 6.4 x 1200) mm.
6	4	NOS	FLAT CROSSARM BRACE (40x 6.0 x 660) mm
7	4	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (12 x 51) mm
8	1	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (16 x 305) mm
9	4	SET	DOUBLE ARMING BOLTS WITH NUTS AND WASHERS(16 x 305) mm
10	1	LOT	HT STAY SET (AS REQUIRED)
11	1	NOS	POLE TELESCOPIC 10 m / 11m

CONSTRUCTION STANDARDS
11 kV DOUBLE ARM STRUCTURE (DA)
TELESCOPIC POLE

NEPAL ELECTRICITY AUTHORITY
Technical Service/ Commercial Department
Distribution and Consumer Services

Top view of double arm pole (11kV)



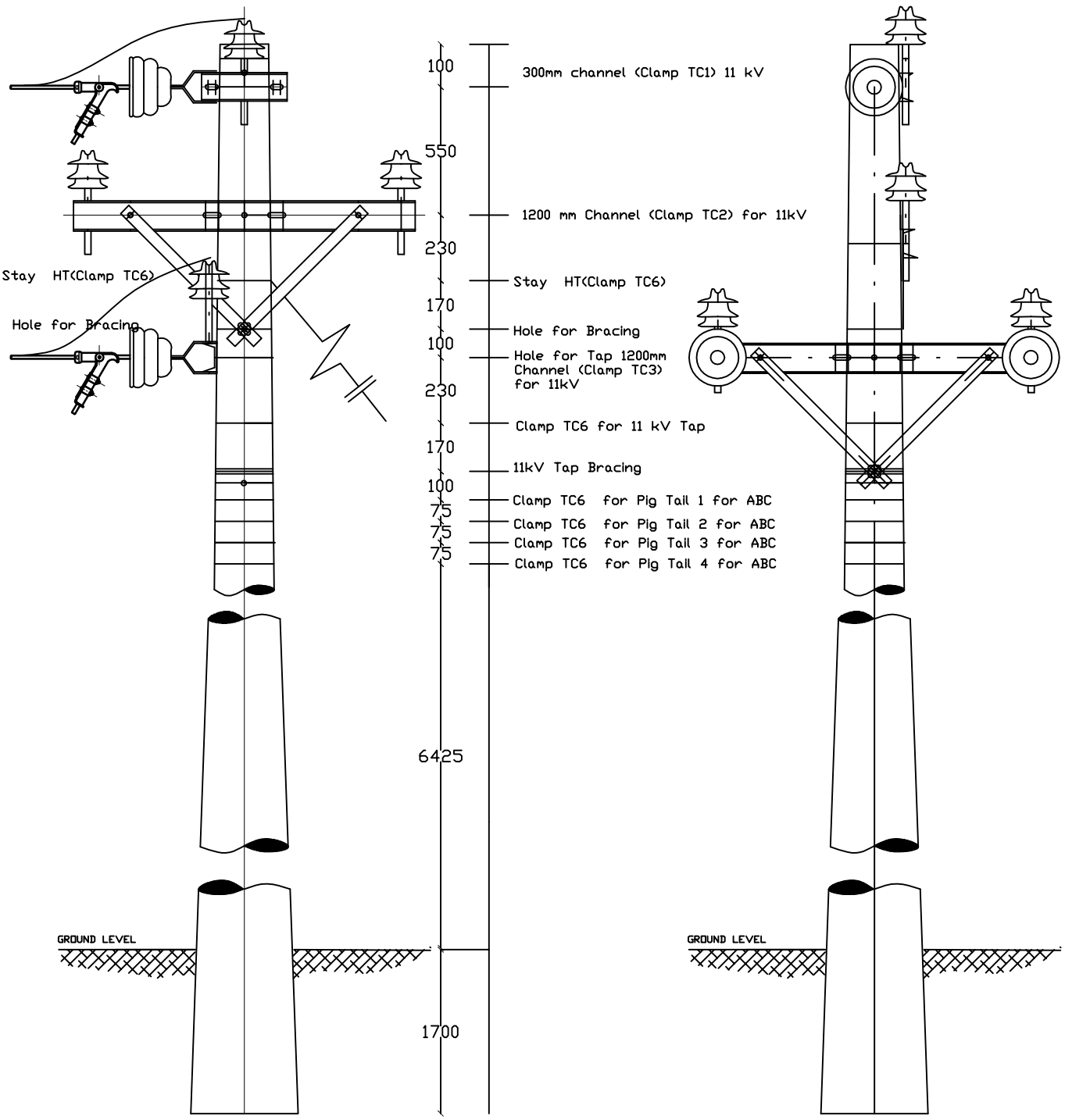
Drawing **CS11-STTP-04**	**11kV, 10 m STT Pole** **Double Arm Structure**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

Refer Drawing No: CS11-STTP- 05 AND 11

S.No.	QTY.	UNIT	MATERIAL
1	5	NOS	PIN INSULATOR
2	5	NOS	INSULATOR PIN
3	5	NOS	PREFORM PIN TIES (TOP TIES)
4	3	SET	DISC INSULATOR
5	3	SET	BRACK STRAP
6	3	SET	TENSION SET WITH BALL AND SOCKET EYE
7	6	NOS	PG CLAMP
8	1	NOS	STEEL CROSSARM CHANNEL (100x 50x 6.4 x 300) mm.
9	1	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS (TC1)
10	2	NOS	STEEL CROSSARM CHANNEL (100 x 50 x 6.4 x 1200) mm.
11	1	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS (TC2)
12	1	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS (TC3)
13	4	NOS	FLAT CROSSARM BRACE (40x 6.0 x 660) mm
14	4	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (12 x 51) mm
16	2	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (16 x305) mm
17	1	LOT	HT STAY SET (TYPE AS REQUIRED)
18	1	NOS	POLE TELESCOPIC 10 m / 11 m

CONSTRUCTION STANDARDS
11 kV TAP OFF STRUCTURE (TO)
TELESCOPIC POLE

NEPAL ELECTRICITY AUTHORITY
Technical Service/ Commercial Department
Distribution and Consumer Services



Drawing	11kV, 10 m STT Pole	NEPAL ELECTRICITY AUTHORITY
CS11-STTP-05	**Tap Off Structure**	**Technical Services / Commercial Department**
		Distribution and Consumer Services

Refer Drawing No: CS11-STTP- 06 AND 12

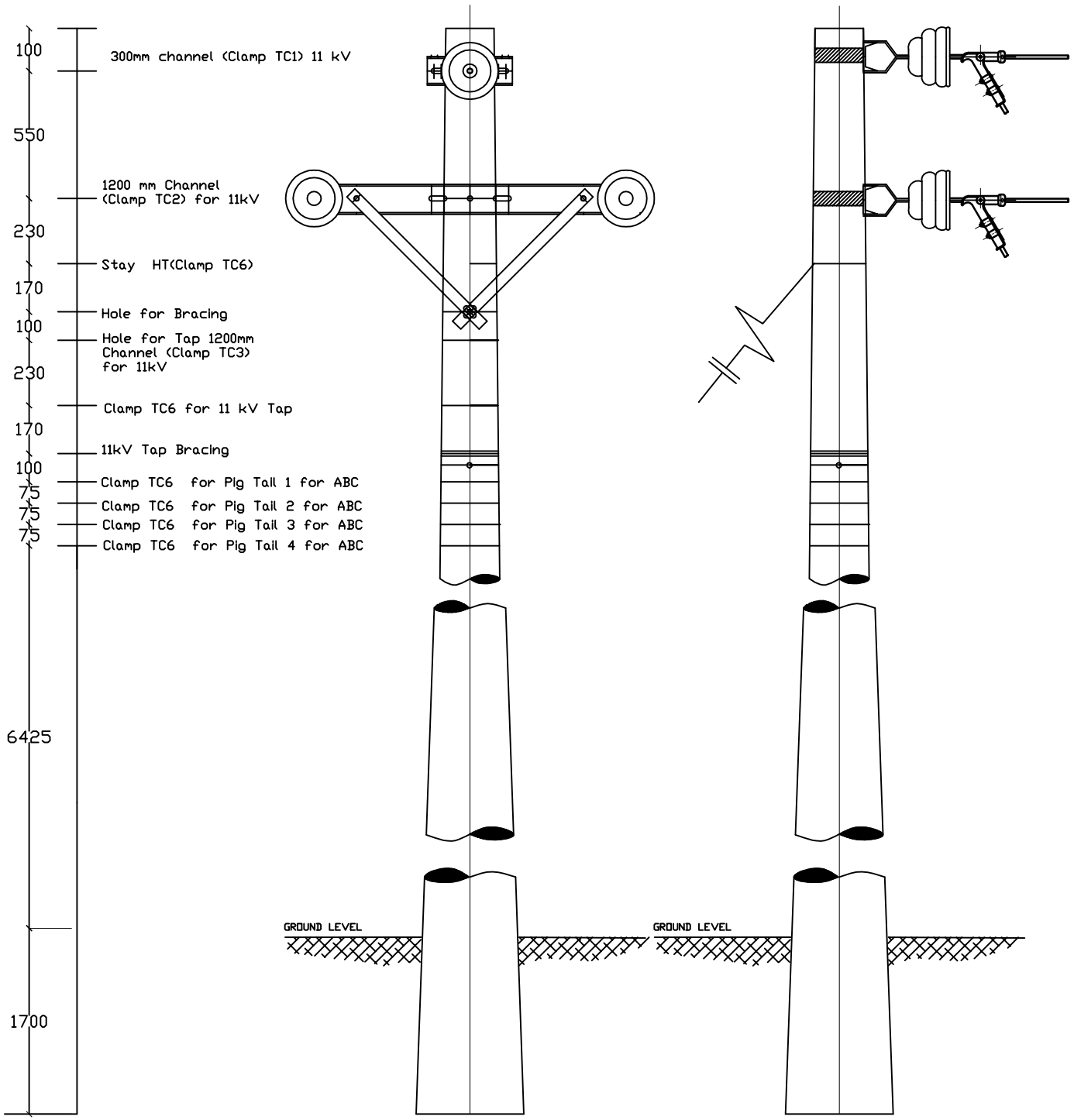
S.No.	QTY.	UNIT	MATERIAL
1	3	NOS	DISC INSULATOR
2	3	SET	BRACK STRAP
3	3	SET	TENSION SET WITH BALL AND SOCKET EYE
4	1	NOS	STEEL CROSSARM CHANNEL (100x 50x 6.4 x 300) mm.
5	1	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS (TC1)
6	1	NOS	STEEL CROSSARM CHANNEL (100 x 50 x 6.4 x 1200) mm.
7	1	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS (TC2)
8	2	NOS	FLAT CROSSARM BRACE (40x 6.0 x 660) mm
9	2	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (12 x 51) mm
10	1	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (16 x 305) mm
11	1	LOT	HT STAY SET (TYPE AS REQUIRED)
12	1	NOS	POLE TELESCOPIC 10 m / 11 m

CONSTRUCTION STANDARDS

11 kV DEAD END STRUCTURE (DE)
TELESCOPIC POLE

NEPAL ELECTRICITY AUTHORITY

Technical Service/ Commercial Department
Distribution and Consumer Services



Drawing	11kV, 10 m STT Pole	NEPAL ELECTRICITY AUTHORITY
CS11-STTP-06	**Dead End Structure**	**Technical Services / Commercial Department**
		Distribution and Consumer Services

Refer Drawing No: CS11-STTP- 07 AND 13

S.No.	QTY.	UNIT	MATERIAL
1	4	NOS	PIN INSULATOR
2	4	NOS	INSULATOR PIN
3	4	NOS	PREFORM PIN TIES (TOP TIES)
4	6	NOS	DISC INSULATOR
5	6	SET	BRACK STRAP
6	6	SET	TENSION SET WITH BALL AND SOCKET EYE
7	6	NOS	PG CLAMP
8	2	NOS	STEEL CROSSARM CHANNEL (100x 50x 6.4 x 300) mm.
9	2	NOS	STEEL CROSSARM CHANNEL (100 x 50 x 6.4 x 1200) mm.
10	4	NOS	FLAT CROSSARM BRACE (40x 6.0 x 660) mm
11	12	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (12 x 51) mm
12	1	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (16 x 305) mm
13	4	SET	DOUBLE ARMING BOLTS WITH SUITABLE NUTS AND WASHERS (16 x305) mm
14	4	NOS	STRAP FOR INSULATOR STRING (50 x 6 x 396) mm
15	1	LOT	HT STAY SET (TYPE AS REQUIRED)
16	1	NOS	POLE TELESCOPIC 10 m / 11 m

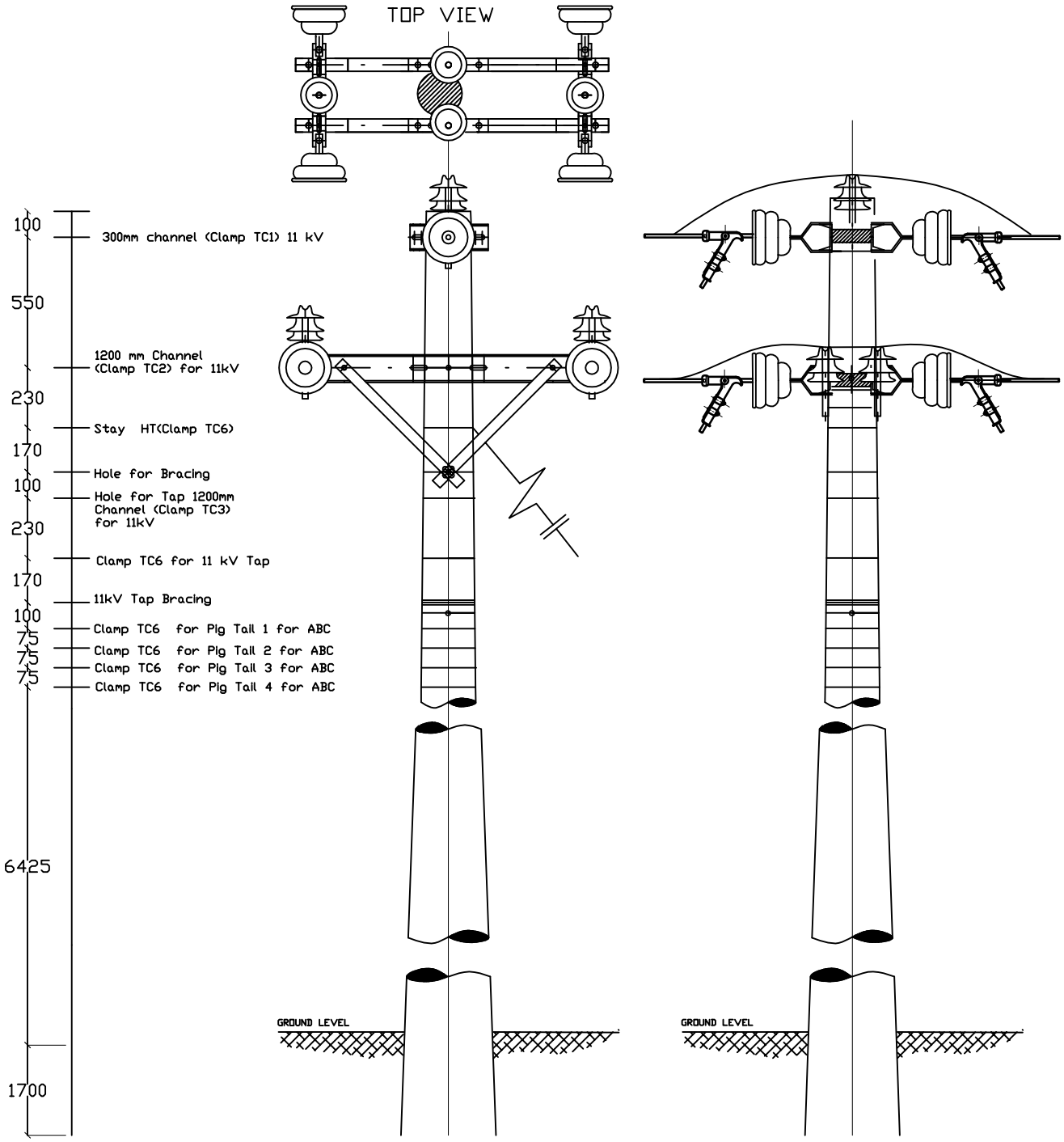
CONSTRUCTION STANDARDS

11 kV DOUBLE DEAD END STRUCTURE (DDE) TELESCOPIC POLE

NEPAL ELECTRICITY AUTHORITY

Technical Service/ Commercial Department

Distribution and Consumer Services



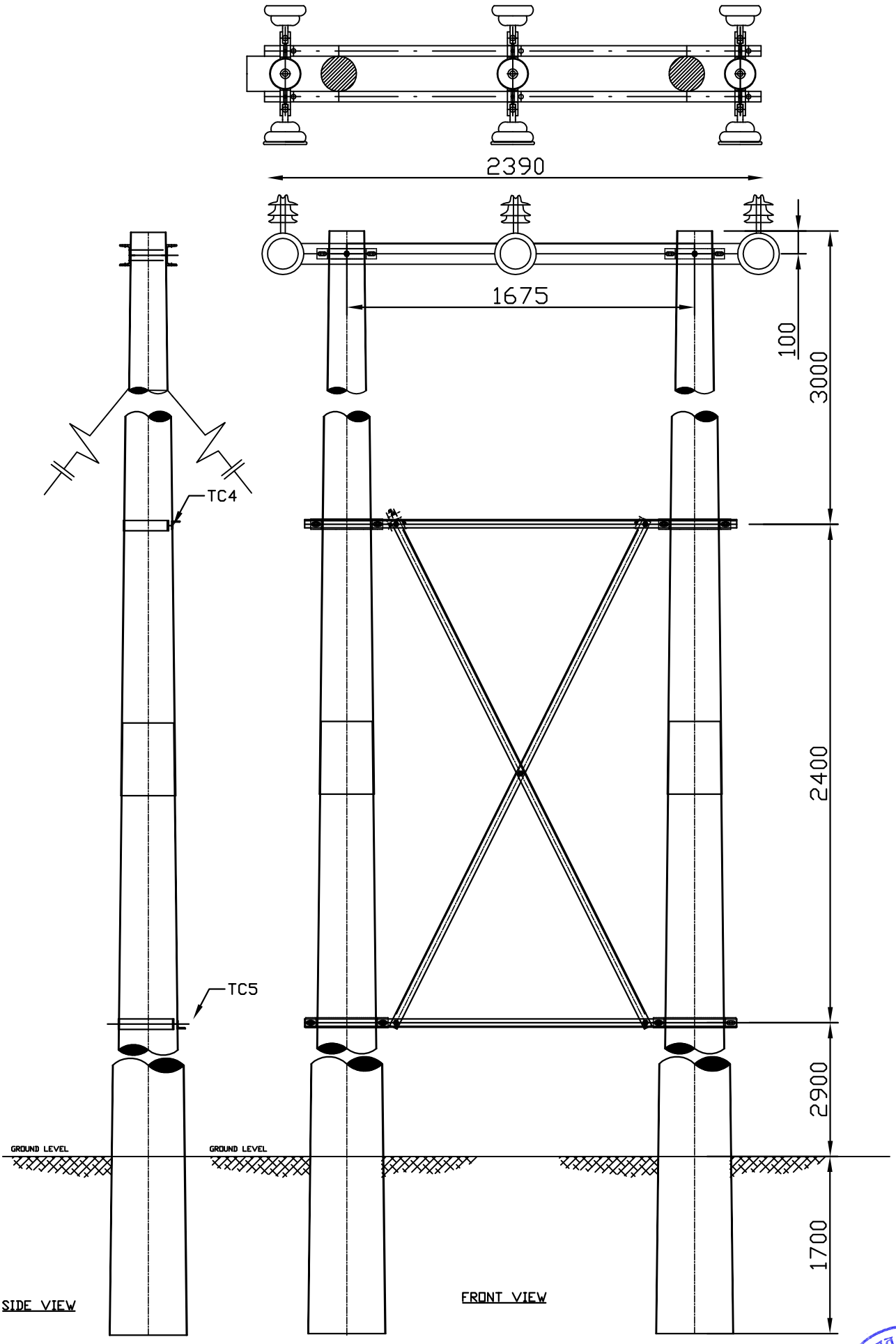
Drawing	11kV, 10 m STT Pole	NEPAL ELECTRICITY AUTHORITY
CS11-STTP-07	**Double Dead End Structure**	**Technical Services / Commercial Department**
		Distribution and Consumer Services

Refer Drawing No: CS11-STTP- 08 AND 14

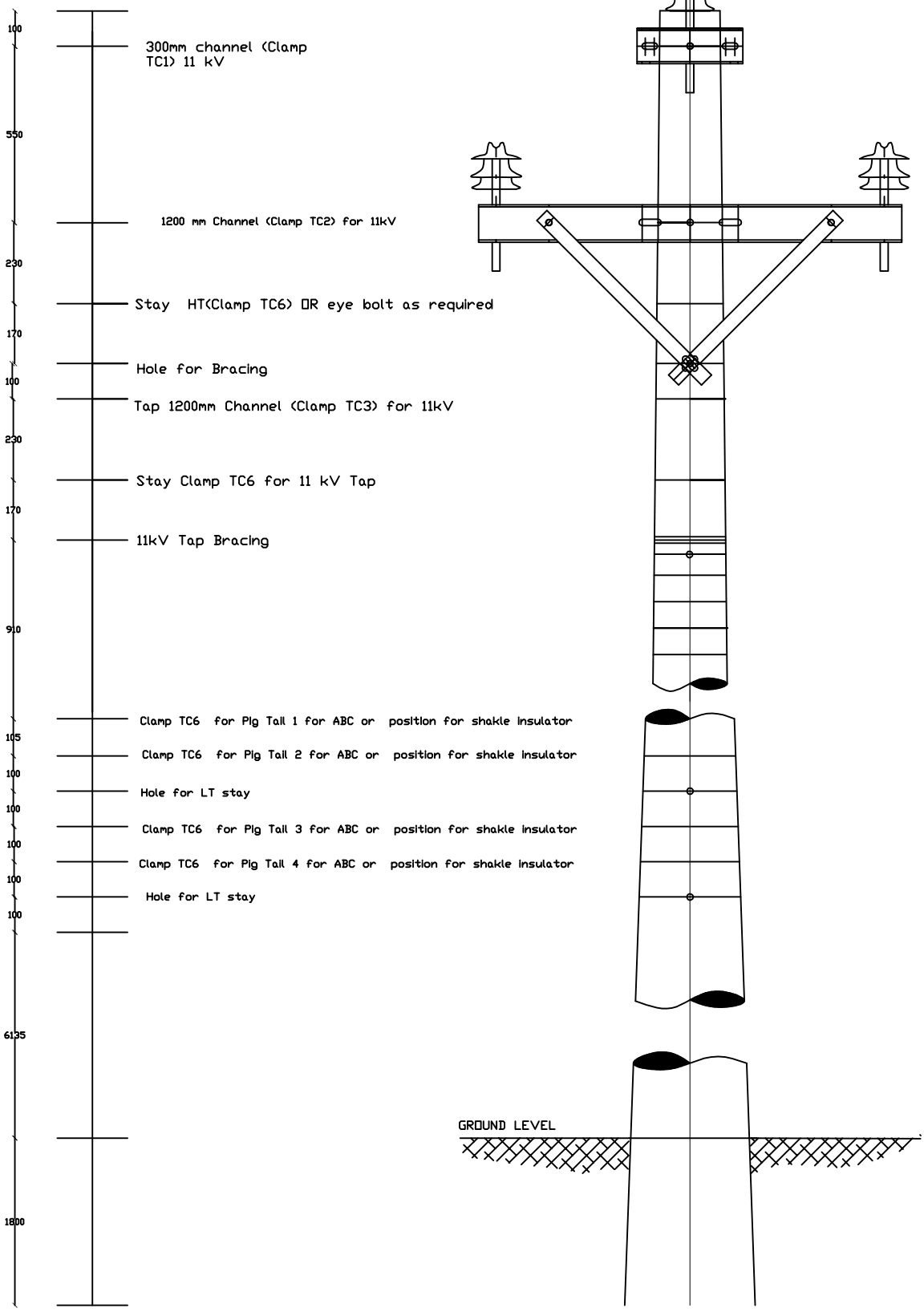
S.No.	QTY.	UNIT	MATERIAL
1	3	NOS	PIN INSULATOR
2	3	NOS	INSULATOR PIN
3	3	NOS	PREFORM PIN TIES (TOP TIES)
4	6	NOS	DISC INSULATOR
5	6	SET	BRACK STRAP
6	6	SET	TENSION SET WITH BALL AND SOCKET EYE
7	6	NOS	PG CLAMP
8	2	NOS	STEEL CROSSARM CHANNEL (100x 50x 6.4 x 2390) mm.
9	2	NOS	BRACING ANGLE (40 x 40 x 5 x 2071) mm.
10	2	NOS	CROSSARM BRACING ANGLE (40 x 40 x 5.0 x 2723) mm
11	17	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (12 x 51) mm
12	2	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS (TC4)
13	2	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS (TC5)
14	4	SET	DOUBLE ARMING BOLTS WITH SUITABLE NUTS AND WASHERS (16 x305) mm
15	6	NOS	STRAP FOR INSULATOR STRING (50 x 6 x 396) mm
16	5	SET	HT STAY SET (TYPE AS REQUIRED)
17	2	NOS	POLE TELESCOPIC 10 m / 11 m

CONSTRUCTION STANDARDS
11 kV H- STRUCTURE (HS)
TELESCOPIC POLE

NEPAL ELECTRICITY AUTHORITY
Technical Service/ Commercial Department
Distribution and Consumer Services

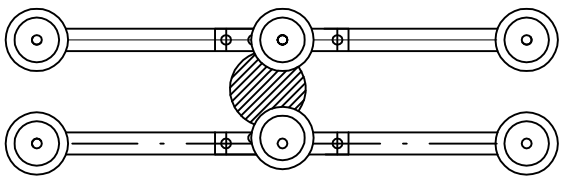


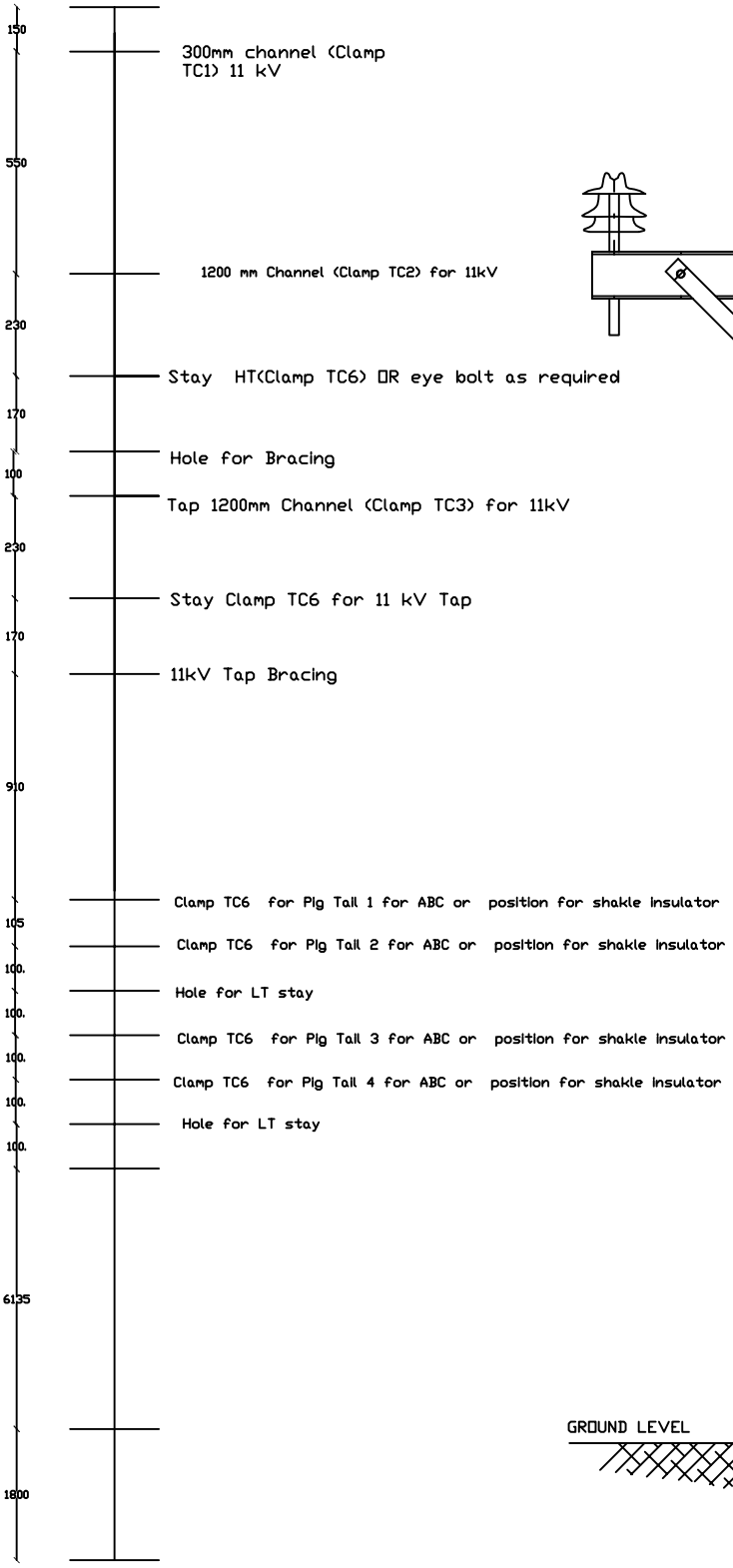
Drawing **CS11-STTP-08**	**11 kV, 10 m STT Pole** **H - Structure**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

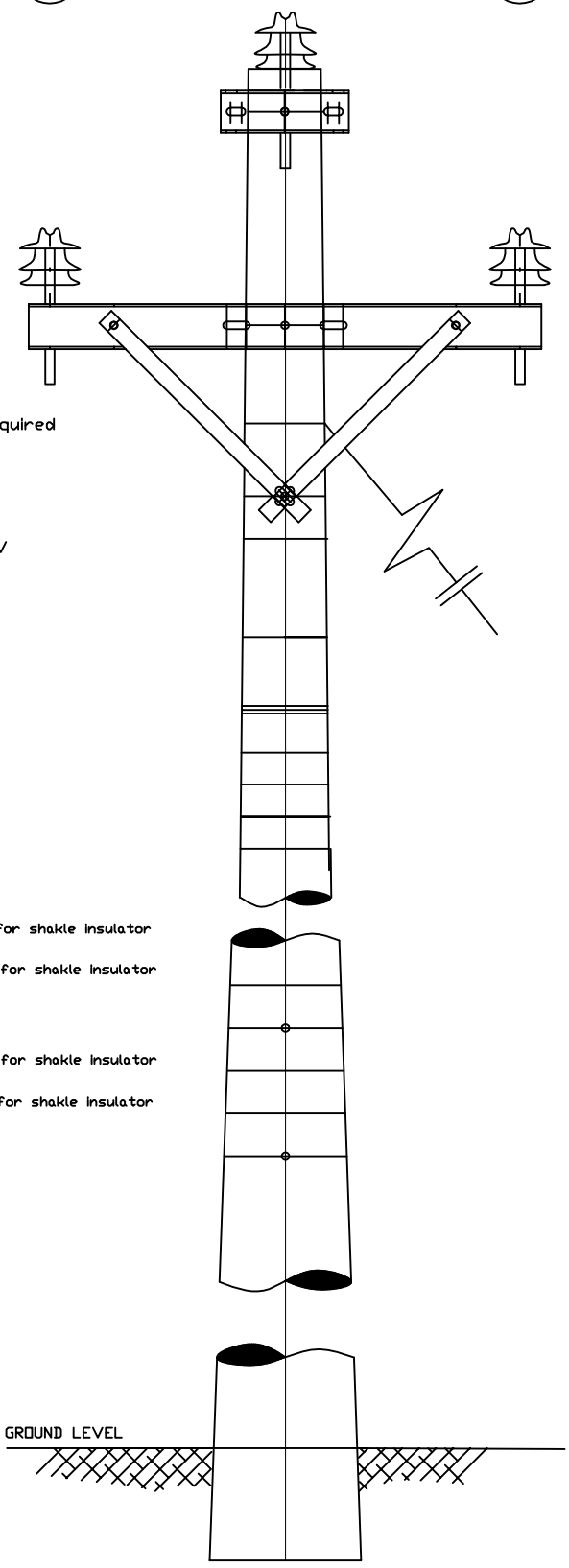


Drawing	11 kV, 11 m STT Pole	NEPAL ELECTRICITY AUTHORITY
CS11-STTP-09	**Single Arm Structure**	**Technical Services / Commercial Department**
		Distribution and Consumer Services

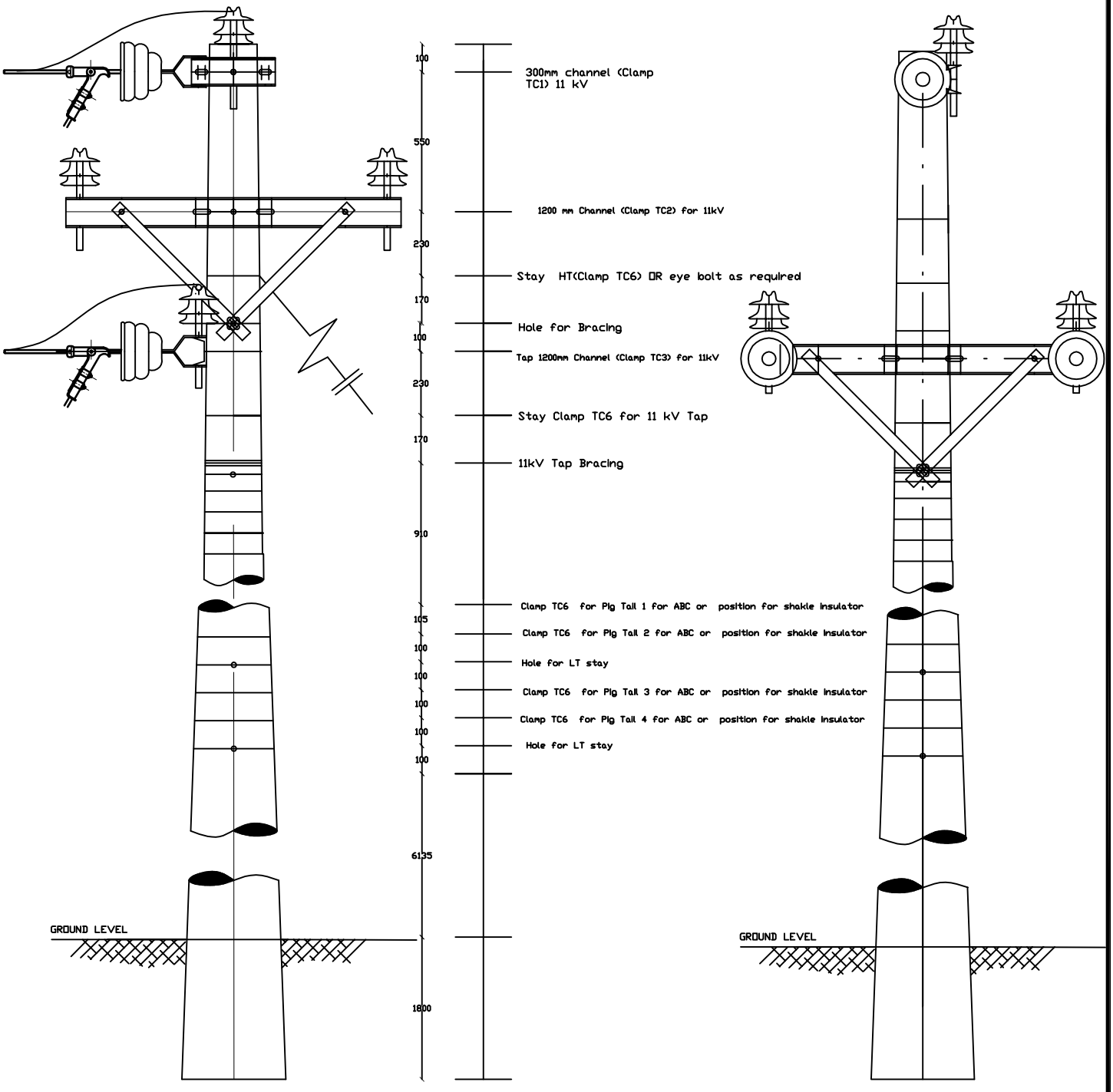
Top view of double arm pole (11kV)



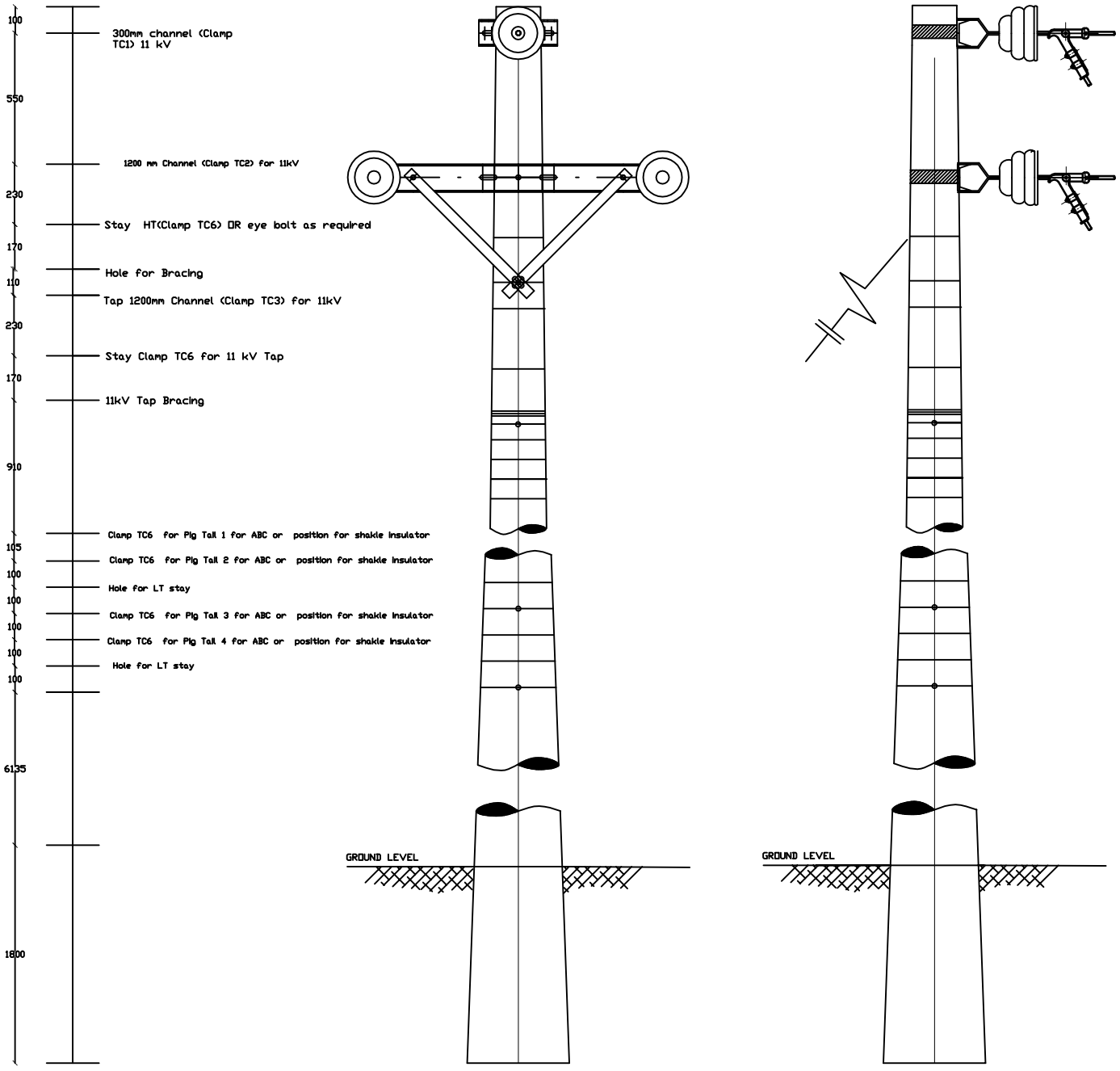




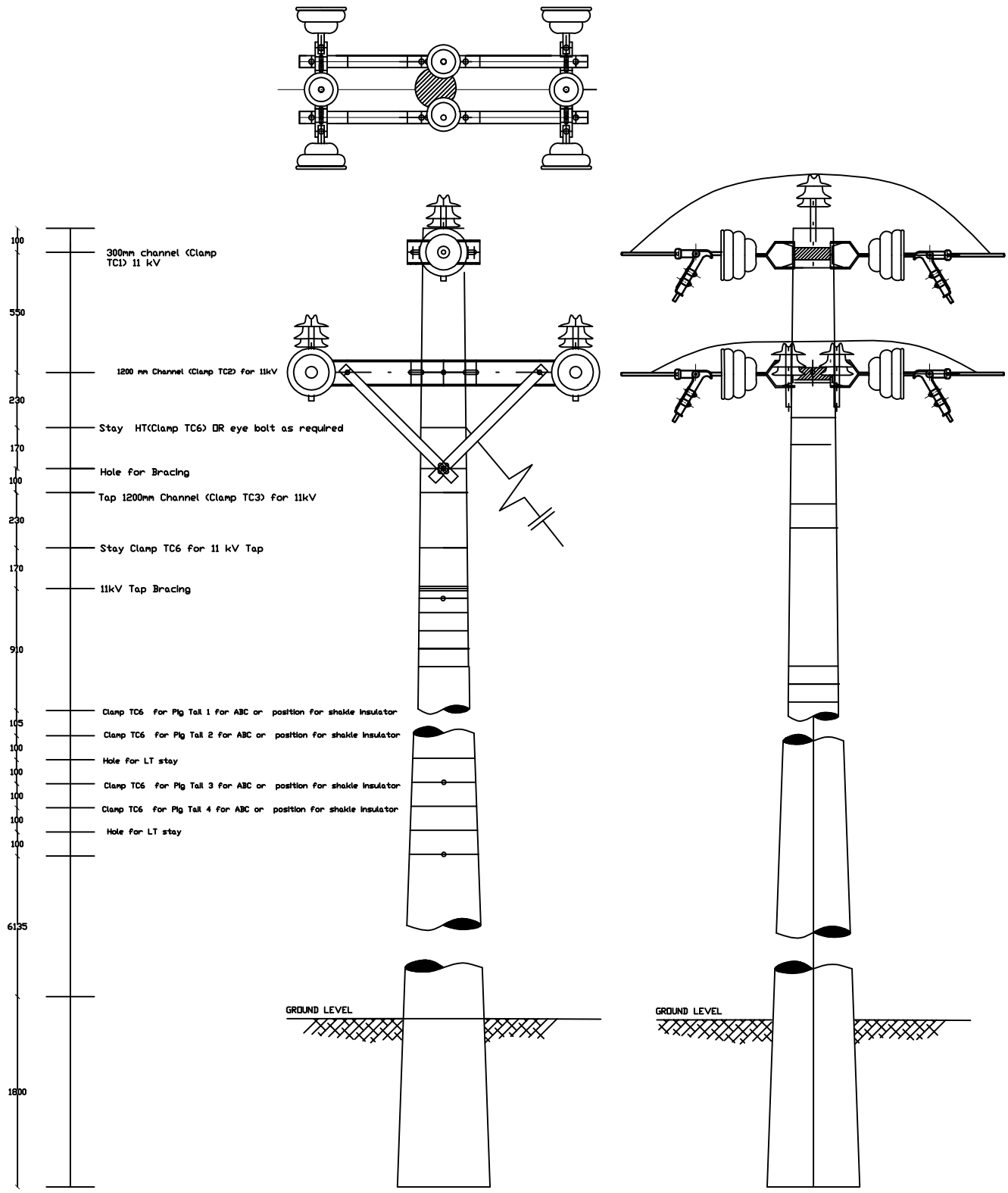
Drawing **CS11-STTP-10**	**11kV, 11 m STT Pole** **Double Arm Structure**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services



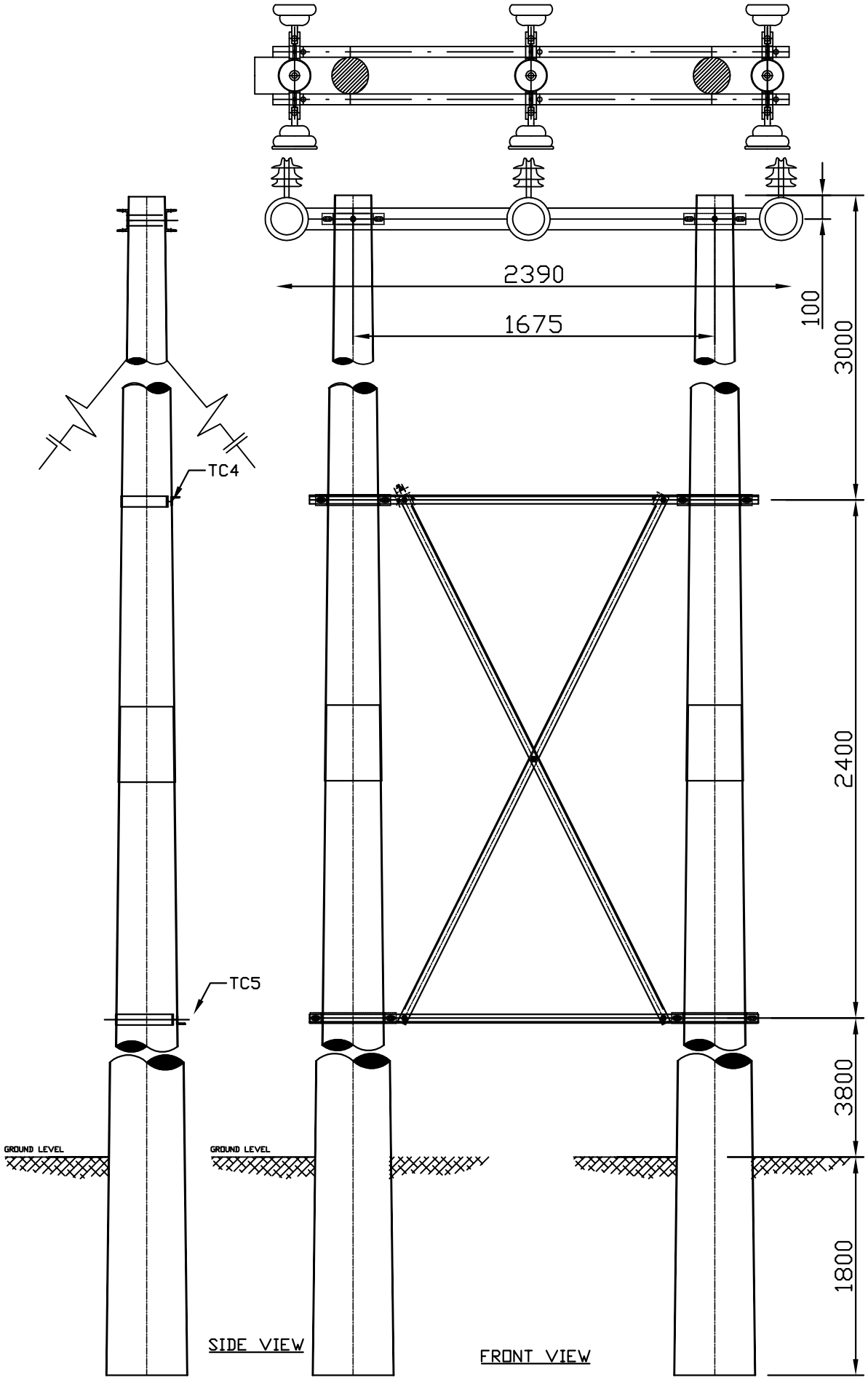
Drawing	11kV, 11 m STT Pole	NEPAL ELECTRICITY AUTHORITY
CS11-STTP-11	Tap Off Structure	Technical Services / Commercial Department
		Distribution and Consumer Services



Drawing	11kV, 11 m STT Pole	NEPAL ELECTRICITY AUTHORITY
CS11-STTP-12	**Dead End Structure**	**Technical Services / Commercial Department**
		Distribution and Consumer Services



Drawing	11kV, 11 m STT Pole	NEPAL ELECTRICITY AUTHORITY
CS11-STTP-13	**Double Dead End Structure**	**Technical Services / Commercial Department**
		Distribution and Consumer Services



Drawing **CS11-STTP-14**	**11kV, 11 m STT Pole** **H - Structure**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

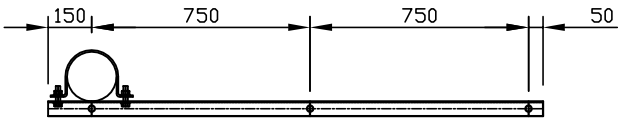
Refer Drawing No: CS11-STTP-15

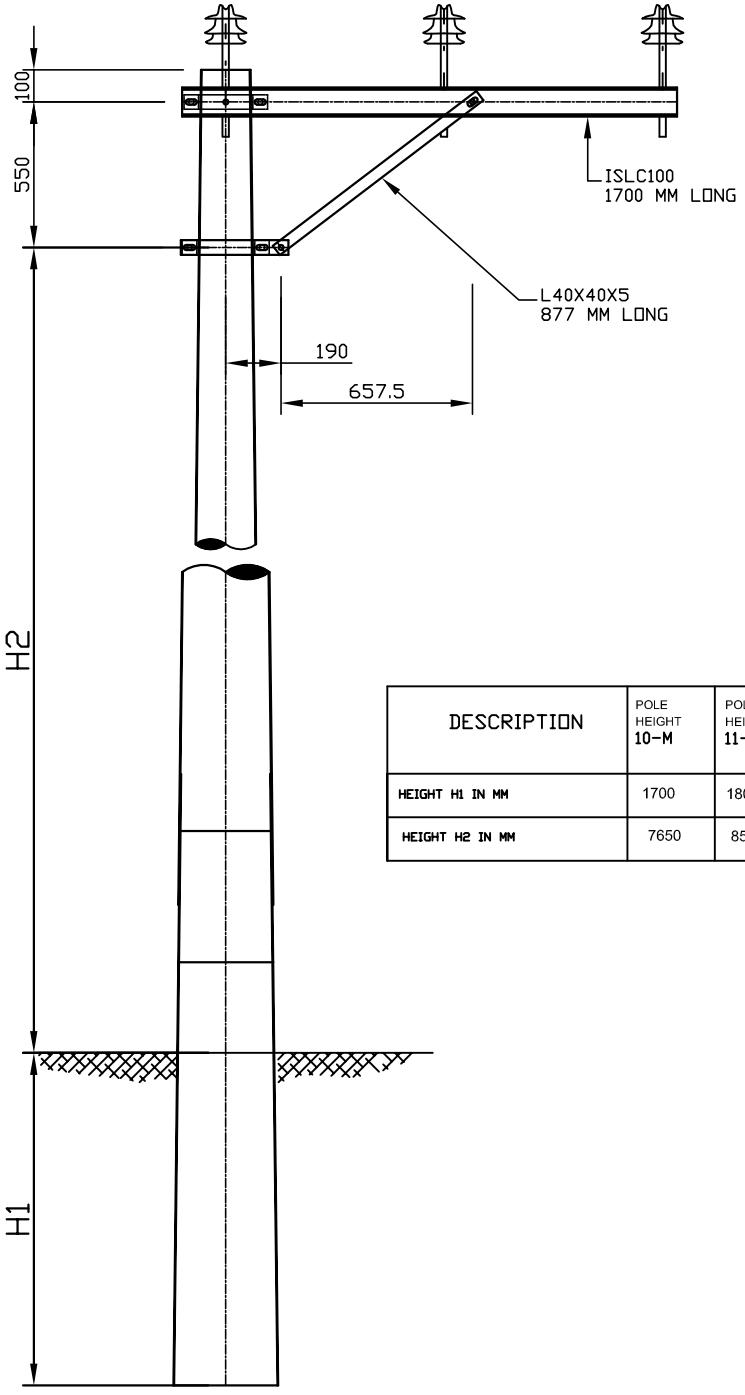
S.No.	QTY.	UNIT	MATERIAL
1	3	NOS	PIN INSULATOR
2	3	NOS	INSULATOR PIN
3	3	NOS	PREFORM PIN TIES (TOP TIES)
4	1	NOS	STEEL CROSSARM CHANNEL (100 x 50 x 6.4 x1700) mm.
5	1	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS (TC1)
6	1	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS (TC2)
7	1	NOS	BRACING CROSSARM ANGLE (40 x 40 x 5 x 877) mm.
8	2	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (12 x 51) mm
9	1	NOS	POLE TELESCOPIC 11m

CONSTRUCTION STANDARDS
11 kV OFFSET STRUCTURE
TELESCOPIC POLE

NEPAL ELECTRICITY AUTHORITY
Technical Service/ Commercial Department
Distribution and Consumer Services

TOP VIEW





DESCRIPTION	POLE HEIGHT 10-M	POLE HEIGHT 11-M
HEIGHT H1 IN MM	1700	1800
HEIGHT H2 IN MM	7650	8550

ALL DIMENSIONS ARE IN MM

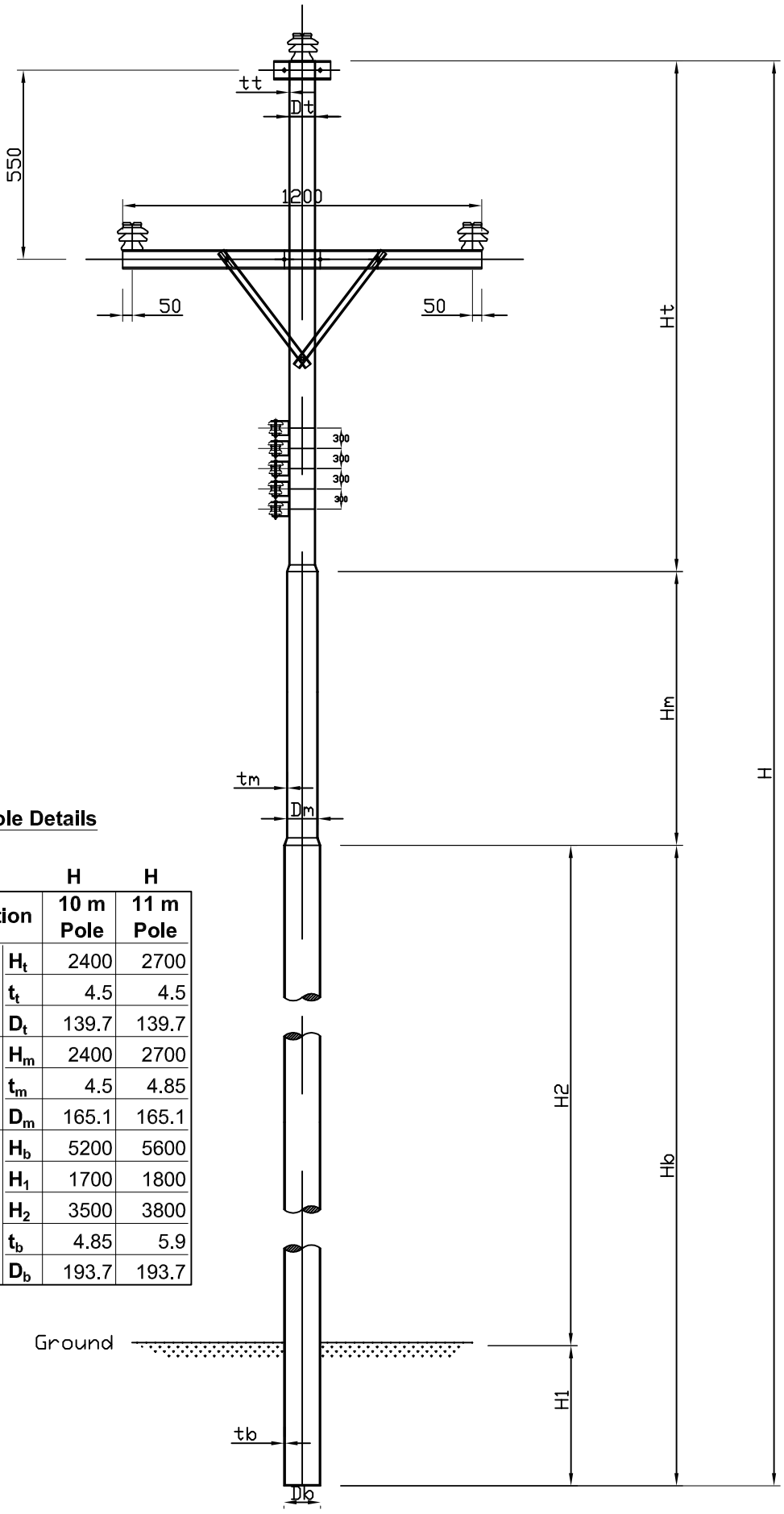
Drawing **CS11-STTP-15**	**11kV, 10/11 m STT Pole** **Offset Pole Structure**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

Refer Drawing No: CS11-STP- 01

S.No.	QTY.	UNIT	MATERIAL
1	3	NOS	PIN INSULATOR
2	3	NOS	INSULATOR PIN
3	3	NOS	PREFORM PIN TIES (TOP TIES)
4	1	NOS	STEEL CROSSARM CHANNEL (100x 50x6.4x300) mm.
5	1	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS (TC1)
6	1	NOS	STEEL CROSSARM CHANNEL (100x 50x6.4x1200) mm.
7	1	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS (TC2)
8	2	NOS	FLAT CROSSARM BRACE(40x 6.0x660) mm
9	2	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (12 x51) mm
10	1	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (16 x305) mm
11	1	NOS	POLE STEEL TUBULAR 10 m /11m

CONSTRUCTION STANDARDS
11 kV SINGLE ARM STRUCTURE (SA)
STEEL TUBULAR POLE

NEPAL ELECTRICITY AUTHORITY
Technical Service/ Commercial Department
Distribution and Consumer Services



Pole Details

Description		H 10 m Pole	H 11 m Pole
Top Section	H_t	2400	2700
	t_t	4.5	4.5
	D_t	139.7	139.7
Middle Section	H_m	2400	2700
	t_m	4.5	4.85
	D_m	165.1	165.1
Bottom Section	H_b	5200	5600
	H_1	1700	1800
	H_2	3500	3800
	t_b	4.85	5.9
	D_b	193.7	193.7

Drawing	11kV, 10/11 m ST Pole	NEPAL ELECTRICITY AUTHORITY
CS11-STP-01	**No Deviation (0 - 7 deg)**	**Technical Services / Commercial Department**
		Distribution and Consumer Services

Refer Drawing No: CS11-STP- 02

S.No.	QTY.	UNIT	MATERIAL
1	3	NOS	PIN INSULATOR
2	3	NOS	INSULATOR PIN
3	3	NOS	PREFORM PIN TIES (TOP TIES)
4	1	NOS	STEEL CROSSARM CHANNEL (100 x 50 x 6.4 x 300) mm.
5	1	NOS	STEEL CROSSARM CHANNEL (100 x 50 x 6.4 x 1200) mm.
6	2	NOS	FLAT CROSSARM BRACE (40x 6.0 x 660) mm
7	2	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (12 x 51) mm
8	1	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (16 x 203) mm
9	1	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS (TC1)
10	1	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS (TC4)
11	1	LOT	HT STAY SET (AS REQUIRED)
12	1	NOS	POLE STEEL TUBULAR 10 m /11m

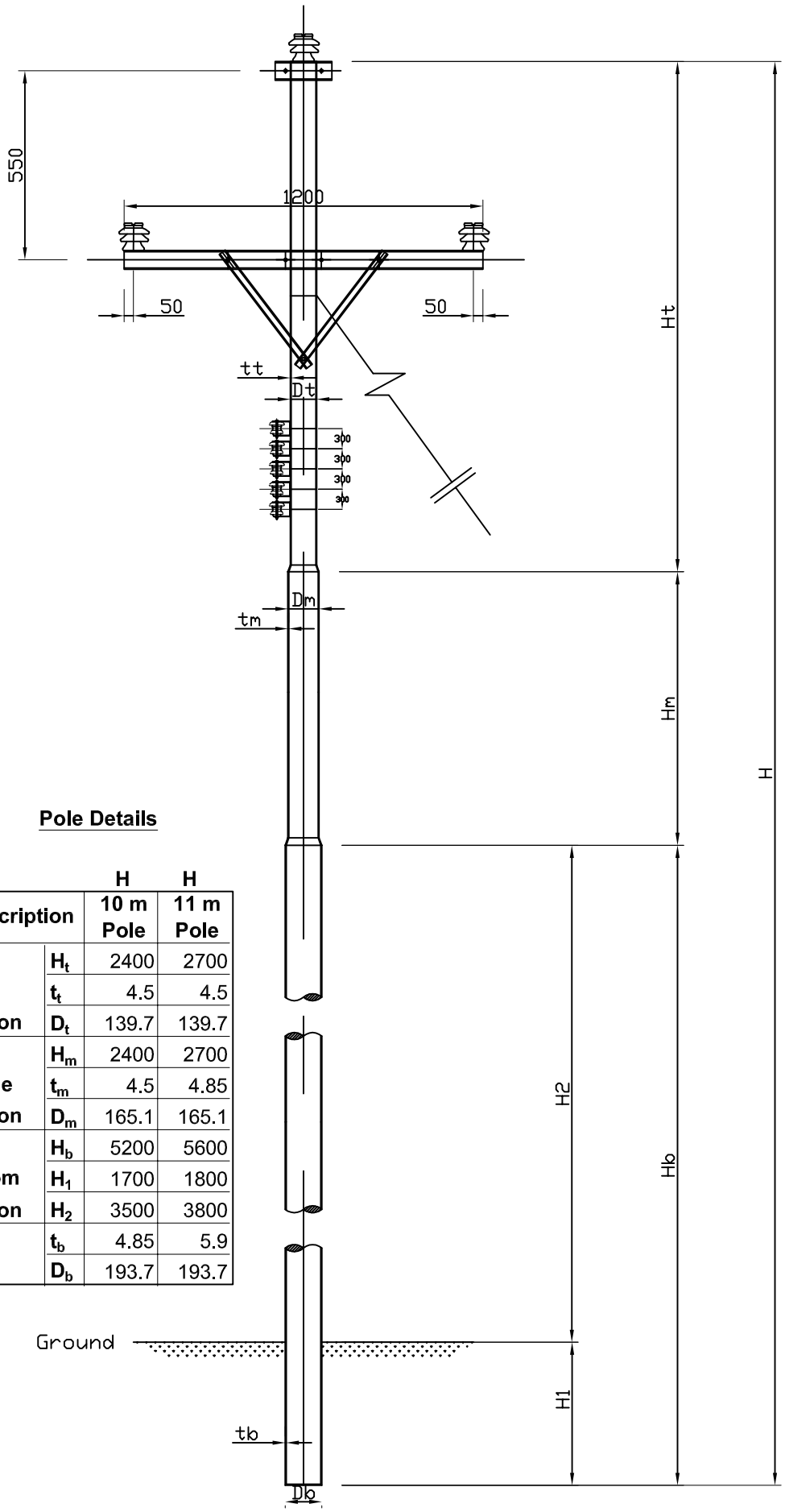
CONSTRUCTION STANDARDS

11 kV SINGLE ARM STRUCTURE (PLA STEEL TUBULAR POLE , LOW ANGLE 8^0 TO 15^0

NEPAL ELECTRICITY AUTHORITY

Technical Service/ Commercial Department

Distribution and Consumer Services



Pole Details

Description		H 10 m Pole	H 11 m Pole
Top Section	H_t	2400	2700
	t_t	4.5	4.5
	D_t	139.7	139.7
Middle Section	H_m	2400	2700
	t_m	4.5	4.85
	D_m	165.1	165.1
Bottom Section	H_b	5200	5600
	H_1	1700	1800
	H_2	3500	3800
	t_b	4.85	5.9
	D_b	193.7	193.7

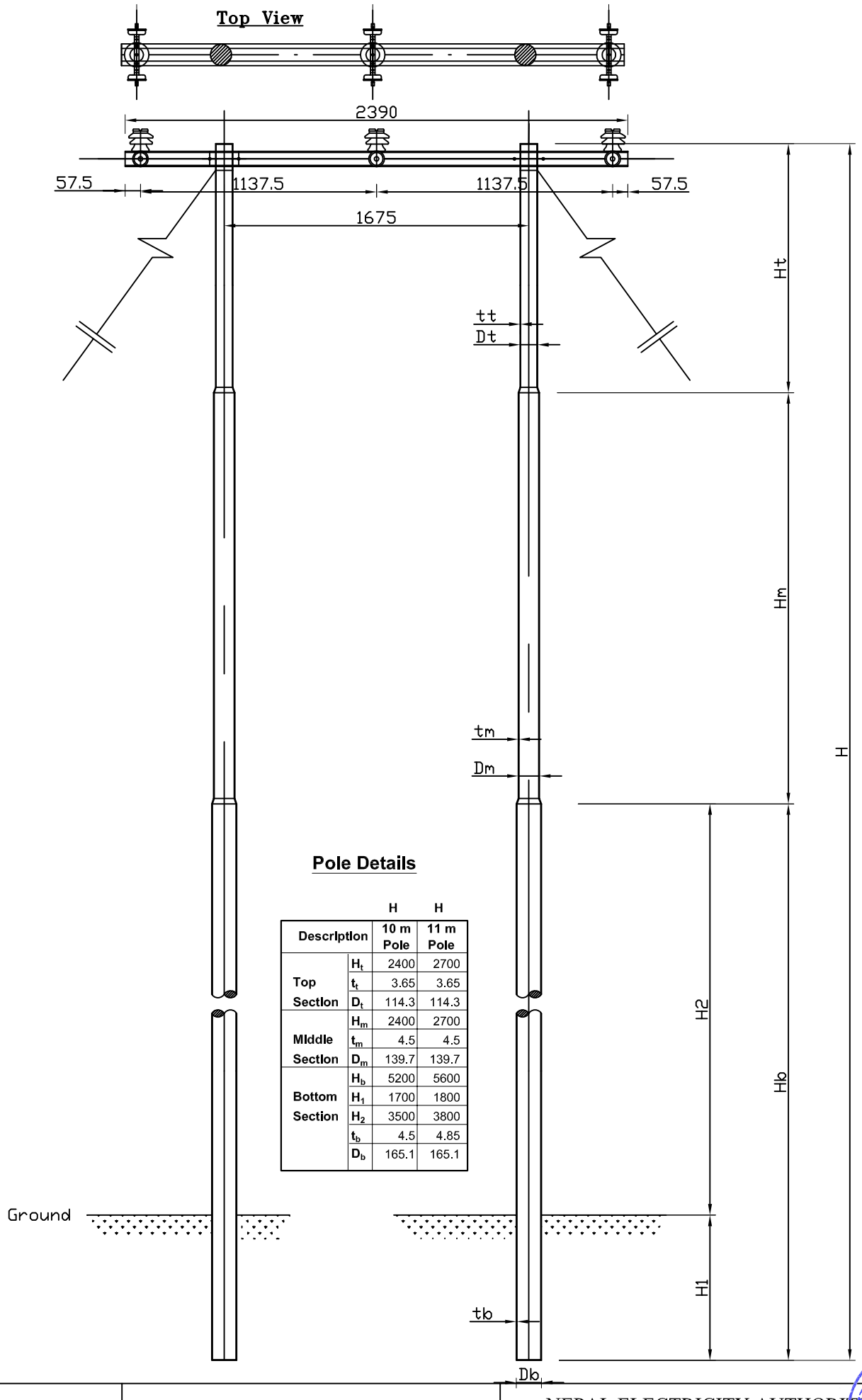
Drawing	11kV, 10/11 m ST Pole	NEPAL ELECTRICITY AUTHORITY
CS11-STP-02	**Low Angle (8 - 15 deg)**	**Technical Services / Commercial Department**
		Distribution and Consumer Services

Refer Drawing No: CS11-STP- 03

S.No.	QTY.	UNIT	MATERIAL
1	3	NOS	PIN INSULATOR
2	3	NOS	INSULATOR PIN
3	3	NOS	PREFORM PIN TIES (TOP TIES)
4	6	SET	DISC INSULATOR
5	6	SET	BRACK STRAP
6	6	SET	TENSION SET WITH BALL AND SOCKET EYE
7	6	SET	PG CLAMP
8	2	NOS	STEEL CROSSARM CHANNEL (100x 50x 6.4 x 2390) mm.
9	6	NOS	STRAP FOR INSULATOR STRING (50 x 6 x 396) mm
10	12	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (12 x51) mm
11	4	SET	DOUBLE ARMING BOLTS WITH SUITABLE NUTS AND WASHERS (16 x305) mm
12	1	LOT	HT STAY SET (AS REQUIRED)
13	2	NOS	POLE STEEL TUBULAR 10 m /11m

CONSTRUCTION STANDARDS
11 kV H- STRUCTURE (PMA)
STEEL TUBULAR POLE, 16^0 TO 30^0

NEPAL ELECTRICITY AUTHORITY
Technical Service/ Commercial Department
Distribution and Consumer Services



Pole Details

Description		H 10 m Pole	H 11 m Pole
Top Section	H_t	2400	2700
	t_t	3.65	3.65
	D_t	114.3	114.3
Middle Section	H_m	2400	2700
	t_m	4.5	4.5
	D_m	139.7	139.7
Bottom Section	H_b	5200	5600
	H_1	1700	1800
	H_2	3500	3800
	t_b	4.5	4.85
	D_b	165.1	165.1

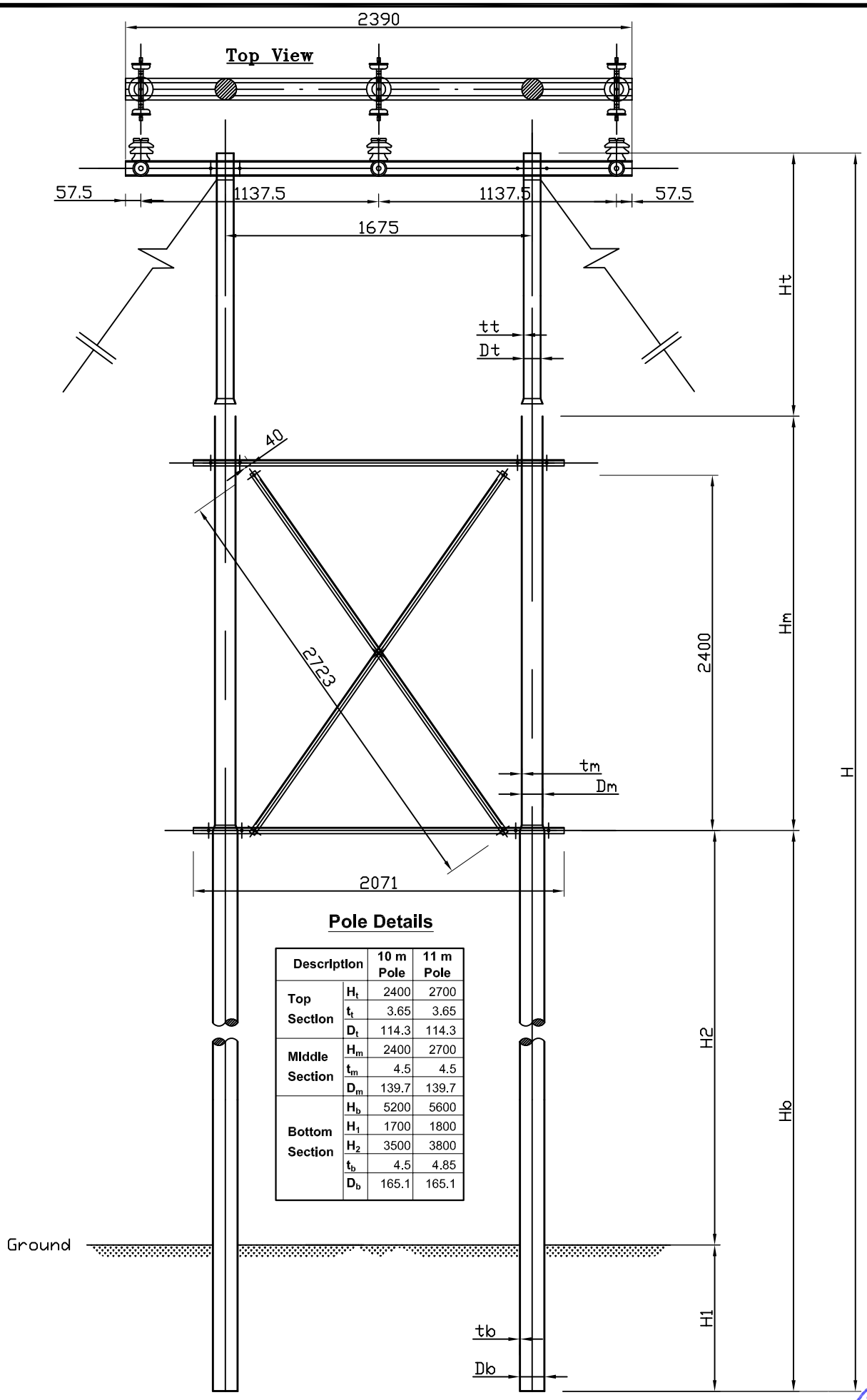
Drawing	11kV, 10/11 m ST Pole	NEPAL ELECTRICITY AUTHORITY
CS11-STP-03	Medium Angle (16 - 30 deg)	Technical Services / Commercial Department Distribution and Consumer Services

Refer Drawing No: CS11-STP- 04

S.No.	QTY.	UNIT	MATERIAL
1	3	NOS	PIN INSULATOR
2	3	NOS	INSULATOR PIN
3	3	NOS	PREFORM PIN TIES (TOP TIES)
4	6	NOS	DISC INSULATOR
5	6	SET	BRACK STRAP
6	6	SET	TENSION SET WITH BALL AND SOCKET EYE
7	6	NOS	PG CLAMP
8	2	NOS	STEEL CROSSARM CHANNEL (100x 50x 6.4 x 2390) mm.
9	2	NOS	BRACING ANGLE (40 x 40 x 5 x 2071) mm.
10	2	NOS	CROSSARM BRACING ANGLE (40 x 40 x 5.0 x 2723) mm
11	17	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (12 x 51) mm
12	2	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS (TC4)
13	2	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS (TC5)
14	4	SET	DOUBLE ARMING BOLTS WITH SUITABLE NUTS AND WASHERS (16 x305) mm
15	6	NOS	STRAP FOR INSULATOR STRING (50 x 6 x 396) mm
16	5	SET	HT STAY SET (TYPE AS REQUIRED)
17	2	NOS	POLE STEEL TUBULAR 10 m /11m

CONSTRUCTION STANDARDS
11 kV H- STRUCTURE
STEEL TUBULAR POLE ABOVE 30^0

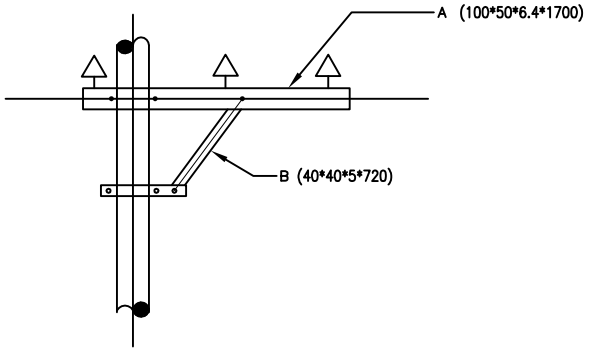
NEPAL ELECTRICITY AUTHORITY
Technical Service/ Commercial Department
Distribution and Consumer Services

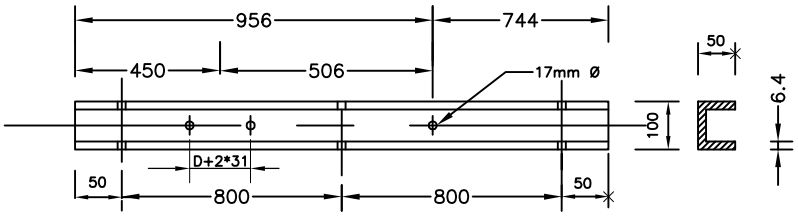


Pole Details

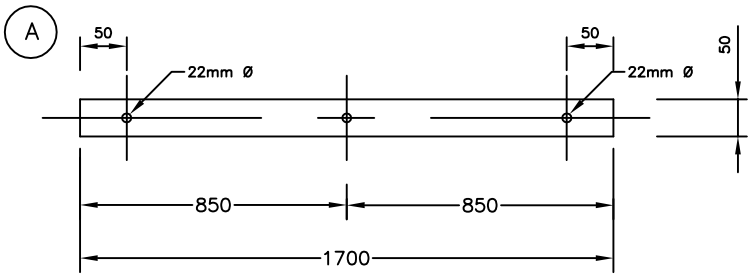
Description		10 m Pole	11 m Pole
Top Section	H_t	2400	2700
	t_t	3.65	3.65
	D_t	114.3	114.3
Middle Section	H_m	2400	2700
	t_m	4.5	4.5
	D_m	139.7	139.7
Bottom Section	H_b	5200	5600
	H_1	1700	1800
	H_2	3500	3800
	t_b	4.5	4.85
	D_b	165.1	165.1

Drawing **CS11-STP-04**	**11kV, 10/11 m ST Pole** **High Angle (Above 30 deg)**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

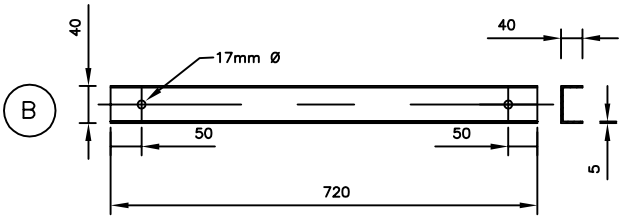




FRONT VIEW



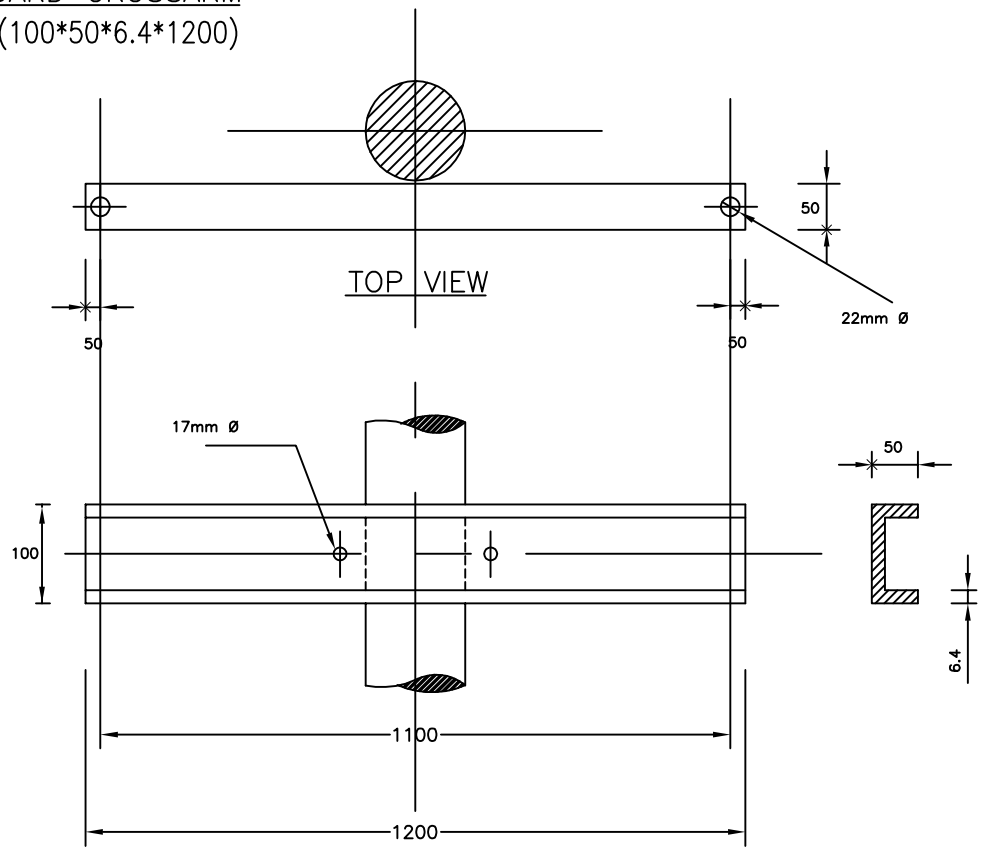
TOP VIEW



LOCATION OF HOLES TO BE CONFIRMED PRIOR TO MANUFACTURE

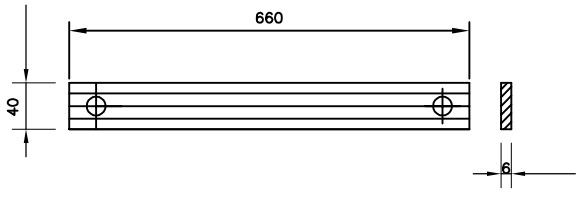
Drawing **CS11-DCKT-01**	**Crossarm & Brace** **11 kV Double Circuit Single Pole Offset Structure (Horizontal)**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

A) STANDARD CROSSARM
(100*50*6.4*1200)



FRONT VIEW

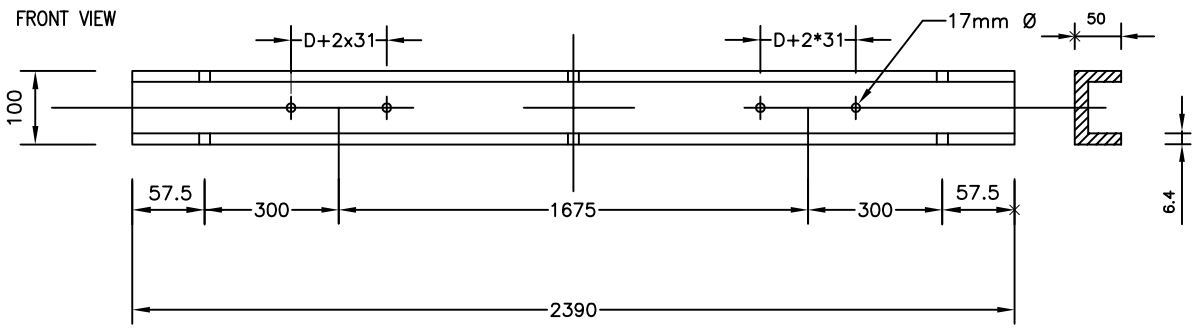
B) FLAT CROSSARM BRACE
(40*6*660)

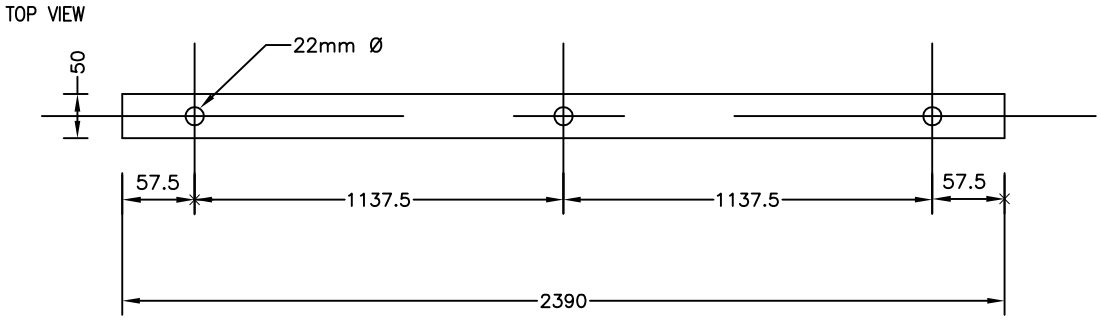


LOCATION OF HOLES TO BE CONFIRMED PRIOR TO MANUFACTURE

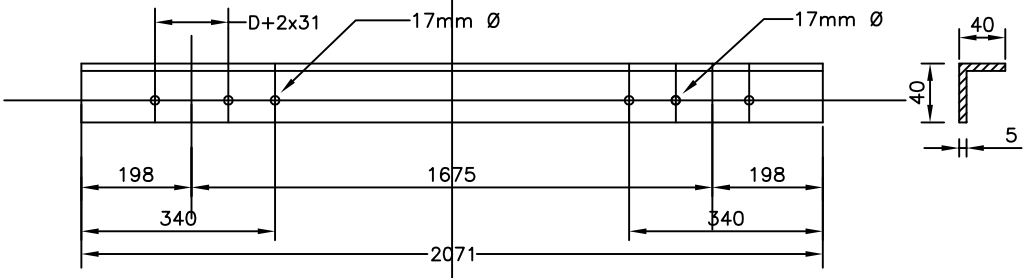
Drawing **CS11-DCKT-02**	**Crossarm & Brace** **11 kV Double Circuit Single Pole** **(Vertical Configuration)**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

CROSSARM CHANNEL (100*50*6.4*2390 MM)

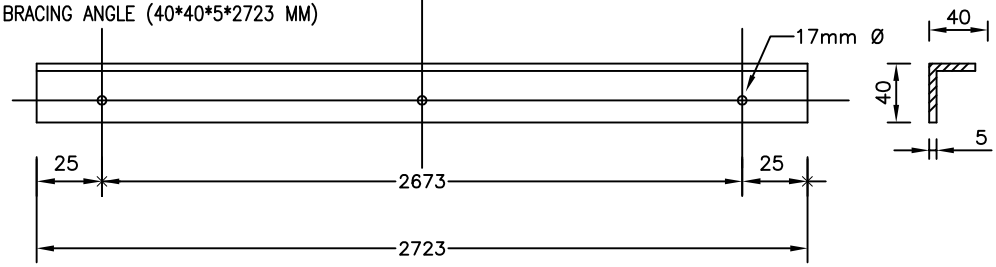




BRACING ANGLE (40*40*5*2071 MM)



CROSS BRACING ANGLE (40*40*5*2723 MM)

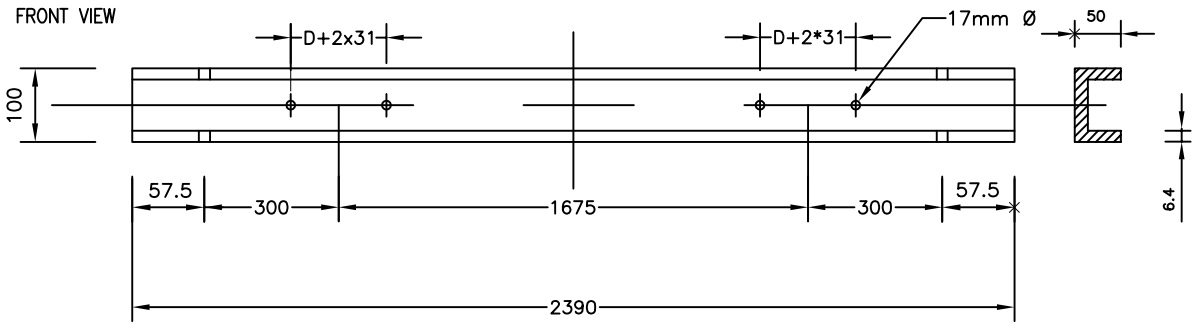


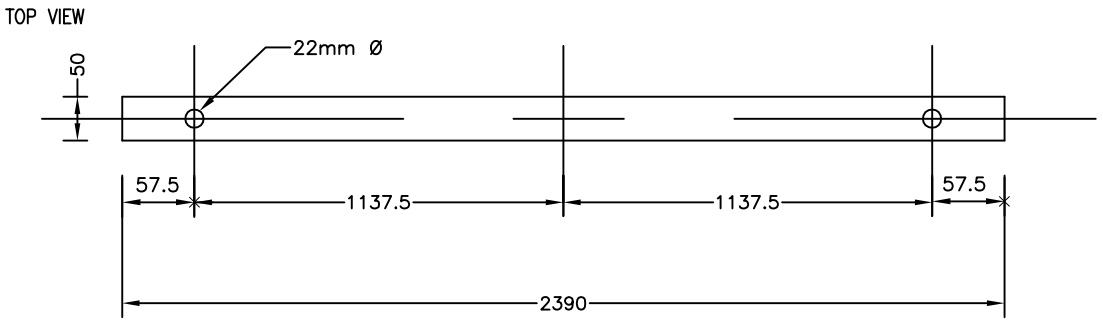
LOCATION OF HOLES TO BE CONFIRMED PRIOR TO MANUFACTURE

D = DIAMETER OF THE POLE

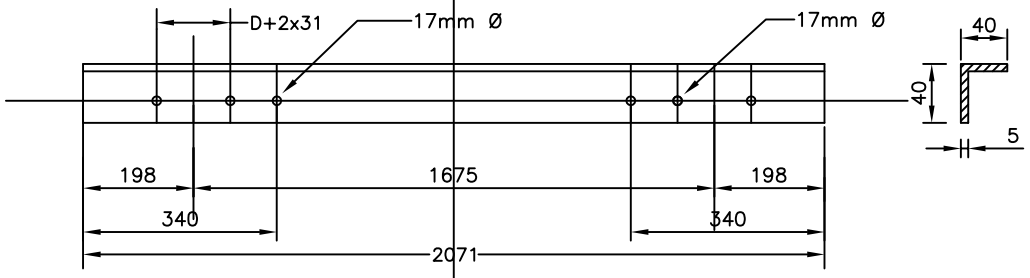
Drawing	Crossarm & Brace	NEPAL ELECTRICITY AUTHORITY
CS11-DCKT-03	**11 kV Double Circuit Double Pole (Horizontal Configuration)**	**Technical Services / Commercial Department** Distribution and Consumer Services

CROSSARM CHANNEL (100*50*6.4*2390 MM)

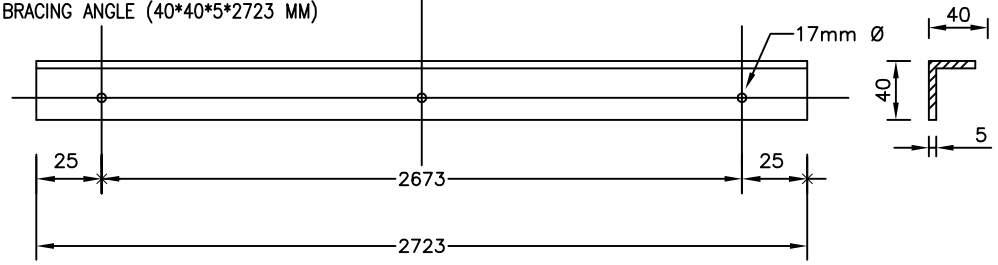




BRACING ANGLE (40*40*5*2071 MM)



CROSS BRACING ANGLE (40*40*5*2723 MM)



LOCATION OF HOLES TO BE CONFIRMED PRIOR TO MANUFACTURE

D = DIAMETER OF THE POLE

Drawing **CS11-DCKT-04**	**Crossarm & Brace** **11 kV Double Circuit Double Pole** **(Vertical Configuration)**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

Refer Drawing No: CS11-DCKT- 05

S.No.	QTY.	UNIT	MATERIAL
1	6	NOS	PIN INSULATOR
2	6	NOS	INSULATOR PIN
3	6	NOS	PREFORM PIN TIES (TOP TIES)
4	4	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS (TC1)
5	2	NOS	STEEL CROSSARM CHANNEL (100x 50x6.4x1700) mm.
6	4	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS (TC2)
7	2	NOS	FLAT CROSSARM BRACE(40x 5.0x720) mm
8	10	SET	BOLTS WITH SUITABLE NUTS AND WASHERS AS REQUIRED
9	1	NOS	POLE TELESCOPIC/TUBULAR 11m

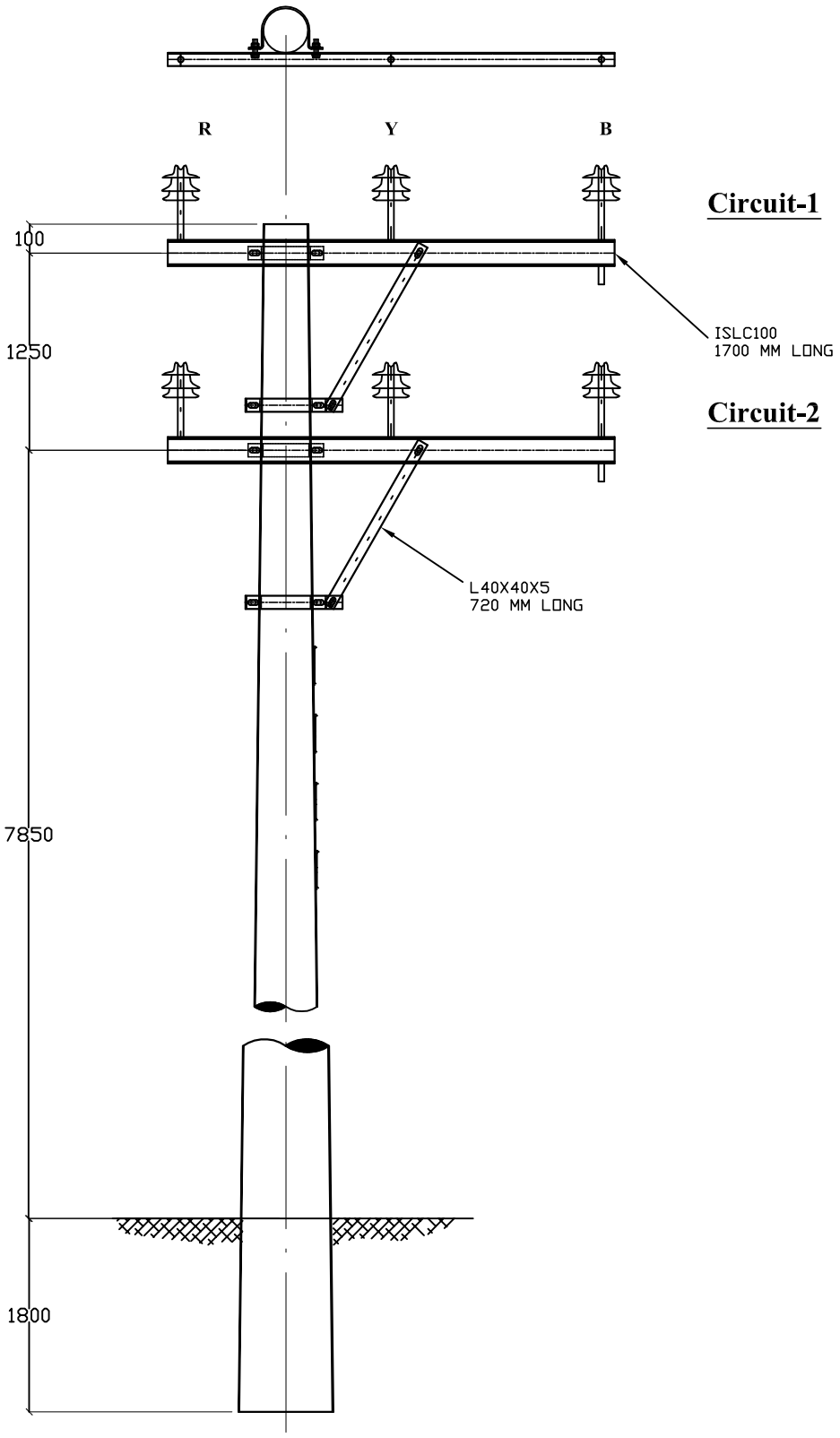
CONSTRUCTION STANDARDS

11 kV DOUBLE ARM STRUCTURE FOR DOUBLE CIRCUIT TELESCOPIC /TUBULAR POLE(STRAIGHT TYPE)

NEPAL ELECTRICITY AUTHORITY

Technical Service/ Commercial Department
Distribution and Consumer Services

TOP VIEW



ALL DIMENSIONS ARE IN MM

Drawing	11kV, 11 m Single Pole	NEPAL ELECTRICITY AUTHORITY
CS11-DCKT-05	**Double Circuit Horizontal**	**Technical Services / Commercial Department**
	(Straight Type)	Distribution and Consumer Services

Refer Drawing No: CS11-DCKT- 06

S.No.	QTY.	UNIT	MATERIAL
1	12	NOS	PIN INSULATOR
2	12	NOS	INSULATOR PIN
3	12	NOS	PREFORM PIN TIES (TOP TIES)
4	4	NOS	STEEL CROSSARM CHANNEL (100x 50x6.4x1700) mm.
5	2	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS
6	4	NOS	FLAT CROSSARM BRACE(40x 5.0x720) mm
7	6	SET	BOLTS WITH SUITABLE NUTS AND WASHERS AS REQUIRED
8	1	LOT	HT STAY SET (AS REQUIRED)
9	1	NOS	POLE TELESCOPIC/TUBULAR 11m

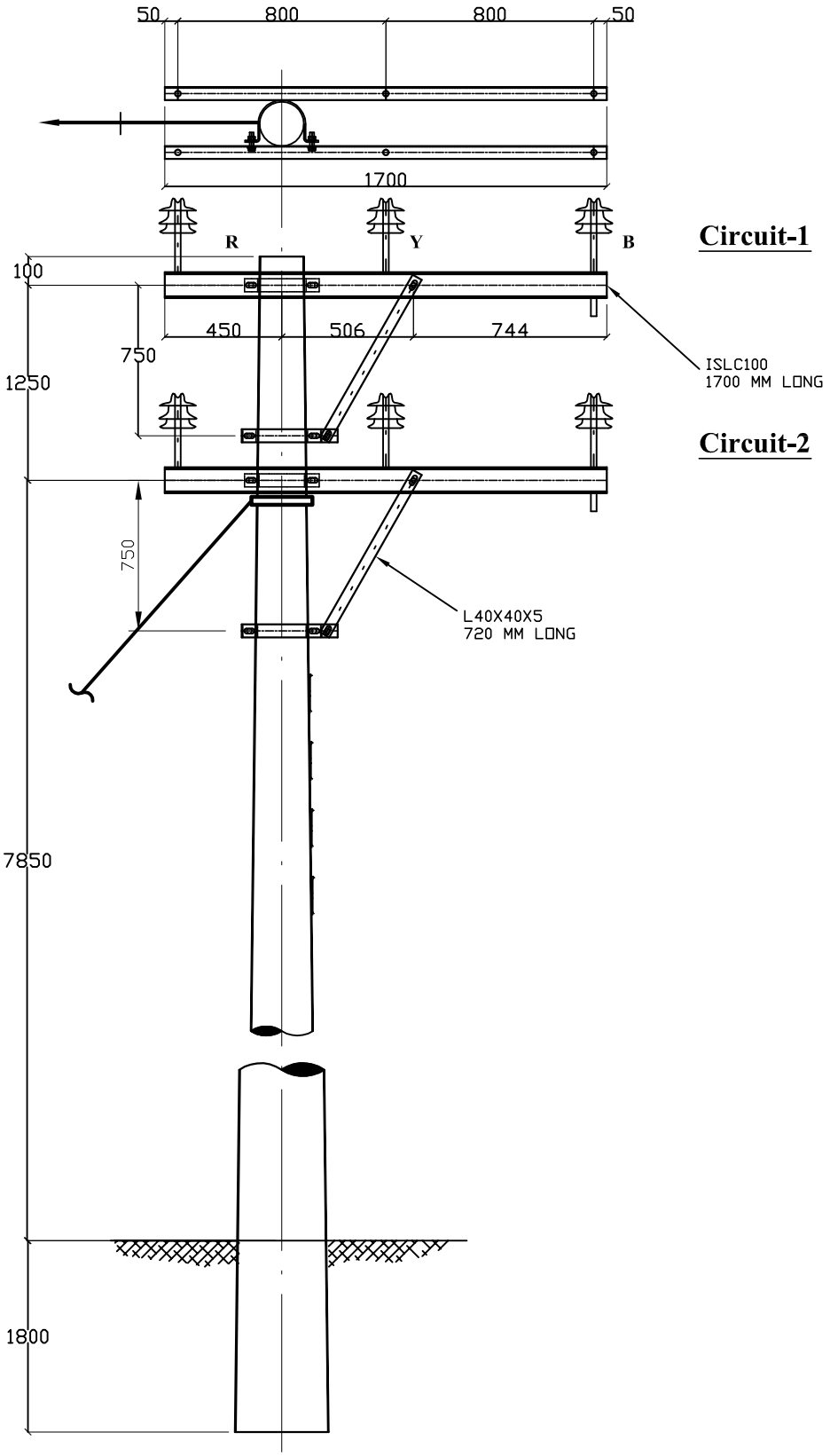
CONSTRUCTION STANDARDS

11 kV DOUBLE ARM STRUCTURE FOR DOUBLE CIRCUIT TELESCOPIC /TUBULAR POLE (ANGLE)

NEPAL ELECTRICITY AUTHORITY

Technical Service/ Commercial Department
Distribution and Consumer Services

TOP VIEW



ALL DIMENSIONS ARE IN MM

Drawing **CS11-DCKT-06**	**11kV, 11 m Single Pole** **Double Circuit Horizontal** **(Angle Type)**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

Refer Drawing No: CS11-DCKT- 07

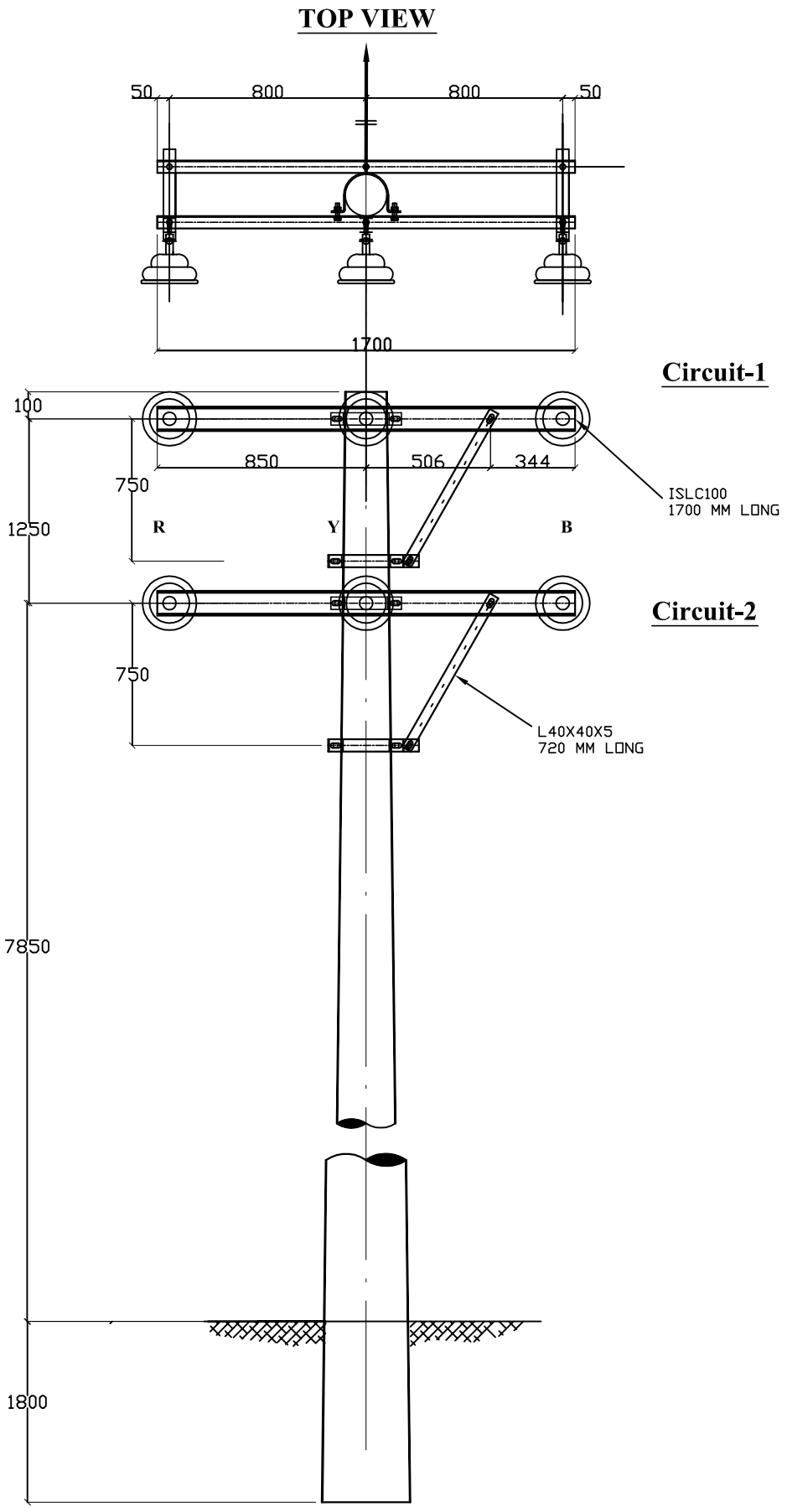
S.No.	QTY.	UNIT	MATERIAL
1	6	NOS	DISC INSULATOR
2	6	SET	BRACK STRAP
3	6	SET	TENSION SET WITH BALL AND SOCKET EYE
4	4	NOS	STEEL CROSSARM CHANNEL (100x 50x6.4x1700) mm.
5	2	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS
6	4	NOS	FLAT CROSSARM BRACE (40x 5.0x720) mm
7	6	SET	BOLTS WITH SUITABLE NUTS AND WASHERS AS REQUIRED
8	1	LOT	HT STAY SET (AS REQUIRED)
9	1	NOS	POLE TELESCOPIC/TUBULAR 11m

CONSTRUCTION STANDARDS

11 kV DOUBLE ARM STRUCTURE FOR DOUBLE CIRCUIT TELESCOPIC /TUBULAR POLE (DEAD END)

NEPAL ELECTRICITY AUTHORITY

Technical Service/ Commercial Department
Distribution and Consumer Services



ALL DIMENSIONS ARE IN MM

Drawing	11kV, 11 m Single Pole	NEPAL ELECTRICITY AUTHORITY
CS11-DCKT-07	Double Circuit Horizontal	Technical Services / Commercial Department
	(Dead End Type)	Distribution and Consumer Services

Refer Drawing No: CS11-DCKT- 08

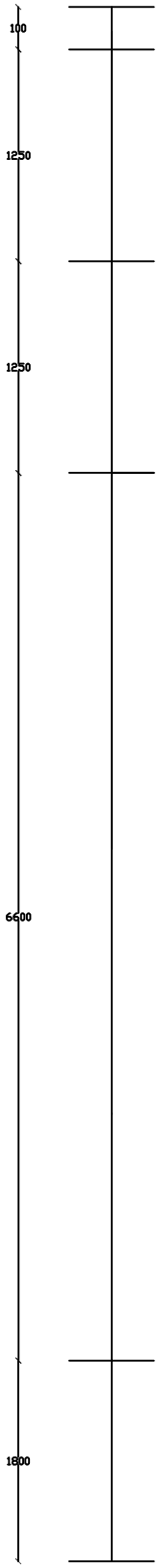
S.No.	QTY.	UNIT	MATERIAL
1	6	NOS	PIN INSULATOR
2	6	NOS	INSULATOR PIN
3	6	NOS	PREFORM PIN TIES (TOP TIES)
4	3	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS (TC1)
5	3	NOS	STEEL CROSSARM CHANNEL (100x 50x6.4x1200) mm.
6	3	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS (TC2)
7	6	NOS	FLAT CROSSARM BRACE(40x 6.0x660) mm
8	15	SET	BOLTS WITH SUITABLE NUTS AND WASHERS AS REQUIRED
9	1	NOS	POLE TELESCOPIC/TUBULAR 11m

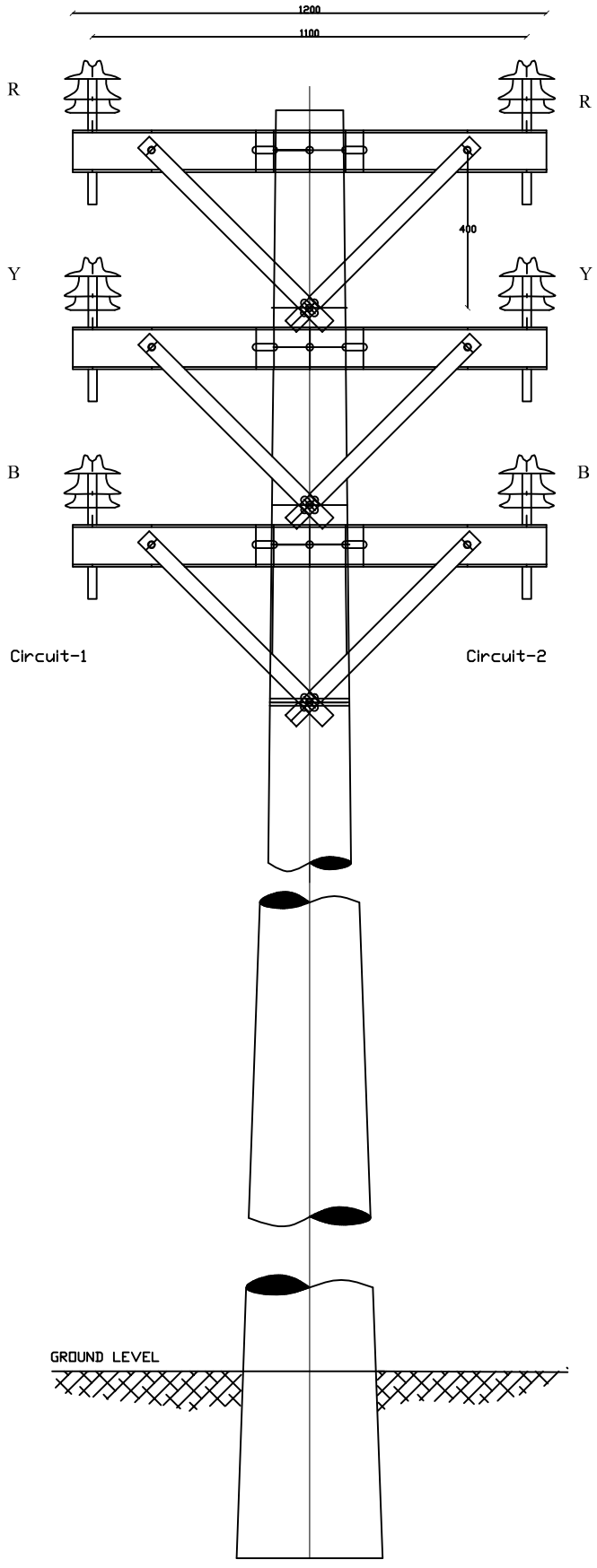
CONSTRUCTION STANDARDS

11 kV SINGLE POLE DOUBLE CIRCUIT (VERTICALLY) TELESCOPIC/TUBULAR POLE (STRAIGHT)

NEPAL ELECTRICITY AUTHORITY

Technical Service/ Commercial Department
Distribution and Consumer Services





Drawing **CS11-DCKT-08**	**11 kV, 11 m Single Pole Double Circuit (Vertical) Straight Type**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

Refer Drawing No: CS11-DCKT- 09

S.No.	QTY.	UNIT	MATERIAL
1	6	NOS	PIN INSULATOR
2	6	NOS	INSULATOR PIN
3	6	NOS	PREFORM PIN TIES (TOP TIES)
4	3	NOS	STEEL CROSSARM CHANNEL (100x 50x6.4x1200) mm.
5	6	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS
6	3	NOS	FLAT CROSSARM BRACE(40x 6.0x660) mm
7	15	SET	BOLTS WITH SUITABLE NUTS AND WASHERS AS REQUIRED
8	1	LOT	HT STAY SET (AS REQUIRED)
9	1	NOS	POLE TELESCOPIC/TUBULAR 11m

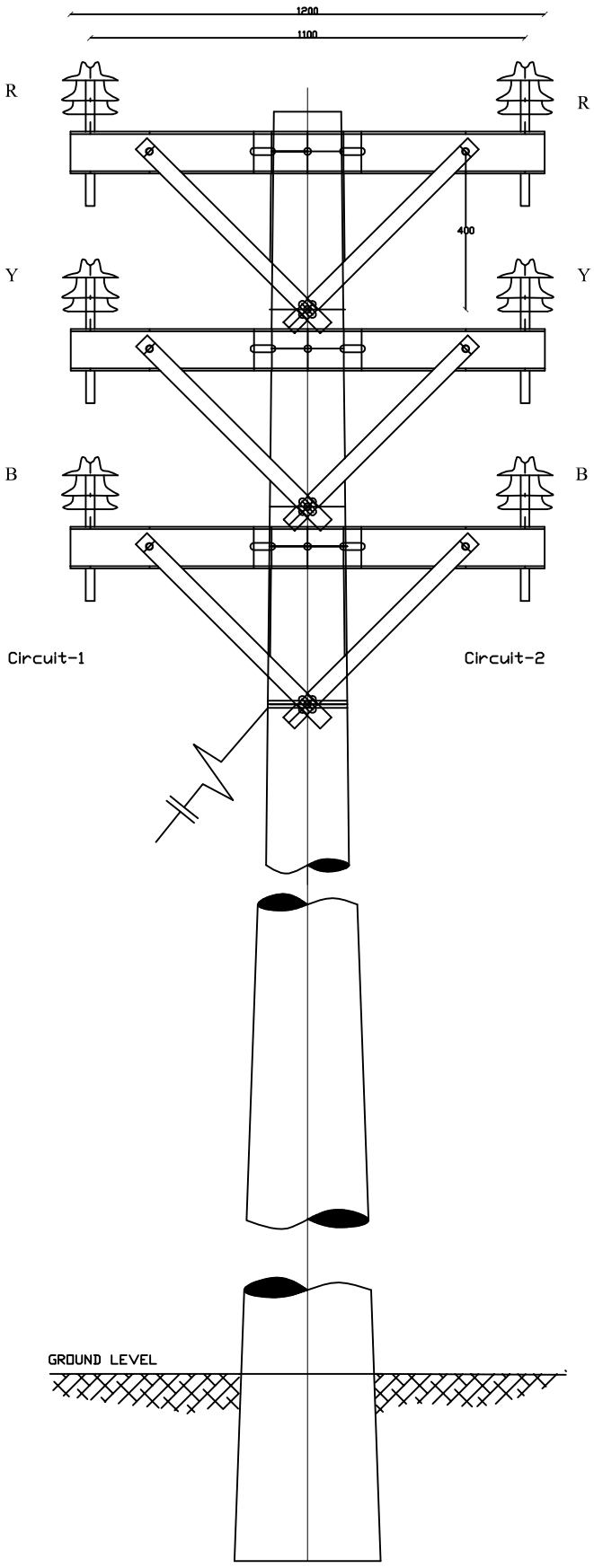
CONSTRUCTION STANDARDS

11 kV SINGLE POLE DOUBLE CIRCUIT (VERTICALLY)
TELESCOPIC /TUBULAR POLE (ANGLE)

NEPAL ELECTRICITY AUTHORITY

Technical Service/ Commercial Department
Distribution and Consumer Services





Drawing **CS11-DCKT-09**	**11 kV, 11 m Single Pole** **Double Circuit (Vertical)** **Angle Type**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

Refer Drawing No: CS11-DCKT- 10

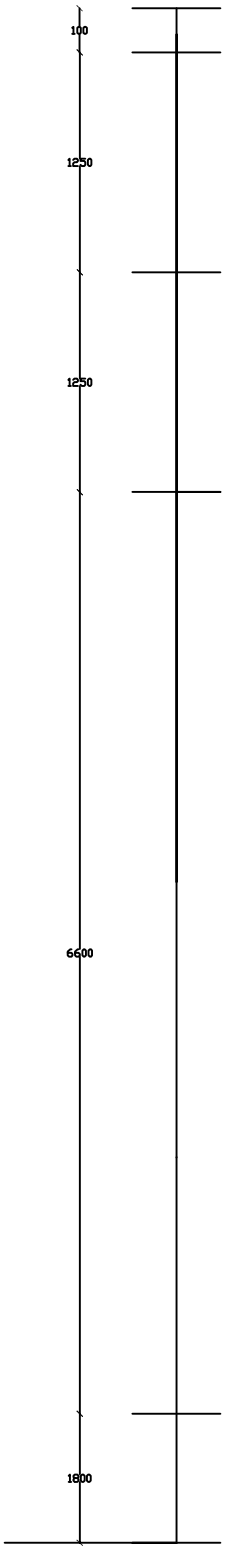
S.No.	QTY.	UNIT	MATERIAL
1	6	NOS	DISC INSULATOR
2	6	SET	BRACK STRAP
3	6	SET	TENSION SET WITH BALL AND SOCKET EYE
4	3	NOS	STEEL CROSSARM CHANNEL (100x 50x6.4x1200) mm.
5	4	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS
6	6	NOS	FLAT CROSSARM BRACE (40x 6.0x660) mm
7	17	SET	BOLTS WITH SUITABLE NUTS AND WASHERS AS REQUIRED
8	1	LOT	HT STAY SET (AS REQUIRED)
9	1	NOS	POLE TELESCOPIC/TUBULAR 11m

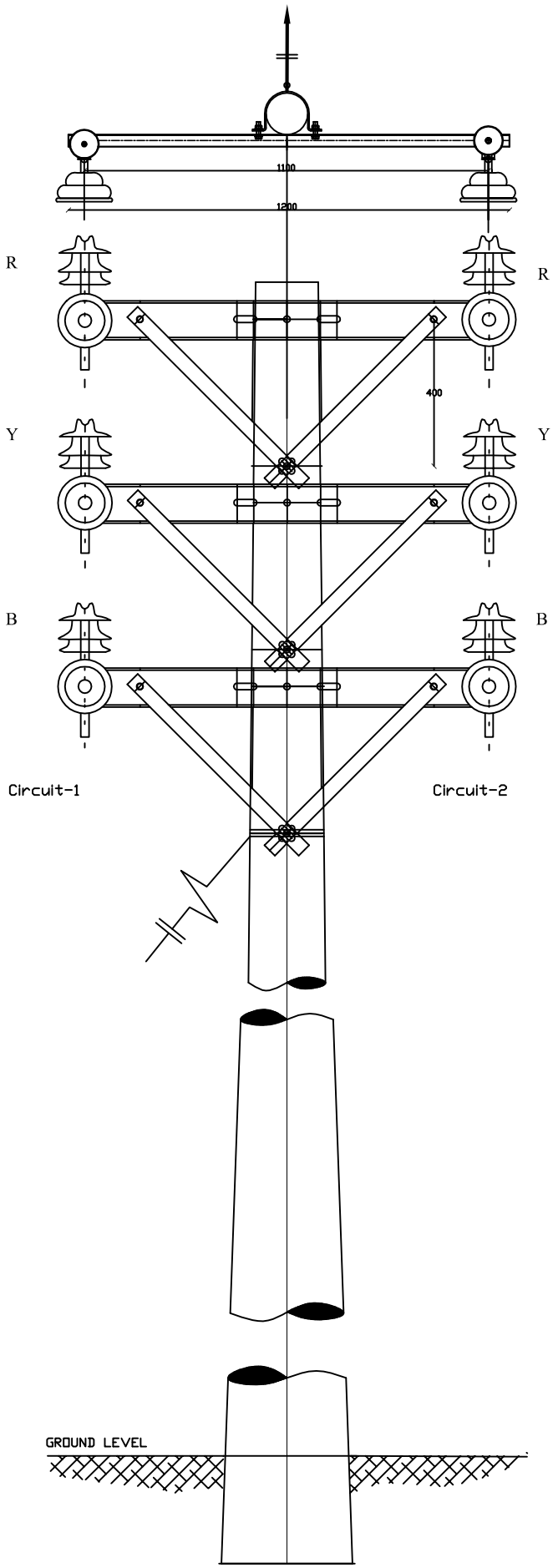
CONSTRUCTION STANDARDS

11 kV SINGLE POLE DOUBLE CIRCUIT (VERTICALLY)
TELESCOPIC /TUBULAR POLE (DEAD END)

NEPAL ELECTRICITY AUTHORITY

Technical Service/ Commercial Department
Distribution and Consumer Services





Drawing **CS11-DCKT-10**	**11 kV, 11 m Single Pole Double Circuit (Vertical) Dead End Type**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

Refer Drawing No: CS11-DCKT- 11

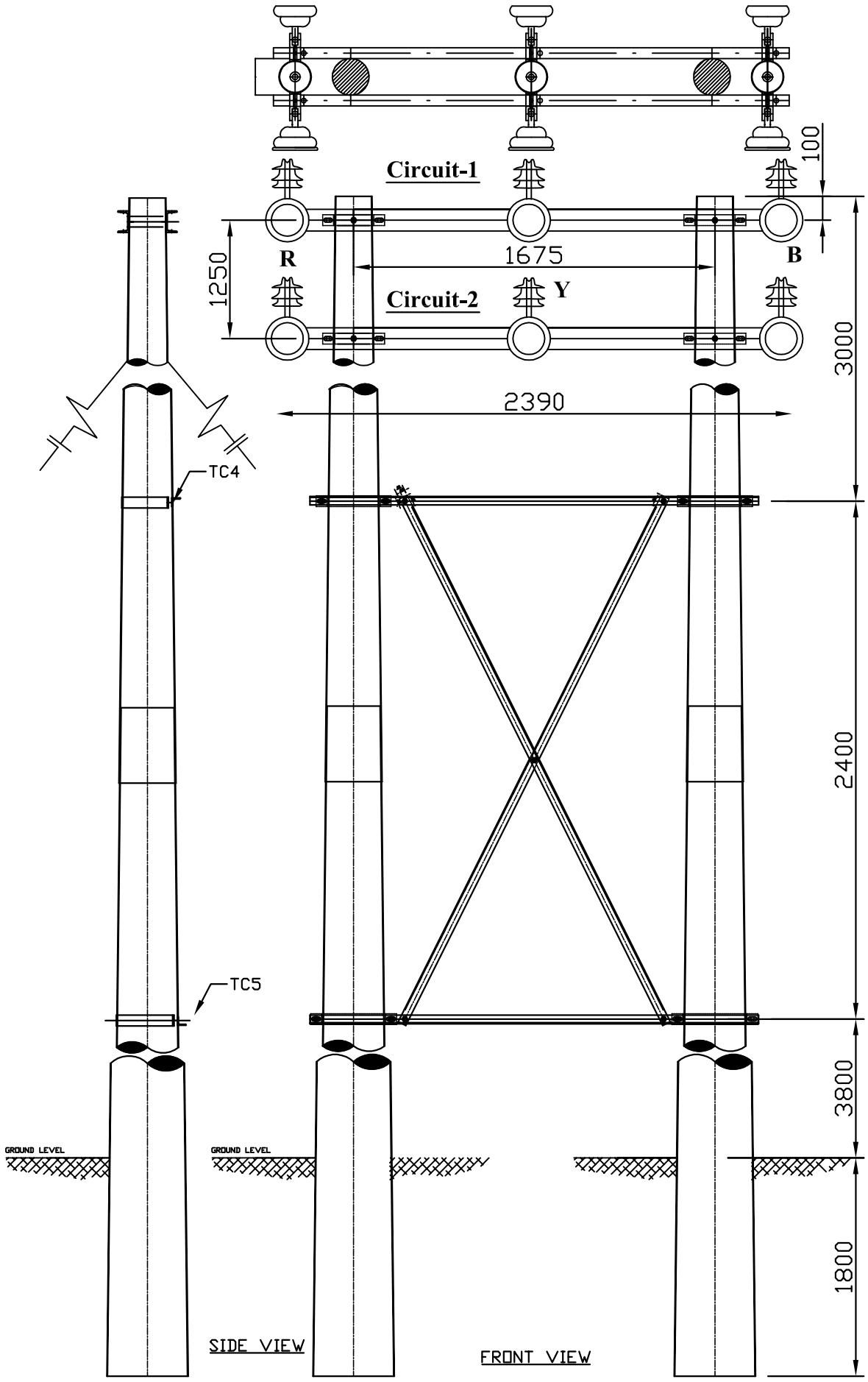
S.No.	QTY.	UNIT	MATERIAL
1	6	NOS	PIN INSULATOR
2	6	NOS	INSULATOR PIN
3	6	NOS	PREFORM PIN TIES (TOP TIES)
4	12	NOS	DISC INSULATOR
5	12	SET	BRACK STRAP
6	12	SET	TENSION SET WITH BALL AND SOCKET EYE
7	12	NOS	PG CLAMP
8	4	NOS	STEEL CROSSARM CHANNEL (100x 50x 6.4 x 2390) mm.
9	2	NOS	BRACING ANGLE (40 x 40 x 5 x 2071) mm.
10	2	NOS	CROSSARM BRACING ANGLE (40 x 40 x 5.0 x 2723) mm
11	17	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (12 x 51) mm
12	2	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS (TC4)
13	2	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS (TC5)
14	8	SET	DOUBLE ARMING BOLTS WITH SUITABLE NUTS AND WASHERS (16 x305) mm
15	12	NOS	STRAP FOR INSULATOR STRING (50 x 6 x 396) mm
16	5	SET	HT STAY SET (TYPE AS REQUIRED)
17	2	NOS	POLE TELESCOPIC/TUBULAR 11m

CONSTRUCTION STANDARDS

11 kV DOUBLE ARM STRUCTURE FOR DOUBLE CIRCUIT TELESCOPIC /TUBULAR POLE TELESCOPIC POLE (H-STRUCTURE)

NEPAL ELECTRICITY AUTHORITY

Technical Service/ Commercial Department
Distribution and Consumer Services



Drawing **CS11-DCKT-11**	**11kV, 11 m Double Pole Double Circuit (Horizontal)**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

Refer Drawing No: CS11-DCKT- 12

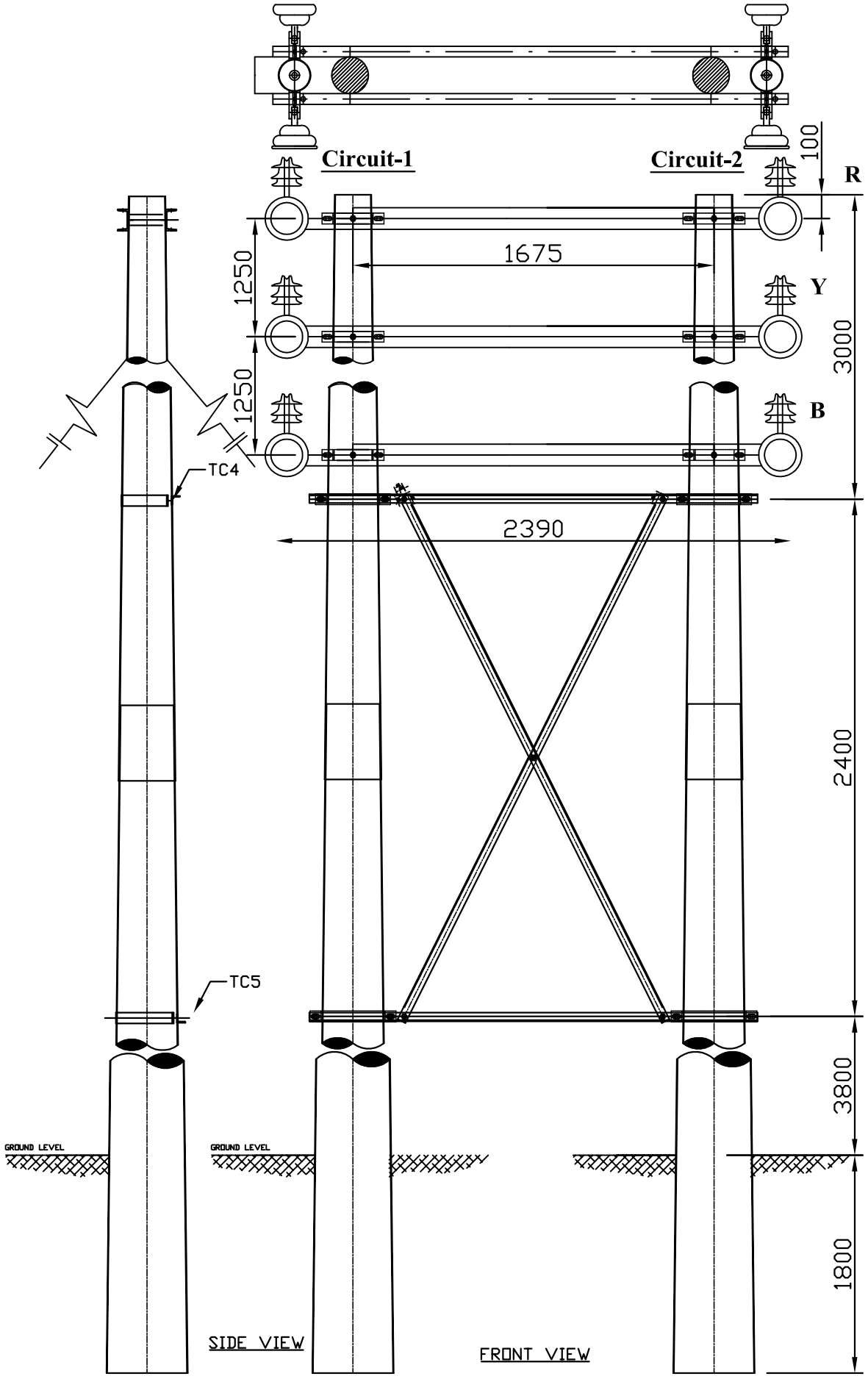
S.No.	QTY.	UNIT	MATERIAL
1	6	NOS	PIN INSULATOR
2	6	NOS	INSULATOR PIN
3	6	NOS	PREFORM PIN TIES (TOP TIES)
4	12	NOS	DISC INSULATOR
5	12	SET	BRACK STRAP
6	12	SET	TENSION SET WITH BALL AND SOCKET EYE
7	12	NOS	PG CLAMP
8	6	NOS	STEEL CROSSARM CHANNEL (100x 50x 6.4 x 2390) mm.
9	2	NOS	BRACING ANGLE (40 x 40 x 5 x 2071) mm.
10	2	NOS	CROSSARM BRACING ANGLE (40 x 40 x 5.0 x 2723) mm
11	17	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (12 x 51) mm
12	2	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS (TC4)
13	2	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS (TC5)
14	12	SET	DOUBLE ARMING BOLTS WITH SUITABLE NUTS AND WASHERS (16 x305) mm
15	12	NOS	STRAP FOR INSULATOR STRING (50 x 6 x 396) mm
16	5	SET	HT STAY SET (TYPE AS REQUIRED)
17	2	NOS	POLE TELESCOPIC/TUBULAR 11m

CONSTRUCTION STANDARDS

11 kV DOUBLE POLE DOUBLE CIRCUIT (VERTICALLY) TELESCOPIC/ TUBULARPOLE (H-STRUCTURE)

NEPAL ELECTRICITY AUTHORITY

Technical Service/ Commercial Department
Distribution and Consumer Services



Drawing **CS11-DCKT-12**	**11kV, 11 m Double Pole** **Double Circuit (Vertical)**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

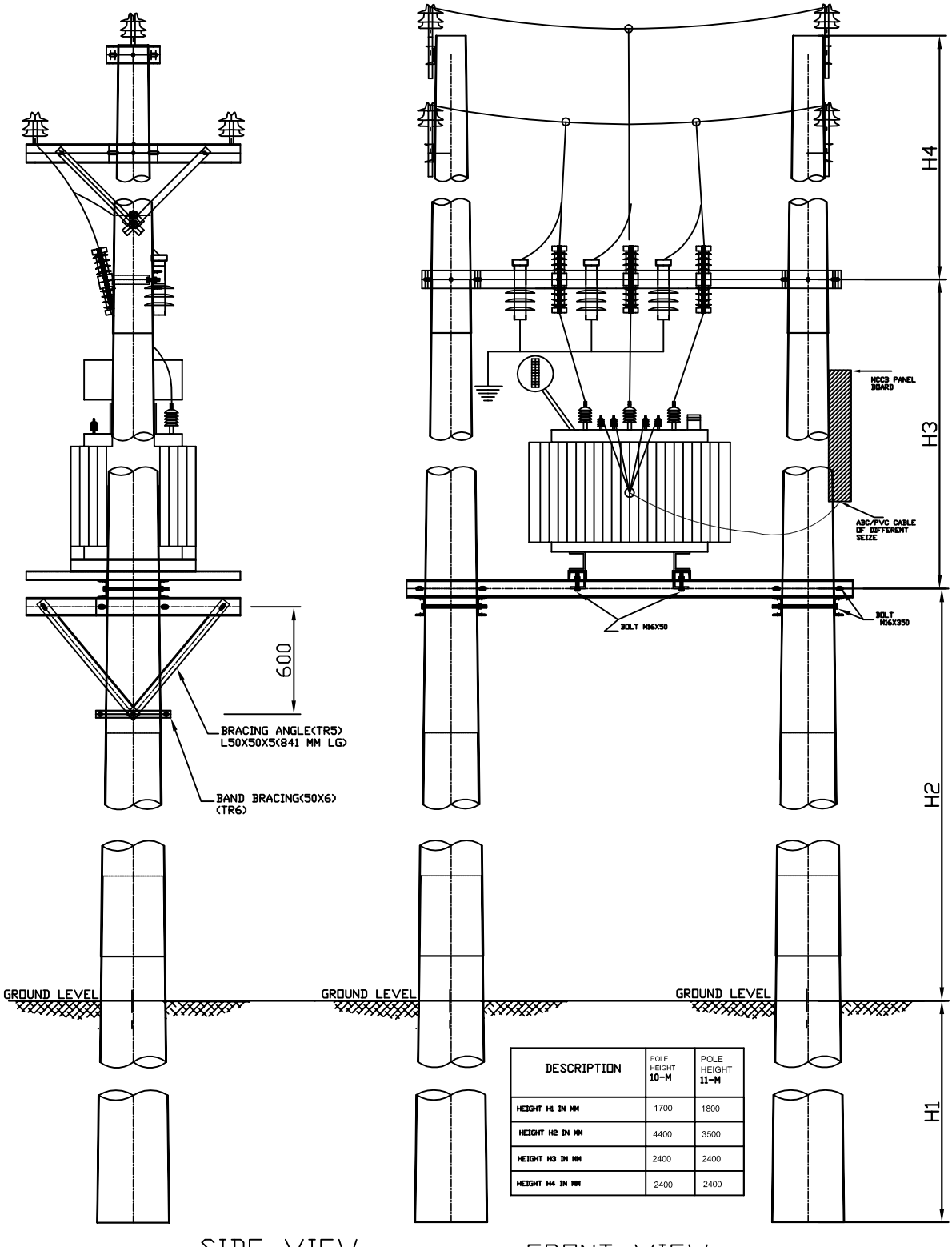
Refer Drawing No: CS 11 -TRN-01 AND 03

S.No.	QTY.	UNIT	MATERIAL
1	6	NOS	PIN INSULATOR WITH PIN AND NUTS/WASHER
2	2	NOS	STEEL CROSSARM CHANNEL (100 x 50 x 6.4 x300) mm.
3	2	NOS	STEEL CROSSARM CHANNEL (100 x 50 x 6.4 x 1200) mm.
4	1	NO	STEEL CROSSARM CHANNEL FOR DO / LA (100 x 50 x 6.4 x2348) mm.
5	1	SET	TRANSFORMER PLATFORM (REFER CS LV-)
6	3	NOS	9 kV SURGE ARRESTOR WITH FITTING ARRANGMENTS
7	3	NOS	11 kV DISTRIBUTION CUTOUT WITH SUITABLE FUSE HOLDERS
8	2	SET	POLE CLAMP WITH NUTS AND BOLTS (TC1)
9	2	SET	POLE CLAMP WITH NUTS AND BOLTS (TC2)
10	2	SET	POLE CLAMP WITH NUTS AND BOLTS (TC7)
11	4	NOS	FLAT CROSS ARM(40 x 6 x 660) mm
12	4	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (12 x 51) mm
13	2	SET	EARTHING SET (WITH GROUND RODS AND ACCESSORIES)
14	1	SET	LV CONNECTOR TYPE AS REQUIRED
15	1	SET	MCCB WITH PANEL BOARD
16	6	SET	PREFORM ED PIN INSULATORS
17	18	M	ABC OR PVC CABLE OF REQUIRED RATING
18	10	M	ACSR CONDUCTOR
19	3	SET	PG CLAMP
20	2	NOS	TELESCOPIC POLE/ PSC POLE

CONSTRUCTION STANDARDS
11/0.4 kV TRANSFORMER STRUCTURE
TELESCOPIC/PSC POLE (INTERMEDIATE)

NEPAL ELECTRICITY AUTHORITY
Technical Service/ Commercial Department

Distribution and Consumer Services



DESCRIPTION	POLE HEIGHT 10-M	POLE HEIGHT 11-M
HEIGHT H1 IN MM	1700	1800
HEIGHT H2 IN MM	4400	3500
HEIGHT H3 IN MM	2400	2400
HEIGHT H4 IN MM	2400	2400

SIDE VIEW

FRONT VIEW

Drawing **CS11-TRN-01**	**10/11 m STT Pole** **11/0.4 Intermediate** **Transformer Structure**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

Refer Drawing No: CS 11 -TRN-02 AND 04

S.No.	QTY.	UNIT	MATERIAL
1	6	NOS	PIN INSULATOR WITH PIN AND NUTS/WASHER
2	2	NOS	STEEL CROSSARM CHANNEL (100 x 50 x 6.4 x300) mm.
3	2	NOS	STEEL CROSSARM CHANNEL (100 x 50 x 6.4 x 1200) mm.
4	1	NO	STEEL CROSSARM CHANNEL FOR DO / LA (100 x 50 x 6.4 x2348) mm.
5	1	SET	TRANSFORMER PLATFORM (REFER CS LV-)
6	3	NOS	9 kV SURGE ARRESTOR WITH FITTING ARRANGMENTS
7	3	NOS	11 kV DISTRIBUTION CUTOUT WITH SUITABLE FUSE HOLDERS
8	2	SET	POLE CLAMP WITH NUTS AND BOLTS (TC1)
9	2	SET	POLE CLAMP WITH NUTS AND BOLTS (TC2)
10	2	SET	POLE CLAMP WITH NUTS AND BOLTS (TC7)
11	4	NOS	FLAT CROSS ARM(40 x 6 x 660) mm
12	4	SET	BOLTS WITH SUITABLE NUTS AND WASHERS (12 x 51) mm
13	2	SET	EARTHING SET (WITH GROUND RODS AND ACCESSORIES)
14	1	SET	LV CONNECTOR TYPE AS REQUIRED
15	1	SET	MCCB WITH PANEL BOARD
16	6	SET	PREFORM ED PIN INSULATORS
17	18	M	ABC OR PVC CABLE OF REQUIRED RATING
18	10	M	ACSR CONDUCTOR
19	6	SET	DISC INSULATOR
20	6	SET	TENSION SET
21	6	SET	BRACK STRAP
20	3	SET	PG CLAMP
21	2	NOS	TELESCOPIC POLE/ PSC POLE

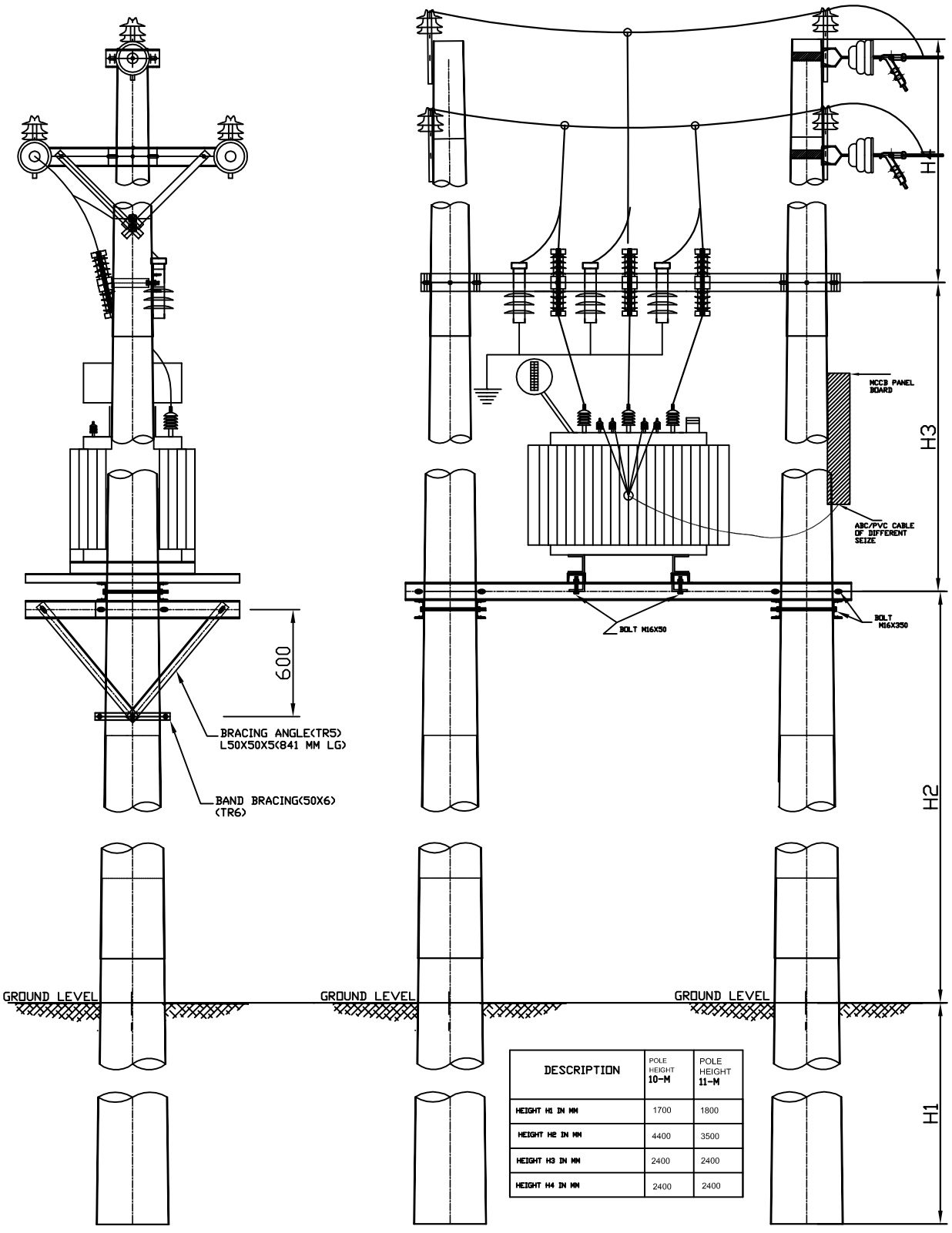
CONSTRUCTION STANDARDS

11/0.4 kV TRANSFORMER STRUCTURE(DEAD END)

TELESCOPIC/PSC POLE

NEPAL ELECTRICITY AUTHORITY
Technical Service/ Commercial Department

Distribution and Consumer Services

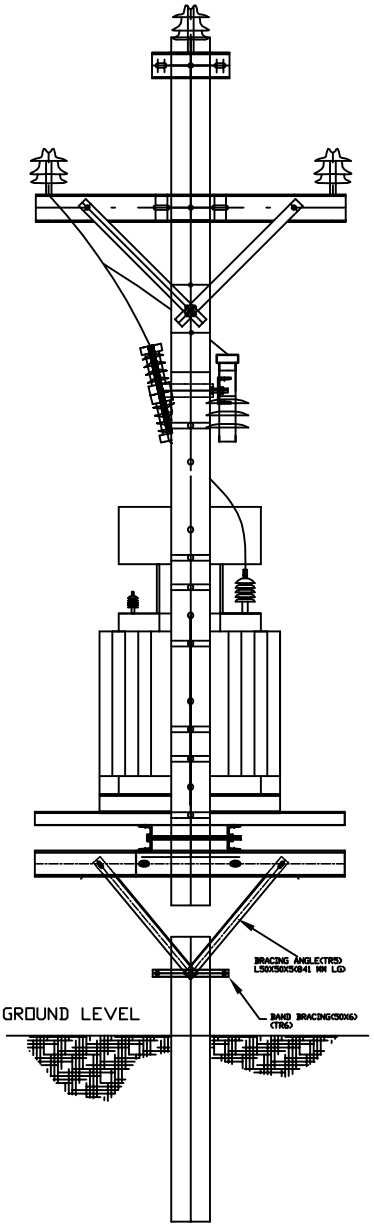


DESCRIPTION	POLE HEIGHT 10-M	POLE HEIGHT 11-M
HEIGHT H1 IN MM	1700	1800
HEIGHT H2 IN MM	4400	3500
HEIGHT H3 IN MM	2400	2400
HEIGHT H4 IN MM	2400	2400

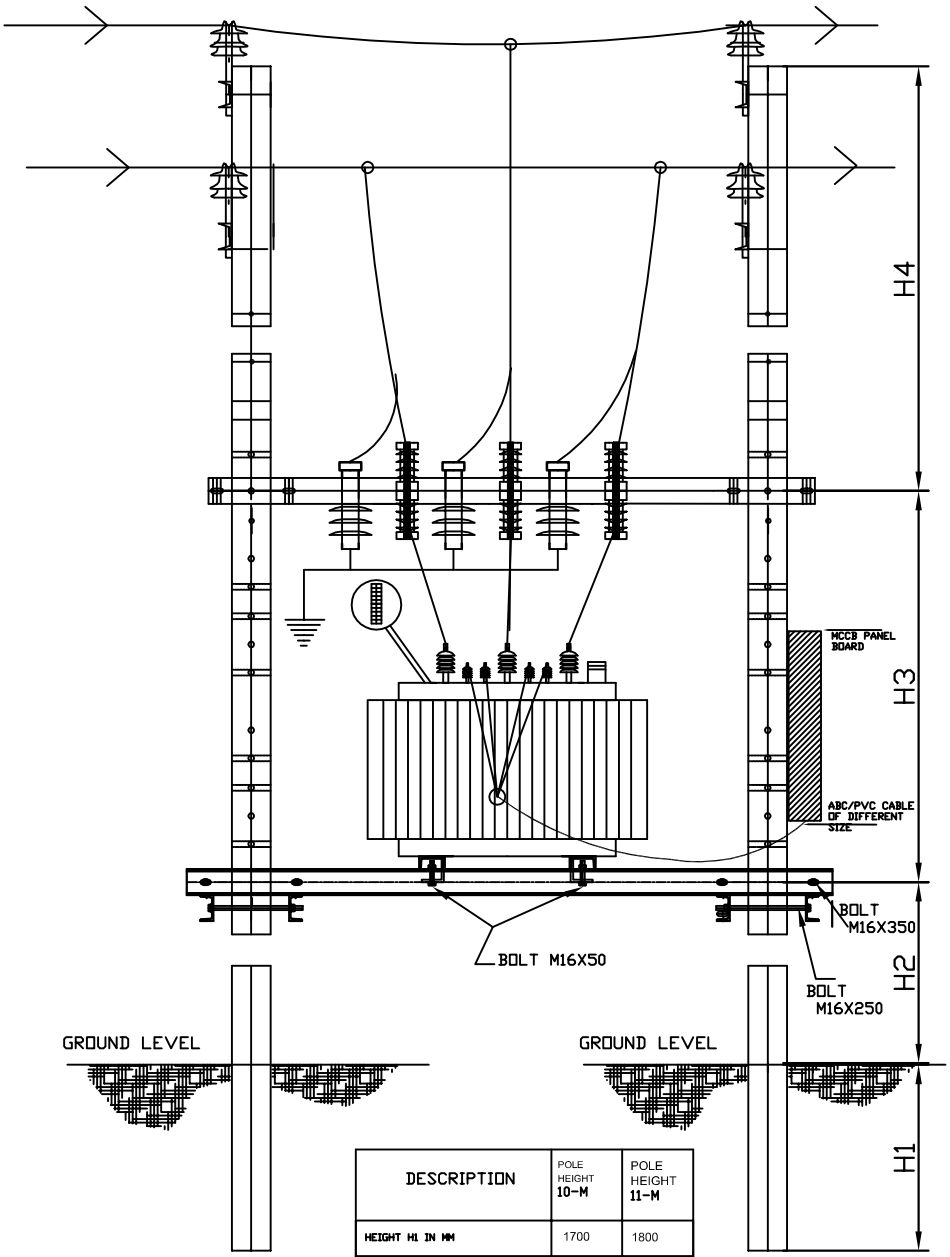
SIDE VIEW

FRONT VIEW

Drawing **CS11-TRN-02**	**10/11 m STT Pole** **11/0.4 Dead End** **Transformer Structure**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services



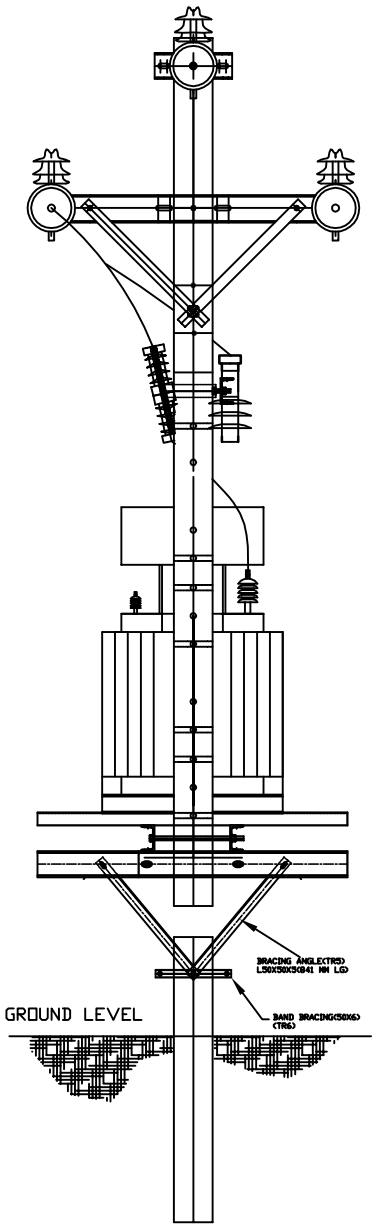
SIDE VIEW



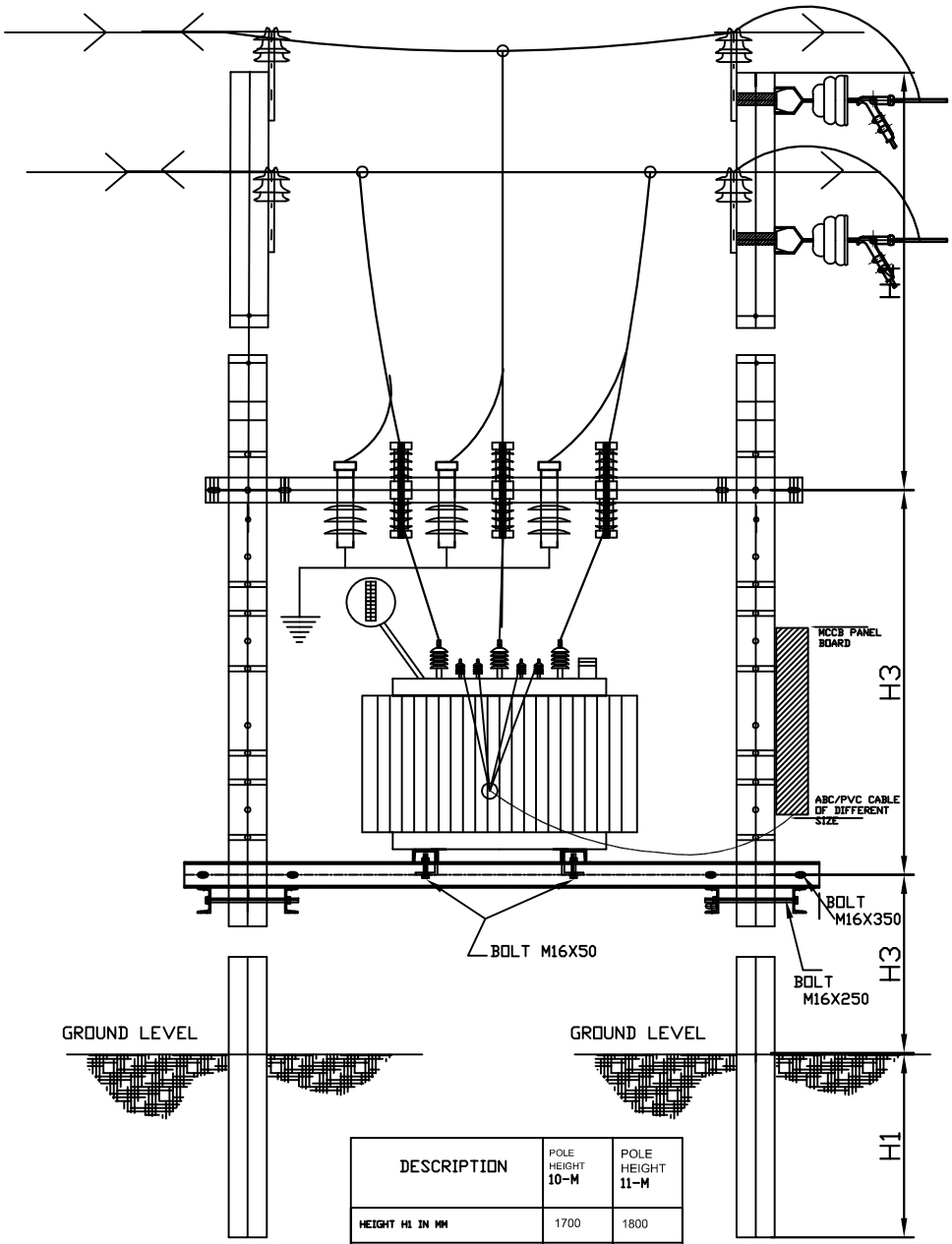
FRONT VIEW

DESCRIPTION	POLE HEIGHT 10-M	POLE HEIGHT 11-M
HEIGHT H1 IN MM	1700	1800
HEIGHT H2 IN MM	4400	3500
HEIGHT H3 IN MM	2400	2400
HEIGHT H4 IN MM	2400	2400

Drawing **CS11-TRN-03**	**10/11 m PSC Pole** **11/0.4 kV Intermediate** **Transformer Structure**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services



SIDE VIEW



FRONT VIEW

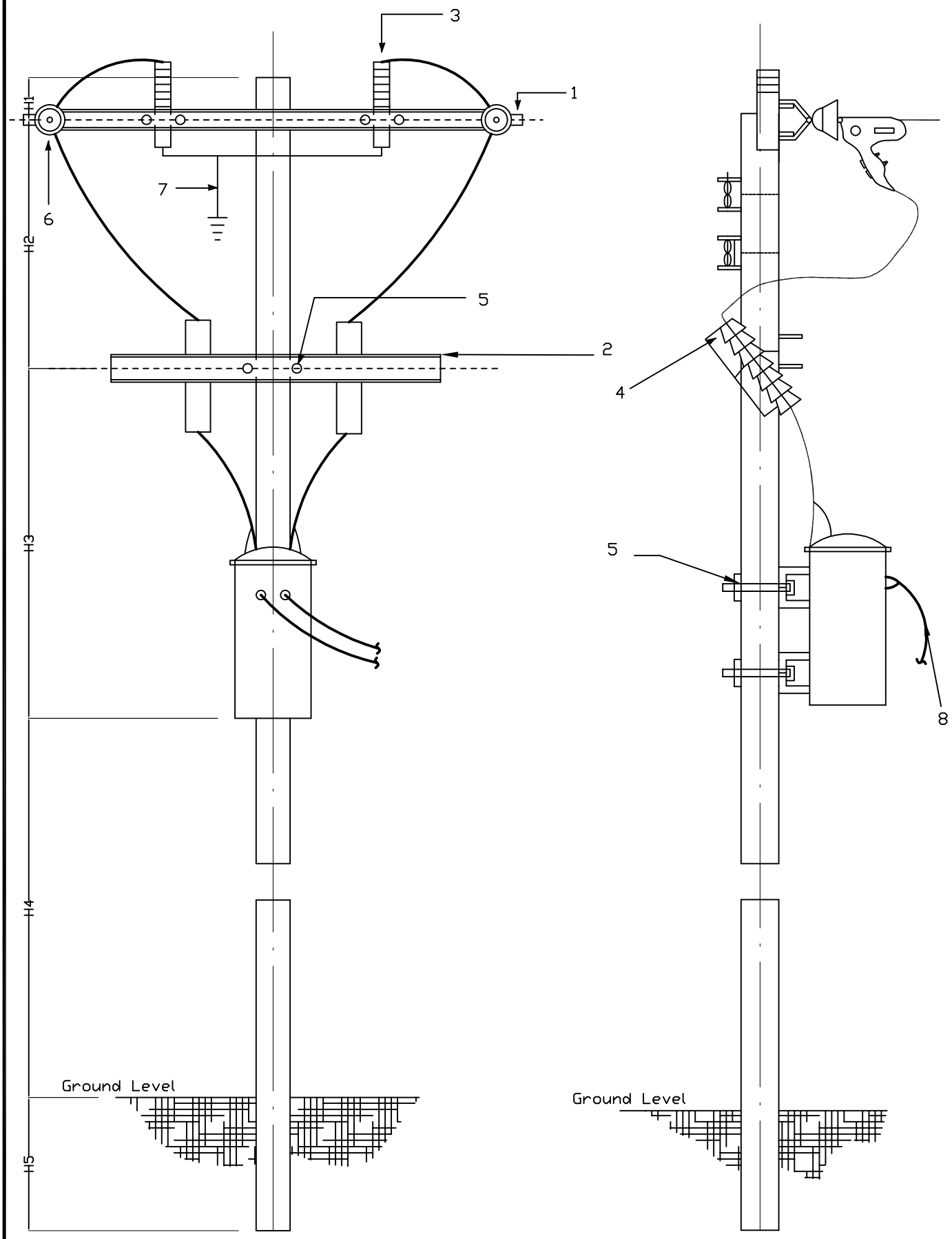
DESCRIPTION	POLE HEIGHT 10-M	POLE HEIGHT 11-M
HEIGHT H1 IN MM	1700	1800
HEIGHT H2 IN MM	4400	3500
HEIGHT H3 IN MM	2400	2400
HEIGHT H4 IN MM	2400	2400

Drawing **CS11-TRN-04**	**10/11 m PSC Pole** **11/0.4 kV Dead End** **Transformer Structure**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

Refer Drawing No: CS 11 -TRN-05

S.No.	QTY.	UNIT	MATERIAL
1	1	NOS	STEEL CROSSARM CHANNEL (100 x 50 x 6.4 x300) mm.
2	1	NOS	STEEL CROSSARM CHANNEL (100 x 50 x 6.4 x 1200) mm.
3	2	NOS	9 kV SURGE ARRESTOR WITH FITTING ARRANGMENTS
4	2	NOS	11 kV DISTRIBUTION CUTOUT WITH SUITABLE FUSE HOLDERS
5	4	SET	SUITABLE POLE CLAMP WITH NUTS AND BOLTS
6	2	SET	DISC INSULATOR WITH TENSION SET
7	2	SET	EARTHING SET (WITH GROUND RODS AND ACCESSORIES)
8	1	LOT	ABC OR PVC CABLE OF REQUIRED RATING
9	1	SET	LV CONNECTOR TYPE AS REQUIRED
10	1	SET	MCCB WITH PANEL BOARD
11	1	LOT	ACSR CONDUCTOR
13	2	SET	BRACK STRAP
14	1	NO.	TELESCOPIC POLE/ PSC POLE

CONSTRUCTION STANDARDS **11/0.4 kV TRANSFORMER STRUCTURE** **SINGLE PHASE TRANSFORMER POLE**	**NEPAL ELECTRICITY AUTHORITY** **Technical Service/ Commercial Department** **Distribution and Consumer Services**



Drawing **CS11-TRN-05**	**Single Phase Transformer Pole**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

Refer Drawing No: CS11-TRN-06

S.No.	QTY.	UNIT	MATERIAL
1	1	NO	CHANNEL FOR DO / LA (100 x 50 x 6.4 x 2348) mm
2	2	NOS	PLATFORM CHANNEL TR1 (100 x 50 x 7.5 x 1200) mm
3	4	NOS	PLATFORM CHANNEL TR2 (100 x 50 x 7.5 x 2500) mm
4	2	NOS	PLATFORM CHANNEL TR3 (100 x 50 x 7.5 x 2500) mm
5	2	NOS	PLATFORM CHANNEL TR4 (100 x 50 x 7.5 x1200) mm
6	8	NOS	BRACING ANGLE TR5 (50 x 50 x 5 x841) mm
7	2	SET	BRACING BRAND TR6 WITH 2-M16 x60 BOLTS,2-M16 x50 BOLTS , 8-M16 NUT, 8-M16 WASHER
8	24	SET	M16 x50 BOLTS WITH 2-M16 NUT AND 2-M16 WASHER
9	8	SET	M16 x350 BOLTS WITH 2-M16 NUT AND 2-M16 WASHER

CONSTRUCTION STANDARDS
TRANSFORMER PLATE
TELESCOPIC POLE

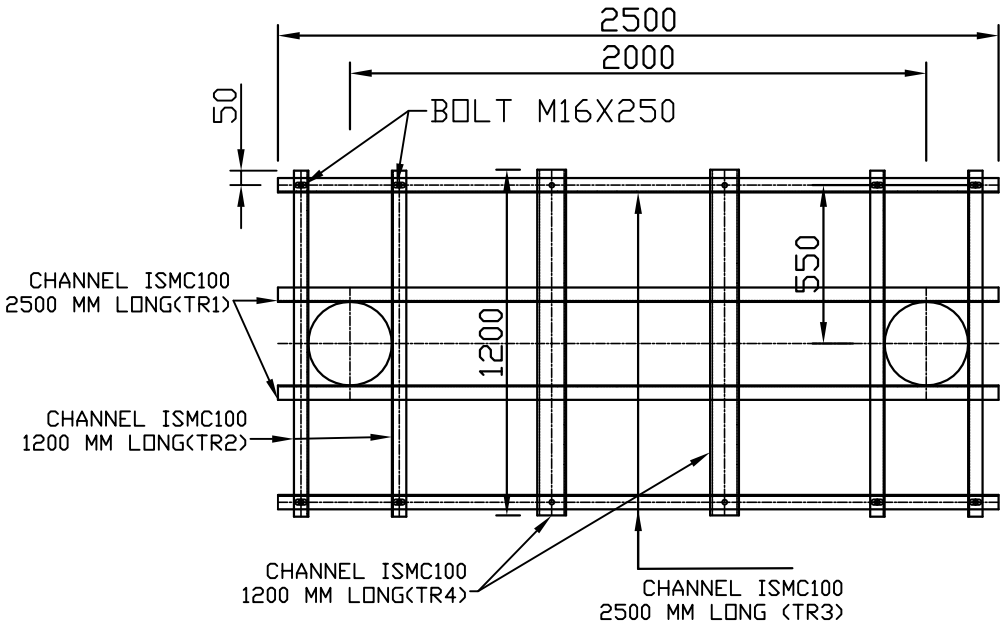
NEPAL ELECTRICITY AUTHORITY
Technical Service/ Commercial Department
Distribution and Consumer Services

Refer Drawing No: CS11-TRN-06

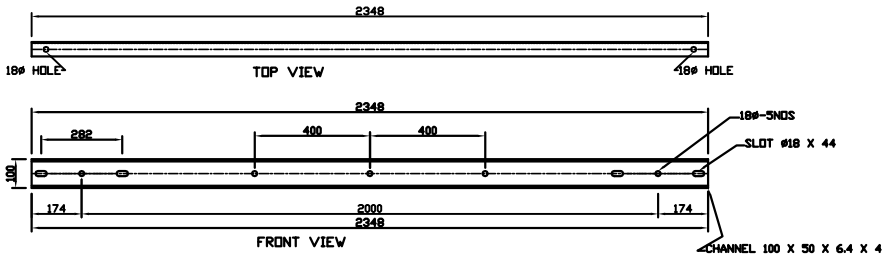
S.No.	QTY.	UNIT	MATERIAL
1	1	NO	CHANNEL FOR DO / LA (100 x 50 x 6.4 x 2348) mm
2	2	NOS	PLATFORM CHANNEL TR1 (100 x 50 x 7.5 x 1200) mm
3	4	NOS	PLATFORM CHANNEL TR2 (100 x 50 x 7.5 x 2500) mm
4	2	NOS	PLATFORM CHANNEL TR3 (100 x 50 x 7.5 x 2500) mm
5	2	NOS	PLATFORM CHANNEL TR4 (100 x 50 x 7.5 x1200) mm
6	8	NOS	BRACING ANGLE TR5 (50 x 50 x 5 x841) mm
7	2	SET	BRACING BRAND TR6 WITH 2-M16 x60 BOLTS,2-M16 x50 BOLTS , 8-M16 NUT, 8-M16 WASHER
8	24	SET	M16 x50 BOLTS WITH 2-M16 NUT AND 2-M16 WASHER
9	4	SET	M16 x250 BOLTS WITH 2-M16 NUT AND 2-M16 WASHER
10	8		M16 x350 BOLTS WITH 2-M16 NUT AND 2-M16 WASHER

CONSTRUCTION STANDARDS
TRANSFORMER PLATE
PSC POLE

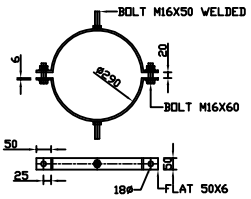
NEPAL ELECTRICITY AUTHORITY
Technical Service/ Commercial Department
Distribution and Consumer Services



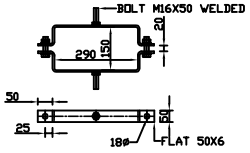
TRANSFORMER PLAT-FORM TOP VIEW



CROSS ARM CHANNEL FOR LA AND DO
ISLC100 (2348 MM LONG)

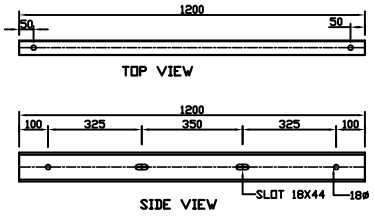


BRACING BAND (TR6) DETAIL
(FOR TELESCOPIC POLE ONLY)

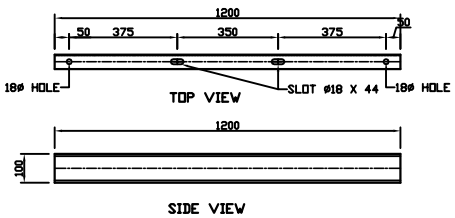


BRACING BAND (TR6P) DETAIL
(FOR PSC POLE ONLY)

SPECIAL NOTE:-
ALL DIMENSION ARE SAME FOR BOTH PSC AND TELESCOPIC POLE

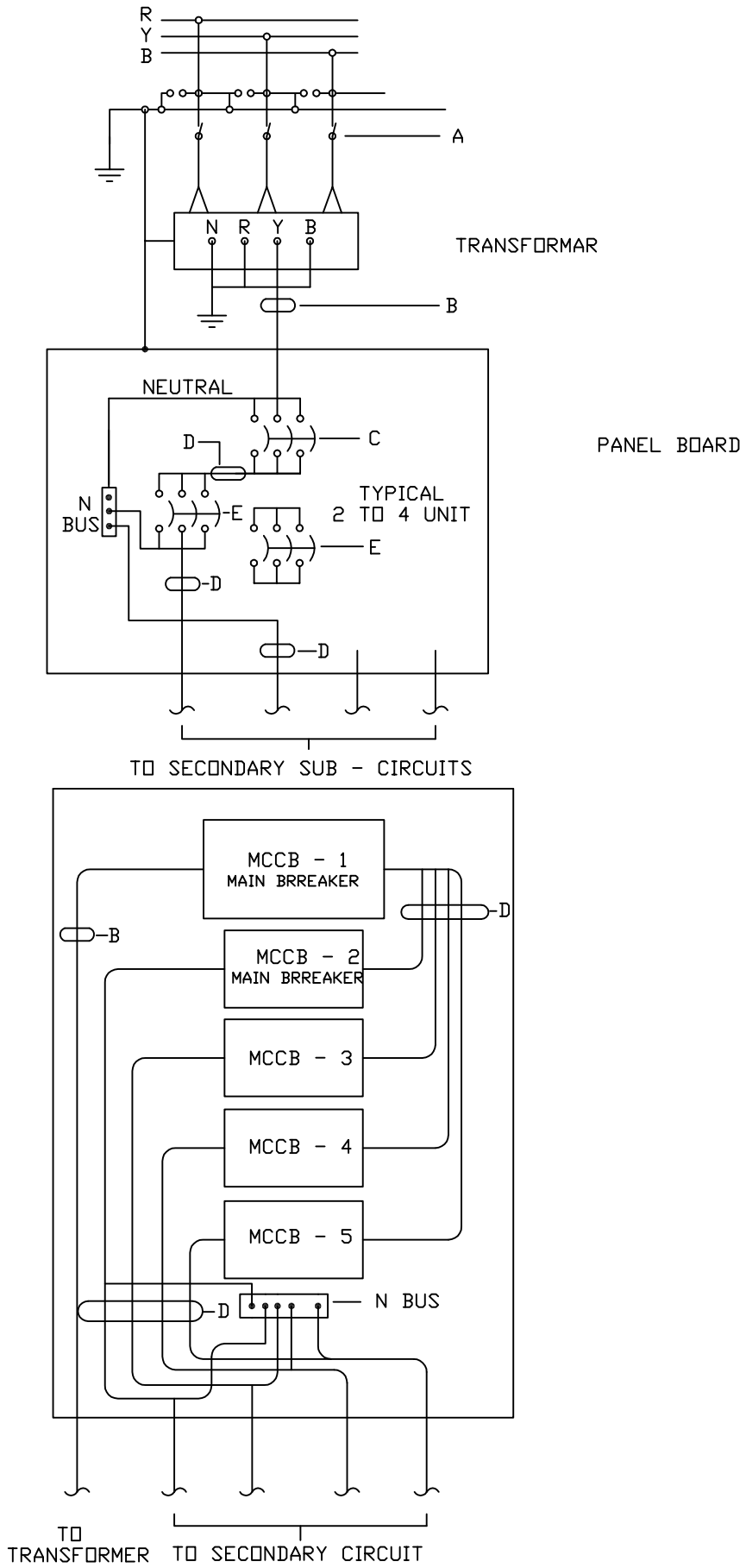


PLATFORM CHANNEL (TR2)
ISMC100(1200 MM LONG)



PLATFORM CHANNEL (TR4)
ISMC100(1200 MM LONG)

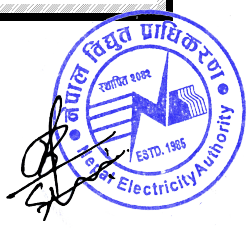
Drawing **CS11-TRN-06**	**Transformer Platform and Accessories**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services



TYPICAL CONNECTION DIAGRAM

Drawing **CS11-TRN-07**	**33kV & 11kV - 400/230 V** **Transformer Structure** **Connection Diagram**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

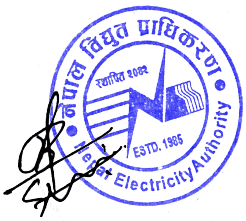
STREET LIGHT



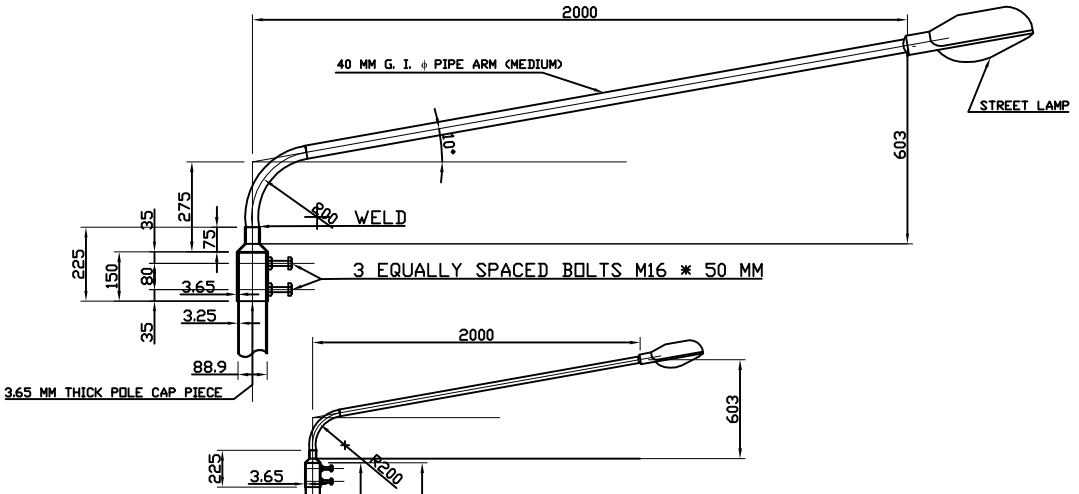
GUIDE LINES FOR STREET LIGHT INSTALLATION

VAHICULAR TARRIFIC	ROAD WIDTH.	LUMINARIES TYPE	LUMINARIES	LUMINAIRES SPACING	MOUNTING HEIGHT (H)	OVERHANG (L)	TILT ANGLE DEGREE
HEAVY	12 M	150W HPSV, 250W HPMV	STAGGERED	30 M	9 M	2.0 M	15
	10 M	150W HPSV, 250W HPMV	SINGLE SIDE	35 M	9 M	2.0 M	10
MEDIUM	10 M	75 W HPSV, 125W HPMV	STAGGERED	30 M	8 M	2.0 M	10
	8 M	80W HPMV, 2X40W WFTL	SINGLE SIDE	25 M 25 M	7 M 7 M	1.5 M 1.5 M	15 15
LIGHT	8 M	1X40W WFTL 2X20W WFTL	SINGLE SIDE	20 M	7 M	1.5 M	15
NOMINAL	6 M	1X40W WFTL 2X20W WFTL	SINGLE SIDE	20 M	6 M	1.0 M	20
NOMINAL	3 M	1X100 W GLS	SINGLE SIDE	40 M	6 M	1.0 M	20

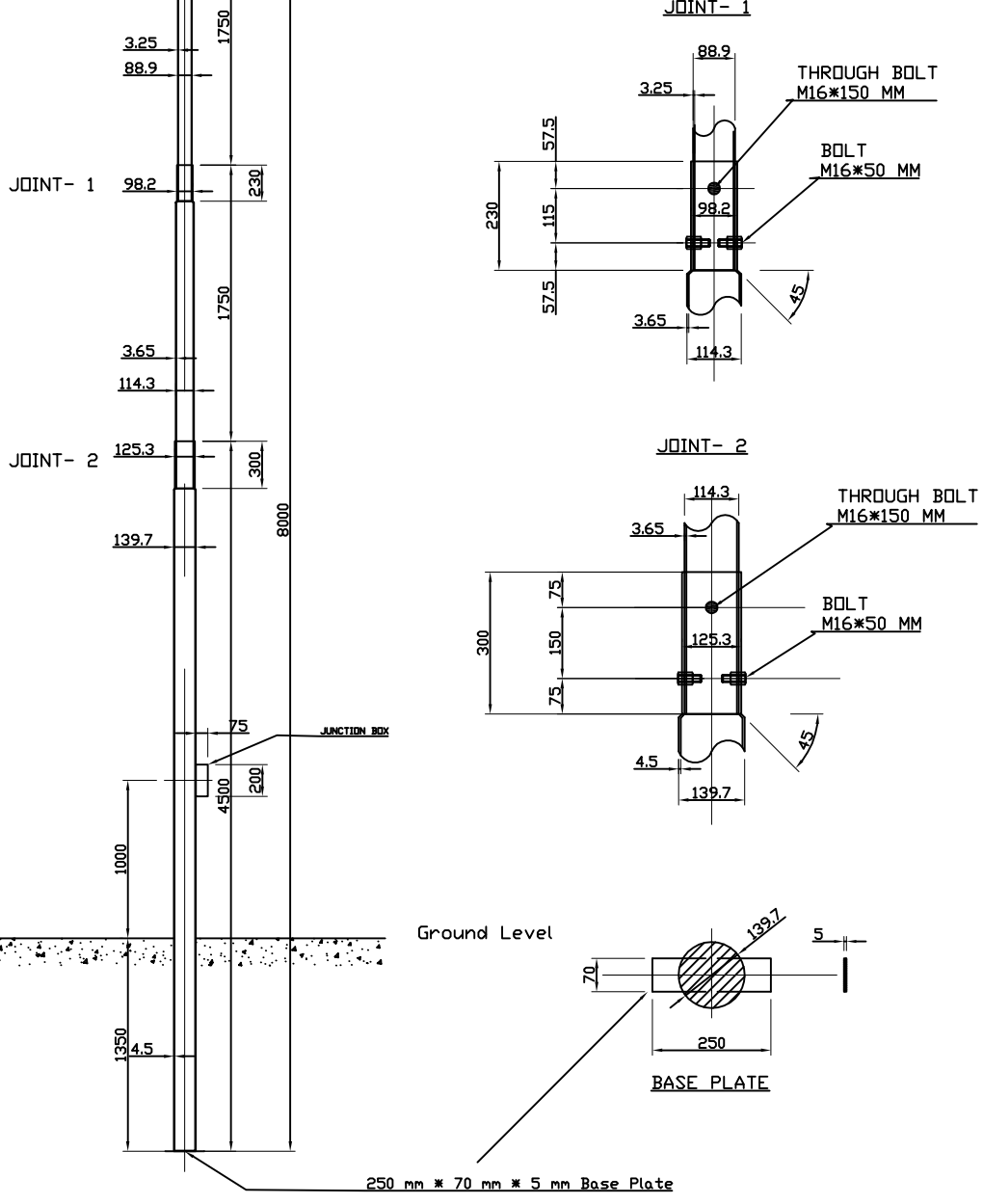
CONSTRUCTION STANDARDS **GUIDE LINE FOR STREET LIGHT INSTALLATION**	**NEPAL ELECTRICITY AUTHORITY** **Technical Service/ Commercial Department** **Distribution and Consumer Services**



OVERHANGING SWAN TYPE ARM DETAILS



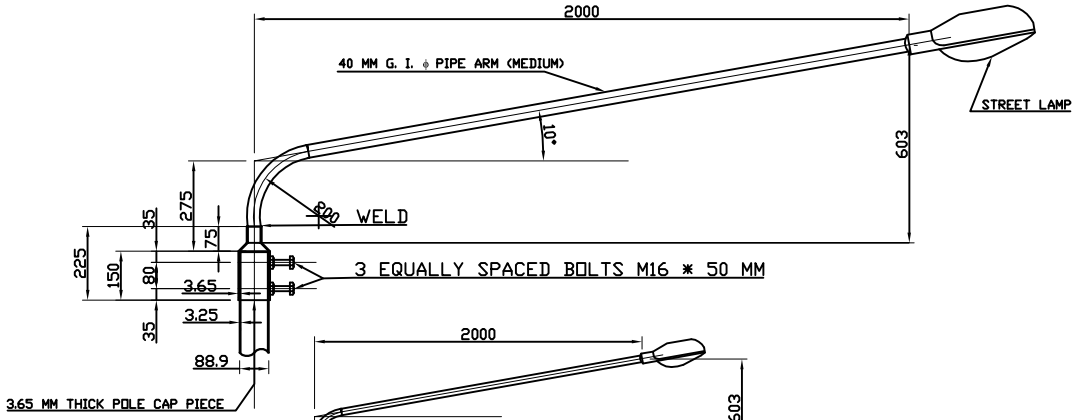
8 M POLE JOINT DETAILS

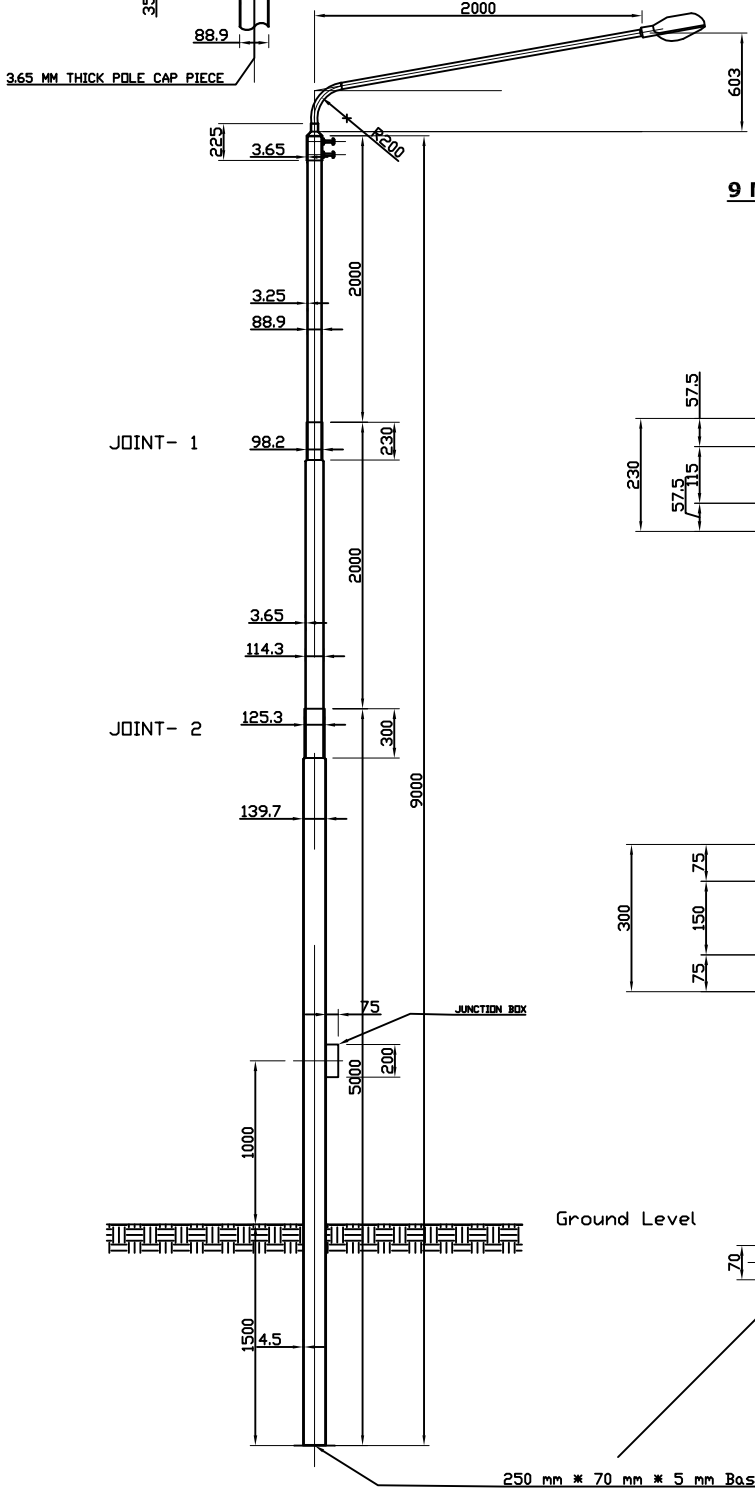


250 mm * 70 mm * 5 mm Base Plate

Drawing **CSLV-SL-01**	**8 m Swaged Tubular Street Lighting Pole**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

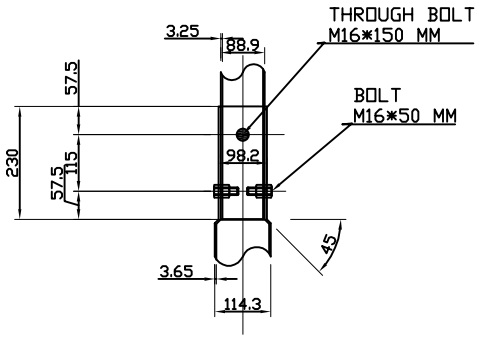
OVERHANGING SWAN TYPE ARM DETAILS



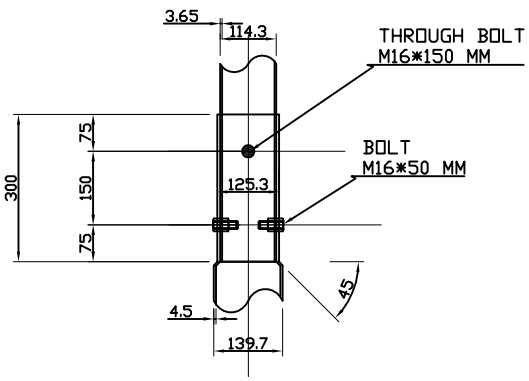


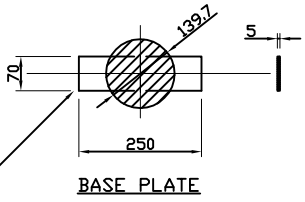
9 M POLE JOINT DETAILS

JOINT- 1



JOINT- 2

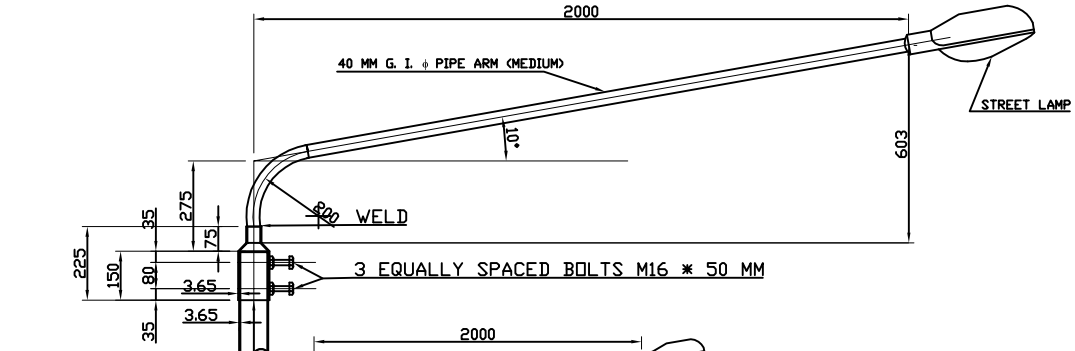




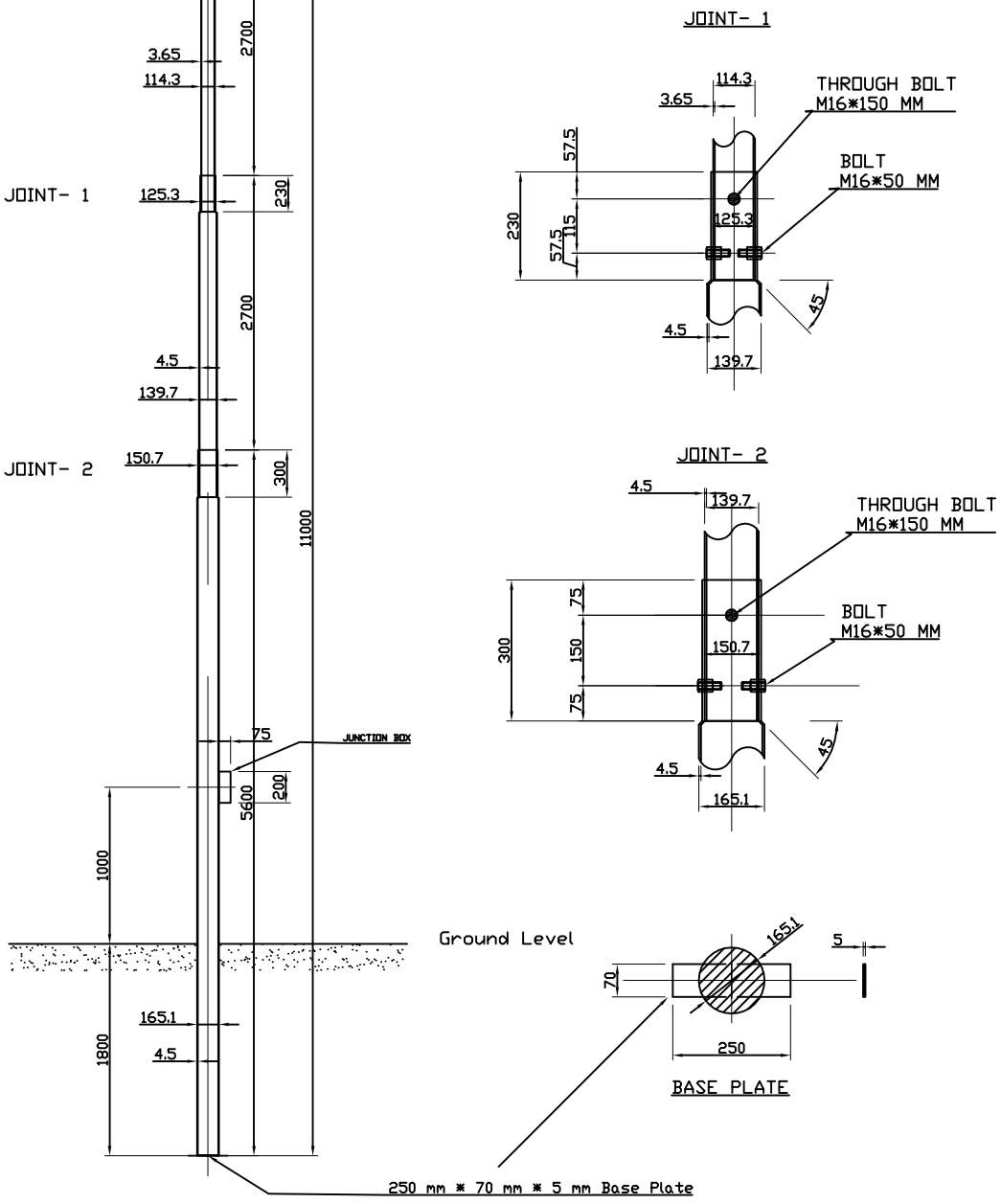
250 mm * 70 mm * 5 mm Base Plate

Drawing **CSLV-SL-02**	**9 m Swaged Tubular Street Lighting Pole**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

OVERHANGING SWAN TYPE ARM DETAILS



11 M POLE JOINT DETAILS



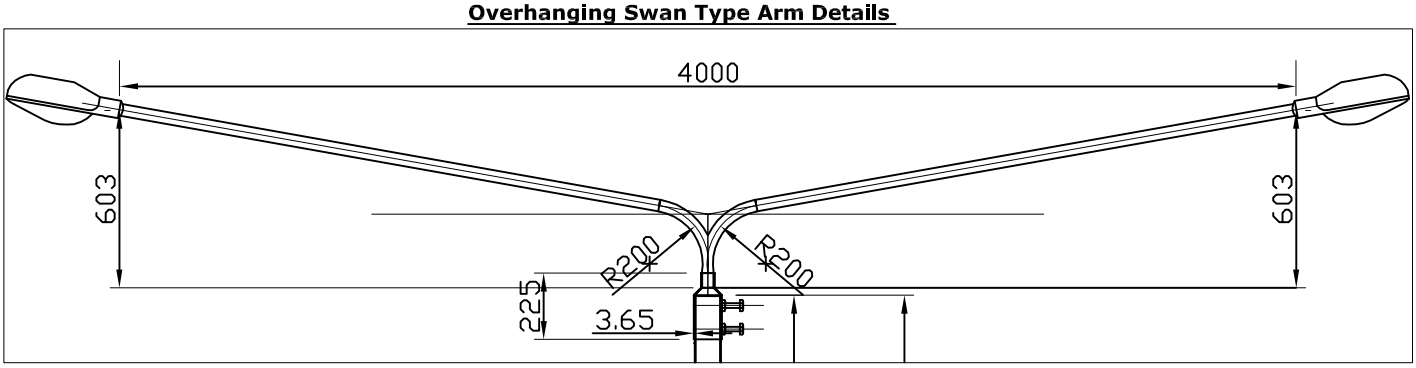
JOINT- 1

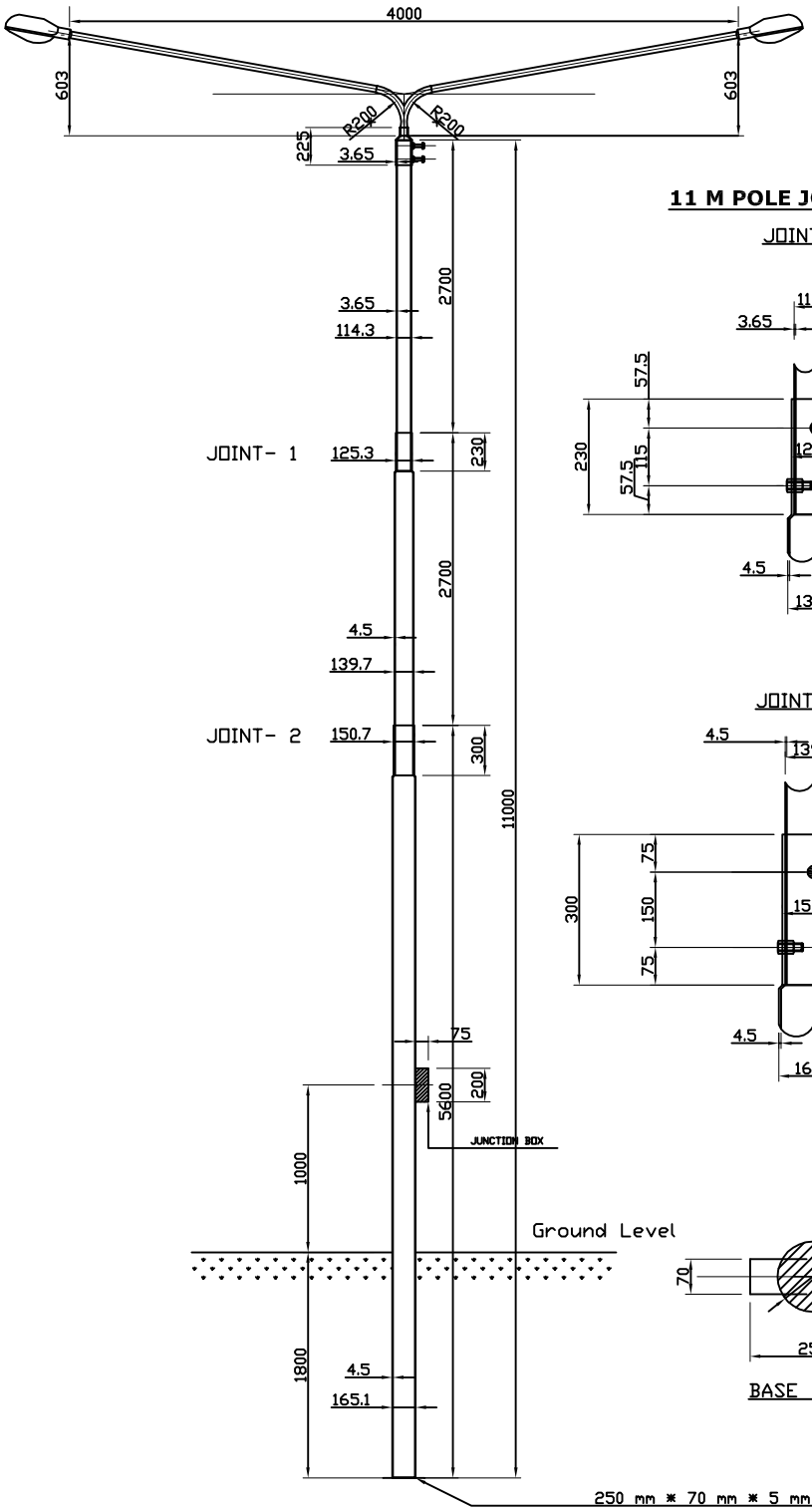
JOINT- 2

BASE PLATE

Drawing **CSLV-SL-03**	**11 m Swaged Tubular Street Lighting Pole**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Service

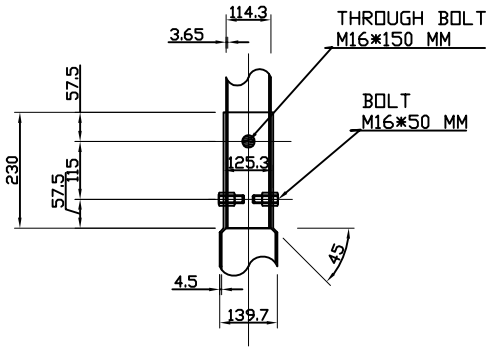
Overhanging Swan Type Arm Details



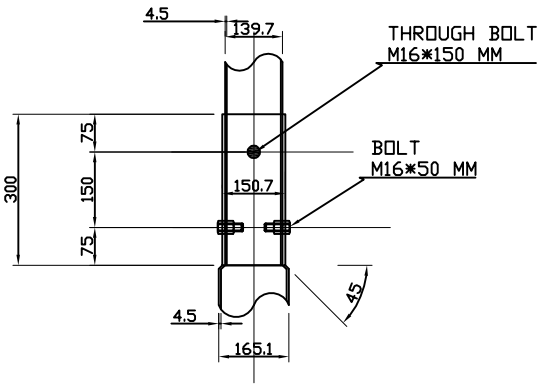


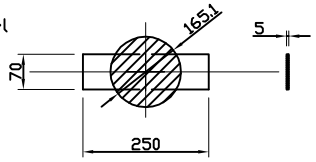
11 M POLE JOINT DETAILS

JOINT- 1



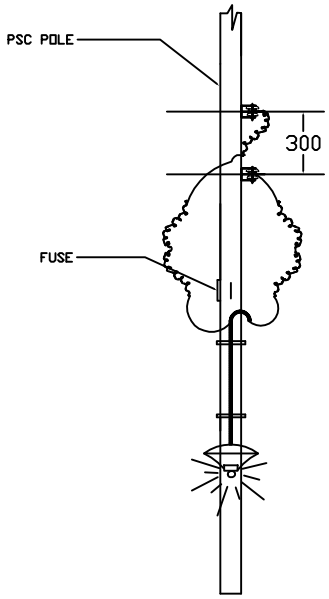
JOINT- 2



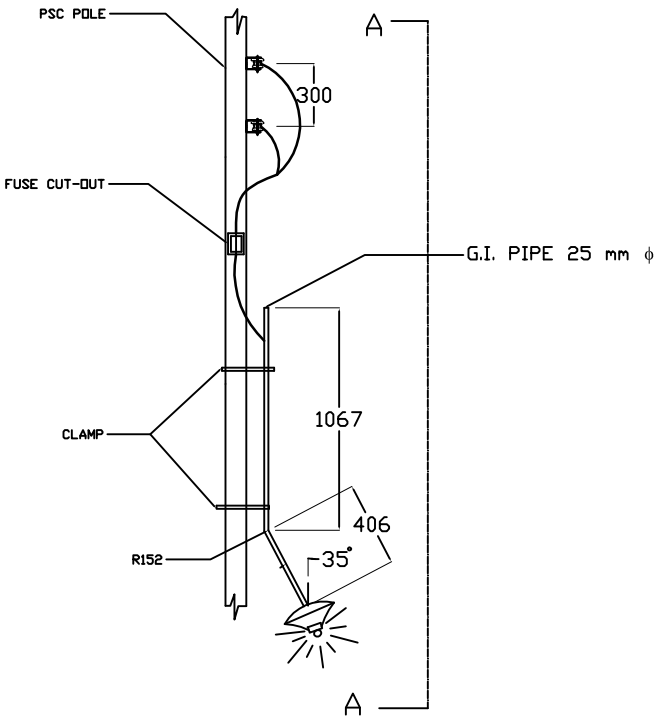


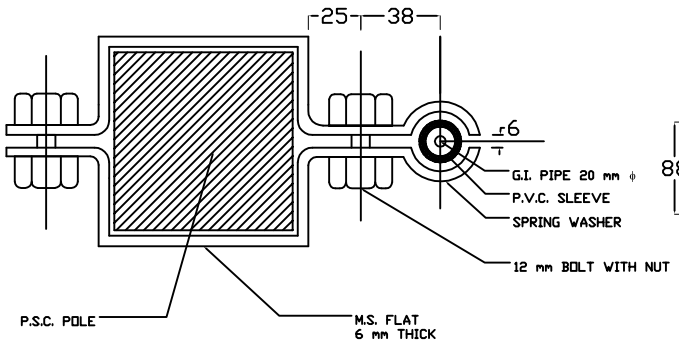
BASE PLATE

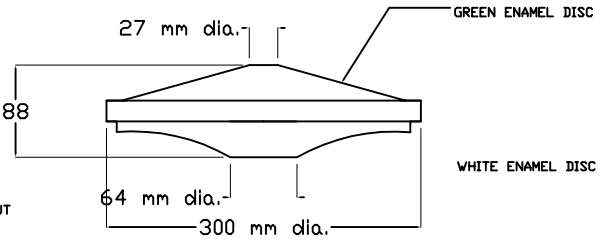
Drawing **CSLV-SL-04**	**11 m Swaged Tubular Street Lighting Pole (Double Arm)**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services



VIEW A A







REFLECTOR

BILL OF MATERIAL

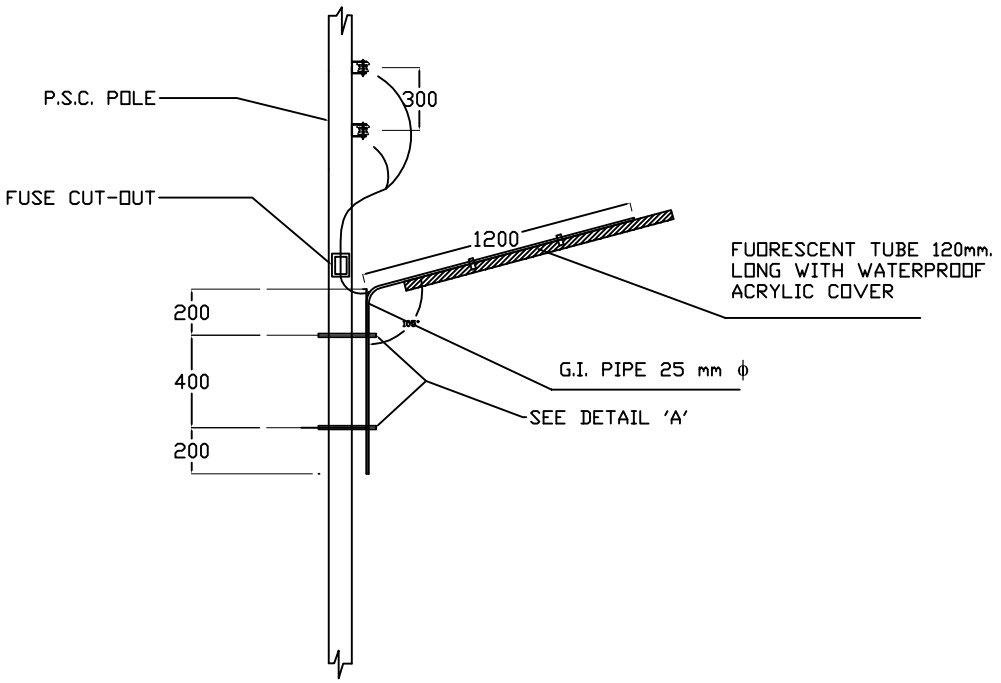
ITEM	QTY
1. G.I. PIPE 20mm. DIA. 1580mm. LONG	1
2. REFLECTOR ASSEMBLE	ONE SET
3. M.S. CLAMP OF 6mm. FLAT	2
4. NUT, BOLTS ETC.	AS REQD.

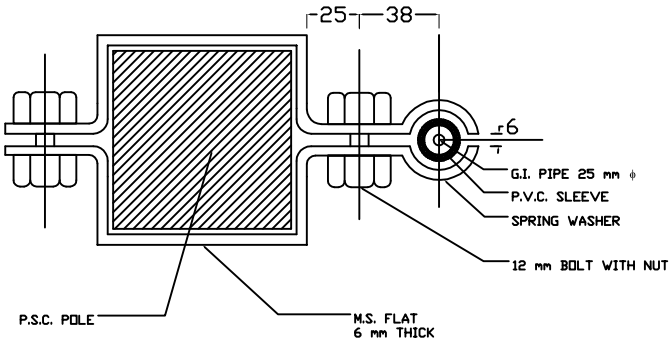
NOTES

1. THE G.I. PIPE OF CLASS 'A' TO BE USED AND SHALL CONFORM TO IS: 4736-1968

2. G.I. PIPE OF 20mm. DIA. IN CONTINUOUS LENGTH WITHOUT CLAMPS BUT WITH P.V.C. BUSHING AT ONE END AND THREADED AT THE OTHER END SHALL BE PROVIDED.

Drawing **CSLV-SL-05**	**DETAILS OF STREET LIGHT FITTINGS (INCANDESCENT LAMP)**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services





DETAIL AT 'A'

NOTES

1. THE G.I. BRACKET MADE OUT OF 32 mm CLASS 'B' (MEDIUM) G.I. PIPE OF 2 m LONG CONFORMING TO I.S.: 1239 AND I.S.: 4736 OF 1968 OR LATEST

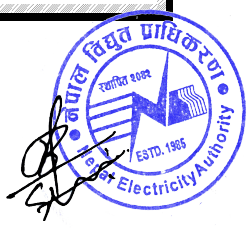
2. THERE SHOULD BOT BE ANY JOINT OF WELDING OR BRAZING.

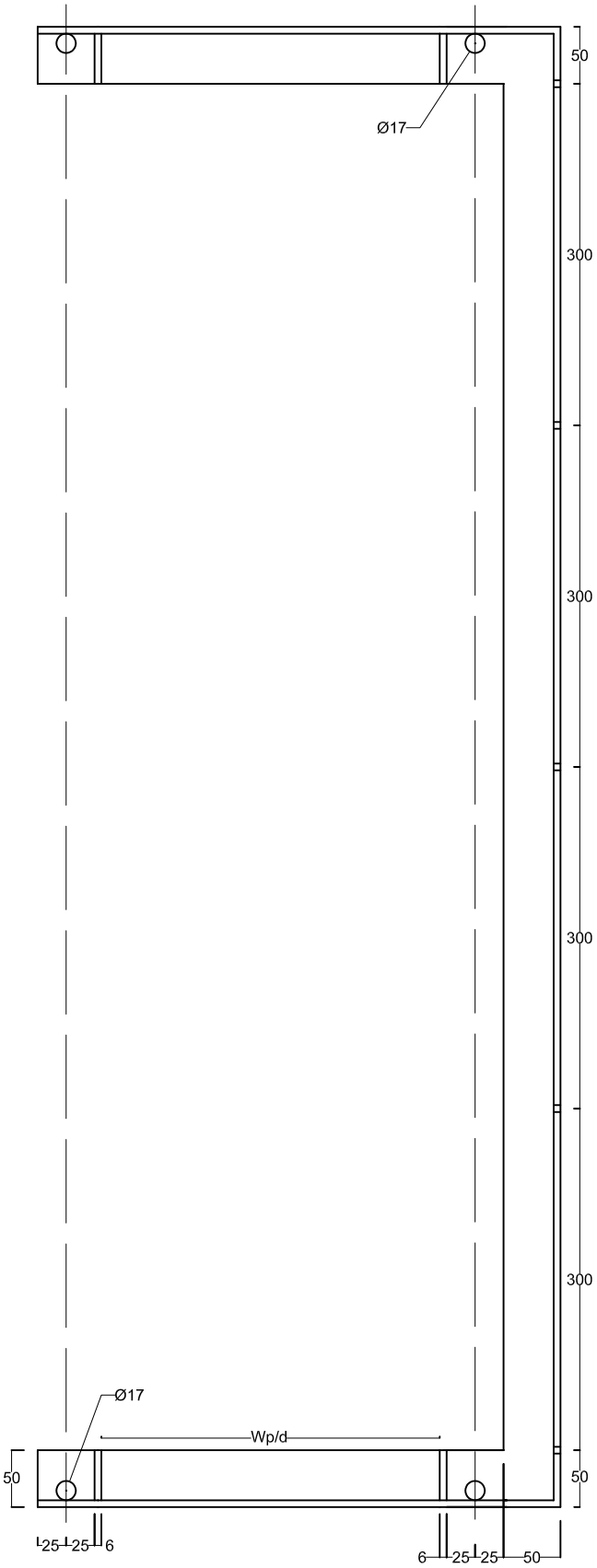
3. THERE SHOULD BOT BE ANY BROKEN EDGES.

4. ALL HOLES ARE OF 14 ϕ TO SUIT 12 ϕ BOLTS..

Drawing **CSLV-SL-06**	**DETAILS OF STREET LIGHT FITTINGS (FLUORESCENT LAMP)**	NEPAL ELECTRICITY AUTHORITY **Technical Services / Commercial Department** Distribution and Consumer Services

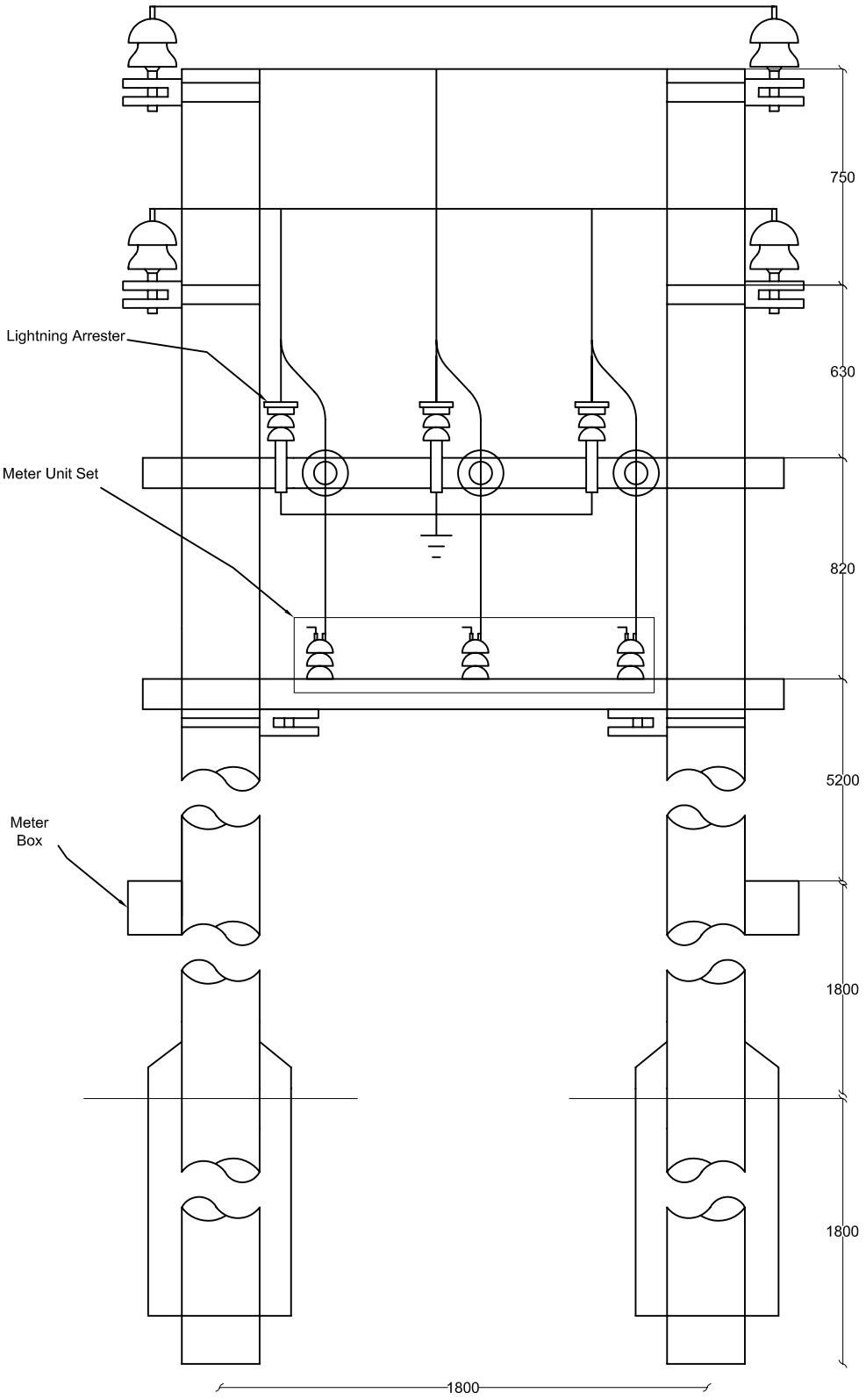
LOW VOLTAGE DISTRIBUTION SYSTEM



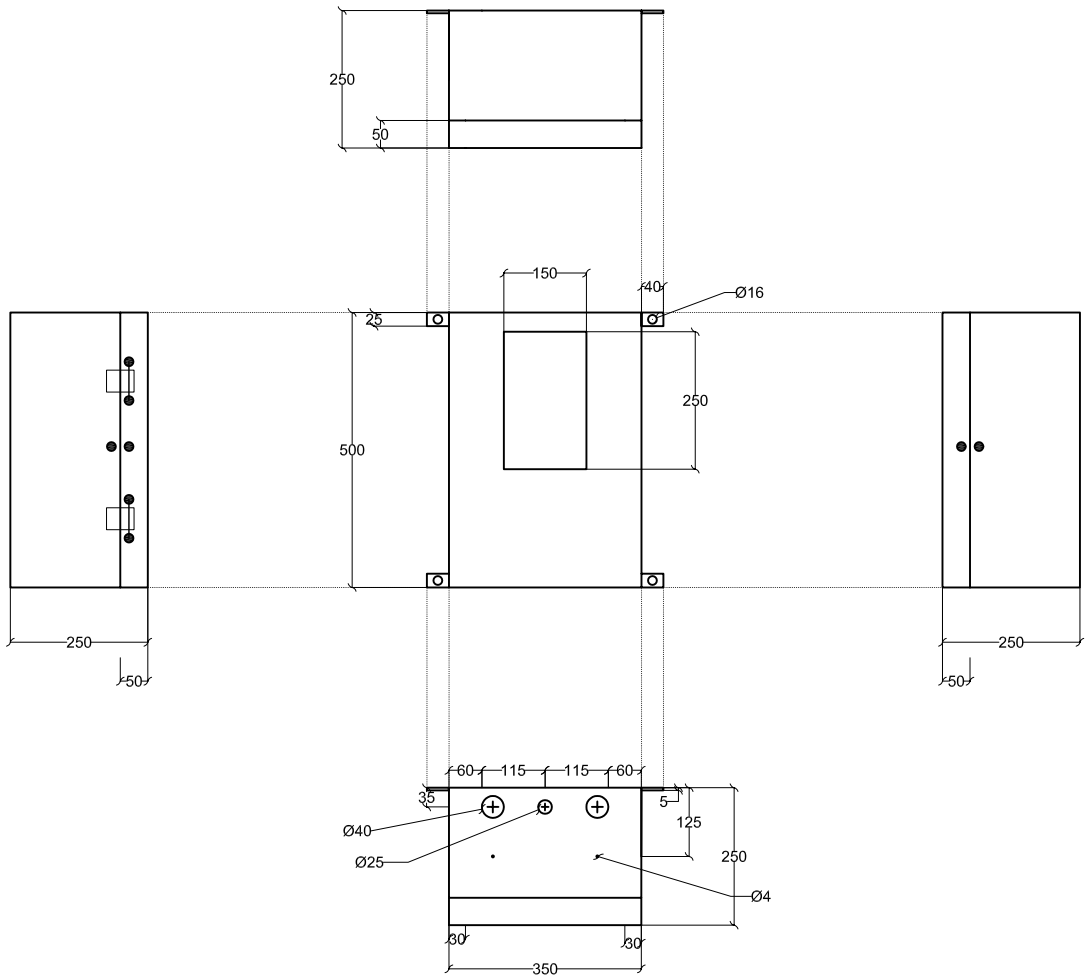


Wp = WIDTH OF CONCRETE POLE
d = DIAMETER OF ROUND POLE

Drawing **CSLV-G-01**	**D-Bracket for LV Line Support in Pole**	NEPAL ELECTRICITY AUTHORITY **Technical Services/ Commercial Department** Distribution and Consumer Services



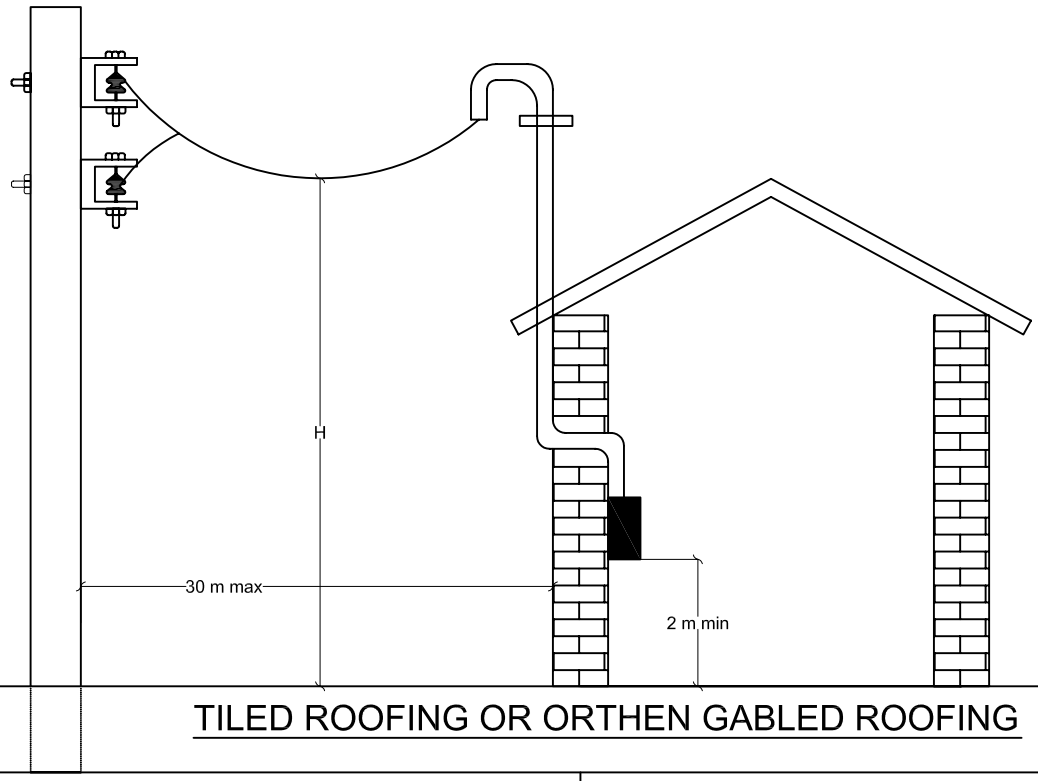
Drawing **CSLV-G-02**	**H.T. Metering Unit Tower Set**	NEPAL ELECTRICITY AUTHORITY **Technical Services/ Commercial Department** Distribution and Consumer Services



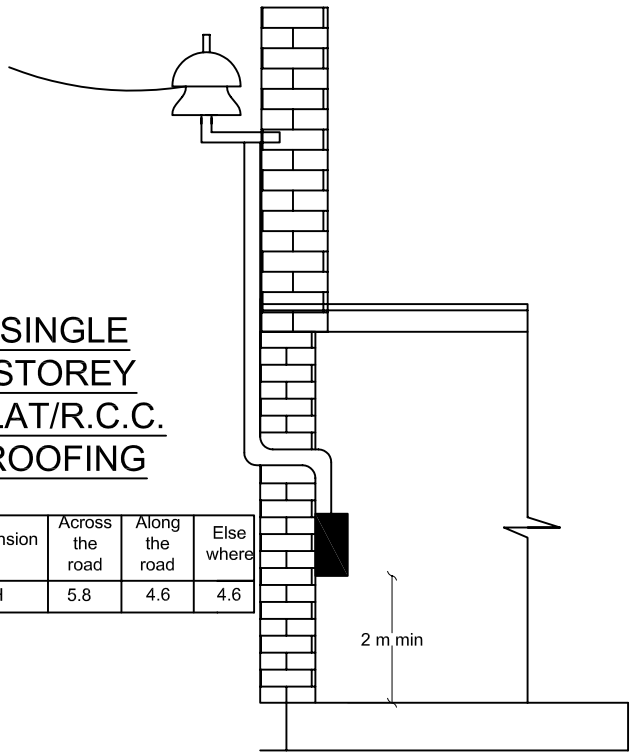
Note:

1. All dimensions are given in mm.
2. Hinge System should not be visible from outside, its mechanism should be through inside as like in steel almirah.
3. As shown in the drawing, sealing holes shall be provided on both sides.
4. Central hole of 25 mm dia as in plan is for control cable of H.T. meter. Outer two holes (clear dia 40 mm) shall be for power cables to be used for whole current meter.
5. Glass (30 mm thick) shall be fixed from inside, ie in any case it shall not be taken out from outside.
6. Meter box shall be made of mild steel sheet of 16 SWG thicknesses.
7. It shall have one coat of red oxide and two coat of smoke grey enamel paint. (Preferably spray painting).
8. It shall be water proof.

Drawing **CSLV-G-03**	**Steel Meter Box for 3 Phase Meter (of all type)**	NEPAL ELECTRICITY AUTHORITY **Technical Services/ Commercial Department** Distribution and Consumer Services

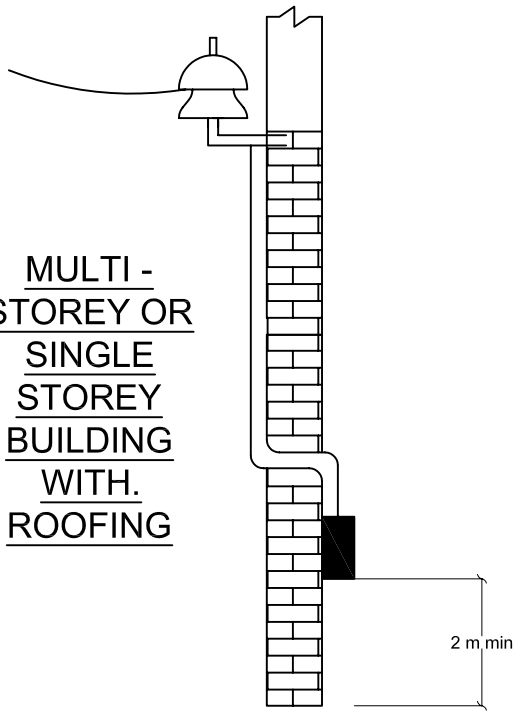


TILED ROOFING OR ORTHEN GABLED ROOFING



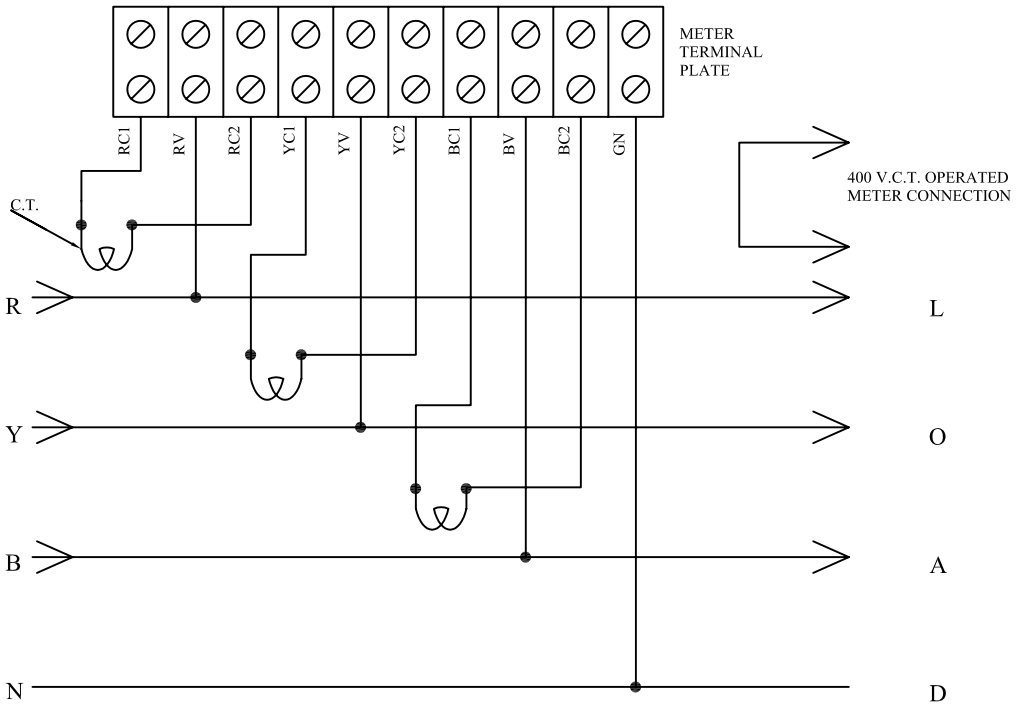
SINGLE STOREY FLAT/R.C.C. ROOFING

Dimension	Across the road	Along the road	Else where
H	5.8	4.6	4.6

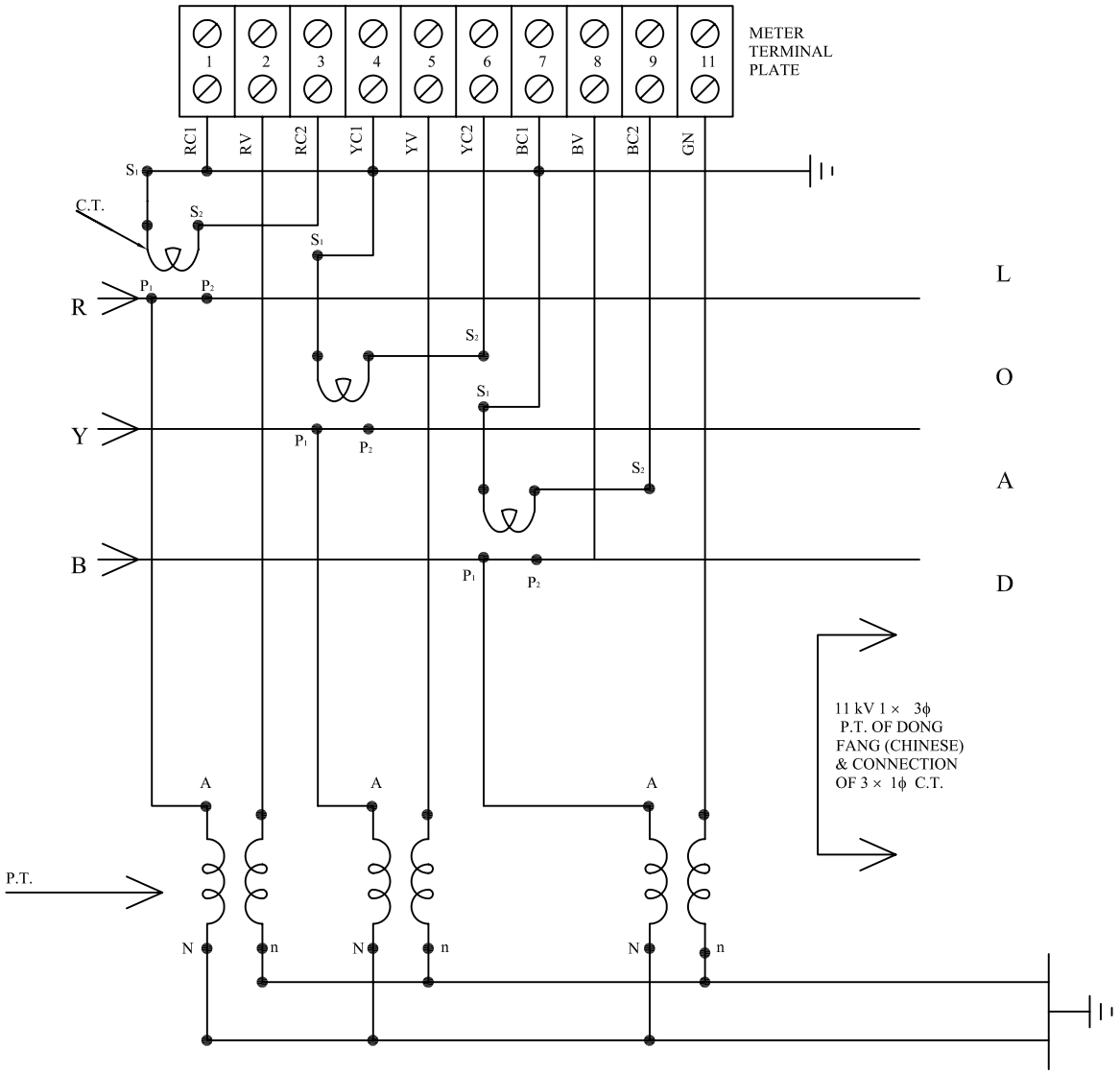


MULTI - STOREY OR SINGLE STOREY BUILDING WITH. ROOFING

Drawing **CSLV-G-04**	**Service Connection (insulated wire)**	NEPAL ELECTRICITY AUTHORITY **Technical Services/ Commercial Department** Distribution and Consumer Services



Drawing **CSLV-G-05**	**Connection Arrangement of CT Operated Meter for LT**	NEPAL ELECTRICITY AUTHORITY **Technical Services/ Commercial Department** Distribution and Consumer Services



Drawing **CSLV-G-06**	**Connection Arrangement of CT Operated Meter for HT**	NEPAL ELECTRICITY AUTHORITY **Technical Services/ Commercial Department** Distribution and Consumer Services

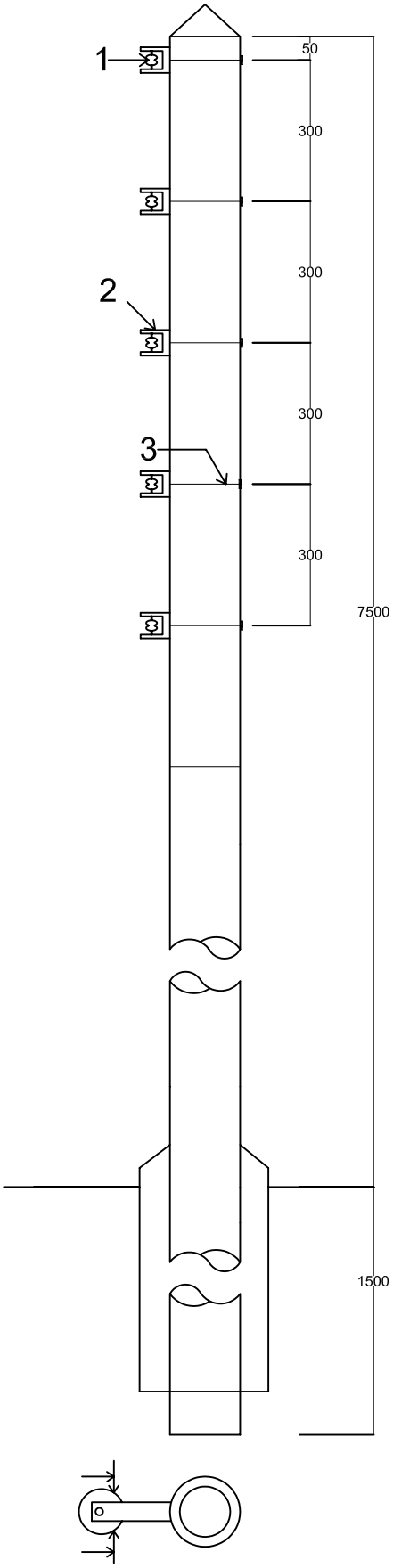
Refer Drawing No: CSLV-CC-01

0° DEVIATION

S.No.	QTY.	UNIT	MATERIAL
1	4	N0	SHACKLE INSULATOR
2	4	SET	D-IRON
3	4	N0	NUT AND BOLT 5\ 8" * LENGTH AS REQUIRED
4	1	LOT	BINDING WIRE
5	1	No.	POLE PSC/ STEEL TUBULAR 8 m / 9 m

CONSTRUCTION STANDARDS
O/H LV INTERMEDIATE SUPPORT
0° DEVIATION

NEPAL ELECTRICITY AUTHORIT
Technical Service/ Commercial Department
Distribution and Consumer Services



Drawing **CSLV-CC-01**	**O/H 400/230 Intermediate Support (0° Deviation)**	NEPAL ELECTRICITY AUTHORITY **Technical Services/ Commercial Department** Distribution and Consumer Services

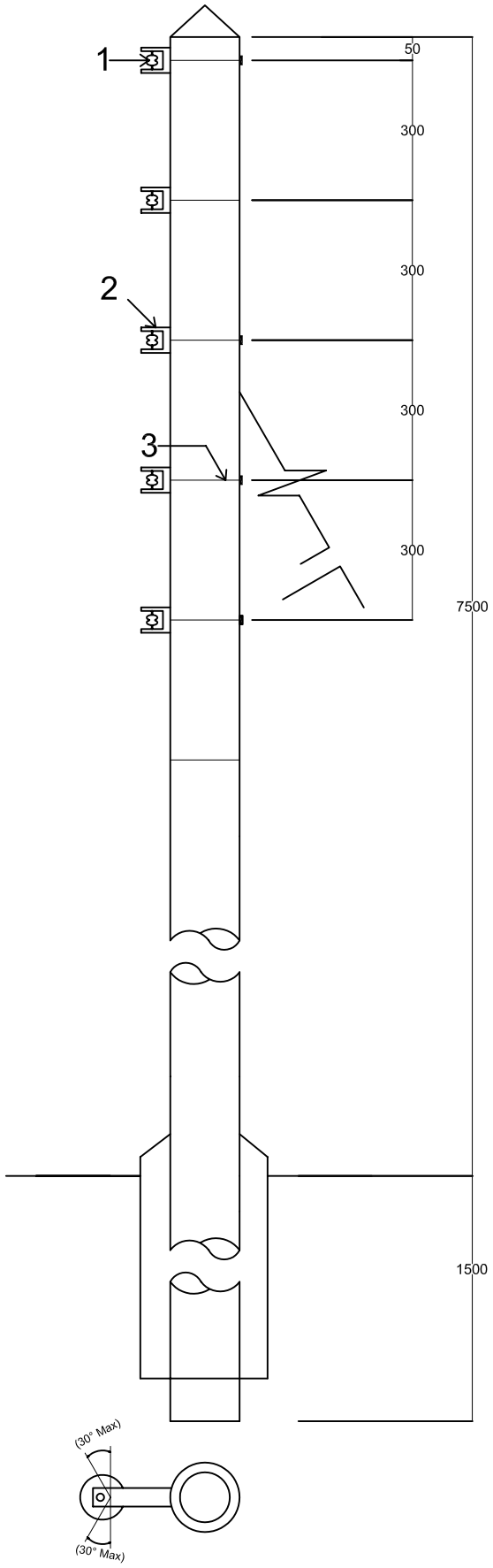
Refer Drawing No: CSLV-CC-02

15° TO 60°

S.No.	QTY.	UNIT	MATERIAL
1	4	N0	SHACKLE INSULATOR
2	4	SET	D-IRON
3	4	N0	NUT AND BOLT 5\ 8" * LENGTH AS REQUIRED
4	1	LOT	BINDING WIRE
5	1	No.	POLE PSC/ STEEL TUBULAR 8 m / 9 m

CONSTRUCTION STANDARDS
O/H LV ANGLE SUPPORT
15° TO 60°

NEPAL ELECTRICITY AUTH0RITY
Technical Service/ Commercial Department
Distribution and Consumer Services



Drawing **CSLV-CC-02**	**O/H 400/230 V Angle Support (15° to 60° Deviation)**	NEPAL ELECTRICITY AUTHORITY **Technical Services/ Commercial Department** Distribution and Consumer Services

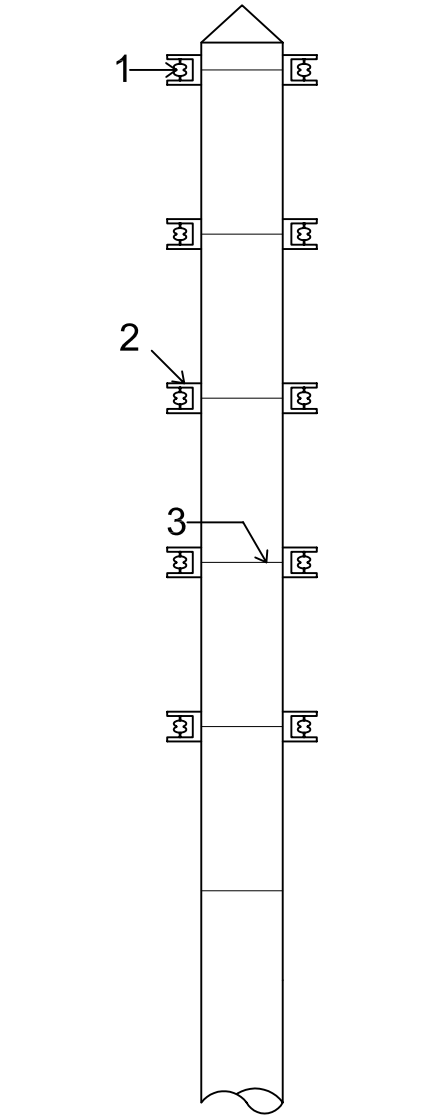
Refer Drawing No: CSLV-CC-03

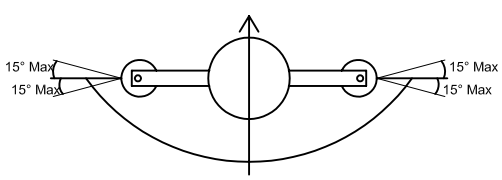
ANGLE SUPPORT DEVIATION UP TO 30°

S.No.	QTY.	UNIT	MATERIAL
1	8	N0	SHACKLE INSULATOR
2	8	SET	D-IRON
3	4	N0	NUT AND BOLT 5\ 8" * LENGTH AS REQUIRED
4	1	LOT	BINDING WIRE
5	1	No.	POLE PSC/ STEEL TUBULAR 8 m / 9 m

CONSTRUCTION STANDARDS
O/H LV ANGLE SUPPORT
DEVIATION UP TO 30°

NEPAL ELECTRICITY AUTHORITY
Technical Service/ Commercial Department
Distribution and Consumer Services





Drawing **CSLV-CC-03**	**O/H 400/230 V Angle Support (Deviations up to 30°)**	NEPAL ELECTRICITY AUTHORITY **Technical Services/ Commercial Department** Distribution and Consumer Services

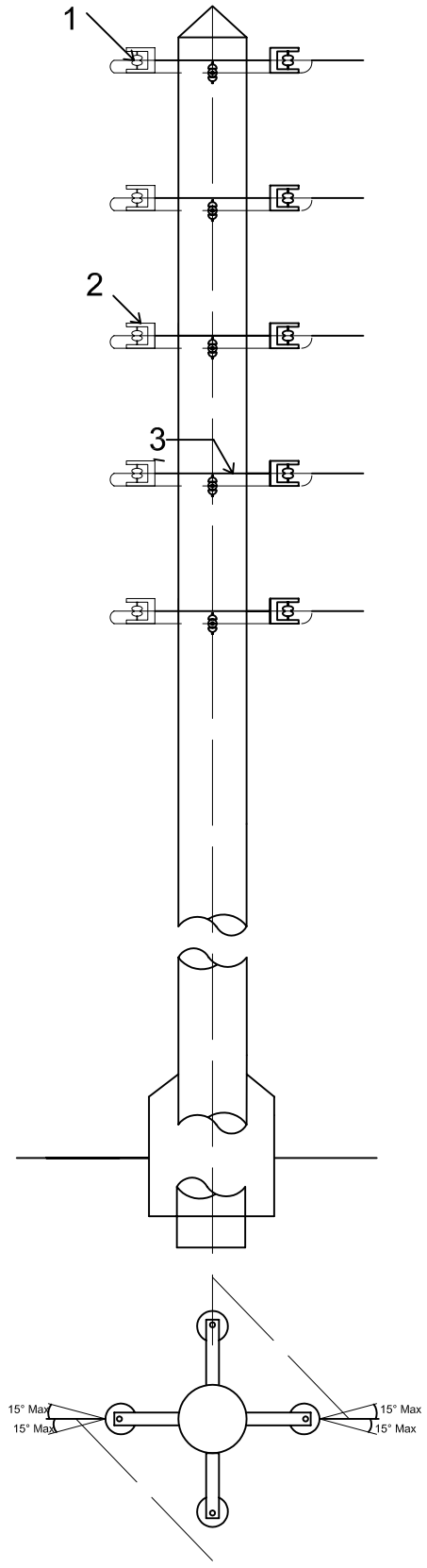
Refer Drawing No: CSLV-CC-04

INTERMEDIATE SUPPORT DEVIATION OVER 30°

S.No.	QTY.	UNIT	MATERIAL
1	12	N0	SHACKLE INSULATOR
2	12	SET	D-IRON
3	12	N0	NUT AND BOLT 5\ 8" * LENGTH AS REQUIRED
4	1	LOT	BINDING WIRE
5	1	No.	POLE PSC/ STEEL TUBULAR 8 m / 9 m

CONSTRUCTION STANDARDS
O/H LV THRE OR FOUR WAY ARRANG DEVIATION OVER 30°

NEPAL ELECTRICITY AUTHORITY
Technical Service/ Commercial Department
Distribution and Consumer Services



Drawing **CSLV-CC-04**	**O/H 400/230 V Three or Four Way Arrangement (Deviation Over 30°)**	NEPAL ELECTRICITY AUTHORITY **Technical Services/ Commercial Department** Distribution and Consumer Services

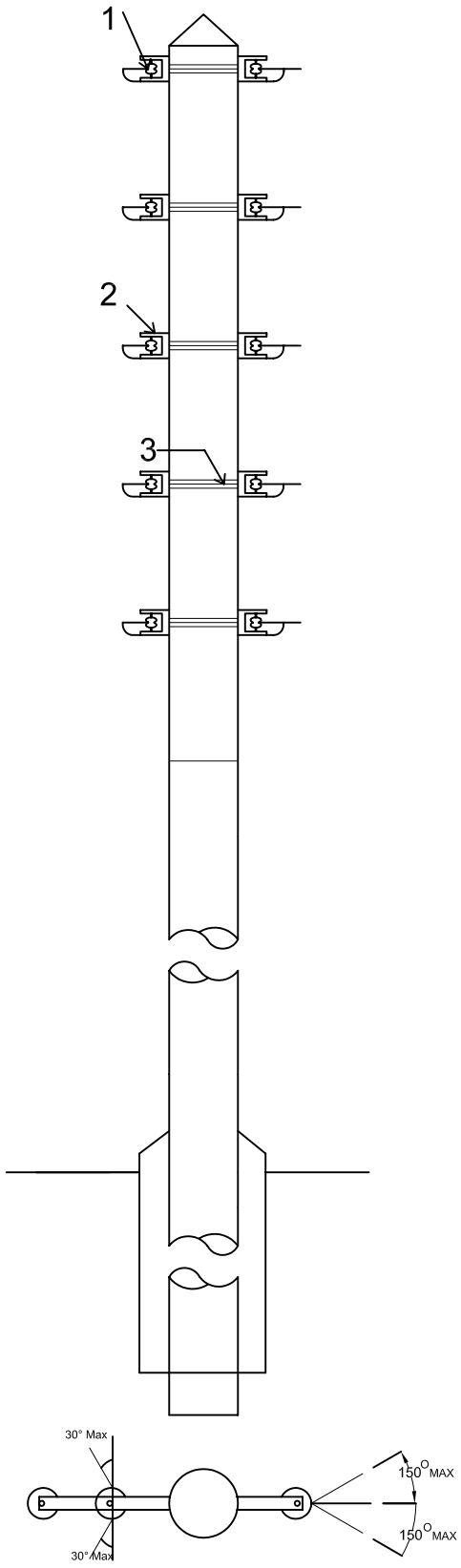
Refer Drawing No: CSLV-CC-05

SUPPORT WITH TEE-OFF CONNECTION

S.No.	QTY.	UNIT	MATERIAL
1	8	N0	SHACKLE INSULATOR
2	8	SET	D-IRON
3	4	N0	NUT AND BOLT 5\ 8" * LENGTH AS REQUIRED
4	1	LOT	BINDING WIRE
5	1	No.	POLE PSC/ STEEL TUBULAR 8 m / 9 m

CONSTRUCTION STANDARDS
O/H LV SUPPORT WITH TEE-OFF CONNECTION

NEPAL ELECTRICITY AUTHORITY
Technical Service/ Commercial Department
Distribution and Consumer Services



Drawing **CSLV-CC-05**	**O/H 400/230 V Intermediate Angle Support with Tee - off Connection**	NEPAL ELECTRICITY AUTHORITY **Technical Services/ Commercial Department** Distribution and Consumer Services

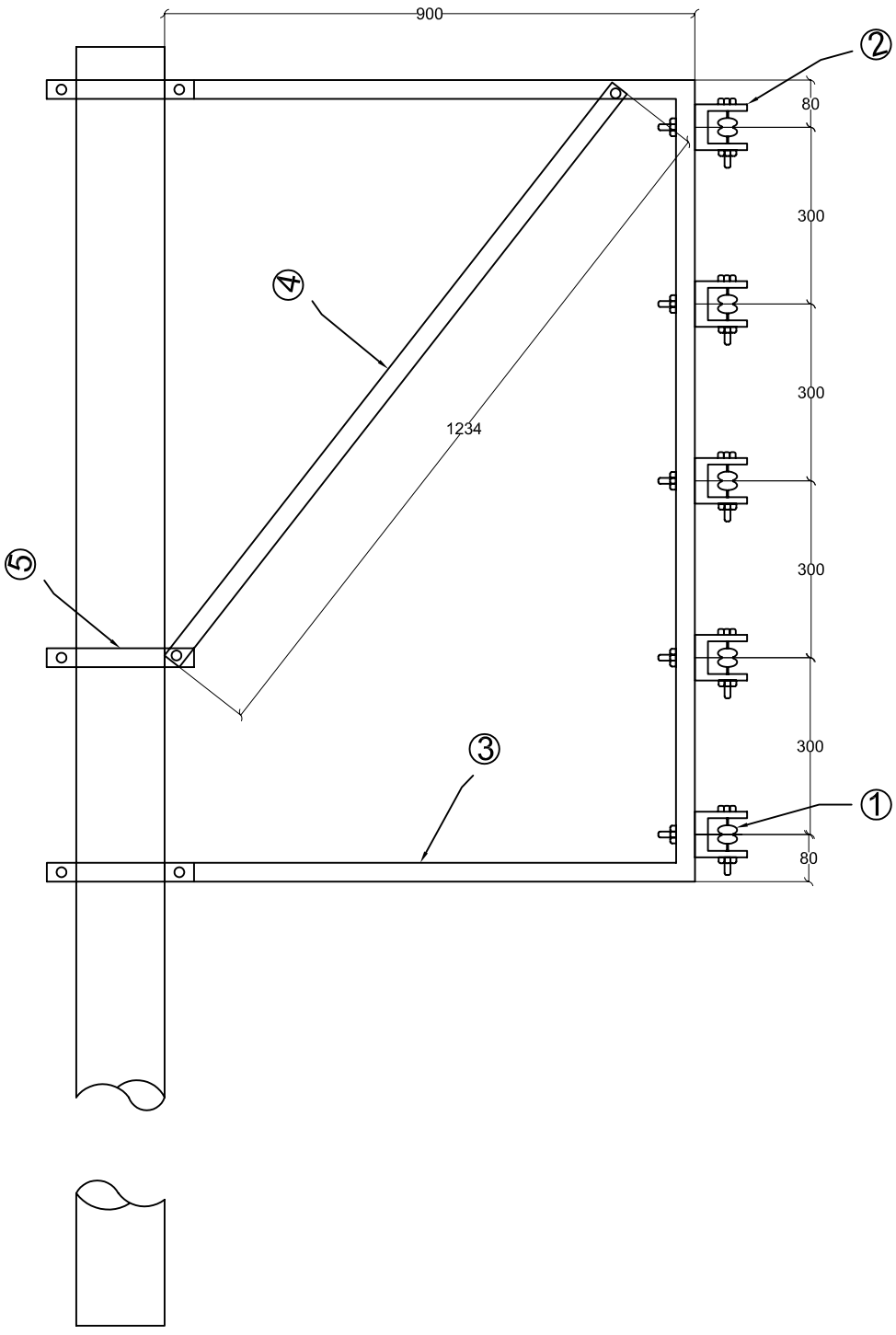
Refer Drawing No: CSLV-CC-06

SUPPORT WITH D-BRACKET

S.No.	QTY.	UNIT	MATERIAL
1	5	N0	SHACKLE INSULATOR
2	5	SET	D-IRON WITH NUT AND BOLT
3	1	N0	STEEL CROSSARM CHANNEL (50x 100 x 6.4) mm, (D BRACKET 900 x 1360) mm.
4	1	NO	BRACING FOR D-BRACKET (50x 100 x 6.4 x 1234) mm
5	3	SET	SUITABLE POLE CLAMPS WITH NUT AND BOLTS
6	1	NO	BOLT 5\ 8" * LENGTH AS REQUIRED
7	1	LOT	BINDING WIRE
8	1	NO	POLE PSC/ STEEL TUBULAR 8 m / 9 m

CONSTRUCTION STANDARDS
O/H LV SUPPORT WITH D-BRACKET

NEPAL ELECTRICITY AUTHORITY
Technical Service/ Commercial Department
Distribution and Consumer Services



Drawing **CSLV-CC-06**	**LV O/H Line Pole with D - Bracket**	NEPAL ELECTRICITY AUTHORITY **Technical Services/ Commercial Department** Distribution and Consumer Services

Refer Drawing No: CSLV-ABC- 01

0° TO 30°

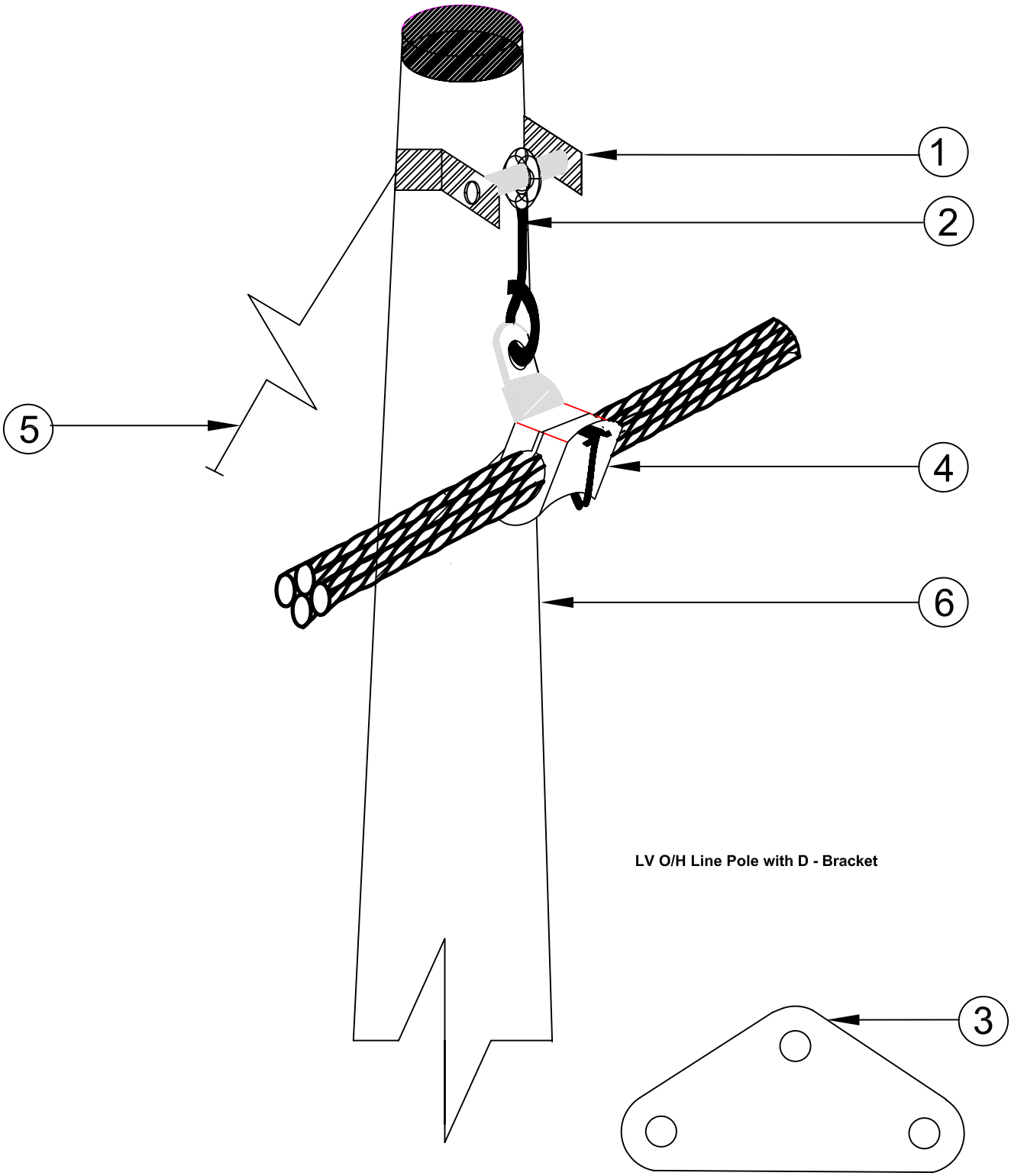
S.No.	QTY.	UNIT	MATERIAL
1	1	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS
2	1	SET	PIGTAIL WITH FABRICATED EYE
3	0	NO.	ANGLE PLATE
3	1	SET	SUSPENSION CLAMP
4	1	NO.	LT STAY SET (TYPE AS REQUIRED)
5	1	NO.	POLE TELESCOPIC 8 m / 9 m

31° TO 60°

S.No.	QTY.	UNIT	MATERIAL
1	1	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS
2	1	SET	PIGTAIL WITH FABRICATED EYE
3	1	No.	ANGLE PLATE
4	1	SET	SUSPENSION CLAMP
5	1	No.	LT STAY SET (TYPE AS REQUIRED)
6	1	No.	POLE TELESCOPIC 8 m / 9 m

CONSTRUCTION STANDARDS
LV TYPE-A (SUSPENSION TYPE)
TELESCOPIC POLE

NEPAL ELECTRICITY AUTHORITY
Technical Service/ Commercial Department
Distribution and Consumer Services



LV O/H Line Pole with D - Bracket

ANGLE PLATE (for angle 31- 60 Deg.)

Drawing	ABC -TTSP-Suspension Type - TYPE A	NEPAL ELECTRICITY AUTHORITY
CSLV-ABC-01		Technical Services/ Commercial Department
		Distribution and Consumer Services

Refer Drawing No: CSLV-ABC- 02

0° TO 30°

S.No.	QTY.	UNIT	MATERIAL
1	2	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS
2	1	SET	PIGTAIL WITH FABRICATED EYE
3	1	SET	SUSPENSION CLAMP
4	0	NO.	ANGLE PLATE
5	1	NO.	TWISTED DOUBLE EYE
6	1	SET	ANCHOR CLAMP WITH NUTS AND BOLTS
7	4	NOS	INSULATED CABLE CAP
8	8	NOS	INSULATED PIERCING CONNECTOR
9	1	NO.	LT STAY SET (TYPE AS REQUIRED)
10	1	NO.	POLE TELESCOPIC 8 m / 9 m

31° TO 60°

S.No.	QTY.	UNIT	MATERIAL
1	2	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS
2	1	SET	PIGTAIL WITH FABRICATED EYE
3	1	No.	ANGLE PLATE
4	1	SET	SUSPENSION CLAMP
5	1	No.	TWISTED DOUBLE EYE
6	1	SET	ANCHOR CLAMP WITH NUTS AND BOLTS
7	4	NOS	INSULATED CABLE CAP
8	8	NOS	INSULATED PIERCING CONNECTOR
9	1	No.	LT STAY SET (TYPE AS REQUIRED)
10	1	No.	POLE TELESCOPIC 8 m / 9 m

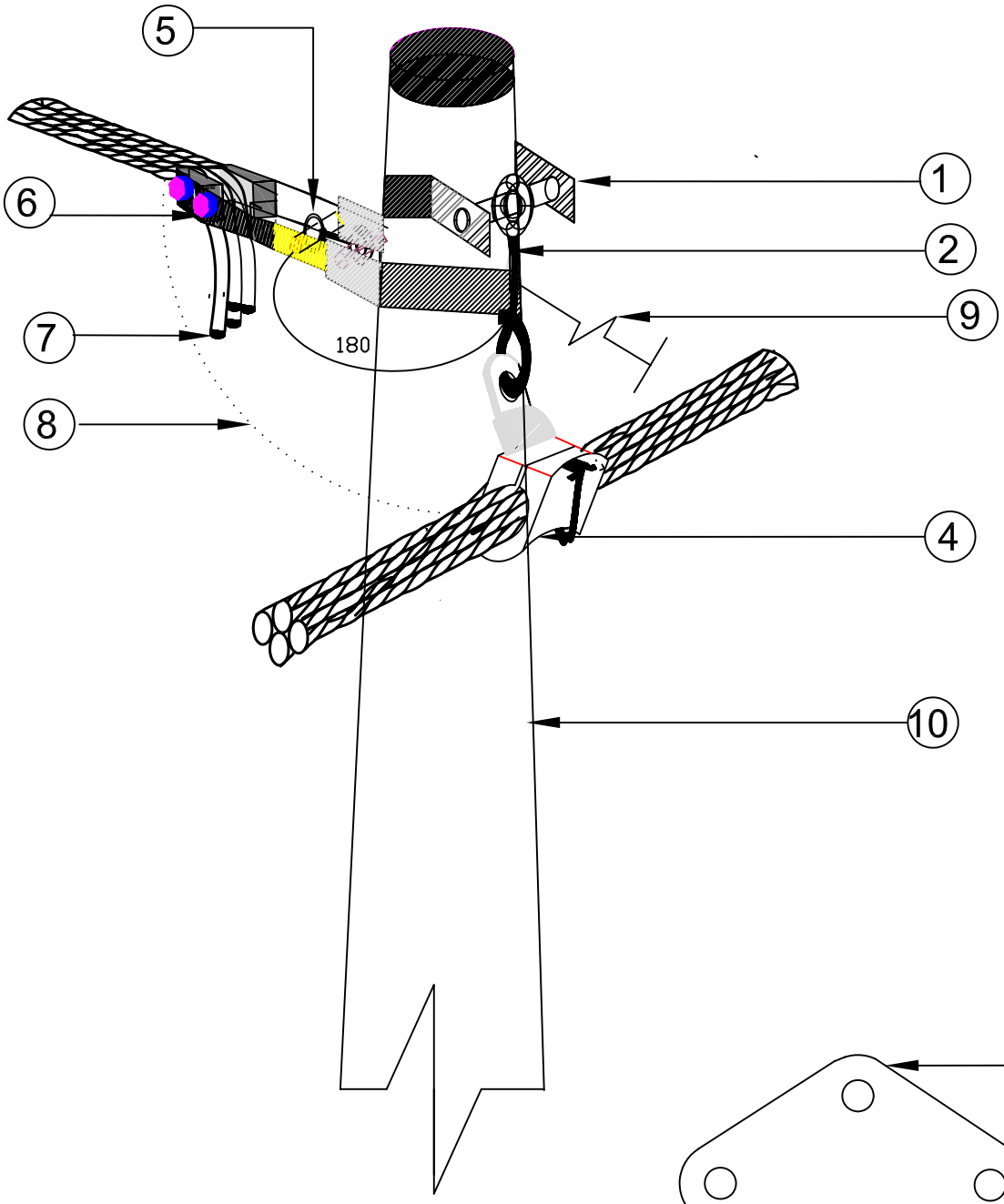
CONSTRUCTION STANDARDS

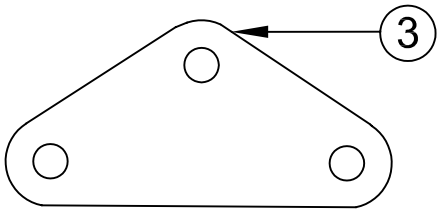
LV TYPE-B (SUSPENSION WITH AN ANCHOR FOR DEAD) TELESCOPIC POLE

NEPAL ELECTRICITY AUTHORITY

Technical Service/ Commercial Department

Distribution and Consumer Services





ANGLE PLATE (for angle 31- 60 Deg.)

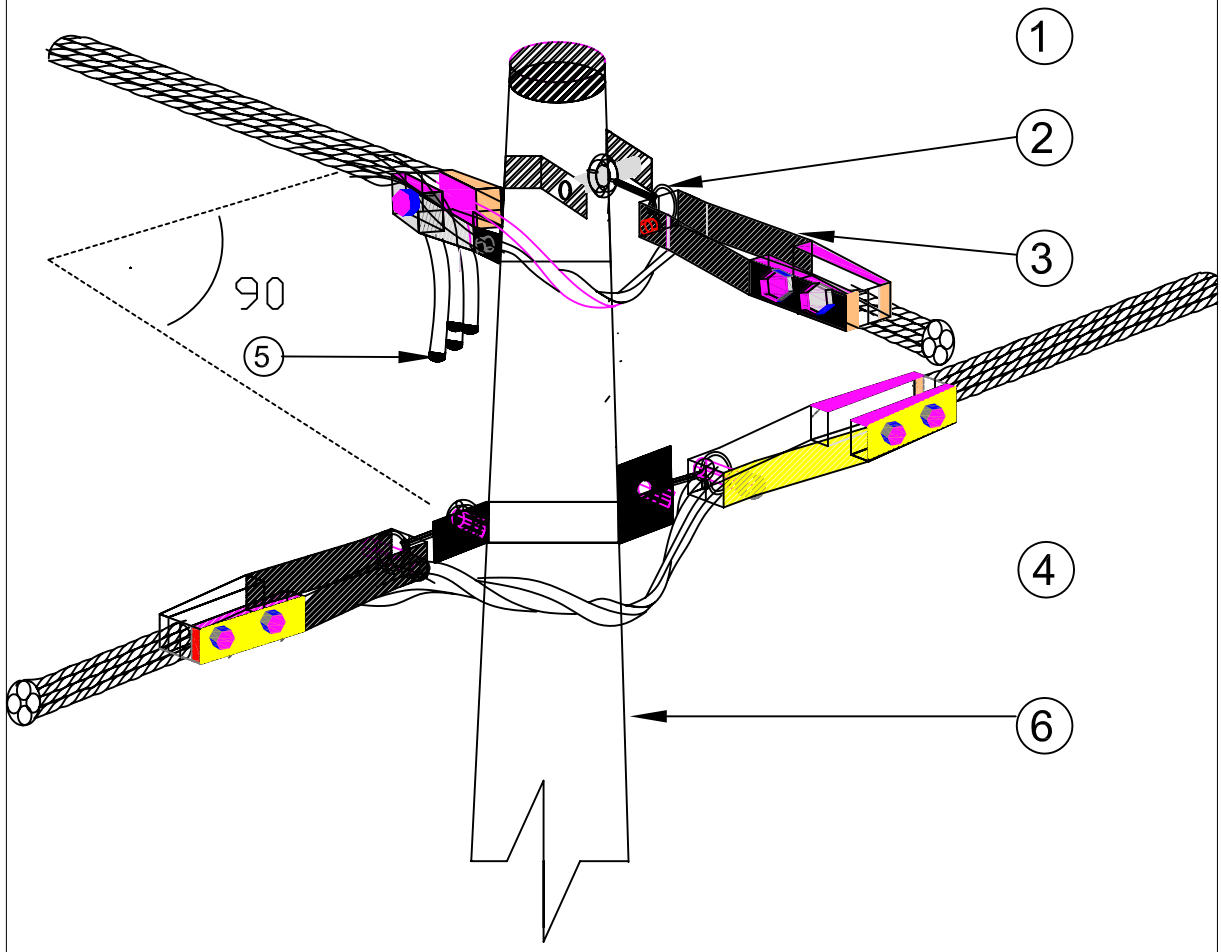
Drawing **CSLV-ABC-02**	**ABC -TTSP-Suspension Type with an Anchor for Dead-TYPE B**	NEPAL ELECTRICITY AUTHORITY **Technical Services/ Commercial Department** Distribution and Consumer Services

Refer Drawing No: CSLV-ABC- 03

S.No.	QTY.	UNIT	MATERIAL
1	2	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS
2	4	No.	TWISTED DOUBLE EYE
3	4	SET	ANCHOR CLAMP WITH NUTS AND BOLTS
4	16	NOS	INSULATED PIERCING CONNECTOR
5	16	NOS	INSULATED CABLE CAP
6	1	No.	POLE TELESCOPIC 8 m / 9 m

CONSTRUCTION STANDARDS
LV TYPE-C (FOUR ANCHOR DEAD END)
TELESCOPIC POLE

NEPAL ELECTRICITY AUTHORITY
Technical Service/ Commercial Department
Distribution and Consumer Services



Drawing **CSLV-ABC-03**	**ABC-TTSP-Four Anchor Dead End-TYPE C**	NEPAL ELECTRICITY AUTHORITY **Technical Services/ Commercial Department** Distribution and Consumer Services

Refer Drawing No: CSLV-ABC- 04

S.No.	QTY.	UNIT	MATERIAL
1	2	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS
2	3	SET	PIGTAIL WITH FABRICATED EYE
3	0	NO.	ANGLE PLATE
3	1	SET	SUSPENSION CLAMP
4	2	No.	TWISTED DOUBLE EYE
5	2	SET	ANCHOR CLAMP WITH NUTS AND BOLTS
6	8	NOS	INSULATED CABLE CAP
7	16	NOS	INSULATED PIERCING CONNECTOR
8	1	No.	LT STAY SET (TYPE AS REQUIRED)
9	1	No.	POLE TELESCOPIC 8 m / 9 m

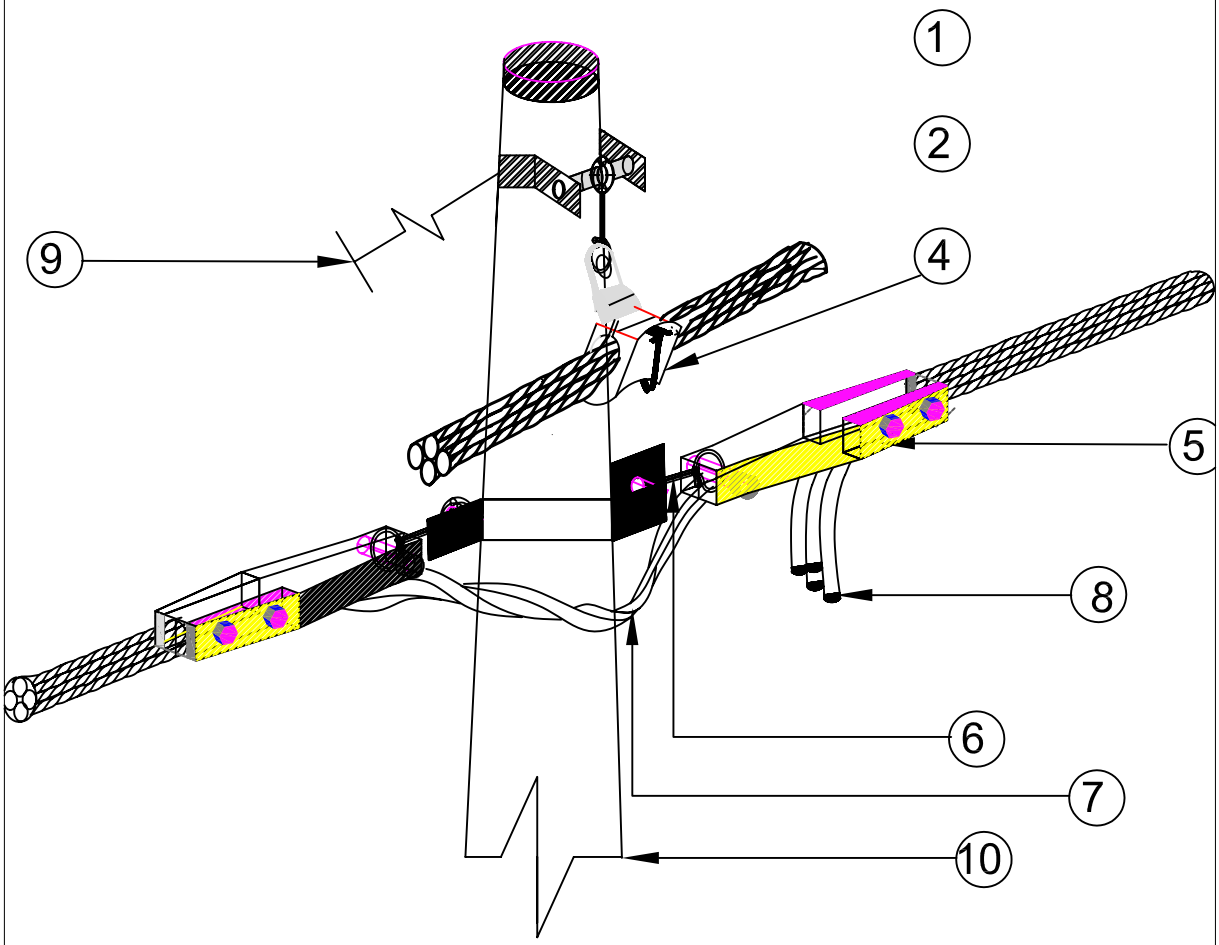
CONSTRUCTION STANDARDS

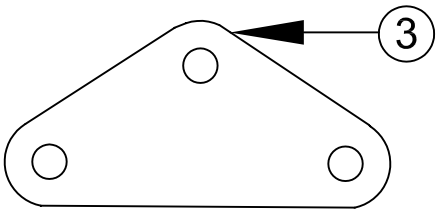
LV TYPE-E (ONE SUSPENSION WITH TWO ANCHOR DEAD)
TELESCOPIC POLE

NEPAL ELECTRICITY AUTHORITY

Technical Service/ Commercial Department

Distribution and Consumer Services





ANGLE PLATE (for angle 31- 60 Deg.)

Drawing **CSLV-ABC-04**	**ABC -TTSP-One Suspension with Two Anchor Dead End-TYPE E**	NEPAL ELECTRICITY AUTHORITY **Technical Services/ Commercial Department** Distribution and Consumer Services

Refer Drawing No: CSLV-ABC- 05

S.No.	QTY.	UNIT	MATERIAL
1	1	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS
2	1	SET	PIGTAIL WITH FABRICATED EYE
3	1	SET	ANCHOR CLAMP WITH NUTS AND BOLTS
4	4	NOS	INSULATED CABLE CAP
5	1	No.	LT STAY SET (TYPE AS REQUIRED)
6	1	No.	POLE TELESCOPIC 8 m / 9 m

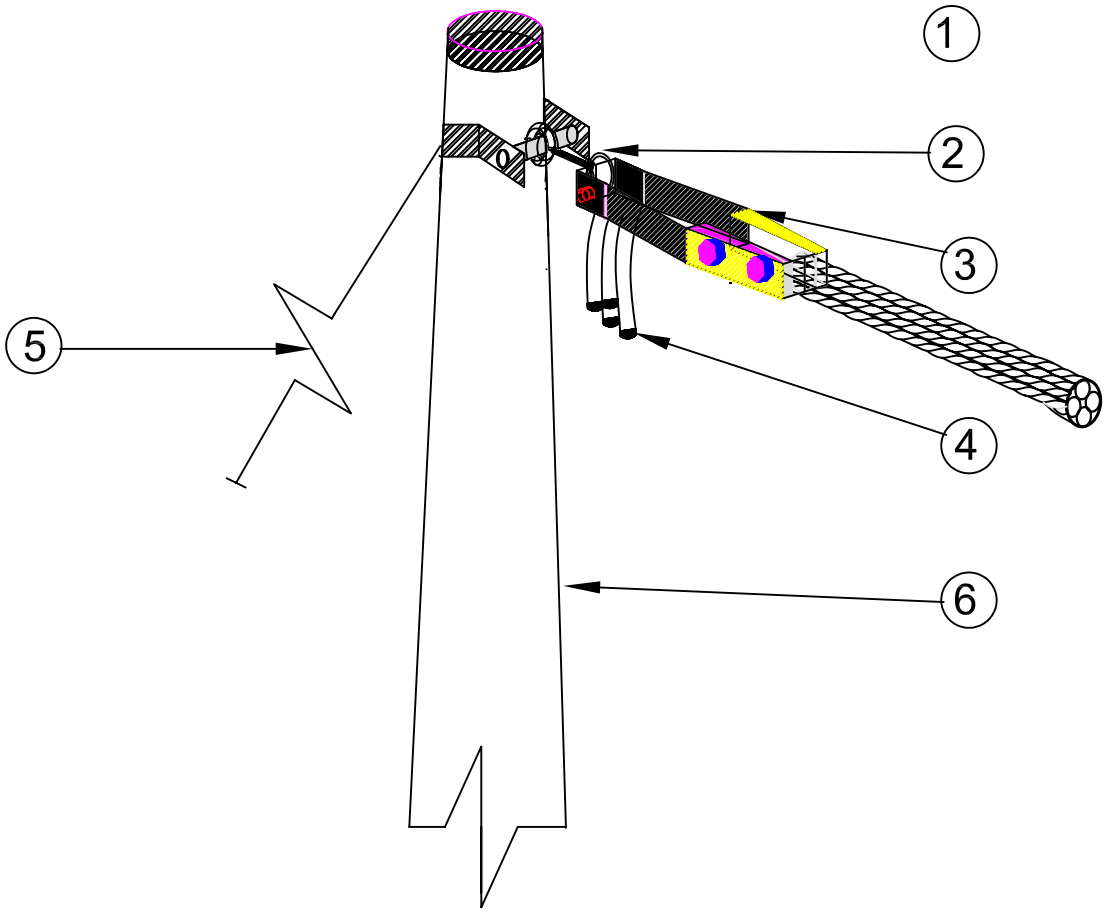
CONSTRUCTION STANDARDS

LV TYPE-F (SINGLE ANCHOR DEAD) TELESCOPIC POLE

NEPAL ELECTRICITY AUTHORITY

Technical Service/ Commercial Department

Distribution and Consumer Services



Drawing **CSLV-ABC-05**	**ABC-TTSP-Single Anchor Dead End - TYPE F**	NEPAL ELECTRICITY AUTHORITY **Technical Services/ Commercial Department** Distribution and Consumer Services

Refer Drawing No: CSLV-ABC- 06

0° TO 30°

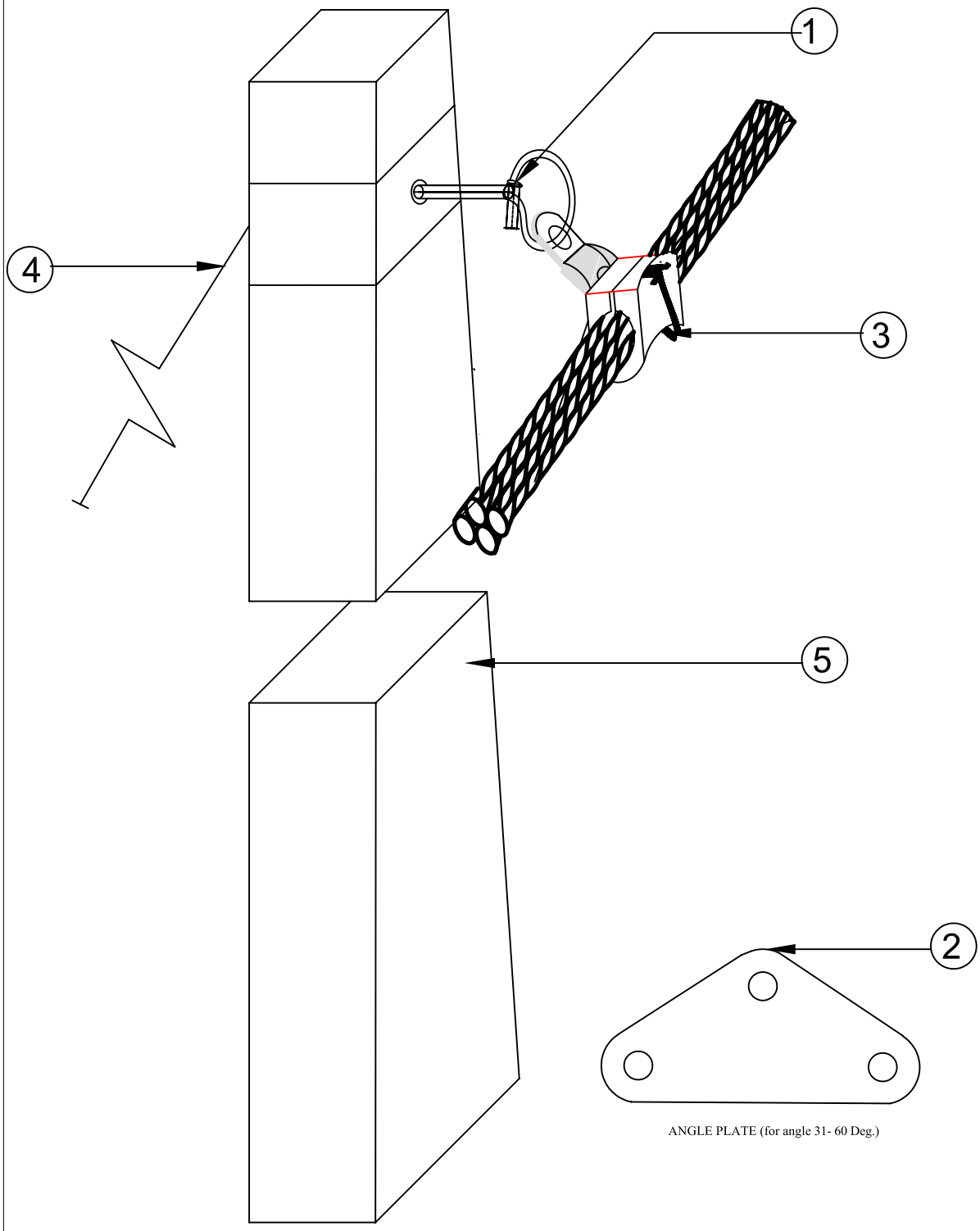
S.No.	QTY.	UNIT	MATERIAL
1	1	SET	PIGTAIL WITH HEXAGONAL NUTS AND WASHERS (16 * 203) mm
2	0	No.	ANGLE PLATE
3	1	SET	SUSPENSION CLAMP
4	1	No.	LT STAY SET (TYPE AS REQUIRED)
5	1	No.	POLE PSC 8 m / 9 m

31° TO 60°

S.No.	QTY.	UNIT	MATERIAL
1	1	SET	PIGTAIL WITH HEXAGONAL NUTS AND WASHERS (16 * 203) mm
2	1	No.	ANGLE PLATE
3	1	SET	SUSPENSION CLAMP
4	1	No.	LT STAY SET (TYPE AS REQUIRED)
5	1	No.	POLE PSC 8 m / 9 m

CONSTRUCTION STANDARDS
LV TYPE-A (SUSPENSION TYPE)
PSC POLE

NEPAL ELECTRICITY AUTHORITY
Technical Service/ Commercial Department
Distribution and Consumer Services



ANGLE PLATE (for angle 31- 60 Deg.)

Drawing **CSLV-ABC-06**	**ABC-PSC-Suspension Type-TYPE A**	NEPAL ELECTRICITY AUTHORITY **Technical Services/ Commercial Department** Distribution and Consumer Services

Refer Drawing No: CSLV-ABC- 07

0° TO 30°

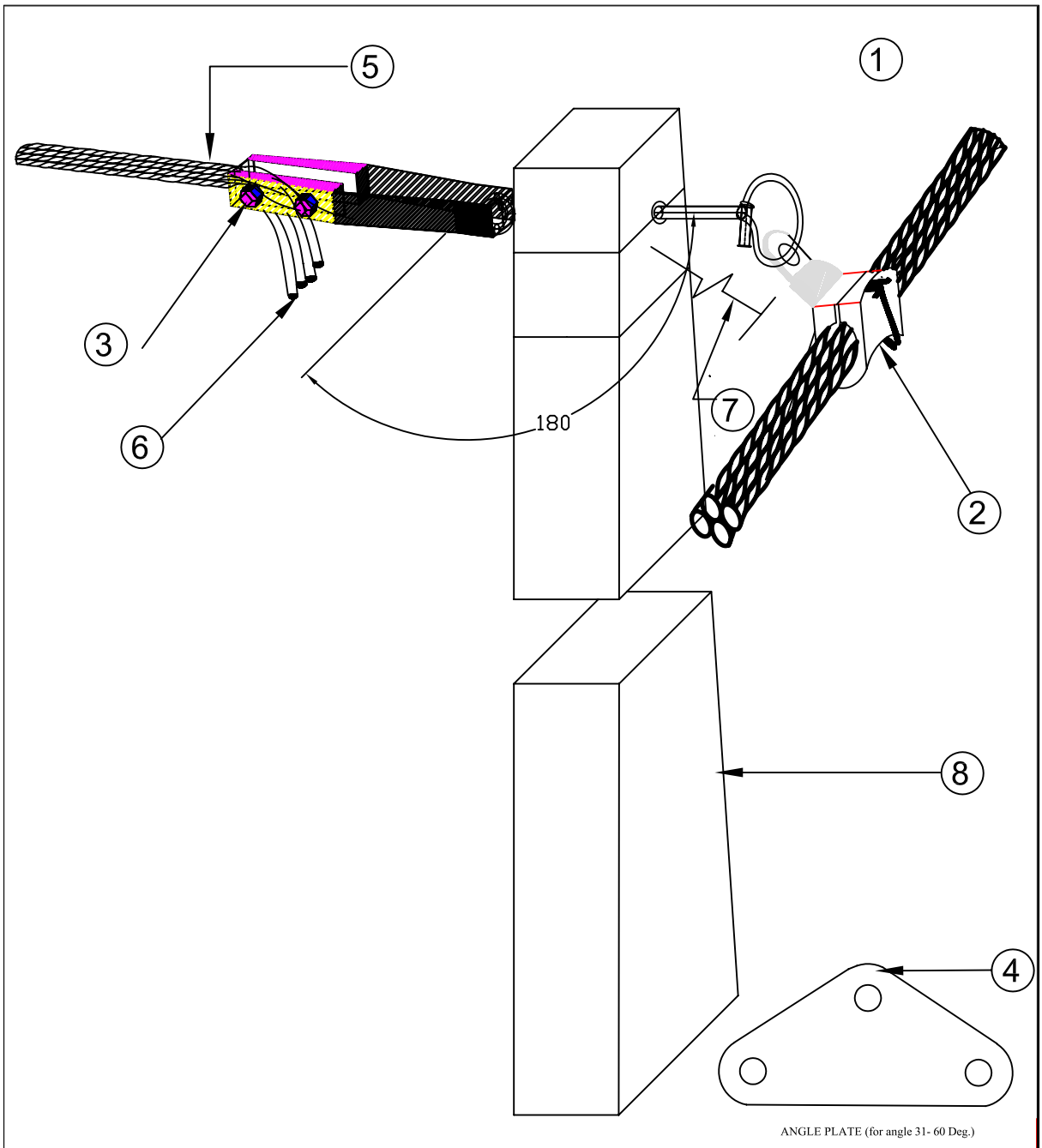
S.No.	QTY.	UNIT	MATERIAL
1	2	SET	PIGTAIL WITH HEXAGONAL NUTS AND WASHERS (16 * 203) mm
2	1	SET	SUSPENSION CLAMP
3	1	SET	ANCHOR CLAMP WITH NUTS AND BOLTS
4	0	NO.	ANGLE PLATE
5	8	NOS	INSULATED PIERCING CONNECTOR
6	4	NOS	INSULATED CABLE CAP
7	1	NO.	LT STAY SET (TYPE AS REQUIRED)
8	1	NO.	POLE PSC 8 m / 9 m

31° TO 60°

S.No.	QTY.	UNIT	MATERIAL
1	2	SET	PIGTAIL WITH HEXAGONAL NUTS AND WASHERS (16 * 203) mm
2	1	SET	SUSPENSION CLAMP
3	1	SET	ANCHOR CLAMP WITH NUTS AND BOLTS
4	1	NO.	ANGLE PLATE
5	8	NOS	INSULATED PIERCING CONNECTOR
6	4	NOS	INSULATED CABLE CAP
7	1	NO.	LT STAY SET (TYPE AS REQUIRED)
8	1	NO.	POLE PSC 8 m / 9 m

CONSTRUCTION STANDARDS
LV TYPE-B (SUSPENSION WITH AN ANCHOR FOR DEAD)
PSC POLE

NEPAL ELECTRICITY AUTHORITY
Technical Service/ Commercial Department
Distribution and Consumer Services



ANGLE PLATE (for angle 31- 60 Deg.)

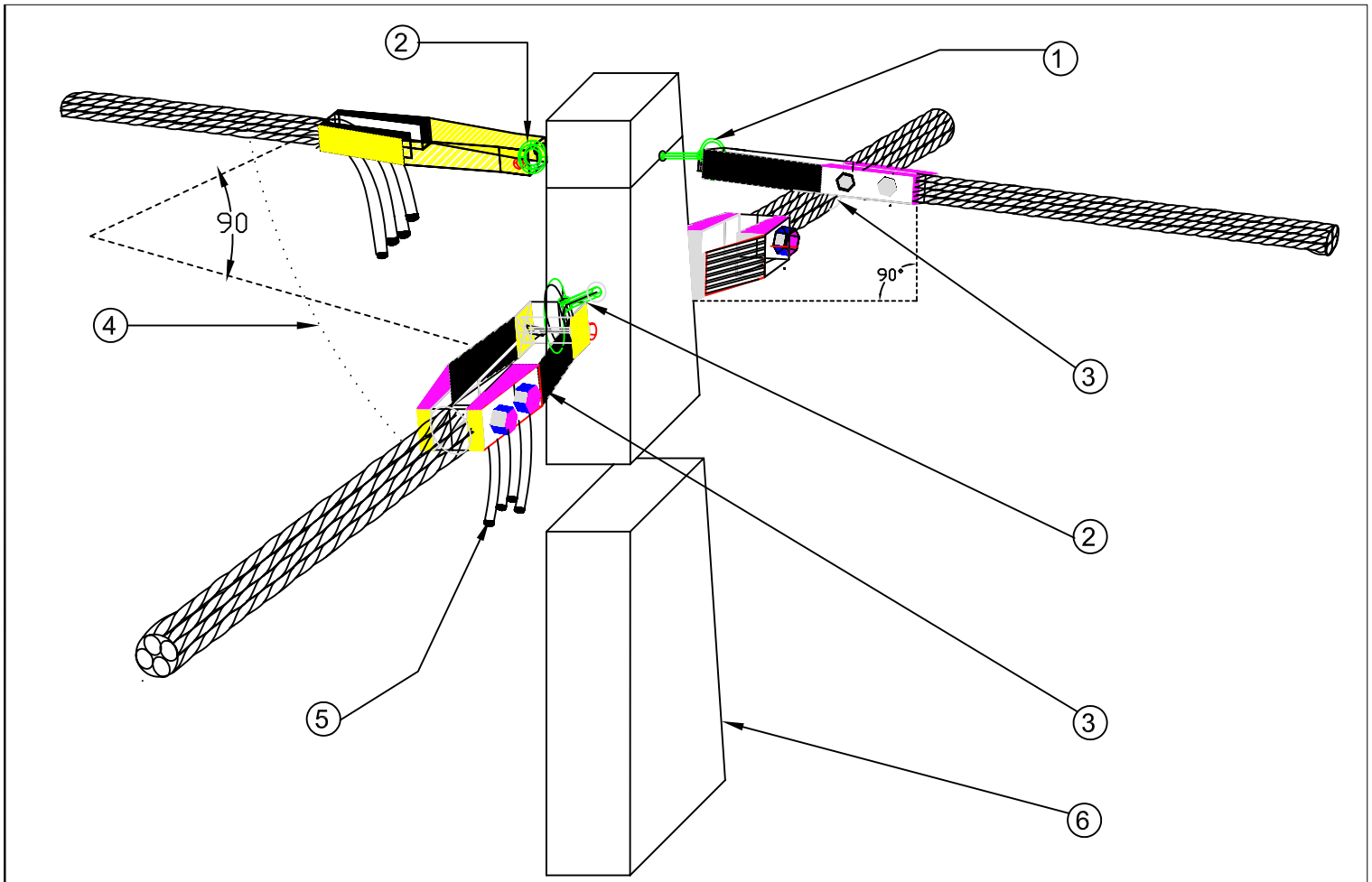
Drawing **CSLV-ABC-07**	**ABC -PSC-Suspension Type with an Anchor for Dead-TYPE B**	NEPAL ELECTRICITY AUTHORITY **Technical Services/ Commercial Department** Distribution and Consumer Services

Refer Drawing No: CSLV-ABC-08

S.No.	QTY.	UNIT	MATERIAL
1	2	SET	POLE CLAMP WITH NUT,BOLT AND WASHERS
2	2	No.	EYE NUT
3	4	SET	ANCHOR CLAMP WITH NUTS AND BOLTS
4	16	NOS	INSULATED PIERCING CONNECTOR
5	16	NOS	INSULATED CABLE CAP
6	1	No.	POLE PSC 8 m / 9 m

CONSTRUCTION STANDARDS
LV TYPE-C (FOUR ANCHOR DEAD END)
PSC POLE

NEPAL ELECTRICITY AUTHORITY
Technical Service/ Commercial Department
Distribution and Consumer Services



Drawing **CSLV-ABC-08**	**ABC-PSC-Four Anchor Dead End-TYPE C**	NEPAL ELECTRICITY AUTHORITY **Technical Services/ Commercial Department** Distribution and Consumer Services

Refer Drawing No: CSLV-ABC-09

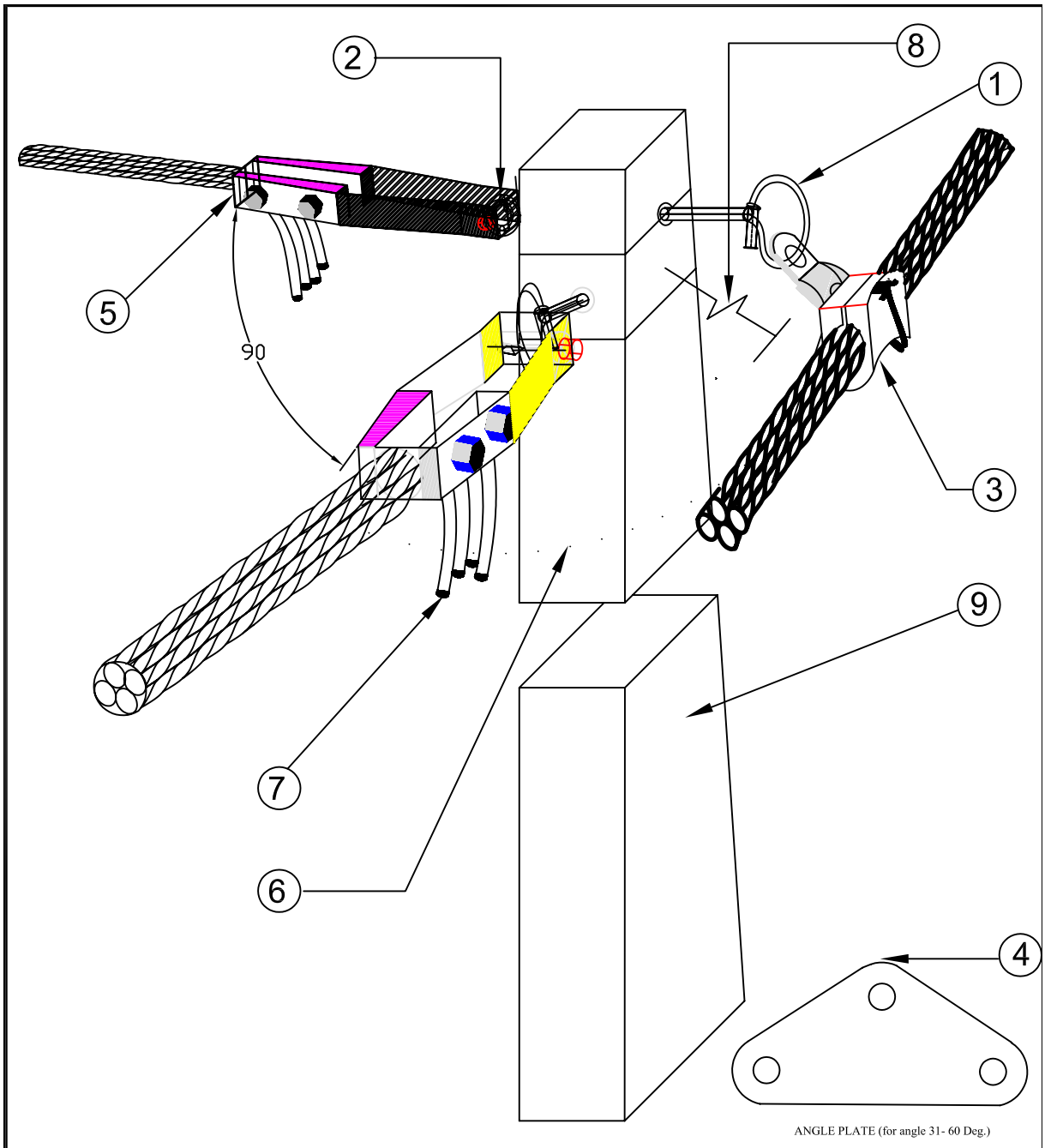
S.No.	QTY.	UNIT	MATERIAL
1	2	SET	PIGTAIL WITH HEXAGONAL NUTS AND WASHERS (16 * 203) mm
2	2	No.	EYE NUT
3	1	SET	SUSPENSION CLAMP
4	1	NO.	ANGLE PLATE
5	2	SET	ANCHOR CLAMP WITH NUTS AND BOLTS
6	16	NOS	INSULATED PIERCING CONNECTOR
7	8	NOS	INSULATED CABLE CAP
8	1	No.	LT STAY SET (TYPE AS REQUIRED)
9	1	No.	POLE PSC 8 m / 9 m

CONSTRUCTION STANDARDS

LV TYPE-E (ONE SUSPENSION WITH TWO ANCHOR DEAD)
PSC POLE

NEPAL ELECTRICITY AUTHORITY
Technical Service/ Commercial Department

Distribution and Consumer Services



Drawing **CSLV-ABC-09**	**ABC -PSC-One suspension with two Anchor Dead End-TYPE E**	NEPAL ELECTRICITY AUTHORITY **Technical Services/ Commercial Department** Distribution and Consumer Services

Refer Drawing No: CSLV-ABC-10

S.No.	QTY.	UNIT	MATERIAL
1	1	SET	PIGTAIL WITH FABRICATED EYE
2	1	SET	ANCHOR CLAMP WITH NUTS AND BOLTS
3	4	NOS	INSULATED CABLE CAP
4	1	No.	LT STAY SET (TYPE AS REQUIRED)
5	1	No.	POLE PSC 8 m / 9 m

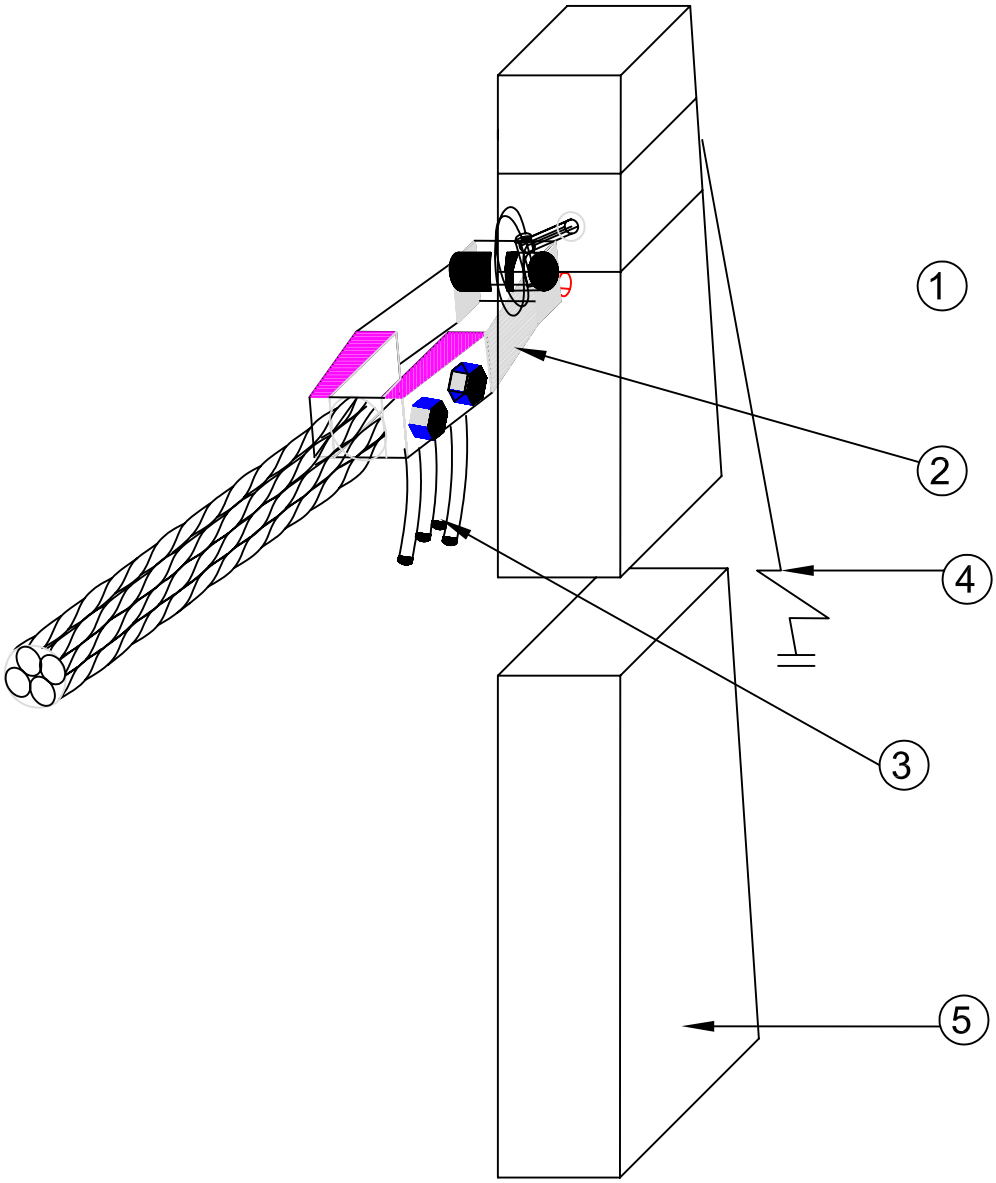
CONSTRUCTION STANDARDS

LV TYPE-F (SINGLE ANCHOR DEAD END) PSC POLE

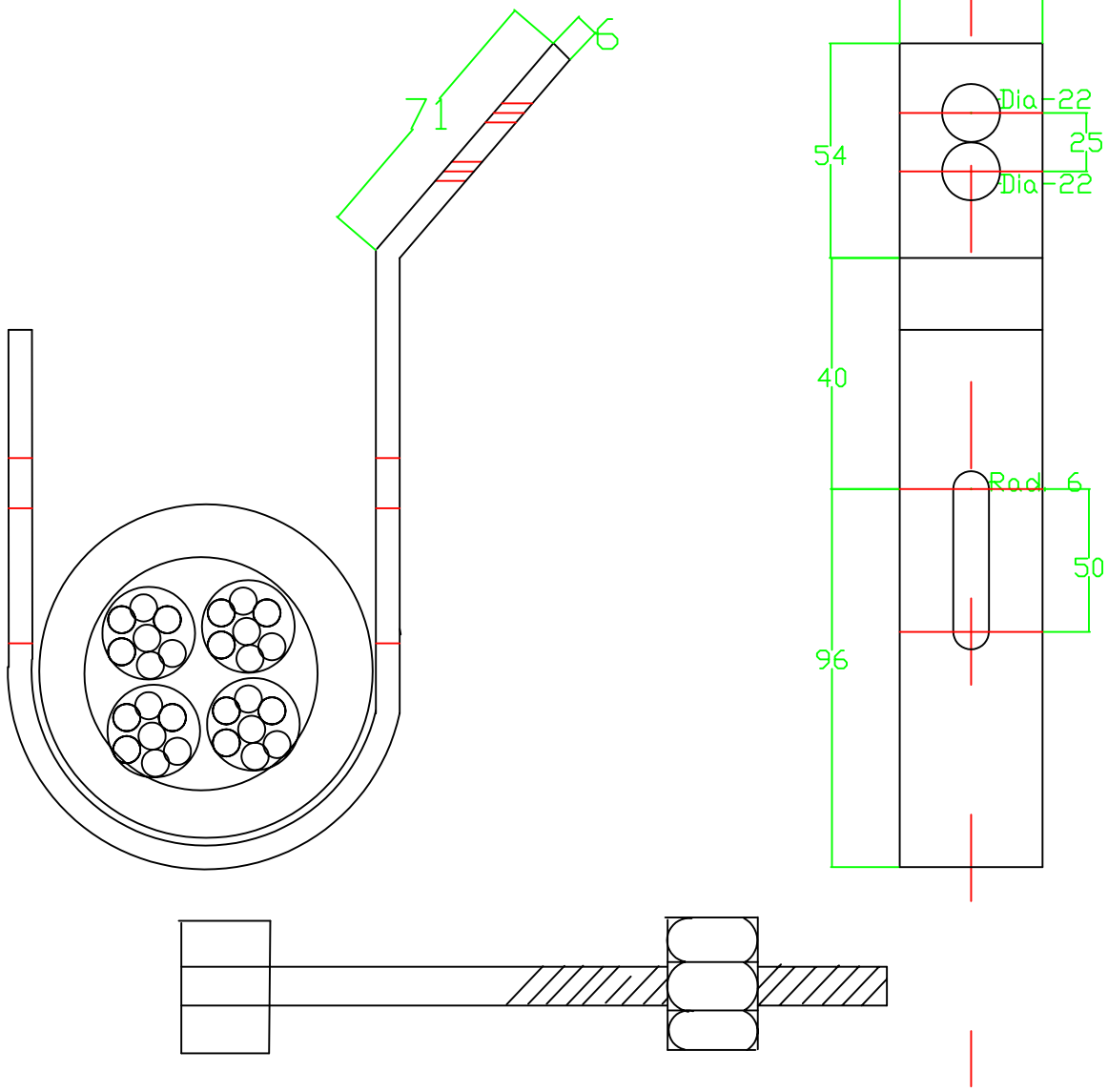
NEPAL ELECTRICITY AUTHORITY

Technical Service/ Commercial Department

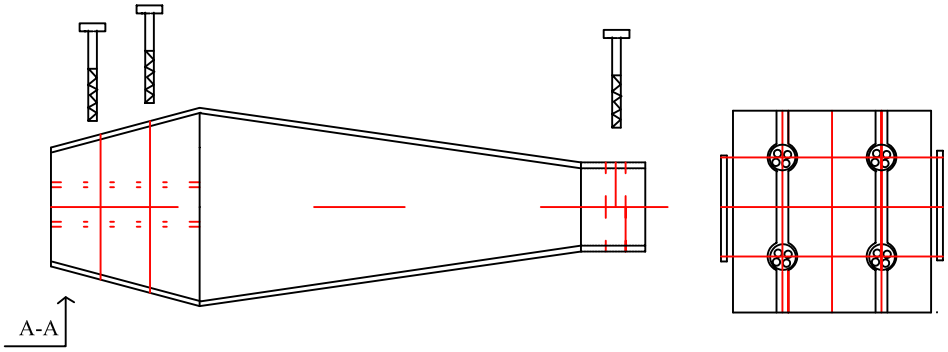
Distribution and Consumer Services



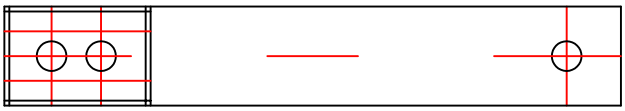
Drawing **CSLV-ABC-10**	**ABC-PSC-Single Anchor Dead End-TYPE F**	NEPAL ELECTRICITY AUTHORITY **Technical Services/ Commercial Department** Distribution and Consumer Services

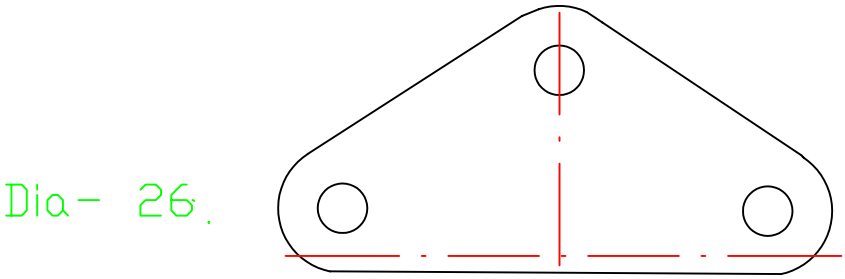


Drawing **CSLV-ABC-11**	**Suspension Clamp**	NEPAL ELECTRICITY AUTHORITY **Technical Services/ Commercial Departmen** Distribution and Consumer Services



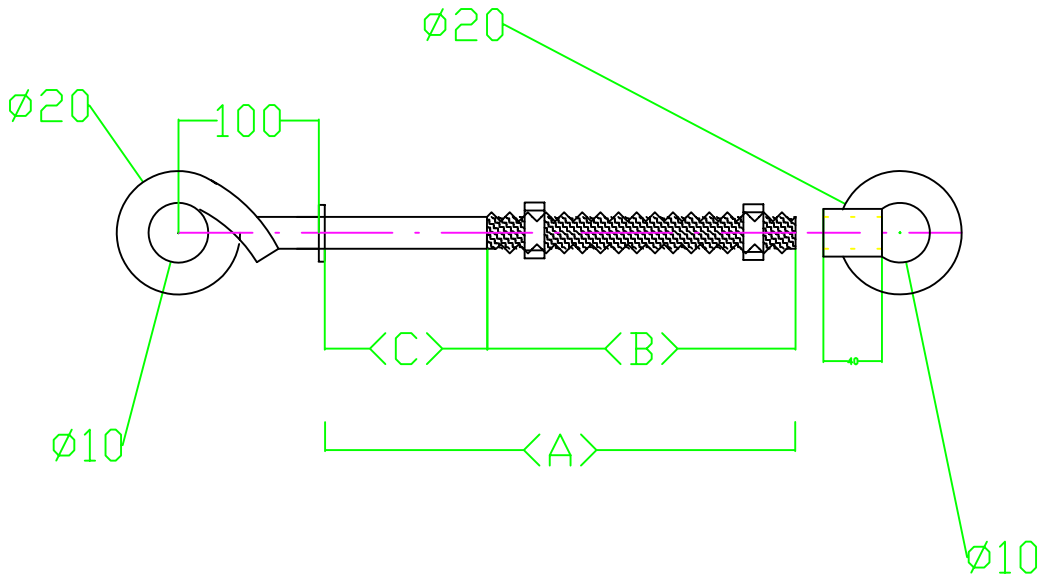
Section A-A



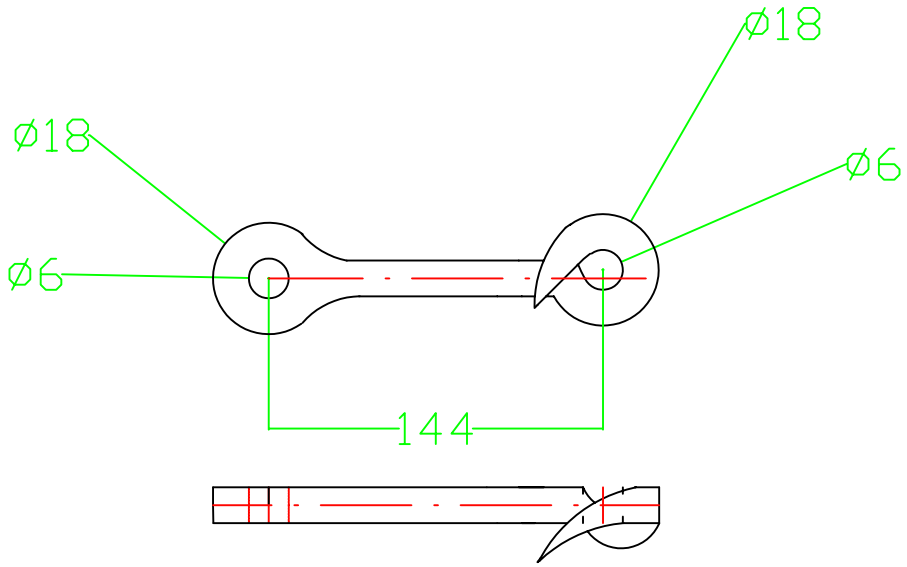


ANGLE PLATE (up to 60 Deg.)

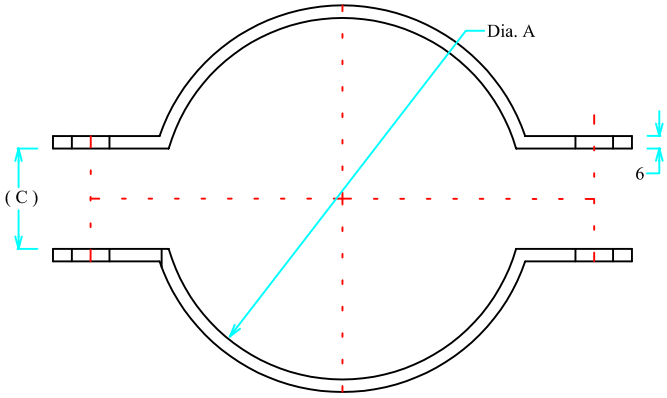
Drawing **CSLV-ABC-12**	**Conceptual Anchor Clamp for ABC Cable**	NEPAL ELECTRICITY AUTHORITY **Technical Services/ Commercial Departmen** Distribution and Consumer Services

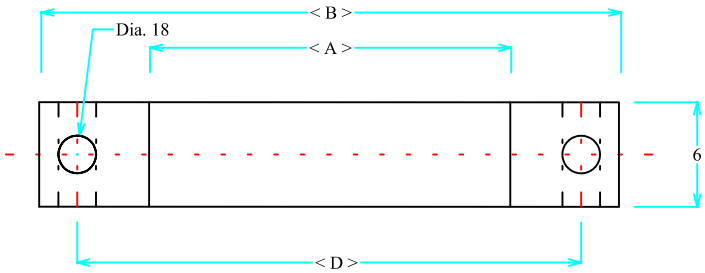


Particular	A , mm	B , mm	C , mm
Pig Tail A1	300	150	150
Pig Tail A2	200	120	80



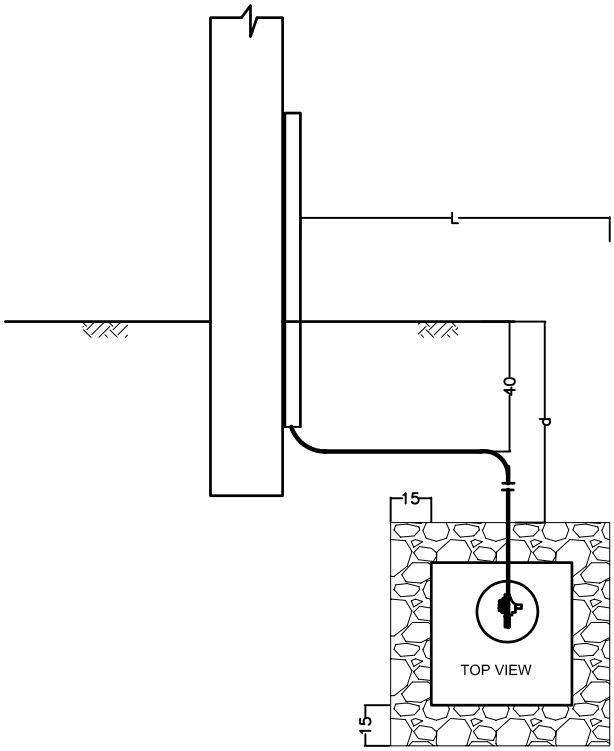
Drawing		
CSLV-ABC-13	**Pig Tail with Adjustable Eye and Double Eye Fitting**	NEPAL ELECTRICITY AUTHORITY **Technical Services/ Commercial Department** Distribution and Consumer Services



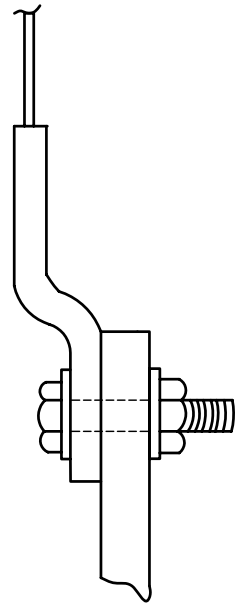


Type	Unit	A	B	C	D
TC6	mm	200	302	50	268
TC8	mm	155	257	50	223

Drawing **CSLV-ABC-14**	**Semicircular Clamp for Telescopic Pole**	NEPAL ELECTRICITY AUTHORITY **Technical Services/ Commercial Department** Distribution and Consumer Services

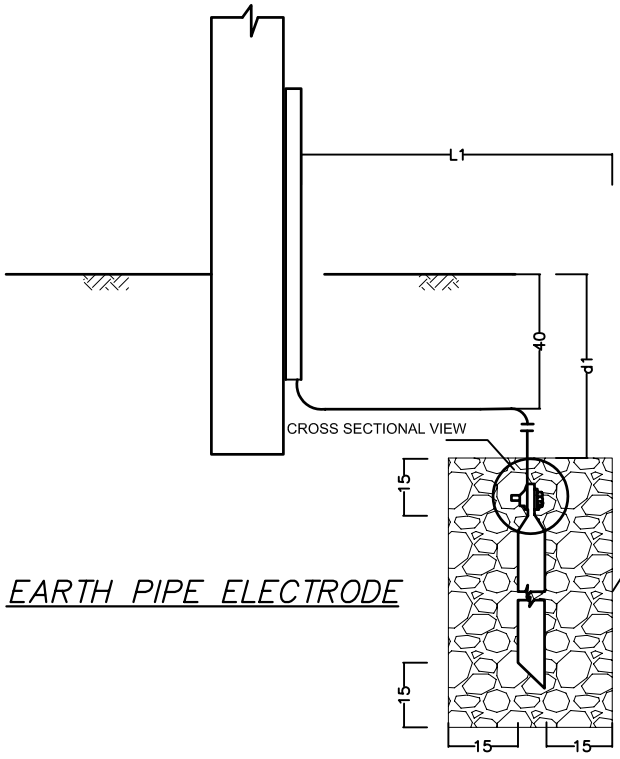


COPPER EARTH PLATE ELECTRODE

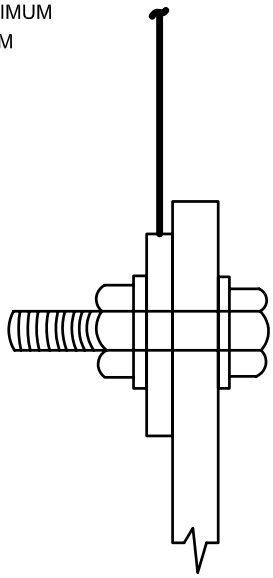


DETAIL OF X

SALT & CHARCOAL
PLATE SIZE:300X300X3.15MM
COPPER WIRE 6 TO 8 SWG
d = 1.5 MINIMUM
L = 1 TO 2M



EARTH PIPE ELECTRODE



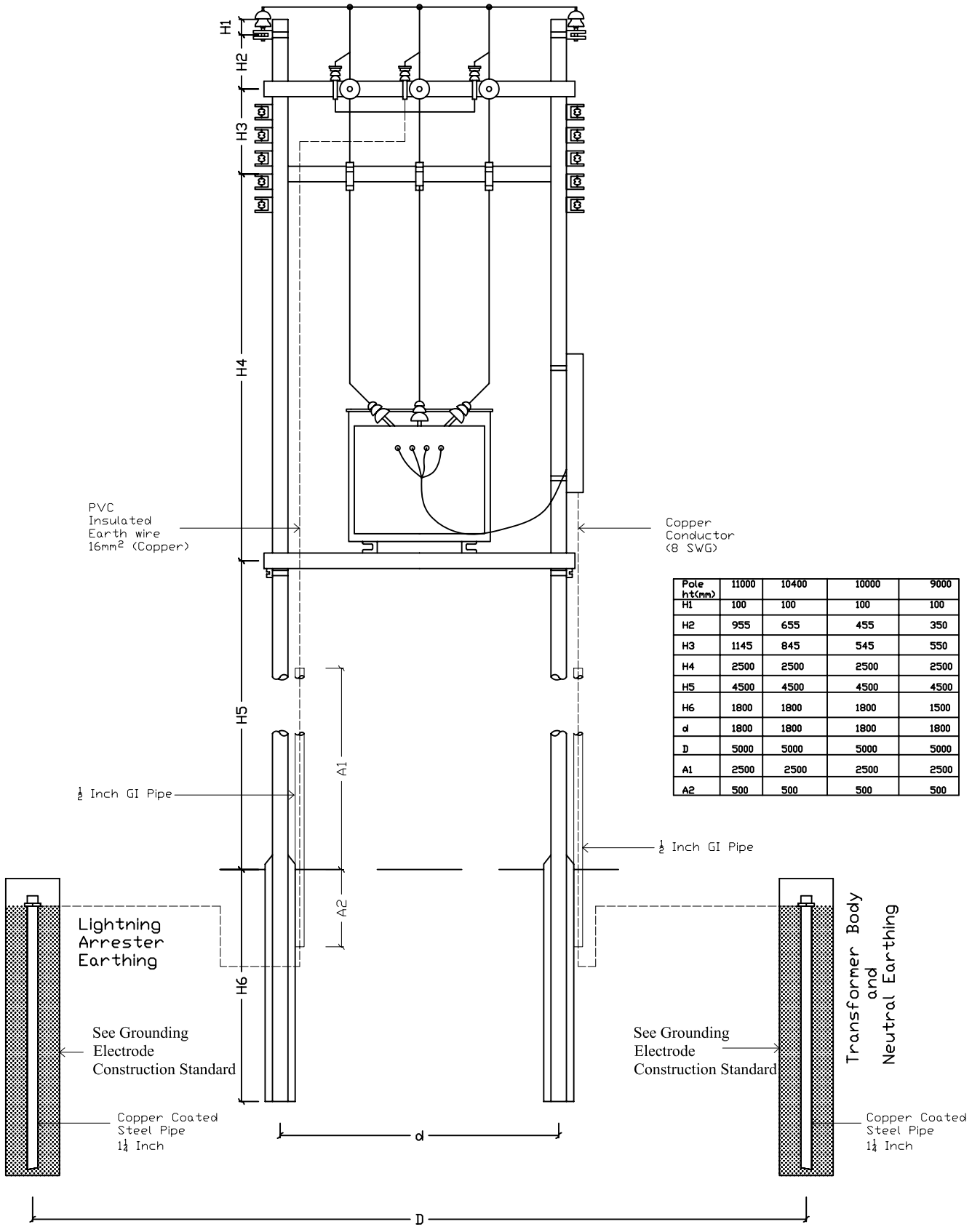
DETAIL OF Y

PIPE SIZE 2.5 m LONG X 35m ° G.I. PIPE.

d1 = 1.5m MINIMUM

L1 = 1 TO 2m

Drawing **CSLV-GR-01**	**Pole Grounding System**	NEPAL ELECTRICITY AUTHORITY **Technical Services/ Commercial Department** Distribution and Consumer Services



Pole ht(mm)	11000	10400	10000	9000
H1	100	100	100	100
H2	955	655	455	350
H3	1145	845	545	550
H4	2500	2500	2500	2500
H5	4500	4500	4500	4500
H6	1800	1800	1800	1500
d	1800	1800	1800	1800
D	5000	5000	5000	5000
A1	2500	2500	2500	2500
A2	500	500	500	500

Drawing		
CSLV-GR-02	**Distribution Transformer Station Grounding**	NEPAL ELECTRICITY AUTHORITY **Technical Services/ Commercial Department** Distribution and Consumer Services

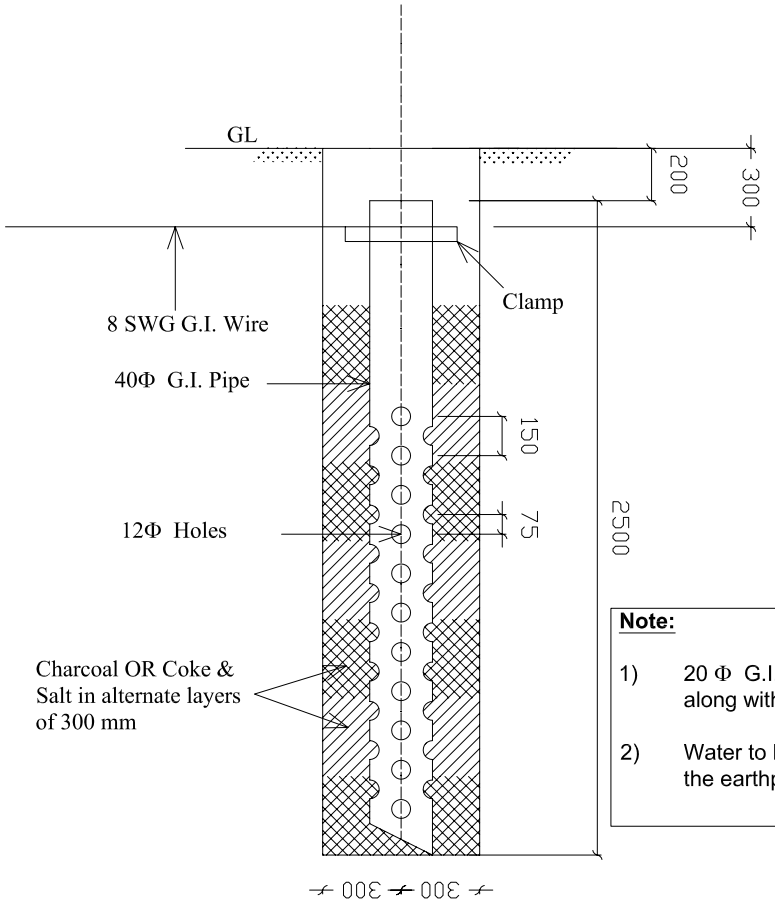
Drawing
CSLV-GR-03

Grounding Electrode

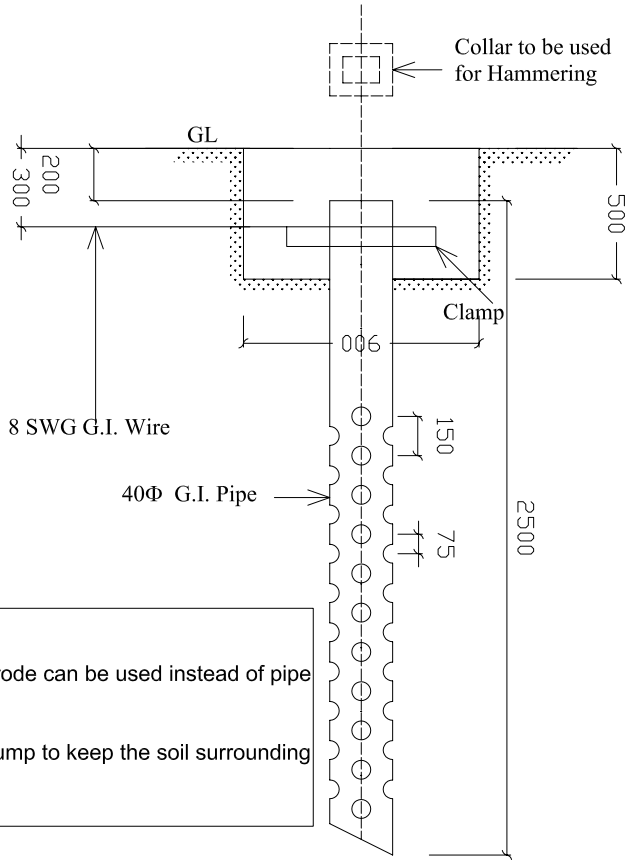
NEPAL ELECTRICITY AUTHORITY

Technical Services/ Commercial Department

Distribution and Consumer Services



a) Earthing For Hard, Stiff or medium clay

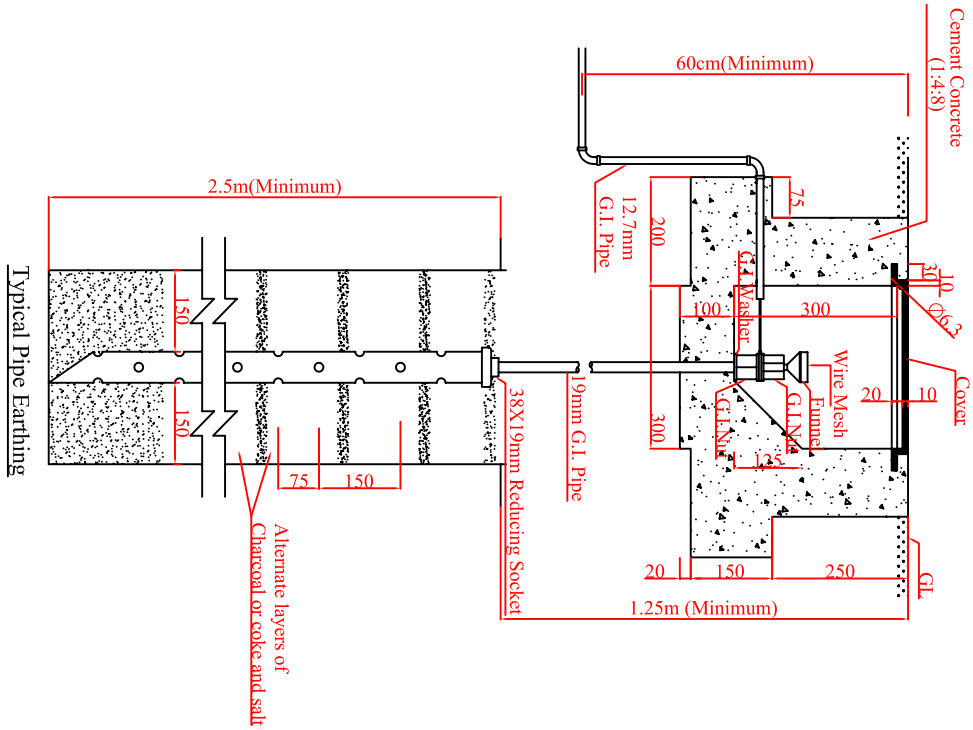


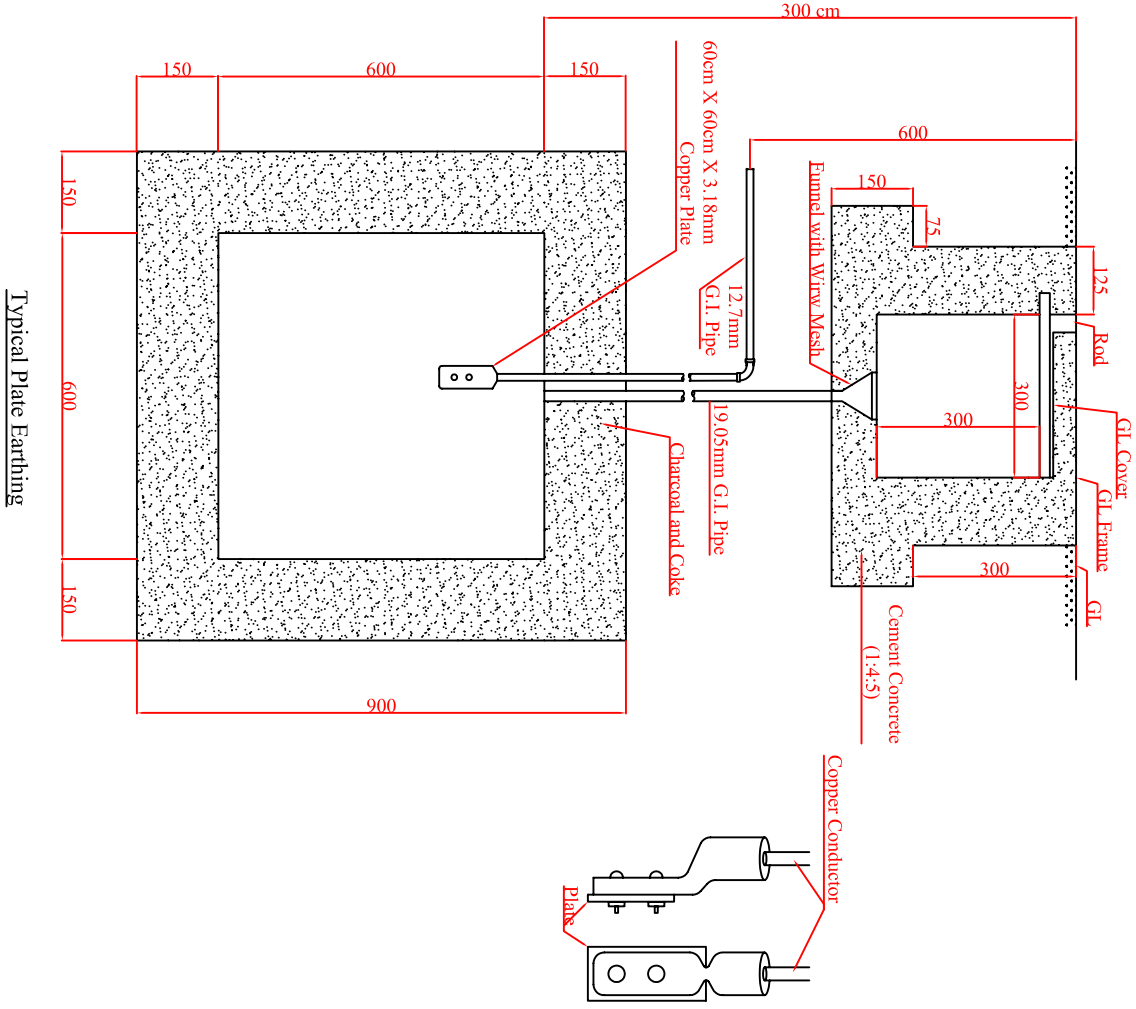
b) Earthing For Ordinary Soil where pipe could be hammered in

Note:

1) 20 Φ G.I. or copper electrode can be used instead of pipe along with earth plate.

2) Water to be poured into sump to keep the soil surrounding the earthpipe/rod moist.



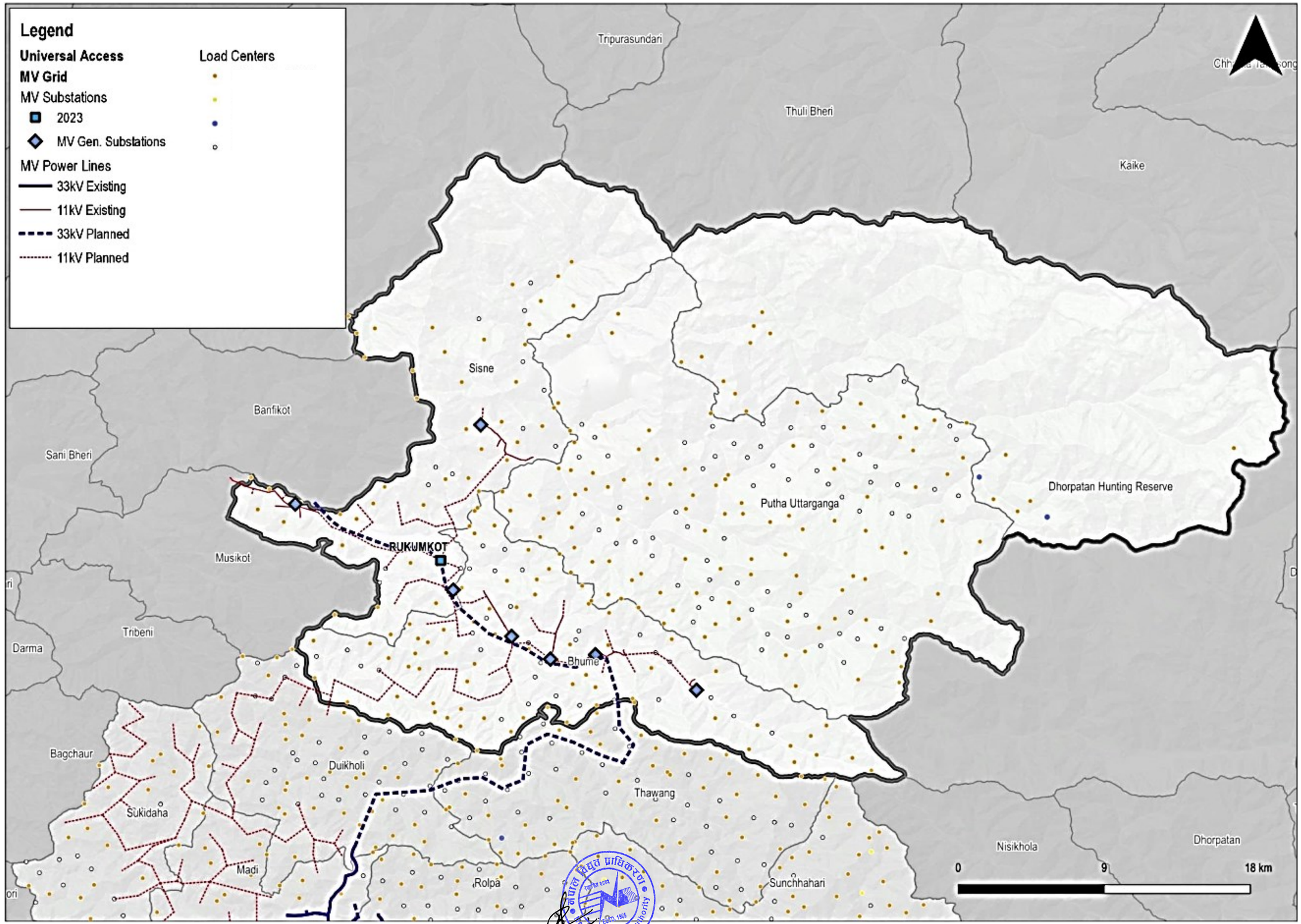


Drawing **CSLV-GR-04**	**Typical Plate & Pipe Earthing**	NEPAL ELECTRICITY AUTHORITY **Technical Services/ Commercial Department** Distribution and Consumer Services

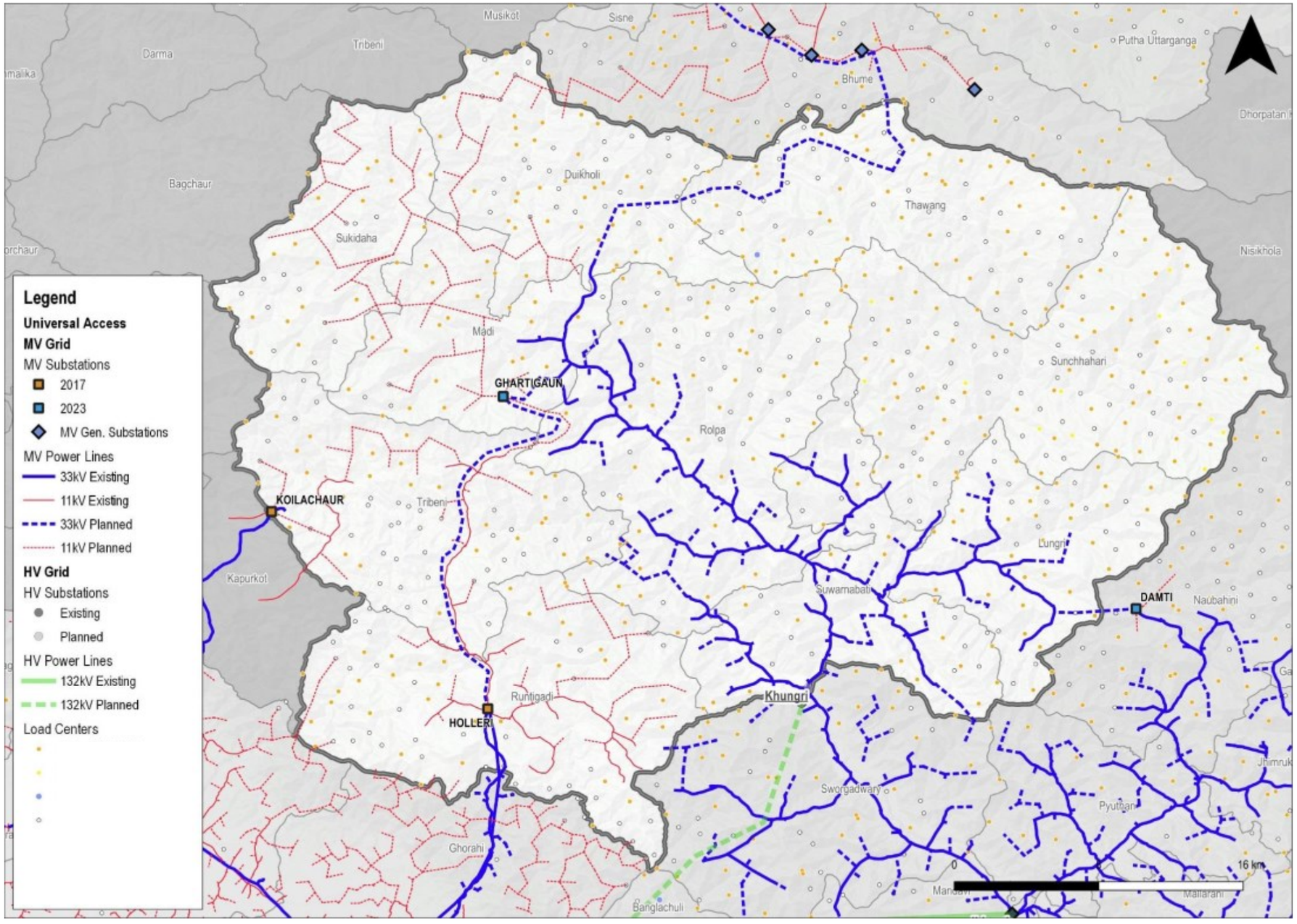
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11 kV and Low Tension Network Indicative Drawings

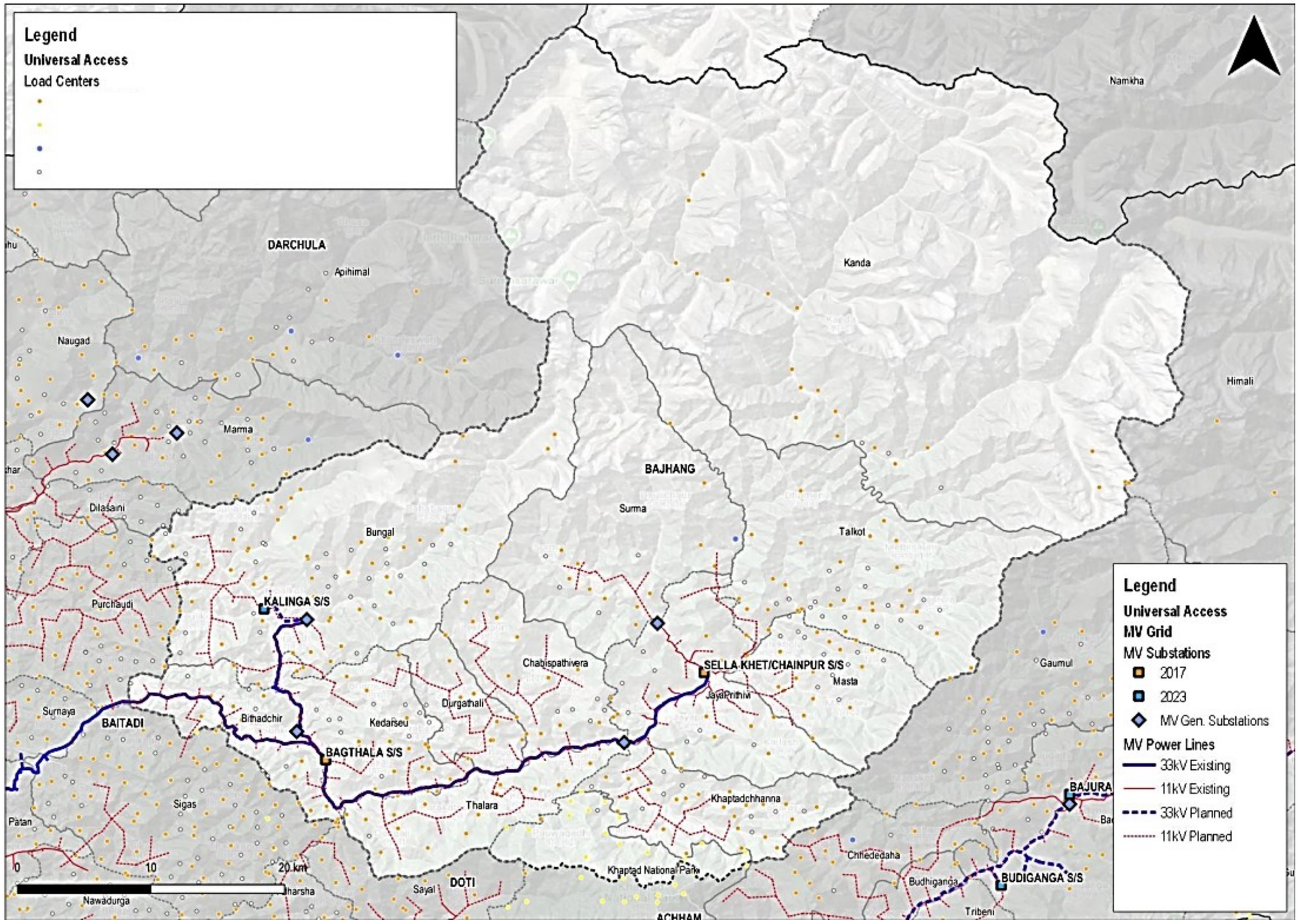
Load Centers of Rukum East District



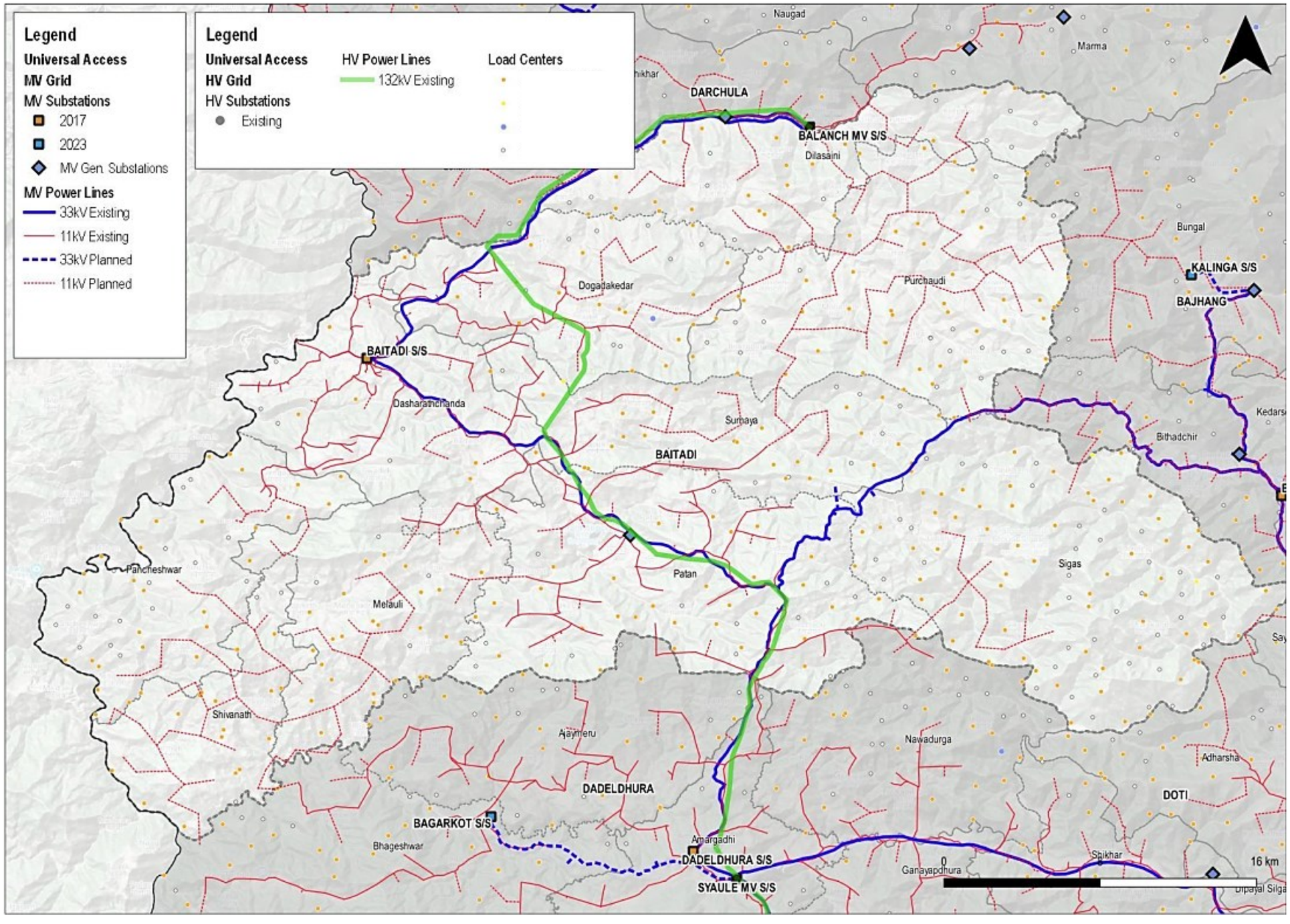
Load Centers of Rolpa District



Load Centers of Bajhang District



Load Centers of Baitadi District



Volume II

Section 6: Employer's Requirements

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A	Scope of Supply of Plant and Services
B	Specifications
C	Drawings
D	Supplementary Information

Name of Tenderer _____

Signature of Tendererer_____

Volume II

Section 6: Employer's Requirements

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A	Scope of Supply of Plant and Services	
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D	Supplementary Information	
	D.1	Environmental and Social Mitigation Works of Projects
	D.2	Relevant Details of Distribution and Rural Electrification Master Plan of NEA

Name of Tenderer _____

Signature of Tendererer_____

Nepal Electricity Authority
Distribution and Consumer Services Directorate
Distribution System Upgrade and Expansion Project
Environmental and Social Information and Corporate Responsibility of Projects

Refer to guidelines of the Funding Agency and relevant Environmental and Social Management Plan.

Name of Tenderer _____

Signature of Tendererer_____

Nepal Electricity Authority
Distribution and Consumer Services Directorate
Distribution System Upgrade and Expansion Project
Relevant Details of Distribution and Rural Electrification Master Plan of NEA

Relevant Details of Distribution and Rural Electrification Master Plan of NEA and coordination with local Distribution Centres shall be facilitated by the Client.

Name of Tenderer _____

Signature of Tendererer_____