NEPAL ELECTRICITY AUTHORITY

(An Undertaking of Government of Nepal)

DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE

NEPAL 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 33/11 kV Substations and 33 kV, 11 kV, 400 V Lines and Distribution System Network

Package No. W5 Sub Project: Piple of Salyan District, Laxmana of Bardia District, Budhebapar and Baddichaur of Surkhet District

Single-Stage: Two-Envelope
Tender Procedure

Issued on:
Invitation for Re-Tenders No.: ***ICB-DCSD-2078/79-DSUEP-AIIB-W5***
Contract Ref. No.: ***ICB-DCSD-2078/79-DSUEP-AIIB-W5***
Employer: ***Nepal Electricity Authority***
Country: ***Nepal***

Volume IIA of III
(Technical Specification for 33 kV Lines and 33/11 kV Substations)

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This section contains the tender evaluation criteria to determine the lowest evaluated Tender and lists the necessary qualifications of Tenderers.

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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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Section 6: Employer's Requirements

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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. Karnali and Sudurpashchim has 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 is planning 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". The government and the Nepal Electricity Authority (NEA) have received funds from the Asian Infrastructure Investment Bank (AIIB) and 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, Karnali and Sudurpashchim Provinces. 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

SN	Funding Agency	Sub-project	District	Province
1	AIIB	Malarani Pipledanda	Salyan	Lumbini
2	AIIB	Kohalpur Machhagadh	Bardiya	Lumbini
3	AIIB	Babiyachaur Budhebhapar	Surkhet	Karnali
4	AIIB	Baddichaur Odaltal	Surkhet	Karnali

Both these substation buildings shall be constructed with Gable Roof suitable for snowy regions. The summary of the components for each sub-project are enlisted in the following section.

1.3 Salient Features of Sub-Project Malarani Pipledanda

Table 2: Salient Features of Malarani Pipledanda subproject

Particular	**Description**
Client	Nepal Electricity Authority
Funding Agency	Asian Infrastructure Investment Bank
Project Location	Pipledanda, Salyan District
33 kV Line	
33kV Line Starting Point	Tapped at Malarani
33kV Line End Point	Piple Substation (Proposed)
System Voltage	33 kV
Length of Line	11 km
Right of way	6 m
Number of Circuit	1
Conductor	ACSR Dog
Type of Poles	Steel Tubular Pole, 11m
Substation	
Voltage Level	33/11 kV
Substation Capacity	1 MVA
No./ Capacity of Transformer	1 no., 1 MVA
Type of Transformer	3 Phase, ONAN, Mineral Oil
Type of Substation	AIS (33kV) and Indoor (11kV)
No. of 33kV Line Bays	1 Incomer,
No. of 11kV Feeders	2

1.4 Salient Features of Sub-Project Kohalpur - Machhagadh

Table 3: Salient features of Kohalpur - Machhagadh subproject

Particular	**Description**
Client	Nepal Electricity Authority
Funding Agency	Asian Infrastructure Investment Bank
Project Location	Machhagadh, Bardiya District
33 kV Line	
33kV Line Starting Point	Bay Extension at Kohalpur Substation
33kV Line End Point	Machhagadh Substation (Proposed)
System Voltage	33 kV
Length of Line	23.1 km Overhead line, 2.6 km Underground Cable
Right of way	6 m
Number of Circuit	2
Conductor	ACSR Dog, Al XLPE 400 sq mm
Type of Poles	Steel Tubular Pole, 13m
Substation	
Voltage Level	33/11 kV
Substation Capacity	16 MVA
Number and Transformers	2 nos, 6/8 MVA each
Type of Transformer	3 Phase, ONAN, Mineral Oil
Type of Substation	AIS (33kV) and Indoor (11kV)
No. of 33kV Line Bays	2 Incomer
No. of 11kV Feeders	8

1.5 Salient Features of Sub-Project Babiyachaur - Budhebhapar

Table 4: Salient Features of Babiyachaur - Budhebhapar subproject

Particular	**Description**
Client	Nepal Electricity Authority
Funding Agency	Asian Infrastructure Investment Bank
Project Location	Budhebhapar, Surkhet District
33 kV Line	
33kV Line Starting Point	Bay Extension at Babiyachaur Substation
33kV Line End Point	Budhebhapar Substation (Proposed)
System Voltage	33 kV
Length of Line	22 km
Right of way	6 m
Number of Circuit	1
Conductor	ACSR Dog
Type of Poles	Steel Tubular Pole, 11m
Substation	
Voltage Level	33/11 kV
Substation Capacity	1 MVA
No./ Capacity of Transformer	1 no., 1 MVA
Type of Transformer	3 Phase, ONAN, Mineral Oil
Type of Substation	AIS (33kV) and Indoor (11kV)
No. of 33kV Line Bays	1
No. of 11kV Feeders	2

1.6 Salient Features of Sub-Project Baddichaur - Odaltal

Table 5: Salient features of Baddichaur - Odaltal subproject

Particular	**Description**
Client	Nepal Electricity Authority
Funding Agency	Asian Infrastructure Investment Bank
Project Location	Odaltalgaun, Surkhet
33 kV Line	
33kV Line Starting Point	LILO at Baddichaur
33kV Line End Point	Odaltal Substation (Proposed)
System Voltage	33 kV
Length of Line	0.3 km
Right of way	6 m
Number of Circuit	2, Loop In Loop Out Arrangement
Conductor	ACSR Dog
Type of Poles	Steel Tubular Pole, 13m
Substation	
Voltage Level	33/11 kV
Substation Capacity	1 MVA
Number and Transformers	1 nos., 1 MVA
Type of Transformer	3 Phase, ONAN, Mineral Oil
Type of Substation	AIS (33kV) and Indoor (11kV)
No. of 33kV Line Bays	1 Incomer, 1 Outgoing, Loop In Loop Out
No. of 11kV Feeders	2

1.7 Environment and Social Management Plan

The contractor shall follow the Environmental and Social Management Plan (ESMP) provided with the tender document and other Environmental and Social Documents of the project given to the Contractor during the contract execution. The payments for the implementation of ESPM shall be made proportionally against each activity upon verification by NEA's officials or representatives as the case may be.

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Abbreviations & Acronyms

Acronym	Full form
AIIB	Asian Infrastructure Investment Bank
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
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	Kilowatt Hours
LILO	Loop-In Loop-Out

Acronym	Full form
LT	Low Tension
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 Substation Equipment and lines for the sub-projects. Standard requirements of the Installation of High-Tension Lines are provided followed by detail requirements of 33 kV lines, and 33/11 kV substations. 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 capacity and details of the substation and lines are enlisted in the Scope of Supply. Drawings following the technical specifications provides SLDs, Schematics of 33 kV poles, Schematic Layouts of overall substation layout and 33 kV switchyard and substation.

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.

The 33/11 kV substations are to be implemented as suitable for operation for both manned and unmanned mode. All the components shall be supplied, installed and commissioned for both mode of operations even if not explicitly mentioned in the specifications.

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 Loading 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.

B Foundation Drawings

The Contractor shall submit foundation drawings, showing his requirements on the civil works in regard to:

- Foundations,
- Recesses, block-outs, openings,
- Conduits,
- Embedded parts,
- Slopes.

The foundation drawings shall include all essential and pertinent information required for the design and execution of the civil works, such as:

- Dimensions,
- Static and dynamic loads,
- Anchor forces, pressures, etc.
- Contours of temporary or permanent installations.

Foundation drawings shall be prepared on the basis of civil works and/or topographic drawings.

C Arrangement Drawings

The arrangement drawings shall show the physical arrangement of equipment, equipment groups or complete units in relation to each other, to piping and cable ducts, to the civil works construction and reserved areas, to agreed coordinates and boundaries. Such drawings shall be prepared for the entire project area as well as for individual locations.

Arrangement drawings for mechanical, electrical and control equipment shall indicate the location of all apparatus and machinery (e.g. pumps, vessels, motors, switchgear, panels

and cubicles, lighting fixtures, socket outlets, connection boxes, transmitters, actuators, loudspeakers, telephones, etc.) and their employment. The equipment shall be denominated with the same standardized abbreviations or code numbers as used throughout the technical documentation.

Spaces available and arrangements shall be such as to make the installation and removal of equipment without impacting on equipment located near it.

All arrangement drawings shall be drawn according to scale.

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. List of layers which will be used shall be subject to approval. In the layout each component shall be identified with a number/code and the layout shall be accompanied by a list where the identification number/code, quantity and reference detailed drawing or catalogue code of each item is indicated.

Systems included in a general layout shall be properly represented on the general layout, when necessary, with different layers, and no separate layouts will be accepted as well as no separate layout of piping and cable routes.

Drawings shall be made in such a way to make possible, when printed, to easy read them, taking into account that the maximum printing format will be DIN standard size A0.

D Assembly Drawings

Assembly drawings shall be submitted for all individual equipment units. The drawings shall indicate the main dimensions, elevations, tolerances, adjustments, clearances, capacities and the reference numbers of the respective shop drawings and part lists.

The assembly drawings for mechanical, electrical and control equipment shall also show the designation, i.e. the Substation identification number of the equipment shown.

Sections shall be properly identified and represented. For example, superimposition of two or more sections shall not be allowed.

E Execution Drawings

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.

Further, for all technical documents which employ designation or Substation identification numbers, a respective list shall be furnished.

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, valves pumps, compressors, motors, relays, switches),
- Certified product (e.g., steel cables, ladders, servomotors),

- Product certified by an underwriter's society (e.g., hoists and cranes, elevators, fire protection equipment, pressure vessels).

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.

Execution drawings shall show the following:

- Materials, dimensions, tolerances, surface roughness, weight, adjustment, clearance,
- Reference to assembly or sub-assembly drawings and part lists,
- Details of fabrication, manufacturing and treatment,
- Assembly of the equipment in plan and elevation with main dimensions, All necessary details of the parts connecting to equipment supplied by others, Location and sizes of connections for oil, grease, water, air, etc.
- Location and size of the instruments and accessories provided,
- Methods of lubrication and sealing,
- Instructions for heat treatment (if any), pressure tests (if any), surface preparation and anti-corrosive protection,
- Full details of parts for which adjustment is provided or which are subject to wear,
- Method and sequence of installation, field joints, erection and lifting devices, jacks, grout plugs, anchoring details, etc., if not shown on foundation drawings.

F Additional 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.
- Details of types of foundations with volume of earth work, concrete and rebar. Conductor tension clamps and jumper terminals.
- Sag Tension Diagrams for all ACSR Conductors

- 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,
- Procedures for pole testing
- Pole Foundation drawings
- 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, and schematic diagrams for mechanical systems, such as oil, air and water, shall be prepared by the contractor. Symbols to be used shall be in accordance with ISO/IEC standards. 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.

Single-line diagrams of individual main components and switchboards shall additionally show the control, indicating, measuring, metering, protection, automatic, and other electric auxiliary devices (also rheostats, hygrostats, cable end boxes, etc.), separated for each individual installation site and location as applicable:

- Switchboard control compartment, circuit breaker/switch compartment, cable termination compartment, etc.
- Control room (in control panel, control desk).
- Unit control board
- Relay room (in auxiliary relay cubicle, marshalling rack, automatic control cubicle, protection cubicle)
- Separate energy meter cubicle. Furthermore, the applied recommended setting of adjustable devices (protection and control elements, time relays, etc.) shall be indicated.

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.

The control part shall be subdivided into separately drawn "current paths", each showing all its components regardless of their actual physical location. The individual circuits are to be drawn in a straight-line sequence, avoiding line crossings. The current paths (to be designated by numbers) shall be drawn starting from two horizontal lines, which represent the control voltage source. All devices forming part of the Works or control devices shall appear between these two lines.

Contact developments of the installed switches, contactors, relays and other apparatus which appear in the diagram shall be shown below the respective contactor coil, indicating by means of numbers and, if not on the same, also the page number, the current path in which the corresponding contact has been used.

Interconnections to other circuit diagrams shall be clearly marked by means of dotted line separations and the corresponding functional designation. The power circuit portion of the installation shall be drawn at the left side of the drawing.

Circuit diagrams shall also contain all terminals and their correct designations. Terminals grouped together to terminal blocks of switchboards, distributors, etc., shall be shown on the circuit diagrams in one fictitious horizontal line surrounded by demarcation lines. If, for any reason, the current paths of circuit diagrams must be separated, the corresponding counter terminal has to be indicated by all means.

The representation of electrical Works and control circuits shall not be terminated at the limits of the scope of supply but has to be extended beyond this limit by all switchgear, protective, measuring and monitoring equipment required for full comprehension of the whole circuit. All terminals and functions of Works to be supplied by others shall be taken over as well.

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, e.g., servomotors, computing modules, etc., 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 Logic Diagrams

The Logic or Functional Diagrams shall be used for representation of logic and sequence controls and interlocking by showing only binary logic elements and their effect on the various, process equipment, disregarding their electrical realization. Logic function elements (AND, OR, NOR, NAND, STORAGE, etc.) shall be used for processing and combining binary signals.

G 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.

H 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.

I Process Flow Diagrams (PFD) and Process Instrumentation Diagrams (P&ID)

The Process or P&I Diagrams shall show the piping including type, dimensions, fittings, flanges, etc., and the flow directions. They shall also show the process data, measuring points, instrumentation control functions and locations of the equipment.

The PFD shall show the main process data and main piping, shall be the base for the development of the P&ID and shall be submitted for approval before them.

P&ID shall include all controls, hydraulic devices, limit switches, position indication functions, size of piping, directions of flows, settings of all valves and pressure switches, pump and motor sizes. At each item shall be assigned a number and a table shall be furnished, listing each item and its function.

Detailed piping drawings shall be also submitted including type, dimensions, fittings, flanges and all other details.

1.2.4 Miniature Model

The Contractor shall also supply a miniature model of switchyard and control building depicting scaled down model of system. It shall be placed in each control building in the SCADA and Administration room in a glassed compartment at a height of 750 mm on a table. The cost of this miniature model shall be included in the engineering/design services cost.

1.2.5 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 pumps, valves, compressors, 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,
- Power requirements for each voltage level (AC/DC).

Specific requirements are described in the following sub-clause.

B Motor Specifications

The Motor Specifications shall include the thermal motor characteristic both for cold and hot condition, the start-up characteristic when running with the driven machine and all data required for selection of the appropriate motor protection relay (both for cold and hot condition) and for locked rotor protection. Construction type, class of protection and insulation shall also be given.

C 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.

D Measurement and Control Apparatus Specifications

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

1.2.6 Lists and Schedules

A Motor and Consumer Lists

The Motor and Consumer Lists shall be prepared for each switchboard and MCC containing at least the following information/data:

- Substation identification number,
- Description,
- Manufacturer, type, rated data of driven machine,
- Manufacturer and type of electric motor/consumer,
- Rated capacity,

- Service factor (ratio between motor output and power requirement of the driven machine),
- Rated speed,
- Rated voltage,
- Rated current,
- Ratio of starting current to rated current,
- Ratio of pull-out torque to rated torque,
- Power factor at rated capacity,
- Efficiency at rated capacity,
- Power consumption at machine design loading,
- Design/enclosure/cooling according to IEC,
- Duty (continuous/intermittent/start-up),
- Starting method/permissible starting frequency,
- Maximum number and overall diameter of power cable,
- Manufacturer and type of bearing,
- Manufacturer, type and quantity of lubricant, service interval,
- Manufacturer, type, number, size, spring pressure and service interval of brushes.

B Motor Starter and Feeder Lists

The Motor Starter and Feeder Lists shall include all starters, contactors and switching devices used for motors and other consumers and contain the following technical information as a minimum:

- Substation identification number,
- Electrical design data as nominal and actual current rating, voltage rating, coil rating, making and breaking capacity, mode of operation,
- Maximum power cable size,
- Maximum control cable size,
- Current transformer ratio, class and capacity,
- Type of protection relaying and catalogue number,
- Setting of protection relays and maximum continuous rating of the protected circuit,
- Type and current rating of the back-up fuses/MCBs for the main and control circuits,
- Denomination of feeder,
- Applicable Standard Circuit Diagram.

The Motor Starter and Feeder Lists can be substituted by adequate equipment lists, already forming part of the switchgear manuals.

C 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.

D Input / Output Lists (I/O Lists)

The I/O Lists shall include all alarm, command, measurement and status signals with related local and remote devices and shall contain at least the following:

- Item/Substation identification number, function code,
- Description and denomination of control/measuring loop,
- Data of local devices (detectors, instrument transformers, transmitters, contacts, etc.),
- Data of remote devices,
- Description and denomination of alarm, command, measurement and status signals,
- Data of alarm annunciator (location and clear text labelling),
- Individual and group alarms.

E List of Final Control Elements

This list shall indicate all control actuators and control valves containing at least:

- Item/Substation identification number,
- Data of pipe and valve connections,
- Data of valve layout,
- Maximal required and rated power.

F 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.

G Site Test Schedules

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

H 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 Substation 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.

I List of Substation identification numbers

A plant identification system with related lists of Substation identification numbers shall be established. The lists shall contain the used Substation identification numbers 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).

J Test Procedures for 33 kV line

The following equipment, apparatus and items shall be tested for 33 kV line,

- Towers – All tower types, to be used for the 33 kV Line need to be tested.
- Poles – All pole types, to be used for the 33 kV Line need to be tested.
- Insulators, hardware and fittings
- Sub-soil tests

- Ground Electrical Resistance
- Piles

1.2.7 Calculations

A General

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.

B Short-Circuit Calculations

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

C Insulation Coordination Study

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

D Earthing Network Calculations

The Earthing Network Calculation shall determine, on basis of the short-circuit currents, the relevant design criteria for the layout of the plant's earthing network and the potential gradient control system, such as:

- Earthing resistance,
- Earth electrodes or conductors (number and dimensions),
- Mesh network and other means for potential gradient control for different locations (mesh widths and dimensioning),
- Maximum touch and step voltages.

E Lightning Protection Study

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

F Load Evaluations

The load evaluations shall demonstrate for each voltage level (AC and DC), and for each individual distribution board, the following data:

- Rated capacity of all consumers,
- Maximum number of identical consumers which can operate simultaneously,
- Total electrical demand in kVA and the power factor at nominal service of the driven machine, subdivided into:
- Start-up
- Rated service
- Shut-down
- Standstill
- Dimensioning of auxiliary transformers,
- Dimensioning of emergency generating units.

The maximum load on one of the MV/LV auxiliary transformers shall be determined with due consideration of the most unfavorable condition when feeding several main and sub-distribution boards, especially in case of emergency.

G Selection of LV Breakers and Minimum Cable Cross Sections

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.

H Definition of Transformer Ratios

The transformer ratios and tap changing ranges shall be determined with due consideration of the plant and network requirements.

I Calculation of Loads and Forces

For transformers, CBs, CTs, PTs, DSESs, Station Transformer and other major equipment the loads and forces shall be calculated and considered in the Contractor design and/or by the civil contractor for the design of the civil structures and foundations.

J Additional Calculation for 33 kV Line

For 33 kV line, additional calculations required for Tower design, tower foundations design, pole foundation designs, pole design, earthing design and current rating of each part of the 33 kV 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. The employer will accept variations supported by detail calculations, and the payment shall be carried out on weight basis.

1.2.8 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.
- Main items of temporary facilities constructed during the reporting period.
- 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.
- 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.

1.2.9 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
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:**	

Document		No of Copies to be Submitted to Employer
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 programe
8.5	Inspection programe 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 Special Conditions of Contract 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 electric motor, oil pressure unit, valve, compressor, crane, 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:

- Carbon brushes of electric motors
- Packings and seals for rotating shafts
- Frequently actuated springs
- Pressure hoses for outdoor installation (if applicable)
- Roller bearings for rotating shafts (if applicable)

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
- Pressure hoses for indoor installation (if applicable)
- Lamps, signal lamps, push buttons and switches
- Fuses, clamps, terminals
- Limit switches, relays
- Roller bearings, sleeves and bushings for movable parts including for spherical joints, if applicable
- Resistance thermometer without indicator
- Motor-starters, contacts for feeder switches
- 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
- Roller bearings, bearing shells, sleeves and bushings for movable parts including for spherical joints with an inner diameter of more than 200 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
- Feeder circuit breakers.

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.

Customary tools shall be of the forged and polished chrome-vanadium type and shall be handed over unused to the Employer.

Suitable wall mounted hardwood or steel storage racks as well as tool carts and/or toolboxes shall be included in the scope.

The Employer shall be entitled to take over the entire erection tools, appliances and instruments at mutually agreed conditions from the Contractor.

The following tools and appliances shall be supplied under this contract for use of the employer:

- Two (2) sets of special tools and gauges required for normal maintenance of the whole of the plant
- One (1) set of special lifting and handling appliances required for the normal maintenance of the whole plant

An itemized list and description of all provided tools, auxiliary devices, storage equipment, etc., shall be included in the Bid. Acceptance of any tools or devices shall not take place before the contractor has submitted the complete final detailed list of tools and appliances.

Ropes, slings etc. shall be handed over in new condition. All lifting tackle shall be stamped with a unique identification number and safe working load. A test certificate from an approved testing authority shall be supplied for each item of lifting equipment.

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.

Additional cost can be accepted only in case of a **substantial** design change by the Employer after award of Contract.

All parts of the plant shall be arranged to facilitate surveillance, maintenance and operation. All control sequences shall be simple and rational.

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.

Only such design and types of equipment shall be offered which have been tested in long-term continuous operation. Innovations cannot be accepted for the main Bid but can be offered as an alternative proposal.

Manufacturers shall take appropriate measures to prevent the ingress of dust into any dust sensitive equipment, such as bearings, relays, control and measuring equipment, etc.

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:

- Valves
- Thermometers
- Terminals and terminal racks
- Indicating instruments and meters
- Auxiliary relays
- Contactors, fuses
- Motor protection switches
- Control devices

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

1.4.3 Noise Level

The noise level caused by the installed equipment shall not exceed the following maximum values if not otherwise stated in the Technical Specifications:

Offices, control rooms, first aid rooms, canteens and similar rooms	55 dB (A)
Residential areas during daytime	50 dB (A)
Residential areas during nighttime	35 dB (A)
Emergency diesel generating unit at 7 m distance	85 dB (A)

The noise level definition and measurement shall be in accordance with ISO and IEC. The values stated shall be adhered to, taking into account a standard civil construction.

The noise pressure level emanating from any part of the facilities measured by the method specified in ISO/R1680 shall be less than the NR85 curve, except during any plant mode change, when a noise pressures level up to the NR100 curve shall be permitted.

During commissioning, or when requested by the Employer, the Contractor shall measure the noise pressure levels as defined above from all major sources and submit curves of noise pressure level plotted against frequency to the Employer. If noise levels are above those specified, the Contractor shall take remedial action to reduce noise levels using methods approved by the Employer.

1.4.4 Equipment Identification

A Piping Systems

All piping system elements including pumps, strainers, valves, measuring instruments and control devices shall be clearly marked and identified by a letter or number code complying with ANSI A 13.1.

Metallic plates shall be used for identification purpose, and shall be secured by means of brass screws, brass bolts with brass nuts or brass clamping devices to the individual item or equipment or to adjacent wall surface, as appropriate.

Identification shall include the following but not limited to:

- Piping system designation and flow direction
- Gauge name plates
- Permanent Valve identification plates on the valve body to indicate:
    - (i) valve number
    - (ii) service terms and abbreviation
    - (iii) operational information (normally closed/normally open).

The identification and direction-of-flow arrows shall be applied to points where piping enters or leaves a wall, partition, floor, ceiling, cluster of piping, or similar obstruction, and at approximately 5-meter intervals on pipe runs.

B 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 and especially during painting. 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 small or medium-sized electric motors, 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 "Plant Identification System".

iv Instruction Plates

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

C Color Codes

The color code for electrical and mechanical equipment, such as transformers, switchgears, pumps, valves, cranes, servomotors, piping for water, oil, air, combustible, poisonous or aggressive liquids or gases, etc., shall be in accordance with the indications of Annex and as agreed upon after award of the Contract.

The coloring of pipelines, moving parts, etc., shall be according to internationally recognized standards, e.g., DIN 2403.

Pipes shall be entirely painted in the marking color according to DIN 2403. Smaller stainless-steel pipes may be marked by painted rings of the respective color.

1.4.5 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 Roundings

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.

1.4.6 Welding and Heat Treatment

All welds shall be as shown in the detailed drawings and shall be made in such a manner that residual shrinkage stresses will be reduced to a minimum.

The Contractor shall submit with his Method Statements adequate information concerning the proposed:

- Extent to which automatic welding techniques will be applied.
- Extent to which manual welding techniques will be applied.
- Extent to which it is the Contractor's intention to use pre-weld heat treatment, post-weld stress relieving, full annealing or normalising consistent with the thicknesses and types of material proposed.
- Welding electrodes, welding wire and flux which will be used with the selected plate material or materials.
- Standard tolerances for the deviations of mating weld profiles.

Pieces to be joined by welding shall be cut accurately to size including the required allowances. According to the proposed welding method, the welding edges shall be sheared, flame-cut or machined to allow thorough penetration and fusion of the weld with the base material.

The cut surfaces shall be free of all visible defects, such as laminations, surface defects caused by shearing or flame-cutting operations. The edges and surfaces to be welded shall

be free of rust, mill scale, grease, oil, paint or any other dirt. Welding over zinc primers shall be permitted, subject to submission of a certificate of a recognised institution stating the pertinent limiting parameters for this welding procedure. In all other cases, welding over paint shall be prohibited; all painting materials next to the joint to be welded shall be removed well beyond the heat- affected zone.

The welding work and heat treatment shall be as per industry standard. Quality control methods, e.g., non-destructive examination, radiographic examination, ultrasonic examination, dye penetration test etc., shall be done in accordance with the appropriate manufacturing code.

Additional non-destructive examinations can be required when it is desired to examine the acceptability of any welds when, in the opinion of the Employer, serious doubt exists as to their quality; in this case, the expenses for this examination shall be borne by the Contractor.

When required in the Technical Specifications, the detailed description of welding procedure (including type of welding electrodes, sequence of welding seams, etc.) for certain parts of the delivery shall be submitted to the Employer before commencement of manufacture.

1.4.7 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.

A Painting Materials

The Contractor shall provide complete and reliable coating systems. Coating materials shall be standard products of a paint manufacturer with proven experience in the field of corrosion protection of the type of equipment to be supplied.

The Contractor shall submit to the Employer for approval the full details of the preparation, type of materials, methods and sequences he proposes to use to comply with the requirements for the protection of the structures, machinery and equipment.

With regard to materials, the Contractor shall submit full details including the source of the basic raw materials, volatile matter content, nature of solvent, number of components, type of coat, coverage, time interval between coats and number of coats, compatibility of each coat with the previous coat, toxic properties, physical properties, shelf life, resistance against chemical attack, resistance against ozone and UV radiation, compatibility with drinking water standards, etc.

The Contractor shall describe in detail the treatment the contractor proposes to apply in order to give adequate protection during transport, site storage, building and concreting and subsequent erection.

Where practicable, the individual coats of primer and subsequent coats shall be of different shades of color.

The Contractor shall submit to the Employer for approval an overall color scheme in accordance with the " color Code" for the finished surfaces of all equipment. All final coats shall be in the colors approved by the Employer. On request of the Employer, painting samples for the different coats and colors shall be provided.

All pigment, paints and primers shall be delivered to Site in sealed containers packed by the manufacturer. The manufacturer's instructions for preparation and application of all painting and protective coats shall be strictly observed.

B Painting System

Annex indicates painting materials considered suitable for the various parts of the work. The Contractor shall state in the Method Statements at least three alternative anticorrosion protection systems by worldwide known manufacturers depending on (see ISO Standard 12944 for reference): (i) the exposure to the existing corrosive environment (air, water, oil concrete, soil); (ii) the contractual durability range (5÷15 years); (iii) the location (outdoor or indoor). complete with the proposed paint materials list and data sheets.

C Surface Preparation

The term "preparation", as used below, incorporates the following:

- Preliminary preparation: (i) removal of sharp edges; (ii) removal of welding projections and splatters; (iii) grind smooth welds and flame-cut parts; (iv) fill in cavities and areas where water can remain stagnant.
- Washing/degreasing using an alkaline agent or the paint solvent in limited areas.

D Execution of Painting

The Contractor shall supply full details regarding the extent to which the sandblasting (as per standard international practice) and subsequent painting shall be performed in his workshop, on the Site or in-situ after installation. A properly equipped paint shop shall be set up at the Site with a crew of specialists experienced and skilled in the preparation and application of protective coatings, to deal with all site-protective treatment.

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.

Painting operations shall only be made in dry weather and shall be interrupted in case of rain, fog or condensation. Painting shall not be carried out at temperatures below 5°C or at temperatures (air or surface) above 50°C and humidity above 80%. During the entire erection period the Contractor shall make available two sets of thermometers and humidity gauges.

Painting works shall only proceed when the prevailing temperature is at least 3°C above dew-point.

Each coat shall be free from pores, runs, pinholes, and sags. Each coat shall be allowed to dry or to harden before the succeeding coat is applied. Where pore-free coats are specified, it shall be compulsory for the Contractor to prove this quality with adequate instruments.

Care shall be taken to maintain full paint thickness at all corners and edges and special attention shall be paid to the application of protective coatings over welds, mitred joints, etc.

The first coat shall be applied (by brush or roller) immediately after sandblasting and shall be finished within two hours, or whatever suitable period was agreed upon between the Employer and the Contractor, to avoid new corrosion.

Shop coats shall be checked for good quality and where necessary, before proceeding with the painting or coating operations at the Site. The Contractor shall clean and repair all shop coats which are defective or damaged.

Oil and grease shall be removed before mechanical cleaning is started. Clean cloths and clean fluids shall be used to avoid leaving a film of greasy residue on the surfaces being cleaned. Any required wash treatment shall be done in accordance with the manufacturer's painting instructions.

The Contractor shall consider that damage to paintwork during shipment, storage and erection is practically unavoidable and the application of all protective treatment should be programmed accordingly. Care must be taken to remove salt crystals, deposited during sea transport and/or storage at a seaport, by thorough washing with clean fresh water. It is essential that before any coat of paint is applied, the surface shall be prepared as described above so that it is clean and free from all deleterious matter and completely dry.

Temporary or permanent welding shall not be permitted on areas where the welding will damage paint or other protective coatings, unless the areas of coatings which would be damaged thereby are accessible for repairing and inspection. Material which has been painted shall be handled with care and protected as necessary to preserve the coating in good condition.

E Quality Control

The first and each successive coat shall not be applied without inspection and approval by the Employer.

The minimum dry-film thickness prescribed in these Specifications shall be observed. Not more than 3 spots on average per $1m^2$ painted surface will be measured for dry film thickness. No measured thickness shall be less than the specified thickness. Where the minimum thickness is not achieved, the coat shall be repaired to reach the specified minimum dry-film thickness.

The dry-film thickness shall be measured by approved gauges. During the entire erection period the Contractor shall make available two sets of electronic paint thickness gauges.

For checks on porosity, the Contractor shall furnish a DC variable high-tension test instrument with built-in pore counter. The test voltage shall not exceed 2000 V. The tests shall not be performed within 0.5 m distance from uncovered, corrosion resistant surfaces.

Upon completion of each coat, the painter shall make a detailed inspection of the painting finishing and shall remove from adjoining work all spattering of paint material. He shall make good all damages that can be caused by such cleaning operations.

A detailed inspection of all painting work shall likewise be made, and all abraded, stained, or otherwise disfigured portions shall be touched up satisfactorily or refinished as required to produce a first-class job throughout and to leave the entire work in a clean and acceptable condition.

F Warranty

The guarantee period for all corrosion protection work shall be 1826 days, 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.

At the end of the guarantee period the corrosion protection may show a degree of rusting not higher than RE1 (one) on the European scale of degree of rusting (see ISO 4628-3) for anti-corrosive paints, (the corrosion committee of the Royal Swedish Academy of Engineering Sciences, Stockholm).

G 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 indictates 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 programmes for all materials ordered. All Q.Ms and Q.Ss and programmes 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 programmes relating to all site construction, testing, pre-commissioning, commissioning and safety procedures. All Q.Ms and Q.Ss and programmes 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. Revolving parts shall be truly balanced both statically and dynamically. If running at normal speed and at any load up to the maximum, no vibration may occur due to lack of balance.

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 33 kV 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

In some locations the High Voltage may even refer to 33 kV, as it is the highest voltage of the 33/11 kV substation system. In such case, the definition of high voltage has to be understood in context.

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 MV and LV 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.

The switchgear shall be of the indoor, completely enclosed (IP 42), metal-clad type with draw out or fixed mounted switching devices as specified. Switchgear installed outdoors shall be of protection class IP 65 and, if necessary, 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 all 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/MCC Feeders and Starters

Circuit breakers, fused load break switches shall be of the draw-out or fixed mounted type. Where two or more starters or feeders are contained in the same cubicle, they are to be separated by barriers of sheet steel or fireproof insulating material. If required, the metal

surface of the cubicle shall be protected by fire-proof insulating material. The panels shall contain all respective starters and contactors with their main incoming and outgoing feeders.

The draw-out switching devices shall be mounted on trucks or slide-in chassis is having adequate guidance by greased sliding rails and/or rollers. They shall be connected to the busbars by means of self-aligning plug and socket arrangements. Drawing out the switching device shall attain complete isolation of each circuit.

The main contacts shall have shutters, which automatically close upon withdrawal of the switchgear. The withdrawal of large circuit breakers shall be facilitated by means of cranks, gears or other devices.

The contact surfaces of the plugs and sockets shall be silver-plated. The contacts shall be amply sized and sufficiently strong to withstand maximum short circuit currents and carry continuously the rated currents without damage or overheating of any kind.

The control circuits shall also be provided with plugs and sockets.

The withdrawable units shall have clearly marked service, test and isolated (ready for complete withdrawal) positions. Mechanical interlock(s) shall be provided to prevent withdrawal of the unit unless the main circuit has been opened. The unit shall positively be locked in the test position before it is manually released for complete withdrawal. The test position shall permit local and remote closing and tripping of the relevant switchgear with the main contacts isolated from the power circuit.

Each switchgear room shall be furnished with a switching unit transportation carriage, the height of which shall be adjustable to the different installation heights.

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. Automatically controlled feeders (motor feeders, outgoing feeders) shall be equipped with a time delayed automatic tripping device operating in case of voltage failure at the busbars or being actuated by another defined signal.

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. Remote controlled circuit breakers shall be provided with an electric spring loading driving motor; manual spring loading and control shall also be possible. Means shall be provided to prevent pumping while the closing circuit remains energised should the breaker either fail to latch or be tripped during closing due to the operation of a protective device. Barriers of approved heat resisting, non-tracking-insulating material shall

separate the phases. 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 co-ordinated 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 utilised 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 co-ordinated short circuit tripping device. The associated thermal over current releases shall be adjustable in order to fit the motor requirements and temperature compensated up to 70oC ambient temperature.

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 minimise 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 motors and 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.

Stop push-buttons mounted local to motors shall trip the associated circuit breaker or contactor regardless of the selected control position.

The contacts of all push-buttons shall be shrouded to minimise the ingress of dust, and accidental contact and shall be amply rated for voltage and current for the circuits in which they are used.

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

H Overvoltage Protection

LV switchboards (AC and DC) 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 and motor-starter-contactor 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 as well as motor starters 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 signalling lamp indicating that the control supply is "ON". Each cubicle shall have a yellow- colored signalling 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 moulds 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 signalise:

- 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).

For local control of selected MV and LV motor drives, the following cast-aluminium pushbutton stations shall be provided:

- One (1) push-button "ON"
- One (1) push-button "OFF" for normal and emergency stop, which upon actuation is mechanically kept in the "OFF" position until released by a special key. To prevent maloperation due to inadvertent contact, a collar or other approved means shall protect the push buttons.

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, motor control centres, 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 mm^2 for all consumers (such as motors, heaters) and current transformer circuits;
- 1.5 mm^2 for control wiring above 60 V service voltage;

- 0.5 mm^2 for control wiring below 60 V and telephone wiring;
- 0.2 mm^2 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 block 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 neighbouring 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 Anti-condensation Heaters

Each individual enclosure accommodating electrical equipment which is liable to suffer from internal condensation due to atmospheric or load variations shall be fitted with heating devices suitable for electrical operation at the specified standard AC voltage, being of sufficient capacity to raise the internal temperature by about 5^{o} C above the ambient temperature. Heaters in motors and similar shall be switched on automatically upon opening of the motor starter, and vice-versa. Heaters in switchgear/MCC cubicles, control cubicles, panels, desks, etc., shall be controlled automatically by adjustable hygrostats (setting range about 50-100% relative humidity). The electrical apparatus so protected shall be of such design that the maximum permitted temperature is not exceeded if the heaters are energised while the apparatus is in operation.

Heaters shall be equipped with a suitable terminal box. All equipment, whether fitted with a heating device or not, shall be provided with suitable drainage and be free from pockets in which moisture can collect.

C 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.

D 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.

E 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.

F 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.

G 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 (motors, 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.

H 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.

I 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 standard, 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 mm^2 for all cables above 60 V service voltage;

- 1.5 mm^2 for all cables between local boards/boxes to the individual instruments;
- 1.5 mm^2 for all thermocouple compensation leads;
- 0.5 mm^2 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[1] 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:

[1] MV refers to 33 kV and 11 kV System

- 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 20°C 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);
- Measurement of voltage drop of motor feeders rated 100 kW or above;
- 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 Sub-grade Earthing System

The sub-grade earthing system shall consist of flexible, bare copper conductors forming an interconnected meshed network with a mesh width not exceeding 20 m. The complete system shall be buried in the soil at a depth of 1 m below ground surface and spread over the plant area. In order to achieve the required overall earthing resistance, earthing electrodes of sufficient length and quantity shall be provided.

At certain intervals and positions, pits shall be provided in which parts or sections of the subgrade earthing systems can be isolated by means of detachable fittings. The sub-grade earthing network is not required below building foundations or concrete slabs with a thickness of 500 mm or more, in which case, however, a closed earthing loop at the circumference of such areas shall be provided.

The design of the sub-grade earthing system shall be in compliance with requirements of the relevant standards and regulations.

Conductors of the sub-grade earthing system shall be connected with each other, with earthing electrodes or reinforcement steel bars by the Cadweld/Thermit welding process or bolted standard terminations of approved manufacturers.

Earthing electrodes of suitable length shall consist of copper-coated sections not exceeding 1.5 m per section and having a diameter of not less than 25 mm. The connections between the individual sections shall be throughout conductive and this connection shall by no means become loose or less effective if once the electrode has been driven into the soil. For ramming the individual sections into the soil, a striking head shall always be used.

Interconnection of a series of earthing electrodes with the sub-grade meshed network shall be made in earthing pits to enable separate measurements.

C Indoor/Outdoor Earthing Systems (Above Ground)

For the various indoor and outdoor locations, earthing systems shall be established composed of common loops with branch connections to the individual equipment. The execution of work shall be performed in strict compliance with internationally recognised standards and the directions given by the Employer.

Every non-current carrying but conductive component of the plant shall be connected either indirectly via the protective earthing system or directly to the sub-grade earthing system.

Within the control room, switchgear rooms and other rooms or buildings containing electrical installations, at least one main protective earthing bus, shall be provided approximately 300 mm above finished floor at the circumference of the building walls. This bus consisting of bare flat copper shall have minimum dimension of 30 × 4mm and shall be connected with the sub-grade earthing system and with the main columns of the building steel structure, if any. The earthing system shall be continued and carried along with the metal cable trays to reach every electrical consumer in a convenient manner. For outdoor installations, a similar system shall be adopted with the main bus (if provided) made of tinned flat copper of 30 × 4 mm.

With the exception of the main bus, earthing conductors of the protective earthing system shall be of tinned copper cables with the following minimum cross-sections:

- Main earthing distribution grid 95 mm^2;
- Branches to sub-grade earthing system 150 mm^2
- HV or MV switchgear or boards 150 mm^2
- Power transformers 150 mm^2
- LV switchgear or boards 150 mm^2
- LV motors of 20 kW and above 35 mm^2
- Intermediate terminal boxes to power circuits 35 mm^2
- Intermediate terminal boxes to control circuits 10 mm^2

- Metal raceways and cable trays every 50 m 35 mm^2
- Tanks, doors, fences or other metal parts 35 mm^2

Every conductor as part of the service earthing system such as neutral conductors, life connections to transformer star-points, or any other conductor specially exposed to transient voltage or current surges, shall be of tinned copper and sized (minimum 50 mm^2) so as to withstand the maximum fault current for 1sec. Such conductors shall be directly connected to the sub-grade earthing system.

If the connection cannot be made in the shortest possible manner (not exceeding a length of 10 m) or a resistance/reactance is connected in series between the life part and the subgrade earthing system, then the earthing conductor shall be sheathed with an adequate insulating material.

With the exception of the indoor main earthing bus, all other earthing conductors (above ground level) shall consist of tinned, stranded copper conductors with the minimum cross section as specified above, taking into account a maximum permissible temperature of 200°C under fault conditions. For connections with other metal parts, the ends of such conductors shall be fitted with cable lugs, rigidly connected with the earthing conductor by means of a hydraulic tool. Interconnections between earthing conductors shall be performed with straight joints or T-joints fixed in the same manner.

Connections with the sub-grade earthing system shall be performed at intervals of approximately 20 m.

The main columns of the control building or any separate building as well as any steel construction shall be connected either directly to the sub-grade earthing system or to the main protective earthing bus installed above ground level.

Such steel structure is likewise to be connected to the potential gradient control grid, if provided. Moreover, steel constructions shall be earthed at least at both ends or in case of a square structure at two points diagonally. Steel reinforcement in mass concrete shall be earthed just inside the exposed surface. Structural steel, pit liners, liners shall be connected to the earthing system at least at 2 points. Earthing connections shall be protected during concreting to avoid breaking of bonds of welded connections.

Earthing cables embedded in concrete shall have expansions or construction joints at right angles to the joint and shall be installed in such a manner that movement will not damage the cable.

All metal structures, such as trays, conduits, tanks, gratings, rails, pipes, louvers, stairs, doors, or enclosures which may become conductive during a fault of an electrical installation by direct contact, arc or via a creepage distance, shall be effectively connected to the protective earthing system. Rails and pipes shall have insulating joints where they leave the protected plant area.

Oil tanks shall be earthed twice with the earthing conductors taken from two different points of the earthing grid. All piping shall be earthed at all service points in an approved manner.

Steel fences within and around the power station area shall be connected to the sub-grade earthing system at all corners and gateposts. If required, an additional earthing cable for potential gradient control shall encircle the outside of the fence at a depth of about 0.5 m

and at a distance of 1 m from the fence. Gates shall be connected to the earthed gatepost with a flexible copper braid of equivalent size. Fences of plastic-coated meshed steel wire with at least 1 mm coating do not need to be earthed.

Metal enclosures and conductive structures of circuit breakers, isolating switches, measuring transformers, busbars, etc., shall be connected to the earthing grid. The housings of the operating mechanism shall be earthed at a point as near as possible to the operating handle.

Power transformer tanks shall be earthed at two points diagonally. These connections shall be made from two different points of the earthing grid. Where the neutral conductor is directly brought from the neutral bushing to earth, an additional connection between bushing and tank shall be provided to ensure a straight electrical connection between tank and neutral.

The neutral conductor shall have the same current carrying capacity as the phase conductors and shall be brought directly to an earthing electrode as part of the sub-grade earthing system.

Lightning arresters shall be connected separately to the earthing grid with 150 mm2 earthing cable connections. The lightning arrester earthing lead must be electrically connected to the metal structure on which the arrester is mounted. In addition, one earthing electrode shall be driven adjacent to the sub-grade earthing system to provide the lowest earth-resistance of the grid at this point.

Each MV or LV motor > 20 kW shall be connected directly to the sub-grade earthing system or to the main earthing bus.

Every room equipped with electronic equipment, line carrier systems and HF links shall have a direct connection to the sub-grade earthing system by means of an insulated earthing conductor of at least 50 mm2 cross-section. This earth conductor shall terminate at an earthing electrode, which has at least two connections to the sub-grade earthing system.

In each concrete cable trench one earthing conductor of 150 mm2 cross-section shall be laid to which all metal parts such as trays, racks or brackets shall be connected. Cable tunnels shall have two earthing conductors of same kind.

D Potential Gradient Control Systems

Every building floor or outdoor concrete slab, housing HV or MV switchgear, switchboards, transformers or other electrical equipment above 1 kV service voltage, shall be provided with a potential gradient control system. The system shall consist of a network of round steel bars of approx. 8 mm diameter having a mesh width not exceeding 5 m to be laid in the final concrete slab approximately 50 mm below floor level. Such installation shall be connected with the main steel structures or the main earthing bus (if provided) at several points, or with the sub-grade earthing system, whatever is more suitable but shall by no means be used in lieu of the protective earthing system.

Outdoor potential gradient control systems consisting of bare copper cables with a cross section not less than 95 mm2 shall be buried into the soil besides or nearby electrical components or metal structures at which a contact or step voltage of more than 100 V can exist during fault conditions. Such conductors shall be connected directly to the sub-grade earthing system and laid in approximately 1 m distance from the circumference of said electrical components or metal structures in a depth not exceeding 200 mm.

If, for any reason, a potential gradient control system as described above cannot be arranged, one of the following measures shall be taken:

- The floor surface at the operation area shall consist of conductive material, which shall be connected to the conductive portions of the electrical installation. The floor surface shall be encircled by an insulated area of at least 1250 mm width.
- The operation area shall be insulated against the maximum possible earth voltage (PVC lining, asphalt or coarse gravel) and all conductive portions of the electrical installation which can be touched simultaneously shall be connected with each other.

E Lighting Protection System

Wherever specified or required a lightning protection system shall be provided under strict observation of the local regulations and relevant standards (e.g. IEC62305). The system shall consist but not be limited to the following:

- Each super-structure shall be provided with the necessary lightning catching rods of stainless steel, with a minimum diameter of 10 mm, roof and down conductors of tinned copper or galvanised steel.
- Steel constructions or down conductors of a civil construction shall be connected at ground elevation to a ring main equipped with an adequate number of earthing electrodes of sufficient length to obtain an earthing resistance of approx. 0.1 Ω. Such ring main shall not be directly connected to the sub-grade earthing system or the protective earthing system.
- Each fuel oil or water tank installed outdoors which is not connected to a sub-grade earthing system shall be connected to 3 earthing electrodes evenly distributed around the circumference.

F 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 Illumination System

A General

The Contractor shall perform the design and engineering of the complete plant lighting system including the preparation of the installation drawings and other required documents. The design of the lighting system shall be in line with regulations of the local authorities and the applicable IEC standards.

All equipment shall be of such performance and quantity as to perfectly suit the purpose. The Contractor is obliged to co-ordinate the lighting installations with the installation of other trades e.g., suspended ceilings, fire-fighting, air-conditioning, piping, etc. Provisions to

facilitate erection, maintenance, cleaning and lamp replacement (e.g. ladders, carriages, and platforms) shall be included.

Lighting fixtures to be installed in rooms with special architectural requirements and/or provided with suspended ceilings shall cope in type and number with such environment. Lighting installations in switchgear and equipment rooms shall be coordinated with the arrangement of the installed equipment to provide adequate lighting for operation and maintenance. In large rooms/halls the fixtures shall be mounted in such a manner as to obtain a uniform illumination level if half of the fixtures of a certain area are switched off.

The illumination levels of indoor lighting system shall be measured horizontally at a height of 1 m above the floor; outdoor lighting of streets and of flood lighted areas at the surface. In new condition of the equipment, the ratio of the minimum to the average illumination level shall not exceed 1:3, and the ratio of the minimum to the maximum illumination level shall not exceed 1:6. The whole lighting system shall be designed to produce adequate visual performance and safety and shall be free from excessive glare, stroboscopic effects and flicker from discharge lamps.

The electrical lighting and power supply systems shall be designed in compliance with IEC 60364, TN networks, subdivided into:

- Normal lighting circuits fed by the plant AC auxiliary services;
- Emergency lighting circuits fed by an emergency power source;
- Security lighting circuits fed by DC or Safe AC systems;
- Socket outlet circuits, 16 A, single phase, and
- Power socket outlet circuits (three-phase, five poles, 16 A and higher ratings as required) fed by the AC auxiliary services.

Lighting fixtures shall be evenly distributed on the three phases.

B Lighting Sub-distribution Boards

The lighting sub-distribution boards shall be of robust sheet metal, flush front design and, depending on size and location, be of the free-standing or wall-mounted (exposed or flush) type. The front doors shall be provided with lockable handles (one key type for all sub distribution boards). They shall be the standard product of a reputed manufacturer.

The electrical equipment of sub-distribution boards shall consist of:

- One main bus-bar system and one emergency bus-bar system (optional) for the specified voltage levels, and AC systems with separate neutral and protective earthing bars (TN network);
- Main incoming breaker for each bus-bar system;
- Contactor for the emergency power supply (optional), automatically controlled upon failure of the main supply;

- MCBs with thermal and magnetic over current release for lighting, socket outlet, and control circuits. Supervised fuses are only allowed as short-circuit limiting element. The tripping characteristics of the MCBs shall ensure selectivity with other switchgear;
- Contactors, auxiliary relays and impulse operated contactors for remote control of lighting circuits;
- About 20% spare feeders of each type (2 nos. minimum);
- One indicating lamp for common fault indication of the tripping of any protection device installed in the board (fuse blowing, control MCB tripping, etc.), mounted in the upper part of the front door, with auxiliary contacts for remote alarm and event recording;
- Terminal blocks.

Photoelectric cells with adequate light intensity adjustment range shall control lighting circuits allocated to outdoor installations. Remote control devices and manual override switches shall also be provided.

An electrical diagram showing all equipment and the circuits being connected to the individual outgoing feeders shall be provided on the rear side of the front door.

C Lighting Fixtures

All lighting fixtures complete with lamps, tubes, instant starting control gear, chokes, compensating capacitors, etc., shall be of approved manufacture, constructed from best quality materials and installed with best workmanship.

Unless a variety of lighting fixtures is specified in the Technical Specifications, the Contractor is to propose and submit details of such fixtures he is intending to use subject to approval. Fixtures and fittings used indoors or outdoors shall be selected to meet perfectly the purpose (location and illumination level) as well as the prevailing environmental conditions (IP protection class, hazardous areas).

Special precaution shall be taken to protect the wiring from damage by heat generated by fittings and lamps. For compensation of the inductive current of the chokes compensating capacitors, shall be provided to obtain approximately unity power factor.

To avoid electrical shocks when touching disconnected fittings which include capacitors, discharge resistors of sufficient size shall be connected in parallel with all capacitors of more than 0.5 µF capacitance.

The equipment shall be furnished with radio interference suppression if the maximum interference voltage stated in the IEC regulations is exceeded.

Diffusers of fixtures carrying labels to indicate e.g. emergency exits etc. shall be fitted with a green colored, translucent foil bearing the approved inscriptions or symbols.

D Cabling

Lighting and socket outlet circuits shall consist of PVC insulated cables with copper conductors neatly and clearly arranged.

Cabling in plaster or concrete-finished rooms shall be executed with PVC-insulated conductors in embedded conduits. In equipment rooms, workshops, storage rooms and the like, cables shall be laid in surface-mounted PVC conduits and in areas endangered by mechanical damage in galvanised mild steel conduits, painted after erection. Mineral insulated metal-sheathed wires or an approved substitute shall be used where necessary.

E Switches

Lighting fixtures in self-contained rooms such as offices, switchgear rooms, battery rooms, etc. shall be switched locally. If more than two switching points are foreseen or required (staircases, large rooms with several entrances, etc.) then push-button switches shall be used to control impulse-operated relays and contactors arranged in the associated sub distribution boards. All other circuits shall directly be controlled from the relevant distribution boards.

Switches (10 A) and socket outlets (16 A single-phase, three pins) installed in rooms with embedded wiring shall be designed for flush mounting in moulded-plastic wall boxes. In all other cases, exposed mounting with shockproof plastic housings of adequate enclosure shall be provided. Switches shall either be of the tumbler or rocker-dolly type.

F Power Sockets Outlets and Plugs

The power socket outlets and plugs shall be of the CEE type, weather-proof, with housings of shock-proof plastic material. Wherever specified or required, the following types of outlets shall be provided:

- Three-phase socket-outlets of 16 A and higher ratings as required with five pins and incorporated fuse with switch, mechanically interlocked;
- Single-phase socket-outlets of 16 with three pins;
- Single-phase safety low voltage (42 V) outlets of 20 A, with three pins, equipped with step-down transformer for continuous loading and isolated secondary winding as well as with earth-fault protection. The transformers shall have special tropical insulation and be totally enclosed in sheet steel housing of protection class IP 65. The complete unit shall be suitable for wall mounting.

At special locations (for example at operation levels), a three-phase socket of adequate rating in combination with a single-phase socket shall be provided.

Outdoor installations subject to sun radiation shall be provided with protection shields. At hot locations, suitably protected metallic housings shall be provided.

G Tests

The complete installations and, as far as reasonable, also the individual components shall be tested as follows:

- Visual inspection;

- Functional tests;
- Measurement of illumination levels.

1.6.8 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.

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

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

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 33 and 11 kV 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 33 and 11 kV 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 33 and 11 kV line works. The Contractor shall have adequate manpower to complete the work within the scheduled time.

1.6.9 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.

1.6.10 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, circuit breaker, CT, PT, DSES, 11 kV feeders, etc.), control building and at interconnecting substation with a heading and a paragraph regarding the function of the equipment in Nepali.

Laminated text on wooden board shall be held on at least four towers, near the Interconnecting substation and take off yard with 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.

Substation 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.

1.6.11 Steel Structures

Generally, design and stress calculation shall conform to:

- DIN 18800 Steel Structures, Calculation and Construction
- DIN 18801 Structural Steel in Buildings, Design and Construction

The materials used for general steel structures shall conform to mild steel as per DIN EN 10 025, S235JRG2 or S355J2G3.

For standards applicable to steel structures of lifting equipment, refer to "Lifting Equipment" and for hydraulic steel structures, refer to "Hydraulic Steel Structures" of these Standard Technical Requirements.

Adequate clearance of at least 2 m shall be provided at overhead steel structures to allow unobstructed passage.

Stairs and ladders shall have an inclination of approximately 30 degrees and 75 degrees respectively. Stairs shall be complete with handrails, min. 900 mm high, and kickboards of 80 mm height.

Vertical ladders shall be installed alternating left hand/right hand side to horizontal platforms placed approx. every 5 m of vertical height. Vertical ladders of more than 3 m height shall be guarded.

Platforms and stairs shall be provided with anti-slip checker plates.

1.6.12 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.

1.6.13 Locking Facility

A General

The Contractor shall provide locking facilities for a security locking system and an isolation locking system for cubicles, equipment and rooms in his supply together with padlocks for access gates and doors related to his equipment. The locking systems shall be approved by the Employer.

B Security Locking System

The security locking system shall be a grand master key system designed to prevent unauthorized access to cubicles, equipment and rooms, and to prevent unauthorized operation of critical plant.

Locks shall be provided for all equipment in the Contractor's supply with a master key opening every lock within each major group, unit or area of Plant.

Every lock in the Contractor's supply shall also be able to be opened by the grand master key held by the Employer.

Before the Contractor begins the erection of equipment, which is locked or installs equipment or door locks on Site, he shall forward two copies of the Grand Master Key to the Employer.

C Isolation Locking System

The isolation locking system shall be either a padlock system or a proprietary locking system, completely independent of the security locking system. Locks shall be provided in sufficient numbers and suitable to lock every electrical or mechanical isolation device which may be required to be isolated in accordance with the Employer's permit system and with approved operation and maintenance procedures. Equipment to be isolated shall include but not be confined to electrical load break and isolating switches, grounding switches, fuse switches, lockable circuit breakers, plant docking devices and all isolating valves.

The keying system shall be a simple independent system in which each lock shall be able to be operated by its own key only and without a master key. The Contractor shall formally hand over to the Employer when requested by the Employer, two keys for each lock, together with the lock maker's authorization certifications to enable him, but nobody else, to duplicate the keys. Each key and lock shall bear a unique identification number, with a blank tag attached for the Employer's use.

D Construction Locks

The Contractor shall provide all locks necessary to restrict access to the facilities included in the Contract from the arrival on Site until the security and isolation locking systems are in place. Isolation locks at the interface between the facilities and equipment controlled by other contractors or the Employer shall, until such time as the facilities or part thereof have been taken over, be fitted with multiple lock devices such that each party may apply their own lock independent of any other party.

1.6.14 Lifting Equipment for Special Applications

A General

Generally, for design, stress calculation, manufacture and installation, the following standards and codes, besides other relevant standards and regulations, shall be applicable:

- DIN 18800 - Steel Structures, Design and Calculation
- DIN 15018 - Cranes, Steel Structures, Calculation and Design
- DIN 15020 - Rope Drives Safety devices for the operating personnel
- FEM - Rules for the Design of Hoisting Appliances

Safety devices for the operating personnel shall be provided wherever it is deemed necessary.

The safety rules outlined in VBG 9 of the German "Verband der Berufsgenossenschaft" or similar internationally recognised codes shall be observed.

Unless otherwise specified, the lifting equipment shall be classified to DIN 15020 as follows:

- For lifting capacity up to 100 kN (10 t) "class 2 m", representing an average daily working time of 2 to 4 hours and an equal share of small, medium, and heavy loads (normal duty);
- For lifting capacity larger than 100 kN (10 t) "class 1Am", representing an average daily working time of 2 to 4 hours and a small share of heavy load lifts (light duty).

The Contractor shall state the various load combinations and factors of safety taken as a basis for calculation of the different components of the crane. In addition, the various factors of safety for the different load combinations shall be stated.

The crane hook shall not shift laterally when lifted or lowered.

Every lifting equipment shall be subject to a static test with an overload = 1.40 × nominal load and a dynamic test with an overload = 1.20 × nominal load in agreement to FEM Standards 1.001 3rd revision (see Sub-Paragraph 8.1.2).

The crane girders and rails shall be calculated for a deflection not exceeding 1/1000 of the span at maximum nominal load.

Steel structures of lifting equipment shall be of welded construction, which can be assembled at Site. All field connections and joints shall be bolted.

For maintenance, inspection and lubrication, appropriate ladders, platforms and steps shall be provided, fitted with anti-slip checker plates, tabular handrails and skirting. Walkways, stairs and platforms for lifting equipment shall generally be designed for a service load of 3000 N/m^2.

B Materials

The material to be used for manufacturing lifting equipment steel structures shall conform to DIN EN10025 or to the equivalent ASTM standards. However, the Contractor shall restrict the structural steel to S235JRG1 and S335J2G3 or ASTM A 36; the latter may be regarded as equivalent to St 42. For these structural steels, connecting bolts and welds, the allowable stresses given in DIN 15018 shall apply.

If the Contractor intends to supply material other than that mentioned above, he can do so, provided their equivalence to the specified material standards is verified by the Contractor and approved by the Employer.

The stresses between the track rails, equipment supporting and fixing elements and the concrete shall not exceed (viz. DIN 1045) the following values:

- Mean allowable compressive stresses 6.0 N/mm^2
- Allowable compressive stresses on edges 8.5 N/mm^2
- Allowable bond and shear stresses 0.8 N/mm^2

The stresses induced by maximum torque shall not exceed 80% of the material yield point.

C Particular Requirements

Nameplates stating the nominal capacity in kN or tons (as required by the Employer) shall be attached to both sides of the lifting equipment structure and to both sides of the tackle. The printing shall be clearly legible from the floor.

Hoists, ropes, drums, sheaves and related equipment shall be calculated to DIN 15020.

Flexible couplings shall be installed to relieve the bearings and shafts from any stresses due to misalignment and to facilitate the removal of motors, wheels and gears. The motor couplings also shall be of the flexible type.

All couplings drive wheels and gears shall be press fit and keyed to the shaft.

All wheels shall have a hardened tread with a minimum Brinell Hardness Number of 400, and shall be made of carbon steel or low-alloy steel forgings. They shall have double flanges, shall be machined to a uniform diameter concentric with the hub bore.

All bearings shall preferably be anti-friction bearings designed to permit easy shaft disassembly and easy replacement. The minimum average lifetime under design load conditions shall be 5000 h.

All gears shall be designed and executed as helical gears. For all high-speed gears and pinions, oil bath lubrication shall be provided. Low-speed gears may be lubricated with soft grease. Suitable oil and grease drip pans shall be installed and be readily accessible for draining and cleaning.

Bridge and trolley drives shall be equipped with spring-set, electrically (solenoid or electrohydraulic) released shoe or disc brakes, with capacities of at least 1.5 times the full operating torque of the drive.

The brake shall be applied when the motor control switch or the main switch is in the "off" position and/or in case of power failure in any phase. The braking action shall be gradual and the brake shall become fully effective after a certain time lag.

Lifting equipment to operate gates shall be designed in accordance with DIN 19704.

1.7 Automation and Control Equipment

1.7.1 Design Criteria

A General

The general requirements for electrical equipment shall be considered for Automation and Control (A&C) 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 electrical, electronic and mechanical 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.

B 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.

C 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.

D Special Local Conditions

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

- Local indicators shall be of stainless steel;
- Copper pipes shall be protected with an external plastic sheath;
- External bolts and screws shall be of non-corrosive material;
- Secondary shut-off valves, balancing and drain/blow-off valves shall be of the noncorrosive type;
- Metallic instrument piping shall be protected with corrosion protecting painting, or shall be of non-corrosive materials;
- 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.

1.7.2 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 plant.

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

1.7.3 Instrumentation System

Only electric measuring signals of 4-20 mA or digital shall be transmitted to the control room. The output signal of transmitters shall be 4-20 mA or digital and linear over the whole measuring range.

The components shall quickly respond to any changes of the measured values. Measuring ranges of indicators, transducers, etc. shall be selected in such a way that the rated value of the measured variable covers approx. 75% of the range.

All local instruments shall, as far as practicable, be mounted vibration free. Wherever required, damping elements shall be used. Corresponding systems shall be grouped together for easy observation.

All local indicating instruments and test connections shall be included in the respective equipment as integral part. 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.

The binary sensors shall be fused separately.

A Flow Measurements

The primary elements of flow meters shall be standard Venturi tubes, pitot tubes or standard orifices. Their design and performance shall be in accordance with the applicable standards.

The design and arrangement of tapping points, piping and valves shall be in accordance with VDE 3512.

At a minimum flow of > 5% of the measuring range, all flow transmitters shall measure correctly. The error limit shall be ±1% for a rate of flow higher than 10%. The error of the primary elements is not included in this accuracy. The root extraction of flow measurement shall be effected electrically within the transmitter.

The arrangement of the throttling devices (straight lengths upstream and downstream from the throttling device) shall be in accordance with the applicable standards. Bends shall be positioned at a sufficient distance upstream from the throttling device, particularly when large orifice ratios are used.

B 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 screwin 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 minimise 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.

C Pressure Measurements

Pressure gauges shall be shock and vibration-proof, preferably by filling with glycerine, and shall be equipped with toothed wheels and toothed segments of the machined type. They shall completely be made of stainless steel and sustain the occurrence of higher than rated pressures without damaging the pressure gauge or affect its calibration. If the pressure is pulsating, the devices concerned shall be connected via flexible tubes or other pulse absorbing means.

The pressure gauges shall be equipped with a radial-connecting stud, to allow the mounting on a gauge holder. Casings shall be dust and watertight and be made of stainless steel.

Pressure gauges with potentiometers will not be accepted for use as a pressure transmitter. The error for pressure transmitters shall be limited to ±0.5%.

Pressure gauges and transmitters for inflammable liquids shall have filled systems and the filling liquid shall be separated from the inflammable liquid by means of adequate isolating membranes.

Each gauge, pressure switch and transmitter for absolute or differential pressure shall be equipped with a pressure gauge isolating valve including a test connection of the screwed type M20×1.5 mm so that such device can be removed without any disturbance of the plant operation.

Pressure gauges and transmitters for pressures of 1 MPa and above shall not be directly mounted on the pressure tapping point. They shall be mounted apart from the tapping point on gauge holders or gauge boards. Whenever possible, pressure gauges and transmitters shall be group-wise combined on racks or consoles.

Pressure gauges for high pressures shall be equipped with a relieve valve for safety reasons in case of leaks (with a rubber reverse flow check). In case of flowing substances, the measuring point shall be selected in locations of undisturbed flow. The high and low-pressure connections of differential pressure gauges shall be marked.

In general, all pressure gauges, transmitters and pressure contacts shall easily be accessible for maintenance and supervision. The adjustment of the pointer shall be possible by means of an adjustment device without removing the pointer from its axle.

The design and arrangement of tapping points, piping and valves shall be in accordance with VDE 3512. The scales shall have a diameter of 100 to 150 mm with black letters and figures on a white ground. The calibration shall be in "**Pa**".

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. CT connected ammeters provided for indication of motor currents shall be provided with suppressed overload scales of 2 times full scale. The dials of such ammeters shall include a red mark to indicate the full load current of the motor.

Where directly connected, ammeters are provided for indication of motor currents they shall be supplied with overload scales indicating up to six times full load current. The dials of such ammeters shall include a red mark to indicate the full load current of the motor.

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

Transmitter connected ammeters shall have 90° or 240° circular scales calibrated 0-120%. The rated motor current shall correspond to 100% scale indication.

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 Recorders

All recorders shall be of the strip-chart type, with dust proof housing. Recorders with circular charts will not be accepted.

The drives of all recorders, including event recorders, shall have either synchronous AC motors or DC motors.

Recorders shall have chart speeds adjustable in steps between 20 and 60 m/h and the measuring range shall preferably be changeable by plug-in modules.

Recorders for electrical variables shall be of the pen-type with measuring units of accuracy class 1.5 and shall have a recording width not less than 55 mm. Flows, pressures, levels shall be recorded on line recorders, other types of measurements shall be recorded on multipoint recorders.

The recording paper shall be of standardised type being the same for all recorders.

H Contact Devices

Contacts of level switches, pressure 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.

1.7.4 Alarm System

The alarm system shall provide all alarms required for a safe and reliable operation of the plant. Alarms shall be initiated locally, in the control room, individual or grouped as required. All alarms shall be recorded on event recorders/station control system.

1.7.5 Logic Controls and Interlocking

The open loop control and interlocking systems shall comprise all controls of motors, circuit breakers, disconnecting switches, motorised valves, dampers, solenoids, etc., including all process interlocks to properly control the plant and protect the equipment.

The remote control and interlocking system shall be performed in solid state technique with logic units. The solid-state equipment for remote controls and interlocks shall be assembled in cubicles installed in appropriate locations. Plug-in units shall be used for easy maintenance and repair.

The electronic system shall comply with the following requirements:

- Application of IC-circuits;

- Dimensioning according the "Worst-Case-Method" and over dimensioning of the elements;
- Short circuit resistant outgoing feeders;
- De-coupling of incoming feeders;
- Protection against overvoltages by means of lightning arrestors and/or protecting diodes;
- Transmitting of commands through two different channels up to the control unit;
- Supervision of the operating time of important controls e.g. valves, gates etc.;
- Temporary supervision of starting processes;
- Supervision of the entire system with respect to active and passive faults;
- Supervision of the plug-in contacts;
- Individual signalisation of faulty units by means of "LED's".

The entire control and supervising system shall be as specified in the Technical Specifications.

1.7.6 Automatic Control System

A complete automatic closed loop control system shall be provided to ensure a safe operation of the plant. The control system shall include all the necessary equipment and instrumentation to perform automatically all required control functions and to allow manual operation of the actuators from the control room as well as locally.

Electronic controllers and programmable logic control units in solid state and microprocessor technique shall be provided.

1.7.7 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.

1.7.8 Process Computer

Process computers with workstations shall be provided. The operation of the plant shall not be restricted by the failure of the process computer system. The redundancy shall be on the basis of the hot stand-by principle. The process computers shall be used for the functions as mentioned under the following sub-items.

A Alarm Recording

The process computers shall take over the function of alarm recording. The printouts shall give a clear text description of the alarm source in all its details.

B Plant Data Collection and Recording

Important analogue/digital values of the plant shall be scanned cyclically, converted, checked, calibrated and an hourly log sheet shall be printed out in order to give a clear status of the general plant performance. Daily and monthly energy balances shall be calculated and printed.

C Failure Recording

The tendency of analogue values important for the plant operation (alarm, required operational steps, tripping etc.) shall be monitored on VDUs and printed out by the process computer.

D Maintenance Protocol

A record shall be printed on a weekly and monthly basis showing the plant components having reached the service time limit and will need maintenance.

E Expert Advice

Advice shall be given in case of failure and repair requirements.

1.7.9 Central Control Room and Local Control Panels

A General

The control systems shall be furnished with the necessary devices for local manual, local automatic and remote automatic/manual control of the units, auxiliary systems, switchgear etc.

To achieve these features, the systems shall mainly include individual local control panels, a central control room and the ancillary installations like power and air supply systems, transducer racks/panels, interface terminal racks/panels, cable and data-bus installations, etc.

B Design and Construction of Desk and Panels

All desks and panels shall be of manufacturer's standard design considering ergonomic aspects and construction complying with the requirements.

All desks, panels and cubicles shall have adequate space for internal wiring and cable terminations.

The cable access to cubicles and marshalling racks shall be from the bottom and/or from the top, as suitable.

All panels and cubicles shall have a minimum of 10% spare equipment and 20% spare space after commissioning.

Cubicles shall be equipped with adjustable temperature supervision and fan, if required, giving a local alarm on the front door of each cubicle and a remote group alarm for each assembly of cubicles.

C Central Control Room

Operation and supervision of the entire plant shall be accomplished from the CCR. All facilities and devices shall be included to provide a clear and comprehensive status of the plant at any time.

Automatic and/or manual control of the generating units, mechanical and electrical auxiliary systems, LV/MV/HV switchgears and hydraulic structures etc. shall be possible.

To realise such tasks, the CCR shall include control panels and desks equipped with all necessary indicating, recording, control, alarm and supervisory devices.

Desks and panels shall be fitted with mosaic type mimic diagrams and display screens to provide clear images of single-line diagrams, hydraulic schemes, process diagrams, measuring values, etc.

The control room layout shall consider clear and logic arrangement of furniture, panels, desks, work stations, printers, lighting, HVAC etc. in-line with ergonomic aspects.

D Electronic Auxiliary Room

Electronic auxiliary rooms shall be made available adjacent to the CCR to accommodate all control and other equipment not directly involved or required for the plant control and supervision. The communication systems may also be installed in this location.

E Local Control

All plant main components or systems shall have their assigned individual local control cubicle (LCC) enabling manual and/or automatic control in all functions by means of solid state hard wired or programmable hardware and software.

For each Power Transformer control board (UCB) is specified in the Technical Specifications providing the following features:

- Manual and automatic control of the units;
- Indication of all relevant electrical/mechanical/hydraulic data and measurements;
- Alarm annunciation and recording of all relevant individual and group alarms;
- Control of main auxiliary electrical/mechanical systems;
- Manual/automatic synchronising;
- Speed/voltage control;
- Start/stop/emergency stop;
- Open/close of main inlet valve.

The units control boards shall form a common assembly with the protection panels, providing a unique appearance. If appropriate the unit MCC shall also be arranged in the same line-up.

LCUs equipped with programmable logic controllers shall be provided for the various plant components and systems (e.g. auxiliary supply systems, station service systems, gates at the headwork and tailrace, etc.).

Close co-operation with the relevant supplier shall, therefore, be mandatory.

F Transmitter Racks and Piping

Wherever practicable, transmitters shall be installed readily accessible in the proximity of the measuring point, free from vibration and protected against damage, moisture, dust, corrosive air, and great temperature changes.

The transmitters shall be grouped and assembled as far as practicable on local transmitter racks or in cubicles with glass or Plexiglas front.

The connecting lines between the primary elements and the transmitters shall be installed with slope that no air pockets or water locks are created.

G Auxiliary Power and Control Air Supply

Important control and protection systems shall have duplicate in-feed with appropriate protection and changeover devices.

The power supply system shall be designed to enable safe operation, to minimise the risk of failure and damages and to facilitate the detection of faults. Closed control loops shall be individually protected.

Miniature circuit breakers with auxiliary alarm contacts shall be provided for protection. Alarms shall be indicated by a lamp in each cubicle and as a group alarm in the control room.

In order to facilitate interconnecting network design, all components of the control system shall have a common reference, isolated from earth. This will allow the first accidental earthing of a circuit without disturbance provided that this earth fault is cleared prior the occurrence of a second one. A suitable monitoring system shall be provided measuring the total resistance of the circuits against earth and to issue an alarm signal.

In addition, an earth fault detection system shall be provided for continuous insulation monitoring and fault location detection without interfering with the control signals.

In case of power supply failure, all final control elements shall automatically switch to a failsafe condition and to initiate an automatic control-loop transfer to the manual mode with necessary annunciation. As soon as the power supply returns, the systems shall remain in the latter mode.

Every pneumatic instrument of the plant shall be supplied with low-pressure control air. A supply branch shall feed one instrument only. Branches shall be fed from headers or sub headers connected with the control air system. The control air shall be available at a pressure of 0.5 to 0.8 MPa and shall be dry and oil free.

The supply units for individual consumers shall include a manual shut-off valve, an adjustable filter regulator unit and a pressure gauge scaled in **"Pa"**. The capacity of pressure regulators shall ensure a sufficient air supply for satisfactory operation of the instruments.

Local cabinets containing several instruments shall be provided with 2 independent supply systems i.e. one system for normal use and the other for emergency. Each system shall include: shut-off valve, a filter and regulator, a safety valve, 2 pressure gauges (one each on inlet and outlet) and 1 spare supply valve at high pressure side.

1.7.10 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.

1.8 Inspection and Tests

1.8.1 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 Special Conditions of Contract, regarding general procedures of inspections and tests, terms, definitions and time schedules of inspections and tests, the following stipulations shall apply.

1.8.2 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 lifetimes 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.

The validity of type tests certificates for the components of any factory will be normally within 5 years from the date of bid submission, if there is a change in design and up to within 10 years from the date of bid submission. These certificates shall be submitted for each of the manufacturer proposed.

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 rested 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.

1.8.3 Factory Acceptance Tests (FATs)

FAT shall be performed on equipment and plants in compliance with the Special 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:

- 33 kV switchgear,

- Main transformers,
- Station transformers,
- 11 kV equipment,
- LV switchgear,
- Diesel set,
- DC and UPS systems,
- 11 kV, 33 kV and LV (AC, DC, Communication, Instrumentation and Control) cable system,
- Electrical protection systems,
- Automation and control systems,
- Communication and security systems,
- ACSR Conductor,
- Medium Voltage Covered Conductor,
- Aerial Bunched Conductors,
- Poles,
- 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.

1.8.4 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 Special 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.

1.8.5 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.

1.8.6 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.

1.9 Transport and Installation

1.9.1 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.

1.9.2 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.

1.9.3 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, electric motors, 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.

1.10 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.

1.10.1 Reference Points

The Contractor shall carefully protect all reference points. Demarcation lines, pegs, etc., moved or destroyed by the Contractor shall be fully and accurately restored at the Contractor's expense.

The Contractor shall be responsible for the true and proper staking-out of the works and levels of reference given by the Employer in writing, for the correctness of the positions, levels, dimensions and alignment of all parts of the works and for the provision of all necessary instruments, appliances and labour in connection with this.

The checking of any staking-out or of any line or level by the Employer shall not in any way relieve the Contractor of his responsibility for its correctness.

1.10.2 Contract Interface Points

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

- Where pipe work and ducting supplied under this Contract connects to equipment already existing, the connections shall be made under this Contract.
- 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.

1.10.3 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.

All parts to be embedded in concrete shall be set accurately in position and shall be supported rigidly to prevent displacement during the placing of concrete. Adjusting screws and bolts shall be drawn tight and secured adequately. Steel wedges shall be secured by welding. Wooden wedges shall not be used.

The Contractor shall verify carefully the position of all parts to be embedded before concrete is poured. All-important measurements and dimensions shall be recorded. Copies of these records shall be given to the Employer for checking and approval before grouting.

The Contractor shall be responsible for the supervision of the grouting work. He shall state the allowable filling velocity and sequence for pouring the concrete in the different places. After concreting, the control measurements shall be verified again, indicated in the above-mentioned records and submitted to the Employer.

Any error in shop work which prevents the proper assembling and fitting of the parts shall be immediately called to the attention of the Engineer and approval obtained for the correction procedures.

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.

Welding, torch-cutting and drilling work on the equipment to be erected shall only be carried out with the approval of the Employer.

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.

After erection, the works shall be finally painted; it shall be done as far as applicable in accordance with the painting specification, and any damaged paint work shall be restored.

All work at the site shall be carried out in such a manner as not to obstruct the operations of other Contractors on the site or interfere with the operation of the Employer's existing installations on the Site. The Contractor shall cooperate with other Contractors and the Employer to attain this end.

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.

The Contractor shall ensure the correctness of electrical and mechanical connections to all equipment supplied under the Contract before such equipment is commissioned.

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.

1.10.4 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, loadcarrying 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.

1.10.5 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. In particular, the following fire prevention measures shall be taken:

No open fires shall be allowed within the site area. Burning of condemned materials shall be carried out in a specially designated area outside of the site area.

Combustible material shall be stored in places where spreading of fire is limited to a minimum. Non-combustible plastic foils shall be used for protection of material.

All combustible material shall be removed from working areas where the work going on requires the use of or produces open flames (e.g. welding). If such removal is impossible, the working area shall be specially protected by suitable firefighting equipment.

The Contractor shall maintain the firefighting equipment fully operational at all times and shall recharge extinguishers after use regardless of by whom they were discharged. Adequate stocks of fresh chemical charges for use in extinguishers shall be kept in readiness on the site.

The Contractor shall nominate certain of his employees who shall be made available for initial training in firefighting duties and subsequently for firefighting drill and servicing of firefighting equipment. The nominated employees shall be available for firefighting duties at all times when they are on the Site.

1.10.6 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.

1.11 Annex

1.11.1 Electrical Standard Ratings

A Voltage

i High and Medium Voltage

High Voltage for the substations shall refer to 66 kV and above and Medium Voltage for the works shall refer to 11 and 33 kV respectively.

ii Low Voltage systems:

- 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.

1.11.2 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.

1.11.3 Motor Voltages and Power Ratings

The service voltages and corresponding power ratings for electric motors to be used in the Project shall be as follows:

A Motors up to 100kW

- Service voltage: 3-phase AC 400/230 V
- Mode of starting: direct on-line

B Motors up to 0.75kW

- Service voltage: single-phase AC 230 V
- Mode of starting: by condenser

C DC motors

- Service voltage: 220 V DC
- Mode of starting: by resistor

1.11.4 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

1.11.5 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.

1.11.6 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 

1.11.7 Required Documents

A General

In compliance with Section Technical Documents of this General Technical Requirements at least the following documents for the electrical and mechanical 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:

- Power transformer
- Station service transformers
- Switchgear assemblies
- Cranes, if applicable

All documents: I

ii Foundation Drawings

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

iii General Arrangement Drawings

For the whole plant and for individual areas / buildings / rooms / trenches: A

iv Short Circuit Calculations

For the following voltage levels:

- HV network (66 kV and above, if applicable)
- MV systems (33 kV and 11 kV MV distribution systems)
- LV auxiliary supply systems
- DC auxiliary supply systems

All documents: A

v Insulation Coordination, Lightning and Switching Overvoltage Study

- Insulation coordination study A
- Lightning and switching over-voltage study A

vi Load Calculations

For all medium and low voltage levels (AC and DC): A

vii Plant Identification System

- Description of the applied plant identification system A
- Frequently updated lists complete with all plant identification numbers for electrical/mechanical equipment I

viii Basic Documentation

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

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

ix Overall Diagrams

- Single-line overall diagrams A
- Three-phase overall diagram with phase sequence and vector groups A
- Substation water supply and drainage system A
- Building water system A

x Documents for all Equipment and Installation as Applicable

- Shop test programs A
- Material test certificates I
- Shop test reports A
- Welding procedures A
- Welder's qualification certificates 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 Substation Yard and Equipment

- General layout plan of Substation
- Sectional profile of substation area in every 5 m Chainage
- Equipment Layout Plan
- Equipment Foundation Layout plan
- Fabrication drawings of Structural Drawing of Equipment support structures and foundation
- Detail drawings of Side drain with layout plan, profile, and Sections
- Detail drawings of cable trench with cable tray
- Profile of boundary wall with cross section details in every 5m
- Drawing of surface draining using PVC perforated pipe
- Drawings of any other necessary structures
- Automation Control and Protection Cabling Diagrams
- Telephone and Internet Connection Diagram
- Fire Fighting Protection Diagram
- Street & Beautification Light Detail Diagrams with Illumination Calculations

All documents: A

D Specific Documents for Buildings

i Control Building

- General layout plan

- Floor plans
- Longitudinal and lateral cross sections
- Foundation Layout
- Column Section and layout
- Reinforcement details of beam, Column Slab etc.
- Typical detail of sill and lintel beam
- Light and Fan Power Supply and Distribution Diagram with calculations
- Power Circuit Power Supply and Distribution Diagram
- Telephone and Internet Connection Diagram
- Fire Fighting Protection Diagram with alarm system as essential for Control Building as per International Practice and Standard

All documents: A

ii Office Building

- General layout plan
- Floor plans
- Longitudinal and lateral cross sections
- Foundation Layout
- Column Section and layout
- Reinforcement details of beam, Column Slab etc.
- Typical detail of sill and lintel beam
- Light and Fan Power Supply and Distribution Diagram with calculations
- Power Circuit Power Supply and Distribution Diagram
- Telephone and Internet Connection Diagram
- Fire Fighting Protection Diagram

All documents: A

iii Staff Quarter

- General layout plan
- Floor plans
- Longitudinal and lateral cross sections

- Foundation Layout
- Column Section and layout
- Reinforcement details of beam, Column Slab etc.
- Typical detail of sill and lintel beam
- Light and Fan Power Supply and Distribution Diagram with calculations
- Power Circuit Power Supply and Distribution Diagram
- Telephone and Internet Connection Diagram
- Fire Fighting Protection Diagram

All documents: A

iv Guard House

- General layout plan
- Floor plans
- Longitudinal and lateral cross sections
- Foundation Layout
- Column Section and layout
- Reinforcement details of beam, Column Slab etc.
- Typical detail of sill and lintel beam
- Light and Fan Power Supply and Distribution Diagram with calculations
- Power Circuit Power Supply and Distribution Diagram
- Telephone and Internet Connection Diagram
- Fire Fighting Protection Diagram

All documents: A

E Specific Documents for Electric Equipment

i Power 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 auxiliary systems:	
	- Arrangement and dimension drawings	A
	- Specifications	A
	- Circuit diagrams	I
	- Block diagrams	A
	- Logic/process diagrams, I/O list	A
	- Part lists	I
	- Terminal diagrams	I

ii Medium 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

iii Medium Voltage Overhead Lines

-	Results of soil investigation	I
-	Line profile drawings	A
-	Conductor and earth wire tension/ sag tables	A
-	Pole, support, and stay anchoring detailed drawings	A
-	Sub grade earthing system layout 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

iv 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

v Batteries

- Specifications and technical data sheets A
- Dimension drawings for individual cells and for battery rooms with complete battery assemblies and racks A
- Load evaluation and calculation of battery capacity A

vi Battery Chargers

- Specifications and technical data sheets A
- Arrangement and dimension drawings A
- Single-line diagrams A
- Standard circuit diagrams A
- Individual circuit diagrams A
- Part lists I
- Terminal diagrams I
- I/O Lists A

vii Diesel Generating Unit

- Specifications and technical data sheets A
- Arrangement and dimension drawings A
- Calculation of unit rating A
- For auxiliary systems (fuel, lubrication, cooling, starting, air intake

	and gas exhaust systems:	
	- Specification	A
	- Arrangement and dimension drawings	A
	- Circuit diagrams	I
	- Block diagrams	A
	- Logic/process diagrams, I/O Lists	A
	- Part lists	I
	- Terminal diagrams	I

viii 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
-	For protection cubicle assemblies:	
	- Arrangement and dimension drawings	A
	- Circuit diagrams	I
	- Block diagrams, tripping schemes	A
	- Logic/process diagrams, I/O list	A
	- Part lists	I
	- Terminal diagrams	I

ix Control Systems

-	Specifications and technical data sheets for hard and software	A
-	Overall system architecture drawings	A
-	I/O Lists grouped according to plant components	A
-	Logic and process diagrams,	I
	Layout drawings for CCR with furniture and lighting system	A
-	Installation drawings	I
-	For control cubicle assemblies:	
	- Arrangement and dimension drawings	A
	- Circuit diagrams	I
	- Block diagrams	A

-	Logic/process diagrams	A
-	Part lists	I
-	Terminal diagrams	I

x Communication Systems

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

xi Lighting and Small Power Installations

-	Lighting fixture schedule with specifications, data sheets and light distribution curves for individual fittings	A
-	Illumination level calculations with type, number and arrangement of lighting fixtures	A
-	Overall single line diagram	A
-	Installation drawings	I
-	Typical installation details	I
-	For lighting main-distribution and sub-distribution boards:	
	- Specifications	A
	- Arrangement and dimension drawings	A
	- Single-line diagrams	A
	- Circuit diagrams	I
	- Part lists	I
	- Terminal diagrams	I

xii Cabling

For power, instrumentation and control installations:

-	Specifications and technical data sheets	A
-	Calculation of cross sections and voltage drops	A
-	Cable lists and connection diagrams,	I
-	Arrangement drawings for cable routing and cable tray installation	A
-	Typical cable tray sections with cables	I

- Typical installation details I

xiii Earthing and Lightning Protection Systems

- Specifications and technical data sheets A
- Earthing network calculation for the complete system A
- Report on test results of specific earthing resistance measurements I
- Overall schematic diagram A
- Installation drawings for buried, embedded and exposed earthing system I
- Installation drawings for potential gradient control systems I
- Installation drawings for lightning protection systems I
- Typical installation details I

xiv Motors

For large size motors (if not standard products) the items mentioned above shall be applicable.

For standard motors the following shall apply:

- Specifications and technical data sheets A
- Arrangement and dimension drawings, I
- Motor list I

F Specific Documents for Fire Protection System

- Specifications and technical data sheets A
- Arrangement and dimension drawings A
- I/O Lists A
- Installation drawings A
- Operation and Maintenance manuals A

G Specific Documents for Air Conditioning System

- Heating and cooling load calculations for all buildings A
- Operation and Maintenance manuals A

H Specific Documents for Potable Water System

- Final statement on definite water flow requirements and corresponding sizing of the equipment, A
- Dimensional design calculations for the main components, A
- Piping & Instrumentation Diagram (P&ID), A
- Component List, A
- Sequence chart of automatic control sequences, including automatic lead/lag control with manual override, A

- Operation and maintenance manual A

I Specific Documents for 33 kV and 11 kV 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

1.11.8 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 Manufacturer

CLASSIFICATION OF TEST CERTIFICATES ACCORDING TO DIN EN 10204			
		the order, with indication of results of non-specific tests	
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

1.11.9 Fire Protection System

A General

This fire protection concept shall serve as a guideline for the design and the implementation of all fire protection installations for the projects as required by the Contract and the pertaining Technical Requirements, relevant local and international Codes and Standards as well as the actual state-of-the-art for fire protection for 33/11 kV Substations.

All fire protection installations shall be designed, installed and commissioned in accordance with the international NFPA-Codes and Standards, mainly NFPA 851.

The design of buildings, civil structures and all fire protection installations shall also be in accordance with local regulations and requirements from the authority having jurisdiction. The fire protection installations shall be ready for operation before commissioning the substation. All the fire protection installations shall be designed, supplied, installed and commissioned in such a way to provide comprehensive fire protection for all buildings and areas of the Project.

These areas and installations are:

- Control Building
- Switchyard
- Interconnecting Substation/Bay
- Buildings and Outdoor Areas

The fire protection installations for these areas shall mainly comprise:

- Structural Fire Fighting
- Fire detection and fire alarm systems
- Fire extinguishers
- Installation material like supports, hangers, sleeves, etc. for the complete fire protection installations
- Spare parts and special tools.

The fire fighting and fire detection systems to be provided are indicated in the following table as a minimum. Number and location of the various installations and systems shall be

determined by the Contractor during detail design, subject to approval by the Employer/Engineer. The Contractor shall, however, add and include any areas / items not listed in the table in order to cover fire protection for the entire Plant.

Table 4: Overview of Fire Protection System to be Installed in 33/11 kV Substation

BUILDING/ AREA/ EQUIPMENT TO BE PROTECTED	**FIRE FIGHTING SYSTEMS**	**FIRE DETECTION SYSTEMS**
Central Control Room and Office Block	CO_2 fire extinguishers, Dry powder fire extinguishers	Smoke detectors, Manual fire alarm stations
Supporting Facilities	CO_2 fire extinguishers, Dry powder fire extinguishers	Smoke detectors, Manual fire alarm stations
Transformer Bays,	CO_2 fire extinguishers, Dry powder fire extinguishers	Smoke beam detectors, Manual fire alarm stations
LV and HV Switchgear Rooms	CO_2 fire extinguishers	Smoke detectors
Storage Rooms	Dry powder fire extinguishers	Smoke detectors
Corridors and Lobbies	Dry powder fire extinguishers	Smoke detectors, Manual fire alarm stations
Outdoor Areas, Interconnecting Substation, along Motor Roads	CO_2 fire extinguishers, Dry powder fire extinguishers	Manual fire alarm stations

B Structural Elements for Fire Protection

In order to avoid an uncontrolled spread of fire inside a building, which would result in a considerable or total loss of the building and equipment, and to provide safe escape routes for the personnel, the buildings shall be subdivided into various fire areas, also called fire zones, separated by approved fire-resistant barriers and elements, such as fire walls, fire resistant ceilings, doors, dampers and fire partitions.

Fire walls, ceilings and partitions shall have a fire resistance rate of not less than 2 hours. Fire doors, gates and dampers installed in fire walls shall have a fire resistance rate of not less than 1½ hours.

In principle, the following plants and rooms shall be designed as independent fire areas, if present:

- Staircases
- SCADA and Administration rooms
- Switchgear rooms
- Battery rooms
- Storage rooms

Walls and doors at the boundaries of designated fire zones in Control building, Office Block and other buildings shall also be provided as fire walls with fire doors or fire gates.

The location and extend of the various fire zones, fire walls and fire rated doors shall be shown on relevant fire zone drawings. Staircases, corridors, lobbies and any other escape routes shall be constructed fire resistant with non-combustible materials only and shall be free from any combustible loads. All penetrations for electrical cables or pipes in fire resistant walls or ceilings shall be sealed with approved bulk heads.

Electrical cables in raised floors, suspended ceilings or any other inaccessible areas, for which water spray systems cannot be provided, shall be protected with a fire-retardant coating.

The coating material shall remain flexible to allow in the future easy removal or addition of individual cables, shall sustain moderate movement of cables and shall be mechanically tough to withstand footsteps.

Tests regarding electrical derating, short circuit threshold, heat transients and resistivity against termites, rats, bugs and other vermin shall be certified.

By these structural provisions, in case of fire in any fire area, heat and smoke shall be confined to a single zone whereas all other areas of a building shall remain unaffected and in full service.

C Fire Detection and Fire Alarm Systems

A centralised, electronic-digital, programmable fire detection and fire alarm system shall be provided for the control building, transformer bays, incoming/outgoing feeders, office blocks, and supporting facilities.

Under the consideration of the scope of work and the requirements the Fire Protection and Alarm System, automatic and individual addressable fire detectors shall be installed in all rooms and areas as listed above in the table OVERVIEW OF FIRE PROTECTION SYSTEMS TO BE INSTALLED and in all other areas containing specific combustible loads or hazards.

Manual and individual addressable fire alarm stations (push buttons) shall be provided in corridors and lobbies following the exit paths and at all emergencies exits. The fire alarm stations shall be colored red and easy noticeable.

Push buttons for manual release of fixed fire extinguishing systems shall have the same design as the manual fire alarm stations but colored blue or yellow.

Automatic fire detectors shall be sensitive either to heat or smoke.

Heat detectors shall be combined fixed temperature / rate-of-rise type detectors with a fixed temperature setting. Smoke detectors shall be optical type. Each automatic detector shall have continuous condition supervision by using pulsing, trend evaluating or equivalent system techniques.

Actuation of any automatic or manual fire detection device shall be displayed on a main fire alarm control panel, which shall be located in the central control room in the administration building. Status information of the fire alarm system shall also be transmitted to the station computer system.

The central fire alarm control panel shall be designed for 230 V AC primary voltage and suitable DC operating voltage for detection and alarm circuits. Back-up batteries shall be provided to operate the detection and alarm circuits for a minimum of 24 hours.

Sirens, horns or bells shall be provided as audible alarms inside all buildings. They shall have a minimum noise level of 105 dB(A) in a distance of 1 m and shall be different in sound from any other alarms installed in the area for other purposes.

Red flash lights shall be provided as visible alarms inside the buildings for the machine hall and for all other areas with a very high noise level.

Red flash lights shall also be installed outside the buildings at the main entrances.

The cables for the fire detection and fire alarm circuits shall be marked as fire alarm cables and laid in conduits.

Every fire alarm, release or shut down operation, short circuit, wire break or any other system troubles shall be indicated and recorded on the central fire alarm control panel.

D Fire Extinguishers

For initial firefighting, portable fire extinguishers with capacities of 6 kg chemical dry powder, for rooms containing electrical equipment with capacities of 5 kg CO_2, shall be provided and placed in the rooms and buildings at strategically critical locations and next to exits.

Further equipment like fire blankets, first aid boxes and rescue tools shall also be provided.

1.11.10 Equipment Designation System Application Guide

A Introduction

i General

This **Application Guide** is based on the IEC Standards No. 113 and No. 750 and on the DIN Standard 40719 part 2 and has been prepared mainly for use in **Hydropower Plant** projects. The electrical section for substation shall apply. The rules described herein are presumed mainly for designation of:

- Electrical equipment items on diagrams, layouts and correspondingly (with suitable labels) on the installed equipment itself
- Various plant areas and rooms
- Power and control cables
- Terminals and signals
- Spare parts
- Drawings and schedules (if required).

ii 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).

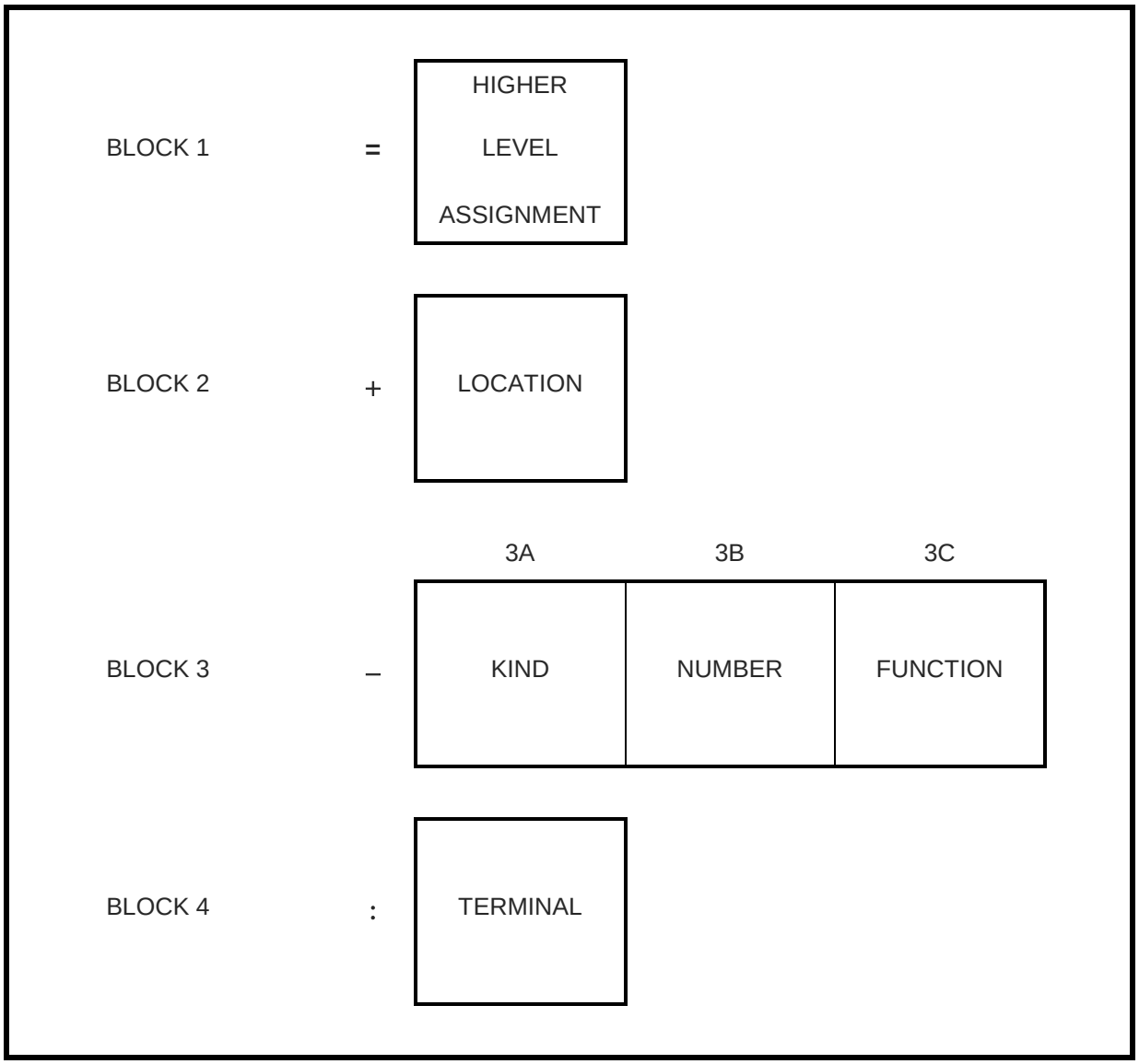
The completed/revised Guide versions shall be regularly distributed to all parties concerned and in the as-built form finally included in the Operation Manual.

iii Alpha-numeric Symbols

Various blocks/boxes have been used for description of the designation code forms. Within these boxes' **"A"** stands throughout the whole document for identification **letter** and **"N"** for a **number**.

B Designation System Blocks

Qualifying symbols are used to distinguish the Blocks 1, 2, 3 and 4 of a complete designation. The different blocks with their qualifying symbols are shown below:


BLOCK 1
=
HIGHER
LEVEL
ASSIGNMENT
BLOCK 2
+
LOCATION
3A
3B
3C
BLOCK 3
–
KIND
NUMBER
FUNCTION
BLOCK 4
:
TERMINAL

The equipment marking codes are composed as follows:

Block 1 Higher-level assignment showing correlation with other parts of the equipment with regard to location and/or function

A supplementary designation may be assigned to an item if it is desired to express its relation to a larger unit of a system, of which it is a part.

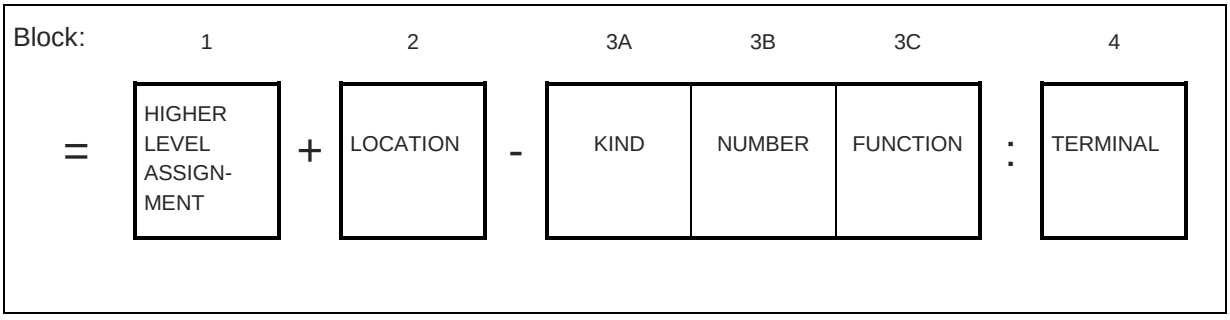
Block 2 Location of item

Block 3 Identification of item:
A = kind of item
B = number of item
C = function of item

Block 4 Terminal and conductor markings

The **qualifying symbol** may be omitted if there is no ambiguity. There can be other symbols used in front of Block 4 to designate e.g. signals ("!"), etc.

The following sequence of designation blocks shall be used if "full identification" is required:



The identification Block 1 ("Plant") shall be entered in the title block of the schematic diagram and in the Blocks 3/4 shown at the items of equipment.

C Plant Identification Code, Block 1

i Sections of Block 1

The identification block is subdivided into the following **5 sections**:

Section:	1	2	3	4	5
Qualifying Symbol =	N	AAA	NN	(A)A	NN(N)
Position:	G1	F1F2F3	FN	A1A2	A3A4
Meaning:	**G**eneral	**F**unction		**A**ggregate	

The individual sections can be recognized by an alternating arrangement of numerals and letters.

The identification **Block 1** has a **maximum of 11 alphanumeric data positions**.

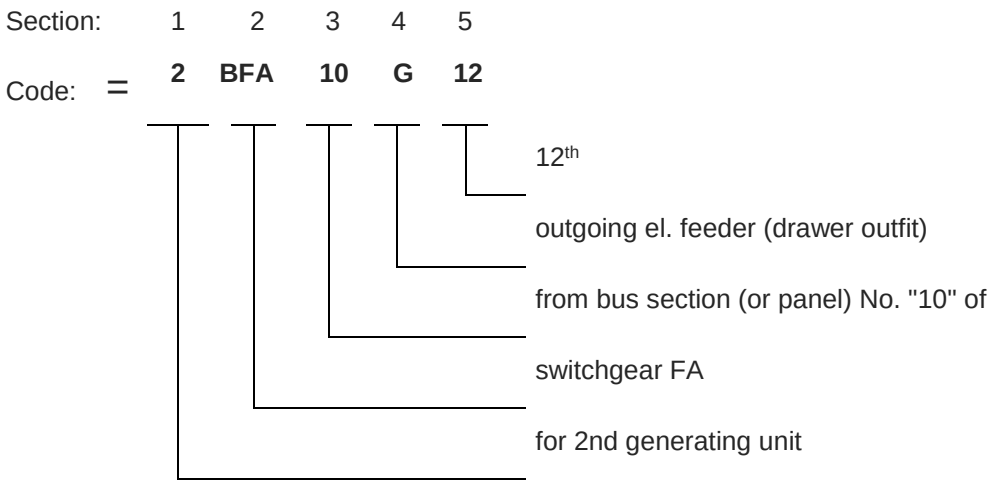
The **positions** indicated **in parenthesis** can be omitted.

Complete sections only from right to the left-hand side can be omitted from the codes.

The **alphabetical data** positions are often allotted a specific meaning, which is laid down in tables.

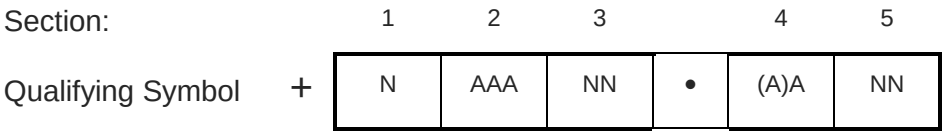
The **numerical data** positions are used for numbering of panels, items, cables, etc.

ii Example



D Location Identification Code, Block 2

The form of identification block for "location" of **electrical equipment** placed in switchboards is as follows:



"•" only in Block 2 between sections 3 & 4 (to distinguish between Block 1 & 2 form)

The sections 1 and 2 are identical with Block 1.

The **panels of one switchboard** shall be numbered in section 3 (e.g. for bus 00 with 01, 02, 03, etc. for bus-section 10 with 11, 12, 13, etc.).

The vertical (columns) and the horizontal (row) spot identification can be described after separator "•" in section 4 and 5 (if required).

For **location identification of other electrical equipment** (machines, assemblies, etc.) the **"room code" according to Section 10** here below can be used (if such identification is required).

E Equipment Identification Code, Block 3

The "Equipment" identification block is preceded by a minus sign (-); it consists of the parts 3A, 3B and 3C

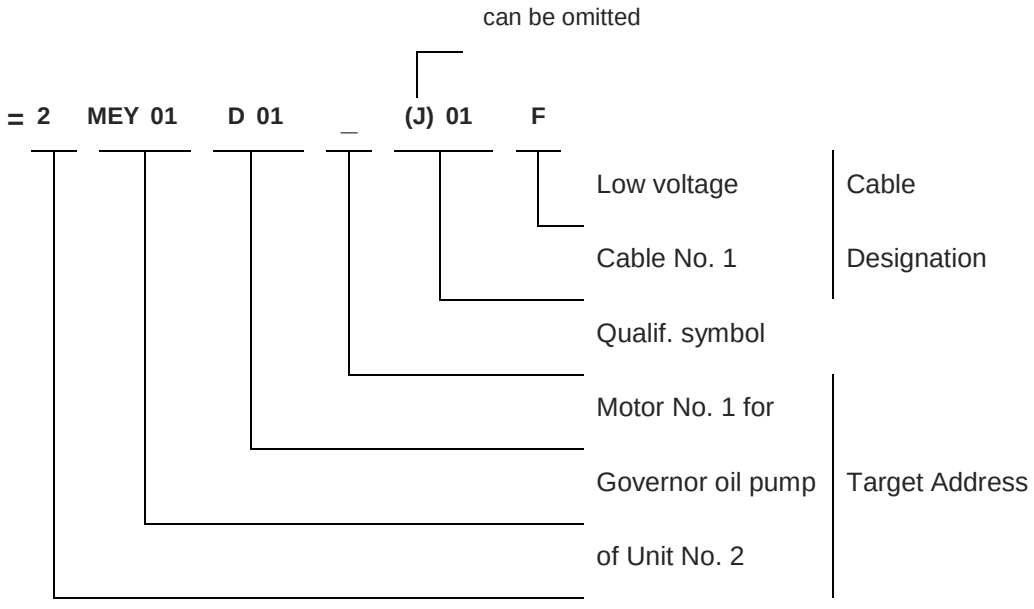
Block:		3A	3B	3C
Section:		1	2	3
Qualifying Symbol	-	A	N N (N)	A (A, N)
Meaning:		Kind	Number	Function

of electrical equipment item

For equipment identification, at least part 3B must be marked in the schematic diagram (if no confusion possible), whereas parts 3A and 3C may be added to part 3B as supplements.

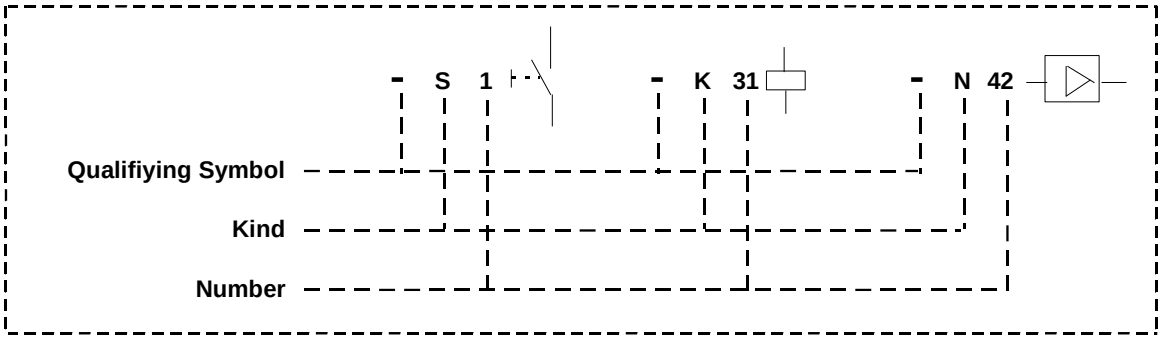
The complete cable identification code comprises the target address (Block 1) and the cable designation (Block 3).

Example

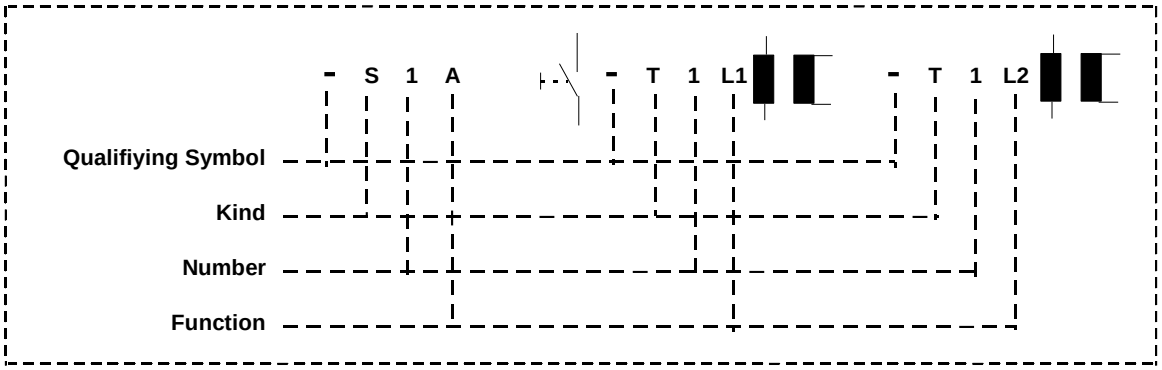


i Equipment Items Designation - Examples (Block 3)

Equipment Identification Codes consisting of a Kind Identifier and a Number



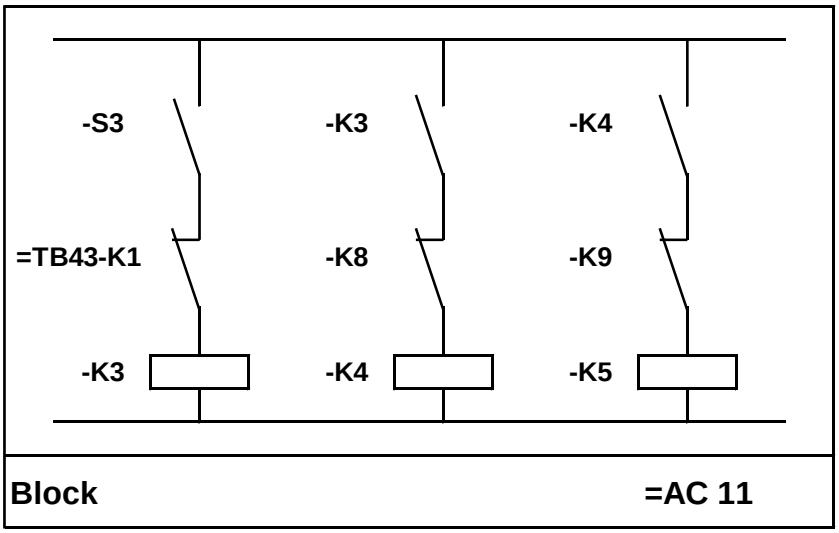
Equipment Identification Codes consisting of a Kind Identifier, a Number and a Function Identifier



Complete Equipment Identification Code - Split Representation

Identification blocks (or parts thereof) which are the same for most of the items of equipment represented in a schematic diagram, e.g. the "Plant" identification block, are shown only once at a suitable place in the diagram, e.g. in the block. The complete code then comprises this common part and that which is marked next to the equipment symbol. Items not covered by the common part are marked (at or near their symbol) with the complete code (see in the following example: contactor contact =TB43 -K1 in diagram =AC11. Marking of the equipment location can proceed in a similar manner.

Example:



The complete identifying codes of all other symbols in the above example would read:

=AC11 -K3, AC11 -K4, =AC11 -K5, =AC11 -K8, AC11 -K9 and =AC11 -S3.

The equipment identification codes are found

- inside enclosures, on or immediately adjacent to the particular item,
- in the equipment or component list, complete with additional information,
- in the parts list complete with additional information that is generally required for reordering.

ii Marking of Integrated Components

With integrated components, one item of equipment forms part of another, each having its own markings, e.g. modular assembly - A1 (super ordinated item) and the transformer - T1 (super ordinated item).

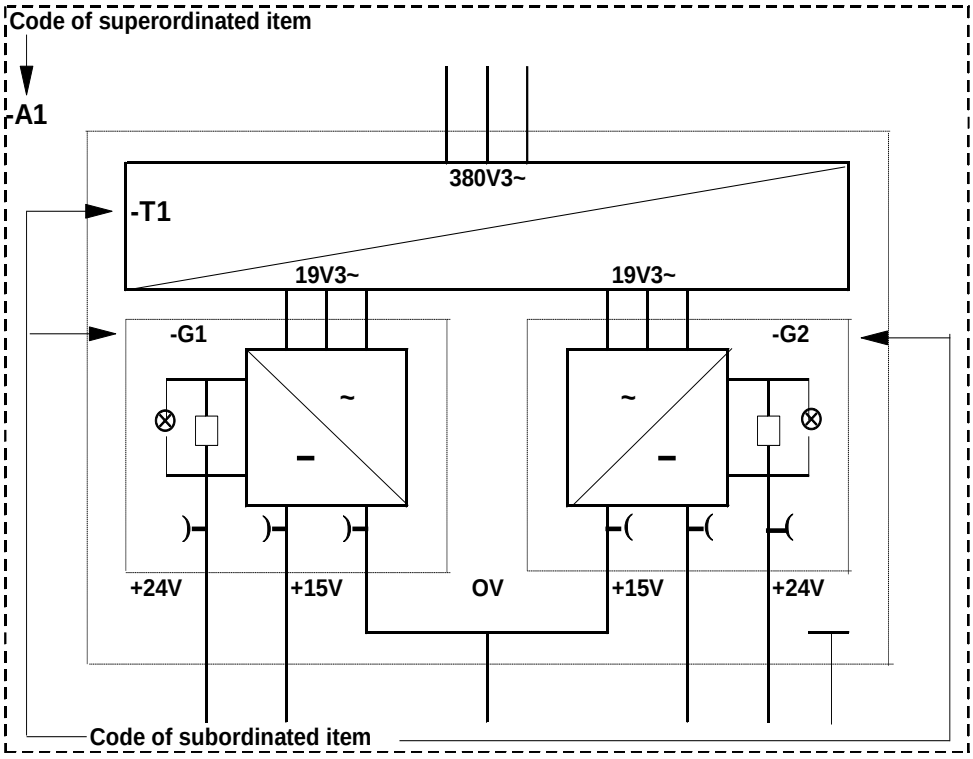


Fig. 11.1: Integrated item of equipment forming part of plant =M3. The modular power pack -A1 consists of transformer -T1 and the power supplies -G1 and -G2. The complete identification codes read: =M3 -A1, =M3 -A1 -T1, =M3 -A1 -G1, =M3 -A1 -G2.

To designate an item of equipment which forms part of a super ordinated item, the two identification blocks are joined together (that of the super ordinated item being on the left).

Example:

The complete identification code of a modular assembly consists of the "Plant" and "Kind,

Number" blocks and reads =M3 -A1. The transformer built into this assembly is designated by the "Kind, Number" -T1 identification block (see Fig. 11.1).

The complete transformer identification code thus reads: =M3 -A1 -T1.

iii Additional Information

- If required, the American standard designation of the protective relays and small apparatus can be used in "Block 3" of the equipment designation code.
- Technical data and type designation can be indicated below the equipment identification code in smaller print.

F Terminal Identification Code, Block 4

Section:		1	2	3
Qualifying Symbol	:	A	NN(N)	A(AN)

The "Terminal" block is used when

- the connections between items of equipment have been replaced by broken lines showing target or similar symbols, as illustrated in Fig. 11.2,
- terminals located in a plant other than the one to which the schematic diagram applies.

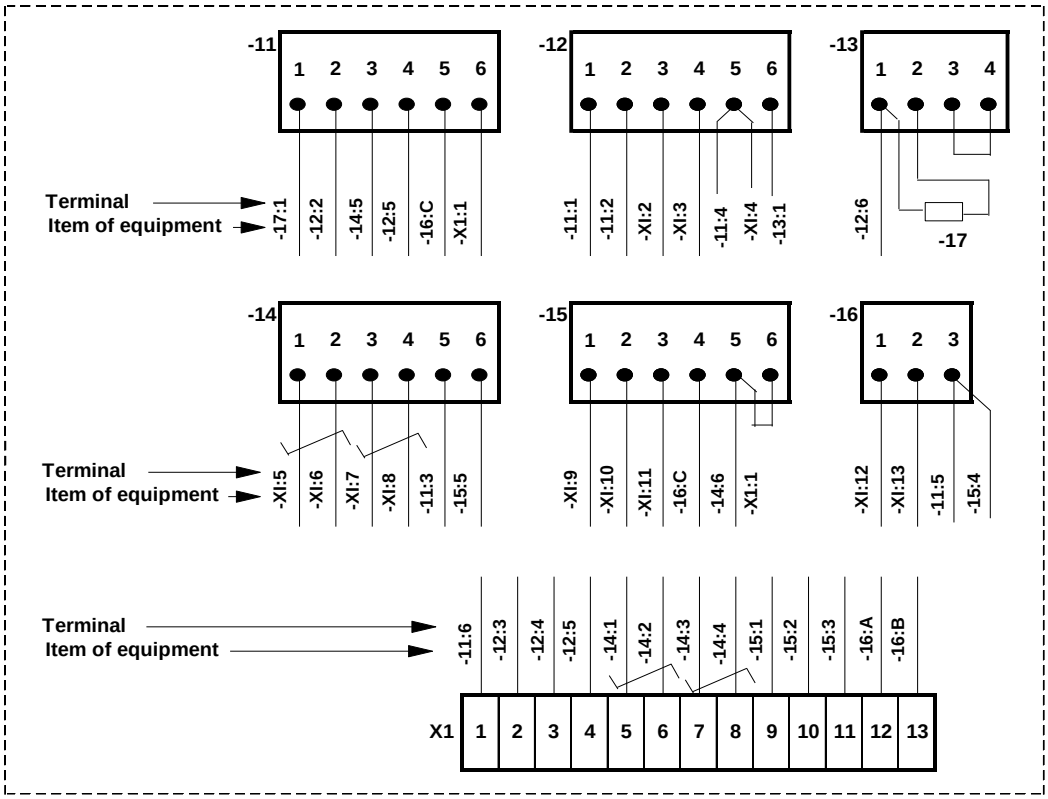


Fig. 11.2: Typical "Terminal" Identification

G Cable Route Designation

For description of the route in which the cables shall be laid following (special) code combined from room identification and route section designation can be used:

Block:		1		3
Code:	+	AAANNANN(N)	–	A(N)NNA
		Room Identification (see para. 10)		Route Section Designation

Example

+ UAA 02 R 15 – E (2) 15 B

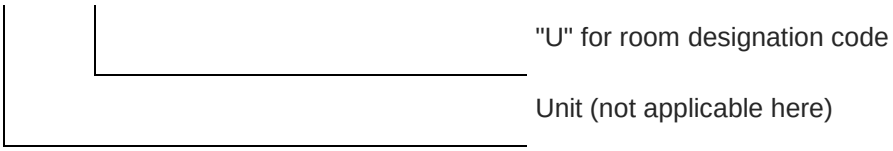
- **UAA 02 R 15**: Designation of room in which the particular tray section is installed (can be indicated only once in the floor/room layout drawing title block)
- **E**: Cable tray
- **(2)**: 2nd Layer (from above)
- **15**: 15th Section
- **B**: Voltage level (B - for HV/MV F - for LV ac/dc power K - for C&I <60 V Q - for communication)

H Room Designation

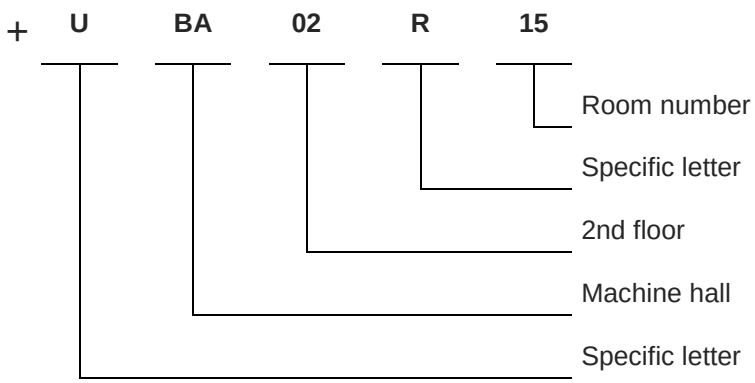
For the identification of various rooms in the plant building (and switchyard) following code can be used:

Section:		1	2	3	4	5
Code:	+	(N)	A	AA	N N	A	NN(N)

- (N): Building/Yard designation
- A: Floor (from deepest to highest)
- AA: "R" for "room designation"
- N N: Room No. (per floor)
- A: Room No. (per floor)
- NN(N): Room No. (per floor)


"U" for room designation code
Unit (not applicable here)

Example


+ U BA 02 R 15
Room number
Specific letter
2nd floor
Machine hall
Specific letter

1.11.11 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:	Type of Coating	Application	
Z = Sand blasting grade to SIS or DIN	A = Resin primer	1 = Spray coating	
Y = Rust + dust removal by acid solution	B = Phosphate zinc primer	2 = Air spray coating	
X = Phosphating and passivating	C = Zinc chromate primer	3 = Airless spray coating	
	D = Resin enamel	4 = Electrostatic powder coating	
	E = Acrylic emulsion enamel	5 = Flow coating	
	F = Lacquer putty		
	G = Lacquer enamel		
	H = Phenol-alkyd resin		
	K = Chlorinated rubber-alkyd resin		
	L = Rubber chloride enamel		

B Painting Schedules for Steel Structure and Components

Plant Type	Surface in contact with or exposed to		Plant Part	Surface prep. grade	Shop and Site Coats						Total dry film thickness µm	Shop coating system
					Primer			Top-Coat				
					Type	No.	Dry film thickness µm/coat	Type	No.	Dry film thickness µm/coat		
	Potable	Outside		2.5	X	2	40	B	3	80	320	T1
Water Systems		Inside	Vessels, tanks	2.5	X	2	40	N	3	100	380	T4
	Water		Filter vessels	3	X	2	40	H	3	110	410	T4
	Atmosphere	Outside, outdoor or indoor exposure	Vessels, tanks, steel structures, machinery	2.5	X	2	40	B	3	80	320	T2
		outside dry, indoor exposure	Steel structures	2	Y	2	40	A	3	45	215	T2
Drainage Systems	Sewer water	Continuous immersion intermittent immersion inside	Pipes, vessels, tanks, basins, steel structures,	3	X	2	40	L	3	110	410	T4
	Atmosphere	Well above water level outside	Machinery	2.5			40	B	3	80	320	T2
I	Oil	Atmospheric Pressure	Pipes, vessels, tanks	3	X	2	40	H	2	110	300	T4

Legend

	Primer	Z Y X	Cement patch Resin-based, with rust inhibitive pigments 2-pack epoxy, zinc-rich	Surface Preparation	Code:		2 2.5 3	Grade 2 Grade 2.5 Grade 3		acc. SIS 055 900 DIN 55 928 or equivalent	
Type of Coating Material	Top-Coats	A B D E G H K L N	Chlorinated rubber Heavy body chlorinated rubber Coal tar Heavy body tar 2-pack epoxy Heavy body 2-pack epoxy 2-pack tar aepoxy Heavy body 2-pack tar epoxy Bitumen, free of phenols	Shop Coat System	T1 T2 T3 T4	Primers only Primers and first top-coat All coats for D ≤ 1200, T2 for D > 1200 All coats if not site welded.					

Volume II

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	10	Cables
	11	Automation and Control System
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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 33 kV lines and Underground Cable.
- Pre-construction Survey of 33/11 kV substation
- Pre-construction Survey of LILO/Tap off Point and Tapping Bay Substation

The pre-construction survey shall follow the Development of Design report of 33 kV lines and 33/11 kV substation including tapping arrangement locations. The reports will constitute all the detail submissions mentioned in general specifications, along with ones presented here.

In case the road is not available immediately at substation location; the pre-construction survey shall also be carried out for the specific section of road required after approval from the Client.

2.2 Structural Data Sheet of 33 kV 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 in a way as follows and as per drawings. The Contractor shall submit the abbreviations description table studying complete drawings and design for approval to the Client.

Table 1: Typical Abbreviations for 33 kV 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	33 kV 400 mm_2 XLPE Power Cable, 1C	XLPE,400,33, 1C
		33 kV 400 mm_2 XLPE Power Cable, 3C	XLPE,400,33, 3C
		ACSR 'WOLF' Conductor	WOLF
4	Pole Frame Type (33kV 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

S.N.	Particular	Description	Code
		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) Information for a single pole location need not be confined to a single row.

b) All works, whether new or on existing systems, shall be documented on the SDS.

c) Each SDS shall include the applicable "As Built" Plan Drawing number(s). Similarly, each "As-Built" Plan Drawing shall include the applicable SDS number(s).

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

The format for SDS shall be developed in reference to the one provided at end of this chapter and approved by the Client.

2.3 Survey Works of 33 kV Line and 33/11 kV Substation

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.
  - Detail Plan and Profile of Substation yard in 5 m section each

2.4 Typical Format for Structural Data Sheet of 33 kV Line

Nepal Electricity Authority

Distribution System Upgrade and Expansion Project

Structure Data Sheet (SDS) of 33 kV Line

Province: Distribution Centre:

District: Name of the Sub 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																					

…

Volume II

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3 STANDARD PRACTICES FOR 33 KV 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 (**CSG 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 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 labor, equipment, and vehicles to load and transport materials and equipment to the Contractor storage facilities and worksites as required. All materials and equipment turned in to the 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 the 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-OHL-PP (Pole Protection for Shallow Riverbeds)**. 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 **CSG-OHL-STAY – relevant Drawings** and the design approved by the Client. 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 **CSG-OHL-STAY-relevant drawings** and the design approved by the Client.

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 sizes, 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.

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 **CSG-OHL-INS – relevant 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 **CSG-OHL-INS – relevant Drawings** for Details.

The pin insulator ties for all types shall be submitted for approval of Client and will be carried out with proper workmanship.

3.2.3 Preformed ties for Stay Wire

Preformed ties for stay wire are furnished as per material list. 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 Line construction

3.3.1 Arrangement of Conductor

The standard position of 33 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 **CSG-OHL- relevant Drawings** for both single and double circuit along with ADSS Cables.

3.3.2 Attachments to poles

Bolt holes are provided on poles for cross-arms, cross-arm braces and stay bolts. See **CSG-OHL- relevant Drawings** for both single and double circuit along with ADSS Cables.

3.3.3 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 **CSG-OHL- relevant Drawings** for both single and double circuit along with ADSS Cables.

3.3.4 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.

3.3.5 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 **CSG-OHL- relevant Drawings** for both single and double circuit along with ADSS Cables.

3.3.6 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 **CSG-OHL- relevant Drawings** for both single and double circuit along with ADSS Cables.

3.3.7 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 **CSG-OHL- relevant Drawings** for both single and double circuit along with ADSS Cables.

3.4 Reconductoring of 33 kV lines

The requirement of reconductoring has been kept to a bare minimum considering the long and tedious process of reconductoring involving extensive shutdowns.

Existing supports can be used in both the cases; however, it is recommended to keep 20% worth of poles and insulator fittings etc. as contingency for any requirements which may arise during the process of reconductoring. In such cases, the existing ACSR Conductor (say ACSR Dog conductor for an example) shall be dismantled and new ACSR Conductor of higher current capacity (Say ACSR Wolf conductor) shall be strung. This will bring the projected voltage drop on these two feeders within acceptable limits.

The process of reconductoring shall be followed as given below –

1. Detailed survey of the existing lines to be reconductored
2. Mobilization of materials and equipment
3. Stringing of higher size conductor (ACSR DOG, ACSR WOLF or as specified by the project implementation unit) by replacing the old ones
4. Clearing the right of way by cutting / pruning of trees / branches
5. Testing and commissioning

The existing line components dismantled shall be removed and recycled wherever possible.

For shutdown of lines to carry out reconductoring, care shall be taken to ensure minimum downtime and avoiding shutdowns during holidays / nighttime. Adequate warning messages

must be given to the affected consumers before carrying out the works – specifying duration of the planned outage and expected restoration time.

Volume II

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4 33 KV LINES

4.1 General

33 kV lines are required for evacuation of power from the transmission grid to the distribution system. In Nepal, distribution system starts from 33 kV feeders which inject power into 33 / 11 kV substations. In the case of DSUEP, 33 kV lines can be connected to the grid in one of the following ways –

- New 33 kV line erection from nearby 132 / 33 kV Grid Substation (GSS)
- LILO (Line-In Line-Out) arrangement from nearby 33/11 kV substation and construction of new 33 kV line
- Direct tapping and extension of existing 33 kV feeder by constructing a new 33 kV line from TP (tapping point) of the existing feeder

Summary of data on proposed 33 kV lines is given in the Scope of Services. The reference drawings are provided in the Drawings Section.

4.2 Major items for 33 kV lines

As given in the section above, the most common 33 kV line configurations are as follows –

- ACSR Dog conductor single circuit with ADSS Cable
- ACSR Wolf conductor single circuit with ADSS Cable
- ACSR Dog conductor double circuit with ADSS Cable
- ACSR Wolf conductor double circuit with ADSS Cable

11-meter-long and 13-meter-long Steel tubular poles shall be used for construction of new 33 kV lines for the sub-projects. For special circuit configurations, 14.5 m long Steel tubular poles shall be used. Steel lattice type 33 kV towers shall be used, if must for some locations like long river crossings.

On the other hand, due to high voltage drop in 2 nos. of 33 kV feeders, 33 kV voltage regulators are required. Major items required for each configuration are as follows –

A. Steel tubular poles

B. ACSR conductor (Wolf / Dog)

C. Pin insulators with spindle

D. Disc insulators with hardware fittings

E. Automatic Voltage regulators

F. ADSS Cable

Specification of each item is given in the ensuing sections.

4.3 Specification of Steel Tubular poles

Steel Tubular poles shall be used for 33kV, 11 kV & LT lines. The specification for poles is enclosed in subsequent section 4: 11 kV lines (Volume IIB of III).

4.4 Specification of Pole Accessories

4.4.1 Specifications of Cross-Arm Brace

This specification covers the fabrication, testing and supply of flat, galvanized steel cross-arm brace

a. Material

The flat cross-arms brace shall be fabricated out of hot-rolled steel flat. The steel flat for cross-arms brace shall be fabricated and tested in accordance with Indian Standards IS: 2062-2011, and IS 1730-1989 or any revision thereof or other equivalent national or international standard provided that the resulting steel stock is of equal quality and strength. The minimum tensile strength of the steel shall be 4200 kg/cm^2.

b. Description

The detail description of the braces shall be as per **CSG-OHL-relevant drawings**. The brace shall be furnished reasonably smooth on all surfaces and free of burrs and sharp projections.

The surface of the steel shall be flat after drilling or punching and free of dimpling or imperfections. The hole edges shall be broken by reaming. The holes shall be full dimension after galvanizing and no minus tolerance of specified hole size will be accepted.

The brace shall have a minimum tensile strength of 3182 kg at the bolt-hole and bolt slot.

The brace shall be capable of being bent 10 degrees at the bolt hole or slot and 140 degrees at any point between hole and slot without cracking of the base metal on the outside of bent portion.

The brace shall be drilled and dimensioned in accordance with **CSG-OHL-relevant drawings** and approved design.

c. Galvanizing

The flat cross arm brace shall be galvanized after fabrication in accordance with IS: 2629-1985 or any revision thereof or any other national or international standards that ensure at least a substantially equal quality to the standard mentioned above will also be acceptable.

d. Tests

Apart from the tests indicated herein in the referenced standards, the channels and angles shall undergo following tests: Visual inspection and verification of dimensions.

4.4.2 Specification of Pole Clamps

This specification covers the fabrication and supply of flat, galvanized steel pole clamps with nuts, bolts and washers for use on overhead power line construction.

a. Material

The pole clamps shall be fabricated out of hot-rolled steel flat. The steel flat for pole clamp shall be fabricated and tested in accordance with Indian Standards IS: 2062-2011, IS 808-1989 and IS 1730-1989 or any revision thereof or other equivalent national or international standard provided that the resulting steel stock is of equal quality and strength. The minimum tensile strength of the steel shall be 4200 kg/sq cm.

b. Description

The detail description of the clamps shall be as per **CSG-OHL-relevant drawings**. The Clamps with bolts through the pole will not be allowed as they weaken the pole strength. Outline details of pole clamps are shown in the **CSG-OHL-relevant drawings**. Dimensions may be changed to comply with the final pole sizes selected. Therefore, the dimensions must be confirmed with the Project prior to manufacture.

Two (2) numbers of galvanized, 16 mm. (dia.) X 60mm. (length), fully threaded bolts with two (2) nuts and washers shall be provided with each pole clamp.

The fittings shall be free of burrs, splinters, splits, sharp points and edges, which may damage conductors or show evidence of poor workmanship.

The surface of the steel shall be flat after drilling or punching and free of dimpling or imperfections. The hole edges shall be broken by reaming. The holes shall be full dimension galvanizing and no minus tolerance of specified hole size will be accepted.

The pole clamps shall have a minimum tensile strength of 3182 kg at the bolt-hole and bolt slot.

c. Galvanizing

The pole clamps and nut, bolts and washers shall be galvanized after fabrication in accordance with IS:2629-1985 or any revision thereof or any other national or international standards that ensure at least a substantially equal quality to the standard mentioned above will also be acceptable.

d. Tests

Apart from the tests indicated herein in the referenced standards, the channels and angles shall undergo following tests: Visual Inspection and Verification of Dimensions.

4.4.3 Specification of Fastners

This specification covers the fabrication and supply of galvanized steel bolts and nuts, as specified herein, for use on overhead power line construction.

a. Material

The bolts and nuts shall be manufactured and tested in accordance with IS: 1363 (Part I)-1984 or the latest version thereof or any other national or international standards that ensures at least equal or better quality to the standard mentioned above, will also be acceptable.

b. General

Bolts and nuts shall be furnished in the types, diameters and lengths specified. However, the dimensions and length of threading of bolt must be confirmed with the Project prior to manufacture.

Thread forms shall be consistent with all material/items listed herein and shall not strip or slip under sustained tensile loading equal to the design tensile strength of the threaded material item.

c. Machine Bolt and Nut

Each machine bolt shall be furnished with two (2) hexagonal nuts and two (2) plain washers assembled thereon.

d. Double-Arming Bolt and Nut

Each double-arming bolt shall be furnished with four (4) hexagonal nuts and two (2) washers assembled thereon.

e. Galvanizing

The pole clamps and nut, bolts shall be galvanized after fabrication in accordance with IS:2629-1985 or any revision thereof or any other national or international standards that ensure at least a substantially equal quality to the standard mentioned above will also be acceptable.

f. Tests

Apart from the tests indicated herein in the referenced standards, the channels and angles shall undergo following tests:

- Visual Inspection
- Verification of Dimensions

4.4.4 Specification of Stay Sets

a. Scope

This specification covers the fabrication and supply of adjustable threaded, galvanized, ferrous, stay sets and nuts for use in overhead line construction.

b. Description

The stay set shall consist of mild steel; galvanized stay rod; stay tightener or adjustable head complete with stay plate a thimble of dimensions shown in the **CSG-OHL-relevant drawings**.

The stay rod shall be fabricated of mild steel of minimum tensile strength of 4200 kg/sq.cm. The other technical features and dimensions are given in Table below.

The stay tightener shall be made of mild steel of minimum ultimate tensile strength of 42,000 kg/sq.cm. The thimbles shall be made of 1.219 mm (18 SWG) GI sheet and shall be suitable for terminating steel stay wire with a preformed grip.

c. Fabrication

The stay rod and nut shall be fabricated to the shape and dimensions shown in **CSG-OHL-relevant drawings**.

The thread form at the threaded end of the rod, and that of the accompanying nut, shall be optional with the supplier.

However, it shall be the responsibility of the Supplier to supply the stay rod with a thread form that shall sustain the rated loads specified in Table below without creep or stripping over the full life of the rod material at specified diameter.

After fabrication, the stay rod and nut shall be hot-dip zinc galvanized in accordance with IS 2629-1985, latest edition, or to an equivalent hot-dip galvanizing standard which produces equal or superior result.

After galvanizing, the nut and rod threading shall be such that the nut may be run the full length of the thread without the use of tools.

d. Tests

Apart from the tests indicated in the relevant referenced standard of steel, the stay set shall undergo following tests:

- Visual Inspection
- Verification of Dimension
- Tensile Strength: The stay set assemblies shall withstand a minimum tensile load as per the standards.
- Bend Test: The stay rod shall be bend-tested over a mandrel of 19 mm through an angle of 90 degrees at any point in the un-threaded section of the rod without fracture of the steel. Temperature of the test shall be 68 degrees Fahrenheit (22.5 deg Celsius)

Table 1: Specifications of Stay Set

SN	Particular	11 kV & 33 kV (HT) lines	0.4 kV (LT) line
1	Length of Stay Rod	2.44 m	1.8 m
2	Diameter of Stay Rod	19 mm	16 mm
3	Ultimate tensile strength of Stay rod and turn buckle	4200 Kg/sq.cm	4200 Kg/sq.cm
4	Minimum breaking load	10,454 kg	6,433 kg
5	Length of Threaded portion	300 mm	300 mm
6	Thimble Shape	Suitable for 7/8, 19/8 SWG stay wire	Suitable for 7/10 SWG stay wire
7	Thimble section	18 SWG (min)	18 SWG (min)
8	Stay plate section	600x600x6 mm	300x300x6 mm
9	Eyebolt Length	300 mm	300 mm
10	Eyebolt diameter	16 mm	16 mm
11	Galvanization	IS 2629 - 1985	IS 2629 - 1985

4.4.5 Specifications of Stranded Stay Wire

a. Scope

This specification covers the fabrication and supply of galvanized stranded steel wire for use in overhead power line as stay wire ropes for line supports.

b. Description

The steel strand shall be fabricated in accordance with IS 2141-2000, BS 183 1972/1983, IS 4826-1979 or an equivalent national or international standard. The wires shall be 45-ton quality.

The steel wire strand shall have a left-hand lay. The steel wires shall have no joint throughout the whole length. Strands shall be uniform and shall have no defects such as cracks, dust encapsulation or crevices.

The manufacturer of the Stranded Stay Wire must have been accredited with ISO 9001 or ISO 9002 quality certification.

Table 2: Ratings and Features

SN	Particular	11 kV and 33 kV line	0.4 kV line
1	Steel Wire Size (No. of wire/SWG)	7/8	7/10
2	Steel Wire Size (No. of wire/SWG) (River Crossing)	19/8	19/10
3	Grade	4	4
4	Tensile grade	Gr. 700	Gr. 700
5	Minimum tensile strength of steel	700 N/mm^2	700 N/mm^2
6	Diameter of each wire	4 mm	3.15 mm
7	Strand diameter (overall)	12 mm	9.45 mm
8	Overall cross section area	88 mm^2	54.52 mm^2
9	Min. breaking load of single wire	8.8 kN	5.46 kN
10	Min. breaking load of strand	54.9 kN	34.00 kN
11	Minimum Weight	690 kg/km	425 kg/km
12	Min. weight of wire in each reel	100 kg	100 kg
13	Min. weight of Zinc coating	275 g/m^2	237.5 g/m^2
14	Applicable standard	IS 2141	IS 2141
15	Governing standard for galvanization	IS 4826	IS 4826

c. Packing

The steel wire strand shall be furnished in reels holding minimum of 100 kg. Each reel shall have a weather-resistant tag securely attached showing the length, nominal diameter, number of individual wires, grade of the strand, and the class of zinc coating.

d. Tests

The testing of individual wires and complete conductor shall be in accordance with the nominated standards.

4.5 ACSR conductors

This Specification covers the fabrication and supply of aluminium conductors, steel reinforced (ACSR) commonly used on overhead power line construction.

4.5.1 Description

The manufacturer of the ACSR conductor must have been accredited with ISO 9001:2000 (design included) quality certifications. The ACSR conductor shall be a concentrically stranded right-hand lay conductor.

The ACSR conductor shall be fabricated in accordance with BS: 215 (Part 2), IS 398 latest revision or any other national or international standards that ensures a substantially equal quality to the standard mentioned above, will also be acceptable.

The following types of conductors shall be supplied:

Code Name	Nominal area (sqmm)	Breaking load (kN)	DC resistance at 20°C (Ω / km)	Aluminium area (sqmm)	Steel area (sqmm)	Total area (sqmm)
Wolf	150	67.3	0.1871	158.10	36.80	194.90
Dog	100	32.7	0.2733	105.00	13.55	118.55

4.5.2 Stranding

In all constructions, the successive layers shall have opposite directions of lay and the outer most layers being right-handed. The wires in each layer shall be evenly and closely stranded. In conductor having multiple layers of aluminium wires, the lay ratio of any aluminium layers shall be not greater than the lay ratio of the aluminium layer immediately beneath it.

4.5.3 Gross weight

The gross weight of each wooden drum containing conductor of all sizes shall not exceed 900 kg. with a tolerance limit of ±10 %. Drums containing conductor having gross weight above 990

kg. will not be accepted in any case. Also, more than two lengths in one conductor drum will not be accepted.

4.5.4 Standard length

Minimum length of ACSR Dog, Panther and Wolf should be 1 (one) Km. Longer lengths are also acceptable provided they are within gross weight limit. The conductor shall be supplied in standard lengths of not less than 95% of the total quantity. The quantity of the conductor in lengths shorter than standard ones shall not exceed 5% of the total quantity to be supplied. Further, single conductor length in respect of such 5 % (maximum) shall be supplied in random length of not less than 50% of the standard length and shall be supplied in individual drum. Such random length shall be acceptable to the maximum extent of 5% of the offered quantity.

4.5.5 Packaging

All conductors shall be furnished on non-returnable treated seasoned wooden reels. 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 unloading, storage in tropics, hauling and field erection of conductor without distortion or disintegration.

Each reel of the conductors furnished shall contain only one (1) length of conductor.

All reels shall be legibly marked in paint with the following information:

a) Size of conductor
b) Type of conductor
c) Length in meters
d) Net weight of conductor
e) Direction of rolling

4.5.6 Tests

The manufactured conductor shall be tested in full compliance with the governing standard including following routine tests:

Aluminum wire

a) Tensile test
b) Wrapping test
c) Resistivity test

Steel wire

a) Determination of stress at 1% elongation

b) Tensile test
c) Torsion test or elongation test as appropriate
d) Wrapping test
e) Galvanization test

4.5.7 Quality Assurance Program

Along with the Bid the Bidder shall furnish quality assurance program of the manufacturer which includes the Quality System and the Quality Plans, which shall include, among others, information to meet the following requirement, failing which the Bid shall be liable for rejection.

i) The structure of the organization
ii) The duties and responsibilities assigned to staff ensuring quality of works
iii) The system for purchasing, taking delivery and verification of materials
iv) The system for ensuring quality of workmanship
v) The quality assurance arrangement shall conform to relevant requirements of ISO 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
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.

4.6 33 kV XLPE Power Cable

This specification covers the design, manufacture, factory test, supply, delivery, type test, construction, of single core, aluminum conductor, cross-linked polyethylene (XLPE) insulated, PVC sheathed, armored Power Cables to be used for underground line at 33 kV Voltage level including all its accessories required.

4.6.1 Description

The equipment and installation works specified in this section shall conform to the latest edition of the appropriate IEC specifications and/or other recognized international standards

The XLPE power cable shall be manufactured and tested in accordance with IEC 60502-2 or the latest version thereof or other equivalent international standards that ensures at least a substantially equal quality to the standard mentioned above.

4.6.2 General Requirements

Cable shall be designed to withstand all mechanical, electrical and thermal stresses under steady state and transient operating conditions. The cable shall be suitable for burying underground in outdoor and/or laying in covered trenches in the climate conditions as specified for project area.

The conductor shall be of EC grade aluminum and shall have flexibility class-2 in accordance to IEC. All conductors shall be stranded, circular and compacted and comply with IEC 60228 or any other equivalent international standards. The maximum conductor temperature shall be 90^0C under continuous operation and shall be 250^0C during short-circuit condition.

The conductor screen shall be an extruded layer of black, semi-conducting compound. The conductor screen shall be extruded in the same operation as the insulation. The interface between the extruded conductor screen and insulation shall be free of any voids. The semi-conducting screens should be effectively cross-linked to achieve the temperature requirements as specified in IEC.

The insulating material shall be cross linked polyethylene (XLPE). 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. The insulation shall not deteriorate at elevated temperatures, when immersed in water and when exposed to the climatic conditions. The insulation properties shall be stable under thermal conditions arising out of continuous operation at rated conductor temperature and under short circuit conditions. 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. The make of XLPE compound shall be from reputed manufacturers like DOW Chemicals (USA), Hanwha Chemical (Korea), Borealis AG (Austria) or Equivalent reputed manufacturer.

The insulation screen shall be an extruded layer of black semi-conducting compound and shall continuously cover the whole area of the insulation. The contact surface between insulation and insulation screen shall be smooth and free from protrusion and irregularities. The interface between the insulation and insulation screen shall be free of any voids. Insulation screen shall be strippable type. The metallic screen shall consist of a layer of copper tape applied in helical form.

The cores shall be laid together with a suitable right hand lay. The interstices shall be filled with nonhygroscopic 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. 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 and screens. The thickness of the inner sheath shall be as per the applicable standards. No tolerance on the negative side shall be acceptable.

The armoring shall be of galvanized steel strip multi core cables. The armoring shall be applied as closely as practical. The armoring shall be applied such that the minimum area of coverage shall be 90% and the gap between any two armor strips shall not be more than the width of strip. The galvanized steel strip shall comply with the requirements of applicable standards with latest amendments. The direction of lay of the armor shall be opposite to that of the cable cores. In case of single core cable, armoring shall be made of non-magnetic material conforming to IEC. The size of armor shall be as specified in the relevant standards.

The outer sheath shall be designed to afford high degree of mechanical protection. The outer sheath shall consist of extruded tough PVC compound insulation over the armoring suitable for the operating temperature of cable and shall meet the requirements of the IEC Standard. The PVC compound for the outer sheath shall conform to type ST-2. The color of the outer sheath shall be black. The sheath shall be heat, oil, chemical and weather resistant. Common acid, alkalis and sealing solution shall not have adverse effect on the material of PVC sheath which shall also be protected against ants, termites by suitable, reliable and durable measures.

The minimum thickness/size of separation sheath, outer sheath and armor at any point shall not fall below the nominal value. No tolerance on the negative side shall be acceptable.

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

Rating and features of the cables to be furnished shall be as per the requirements. The short circuit current rating shall be as per IEC.

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

Table 3: Technical Requirements of 33 kV line

SN	Description	Requirements
1	Rated voltage (Uo/U)	18/30 kV
2	Highest voltage of three-phase system (Um)	36 kV
3	Rated lightning impulse withstand voltage	170 kVp

SN	Description	Requirements
4	Rated power-frequency short duration withstand voltage for one minute	70 kV
5	Insulation	
5.1	Material of Insulation	XLPE
5.2	Minimum Thickness of Insulation	8 mm
6	Conductor	
6.1	Type of Conductor	EC grade aluminum
6.2	Stranded Conductor	yes
7	Number of Cores	1 (one)
8	Maximum Initial conductor Temperature during operation	< 90 deg. C
9	Maximum Final Conductor Temperature during short circuit	< 250 deg. C
10	Short circuit current rating of Metallic Screen and Armour combined	More than 12 kA for 1 sec.

4.6.3 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 bidder 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 purchaser 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 purchaser 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:

(i) Tensile test

(ii) Wrapping test

(iii) Resistance test

(b) Tests for armouring strips I wires. :

(c) Tests for thickness of insulation (eccentricity) and sheath.

(d) Physical tests for insulation. :

(i) Tensile strength and elongation at break.

(ii) Ageing in air oven

(iii) Hot set

(iv) Shrinkage test

(v) Water absorption test (gravimetric)

(e) Physical tests for outer seath :

(i) Tensile strength and elongation at break.

(ii) Ageing in air oven

(iii) Shrinkage test

(iv) Hot deformation

(v) Loss of mass in air oven

(vi) Heat shock

(vii) Thermal stability

(viii) 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)

XLPE cables shall be tested as per IS 7098 / IEC.

b. Routine Tests (Factory Acceptance Tests)

The following tests shall be carried out at the manufacturer's plant before shipment as far as applicable for each type of conductors and cables:

i) Appearance check

ii) Conductor resistance measurement

iii) Capacitance measurement

iv) Insulation resistance measurement

v) A.C. withstand voltage

vi) A.C. long duration withstand voltage

vii) Impulse withstand voltage

viii) A.C. long duration breakdown voltage

ix) Impulse break-down voltage

x) Dielectric loss tangent

xi) Temperature-voltage characteristic

xii) Dimension

- Conductor outermost diameter
- Insulation thickness - Sheath thickness
- Over-sheath thickness
- Thickness of each tape
- Interval of tape lapping
- Total diameter

xiii) Bending withstand characteristic

xiv) Over-sheath, tensile strength

xv) do. -, thermal aging

xvi) do. -, oil-proof

xvii) do. -, non-inflammability

xviii) do. -, thermal deformation

xix) do. -, hardness

4.6.4 Packaging

The conductor shall be supplied in non-returnable drums/reels. The drum/reel shall be made of steel suitably protected against corrosion. Protective external lagging of sufficient thickness shall be provided and fitted closely on the reels. Binder consisting of steel straps shall be provided over the external laggings. The drum shall be new and sufficiently rugged in construction to withstand ocean shipping, road transport, several loading and unloading, storage in tropics, hauling and field erection of cables without distortion or disintegration.

Each reel of conductor furnished shall contain only one (1) length of cable.

All reels shall be legibly marked in paint with the following information:

a) Voltage grade of Cable

b) Size of cable

c) Type of Conductor

d) Type of insulation

e) Length in meters

f) Net weight of cable

4.7 33kV and 11 kV Cable Termination and Joint Kits

This specification covers the design, manufacture, factory test, supply and delivery of cable termination and joint kits for single/three cores, aluminum/copper conductor, XLPE insulated armored power cable used in underground 33 kV/11 kV distribution system.

4.7.1 Description

All high voltage terminations and jointing kits shall be standard quality type. They shall be factory engineered kits containing all the necessary components to reinstate the cable insulation, metallic shielding of each core, together with the reinstatement of the sheath, of the cable being terminated.

The heat shrinkable termination and joint kit shall be manufactured and tested in accordance latest version of IEC, or any other national or international standard that ensures at least a substantially equal quality to the standard mentioned above will also be acceptable.

The manufacturer of the termination and joint kit (Indoor, outdoor and straight- through) must have been accredited with ISO 9001 quality certification.

The entire termination and joint kit shall be environmentally sealed and capable of preventing the ingress of external moisture and contamination.

Kits shall contain sufficient cleaning solvents and cleaning clothes for the proper making of the joint or termination.

Voltage stress relief shall be provided, and this may be inherent in the heat recoverable polymeric material.

The terminating or jointing materials shall not be subjected to storage limitations such as controlled temperature or humidity restrictions, nor have self-life limitations.

4.7.2 Testing

The routine tests of the kits shall be done at manufacturer's plant in accordance with IEC or other equivalent national or international standards including following tests.

- Appearance Test
- Construction Test
- High Voltage Test

4.8 Specification of Porcelain Insulators

This Specification covers the fabrication and supply of porcelain insulators, as herein specified, for use on overhead power line construction.

4.8.1 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.

4.8.2 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.

4.8.3 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.

4.8.4 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 or as mentioned in ESMP report
- 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.

4.8.5 System parameters

- Nominal system voltage: 33 kV
- Highest system voltage: 36 kV
- Power frequency: 50 Hz
- Number of Phases: 3
- System earthing: 33 kV Impedance earth

4.8.6 Pin Insulators - Description

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 ratings and features of the insulator pins shall be as follows:

Particulars	**33 kV Pin Insulator**
Highest System Voltage	36 kV
Rated Voltage	33 kV
Creepage Distance (min)	580 mm

Particulars	33 kV Pin Insulator
Wet Power Frequency Withstand Voltage	75 kV
Impulse Withstand Voltage	170 kV
Puncture Power Frequency Voltage (min)	180 kV
Visible Discharge Voltage (Effective)	27 kV
	33 kV Insulator Pin
G.I. Pin Head	Large IS Ref. L300N
Total Length	450 mm
Stalk Length	300 mm
Shank Length	150 mm
Minimum Failing Load	10 kN
Applicable Standard	IS 731-1971, IS 2486 (Part II), IEC 60815

The manufacturer must have been accredited with ISO 9001 with design and manufacturing quality certification.

4.8.7 Disc Insulators - Description

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

Particulars	11 kV disc insulator
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

The manufacturer must have been accredited with ISO 9001 with design and manufacturing quality certification.

4.8.8 Stay Insulators - Description

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:

Particulars	33 kV Stay Insulator (Type 1)
Highest System Voltage	36 kV
Rated Voltage	33 kV
Creepage Distance (min)	57 mm

Particulars	33 kV Stay Insulator (Type 1)
Minimum Failing Load	88 kN
Power Frequency Puncture Withstand Voltage, 1 minute	
Dry	27 kV
Wet	13 kV
IS Designation	C

The manufacturer must have been accredited with ISO 9001 with design and manufacturing quality certification.

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

Type Tests

The Tenderers shall include with their offers type test certificates issued by an independent testing laboratory of repute comprising, among other:

- Dry lightning impulse withstand voltage test;
- Wet power frequency withstand voltage test.
- Visual examination test
- Checking of threads on head
- Galvanizing test
- Mechanical test

Acceptance Tests

- Checking of threads on head
- Galvanizing test
- Mechanical test

Routine Tests

Following routine test shall be carried out on the sample in accordance with the governing standard:

- 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.

4.8.16 Quality Assurance Program

Along with the Bid the Bidder shall furnish quality assurance program of the manufacturer which includes the Quality System and the Quality Plans, which shall include, among others, information to meet the following requirement, failing which the Bid shall be liable for rejection.

i.) The structure of the organization;
ii.) The duties and responsibilities assigned to staff ensuring quality of works;
iii.) The system for purchasing, taking delivery and verification of materials;
iv.) The system for ensuring quality of workmanship;
v.) The quality assurance arrangement shall conform to relevant requirements of ISO 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;
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.

4.9 Disc insulator fittings

This specification covers the fabrication and supply of tension type disc insulator fittings.

4.9.1 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 as per design and drawings 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 IS 2486, IEC 60383 or any other equivalent national or international standards. The manufacturer of the disc insulator fittings must have been accredited with ISO 9001 with design and manufacturing quality certification.

4.9.2 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.

4.9.3 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.

4.9.4 Tests

The disc insulator fittings shall comply with the following tests as per IEC 60168, IS 2486 or any other equivalent national or international standards.

Type Test

- Verification of Dimensions
- Visual Examination Test
- Slip Strength Test
- Mechanical Test
- Electrical Resistance Test
- Heating Cycle Test
- Galvanizing Test

Acceptance Tests

- Verification of dimensions
- Galvanizing Test
- Mechanical Tests

Routine Tests

- Visual Examination Tests
- Routine Mechanical Test

4.9.5 Marking

The tension clamp shall be marked on it following:

- Name or trademark of manufacturer
- Name of the Purchaser as follows: "NEA-DSUEP"

4.9.6 Quality Assurance Program

Along with the Bid the Bidder shall furnish quality assurance program of the manufacturer which includes the Quality System and the Quality Plans, which shall include, among others, information to meet the following requirement, failing which the Bid shall be liable for rejection.

i.) The structure of the organization;
ii.) The duties and responsibilities assigned to staff ensuring quality of works;
iii.) The system for purchasing, taking delivery and verification of materials;
iv.) The system for ensuring quality of workmanship;
v.) The quality assurance arrangement shall conform to relevant requirements of 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;
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.

4.10 Specification of for Metal Free ADSS Fiber Optic Cable and associated hardware & fittings

This Specification covers the functional & technical specifications of ADSS (All Di-Electric Self Supporting) Fiber Optic cabling and associated hardware & fittings.

4.10.1 Description

This Specification covers the functional & technical specifications of ADSS (All Di-Electric Self Supporting) Fiber Optic ADSS Optical Fiber Cable shall be installed on 33kV/11kV lines and

may also be installed on LT lines. The estimated cable route length requirements are indicated in the price schedules. However, the Contractor shall supply & install the ADSS Optical Fiber Cable as required based on detailed site survey to be carried out by the Contractor during the project execution.

4.10.2 Functional Requirement

The design and construction of ADSS metal free optical Fiber cable shall be inherently robust and rigid under all conditions of installation, operation, adjustment, replacement, storage and transport. The cable shall possess good performance characteristics such as anti-impact, anti-vibration, anti-bending, prevention of thermal aging etc. All the elements consisting of ADSS cable shall be non-metallic.

The ADSS optical Fiber cable shall be able to work in saline atmosphere and should be protected against corrosion.

Life of cable shall be at least 25 years. Necessary statistical calculations shall be submitted by the manufacturer, based upon life of the Fiber and other component parts of the cable. The cable shall meet the cable aging test requirement.

It shall be possible to install the ADSS optical Fiber cable with Accessories and Fixtures as per the GR No. TEC/GR/TX/OAF-001/03/MAR-17 and subsequent amendments, if any. If any special Accessories and Fixtures are required for installation of the ADSS optical Fiber cable, the same shall be provided along with the cable. The accessories required for mounting the splice closure on towers shall also be supplied along with splice enclosure.

The ADSS optical Fiber Cable shall be suitable and compatible with the dimensions, fixing, terminating and splicing arrangement of the splice closure supplied along with the cable & vice versa. The manufacture shall indicate the type, make and the model no. of the splice closure to be supplied along with cable. The cable supplied shall also meet other requirement of the splice enclosure Universal type GR No. TEC/GR/TX/OJC-002/03/APR-2010 & subsequent amendments, if any.

The Self-Supporting Metal Free ADSS Optical Fiber cable shall be designed and manufactured supplied under this contract as per TEC GR TEC/GR/TX/OFC-022/02/MAR-17 Type III-A or with latest amendment, if any, to meet the following conditions of operation, installation and storage:

For Type III A

a. Maximum Length: 100 meters

b. Maximum Ice loading: 0 Kg per meter

c. Operational Wind velocity: 100 kms. per hour

d. Sag of the span length:

i. Maximum Sag allowed without excess load: 1% of the span length

ii. Maximum Sag allowed with excess load: 2% of the span length

e. Operating Temperature: -40 ℃ to 70 ℃

f. Tensile force design parameter: 9.81x4.0xW

(Note W is the mass of 1 km length of the cable in Kg)

g. Minimum bending radius: 10D (D – Diameter of cable)

h. Minimum distance of cable from Phase Conductor on 33/11 kV line: 1.5 Meter

4.10.3 Technical Requirement

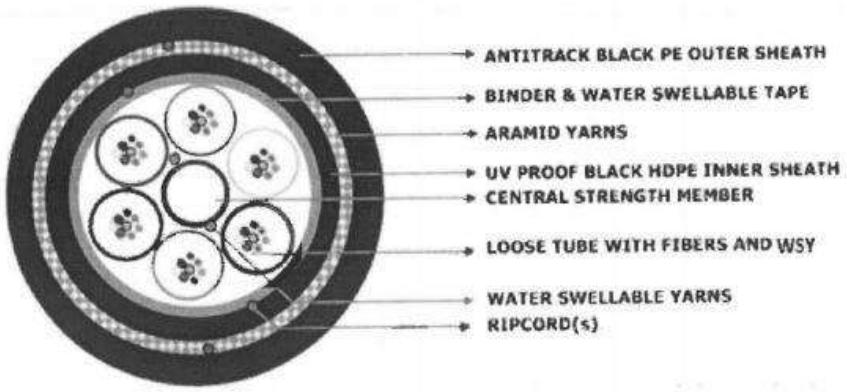
DWSM (Dual Window Single Mode) Optical Fiber used in manufacturing optical fiber cables shall be as per ITU-T Rec G.652D. The specifications of fiber shall be as per Table given below.

Table 4: DWSM Optical Fiber Characteristics

Fiber Description:	Dual-Window Single-Mode
Mode Field Diameter:	8.6 to 9.5 μm (± 0.6μm)
Cladding Diameter:	125.0 μm ± 1 μm
Mode field concentricity error	≤ 0.6μm
Cladding non-circularity	≤ 1%
Cable Cut-off Wavelength lcc	≤ 1260 nm
550 nm loss performance	As per ITU-T G.652 D
Proof Test Level	≥ 0.69 Gpa
Attenuation Coefficient:	@ 1310 nm ≤ 0.34 dB/km @ 1550 nm ≤ 0.21 dB/km
Chromatic Dispersion; Maximum: Zero Dispersion Wavelength: Zero Dispersion Slope:	18 ps / (nm x km) @ 1550 nm 3.5 ps / (nm x km) 1288-1339nm 5.3 ps / (nm x km) 1271-1360nm 1300 to 1324nm 0.092 ps / (nm^2xkm) maximum
Polarization mode dispersion coefficient	≤ 0.2 ps/km^½
Temperature Dependence:	Induced attenuation ≤ 0.05 dB (-60°C - +85°C)

Bend Performance:	@ 1310 nm (75±2 mm dia Mandrel), 100 turns; Attenuation Rise ≤ 0.05 dB @ 1550 nm (30±1 mm radius Mandrel), 100 turns; Attenuation Rise ≤ 0.05 dB @ 1550 nm (32±0.5 mm dia Mandrel, 1 turn; Attenuation Rise ≤ 0.50 dB

4.10.4 ADSS Optical Fiber Cable Construction Specifications for Dry-Dry Core (Type III B)



Typical Structural Drawing for 48 Fiber of Cable

Secondary Protection:

The primary coated Fibers may be protected by loose packaging within a tube or tubes which shall contain water swellable yarn to prevent water ingress in loose tube.

Number of Fibers: 48

Strength Member: Solid FRP non - metallic strength member in the centre of the cable core shall be provided. The strength member in the cable shall be for strength and flexibility of the cable and shall have anti buckling properties. This shall also keep the Fiber strain within permissible values.

Cable Core Assembly:

Primary coated Fibers in loose tubes, stranded together around a central strength member (using helical or reverse lay techniques), shall form the cable core.

Core Wrapping:

The main cable core containing Fibers shall be wrapped by layer/layers of water swellable tape & binder (as per Section IX of TEC/GR/TX/ORM-01/04/Sep-09).

Moisture barrier (protection): The main cable core (containing Tube/FRP & Core wrapping) shall be protected by water swellable yarn as per section XIX of GR TEC/GR/TX/ORM-01/04 SEP.09.

Inner Sheath:

A non-metallic moisture barrier sheath may be applied over and above the cable core. The core shall be covered with tough weather resistant High-Density Polyethylene (HDPE) sheath, black in colour. Thickness of the sheath shall be uniform and shall not be less than 1.0mm. The sheath shall be circular, smooth, free from pin holes, joints, mended pieces and other defects. Reference test method to measure thickness shall be as per IEC 189 para 2.2.1 and Para 2.2.2.

Note: HDPE material (in black colour) from the finished cable, shall be subjected to following tests (on sample basis) and shall conform to the requirement of the material as per the GR No. TEC/GR/TX/ORM-01/04 SEP-09 (Section-ill)

i. Density
ii. Melt flow index
iii. Oxidative Induction time
iv. Carbon black content
v. Carbon black dispersion
vi. ESCR
vii. Moisture content
viii. Tensile strength and elongation at break

Reinforcement:

The ADSS optical Fiber cable shall be helically reinforced with Aramid Yarn in the periphery over the inner sheath. The Aramid Yarn shall be uniformly and equally distributed on the entire periphery (circumference) of the cable. The quantity of the Aramid Yarn used per kilometer length of the cable shall be as per requirement in Annexure VI for Type III B in TEC GR TEC/GR/TX/OFC-022/02/MAR-17. The Aramid Yarn shall be as per the GR No. TEC/GR/TX/ORM-01/04 SEP.09 (Section XVII) and the subsequent amendments, if any.

Outer Jacket:

A circular and uniform tough weather resistant polyethylene compound Antitrack Polyethylene material sheath/Jacket, black in colour, (UV Stabilised) shall be provided over and above the reinforcement of Aramid Yarn. The thickness of the outer sheath/Jacket shall not be less than 1.8mm. The sheath shall be free from pin holes, joints, scratches, mended pieces and other defects etc. and it shall have smooth finish.

Note: Antitrack PE material (in black colour) from the finished cable, shall be subjected to following tests (on sample basis) and shall conform to the requirement of the material as per GR No. TEC/GR/TX/ORM-01/04 SEP.09 and the subsequent amendments, if any.

i. Density
ii. Melt flow index
iii. Oxidative Induction time
iv. Carbon black content
v. Carbon black dispersion
vi. ESCR
vii. Moisture content
viii. Tensile strength and elongation at break

Cable diameter:

The manufacturer shall define the cable diameter. The finished cable diameter shall be as per Annexure VI for Type III B as per TEC GR TEC/GR/TX/OFC-022/02/MAR-17.

RIP Cord:

a) The suitable water blocking ripcords (two each for Inner & Outer sheath) shall be provided which shall be used to open the inner and outer sheath of the cable. It shall be capable of consistently slitting the sheath without breaking for a length of 1 meter at the installation temperature. The rip cord(s) shall be properly waxed to avoid wicking action and shall not work as a water carrier.

b) The ripcord used in the cable shall be readily distinguishable from any other components (e.g. Aramid Yarn etc.) utilized in the cable construction.

Details of Technical parameters of type III A shall be as per IEC Standard (as follows) and approved by the Client.

DRY DRY CORE CABLE DESIGN

The following parameters of the component parts of the cable are to be taken in to account while designing and manufacturing the optical Fiber cables of the required Fiber count. These parameters shall be checked during evaluation of the OF cables: A

S.N.	Parameter	Unit	48 Fiber OF Cable
1	FRP Rod EAA Coated	mm	2.5+0.1/-0.0
2	FRP up jacketing thickness	mm	0

S.N.	Parameter	Unit	48 Fiber OF Cable
3	Tube ID (min)	mm	1.7
4	Tube OD	mm	2.4 ± 0.1
5	No of Fiber / tube	No	12
6	Color of Fiber		BL, OR, GR, BR, SL, WH, RD, BK, YL, VI, PK, NAT
7	No of loose tubes	No	4
8	Color of loose tubes		BL, OR, GR, BR
9	No of dummy cord	No	2
10	Tube stranding lay over length	mm	90-110
11	Aramid Yarns-Min	Kg/Km	10
12	Cable diameter	mm	14.5 ± 0.5
13	Nominal cable weight	Kg/Km	140-170
14	Cable to be designed to Fiber strain value of.	%	0.1
15	Excess Fiber length	%	0.7
16	Cable to be tested at defined load for fiber strain value of	%	0.25

4.10.5 Raw Material

The cable shall use the raw materials approved against the latest TEC specs or equivalent. The change in the design of the optical cable shall call for fresh type testing. The material used in optical Fiber cable must not evolve hydrogen that will affect the Fiber loss.

A test certificate from a recognized laboratory or institute may be acceptable.

4.10.6 Cable Material Compatibility

Optical Fiber, buffers/core tubes, and other core components shall meet the requirements of the compatibility with buffer/core tube filling material(s) and/or water-blocking materials that are in direct contact with identified components within the cable structure as per latest TEC specs or equivalent.

4.10.7 Safety Requirement

The material used in the manufacturing of the optical Fiber cables and for use in splicing and maintenance shall be non-toxic and dermatologically safe in its lifetime and shall not be hazardous to health.

4.10.8 Operating requirement

The design and construction of ADSS metal free optical Fiber cable shall be inherently robust and rigid under all conditions of operation, adjustment, replacement, storage and transport. The optical Fiber cable shall be able to work in the environment prevailing in Nepal. The Contractor shall take into consideration the UTS of transmission line while designing the ADSS Cable.

The ADSS optical Fiber cable shall work satisfactorily in electrical field environment of 33 kV and shall not degrade with presence of electrical field. The cable shall be installed on 33 kV lines and the fittings location shall be so selected the field at the point of installation shall not exceed 33 kV.

The bidder may consider the design span length of 100 meter for bidding purpose. However, actual span length shall be determined by the Contractor during the site survey.

The supplied cable shall meet the span, wind loading requirement of the specified location where the cable is to be installed.

4.10.9 Optic Fiber Cable Lengths

The fiber optic route lengths are as specified in appendices and price schedules. The lengths specified in appendices are route lengths; however, the actual fiber cable length shall exceed the route lengths on account of extra cable requirement due to loop, jointing & splicing.

The exact cable lengths shall be determined by the Contractor during the survey. The same shall be used by the Contractor for final link design during the detailed engineering of the project. The payment will be made for installation on the executed route length only. Up to 3% wastages of OFC shall be allowed for specified service loops, lengths for wastage, installation/working for FO cable, sag, joints, terminations etc. during material reconciliation after measurement.

4.10.10 Cable Ends

Both cable ends (the beginning end and end of the cable reel) shall be sealed and readily accessible. Minimum 5 meter of the cable of the beginning end of the reel shall accessible for testing. Both ends of the cable shall be kept inside the drums and shall be located so as to be easily accessible for the test. The drum (confirming to latest TEC Specs or equivalent) should be marked to identify the direction of rotation of the drum. Both ends of cable shall be provided with cable pulling (grip) stocking and the anti-twist device (free head hook).

Anti-twist device (Free head hook) shall be provided attached to both ends of the cable pulling arrangement. The arrangement of the pulling eye and its coupling system along with the anti-twist system shall withstand the prescribed tensile load applicable to the cable.

4.10.11 The nominal drum length

Generally, the length of ADSS optical Fiber cable in each drum shall be 2 km ± 5 %. However, it can be optimized as per site conditions during detail engineering. The drum shall be marked with arrows to indicate the direction of rotation. Packing list supplied with each drum shall have at least the following information: Drum no., Type of cables, Physical Cable length, No. of Fibers, Length of each Fiber as measured by OTDR, The cable factor – ratio of Fiber/cable length, Attenuation per km. of each Fiber at 1310 & 1550 nm, User's/consignee's name, Manufacturer's Name, Month, Year and Batch no., Name of the route.

4.10.12 Optical Fiber Strain

The following shall be ensured while performing sag tension calculations:

(a) The cable strain margin is defined as the maximum cable strain at which there is no Fiber strain.

(b) The no Fiber strain condition is defined as Fiber strain of less than or equal to 0.05%, as determined by direct measurement through IEC/ETSI(FOTP) specified optical reflectometry techniques. There should not be any Fiber strain at any condition

The Contractor shall offer suitable ADSS optical Fiber cable for various spans for the ADSS FO cable meeting the following conditions for Employer's approval: The ground clearance & Electrical clearance shall be met for the actual site conditions.

4.10.13 Cable Marking

The cable marking shall be imprinted and indelible (indented). The marking on the cable shall be indelible of durable quality and at regular intervals of one meter length. The alternatively permanent printing with the laser shall also be acceptable. In case of laser printing method; the

impression shall not exceed the depth of 0.15 mm. The accuracy of the sequential marking must be within –0.25% to +0.5% of the actual measured length. The markings on the cable must not rub off during normal installation.

The marking shall be of clearly contrast colour on the black HDPE sheath in case hot foil indentation method is used. The colour used must withstand the environmental influences experienced in the field.

Two orange colour (UV stabilized) lines of minimum 3 mm width diametrically opposite to each other, continuous over the length of the cable shall be applied (marked) for easy identification of this cable from other cables.

The type of legend marking on O.F. cable shall be as follows:

(i) Company Legend
(ii) Legend containing international acceptable Laser symbol
(iii) Type of cable i.e., Slotted or Loose Tube or Uni-tube (Central Tube)
(iv) Type of Fiber ie. DWSM
(v) Number of Fibers
(vi) Year of manufacturer
(vii) Sequential length marking
(viii) Employer's Name

4.10.14 Installation, Accessories and Fixtures for ADSS Cable

The scope of supply of the Metal Free ADSS Optical Fiber Cable includes the assessment, supply and installation of all required installation accessories and fixtures. The Bidder shall provide documentation justifying the adequacy and suitability of the hardware used. To ensure their satisfactory performance, the Contractor shall determine the exact requirements of all accessories and fixtures used to install and secure the cable.

The cable hardware accessories and fixtures shall follow the general requirements regarding design, materials, dimensions & tolerances and markings etc. as specified in TEC GR No. TEC/GR/TX/OAF-001/03/MAR-17 with latest amendment. The cable accessories & fixtures drawing & Data Requirement Sheets (DRS) document shall consist of three parts: (1) A technical particulars sheet (2) An assembly drawing i.e., level 1 drawing and (3) Component level drawings i.e., level 2 & lower drawings. All component reference numbers, dimensions and tolerances, bolt tightening torques & shear strength and ratings such as UTS, slip strength etc. shall be marked on the drawings.

The required joint box shall also be provided by the Contractor and the details of which shall be submitted for Employer's approval. The joint box shall comply to ingress protection class IP 66

or better. The in-line splice enclosures shall be metallic type and support mechanical opening and closing.

The required strengthening of existing structures/towers/poles shall be carried out by the Contractor for installation of offered ADSS cable.

As the ADSS cable is designed for 100 m span for self-supporting condition, for the span greater than 50 m, the additional strength wire along with the clipping arrangement to support the ADSS cable for installation of ADSS cable system shall also be provided by the Contractor at no additional cost to the Employer. However, the actual span lengths may vary at site and the fittings & accessories shall be provided as per site requirement.

The above requirement of, strength wires, strengthening of existing structure/poles/towers shall be submitted by the Contractor for Employer's approval and same shall be provided as per approval.

The typical details of Installation fixtures are given below, however contractor to supply any additional items required for successful installation of Self-Supporting Metal Free ADSS Optical Fiber Cable without any extra cost to employer:

S.N.	Item Details	Unit	Required Quantity/Pole
A	**Tension Fitting set**		
1	D Shackle or J Tension Hook	Set	2
2	Turn Buckle	Set	2
3	Extension Link	Set	2
4	Clevis Thimble	Set	2
5	Protective Helix (T)	Set	2
6	Terminating Helix	No.	2
7	Jumper Cable Clamp	Set	1
8	Pole clamp – tubular	Set	1
B	**Suspension Fitting set**		
1	Twisted Eye Link	Set	1
2	Protective Helix (S)	Set	1

S.N.	Item Details	Unit	Required Quantity/Pole
3	Armor Grip Helix	Set	1
4	Suspension Clipper with Elastomer Pad	Set	1
5	Spiral Vibration Damper (SVD)	Set	2
6	Pole clamp – (as per pole design tubular, rail etc.)	Set	1
C	Pole Mounted Stay Clamp (light) for Jumper clamp	No.	1
D	Demountable Pulley with rubberized wheel	Set	1
E	Adjustable cable storage bracket	Set	1

4.10.15 Optical Fiber Splicing

Splicing of the optical Fiber cabling shall be minimized through careful planning. There shall be no mid-span splices allowed. All required splices shall be planned to occur within facilities or on tower structures. All optical Fiber splicing shall comply with the following:

(a) All Fiber splices shall be accomplished through fusion splicing.

(b) Each Fiber splice shall be fitted with a splice protection sheath fitted over the final splice.

(c) All splices and bare Fiber shall be neatly installed in covered splice trays. No more than 12 (twelve) Fibers shall be installed in each splice tray.

(d) For each link, bi-directional attenuation of single mode fusion splices measured at 1550 nm shall not average more than 0.05 dB. The bi-directional splice loss of each splice shall not exceed 0.1 dB when measured at 1550 nm.

(e) For in-line splicing, Fiber optic cable service loops of adequate length shall be provided so that all splices occurring at tower structures can be performed at ground level.

4.10.16 Optical Fiber Termination and Splicing

Optical Fiber terminations shall be done in Fiber Optic Distribution Panels (FODP) at Substations and FMS (Fiber Management System) at RMU (Ring Main Unit) locations. The Contractor shall provide rack /wall mounted Fiber Optic Distribution Panels (FODPs) & FMS that shall be 1U, 2U, 3U like size and able to fit in cabinet at GO switch panel and Sub-Station

FODP. The location of FODP rack shall be fixed by the Contractor, with the Employer's approval.

The technical specification of FODP is given in 4.10 (below) of this specification.

4.10.17 Optical Fiber Connectors

Optical Fibers shall be connectorized with FC-PC type connectors preferably. Alternatively, connector with matching patch cord shall also be acceptable. Fiber optic couplings supplied with FODPs shall be appropriate for the Fiber connectors to be supported. There shall be no adapters.

4.10.18 Service Loops

For purposes of this specification, cable and Fiber service loops are defined as slack (extra) cable and Fiber provided for facilitating the installation, maintenance and repair of the optical Fiber cable plant.

(a) Outdoor Cable Service Loops: In-line splice enclosures installed outdoors and mounted on the utility towers, shall be installed with sufficient Fiber optic cable service loops such that the recommended minimum bend radius is maintained while allowing for installation or maintenance of the cable to be performed in a controlled environment at ground level.

(b) Indoor Cable Service Loops: FODPs shall provide at least three (3) metres of cable service loop. Service loops shall be neatly secured and stored, coiled such that the minimum recommended bend radius' are maintained.

(c) Fiber Units Service Loops: For all Fiber optic cable splicing, the cable shall be stripped back a sufficient length such that the fan-out of Fiber units shall provide for at least one (1) meter of Fiber unit service loop between the stripped cable and the bare Fiber fan-out.

(d) Pigtail Service Loops: Connectorized pigtails spliced to bare Fibers shall provide at least 1 meter of service loop installed in the FODP Fiber organizer and at least one (1) meter of service loop to the couplings neatly stored behind the FODP coupling panels.

(e) Fiber Service Loops: At least 0.5 meter of bare Fiber service loop shall be provided on each side of all Fiber splices. The bare Fiber service loops shall be neatly and safely installed inside covered splice trays.

4.10.19 Anti-Rodent Compliance

ADSS cable is to be installed on rodent prone areas; ADSS should have anti rodent complied

4.10.20 Methodology for Installation and Termination

a. Installation Techniques

The techniques used in installation of ADSS Optical Fiber Cables are described here. With the proper installation hardware and skilled resource, any of these methods can be used to install ADSS cable. Many a times, it will become necessary to use a combination of these methods to achieve full installation. Selection of the specific technique (i.e., Moving Drum method, Stationary Drum method or Manual Installation method), or a combination thereof, shall largely depend on the actual site conditions. The contractor shall select the most appropriate installation technique suitable to the site conditions.

b. Moving Drum method

In this method the cable is pulled directly from the cable drum mounted on a moving vehicle as it drives along the pole line. The cable drum must be mounted on a proper support to allow easy cable pay off. At the dead-end point, the cable is terminated using Termination Assembly sets and tensioned using turnbuckles to maintain cable sag within permissible value. To start installation, park the vehicle with the cable drum approximately 15 - 20 meters away from the pole facing away from it down the pole line. The cable must pay off from top of the drum towards the rear of the vehicle Install the termination supports and temporary hooks on the poles at the starting point and subsequent poles. Pull off the necessary amount of slack, lift the dead-end to the top of the pole and mount on the termination assembly. Once the cable is fixed at both ends with at the terminating assemblies, carry out tensioning. After the cable **section is properly tensioned and secured at both ends lift the cable out of the hooks at each of the intermediate pole and support it with the suspension set assemblies.**

c. Stationary Drum Method

In this method of ADSS cable installation, the cable is pulled along the cable route through temporary support hardware. Stationery drum installation method requires installation of temporary support hardware such as pulley blocks.

A rope wound on the tension limiting winch is passed through the pulleys and connected to the cable on the drum installed on a stand which allows free rotation of the drum. The pulling load should normally not exceed 60% of the maximum permissible cable tension recommended by cable supplier.

The cable drum and winch locations must have vehicular access. The cable drum should always be placed on levelled ground so that its flanges are vertical thus avoiding rubbing of cable against flanges. The orientation should be such that the cable pay-off is directly in the direction of pull. Always pay-out the cable from top of the drum and not from bottom. The drum

should have provision to allow controlled pay-out of cable. Cable pay-out needs to be controlled to prevent free running or jerking.

Once the cable is completely pulled end to end, it is then ready for installation of permanent supporting system of terminating and suspension set assemblies at required locations and tensioning for sag control.

d. Manual Installation method

Manual installation method technique is similar to stationary drum method, except that in this case the cable is uncoiled from the drum and placed on the ground in the shape of 8. The pulling operation is same as in stationary drum method. The hardware requirement and pulling equipment also remains same.

For pulling in both directions, two loops of shape of 8 can be made and each can be pulled in separate directions. Loops of size 4 to 5m x 1.5m should be sufficient in most cases.

e. Installation of Accessories

1. Pole Clamp

Prior to fixing any temporary supports / stringing blocks or permanent cable suspension/termination assemblies, it is necessary to fix pole clamps. Appropriate type of pole clamps will be required depending on the shape of the pole. The two halves shall be opened and fixed at the specified height using tightening bolts.

2. Terminating (or dead End) Assembly

Termination assemblies are required at dead ends locations where:

i. Cable needs to be terminated at the end facility

ii. Loops are to be kept for future maintenance activities

For double sided termination assembly 2 sets would be required.

To fix a termination Assembly following accessories are required:

i. Protective Helix on the cable,

ii. Terminating Helix with a thimble,

iii. Clevis Thimble,

iv. Spiral Vibration Damper

3. Suspension Assembly

ADSS optical Fiber cable shall be supported on all intermediate poles between two terminating poles using the pole clamp and a suspension assembly set.

To fix a suspension Assembly following accessories are required:

i. Protective Helix on the cable,

ii. Suspension Helix,

iii. Clevis Thimble,

iv. Spiral Vibration Dampers

4. Installation Cable Loop / storage / Joint Closure

Cable loops are to be provided for future maintenance purposes at regular spacing. A fixture is required to be installed. Excess cable is then wound & kept on support. The fixture provides a means to ensure Proper bend radius is maintained. Separate clamp is required for installation of Joint Closures.

5. Supporting Jumper Cable Clamp

Jumper cable hanging between a pair of Termination Assemblies installed at locations where there is sharp change in direction need to be supported with a special twisted link. To support jumper cable, use already installed clamp.

6. **Cable Tensioning**

After the required Length of cable has been placed, the cable shall be properly tensioned before it is permanently secured into suspension assemblies. The temporary dead end should be installed 4 to 5 m from the pole so that after complete tension is applied, appropriate permanent termination assembly set can be installed while the cable is in tension. The chain hoist will also need to be tied to the pole directly using a sling and on to pole clamp.

Once the cable sanction are under the required tension and the sag is within limits (i.e. less than 1% of span), the "free" end of the cable used for tensioning is fitted with termination assembly set and terminated. Once the load is transferred on to permanent termination end, the temporary arrangement shall be removed.

f. Machinery / Equipment / Tools

Ropes and Light weight ladder for installation of termination / suspension assemblies, clamps etc. Temporary supports, dynamometer, chain hoists, temporary dead ends steel cables, etc. required during cable laying and / or cable pulling and cable preparation kits, etc. as applicable will have to be arranged by the Agency.

Van with portable splicing machines and OTDR, power meter, cable preparation kits, etc. for splicing and testing of installed ADSS Optical Fiber Cable.

Other tools and tackles shall include wrenches, spanners, screwdrivers, hummer, ropes etc.

All safety equipment such as safety belts, insulating and cotton gloves and hard hats, fluorescent vests etc. as required.

g. Other guideline for ADSS Cable installation

All optical Fiber cable termination, installation, stringing and handling plans, guides and procedures, and engineering analysis shall be submitted to the Employer for review and approval in the engineering/design phase of the project, prior to establishing the final cable lengths for manufacture. Installation procedures including details of personnel and time required shall be documented in detail and submitted to Employer for approval. All installation practices shall be field proven and ISO accredited.

All cable segments shall include service loops as specified in this specification .The maximum allowable stringing tension, maximum allowable torsional shear stress, crush strength and other physical parameters of the cable shall not be exceeded. The preventative measures to be taken shall be documented in detail and submitted to Employer in advance of installation.

Optical Fiber attenuation shall be measured after installation and before splicing. Any increase in attenuation or step discontinuity in attenuation shall not be acceptable and shall constitute a cable segment failure. In the event of cable damage or any Fiber damage, the complete section (tension location to tension location) shall be replaced as mid-span joints are not acceptable.

Any or all additional steel work or modifications required to attach the Fiber cabling to the overhead transmission/ distribution line towers shall also be carried out by the Contractor. It shall be the Contractors responsibility to provide adequate communications among all crew members and support staff to ensure safe and successful installations.

4.10.21 Cable Raceways

To the extent possible, existing cable raceways shall be utilised. The Contractor is required to provide and install any additional indoor cable raceways which may be required for proper implementation of the Fiber optic cabling system. This requirement shall be finalised during survey. The cable raceways shall conform to the following:

(a) All cable raceways shall be sized to support full loading requirements plus at least a 200% safety loading factor.

(b) Indoor cable raceways shall be fabricated from construction grade aluminium, galvanized iron or anodized sheet metal or any other suitable material approved by the Employer. Suitable anti-corrosion measures shall be provided. Steel fabricated raceways shall be finished inside and out, treated to resist rust and to form a metal-to- paint bond.

(c) Mechanical construction drawings of the cable raceways shall be submitted for Employer's information & review.

4.10.22 Testing

a. Type Testing

The Contractor shall submit along with their bid the earlier carried out type test reports for the offered ADSS optical Fiber cable, its accessories and fixtures etc. meeting the requirement. The Contractor shall submit the previously carried out type test report for the same design of cable for the tests. All items should have been type tested as per relevant standards for the tests and the Contractor shall submit the test reports and certificates along with the bid.

Type Testing on ADSS Optical Fiber Cable

The type test on the ADSS Cable shall be as per procedure mentioned in TEC GR: TEC/GR/TX/OFC-022/02/MAR-17 or equivalent standard. The Fiber should have been type tested as per relevant international standards for the tests listed in Table given below.

S.N.	Name of Test
1	Tensile strength Test
2	Abrasion Test
3	Crush Test (Compressive Test)
4	Impact Test
5	Repeated Bending
6	Torsion Test
7	Kink Test
8	Cable Bend Test
9	Snatch Test
10	Cable Bend Test at High & Low Temperature
11	Temperature Cycling
12	Cable Aging Test
13	Cable Freezing Test

S.N.	Name of Test
14	Water Penetration Test
15	Test of Figure of Eight on the cable
16	Flexural Rigidity Test on the optical Fiber cable
17	Static Bend Test
18	Cable Jacket Yield Strength and Ultimate Elongation
19	Drip Test
20	ECSR Test
21	UV Resistance Test
22	Embrittlement Test of Loose Tube
23	Kink Resistance Test on the Loose Tube
24	Drainage Test for Loose Tube
25	Check of Easy removal of Sheath
26	Check of the effect of Aggressive Media on the Cable
27	Electrical Test
28	Aeolian Vibration Test (Type Test)
29	Galloping Test
30	Sheave Test
31	Creep Test
32	Tracking & Erosion Test

Type Testing for ADSS FO Cable Accessories & Fixtures

The type test on the ADSS Cable shall be as per procedure mentioned in TEC GR: TEC/GR/TX/OAF-001/03/MAR-17 (latest amendments) or equivalent standard, if any. The

applicability of the tests for the particular type of accessories and fixtures shall be as given below.

S.N.	Name of Test
1	Verification of dimensions: Applicable to all fittings
2	Tensile strength test: Applicable to tension & suspension clamp assemblies
3	Tensile strength test for helically formed product
4	Slip Strength Test
5	Resilience Test
6	Galloping / Fatigue test
7	Aeolian Vibration Test
8	Tension and Attenuation Test (Dead End Assembly)
9	Wrapping Test
10	Galvanising Test
11	Hardness Test of Elastomer pad

b. Factory Acceptance Testing

Factory Acceptance Tests on ADSS optical Fiber cable

The tests listed in Table given below shall be carried out as Factory Acceptance Test for ADSS optical Fiber cable meeting the requirements specified in this Chapter.

S.N.	Factory Acceptance Test
1	Attenuation Coefficient (1310, 1550): By EIA/TIA 455- 78A or OTDR
2	Point discontinuities of attenuation: By EIA/TIA 455- 78A or OTDR
3	Visual Material verification and dimensional checks as per approved drawings

4	Water Ingress test
5	Tensile strength test / Strain test
6	Impact test
7	Kink test
8	Environmental test
9	Crush Test
10	Drip test

Factory Acceptance Tests on ADSS cable accessories & fixtures

The FAT on accessories & fixtures of ADSS optical Fiber cable shall be carried out as specified in Table given below.

S. N.	**Factory Acceptance Test**
1	Visual and dimensional checks of all components
2	Tensile test
3	Slip test
4	Galvanising test
5	Wrapping test
6	Hardness tes

4.10.23 Quality Assurance Program

Along with the Bid the Bidder shall furnish quality assurance program of the manufacturer which includes the Quality System and the Quality Plans, which shall include, among others, information to meet the following requirement, failing which the Bid shall be liable for rejection.

i.) The structure of the organization;

ii.) The duties and responsibilities assigned to staff ensuring quality of works;

iii.) The system for purchasing, taking delivery and verification of materials;

iv.) The system for ensuring quality of workmanship;

v.) The quality assurance arrangement shall conform to relevant requirements of ISO 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;

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.

4.11 Specification of for FMS, FODP and Splice Enclosure

This Specification covers the functional & technical specifications of Fiber Management System (FMS), Fiber Optic Distribution Panel (FODP) and Joint Box (Splice Enclosure).

4.11.1 FMS

Fiber Management System (FMS) or Line Interface Unit (LIU) shall be used at RMU & GO switch locations. These FMS shall be used to connect Fiber optic cable from Manhole / Splice enclosure to the communication equipment.

Indoor FMS Shall be 1U/2U/3U/4U size and rack mountable through sliding into panel. It shall be as per relevant TEC GR. Outdoor FMS shall be wall mountable or shall be mountable to Ground/Footpath. Outdoor FMS shall also conform IP68 protection and latest TEC GR.

Indoor type FMS shall be installed into the existing Cabinet/Panel of RMU panel. However for outdoor FMS cabinet to be provided along with cabinet and locking arrangement.

TEC GR Reference: GR/FDM-01/02/APR-2007 (Type-I) with latest amendment No. TEC/T/OFC-FDMS/149/2012. FMS should have following features:

1. Metal base material with powder coating for light mounting.
2. Connectivity available for all type of connector available e.g. SC, LC, FC, ST, E2000 Terminations. There should be arrangement of termination of 96/48/24/12/6 Nos. of fibers
3. It should be mountable in standard 19" rack and of slider type.
4. Shall supplied with all accessories e.g. Cable Ties, mounting ear screw, sleeves, Tissue, Fiber cleaner liquid etc. The FMS shall be manufactured as per latest state of art technology. Body should be of MS steel; powder coating painting (min. 70 micrometer thickness) shall be provided with rust resistance paint.

a. Specifications of Patch Cords

The Patch cords should be confirming to TEC NO.: TEC/GR/TX OFJ-01/05/NOV-09 with latest amendment No. TEC/T/OFC-OFJ/155/2013.

4.11.2 Joint Box

a. Joint Box (Splice Enclosure) and Splicing:

The UGFO and ADSS cables would be required to be spliced at every joint, normally at a distance of every 2 km. Splicing to be for underground cable at Manhole and for ADSS cable on the 33 kV poles. For the ADSS Joint Box, pole mounting structure to be provided along with joint box. Joint box shall be as per TEC GR TEC/GR/TX/OJC-002/03/APR-2010 or latest

amendments, if any. Joint Box shall be universal type that can be placed on underground and overhead locations.

Joint Box shall be suitable to both straight joint and branch joints. Maximum 12 Fibers shall be splices in one splice tray.

For the joint between UGFO and ADSS it will be done preferably on O/H (on the poles).

Manhole shall be placed at around 200m for installation/pulling of UGFO. At these manhole where splicing is not to be done UGFO cable shall kept with 15 meter additional loop for future Telecom purpose.

b. Cable Entry and Sealing Arrangements:

The base shall have a minimum 4 single cable entry ports and one port for express (looped) cable entry. The arrangement shall be provided for terminating looped or express cable by making a suitable necessary provision. All ports shall be sealed and entry ports (sealed) shall be opened as per the requirement. The opening of any port shall not cause any interference to any existing cable. No heat shrink of any type shall be allowed on the cable for sealing. No screws or nut & bolts of any type shall be allowed. The sealing material shall be termite proof. No consumable items shall be required for sealing. The sealing components must be reusable and shall have unlimited shelf life. The sealing arrangements shall be specified along with opening and closing arrangement by the manufacturer and the same shall be tested. It shall be possible to terminate all cables having outer diameter of 20mm (Max.). The joint enclosures shall contain Fiber organizer system where the extra length of Fibers and splices are stored in systematic & secured manner. The method or device for safely routing and securing buffer tube and bare Fiber shall be provided. The joint enclosures shall allow an easy opening and re-closing without degradation in the performance of joint enclosure. Access to the inner junctions shall be possible without damaging the existing cables. The closure must be designed such that no installed cable is disturbed or require re-sealing of the existing cables during installation of additional cables.

c. 4.10.3.3 Holding Arrangements

The box shall provide the following:

1. Holding arrangement and framework for properly securing cable organizers with splice trays.
2. Securing arrangement for holding Fibers.
3. Holding device to hold strength member of Fiber optic cable securely.
4. Any other extra component required for providing strength and reliability to the Joint Box.

d. Compatibility

All the component and parts used shall be compatible with the optical Fiber cable, Fiber splices and cable components. Their use for long should not result in increase in transmission loss or deterioration in other properties.

e. Marking on body of the Joint box

The following information by marking on Joint box shall be provided:

1. Manufacturer's name & date
2. Type of Joint box
3. Number of Splice organiser cassettes
4. Number of splices per cassette
5. Batch number and serial number.

4.11.3 Fiber Optic Distribution Panel

This section describes the general requirements, type and factory testing requirements of Joint Box for underground optical Fiber cables. At locations requiring the termination of at least one pair Fiber within a cable, all Fibers within that cable shall be connectorized and terminated in FODPs in a manner consistent with the following.

a. FODP shall be provided to accommodate rack mountable 1U (24F) & 2U (48F) FODP Sub rack with Splicing & Patching Trays, with suitable patch cord & Adaptors in 2200x600x600 Cabinet.
b. All Fiber optic terminations shall be housed using FODPs provisioned with splice organizers and splice trays. All Fibers within a cable shall be fusion spliced to pre-connectorized pigtails and fitted to the backside of the provided couplings. The pigtails and the Fibers shall be stored and dressed neatly in the provided trays and holders. The pigtails/Fibers shall be numbered using suitable ferrules.
c. Ground lugs shall be provided on all FODPs and the contractor shall properly ground all FODPs. The FODPs shall be properly fixed/grouted to the floor and or with wall with better support. Necessary installation material for fixing the FODP on wall or ground shall be provided by the Contractor.
d. The location of FODPs rack shall be fixed by the contractor, with the Employer's approval.
e. Flexible protection shall be provided to the patch cord bunches going out from FODP to another equipment.

4.10.4.1 Optical Fiber Connectors

FC-PC type connectors shall be used. Average loss of the FC-PC connectors shall not exceed 0.5dB.

4.10.4.2 Optical Fiber Splices

Splicing of the optical Fiber cabling shall be minimized through careful planning. It is important that all splicing work be done under clean conditions. All required splices shall be planned to occur at Joint location/manhole. All optical Fiber splicing shall comply with the following:

a. All Fiber splices shall be accomplished through fusion splicing.

b. Each Fiber splice shall be fitted with a splice protection sheath fitted over the final splice.

c. For splicing of each Fiber, every effort shall be made to minimise the bidirectional average splice loss.

d. All splices and bare Fiber shall be neatly installed in covered splice trays.

e. Average bi-directional splice loss at any particular splice shall not exceed 0.1dB but total bi-directional average of all splices in a link shall not exceed 0.05dB.

f. Fiber optic cable service loops as indicated in technical specifications shall be provided.

4.11.4 Splicing of Fibers in existing Joint Box or FODP

In case it is required to do re-splicing for rectification or splice new cable in an existing Joint Box, above stipulations for splicing shall be applicable. In such conditions, splicing of only few Fibers of the existing cables in the Joint Box with the new cable shall be done. For working in existing Join Box/FODP, the Contractor shall take due care so that the traffic in the balance Fibers is not affected.

4.11.5 Service Loops

For purposes of this specification, cable and Fiber service loops are defined as slack (excess) cable and Fiber provided for facilitating the installation, maintenance and repair of the optical Fiber cable system.

a. Outdoor Cable Service Loops: At manhole chambers splices are installed with sufficient Fiber optic cable service loops (as mentioned in Technical Specification) such that the recommended minimum bend radius is maintained while allowing for installation or maintenance of the cable to be performed in a controlled environment at ground level. Optical cable service loops (excess cable) shall also be provided at all crossings in manholes (as mentioned in Technical Specification).

b. Indoor Cable Service Loops: At FODPs, Contractor shall provide at least three (3) metres of cable service loop. Service loops shall be neatly secured and stored, coiled such that the minimum recommended bend radius is maintained.

c. Fiber Units Service Loops: For all Fiber optic cable splicing, the cable shall be stripped back a sufficient length such that the fan-out of Fiber units shall provide for at least one (1) metre of Fiber unit service loop between the stripped cable and the bare Fiber fan-out.

d. Pigtail Service Loops: Connectorised pigtails spliced to bare Fibers shall provide at least 0.5 metre of service loop installed in the FODP Fiber organizer and at least one (1) metre of service loop to the couplings neatly stored behind the FODP coupling panels.

e. Fiber Service Loops: At least 0.5 metre of bare Fiber service loop shall be provided on each side of all Fiber splices. The bare Fiber service loops shall be neatly and safely installed inside covered splice trays.

4.11.6 Testing Requirements

a. Type Testing

Type tests for Joint Box:

The Joint Box offered to be supplied should have been type tested as per requirement specified in TEC/GR/TX/OJC-002/03 APR-10 with latest revisions or equivalent standard. The contractor shall submit the earlier carried out type test reports for the offered joint box meeting the requirement. List of type tests on joint box are given below:

(i). Water Ingress Test.

(ii). Drop and Topple Test.

(iii). Air Tightness Test.

(iv). Static Load Test.

(v). Impact Test.

(vi). Vibration Test.

(vii). Environmental Cycle Test.

(viii). Salt Spray (Mist) Test.

(ix)(a). Resistance to Aggressive Media Test.

(ix)(b). Resistance to Stress Cracking Test.

(x). Variation in Attenuation.

(xi). Torsion Test.

(xii). Flexure Test.

(xiii). Clamping Test.

(xiv). Thermal Aging.

(xv). Current Surge Test.

(xvi). UV Test.

b. Factory Acceptance Testing

Factory Acceptance Tests for Joint Box (Splice Enclosures)

S.N.	Name of test
1	Visual Inspection
2	Tightness (Sealing) Test
3	Static Load test
4	Impact test
5	Axial pull out test
6	Bending test
7	Water ingress test
8	Reopening test

Factory Acceptance Test for FODP

Visual check of Quantities and Specific Component Number for each component of FODP and dimensional checks against the approved drawings.

Factory Acceptance Test for FMS

Visual check of Quantities and Specific Component Number for each component of FMS and dimensional checks against the approved drawings

4.11.7 Quality Assurance Program

Along with the Bid the Bidder shall furnish quality assurance program of the manufacturer which includes the Quality System and the Quality Plans, which shall include, among others, information to meet the following requirement, failing which the Bid shall be liable for rejection.

i.) The structure of the organization;
ii.) The duties and responsibilities assigned to staff ensuring quality of works;
iii.) The system for purchasing, taking delivery and verification of materials;

iv.) The system for ensuring quality of workmanship;

v.) The quality assurance arrangement shall conform to relevant requirements of ISO 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;

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.

4.12 3 phase, 33 kV step voltage regulator (Not Applicable)

4.12.1 Scope

This specification guides the construction and operation of 3-phase, 33 kV, automatic step voltage regulators for use at 33 kV lines in Nepal. The 33 kV AVR shall be capable of correcting wide voltage variation ranges continuously and in "on-load" condition. The variations of more than ± 1% shall be sensed through a solid-state relay. This relay shall operate on internal auxiliary supply and send signals to the stabilizer's motor, which drives the roller mechanism in lower and higher direction to bring voltage to the rated output voltage within steps of + / - 1%.

4.12.2 Construction

The voltage regulator shall have helical coils mounted on a laminated grain-oriented steel core. Carbon rollers shall be assembled on to a Fiber glass carrier board and shall traverse the length of the coil track. The rollers shall be connected to the electrical output terminals.

The HT Automatic Voltage Regulator shall consist of two tanks to facilitate servicing of the moving parts of Rolling Contacts and other components in the regulator without disturbing the main tank.

Apart from the regulating coil, there shall be compensating windings connected in parallel, which shall be short-circuited to reduce the effect of core-flux fringing. It shall keep the reactance of the regulator constant at all positions of the rolling contact.

4.12.3 Technical parameters

Table 5: Technical Specifications of 33 kV AVR

Capacity	**Up to 14,000 kVA**
No. of phases	3 phases
Rated frequency	50 Hz
Rated voltage	33 kV
Tapping	-30 % to +20 %
Insulation class	Class A
Vector group	Dyn11
Duty cycle	Continuous
Winding type	Electrolytic Grade Copper Wound

4.12.4 Standard fittings

The following standard fittings shall be supplied with the AVR –

a. Rating and diagram plate
b. Earthing terminals
c. Lifting lugs
d. Thermometer pocket
e. Oil Conservator with drain plug: Air release hole with plug
f. Oil Level indicator: Explosion vent with diaphragm
g. Top-filter Valve: Inspection cover
h. Silica gel breather: Drain –cum-bottom-filter valve
i. Cooling radiators: Uni / Bi- directional rollers

4.12.5 Standard feature set

The HT AVR shall offer the following minimum feature set –

1. The tank shall be constructed from stainless steel so that it provides zero corrosion
2. The sealed tank shall be pre-fitted with a pressure relief device for gases to escape during tap changes.
3. It shall feature an external MOV-type bypass arrester that shall provide protection to the regulator series winding from surge and system transients.

4. It shall have a clear Oil-sight gauge to check oil levels and oil conditions without de-energizing the regulator.
5. The motor capacitor shall be installed in the control cabinet to enable replacement without bypassing and taking the regulator out of service.
6. Polarized Disconnect Switch (PDS) shall be provided to facilitate quick installation or replacement with minimum outage.
7. It shall have a cover-mounted terminal block to provide easy access to the wiring and terminal connections.
8. The controller unit shall be configurable with independent "Raise" / "Lower" settings. There shall be Independent Undervoltage & Overvoltage settings for cut off together with Variable Time Delay settings
9. There shall be appropriate LED indications for all Raise, Lower, Undervoltage, Overvoltage and Time Delay Operations
10. The AVR controller shall feature serial communication (RS232 / RS485 or Optical fiber link) as well as ethernet communication interface (via RJ45) to support remote operation through SCADA / DMS Head End systems.

4.12.6 Quality Assurance Program

Along with the Bid the Bidder shall furnish quality assurance program of the manufacturer which includes the Quality System and the Quality Plans, which shall include, among others, information to meet the following requirement, failing which the Bid shall be liable for rejection.

i.) The structure of the organization
ii.) The duties and responsibilities assigned to staff ensuring quality of works
iii.) The system for purchasing, taking delivery and verification of materials
iv.) The system for ensuring quality of workmanship
v.) The quality assurance arrangement shall conform to relevant requirements of 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
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.

Volume II

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5 POWER TRANSFORMERS

5.1 Scope

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

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

- IEC 60076 Power transformer
- IEC 60137 Insulating bushings for alternating voltages above 1 kV
- IEC 60156 Insulating liquids - Determination of the breakdown voltage at power frequency – Test method
- IEC 60296 Specification for unused mineral insulating oils for transformers and switchgear
- IEC 60551 Determination of transformer and reactor sound levels
- IEC 60616 Terminal and tapping markings for power transformer
- IEC 60722 Guide to the lightning impulse and switching impulse testing of power transformers and reactors
- Manufacturer of power transformer shall hold valid ISO 9001 (including design) quality certificate

5.2 Equipment to be furnished:

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

5.3 Design requirement

The transformer shall be connected to three phase 50 Hz system with higher side voltage being 33 kV. The Transformers shall be installed Outdoor in the Hot and Humid atmosphere. The Transformer shall be Oil Immersed and designed for the cooling system as specified in the appendices.

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

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 IEC60076.

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

- Voltage varying ± 10% of rated Voltage
- The Frequency varying ± 2.5% of rated Frequency.

The Transformer shall be capable of delivering its rated output at any tap position. The Transformer shall be free from annoying hum and Vibration when in Operation even at 10% over Voltage. The noise level should be as per respective IEC Standards. The manufacturer of the transformer shall be the holder of valid ISO 9001certificate (including design). The Transformer shall be designed and constructed so as not to cause any undesirable interference in radio or communication circuits.

Table 1: Technical Particulars of Power Transformers and Accessories

S.N.	**Description**	**Rated Capacity**
1.	Rated Capacity	1 MVA, 3 MVA, 6/8 MVA, 12/16 MVA
2.	Quantity Required	As per price schedule
3.	Service	Outdoor
4.	Type	Oil Immersed
5.	Type of Cooling	ONAN (1, 3 MVA), ONAN/ONAF (6/8, 12/16 MVA)
6.	Temperature Rise above 45^{o}C ambient temperature	
a)	In Oil by Thermometer	50^{o}C
b)	In winding by Resistance	55^{o}C
7.	Number of Phases	3 phase, 50 Hz.
8.	Maximum Voltage (Phase to Phase)	
a)	Primary, kV	36
b)	Secondary, kV	12

S.N.	Description	Rated Capacity
9.	Rated Voltage (Phase to Phase)	
a)	Primary, kV	33
b)	Secondary, kV	11
10.	Insulation Level of Winding	
a)	Basic Impulse level as per IEC 76	
	Primary, kV	170
	Secondary, kV	75
b)	Frequency Induced Over Voltage (Impulse)	
	Primary, kV	70
	Secondary, kV	28
11.	Connections	
a)	Primary	Delta
b)	Secondary	Star
12.	Vector Group Reference	
	Primary-Secondary	Dyn 11
13.	Tap Changer	
a)	Type of Tap Changer	Off-Load (1, 3 MVA), On-Load (6/8, 12/16 MVA)
b)	Range of Taps	±10%, step 2.5% (1, 3 MVA), ±10%, step 1.25% (6/8, 12/16 MVA)
c)	Number of Taps	9 (1, 3 MVA), 17(6/8, 12/16 MVA)

S.N.	Description	Rated Capacity
d)	Method of Tap Changer Control	
	Mechanical Local	
14.	Percentage Impedance Voltage at Rated MVA and 75°C	5% (1 MVA), 7% (3 MVA), 8% (6/8 MVA and 12/16 MVA) or as per IEC 60076 - 5
15.	System Grounding	
a)	Primary	Ungrounded
b)	Secondary	Solidly Grounded
16.	System Fault Level	25 kA at 33 kV
17.	Neutral Terminals	
a)	Primary	No
b)	Secondary	Yes

5.4 Construction Features

5.4.1 Tank

The tank should be suitable to house complete core and maintain oil level up to the top of the core and windings even when the cover is open. The tank shall be all welded Construction and fabricated from the sheet steel of adequate thickness. All seams shall be properly welded to withstand requisite impact during short circuit without distortion. All welding shall be stress relieved.

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

The Transformer cover shall be bolted on to the tank with weatherproof, hot oil resistant, resilient gasket in between for complete oil tightness. If gasket is compressible, metallic stops should be provided to prevent complete compression. Bushing turrets, cover of inspection holes and other devices shall be designed to prevent leakage of water into or oil from the tank during

normal or abnormal conditions. The tank cover shall be provided with two numbers of grounding pads and connected separately to tank grounding pads.

The tank shall be provided with sets of bi-directional flanged wheels for rolling the Transformer parallel to either central line on the rail. All heavy removable parts shall be provided with mounting rails along with the eye bolt for ease of handling and necessary lugs and shackles shall be provided to enable the whole Transformer to be lifted by the Crane or other means. Manholes of sufficient size shall be provided for access to leads, windings, bottom terminal of bushing and taps.

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

5.4.2 Core & Windings

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

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

Coil assembly shall be suitably supported between adjacent sections by insulating spacers and barriers. Bracing and other insulation used in the assembly of the winding shall be arranged to ensure a free circulation of the oil and to reduce the hot spot of the winding.

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

The core shall be rigidly clamped to ensure adequate mechanical strength. Core and Coil Assembly shall be capable of withstanding the vibrations and shock during transportation, Installation, service and adequate provision shall be made to prevent movement of core & coil assembly relative to the tank during these conditions. The core and coil assembly shall be securely fixed in position so that no shifting or deformation occurs during movement or under short circuit stresses.

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

- Invoice of the supplier
- Mill's Test Certificates

- Packing List
- Bill of Lading
- Bill of Entry certificate by the Customs

Core Materials shall be directly purchased either from the manufacturer or through their accredited marketing organization of repute and not through any agent. The core shall be provided with lifting lugs suitable for lifting complete core and Coil assembly of transformer.

The Coils shall be manufactured from electrolytic copper of suitable grade as per relevant international standards. The maximum current density for design of the transformers shall not exceed 320 A/Sq.cm. They should be properly insulated and stacked. All Insulating materials shall be of proven design. Coils shall be so insulated that impulse and Power Frequency Voltage stresses are minimum.

All leads from the windings to the terminal board and bushings shall be rigidly supported to prevent injury form vibration or short circuit stresses. Guide tube shall be used where practicable.

5.4.3 Tapping

No Load Tap as specified in the appendices shall be provided on the high voltage winding of the transformers. The transformer shall be capable of operation at rated output at any tap position provided the primary does not vary by more than ± 10% of the rated voltage corresponding to the normal tap.

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

All other parts and accessories required for installation and normal operation of No-Load Tap Changer and On-Load Tap Changer shall also be furnished.

5.4.4 Transformer Oil

The Transformer Oil shall conform to the latest revision of IEC Publication 60296, properly inhibited for preventing of sludging. The necessary first filling of oil shall be supplied for the transformer in nonreturnable container suitable for outdoor storing. Ten percent (10%) excess oil shall also be provided to take wastage into account.

5.4.5 Oil Preservation System

Oil preservation system shall be by means of conservator tank.

5.4.6 Conservator Tank System

The Conservator Tank shall be mounted on a bracket fixed on the tank. The Conservator Tank shall be provided without compartment, for the main Transformer Tank. The Conservator Tank shall be connected with the Main Transformer tank by pipes through double float Buchholz relay (Gas Operated Relay) with valves at both ends. Contact of the Oil in the compartment for the Main Tank with atmosphere shall be prohibited by using a flexible urethane air cell. The cell shall be vented into the atmosphere through a silica gel breather and shall inflate or deflate as Oil volume changes.

The Conservator Tank shall be provided with its own breather, filler cap and drain plug. The Conservator Tank shall be provided with dial type Level Indicator visible from the ground level and fitted with low oil level alarm Contact and Plain oil level gauge.

5.4.7 Temperature Indicators

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

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

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

5.4.8 Buchholz Relay

The Buchholz relay shall be provided with two floats and two pairs of electrically separate contacts – One pair for Alarm & other pair for Tripping function. The Buchholz relay shall be provided with the facility for testing by Injection of air by hand pump and with cock for draining and venting of air.

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

5.4.9 Transformer Bushings

All Bushings shall confirm to the requirements of the latest revisions of IEC Publication 60137. The Bushings shall be located so as to provide adequate electrical clearances between phases and also between phase and ground as per relevant standards.

All Bushings shall be porcelain type and shall be furnished complete with terminal connectors of adequate capacity. The porcelain used in bushings shall be Homogenous, Nonporous, uniformly glazed to Brown colour and free from Blisters, Burns and other defects. Stresses due to expansion and contraction in any parts of the Bushings shall not lead to deterioration.

Liquid / Oil filled Bushings for 36kV and above shall be equipped with Liquid Oil level Indicators and means for sampling and draining of liquid. The angle of inclination to vertical shall not exceed 30°. Oil in oil filled Bushings shall meet the requirement of the Transformer Oil standards specified.

5.4.10 Marshaling Box

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

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

- Load disconnect Switch for Incoming Power Supply for Auxiliaries
- Cooler Fan and Pump Motor starters
- FAN START STOP Control Switches for ONAF type only
- AUTO-MANUAL Switches
- Wiring and Termination individually of the following alarm contacts for remote pre trip alarm
- Buchholz relay alarm for Main Tank
- Winding Temperature High Alarm
- Oil Temperature High Alarm
- Tank Oil Level Low Alarm
- Tap Change incomplete alarm

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

- Winding Temperature High Trip
- Oil temperature High Trip

- Buchholz Relay Trip or Sudden Oil Pressure Relay Trip
- Pressure Relief Device
- Cubicle Illumination lamp with door switch and space heater with thermostat and ON-OFF switch shall be provided

5.4.11 Wiring

Wiring shall be done as specified

5.4.12 Cable Termination

Marshaling box shall be designed to facilitate cable entry from bottom. Removable plates shall be furnished with compression type cable glands to make entry dust proof and no weight is transferred to the terminal. The glands shall be suitable for terminating Cable Armor. Sufficient space shall be provided to avoid sharp bending and for easy connection. A minimum space of 200mm from the gland plate to the nearest terminal block should be provided.

5.4.13 Terminal Blocks

Terminal Blocks shall be as specified

5.4.14 Painting Works

All painting works shall be done as specified

5.5 Auxiliary Supply

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

5.6 Current Transformer

The Bidders are required to propose the detail scheme of ac circuit after making a Site visit and studying the existing ac system of the Transformer Protection and Metering. The existing data are enclosed. The details about the Current Transformer will be finalized after the approval of the scheme or as instructed by the Owner. The Bushing Current Transformer (BCTs) shall be provided as per the **Single Line Diagrams.**

5.7 Tap Changing Equipment

Each transformer shall be provided with Off load tap / On Load Tap changing equipment as specified elsewhere. 1 MVA and 3 MVA transformers shall be equipped with Off Load Tap Changer. 6/8 MVA and higher shall be equipped with Off load/On Load Tap changer suitable for operation on both modes.

5.7.1 OFF Load Tap Changing

Off load tap changer shall be provided for generator transformer on higher voltage side with taps of ± 2*2.5%. The position must be clearly indicated and means of locking shall be provided. The tap changer shall be rated for full output at each tap. The entire tap changing gear shall be adequately designed and dimensioned to ensure low wear and reliable operation with a minimum of maintenance. It shall be so located on the transformer that it can be operated by an operator standing at the level of the transformer track. It shall be enclosed in a separate oil chamber attached with the tank.

The operating mechanism of tap changer shall be such that it should not be left at intermediary position. Under abnormal conditions such as may occur, if the contactor controlling one tap changer sticks, the arrangement must be such as to switch off supply, to the motor so that an out of step condition is limited to one tap difference between the units. Necessary protection to prevent over-operation from the setting range shall be provided.

5.7.2 ON Load Tap Changing (OLTC) Equipment

The On Load Tap Changer (OLTC) shall be of high-speed resistor type with vacuum technology include the following:

5.7.2.1 Main OLTC Gear Mechanism

Three phase transformers shall be provided with voltage control equipment of the tap changing type for varying its effective transformation ratio whilst the transformers are on load.

OLTC shall be motor operated suitable for local as well as remote operation. The diverter switch or arcing switch shall be designed so as to ensure that its operation once commenced shall be completed independently of the control relays or switches, failure of auxiliary supplies etc. To meet any contingency which may result in incomplete operation of the diverter switch, adequate means shall be provided to safeguard the transformer and its ancillary equipment. The current diverting contacts shall be housed in a separate vacuum interrupter chamber not communicating with the oil in main tank of the transformer. The contacts shall be accessible for inspection without lowering oil level in the main tank and the contacts shall be replaceable. Electrical arcing took place in a vacuum interrupter only.

Necessary safeguards shall be provided to avoid harmful arcing at the current diverting contacts in the event of operation of the OLTC gear under overload conditions of the transformer.

Tap changer shall be so mounted that bell cover of transformer can be lifted without removing connections between windings and tap changer.

5.7.2.2 Local OLTC Control Cabinet (Drive Mechanism Box)

Each transformer unit of OLTC gear shall have following features:

OLTC shall be suitable for manually handle operated and electrically motor operated. For local manual operation from Local OLTC Control cabinet (Drive Mechanism Box), an external handle shall be provided.

OLTC's Local control cabinet shall be mounted on the tank in accessible position. The cranking device/handle for manual operation for OLTC gear shall be removable and suitable for operation by a man standing at ground level. The mechanism shall be complete with the following:

- Mechanical tap position indicator which shall be clearly visible from near the transformer.
- A mechanical operation counter of at least five digits shall be fitted to indicate the number of operations completed and shall have no provision for resetting. Mechanical stops to prevent over-cranking of the mechanism beyond the extreme tap positions.
- The manual control considered as back up to the motor operated on load tap changer control shall be interlocked with the motor to block motor start-up during manual operation.
- The manual operating mechanism shall be labelled to show the direction of operation for raising the voltage and vice-versa.
- An electrical interlock to cut-off a counter impulse for reverse step change being initiated during a progressing tap change and until the mechanism comes to rest and resets circuits for a fresh position.

For electrical operation from local as well as remote, motor operated mechanism shall be provided. It shall not be possible to operate the electric drive when the manual operating gear is in use. It shall not be possible for any two controls to be in operation at the same time. Transfer of source in the event of failure of one AC supply shall not affect the tap changer. Thermal device or other means shall be provided to protect the motor and control circuit.

The Local OLTC Drive Mechanism Box shall house all necessary devices meant for OLTC control and indication. It shall be complete with the followings:

i. A circuit breaker/contactor with thermal overload devices for controlling the AC Auxiliary supply to the OLTC motor
ii. Emergency Push Button to stop OLTC operation
iii. Cubicle light with door switch
iv. Provided with anti-condensation metal clad heaters to prevent condensation of moisture

v. Padlocking arrangement for hinged door of cabinet
vi. All contactors relay coils and other parts shall be protected against corrosion, deterioration due to condensation, fungi etc.
vii. The cabinet shall be tested at least IP 55 protection class.

All relays and operating devices shall operate correctly at any voltage within the limits specified in the General Requirements. In case auxiliary power supply requirement for OLTC DM Box is different than station auxiliary AC supply, then all necessary converters shall be provided by the Contractor.

Operating mechanism for on load tap changer shall be designed to go through one step of tap change per command only, until the control switch is returned to the off position between successive operations / repeat commands.

Limit switches shall be provided to prevent overrunning of the mechanism and shall be directly connected in the control circuit of the operating motor provided that a mechanical de-clutching mechanism is incorporated. In addition, a mechanical stop shall be provided to prevent over-running of the mechanism under any condition. An interlock to cut-out electrical control when it tends to operate the gear beyond either of the extreme tap positions.

OLTC local control cabinet shall be provided with tap position indication for the transformer. Drive Mechanism shall be equipped with a fixed resistor network capable of providing discrete voltage steps or provide 4-20 mA transducer outputs for tap position indication input to Digital RTCC/SCADA system.

'Local-remote' selector switch shall be provided in the local OLTC control cabinet. In Local mode, all electrical commands from remote (i.e., from Digital RTCC, SCADA etc.) shall be cut-off/blocked. Electrical operations to change tap positions shall be possible by using raise/lower push buttons under local mode from Marshalling Box. In remote mode electrical commands from Digital RTCC/SCADA etc. shall be executed. The remote-local selector switch shall be having at-least two spare contacts per position.

Following minimum contacts shall be available in DM Box. Further these contacts shall be wired to Digital RTCC panel:

a. INCOMPLETE STEP which shall not operate for momentary loss of auxiliary power.
b. OLTC motor overload protection
c. Supply to DM Motor fail
d. OLTC IN PROGRESS
e. Local / Remote Selector switch position
f. OLTC upper/lower limits reached

All relays, switches, fuses etc. shall be mounted in the OLTC local control cabinet and shall be clearly marked / labelled for the purpose of identification.

A permanently legible lubrication chart if required shall be fitted within the OLTC local control cabinet.

5.7.3 Digital Remote Tap Changer Control (RTCC) Panel

The digital RTCC panel shall have Automatic Tap Changer control and monitoring relay with Automatic Voltage Regulating features (referred as Digital RTCC relay) to remotely control and monitor OLTC. The relay shall be offered from the manufacturer who has already supplied Digital RTCC relay, which is in operation for at-least 2 years for transformer OLTC application.

Digital RTCC relay shall be microprocessor based adopting the latest state of the art design & technology with in-built large display for ease of programming and viewing. The unit supplied shall be field programmable so that in the event of change in transformer / location, it could be customized to site conditions without sending back to works. The programming shall be menu driven and easily configurable. If it is designed with draw out type modules, it should take care of shorting all CT inputs automatically while drawing out. The CT / VT ratio shall be field programmable and Relay shall display the actual HV Voltage and current considering suitable multiplying factors. The system shall be self-sufficient and shall not require any additional devices like parallel balancing module etc.

All Digital RTCC Relays shall be of same make for smooth integration of these relays for parallel operations of all transformers in the substation.

The digital RTCC Panel shall be provided with digital RTCC relay having Raise/Lower push buttons, Manual/ Automatic mode selection features, Master / Follower/ Independent/ Off mode selection features and emergency stop Push Button for control of OLTC. Touch screen option in the relay, instead of electrical push button/switch is also acceptable.

In Manual Mode: In this mode, power system voltage based automatic control from digital RTCC relay shall be blocked and commands shall be executed manually by raise/lower push buttons.

In Auto Mode: In Auto mode, digital RTCC relay shall automatically control OLTC taps based on power system voltage and voltage set points. An interlock shall be provided to cut off electrical control automatically upon recourse being taken to the manual control in emergency.

Master / Follower/ Independent/ Off mode

Master Position: If the selector switch is in master position, it shall be possible to control the OLTC units of other parallel operating transformers in the follower mode by operation from the master unit.

Follower Position: If the selector switch is in Follower position control of OLTC shall be possible only from panel where master mode is selected.

Independent Position: In independent position of selector switch, control of OLTC shall be possible only from the panel where independent mode is selected. Suitable interlock arrangement shall be provided to avoid unwanted/inconsistent operation of OLTC of the transformer.

Raise/Lower Control: The remote OLTC scheme offered shall have provision to raise or lower taps for the complete bank of three 1-phase transformers/3-Phase Transformers. Individual 1-phase OLTC operation shall not be possible from the remote control panel.

Digital RTCC relays shall communicate with SCADA using IEC 61850 protocols to monitor, parameterize & control the OLTC. Any software required for this purpose shall be supplied. The supplied software shall not have restriction in loading on multiple computers for downloading and analyzing the data. Software shall indicate the current overview of all measured parameters of the connected transformer in real time. The digital RTCC Relay shall have multiple selectable set point voltages and it shall be possible to select these set points from SCADA, with a facility to have the possibility of additional set points command from SCADA.

Communication between the Digital RTCC relays to execute the commands for parallel operation shall be implemented using required communication protocol. IEC - 61850 GOOSE messaging between Digital RTCC relays for OLTC parallel operation is not permitted. Suitable communication hardware shall be provided to communicate up to distance of 1km between digital RTCC relays. Scope shall also include communication cables between digital RTCC relays. Cables as required for parallel operation of OLTCs of all transformers from Digital RTCC relays shall be considered included in the scope of Bidder.

The Digital RTCC relay shall have programmable Binary Inputs (minimum 7 Nos.) and Binary outputs (minimum 7 Nos.) for Employer's future use. It shall be possible to have additional module for Binary Input / output as well as Analogue input module depending upon requirement.

The relays shall ensure positive completion of lowering/raising of the OLTC tap, once the command is issued from the relay. "Step-by-Step" operation shall be ensured so that only one tap change from each tap changing pulse shall be effected. If the command remains in the "operate" position, lock-out of the mechanism is to be ensured.

Following minimum indications/alarms shall be provided in Digital RTCC relay either through relay display panel or through relay LEDs:

a. INCOMPLETE STEP alarm

b. OLTC motor overload protection alarm

c. Supply to DM Motor fail alarm

d. OLTC IN PROGRESS alarm

e. Local / Remote Selector switch positions in DM Box

f. OLTC upper/lower limits reached alarm

g. OLTC Tap position indications for transformer units

5.8 Tests

5.8.1 Routine Tests

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

- Applied Voltage Tests
- Induced Voltage Tests
- No-Load and Excitation Current Test
- Impedance Voltage and Load Loss Test.
- Resistance Measurement
- Ratio Test
- Polarity and Phase Relation Test
- Leakage Test
- Insulation Resistance Test
- Insulation Power Factor Test

5.8.2 Special Tests

The Following tests shall be performed –

- Zero Phase Sequence Impedance measurement
- After fabrication, the tank fitted with all Valves, Covers, Conservator Tank etc. shall be completely filled with Transformer Oil and subjected to a pressure of 25% over the Normal pressure of the Oil. This pressure shall be maintained for 12 hours during which time there should be no leakage of oil nor there shall be permanent set when pressure

is released. If any leakage or permanent set occurs, the test shall be conducted again after rectification of the defects.

- The Transformer Tank shall be subjected to full Vacuum as far as possible for 12 hours
- After assembly, each core shall be pressure tested for 1 minute at 2kV ac between all bolts, side bolts, structural steel works and core
- Excitation loss and current measurement shall be made at 90%, 100% and 110% of rated Voltage

5.8.3 Design Tests

Following design Test shall be performed on the Transformer in accordance with latest revision of IEC Publication 60076, if such tests have not yet performed by the Manufacturer earlier in size commensurate with the Tendered Transformer. However, if such had been performed earlier, then the design tests can be submitted. If the submitted design tests in the opinion of the Owner, cannot be approved, then such tests have to be conducted.

- Temperature Rise Test
- Impulse Voltage Withstand Test
- Short Circuit Test

5.8.4 Tests of Miscellaneous Components

The various components of the Transformer such as insulating oil, Bushings, Current Transformers etc. shall be tested with the relevant Standards. The bodies of all valves and pipe works shall withstand a hydraulic pressure of 20psig for 15 minutes. The Testing medium shall be insulating oil as per IEC Publication 296.

5.8.5 Test Certificates

Test Certificates should be submitted in required number of copies for approval. The Routine, Special and Design Test Certificates of the Transformer shall be furnished for approval before the delivery of the Equipment from the Factory.

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

5.8.6 Field Tests

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

- Construction Inspection & Completeness inspection
- Insulating Oil Test

- Insulation Resistance Measurement\
- Ratio Test
- Tap Changer Operation Test
- Magnetic Balance Tests
- Short Circuit Test
- Magnetizing Current Test
- Vector Group Test
- Winding Resistance Test
- Calibration of WTI & OTI.
- Setting of Alarm/Trip And cooler Controls and operation Check

5.9 Transformer accessories

Transformers furnished under this Specification shall be equipped with –

- Oil Conservator with one compartment with filler caps and drain plugs
- Two sets of Silica Gel Breather with Connecting Pipes and Oil Seals
- Air Release Plugs
- Double float Buchholz Relay with Electrically Separate Trip and Alarm
- Contacts for Transformer Tank
- Two Nos. of Shut-Off valves at both sides of each Buchholz
- Sudden Gas Pressure relay with Trip Contact
- Mechanically Operated Self Resetting Type Pressure Relief Device with visible Operation Indicator and Trip Contact
- 150mm Dial Magnetic level Gauge with Low Oil level alarm
- Direct reading Plain Oil Level Gauge
- 150 mm dial Oil Temperature Indicator with Maximum Reading pointer and individually adjustable Separate Sets of Contact for Alarm and Trip
- 150 mm Dial Winding Temperature Indicator with individually adjustable electrically separate sets of Contacts for two stage cooler control, Alarm and Trip with detector element complete with Heating Coil, CT's etc. Drain Valve with Threaded Adapter
- Sample Valve (Top and Bottom)

- Filter Valve with Threaded Adapter (Top and Bottom)
- Cover Lifting Eyes
- Jacking Pads, Hauling and Lifting Lugs
- Bi-directional Wheels
- Rails
- Clamping Device with Nuts & Bolts for clamping the Transformer on Foundation rails
- Ladder with Safety device for access to the Transformer top and Buchholz relay
- Grounding Pads each with 2nos. tapped holes, bolts and washer for Tank, Radiator and cable end box Grounding
- Rating Plates and Terminal marking plate
- Marshaling Box for housing Cooler Control Equipment and Terminal connections
- Any other Accessories.

5.10 Capitalization of Transformer Losses

When evaluating the individual tender received from various Tenderers, the loss of Power transformers shall be capitalized and evaluated Tender Price shall be calculated as below:

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

where,

P_E = Evaluated price

P_b = Tender price

K_{NL} =Value of no-load loss

K_L = Value of load loss

L_{NL} = Guaranteed no-load losses.

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

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 1180 / kW

The Tenderer shall furnish guaranteed no-load and full-load loss data at rated load with the bid for all rating of transformers contained herein. The Supplier shall furnish a test certificate for each transformer supplied, which shall show the actual no-load and full-load losses of the

transformer at rated load. For the purpose of evaluation, the higher values of no-load and full-load losses shall be considered from the values guaranteed by the Tenderer and the values given in the test reports.

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

- No-load Loss = USD 9,368 per kW
- Full-load Loss = USD 2,360 per kW

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

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

5.11 Quality Assurance Program

Along with the Bid the Bidder shall furnish quality assurance program of the manufacturer which includes the Quality System and the Quality Plans, which shall include, among others, information to meet the following requirement, failing which the Bid shall be liable for rejection.

- The structure of the organization.
- The duties and responsibilities assigned to staff ensuring quality of works.
- The system for purchasing, taking delivery and verification of materials.
- The system for ensuring quality of workmanship.
- The quality assurance arrangement shall conform to relevant requirements of ISO9001.
- 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.
- List of manufacturing facilities available.
- 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

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6 33 KV SWITCHGEAR

6.1 Specification of 33 kV circuit breaker

6.1.1 Scope

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

Circuit breakers shall be offered from reputed makes like Hitachi /GE /ABB /Mitsubishi /LG /Fuji / Siemens/CGL, Areva or equivalent. The equipment specified in this Section shall conform to the latest edition of the appropriate IEC specifications and/or other recognized international standards. In particular:

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

6.1.2 Equipment to be furnished

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

6.1.3 Design Requirements

The circuit breakers shall be suitable for 3-phase, 50 Hz in 33 kV system. Circuit breaker shall be installed outdoor in a hot and humid climate. All equipment and accessories shall be provided with tropical finish to prevent fungus growth. The maximum temperature rise in any part of the equipment at specified rating shall not exceed the permissible limit as stipulated in relevant standards. The de-rating of the equipment shall be made taking 45 deg. C as an ambient temperature of the site, if it is designed for any lower ambient temperature. The rated peak short circuit current or the rated short time current carried by the equipment shall not cause:

a) Mechanical damage to any part of the equipment

b) Separation of contacts

c) Insulation damage of "Current Carrying Part"

Technical particulars of the circuit breaker shall be as given in this specification below. All auxiliary equipment shall be suitable for 3 phase 4 wire, 50 Hz, 400 V.

Table 1: Technical Requirements of Vacuum Circuit Breaker

1. Type	Vacuum, outdoor type
2. Quantity required	As per Price Schedule
3. Voltage rating	
(a) Nominal system voltage	33kV
(b) Rated maximum voltage	36kV
4. Insulation level	
(a) Impulse withstand voltage	170kV
(b) Power frequency withstand voltage (1 min)	75kV
5. Frequency	50Hz
6. Current rating	
(a) Rated continuous current at 45 deg. C ambient	630/800/1250A
(b) Rated interrupting current	25 kA
7. Re-closing duty cycle (Rated operating sequence)	0-0.3 sec-CO-3 min.-CO
8. Auxiliary supply	
(a) Control circuit	DC 110V
(b) Space heater and	AC, 3Ph-4W, 400V, 50Hz
auxiliary equipment	

9.	
i) Total maximum break time	60 ms
ii) First pole to clear factor	1.5
iii) Additional Auxiliary Contacts	6 NO, 6 NC
iv) Maximum make time	120 ms
v) Spring charging motor	110 V DC

6.1.4 Construction Features

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

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

a. Contacts

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

b. Local test switch

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

c. Emergency trip

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

d. Position indicator

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

e. Operating mechanism

The operating mechanism of the circuit breakers shall be spring charged by 110V D.C. motor and with mechanical charging. The tripping circuit mechanism and the closing control circuit mechanism shall each have a nominal voltage rating of 110 volts DC. The tripping circuit shall operate satisfactorily for a tripping operation over a voltage range of 70-110%. The closing control circuit shall operate satisfactorily over a voltage range of 85-110%.

f. Operation Counter

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

6.1.5 Accessories

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

a) Padlocks and duplicate keys

b) Operation counter

c) Earthing terminals

d) Nameplate

e) Other necessary accessories

f) Operating handle

6.1.6 Spare parts

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

6.1.7 Tests

a. Routine tests

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

a) Construction inspection

b) Leakage test

c) Operating speed check

d) Dielectric test

e) Pressure test

f) Control and secondary wiring check test

g) Mechanical operation test

h) Operating mechanism system check

b. Design tests

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

a) Bushing tests

b) Dielectric withstand test

c) Current carrying test

d) Normal current switching test

e) Short circuit switching test

f) Mechanical operation life test

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

a) Replace all latches and pins

b) Replace all major parts which are subject to fatigue, including, but not restricted to, contacts, movable crossheads, spring and linkages.

c. Field tests

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

a) Construction inspection

b) Measurement of insulation resistance

c) Operating speed check

d) Mechanical operation test

e) Operating mechanism system check

6.1.8 Performance Guarantee

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

6.1.9 Drawings, Data and Manuals

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

a) General equipment layout

b) Outline drawings of the breaker and control cubicle with accessories

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

a) General equipment layout

b) Outline drawing of the breaker and control cubical with accessories

c) Loading data and foundation detail

d) Elementary control wiring diagram

e) Internal wiring diagram

f) External connection diagrams, showing terminal boards and other external connection points for each assembly and the required interconnecting wiring

g) Drawing showing typical cross-section of the operating mechanism and breaker mechanism

h) Drawing showing typical cross-section and assembly of interrupting device

i) Drawing showing assembly of principal component parts and accessories

j) Drawing showing details of bushing or porcelain supporting columns, including dimension details of flanges and outline dimensions

k) Drawing to show details at all points where adjustments may be made to operating dimension mechanism, breaker mechanisms and contacts

l) Any other drawings and data required for design and installation of circuit breaker

m) Instruction manual for storage, installation, operation and maintenance of circuit breaker and operating mechanism

6.1.10 Nameplate

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

a) Manufacturer's name

b) Manufacturer's serial number and type designation

c) Year of manufacture

d) Rated voltage, kV

e) Rated insulation level, kV

f) Rated frequency, Hz

g) Rated normal current, A

h) Rated short-circuit breaking current, kA

i) Rated interrupting time cycles

j) Weight of circuit breaker, kg

6.1.11 Special Tools

In addition to the tools, which are regularly furnished with such breakers, the Contractor shall also supply all necessary special tools or equipment for assembling and disassembling the breaker. The Contractor shall submit an itemized list of such equipment.

6.1.12 Quality Assurance Program

Along with the Bid the Bidder shall furnish quality assurance program of the manufacturer which includes the Quality System and the Quality Plans, which shall include, among others, information to meet the following requirement, failing which the Bid shall be liable for rejection.

i. The structure of the organization.

ii. The duties and responsibilities assigned to staff ensuring quality of works.

iii. The system for purchasing, taking delivery and verification of materials.

iv. The system for ensuring quality of workmanship.

v. The quality assurance arrangement shall conform to relevant requirements of ISO9001.

vi. Statement giving list of important raw materials, names of manufacturer for the raw materials, list of standards according to which the raw materials are tested, list of 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.

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.

6.2 Specification of 33 kV Disconnecting switch with Earth Switch

6.2.1 Scope

This specification covers the design, manufacture, assembly, shop test, supply, delivery, installation works, and field test of disconnecting switches complete with all accessories operation suitable for both manned and unmanned substation operation mode for efficient and trouble-free operation. The equipment specified in this Section shall conform to the latest edition of the appropriate IEC specifications and/or other recognized international standards. In particular –

- IEC 62271: High voltage alternating current disconnectors and earthing switches
- IEC 60529: Degree of protection provided by enclosures
- IEC 62271-102: High-voltage switchgear and control gear – Part 102: Alternating current disconnectors and earthing switches

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

6.2.2 Design requirements

The disconnecting switches and earth switches shall be used for the 33kV, 50Hz, 3 phase system. The equipment shall be installed outdoor in a hot, humid climate; therefore, all equipment, accessories and wiring shall be provided with tropical finish to prevent fungus growth. The maximum temperature rise in any part of the equipment at specified rating shall not exceed the permissible limits as stipulated in relevant standards. The de-rating of the equipment shall be made taking 45^{o}C as an ambient temperature of the site, if it is designed for any lower ambient temperature.

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

- Mechanical damage to any part of the equipment
- Separation of contacts
- Insulation damage of "Current Carrying Part."

The grounding switch shall be capable of making to a dead short circuit without damage of the equipment or endangering operator. The disconnecting switches shall be rotating post type with contact blades moving through horizontal plane. The disconnecting switches shall be able to carry the rated current continuously and rated short time current for three seconds without exceeding the temperature limit specified in the relevant standard. 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.

The disconnecting switch shall be motor operated with provisions for local, control building level and remote level operation.

Table 2: Technical Particulars of 33 kV Disconnecting Switch with Earth Switch

1. Type	3-pole, single throw, outdoor
2. Quantity required	As per Price Schedule
3. Voltage ratings	
(a) Nominal system voltage	33kV
(b) Rated maximum voltage	36kV
4. Frequency	50Hz
5. Insulation levels	
(a) Basic impulse level (BIL)	170kV
(b) Power frequency withstand	
voltage (1 min.)	75kV
6. Current ratings	
(a) Continuous current	630/800/1250A
(b) Short time current (1 seconds)	25 kA
(c) Peak short time current	32kA
(d) Making current of grounding switch	32kA
7. Operating mechanism	manually gang operated

Table 3: Technical Particulars of 33 kV Disconnecting Switch without Earth Switch

1.	Type	3-pole, single throw, outdoor
2.	Quantity required	As per Price Schedule

3.	Voltage ratings	
(a)	Nominal system voltage	33kV
(b)	Rated maximum voltage	36kV
4.	Frequency	50Hz
5.	Insulation levels	
(a)	Basic impulse level (BIL)	170kV
(b)	Power frequency withstand voltage (1 min.)	75 kV
6.	Current ratings	
(a)	Continuous current	630/800/1250A
(b)	Short time current (1 seconds)	25kA
(c)	Peak short time current	32kA
7.	Operating mechanism	manually gang operated

6.2.3 Construction features

The 3-pole disconnecting switches shall be gang operated type so that all the poles make and break simultaneously. The disconnecting switches shall be designed for upright mounting on steel structure. The disconnecting switches shall have padlocked arrangement in both "open" and "closed" positions. All current carrying parts shall be non-ferrous metal or alloy. All live parts shall be designed to avoid sharp points and edges. All metal parts shall be of such material and treated in such a way as to avoid rust, corrosion and deterioration due to atmospheric conditions. Ferrous parts shall be hot dip galvanized. Bolt nuts, pins, etc. shall be provided with appropriate locking arrangement such as locknuts, spring washers, key etc. Bearing housing shall be weatherproof with provision for lubrication. The design, however, shall be such as not to require frequent lubrication. All bearings in the current path shall be shorted by flexible copper conductor of adequate size (minimum – 70 s.q. mm) to allow the specified fault current through it without injury.

a. Main contacts

The main contacts shall be of silver-plated copper alloy and controlled by powerful springs designed for floating and pressure point contact. The contacts shall have sufficient area and pressure to withstand the electromagnetic stresses developed during short circuit without excessive heating liable to pitting or welding. Contacts shall be adjustable to allow for wear, shall be easily replaceable and shall have minimum movable parts and adjustments. The blade shall be made of electrolytic copper tube or aluminum tube of liberal section. Rotating feature of the blade at the end of tube travel for contact wiping shall be provided. Arcing horns shall be provided to divert the arc from main contacts to the separating horns after the main contacts have opened. Arcing horns shall be of renewable type.

b. Insulators and terminals

Insulators shall be post type, brown glazed and composed of stacked units. The porcelain used for insulators shall be manufactured by wet process and shall be homogeneous and free from cavities and other flaws. Caps and pins shall be of the highest quality malleable iron or forged steel and smoothly galvanized. Arcing horn as required shall be furnished. All insulators of identical ratings shall be interchangeable. The terminals of the disconnecting switch shall be provided with terminal connectors.

6.2.4 Operating Mechanism

The manual operating mechanism shall be of torsion type suitable for operation in the horizontal plane. The operating handle shall be equipped with each switch and shall be arranged for mounting on the steel base supporting structures. Means shall be provided on each switch for taking up loose trajectory in the operating mechanism and for adjusting the travel of each blade independently. The Contractor shall furnish all supplemental members required to secure the installation of the complete switch mechanism to the supporting structures. All switches shall be self-locking in the open and closed positions independent of the control shaft restraint. Each mechanism shall be provided with an indicator showing direction of rotation for opening or closing and shall be provided for grounding and for padlocking in the open and closed positions. Each operating mechanism shall be furnished complete with all necessary operating pipes, interphase shafts, pipe couplings, guide bearings, ground braids, mounting brackets, mounting bolts, operating handle, auxiliary switches and offsets required for operation from the ground. All operating rods and levers shall be cut to length and all machining operations and threading shall be complete in the factory. The manually operated disconnecting switches shall also be provided with a minimum four (4) normally closed and four (4) normally open auxiliary contacts for remote indications.

a. Assembly

Each disconnecting switches along with its base frame and operating mechanism shall be completely assembled and checked at manufacturer's works for correct alignment and operation prior to dispatch. All parts and accessories shall have appropriate match marks and part number for identification at site.

6.2.5 Tests

a. Routine tests

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

b. Design tests

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

c. Field tests

- Construction inspection
- Measurement of insulation resistance
- Mechanical operation test

6.2.6 Quality Assurance Program

Along with the Bid the Bidder shall furnish quality assurance program of the manufacturer which includes the Quality System and the Quality Plans, which shall include, among others, information to meet the following requirement, failing which the Bid shall be liable for rejection.

i. The structure of the organization.

ii. The duties and responsibilities assigned to staff ensuring quality of works.

iii. The system for purchasing, taking delivery and verification of materials.

iv. The system for ensuring quality of workmanship.

v. The quality assurance arrangement shall conform to relevant requirements of ISO9001.

vi. Statement giving list of important raw materials, names of manufacturer for the raw materials, list of standards according to which the raw materials are tested, list of 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.

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 Load Break Switch

6.3.1 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 operation mode Load Break Switch. Manufacturer shall be holder of valid ISO 9001 certificate.

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 33 kV components. The Load Break Switch shall be normally installed in the line from where the line is tapping or branching.

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

- IEC 60529: Degree of protection provided by enclosures
- High-voltage switchgear and control gear – Part 102: Alternating current disconnectors and earthing switches

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

6.3.2 Design Requirements

The LBS shall be suitable for use on effectively earthed networks and under the system conditions and service conditions as follows:

S. N	Particular	Unit	Quantity
1	Rated Voltage	kV	33
2	Highest System Voltage	kV	36
3	Rated Normal Current	A	FLBS: 400
4	No. of Poles		3
5	Switch Type		Air Load Break Switch
6	Operating Condition		Vertical/Horizontal Break, Outdoor Type
7	Applicable Standard		IEC 62271-103
8	Temperature		-10 degrees C to +55 degrees C
9	1min power frequency withstand voltage	kV	28
10	Lightning Impulse withstand voltage	kV	75
11	Rated Frequency	Hz	50
12	Rated Short time withstand current	kA, s	25,1
13	Short Circuit Making Current	kA peak	62.5
14	Breaking/Interrupting Medium		Air (Solid State)
15	Isolating Medium		Air
16	Insulator Type		Polymer
17	Creepage Distance (Minimum)	mm	300
18	Operating Mechanism		Motorized and Manual
19	Mounting of Motor / Motor Operating Mechanism		On the Pole with the switch
20	Mounting Type		Pole Mounted

6.3.3 Construction

The R,Y,B three-phase of the load break switch shall be installed on one great sectional galvanized square steel base, joint together with one integrative drive axis inter- phase 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 FLBS 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 FLBS shall be suitable for mounting on channel on double pole (DP) Structure.

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.

The load break switch should be capable of being integrated with SCADA functions using an IED (Intelligent Electronic Device). The load break switch should be capable of reporting switch ON/OFF status and should be capable of being operated (OPEN/CLOSE).

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.

Depending on the design, each phase should have 2/3 insulators for fixed contacts and pads and 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 2.0 A sq mm.

The local control and indication shall be as given in Table below.

Item	Features	Remarks

Local control (See Note 1)	Local/Remote FLBS Open FLBS Close	2 position key switchable Secure control Secure control

Note 1: The two-position switch (labelled as below) shall allow the FLBS controller to be set in the following modes:

Remote: In this mode a local operator can trip the FLBS and change the mode. A remote operator can trip or close the FLBS.

Local: In this mode a local operator can trip and close the FLBS. A remote operator can only trip the FLBS.

6.3.4 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.

6.3.5 Solid Dielectric Insulation

The phase to phase shall be adequate for meeting the dielectric requirements. The creepage distance of insulators shall be minimum 900 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 pole to pole when the switch is open should take into consideration of the case when the chamber does not operate.

6.3.6 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 remote.

6.3.7 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 220VAC/110VDC 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 high end 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.

6.3.8 Tests

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

The contractor shall furnish complete data for applying and coordinating the Load Break Switches supplied.

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.

6.3.9 Quality Assurance Program

Along with the Bid the Bidder shall furnish quality assurance program of the manufacturer which includes the Quality System and the Quality Plans, which shall include, among others, information to meet the following requirement, failing which the Bid shall be liable for rejection.

i. The structure of the organization.

ii. The duties and responsibilities assigned to staff ensuring quality of works.

iii. The system for purchasing, taking delivery and verification of materials.

iv. The system for ensuring quality of workmanship.

v. The quality assurance arrangement shall conform to relevant requirements of 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.

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.

6.4 Specification of Power fuse

6.4.1 Scope

This specification covers the design, manufacture, assembly, shop test, supply, delivery, installation works and field test of power fuse. Manufacturer of fuse shall be holder of valid ISO 9001 certificate.

6.4.2 Design Requirements

Power fuse shall be in accordance with IEC standards. The fuse set shall be of drop out type and fuse shall be contained inside fiberglass suitable for outdoor use in a tropical climate. Complete fuse mountings and holders shall be furnished as specified in Technical Particulars enclosed. Refill units are to be furnished separately. All terminals shall be of high conductivity copper alloy and all terminals for aluminium shall be plated with hot-flowed electro-tin or cadmium.

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

Table 4: Technical Requirements of Power Fuse

Type	Single pole, single throw, drop out, hook stick operated, outdoor type
Quantity required	As per Price Schedule
Voltage ratings	
Nominal voltage class	33kV
Rated maximum voltage	36kV
Basic impulse level (BIL)	170kV
Power frequency withstand voltage	70kV
Mounting position	Vertical

6.4.3 Tests

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

a. Data

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

6.4.4 Quality Assurance Program

Along with the Bid the Bidder shall furnish quality assurance program of the manufacturer which includes the Quality System and the Quality Plans, which shall include, among others, information to meet the following requirement, failing which the Bid shall be liable for rejection.

x. The structure of the organization.

xi. The duties and responsibilities assigned to staff ensuring quality of works.

xii. The system for purchasing, taking delivery and verification of materials.

xiii. The system for ensuring quality of workmanship.

xiv. The quality assurance arrangement shall conform to relevant requirements of ISO9001.

xv. 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.

xvi. List of manufacturing facilities available.

xvii. List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections.

xviii. 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.

6.5 Specification of Instrument transformers

6.5.1 Scope

This specification covers the design, manufacture, assembly, shop test, supply, delivery, and installation work and field test of instrument transformers. The equipment specified in this

Section shall conform to the latest edition of the appropriate IEC specifications and/or other recognized international standards. In particular –

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

Manufacturer of instrument transformer shall hold valid ISO 9001(including design) quality certificate. Equipment governed by this specification are given below –

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

6.5.2 Current Transformer

- The Current Transformers shall be completed in all respects and shall conform to the modern practice of design and manufacture.
- The Current Transformers shall be of low Reactance outdoor type, Single Phase, 50 Hz, mounted in oil filled, self-cooled, shaded porcelain bushing , suitable for operation under the service conditions as specified in the general condition of site without protection from sun, rain & dust.
- The maximum permissible temperature rise of the Current Transformer winding with rated continuous primary current at rated frequency and burden over an ambient temperature should be as per IS : 2705 (Part-I) : 1992, considering ambient temperature 40 º Celsius for design purpose.
- The Current Transformers shall be suitable for up right mounting on steel structures and shall preferably be suitable for horizontal transportation. Necessary flanges, bolts, clamps fittings etc. for base of CT shall be arranged by the manufacturer . Fixing Hole center to center distance in 'X' & 'Y' direction shall be 330 mm. (± 5 mm by slotted holes).
- The CT shall be complete with all accessories like terminal connectors, weather proof terminal box for secondary connection, lifting lugs, grounding terminals, oil level gauge glass, filling and draining plugs and name plate.

- The CT shall be oil immersed type provided with Class-A insulation. The design and construction of CTs shall be sufficient to withstand the thermal and mechanical stresses resulting from the specified short circuit currents.
- The core of the CTs shall be high grade non-ageing, silicon laminated steel of low hysteresis loss and high permeability to ensure high accuracy confirming to IS :3024. The core material used for metering shall be stated in tender.
- The exciting current shall be as low as possible and the CTs shall be capable of maintaining its rated accuracy at different burdens and saturation limits.
- CT characteristics shall be such as to provide satisfactory performance for burdens ranging from at least 25% to 100% of rated burden in case of metering CT cores and knee point voltage in case of Protection Special CT core.
- Necessary markings for connections shall be marked on each CT and load terminations at the associated terminal block. Provision shall be provided for short circuiting and grounding of CT secondary at the terminal blocks.
- The CT secondary terminals shall be brought out in a weather proof secondary terminal box. The secondary terminal box shall be fixed in the P2 side of CT.
- The oil immersed type CT shall be hermetically sealed to eliminate breathing and to prevent ingression of air and moisture from the environment. Each CT shall be provided with oil level gauge, which can be read from the ground level and a pressure-releasing device to just release the abnormal internal pressure. If any inert gas is used particulars of gas above oil and means of separation of oil from gas to be indicated.
- Oil level indicator should be fixed in such a position so that oil level should confirm that the Primary studs inside the CT are emerged in oil.
- The CT secondary to be used for metering and instruments shall be of accuracy class and ISF as specified. The saturation factor of this core shall be low enough so as not cause any damage to measuring instruments in the event of maximum short circuit current.
- The CT secondary to be used for protective relaying purpose shall be of accuracy class as specified. The magnetization curve of the cores shall be furnished with tender.
- The ratio changing arrangement shall be provided on secondary side of the CT. Terminal marking for connections shall be marked on both primary and secondary terminals of each CT.
- The oil immersed type CTs must be Dead Tank type.
- Primary & Secondary windings shall be of copper. Size, No. of Turns etc. are to be mentioned in GA drawing in line with Short Circuit Test Report.
- C.T. Stud sizes shall be as follows :

a) Primary Terminal : Primary Stud of the CT will be of plain solid round (threading is not required) with Tin Plated Electrolytic Copper having minimum Diameter of 30 mm (negative tolerance is not allowed) and minimum outside length of 80 mm.

b) Secondary Terminal : M8 type with 70 mm long Nickel-Plated Brass with suitable size along with suitable nuts & washers.

- Porcelain bushing conforming to latest edition of IEC shall be used for the CT.
- Cast metal end caps for the bushing shall be of high strength & made of brass. They shall have smooth surface to prevent discharge taking place between the metal parts and porcelain as a result of ionization.
- The insulation of bushings shall be coordinated with that of the Current Transformer such that the flashover, if any will occur only external to the CT.
- Primary terminals shall be complete with suitable rigid type terminal connector suitable for PT Stud to ACSR conductor.
- Each of the porcelain bushing/hollow insulator shall have Creepage distance for specified voltage class.
- The insulating oil to be used for CT shall comply in all respect with the provisions of the latest edition relevant IEC.

a. Junction boxes

Junction boxes shall be rigid weatherproof type complete with terminal blocks suitable for cable size having the range up to 2x6 sq. mm for termination of the secondary connections (such as delta or wye connection). They shall be made of metal, which will resist corrosion on both inside and outside surfaces; otherwise, they shall be suitably protected by galvanizing. Cover of the junction box shall be of hinge door type complete with door handle. Two drainage holes shall be provided at the bottom of the junction box. In case the junction boxes are steel sheet, the thickness of such steel sheet shall be at least 1.2mm. Junction boxes shall be sized and arranged to provide easy access for external cables and adequate space for internal wiring and installed equipment. Enclosure protection class of the junction boxes shall be IP55W the terminal blocks used should be provided with shorting links on the top of the unit with the primary coil leads extending through insulated bushing for series or multiple connections. A steel base shall support the high voltage bushing and tank. The bushings shall be sealed to the tank and the base with oil tight joints.

b. Termination for Current transformers

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

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

Table 5: Technical Requirements for Current Transformer

1.	Type	Outdoor, oil immersed for protection and metering
2.	Quantity required	As per Price Schedule
3.	Rated primary voltage	33kV
4.	Max. system voltage	36kV
5.	Impulse withstand voltage	170kV
6.	Rated frequency	50Hz
7.	Number of cores	2
8.	Current Ratio *	400-200/1-1
9.	Rated Burden*	15 VA
10.	Accuracy	5P/20 for protection and 0.2 for metering
11.	Power Factor	0.85
12.	Over voltage factor	1.1 Continuous
		1.5 For 30 sec
13.	No of secondary windings	as required
14.	Over load factor	200%
15.	Short time thermal rating	25 kA

*** CT ratio and Burden will be decided during drawing approval.**

6.5.3 Voltage Transformer

- The Potential Transformers shall be complete in all respects and shall conform to the modern practice of design and manufacture.
- The Potential Transformers shall be electromagnetic, outdoor type, single phase, oil filled, self-cooled, having shaded porcelain bushing as per IS: 2099, suitable for operation under the service conditions without protection from sun, rain and dust.
- The maximum temperature rise at 1.1 times rated primary voltages, rated frequency and rated burden, will be within the limits of relevant IS/IEC, considering ambient temperature 40 º Celsius for design purpose.
- The Potential Transformer shall be capable to withstand line discharge effect and also the ferro resonance effect.

- The Potential Transformers shall be suitable for up right mounting on steel structures. Necessary flanges, bolts, clamps fittings etc. for base of P.T. are within the scope of the supplier.
- The P.T. shall be complete with all accessories like Primary Terminals, Terminal Connectors, suitable for ACSR 'DOG' weather proof Terminal Box for secondary connection, lifting lugs, grounding terminals, oil sight glass, pressure relief device, filling and draining plugs and name plate.
- The P.T. shall be oil immersed type provided with class A insulation. It shall be of hermetically sealed type construction to prevent air & moisture from entering the tank.
- The core of the PTs shall be high grade non-aging, silicon laminated steel of low hysteresis loss and high permeability to ensure high accuracy at both normal and over voltages conforming to IS:3024.
- PT Characteristics shall be such as to provide satisfactory performance for burdens ranging from at least 25% to 100% of rated burden over a range of at least 5% to 100% & 190% rated voltage in case of protective cores and a voltage range of 80% to 120% (0.8 pf lagging) in case of measuring cores.
- The P.T. secondary terminals shall be brought out through fuse of suitable rating in a weather proof terminal box for easy access. The primary neutral to be earthed through a detachable link separately in the secondary terminal box having a partition from the secondary terminals.
- PT Stud sizes shall be as follows :

  a) Primary Terminal : Primary Stud of the PT will be of plain solid round (threading is not required) with Tin Plated Electrolytic Copper having minimum Diameter of 16 mm (negative tolerance is not allowed) and minimum outside length of 80 mm.

  b) Secondary Terminal : M8 type with 70 mm long Nickel-Plated Brass with suitable size along with suitable nuts & washers.

- Porcelain bushing conforming to latest edition of IEC shall be used for the PT.
- Cast metal end caps for the bushing shall be of high strength & made of brass. They shall have smooth surface to prevent discharge taking place between the metal parts and porcelain as a result of ionization.
- The insulation of bushings shall be coordinated with that of the Current Transformer such that the flashover, if any will occur only external to the PT.
- Primary terminals shall be complete with suitable rigid type terminal connector suitable for PT Stud to ACSR conductor.

- Each of the porcelain bushing/hollow insulator shall have Creepage distance for specified voltage class.
- The insulating oil to be used for PT shall comply in all respect with the provisions of the latest edition relevant IEC.

a. Termination for Potential transformer

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

b. Junction boxes

Junction boxes shall be rigid weatherproof type complete with terminal blocks suitable for cable size having the range up to 2x6 sq. mm for termination of the secondary connections (such as delta or wye connection). They shall be made of metal, which will resist corrosion on both inside and outside surfaces; otherwise, they shall be suitably protected by galvanizing. Cover of the junction box shall be of hinge door type complete with door handle. Two drainage holes shall be provided at the bottom of the junction box. In case the junction boxes are steel sheet, the thickness of such steel sheet shall be at least 1.2mm. Junction boxes shall be sized and arranged to provide easy access for external cables and adequate space for internal wiring and installed equipment. Enclosure protection class of the junction boxes shall be IP55W the terminal blocks used should be provided with shorting links on the top of the unit with the primary coil leads extending through insulated bushing for series or multiple connections. A steel base shall support the high voltage bushing and tank. The bushings shall be sealed to the tank and the base with oil tight joints.

c. Protective devices

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

6.5.4 Accessories

The following items shall be provided for each instrument transformer –

- Nameplate
- Oil level gauge
- Oil valves or plugs
- Power factor test terminals
- Necessary terminal connections

- Grounding terminals
- Other necessary accessories

Table 6: Technical Requirements for Potential Transformer

1. Type	Outdoor, oil immersed
2. Quantity required	As per Price Schedule
3. Rated primary voltage	33/ √3 kV
4. Max. system voltage	36kV
5. Impulse withstand voltage	170kV
6. Rated frequency	50Hz
7. Connection	Line to ground
8. Number of secondary winding	2
9. Voltage ratio	33,000/ √3/110/√3V
10. Rated burden for each winding	100 VA
11. Accuracy	3P and 0.2 for metering
12. Power factor	0.85
13. Rated voltage factor	1.1 continuous, 1.5 for 30 sec

6.5.5 Tests

a. Routine tests for current transformers

Each current transformer shall be subjected to the following tests –

- Applied potential test
- Induced potential test
- Accuracy tests (including excitation curve for relaying class)
- Polarity check
- Winding resistance measurement for each ratio

b. Design tests for current transformers

Type test records of an identical unit of current transformer shall be submitted to NEA / NEA's representative. In case type test records are not available, the actual tests shall be performed. The items of test shall be as follows –

- Short time current test
- Temperature rise test
- Power frequency withstand voltage (wet) test
- Impulse voltage withstand test
- Temperature rise test

c. Routine tests for potential transformers

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

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

d. Design tests for current transformers

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

- Voltage test between phase and ground terminals
- Power frequency withstand (wet) test
- Impulse test
- Radio-influence voltage test
- Short time over voltage test
- Thermal burden test

e. Field tests

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

- Constructions inspection
- Polarity check
- Ratio test

- Measurement of insulation resistance

6.5.6 Quality Assurance Program

Along with the Bid the Bidder shall furnish quality assurance program of the manufacturer which includes the Quality System and the Quality Plans, which shall include, among others, information to meet the following requirement, failing which the Bid shall be liable for rejection.

i. The structure of the organization.

ii. The duties and responsibilities assigned to staff ensuring quality of works.

iii. The system for purchasing, taking delivery and verification of materials.

iv. The system for ensuring quality of workmanship.

v. The quality assurance arrangement shall conform to relevant requirements of ISO9001.

vi. Statement giving list of important raw materials, names of manufacturer for the raw materials, list of standards according to which the raw materials are tested, list of 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.

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.

6.6 Specification of Lightning arrester

6.6.1 Scope

This specification covers the design, manufacture, factory test, delivery, field test and installation of 33 kV lightning arresters, complete with all accessories. The equipment specified in this Section shall conform to the latest edition of the appropriate IEC specifications and/or other recognized international standards. In particular –

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

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

6.6.2 Design Requirements

The lightning arresters shall be station type, single pole, gap less type rated voltage 30 kV for 33 kV system. The nominal discharge current shall not be less than 10 kA. The active part of the lightning arresters shall be accommodated in porcelain insulators which are suitably reinforced to prevent explosion of an arrester. Pressure relief device shall be provided for the safe discharge of internal pressure. The lightning arresters shall be mounted on galvanized steel structure. Terminal connectors for both line and ground terminals shall be furnished. Surge monitoring device consisting of surge counter, etc., along with insulating bases for mounting at the bottom of the arrester, shall be furnished.

Table 7: Technical Requirements of Lightning Arrester

Type	Outdoor, station type
Quantity required	As per Price Schedule
Mounting	Pedestal
Rated frequency	50Hz
System voltage	33kV
Rated voltage	30kV
Impulse withstand voltage (BIL)	170kV
Power frequency withstand voltage	70kV
Nominal discharge current	10kA
Surge Counter	shall be the ISO 9001 holding company

6.6.3 Tests

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

- Construction test
- Insulation resistance test and leak current test

Type test certificates on similar equipment and routine test certificate carried out for following tests shall be furnished for approval of the NEA / NEA's representative

- Voltage withstand test
- Impulse voltage characteristic test
- Discharge voltage characteristic test
- Discharge current withstand test
- Duty cycle test
- Pressure relief test

- Contamination test

6.6.4 Nameplate

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

- Manufacturer's name
- Manufacturer's serial number and type designation
- Year of manufacture
- Rated voltage
- Nominal discharge current

6.6.5 Quality Assurance Program

Along with the Bid the Bidder shall furnish quality assurance program of the manufacturer which includes the Quality System and the Quality Plans, which shall include, among others, information to meet the following requirement, failing which the Bid shall be liable for rejection.

i. The structure of the organization.

ii. The duties and responsibilities assigned to staff ensuring quality of works.

iii. The system for purchasing, taking delivery and verification of materials.

iv. The system for ensuring quality of workmanship.

v. The quality assurance arrangement shall conform to relevant requirements of ISO9001.

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.

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.

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.

6.7 Specification of Control and relay panel

6.7.1 Scope

This specification covers study, design, manufacture, assembly factory, test, supply, delivery, installation works, and field test and commissioning of control and relay panels. Transformer protection equipment / relays as required shall have to be supplied and installed accordingly. The panel shall be used for the protection of the following:

a. Transformer

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

b. 33 kV outgoing and incoming line.

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

c. 11 kV outgoing lines.

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

6.7.2 Manufacturers for protection equipment

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

- Alstom / Areva
- Fuji
- CG Electric
- Reyrolle / Easun Reyrolle
- ABB
- Siemens
- Toshiba
- Mitsubishi
- GE

6.7.3 Construction features

The panel dimensions specified are tentative only, therefore it should be ensured that all the equipment required can be properly accommodated in the respective space. The panels shall also be of a size & type which can be easily accommodated within the space of existing panels & existing control room without the necessity for expansion of the control room. The 33 kV

panel shall be of Simplex type or Duplex type as per the layout of the respective Substation. All new substations shall have simplex type panels.

In case, the Panels are Duplex type, it shall comprise two vertical front and rear panel sections connected back-to-back by formed sheet steel roof tie members and a central corridor in between. The corridor shall facilitate access to internal wiring and external cable connections. Both ends of the corridor shall be provided with double leaf doors with lift off hinges. Doors shall have handles with built-in locking facility. Separate cable entries shall be provided for the front and rear panels. However, interconnection between panels shall be by means of inter panel wiring at the top of the panels.

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

Panels shall be completely metal enclosed and shall be dust, moisture and vermin proof. Panel enclosures shall provide a degree of protection not less than IP 54 as per IEC. It shall be free standing, floor mounting type and shall comprise rigid welded structural frames enclosed completely with specially selected smooth finished, cold rolled sheet steel of thickness not less than 3 mm for front and rear portions and 2mm for sides, top and bottom portions. There shall be sufficient reinforcement to provide level surfaces, resistance to vibration and rigidity during transportation and installation. All doors, removable covers and panels shall be gasketed all around with gaskets. Ventilation louvers, if provided, shall have screens and filters. The screens shall be made of either brass or GI wire mesh. Design, materials selection and workmanship shall be such as to result in neat appearance inside and outside with no welds, rivets or bolt heads apparent from outside, with all exterior surfaces true and smooth. Panels shall be suitable for floor mounting. Metal sills in the form of galvanized steel channels properly drilled shall be furnished along with anchor bolts and necessary hardware for mounting to a concrete floor. Any irregularity between the sills and flooring shall be sealed to prevent entry of dust, moisture and vermin. Panels shall have additional rolled channel plinth at the bottom with smooth bearing surface. The panels shall be fixed on the sills with intervening materials. The type of anti-vibration strips which shall be supplied by the Contractor shall be subject to the approval of NEA.

Cable entries to the panels shall be from the bottom unless otherwise specified. The bottom plates of the panels shall be fitted with removable plates of adequate size for holding the cables using cable connectors to seal from dust and moisture. All cable connectors required shall be provided by the Contractor and shall be screwed type and shall be suitable for PVC armored cables. Control and relay panel enclosure protection class shall be of IP 54. When in closed position there shall not be any chances of entering lizards, mousse etc. inside the panel.

a. Component Mounting

All equipment on front of panel shall be mounted flush or semi-flush. In case of semi-flush mounting, only flange or bezel shall be visible from the front. Equipment shall be mounted such that removal and replacement can be accomplished individually without interruption of service to adjacent equipment. Equipment mounted inside the panel shall be so located that terminals and adjacent devices are readily accessible without the use of special tools. Terminal markings shall be clearly visible. Cut-outs and wiring for free issue items, if any, shall be according to corresponding equipment manufacturer's drawings. Cut-outs, if any, provided for future mounting of equipment shall include cover plates. The centerline of switches, push buttons and indicating lamps shall be not less than 750 mm from the bottom of the panel. The centerline of relays with targets and/or requiring adjustment, motors, test switches, and recorders shall be not less than 450 mm from the bottom of the panel. No components shall extend below 200 mm. It will be preferable if existing panel layout is used to give uniform appearances. The centerline of switches, push buttons and indicating lamps shall be matched to give a neat and uniform appearance. Likewise, the top lines of all meters, relays and recorders, etc. shall be matched.

In the existing substation, panels shall be as far as possible matched with the existing panels in the control room in respect of Dimensions, Color, Appearance, Size and Arrangement of equipment on the front. The standard phase arrangement when facing the front of the switchboard shall be R-S-T from left to right, from top to bottom, and front to back. All relays, instruments, other devices, buses and equipment involving three phase circuit shall be arranged and connected in accordance with the standard phase arrangement.

b. Mimic diagrams

Mimic diagrams shall be provided on panels as required. Mimic diagrams shall be screwed on to panels and shall be made of anodized aluminium or plastic of approved fast color material which can be easily cleaned. The width of the mimic bus shall be subject to approval of NEA. The colors for the various voltages in the mimic diagram shall be as per the existing colors. When semaphore indicators are used for disconnecting switch positions, they shall be so mounted in the mimic that the disconnecting switch's 'close' position shall complete the continuity of the mimic. Similarly, when control switches of stay-put type are mounted in the mimic, the 'close' position of the switch shall complete the mimic.

c. Annunciators

Annunciators of the visual and audible type shall be provided on the panels when called for in the equipment lists, if enclosed. Annunciators shall be suitable for operation for the voltages specified. Annunciators shall be of facia type with 35mm x 50mm (minimum) translucent plastic

window for each alarm point. Annunciator facia plates shall be engraved in block letter with respective alarm inscriptions, which will be furnished by NEA. Alarm inscriptions shall be engraved on each window in not more than three lines and size of the lettering shall be not less than 3 mm. The inscriptions shall be visible only when the respective light is lighted. If any other type of Annunciators is to be used, prior approval from the Owner should be taken before manufacturing. The annunciators shall be suitable for operation with normally open fault contacts which close on a fault. When specified in bill of materials, some of the annunciator points shall be suitable for operation with normally closed faults contacts which open on a fault. It shall be possible at site to change annunciators from "open to fault" to "close to fault" and vice versa. Annunciators shall be suitable for accepting fleeting faults of duration not less than 15 milliseconds. Annunciators shall be compact self- contained units with associated relays mounted behind the facia units. In case the associated relays cannot be housed behind the annunciator facia units, these shall be mounted and wired in a separate panel which shall be included in the offer. However, the latter arrangement is not preferred due to additional space requirement and wiring interconnections. Alarm relays and facia units shall be interchangeable. Annunciator facia units shall be suitable for flush / semi-flush mounting on panels. Replacement of individual facia inscription plates and lamps / LED / LCD shall be possible from front of the panels. One alarm buzzer common to annunciators on all the panels shall be provided. Similarly, "Sound Cancel", "Acknowledge", "Reset" and "Lamp Test" push buttons common to annunciators on all the panels shall be provided. These common devices shall be located in a particular panel as determined by NEA. In case of static annunciator schemes, special precaution shall be taken by the Contractor to ensure that spurious alarm conditions do not appear due to false influence of external magnetic fields on the annunciator wiring and switching disturbances from the neighboring circuits. Each annunciation window shall be provided with two lamps to provide safety against lamp failure. Lamps shall operate in parallel such that failure of one will not affect operation of the other.

Sequence of Operation of the Annunciator shall be as follows

Alarm condition	**Fault contact**	**Audible alarm**	**Visual alarm**
Normal	Open	Off	Off
Abnormal	Close	On	Flashing
Sound cancel	Close or Open	Off	Flashing
Acknowledge	Close or Open	Off	Steady on
Back to Normal	Open	Off	Steady on

Alarm condition	Fault contact	Audible alarm	Visual alarm
Reset	Open	Off	Off
Lamp test	Open	Off	Steady on

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

Any new annunciation appearing after the operation of "Sound Cancel" for previous annunciation, shall provide a fresh "Audible Alarm" with accompanied "Visual Alarm" even if the process of "Acknowledging" or "Resetting" of previous alarm is going on or yet to be carried out. Provision of testing facilities for flasher and audible alarm circuits of annunciators shall be provided.

6.7.4 Relay Protection

a. Overcurrent and Earth-fault protection

Non-Directional Phase Overcurrent Protection shall be single pole & have an inverse characteristic with a definite minimum time of 3 sec at 10 times setting. It shall have a variable setting range of 5 – 200 % of rated current.

Non-Directional Earth Fault protection shall be single pole type and shall have an inverse characteristic with a definite minimum time of 3 sec at 10 times setting. It shall have an adjustable setting of 5-80% of rated current.

Directional Overcurrent Protection (not applicable)

Phase over current relay shall be single pole X 3 type and have an inverse characteristic with a definite minimum time of 3 secs at 10 times setting. It shall have a variable setting range of 5 – 200 % of rated current. It shall have a characteristic angle of 45 degree and a directional controlled low transient over-reach high set instantaneous unit of continuously variable setting range 200 – 1200 % times of rated current. It shall be of voltage polarized directional controlled type.

Directional Earth fault overcurrent protection (not applicable) - Earth fault overcurrent relay shall be single pole type and shall be of zero-sequence voltage polarized directional controlled. It shall have an inverse characteristic with a definite minimum time of 3 secs at 10 times setting. It shall have an adjustable setting range of 5 – 80 % of rated current. have a directional controlled low transient overreach high set with a continuously variable setting range of 5-20 times of rated current. have a characteristics angle of 45 degree.

Local Breaker Back Up Protection

Relay shall –

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

b. Differential Relay

The differential relay shall be used for protection of transformer greater than 3MVA. It shall be of 3 phases with 6 through current restraint inputs. The relay shall have built in trip relay, indicator & test switch. It shall have complete phase and earth fault protection. The harmonic restrained operation time of the relay shall be approximately 30 ms at 3 times of pickup current. Similarly, unrestrained operation time shall be 10 - 20 ms at twice pickup current with minimum impulse time of 3 minutes. The relay shall have variable percentage restraint for external fault, even at use of OLTC. The relay shall have second harmonic restraint from all the three phases for inrush security & fifth harmonic restraint for all three phases for over excitation security. The sensitivity shall be settable to 10 – 50 % of rated current of 1 Amp. Un-restrained operation settable to 20 times of rated current. The relay shall be provided with separate interposing CT for ratio and phase angle matching and equalizing of zero sequence current, or by other programming method.

Manufacturer of Protection Relay shall be as specified.

c. Other Requirements

Layout of panel in the control room, individual panel layout incorporating the hardware and control wiring diagrams and schematics shall be prepared by the contractor and be sent to the employer for approval. All auxiliary relays, if and when required for the completeness of the various protection schemes covered in this order, shall be deemed to be included in the scope of supply whether or not such items are specifically mentioned in the enclosed bill of material.

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

Connections from CT and PT to panel mounted energy meter (to be provided by contractor) shall be clearly marked. Panels shall be mounted to concrete foundation on galvanized steel channels with an intervening layer of anti-vibration strips made of shock absorbing materials which shall be supplied by the contractor. Cable entries for all the panels shall be from bottom. The bottom plates of the panels shall be fitted with removable plates of adequate size for holding cables and sealing from dust and moisture. A ground bus of bare copper strip of minimum size 25 x 6 mm along the length of each panel shall be provided and shall be connected to the ground mat of the station.

6.7.5 Space Heater

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

6.7.6 Plug Point

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

6.7.7 Tests

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

- Mechanical operation test
- Verification of degree of protection
- Calibration test for meters
- Characteristic test for relays
- High voltage test of insulation (2000 volts for 1 minute)
- Electrical control, interlock and sequential operation tests

Type tests and routine tests shall be carried out on all associated equipment as per relevant standards approved by the Employer. Certified copies of all type and routine test certificates shall be submitted for the Employer's approval before dispatching the control and relay panel. After completion of the installation, panels shall be subjected but not limited to the following field tests –

- Electrical control, interlock and sequential operation tests
- Calibration test for meters
- Measurement of insulation resistance
- Characteristic test for relayss

6.7.8 Transformer Protection

33 / 11 kV, 6 / 8 & 12/16 MVA transformer shall be protected by the following relays

- Over current relay
- Earth fault relay
- Differential relay
- Definite over current relay (if applicable)
- Mechanical Thermal Protection Relay
- Restricted Ground Earth Fault Relay

33 / 11 kV, 1 & 3 MVA transformer shall be protected by the following relays

- Over current relay
- Earth fault relay

6.7.9 Quality Assurance Program

Along with the Bid the Bidder shall furnish quality assurance program of the manufacturer which includes the Quality System and the Quality Plans, which shall include, among others, information to meet the following requirement, failing which the Bid shall be liable for rejection.

i. The structure of the organization.

ii. The duties and responsibilities assigned to staff ensuring quality of works.

iii. The system for purchasing, taking delivery and verification of materials.

iv. The system for ensuring quality of workmanship.

v. The quality assurance arrangement shall conform to relevant requirements of 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.

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.

6.8 Specification of Miscellaneous Materials

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

6.8.1 Technical Requirements

a. Insulators

(a) General

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

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

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

Damaged insulators shall be replaced.

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

(b) Materials

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

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

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

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

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

(c) Number of discs

String insulators shall comprise of 3 nos. of 11kV disc insulator.

(d) Marking

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

(e) Post insulator

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

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

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

(f) Standard particulars of insulator units

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

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

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

b. Bus Conductor and fittings

(a) General

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

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

	Bus	Material	Min.Size
-	33kV Main	ACSR	Dog
-	33kV Branch	ACSR	Dog

In case of existing substation conductors and connectors to be used for extension shall be as nearly as possible identical with the existing equipment.

Materials used for bus bars and connections shall be stressed to not more than two-fifths of their elastic limit. Provision shall be made for expansion and contraction with variation in conductor temperature and bus bars shall be arranged so that they may be readily extended in length with a minimum of disturbance to existing equipment.

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

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

(b) Strain bus and fittings

The conductor shall be aluminum conductor steel reinforce (ACSR)

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

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

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

The surface of the conductor shall be free from points, sharp edges, abrasions or other departures from smoothness or uniformity that would tend to increase radio interference and

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

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

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

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

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

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

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

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

(c) Tubular bus and fittings

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

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

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

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

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

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

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

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

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

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

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

(d) Overhead ground wire

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

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

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

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

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

Joints or splices may be made in the individual wires prior to drawings to final size or in the finished wire composing the strand. Such joints shall have protection to

corrosion equivalent to that of the finished wire itself and shall not decrease the strength of the finished strand below the specified minimum breaking strength. Joints in the individual wires in the finished strand shall be separated by at least 15.2 meters.

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

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

6.8.2 Tests

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

a. Type tests

a. Low frequency wet withstand test

b. Critical-impulse flashover test

c. Impulse withstand test

d. Radio-influence voltage test

e. Compression strength test

f. Thermal shock test

b. Quality conformance tests

a. Visual and dimensional test

b. Porosity test

c. Galvanizing test

d. Cantilever strength test

e. Torsional strength test

f. Tensile strength test

c. Routine tests

a. Flashover test

b. Tension proof test

Bus materials

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

(a) Aluminum tube

a. General inspection

b. Chemical composition of aluminum alloy

c. Conductivity measurement of aluminum tube

d. Dimension and weight measurement

e. Certified report of aluminum alloy from the original manufacturer

(b) Bus support clamp and connector

a. General inspection

b. Dimension measurement

c. Chemical composition of aluminum alloy

d. Certified report of aluminum alloy from the original manufacturer

(c) Connectors for stranded conductor

a. General inspection

b. Measurement of dimension

c. Compression test

d. Certified report of aluminum alloy from the original manufacturer

(d) Miscellaneous hardware

a. General inspection

b. Measurement of dimension

c. Tension test

d. Galvanizing test

6.8.3 Packing and Marking

Insulator

(a) Packaging

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

(b) Marking

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

Bus materials

(a) Packing

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

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

(b) Marking

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

6.8.4 Guarantee

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

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

6.8.5 Ceiling mounted Air-Conditioners

General

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

Equipment to be furnished

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

Scope of Works

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

A. Civil works like breaking of wall and repairing wherever necessary.

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

Design Requirements

a) Type - Cassette (Cooling/heating)

b) Minimum Cooling/heating Capacity for

1 Ton	12000 Btu/hr
1.5 Ton	**18000 Btu/hr**

2 Ton	24000 Btu/hr

c) Indoor noise level

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

d) Compressor

a. Super silent, Power saving

b. Hermetically sealed

c. Rotary/reciprocating

e) Rated Voltage/Frequency

a. 230 V, 50 HZ, Single Phase

f) Fan Speed

a. Three Speed with air deflection System

b. Operation mode with remote control

c. Heat/Cool/ Dry/Fan

g) Air Swing

a. To be Present, Automatic

i) Air filter

a. Anti –fungal/cleanable

j) Refrigerant

- R410A (Non-CFC)

Manufacturers

The AC shall be from the following manufacturers

Mitsubishi

Diakin

Samsung

Or equivalent makes / brand

Quality Certification:

ISO 9001 certified and CE certification.

6.8.6 Quality Assurance Program

Along with the Bid the Bidder shall furnish quality assurance program of the manufacturer which includes the Quality System and the Quality Plans, which shall include, among others, information to meet the following requirement, failing which the Bid shall be liable for rejection.

i. The structure of the organization.

ii. The duties and responsibilities assigned to staff ensuring quality of works.

iii. The system for purchasing, taking delivery and verification of materials.

iv. The system for ensuring quality of workmanship.

v. The quality assurance arrangement shall conform to relevant requirements of ISO9001.

vi. Statement giving list of important raw materials, names of manufacturer for the raw materials, list of standards according to which the raw materials are tested, list of 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.

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.

Volume II

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7 SPECIFICATION OF 12KV SWITCHGEAR

7.1 Scope

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

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

- Breaker compartment
- Bus bar compartment
- Cable, C.T. and P.T. compartment
- Instrument and relay compartment (LV compartment)

All Switchgear operation shall be performed behind a close door. Additionally, it shall even be possible to perform all preparations for work inside the cubicle with full degree of protection. The use of insulation material shall be reduced to minimum, only ripped insulators with high-anti-tracking characteristics shall be used for necessary conductor supports. Cubicle front shall be covered by a door with inspection windows for mechanical indication for CB ON / OFF position, spring charged and counter indication of CB operation. The cubicle shall be of modular design consisting of separate modules for busbar, circuit breaker, cable and low voltage compartment, and instrument component. Each compartment shall have its own pressure relief flap. The fixed contact shall be mounted in bushing moved by circuit breaker carriage. Earthing to cable feeder and busbar shall be done via earthing switch manually operated from panel front. Fixed contacts shall have flat silver plating and contact pressure of male and female contacts during connected position according to the International Standard. Busbars and Jumpers shall have made of flat electrolytic bare copper contact with special heat shrinkable sleeves which provide effective insulation between phases or phase to earth, even if bridged by vermin or other conducting body and suitable for rated current not less than 2000 A. Bus bar shall be latched per panel and easy to replace by standard normal material. Flexible insulation

shrouds shall cover the bus bar to Jumper Joints and jumper to stationary contact joints. Bottom of the cubicle shall be covered with a bottom mica plate through which cables are passed into the panel through the appropriate cable glands. The proposed switchgear panel shall be extendible. The proposed switchgear panel shall be suitable for mounting of standard Current and Voltage Transformer according to IEC standard. Attention shall be given during design and fabrication for preventing rodents to enter into the chamber. Panel shall be of enclosure protection of class IP 54.

7.2 Withdrawable part (Carriage)

The chassis shall be made of sheet-steel section and shall carry the switching device, moving mechanism, 4 rolling contact bearings for movement and interlocking mechanism. Movement for carriage shall be done manually and shall be independent from switch room floor. Moving contacts shall be double flat contact with silver plated contact pieces. The flexible fixing shall allow high tolerance and avoiding overheating. Connection of auxiliary supply to the fixed part shall be verified via multi-pole plug which shall be included in the interlocking system. For the easy and assured insert of the plug the hose should come from the fixed part and the plug shall be on the withdrawable part. CB and isolating switch carriage shall have the provision to operate mechanically behind the closed door in operating and test position. Carriage of the same rating shall be exchangeable. It shall be possible to insert CB with higher current in lower rated cubicle but not vice versa.

7.3 11 kV Metal-clad switchgear

Insulation

12 kV primary equipment shall be insulated as per IEC Standards and to meet or exceed the following criteria –

- Rated Lightning Impulse Withstand Voltage: 75 KVp
- Rated Power Frequency Withstand Voltage: 28 kVrms

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

Clearances

12 kV primary equipment clearances between phases and phase to earth shall not be less than as in BS 162 or in this specification, whichever is greater. The layout of the equipment shall provide for safe access for operation and maintenance whilst the remaining sections equipment are alive. Minimum clearances in air for the 12 kV 'Indoor' primary equipment shall not be less than –

- Phase to Phase: 127 mm

- Phase to Earth: 76.2 mm

The busbars shall be insulated by high grade phase insulation. Busbars partitioning shall be done by means of a bushing plate with Cast-Resin Insulators and cubicles shall be partitioned with earthed sheet metal barriers.

Current carrying capacity

12 kV busbars and connections thereto shall be designed to carry current corresponding to maximum permissible overload of the connected equipment without exceeding temperature rise specified in the relevant standards. Busbars shall be designed to safely withstand with an appropriate margin of the mechanical and thermal effects corresponding to at least the following short circuit currents –

- Symmetrical three-phase: 25 kA rms
- Peak making current: 63 kAp

7.4 Circuit Breakers

12 kV Circuit Breakers shall be Vacuum type arc quenching system, easily withdrawable and housed in a cubicle. It shall consist of three vacuum interrupters, three supports and the operating mechanism. The operating mechanism shall have motor-charged spring-operated system with provision of hand operated mechanism. With the breaker in close state, spring energy shall be for a "Trip / Close / Trip" Cycle.

Technical Requirements

The Circuit Breakers shall meet requirements of IEC 62271-100.

Vacuum Interrupter:

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

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

The operating mechanism shall have two trip coils and shall be electrically trip–free and anti-pumping.

The spring charging motor, the closing coil, the tripping coils and all other control devices of all circuit breakers shall be suitable for 110V DC operation.

A manually operated mechanism for closing and tripping shall be provided in the breaker cubicle for maintenance and emergency operation. This device shall be so interlocked that while it is operative, the breaker cannot be operated remotely.

Each circuit breaker shall be equipped with an operation counter (to register tripping operations) and position indicator, on the cubicle front.

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

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

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

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

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

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

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

The Circuit Breakers shall be tested in accordance with IEC 62271-100 and shall include the following routine tests

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

The quality assurance of the equipment and their auxiliary shall be based on ISO 9001 standard. The minimum operating cycle (without maintenance) of interrupters and operating mechanisms shall be suitable for operation over 10 years or 10,000 operations with rated current or 100 operations with rated short circuit current and overall life shall be more than 30,000 operating cycles.

The Vacuum Circuit Breaker installed in the Switchgear shall move into following position in the circuit breaker components

- Running Position (Run) - Main circuit and control circuit connected to all circuits
- Test Position (Test) - Main circuit separated from the circuit and only control circuits are connected
- Disconnected Position - As a control circuit connector that would be plugged by hand during the test position both main and control circuit are disconnected from the circuit

Table 1: Technical Requirements of Circuit Breaker

Type	Metal enclosed; Indoor switch type Metal enclosed Indoor switchgear cubicle type with vacuum interrupters.
Nominal Service Voltage (kV)	11
Rated Voltage (kV)	12
Rated Frequency (Hz)	50
Rated Nominal Current (A)	
Breaker for Bus Coupling	1200A /2000A
Feeder Breaker	630A/ 800A

Incomer for Main Power Transformer	1250A
Rated Short-Time Breaking Current (asymmetrical) at Rated Voltage,	25 kA
Rated Short-Time Making Current at Rated Voltage	62.5 (KA)p
Rated Operating Mechanism	Motor-spring operated. Provision for Manual Operation.
Bus Bar Rating	2000 A

7.5 Earthing Switches

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

The 11 kV metal clad switchgear shall include earthing switches to facilitate earthing of each cubicle.

Technical Requirements

- The Earthing Switches shall meet the requirements of IEC 62271-102.
- Auxiliary switches shall be provided as specified for the circuit breakers
- Provision shall be made for padlocking in the open and closed position
- Manual control of the switches and position indicator external to the cubicle shall be provided
- The earthing switch shall be interlocked manually with transformer circuit breakers

Interlocking

The following operation shall be taken place only when the under stated interlocking conditions are fulfilled to ensure personal and operational safety. Transferring the withdrawable part from the disconnecting position to the service position –

- Control circuit plug inserted
- High voltage compartment door closed
- Circuit breaker in OPEN position
- Earthing switch in OPEN position

Transferring the withdrawable part from the service position to the disconnected position

- Circuit breaker in OPEN position

Operating the circuit breaker

- Withdrawable part in the interlocked final position (service or disconnecting position)

Operating the earth switch

Withdrawable part in the interlocked disconnected position windows shall be provided to allow visual inspection. The switches shall be tested in accordance with IEC 62271-102 and IEC 62271-103 and shall include the following routine tests

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

Safety Device

Individual explosion vents should be provided for breaker / busbar / cable chambers on the top of the panel to let out the gases under pressure generated during an unlikely event of fault. Cubical with the front plate is pressure tested for the internal arc fault as per relevant standard. Circuit breaker and the sheet metal enclosures are fully earthed.

Table 2: Technical Requirements

Rated Voltage kV	12
Rated Current A	2000, 1250 & 800
Short Circuit Current withstand capability (as specified above)	
Bus Bar Rating A	2000

7.6 Low Voltage Compartment

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

Wiring inside the cubicle shall be done by at least 4 sq mm insulated stranded copper wires for current circuits and 2.5 sq mm for voltage circuits.

The following equipment shall be mounted in the low voltage compartment

- 1 No Ammeter, Digital Type of class C designation, with selector switch (for incoming and out-going circuit breaker)
- 1 No Voltmeter, Digital type, with Voltage Selector switch (for incoming circuit breaker only)
- 1 No kVA meter, Digital type of class designation (for incoming circuit breaker only)
- 1 No Energy meter 3 Phase 4 wire, 3 Element, as specified (for incoming and out-going circuit breakers)
- 1 No Power Factor Meter Digital type 3 Phase, 4Wire, 3 Element (for incoming and outgoing circuit breaker only)
- 3 Nos Overcurrent Relay Numerical Type 1A secondary current with (for incoming and out-going bus coupler circuit breaker)
    - Setting range 50-200% (for Overcurrent element)
    - Setting range 200-400-600% (for High Set Element)
- 1 Earth-fault Relay, Numerical Type, with Secondary Current 5A and with Instantaneous tripping Setting range 10-40% (For incoming and outgoing circuit breaker)
- Auxiliary relay and coupling relay if required
- Anti-condensation heater (for incoming and outgoing circuit breaker)

7.7 Current Transformer

The 12kV Metalclad Switchgear shall include protection and metering Current Transformers as specified. The Current Transformers shall be Epoxy Resin insulated block type Current Transformers. The CT ratio, accuracy class and burden shall be as per Single Line Diagrams and as approved by the Client.

The current transformer shall comply with the requirements of IEC 61869 and shall confirm to the specified insulation requirements and shall withstand without damage the applicable short-circuit current specified. Primary ratio taps shall not be accepted. The ratio provided in the Single Line Diagram is tentative, the final decision shall be taken prior approval of the drawing. The manufacturer of current transformer shall be the holder of valid ISO 9001 certificate.

Maximum temperature rises at rated primary current shall not exceed 50^{o}C. Accuracy classes for the protection and metering shall not be less than 5P20 and 0.2 respectively. Burden and accuracy class shall be adequate to ensure correct operation of associated protective devices and instruments. Saturation curves shall be provided with C.T. characteristics. Each set of secondary windings shall be wired to suitable terminal blocks and earthed at the first control or relay panel to which they are connected. Differential protection circuits (involving more than one

set. of CTs) shall be earthed at one location only. The Current Transformers shall be tested in accordance with IEC 61869-2 and shall include the following routine tests

- Verification of terminal markings polarity etc.
- Power frequency tests on primary windings
- Power frequency tests on secondary windings
- Overvoltage inter-turn tests
- Determination of ratio error and phase displacement

7.8 Voltage Transformers

The voltage transformers shall comply with the requirements of IEC 61869-3. Accuracy class for the metering case shall be 0.2 while for the protection shall be 3P. Bidder shall insure burden is sufficient for the smooth operation. The voltage transformers and their fuses shall meet the specified insulation requirements and have a rated primary voltage of 11 kV with knee of saturation curve not lower than 12 kV and ratios per single line diagram.

The voltage transformer shall be provided with high rupturing capacity (HRC) fuses for primary and secondary circuits. The fuses shall be rated for the short circuit levels specified. The voltage transformers shall be tested in accordance with IEC 61869-3, and shall include the following routine tests –

- Verification of terminal markings
- High voltage power frequency withstand test on primary windings
- High voltage power frequency withstand test on secondary windings
- Tests for accuracy

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

Table 3: Technical Parameters of Voltage Transformer

Type	Epoxy-resin insulated, single pole with 7.3A Primary side fuses
Basic Impulse Level	75kV
Primary Voltage	11/ √3 kV
Secondary Circuit	110/ √3 V
Rated burden	100 VA
Accuracy classification	0.2 Class

7.9 Control protection & instrumentation

This covers the detailed requirements 11 kV switchgear panel cubicles, and design, manufacture, transport, installation and commissioning of new 12 kV metal clad VCB switchgear. The substation will normally be unattended, and operation will be automatic. Normally closing of circuit breakers shall be remote operation and operation of earthing switches will be remote if it is not mentioned. Local control facilities adjacent to the equipment shall be provided for maintenance, inspection and emergency operation. The control system shall be designed to permit the following operating modes –

- Automatic start/stop operation refers to spring-charged motor for operating mechanism of 11 kV VCB
- Automatic tripping of 11 kV VCB, LV MCB if faults occur in protected lines equipment or circuits
- The control system shall be arranged in such way that it is possible to change between remote automatic and local manual control any time
- Solid state modular equipment shall be used wherever possible
- The designs shall be in general conformity with the single line diagrams and layout drawings accompanying this specification. Under manual control the individual operations shall each be subject to safety interlocks being satisfied.
- The control scheme shall be operationally simple, safe, easy to maintain and functionally consistent. Each module shall have sufficient test points to felicitate fault finding. Control circuits shall be brought out to isolating terminals to permit efficient trouble shooting.
- Each cubicle shall be provided with a sufficient point annunciator to identify an alarm condition, including audible alarm, test, acknowledge and reset push buttons
- Control switches for circuit breakers shall be of the discrepancy type. Two independent movements shall be required to initiate an operation. The position of manually operated disconnector shall be indicated by means of discrepancy indicators.

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

S.N.	Condition	Lamp	Alarm

S.N.	Condition	Lamp	Alarm
1	Normal	Off	Off
2	Alarm flashing	On	On
3	Acknowledge	On	Off
4	Normal	Off	Off
5	Lamp test	On	Off

Required signals or alarm systems are as follows –

- CB Off/On position by green/red lamp
- Flag or lamp indication of faults for Overcurrent Protection, E/F Protection, DC Supply Failure, CB Failure, MCB tripped, AC supply failure, Interlocking system disturbed, CB driving faults.

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

Protection required

The protection system shall be in accordance with the drawings (CSG-SLD-…) and as mentioned hereunder. Additional protection system shall be installed, if these appear insufficient.

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

Transformer Protection

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

- Differential relay shall be provided for the protection of transformer 6/8 MVA and higher.
- Backup protection shall be provided in the form of inverse time over current relay connected into the transformer LV neutral connected current transformer

7.10 Minimum requirement for switchgear

All 11 kV feeder and bus coupler cubicles shall house single circuit breaker. Each circuit and feeder shall be equipped with the following devices and equipment

Withdrawable module with –

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

Bus Coupler with –

- Copper busbars of rating 2000 A
- Epoxy resin insulated block type current transformer 1st core: 0.5 class 30 VA (for measurement) 2nd core: 5P20 30 VA (for protection)
- Breaker carriage

Table 4: Technical Requirement of 12 kV Switchgear

S. N.	Description	Unit	Requirement
1	Manufacturer		
	Country of Origin		
	Year of manufacturing experience		
	Model No.		
	Manufacturer's designation		
2	Applicable Standard		IEC 62271
3	Type		3 Phase, Indoor
4	System Parameters		
	Operating Altitude	m	Up to 3000 above msl

S. N.	Description	Unit	Requirement
	Max. ambient temperature	Deg. C	45
	frequency	Hz	50
	System fault level	kA	25 for 3 sec.
	Rated Nominal Voltage	kV	11
	Rated Maximum Voltage	kV	12
	Power frequency withstand voltage (1min rms)	kV	28
	Impulse withstand voltage (peak)	kVp	75
5	Rated Current (Continuous at 45 degree ambient)		
	incomer	A	1250
	outgoing	A	630/800
	Trunking chamber	A	1200/2000
	Busbar	A	2000
9			
9.1	Short time for 1 sec at max. kV	kA	25
	Momentary	kV	
	Rated short circuit breaking current	kA	
	Peak	kA	63
	RMS Symmetrical	kA	
10	Interrupting time at 100% capacity		

S. N.	Description	Unit	Requirement
10.1	Maximum Opening time	ms	
10.2	Total interrupting time	ms	60
11	Closing time	ms	
12	Make time	ms	120
13	Maximum capacitive current breaking capacity (rms)	A	
14	Insulation level		
14.1	Impulse withstand voltage (peak)	kV	75
14.2	Power frequency withstand voltage	kV	28
15	Vacuum chamber		
	Make time	ms	
	Rating	A	
16	Breaker		
16.1	Manufacturer & Country of origin		
16.2	Reference standard		
16.3	Type	Spring Operated	
16.4	Operating voltage of closing and tripping coil (DC)	V	110
16.5	Operating voltage range	% of rated voltage	
16.6	Closing time		85-110%

S. N.	Description	Unit	Requirement
16.7	Tripping time		70-110%
16.8	Closing and tripping current	A	
16.9	Rated Voltage (DC) for tripping and closing	V	110
16.10	Spring charging motor rating		
	Capacity	W	
	Rated voltage (DC)	V	110
16.11	Time required by motor to charge the spring completely	sec	
16.12	Push button for local/ remote control	yes/no	yes
16.13	Selection switch for local/remote control	yes/no	yes
17	Potential transformer		Required
	Manufacturer & Country of origin		
	Type		
	Reference standard		IEC
	Frequency	Hz	50
	Voltage class	kV	12
	Number of phases		3
	Voltage Ratio	kV	11/√3:0.11/√3
	Rated Nominal primary voltage	kV	11/√3
	Rated Maximum primary voltage	kV	12/√3

S. N.	Description	Unit	Requirement
	Power frequency withstand voltage (1min rms)	kV	28
	Impulse withstand voltage (peak)	kVp	75
	Rated burden	VA	100
	Accuracy class		0.2
	Over Voltage factor		
	Creepage Distance	mm	280
18	Current transformer		Required (Separate for each incomer & feeder panel)
	Manufacturer and country of origin		
	Type		
	Frequency	Hz	50
	Voltage class	kV	12
	Reference standard		IEC
	Auxiliary DC Supply	V	110
18.1	For Incoming		
	Nos of core		3
	Ratio/class/burden		1200-600/1A
	Metering		5P20,15VA
	Protection		0.2,15VA
	Differential		PS,15VA

S. N.	Description	Unit	Requirement
18.2	For outgoing		
	Nos of core		2
	Ratio/class/burden		600-300/1A
	Metering		5P20,15VA
	Protection		0.2,15VA
19	Indicating Instruments		
19.1	Ammeter		Required (Separate for each incomer & feeder panel)
	Manufacturer and country of origin		
	Type		digital
	Numbers		1/phase
	Range of indication	A	0-1200-for incomer 0-600-for outgoing
	Accuracy class		0.2
	Scale		Linear
	Overload range	%	1.5
	Auxiliary DC Supply	V	110
	VA Burden	VA	
	Catalogue furnished	yes/no	yes
19.2	Voltmeter		Required (Separate)
	Manufacturer and country of origin		

S. N.	Description	Unit	Requirement
	Type		digital
	Numbers		1/phase
	Range of indication	kV	0-15
	Accuracy class		0.2
	Scale		Linear
	Overload range	%	1.1
	Auxiliary DC Supply	V	110
	VA Burden	VA	
	Catalogue furnished	yes/no	yes
19.3	Apparent Power meter		Required (Separate for each incomer & feeder panel)
	Manufacturer and country of origin		
	Type		
	Rated voltage	kV	11√3:0.11√3
	Rated Current	A	300-200-100/1
	Accuracy class		0.2
	Range of indication	MVA	0-15 or 10
	Auxiliary DC Supply	V	110
	VA burden	VA	
	Current coil		

S. N.	Description	Unit	Requirement
	Voltage coil		
	Catalogue furnished	yes/no	yes
19.4	kWh Meter		Required (Separate for each incomer & feeder panel)
	Manufacturer and country of origin		
	Type		static 3-phase, 4 wire
	Accuracy class		0.2/0.5
	Rated voltage	kV	11√3:0.11√3
	Rated Current	A	300-200-100/1
	VA burden	VA	
	Current coil		
	Voltage coil		
	Auxiliary DC Supply	V	110
	Reverse rotation locking mechanism provided	yes/no	yes
19.5	Annunciators		
	Manufacturer and country of origin		
	Type		
	Number of active points	No	4
	Type of mounting		Flush
	Replacement of individual inscription	yes/no	yes

S. N.	Description	Unit	Requirement
	plates and lamps from front panel possible		
	Sequence of operation as per specification	yes/no	yes
20	Protective Relay		
20.1	Overcurrent relay		
	Manufacturer and country of origin		
	Type		static Non-directional
	Manufacturer's type designation		
	Applicable standard		
	No of poles		Single*3
	Current setting range	% of rated current	5-200%
	Operating range		
	Operating time at 10 times current setting	sec	3
	Reset time	ms	
	Characteristics		IDMT (standard inverse)
	Instantaneous unit provided	yes/no	yes
	Operating range		
	NO Contacts		
	Insulation test according to IEC	yes/no	yes
	Indication		
	Hand reset flags provided	yes/no	yes

S. N.	Description	Unit	Requirement
	Light emitting diode provided	yes/no	yes
	Auxiliary DC supply	V	110
	Technical literature provided	yes/no	yes
20.2	Earth fault relay		
	Manufacturer and country of origin		
	Type		Static, Non-directional
	Applicable standard		IEC
	Continuous overload capacity	x In	
	Current setting range	% of In	5-80%
	Operating range		
	Operating time at 10 times current setting	sec	3
	Characteristics		IDMT (standard inverse)
	Instantaneous unit provided	yes/no	yes
	NO Contacts		
	Insulation test according to IEC	yes/no	yes
	Indication		
	Hand reset flags provided	yes/no	yes
	Light emitting diode provided	yes/no	yes
	Auxiliary DC supply	V	110
	Is Manufacturer ISO 9001 holder?	yes/no	yes
	Technical literature submitted	yes/no	yes

S. N.	Description	Unit	Requirement
	Type test certificate submitted	yes/no	yes
20.3	Auxiliary Tripping and Lockout Relay		
	Manufacturer and country of origin		
	Type		
	Manufacturer's type designation		
	Applicable standard		
	Operating time	ms	<15
	Contact rating at 125V DC	A	
21	Construction of Control and Relay Panel		
	Type		
	Manufacturer's type designation		
	Applicable Standard		
	Location		Indoor
	Mounting		Floor/Trench mounted
	Lifting hooks	yes/no	yes
	Control panel furnished as per specification	yes/no	yes
	Enclosure protection class	IP	IP54
	Type of Sheets used		
	Thickness of sheet metal used		
	Load Bearing parts	mm	>3

S. N.	Description	Unit	Requirement
	Non-load bearing parts	mm	>2
	Painting		Light grey RAL 7032
	All instruments, meters, relays and control switches flush or semi flush type		flush
22	Earthing switch		
	Type		Integrated
	rating		
	interlocking	yes/no	yes
23	Surge Arrestor		
	Type		ZnO
	Rating	kA	9kV,10kA
24	Space heater provided for cubicle	yes/no	yes/rating
25	Operating duty cycle		0-0.3sec-co-3min-co
26	Number of possible operations without maintenance under:		
	Rated short circuit braking current	No	100
	Rated normal current	No	10000
27	Clearances		
27.1	Phase to phase	mm	127
27.2	Phase to earth	mm	76.2
28	Padlocking provision for cubicle	yes/no	yes

S. N.	Description	Unit	Requirement
29	Total weight of the circuit breaker	kg	

7.11 Tests

Factory tests

- Factory tests shall include inspection and routine testing of all relays and devices as per BS and IEC publications
- Continuity and insulation testing of all devices and wiring, and complete control sequences testing shall be performed to the extent feasible in the plant
- All electronic equipment items and the subsystem shall be operated continuously for a minimum of two hundred (200) hours prior to shipment in accordance with the approved testing procedures to ensure the operational integrity of each component and of the total system
- Type test reports for each protective relay shall be provided
- Each component of protective equipment shall be tested at the Manufacturer's work or at site to establish its performance characteristics

7.12 Quality Assurance Program

Along with the Bid the Bidder shall furnish quality assurance program of the manufacturer which includes the Quality System and the Quality Plans, which shall include, among others, information to meet the following requirement, failing which the Bid shall be liable for rejection.

i.) The structure of the organization.
ii.) The duties and responsibilities assigned to staff ensuring quality of works.
iii.) The system for purchasing, taking delivery and verification of materials.
iv.) The system for ensuring quality of workmanship.
v.) The quality assurance arrangement shall conform to relevant requirements of ISO9001.
vi.) Statement giving list of important raw materials, names of manufacturer for the raw materials, list of standards according to which the raw materials are tested, list of 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.

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.

Volume II

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8 STATION SUPPLY SYSTEM

8.1 General

This description of the low voltage distribution system shall be as per the Single Line Diagram provided in Construction Standard Guidelines. The installation shall be such that, the Load Break Switch supplying Station Transformer and the MCCBs supplying the main distribution bus shall be controllable from SCADA system remotely. The Status of emergency supply system and other low voltage distribution boards – voltage availability shall be included in the SCADA system.

8.2 Station transformer

8.2.1 Scope

This specification covers the design, manufacture, assembly, shop test, supply, delivery, installation, field testing and commissioning of the station service transformers complete with all accessories, fittings and auxiliary equipment for efficient and trouble-free operation as specified herein under. The Contractor shall undertake all the works (complete supply and installation) relating to the connection of the station service transformer to the HV/LV control and distribution panels. The equipment specified in this Section of the Contract shall conform to the latest edition of the appropriate IEC specifications and/or other recognized international standards. In particular:

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

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

8.2.2 Equipment to be furnished

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

8.2.3 Design Requirements

The transformers shall be connected to three phase, 50Hz system of 33kV system. The transformer shall be installed outdoor in a hot, humid atmosphere. The transformer shall be oil immersed and designed for the cooling system as specified in Appendices.

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

Technical Requirements of Station Transformer

Type		Three-phase, 33/0.4 kV
Rated power		100 kVA
Rated voltage	- Primary	33kV
	- Secondary	400/230V
Max system voltage	- Primary	36 kV
	- Secondary	0.44 kV
Rated Frequency		50Hz
Connection	- Primary	Delta
	- Secondary	Grd. Wye
Cooling System		ONAN
Vector group		Dyn11
Rated impedance voltage		3.5 - 4.5%
BIL for windings and bushings for primary side		170 kV
Withstand voltage, 50 Hz, 60 Sec.		
	- Primary	70 kV
	- Secondary	3 kV
No load tap changer		+/- 5% on HV side
Mounting		Platform
Insulation levels (IEC) 76		LI 170 AC 70/AC 3
Insulation temperature class (IEC 76)		A
Maximum allowable noise level at 3 metre hemispherical radius		<44 dB
Applicable standard		IEC 60076

8.2.4 Construction Features

a. Tank

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

b. Core & Coils

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

All insulating material shall be of proven design. Coils shall be insulated that impulse and power frequency voltage stresses are minimum. The core and coil assembly shall be securely fixed in position so that no shifting or deformation occurs during movement of transformer or under short circuit stresses.

c. Tap changer

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

Mechanical means shall be provided for limiting the maximum and minimum traveling of the extreme tap positions to be at the maximum and minimum positions of the tap changer.

d. Insulating oil

The insulating oil shall conform to the latest revision of IEC Publication 60296, properly inhibited for preventing of slugging.

e. Oil preservation system

Oil preservation shall be by means of conservator tank system.

8.2.5 Accessories

The following accessories shall be provided with each transformer:

a) Upper oil filter valve

b) Lower oil filter and drain valve

c) Oil sampling device

d) Liquid level gauge

e) Lifting lugs

f) Nameplate

g) Hand-hole

h) Tank grounding terminal connector suitable for grounding cable

8.2.6 Tests

a. Routine tests

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

a) Applied voltage test

b) Induced voltage test

c) No-load loss and excitation current tests

d) Impedance voltage and load loss tests

e) Resistance measurement

f) Ratio tests

g) Polarity and phase-relation tests

h) Leakage tests

i) Insulation resistance tests

b. Design tests

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

a) Temperature rise tests

b) Impulse voltage tests

c. Field test

After installation at Site, the transformer shall be subjected but not limited

to the following field tests.

a) Construction inspection

b) Measurement of insulation resistance

c) Ratio test

d) Polarity test

8.2.7 Quality Assurance Program

Along with the Bid the Bidder shall furnish quality assurance program of the manufacturer which includes the Quality System and the Quality Plans, which shall include, among others, information to meet the following requirement, failing which the Bid shall be liable for rejection.

i.) The structure of the organization.

ii.) The duties and responsibilities assigned to staff ensuring quality of works.

iii.) The system for purchasing, taking delivery and verification of materials.

iv.) The system for ensuring quality of workmanship.

v.) The quality assurance arrangement shall conform to relevant requirements of ISO9001.

vi.) Statement giving list of important raw materials, names of manufacturer for the raw materials, list of standards according to which the raw materials are tested, list of 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.

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.

8.3 Low voltage distribution system

8.3.1 Scope

This specification covers the design, manufacture, assembly, testing at manufacturer's works, supply and delivery, properly packed of low voltage distribution boards all complete in entire substation including buildings and outdoor.

8.3.2 Standards

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

8.3.3 Equipment to be furnished

The equipment to be furnished shall strictly be in accordance with the specifications and the Price Schedule. Each distribution board must have sufficient number of spare feeder (at least 20% of various sizes used in the Distribution Boards with a minimum 1 no. on each bus).

The incoming molded case circuit breakers and bus bar ratings shall be selected considering the spares also. The distribution boards shall be complete with all accessories and materials. The base channel frames for the distribution boards for grouting in the floor complete with anchor bolts, nuts and leveling attachments. Special tools and tackle for erection and maintenance of the distribution boards and other equipment.

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

8.3.4 Design Requirements

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

The DC distribution board is meant for distribution of DC power to switchgear, control, relay and metering panel, emergency lighting fire protection system etc. The distribution boards will be located indoor in a hot and humid atmosphere. All equipment, accessories and wiring shall be provided with suitable finish for prevention of fungus growth.

The AC distribution board shall be designed for operation in a 400V +10%. 3 phase, 4-wire, 50Hz +5% neutral ground system. The DC distribution board shall be designed for 110V DC, 2-wire system. The de rating of the equipment shall be done taking 45 deg. C as an ambient temperature of the site, if it is designed for lower ambient temperature. Furthermore, design and selection of all equipment shall be made liberally with a good margin of safety factors.

8.3.5 Construction Features

a. General

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

a) The construction shall be compartmentalized

b) All distribution boards shall be dead front type. All switches, circuit breakers, etc. shall be operable from the front

c) All bolts and nuts exposed to external atmosphere shall be cadmium plated or zinc passivated.

d) The working height shall be limited to a maximum of 2,000 mm. The design shall be such as to permit easy extension of distribution boards at site on either end.

e) The distribution boards shall consist of vertical sections, fabricated from a minimum of 2mm thick sheet steel, shaped and reinforced to form a rigid freestanding structure

f) The minimum clearance of the power terminal lug from the bottom plate shall be maintained as 200mm

g) The AC distribution board designed for 4-wire system shall have a fully insulated neutral bus of cross-section same as the main phase buses

h) Anchor bolts and nuts for each distribution board shall be supplied along with the distribution board

i) All distribution boards mounted indoor shall be provided with enclosure protection of IP 42 as per IEC

b. Bus bars

Bus bars shall be copper, liberally sized for the specified current ratings (both short circuit and continuous currents). Maximum temperature of the bus and bus connection shall be limited to 90 deg. C. All bus bars, links, etc., shall be covered to prevent accidental contacts. Buses shall be spaced with adequate clearance between phases and between phase and ground.

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

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

8.3.6 Specific Requirement

a. Molded case circuit breakers (MCCB)

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

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

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

The MCCB shall be equipped with Earth Leakage Protection.

b. Cable termination

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

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

c. Ground bus

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

8.3.7 Nameplate

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

Material for nameplate shall be a plastic sheet, 3 mm thick or approved equivalent. The letters shall be white on black background. The nameplate shall be held by self-tapping screws. The size of the nameplates shall be proportionate to the size of the modules. Also, individual panel number and danger plate shall be furnished at the back of the panel.

8.3.8 Tests

a. Routine and type test

Type test certificates and results as per relevant IEC. Specification for all the equipment offered under the scope of this specification shall be furnished. Each distribution board shall be completely assembled, wired adjusted and tested for operation under simulated conditions to ensure correctness of wiring and proper functioning of all equipment. All component parts such as MCCB'S, meters, etc., shall be tested in accordance with relevant IEC Specification.

All current carrying parts and wiring shall be subjected to a high potential test. All routine tests shall be conducted on all distribution boards.

8.3.9 Drawings, Data & Manuals

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

a) Bidder's proposed distribution scheme in single line diagram for all distribution boards

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

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

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

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

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

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

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

8.3.10 Quality Assurance Program

Along with the Bid the Bidder shall furnish quality assurance program of the manufacturer which includes the Quality System and the Quality Plans, which shall include, among others, information to meet the following requirement, failing which the Bid shall be liable for rejection.

i.) The structure of the organization.
ii.) The duties and responsibilities assigned to staff ensuring quality of works.
iii.) The system for purchasing, taking delivery and verification of materials.
iv.) The system for ensuring quality of workmanship.
v.) The quality assurance arrangement shall conform to relevant requirements of ISO9001.
vi.) Statement giving list of important raw materials, names of manufacturer for the raw materials, list of standards according to which the raw materials are tested, list of 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.

8.4 Emergency Supply Diesel Generator

8.4.1 Scope

This specification covers the design, manufacture, assembly, shop test, supply, delivery, installation, field testing and commissioning of the portable diesel generator as emergency supply system to the 33/11 kV substation with all accessories, fittings and auxiliary equipment for efficient and trouble-free operation as specified herein under. The Contractor shall undertake all the works (complete supply and installation) relating to the connection of the diesel generator to the HV/LV control and distribution panels. The equipment specified in this Section of the Contract shall conform to the latest edition of the appropriate IEC specifications and/or other recognized international standards.

The Scope of works shall comprise the following:

- One (1) Diesel Generator, rated 10 kVA, 0.4 kV, 1500 rpm;
- One (1) set of special tools and devices;
- One (1) lot of special spare parts.

8.4.2 Standards

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

8.4.3 Design Requirements

The principle design requirements of the Diesel Generators are as follows:

Type		3-phase, synchronous
Design		Horizontal
Cooling		Air-cooled
Rated output	kVA	10
Rated voltage	V	400 / 230
Rated frequency	Hz	50
Voltage regulation	± %	5
Rated speed	rpm	1,500
Power Factor		0.8

Insulation Class	F
Protection class	IP42
Excitation System	Brushless with rotating diodes, self-regulating

8.4.4 Construction Features

The DG units shall be complete, self-contained, independent units including all auxiliary equipment and controls as specified and required for proper and satisfactory operation.

The emergency diesel generating units shall be a standard product of a competent manufacturer, factory assembled and tested.

The offered engine model shall be one from the existing regular production range used by the supplier.

a. Starting System

The starting system shall consist of 12 V batteries with battery chargers.

Two sets of batteries of the Lead/Acid type with a total capacity sufficient to maintain cranking speed through a 4-minute cycle of 15 s crank followed by 15 s rest for 6 consecutive cycles shall be provided. Each battery set shall have the capacity for 3 consecutive cycles.

One battery with charger shall be provided for control and common auxiliaries.

The batteries shall be installed in a heavy gauge sheet steel cabinet with adequate ventilation.

b. Automatic Start Mode "Service"

Selector switches in "Automatic/Service: The selector switches "Automatic/Manual" and "Service/Test/Off" shall be provided in the local control cubicle.

Following a loss of normal station auxiliary supply, the DG Unit shall start automatically and be brought to nominal speed and voltage on receiving a signal from the mains monitoring devices. All accessories required for starting and completing the sequence of operation for the above purpose shall be provided.

Immediately after the DG unit reached rated speed and rated voltage, voltage and frequency monitoring devices located in the control cubicle shall send a command for closing the generator circuit breaker.

The loading of the DG unit shall be realised via the ACS in the CCR.

c. Manual Start Mode "Service"

Selector switches in "Manual/Service": The operation scheme shall be same as the auto mode detailed above except that the starting command shall be given manually via push button/touch screen either from the local control cubicle (LCC) or the CCR.

d. Manual Start Mode "Test"

Selector switches in "Manual/Test": The operation scheme shall be same as that of manual start into service mode, except that the closing command for the generator circuit breaker shall not be given automatically.

8.4.5 Spare Parts and Tools

a. General Spare Parts

Reference is made to the General Technical Specifications.

b. Special Spare parts

- Two (2) Thermostats, including seals and gaskets , if applicable
- Two (2) Starter coils, if applicable
- Five (5) Gaskets for valve cover , if applicable
- One (1) Set of bearings, if applicable
- One (1) Voltage regulator, if applicable
- One (1) Set of diodes, if applicable
- One (1) Rectifier module, if applicable
- One (1) Set of varistors, if applicable

c. Recommended Spare parts

The Tenderer shall recommend the spare parts he considers necessary for a five years operation of the equipment. These spare parts shall be quoted in the price lists but not included in the total price.

d. Tools and Appliances

The manufacturer's standard set of tools and devices required to carry out all maintenance and normal overhaul of the diesel engine and associated systems shall be provided.

8.4.6 Tests

a. Workshop Tests

The complete DG units assembled in the workshop shall be subject to type and routine tests in compliance with the related standards and the technical specifications.

The shop tests shall be performed as per applicable IEC Standards:

1. Diesel Generator:

- General inspection, dimension check;
- Winding resistance measurement of armature and field;

- Polarity of the field coils;
- No-load saturation test;
- Temperature rise test;
- Over speed test;
- Vibration measurement;
- Efficiency calculation;
- Insulation resistance measurement of field coils;
- Insulation resistance measurement of armature coils, before and after the high potential test, including polarisation index measurements;
- Dielectric test;
- Measurement of dielectric loss angle (power factor);
- Functional test of the excitation system.

2. Control and protection equipment:

- General inspection;
- Insulation resistance measurement;
- Dielectric test;
- Functional test.

b. Site Tests

The following field tests shall be performed:

- General inspection;
- Insulation resistance measurement;
- Dielectric test;
- Measurement of dielectric loss angle (power factor);
- Sequence and operation test;
- Trial operation for 12 hours.

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9 SPECIFICATION OF DC SYSTEM

9.1 Scope

This specification covers the design, manufacture, delivery, installation and field test of the maintenance free battery and suitable battery charger for 110 V DC system complete with all necessaries for efficient and trouble-free operation as specified herein under. Manufacturer of battery and battery charger shall be holder of valid ISO 9001 certificate.

The Battery charger shall also include D.C. distribution board and complete work required on DC system of the 33/11 kV Substation.

9.2 Maintenance free Battery

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

- 0 - 1 min – Simultaneous tripping of all breakers on under voltage. In case the circuit breakers charge after tripping, starting current of the spring charged motor of all the above circuit breakers shall be considered for the entire 0 - 1-minute period. Emergency lighting load, control, indication, protection and annunciation load.
- 1 - 89 min – Emergency lighting load, control, indication, protection and annunciation load.
- Last minute – Control, indication, protection and annunciation load, emergency lighting load, closing of breaker-one at a time and spring charging if spring charging occurs after closing of breaker. Consider staring current of one spring charging motor and running current of another spring charging motor to occur simultaneously during the entire one minute a period.

The Contractor shall compute the Ampere hour rating (10-hour rating) of the battery considering margin over the above duty cycle so that the battery shall be capable of delivering the ultimate DC load of the substation when the future switchgear and its protection panel will be installed in the same substation. The minimum capacity shall be not less than 250 Ah. The minimum ambient temperature shall be 5^{o}C. The minimum voltage at the end of the load cycle shall not be less than 1.75 volts per cell. The batteries shall be storage type, maintenance free valve regulated lead acid type (VRLA type).

Each cell shall be in a suitable leak proof container with sealed cover. The batteries shall be furnished complete with cell interconnectors and a suitable rack protected with acid resistant

paint. The arrangement of the rack shall be such as to allow easy access and adequate space for normal maintenance in battery room. Rated life of each battery shall be at least ten (10) years.

Bidder shall select number of cells, float and Boost voltage to achieve following system requirement:

System Voltage	Maximum Voltage during Float operation	Minimum voltage available when no charger working, and battery fully discharged up to 1.85V per cell.	Minimum Nos. of Cell
110 V	121 V	99 V	54

9.3 Battery charger

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. The battery charger shall be suitable for 400 volts + 10 %, 3 - phase, 50 Hz supply.

The charger shall have fully automatic voltage regulation and electronic current limiting. The voltage regulation shall be within ± 1 % for a 0 – 100 % load variation and ± 10 % voltage variation on the AC side and frequency variation of ± 2.5%, a combined voltage and frequency variation of ±10%. Cooling shall be by means of natural convection. The minimum rating of the battery charger shall be not less than 50 Amperes. The battery charger shall be housed in a freestanding floor mounted cabinet with enclosure protection of IP-30 as per IEC. The instruments, switches and lamps shall be flush or semi-flush mounted on the front panel.

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

9.4 Wiring

Wiring shall be complete in all respects so as to ensure proper functioning of control, protection and metering scheme. All wiring shall be completed up to terminal blocks. Wiring shall be done with 2.5 sq mm (minimum) class 5 stranded copper conductor, flexible PVC insulated wire. The wire shall have a voltage grade of 600 V as per IEC.

Lower cross section of wires may be used for solid-state devices only. Each wire shall be identified at both ends with wire designations in accordance with the approved wiring diagram. Interlocking type ferrules shall be used for identification. Not more than two wires shall be connected to any terminal at each end. If necessary, a number of terminals shall be umpired together to provide wiring points. Wires shall be neatly bunched and adequately supported so as to prevent sagging strain on termination. Wires shall not be spliced or tapped between terminal points. All spare contacts of relays and contactors shall be wired up to the terminal block.

9.5 Cable termination

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

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

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

9.6 Accessories

The following accessories shall be furnished for the batteries –

- Connector bolt wrench
- Cell testing voltmeter with leads
- Battery racks
- Other necessary accessories

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

- Solid state surge protectors on the AC and DC sides
- AC failure alarm relay

- DC time delay low voltage relay
- Ground detection alarm for positive and negative leads
- Manual voltage adjust switch
- DC ammeter and voltmeter

9.7 Special Tools and Appliances

The Contractor must supply the following special tools and appliances in the DC Room.

- One (1) plastic filler bottle 10 l for distilled water
- One (1) plastic funnel
- Two (2) syringe hydrometer, scaled approx. 1.15 - 1.25
- Two (2) thermometer
- One (1) cell test voltmeter -3/0/+3 V
- One (1) protection kit (pair of gloves, glasses, apron)
- One (1) eyewash facility
- One (1) wall mounted operation instruction plate

9.8 Spare Parts

9.8.1 General Spare Parts

General Spare Parts shall be provided as per the General Technical Requirements.

9.8.2 Special Spare Parts

- Five (5) spare cells for each battery system
- 100 l electrolyte
- Two (2) battery charger power module of each type
- Five (5) sets of cell connectors and fixing of each type
- Two (2) battery charger control module
- One (1) Inverter power module, if applicable
- One (1) Inverter control module, if applicable
- One (1) set of printed cards for Inverter, if applicable
- Two (2) ACB of each type, if applicable
- One (1) lot of wear and tear parts for each type of ACB, if applicable
- Three (3) MCCB of each type
- Five (5) MCB of each type
- Two (2) power contactors of each type
- Five (5) sets of replacement contacts for power contactors of each type
- Two (2) power contactor coils of each type
- Two (2) voltage monitoring devices
- One (1) protection relay of each type

- Two (2) sets voltage regulator unit
- 100% of fuses installed
- 100% of bulbs installed

9.8.3 Recommended Spare Parts

The Tenderer shall recommend the spare parts he considers necessary for a five years operation of the equipment. These spare parts shall be quoted in the price lists but not included in the total price.

9.9 Tests

Type and routine tests at manufacturer's works and acceptance test at site shall be carried out on battery as per stipulation of latest standard of IEC. The test shall include following tests –

- General inspection
- Leakage test and internal short test for each cell
- One cell shall be type tested for discharge at ten-hour rate to 1.85 V DC at 25^{o}C
- After initial charging the following tests shall be performed at site
    - Capacity test
    - Efficiency test
- The battery charger shall be subjected to the following tests at manufacturer's works
    - Measurement on insulation resistance
    - High voltage test
    - Performance test
    - Temperature rise test
- Test certificates shall be submitted to NEA for approval

9.10 Quality Assurance Program

Along with the Bid the Bidder shall furnish quality assurance program of the manufacturer which includes the Quality System and the Quality Plans, which shall include, among others, information to meet the following requirement, failing which the Bid shall be liable for rejection.

i.) The structure of the organization;

ii.) The duties and responsibilities assigned to staff ensuring quality of works;

iii.) The system for purchasing, taking delivery and verification of materials;

iv.) The system for ensuring quality of workmanship;

v.) The quality assurance arrangement shall conform to relevant requirements of ISO9001;

vi.) Statement giving list of important raw materials, names of manufacturer for the raw materials, list of standards according to which the raw materials are tested, list of 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.

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10. SPECIFICATION OF CABLES

10.1 Scope

This specification covers the design, manufacture, factory test, supply, delivery, field test and installation of all power, control and instrumentation cables required for the entire project. Manufacturer of 12 kV power cable shall be holder of valid ISO 9001 certificate.

10.2 Equipment to be furnished

- 12 kV XLPE power cable
- Low voltage power cable
- Control and instrumentation cable
- Communication cable

10.3 Principal Design Features

The design of medium and low voltage cables shall be based on –

- Ambient conditions at the different locations but considering 40 C as minimum standard.
- Temperature and grouping correction factors according to cable laying method
- Cable length with consideration of the permissible voltage drop
- Permissible short-time withstand current
- Thermal and dynamic stresses at short circuit conditions

The maximum permissible conductor temperature for continuous and fault current condition respectively shall be-

- 70/160^{o} C for PVC insulation (IEC 60502)
- 90/250^{o} C for XLPE insulation

The color of outer sheaths of cables for different voltage levels shall be different and in accordance with the manufacturing standards. The color of the PE/N conductors for cables and wires shall follow the IEC standard standards. (IEC standard 60364)

The material for insulation and sheathing of cables shall have high dielectric strength and insulation resistance characteristics.

Cables shall be insulated and sheathed with materials featuring the following properties-

- Non halogent
- Inhibition of fire propagation
- Heat stabilized
- Not producing corrosive and toxic gases and vapors in case of fire
- Low smoke generation
- Resistant against environmental influences, in particular humidity, fungi, oil and vermin

- Safe against repeated overloads and short circuits
- Easy handling

The design of the cables shall prevent water penetration, radial vapour diffusion and longitudinal water propagation.

All conductors shall be made of annealed copper as per IEC standard 60228 or equivalent.

The accessories for terminating cables shall conform to IEC standard 61442, IEC standard 60502 or equivalent.

10.4 Particular Design and Construction Requirements

10.4.1 12 kV Power Cables

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

Conductor shall consist of stranded Copper wires. They shall comply with IEC publication. The maximum conductor temperature shall be 90^{o}C.

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

Anti-termite protection shall be applied to the cable and shall consist of a nonmagnetic metallic barrier. The outer covering of the cable shall be extruded, continuous black PVC suitable for the operating temperature of cable and shall meet the requirements of IEC standard.

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

Outdoor and indoor termination shall be done by heat or cold shrinkable type termination kits. Termination for cable shall be provided in sufficient quantities for complete installations of substations.

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

All cables shall be Fire Resistant Low Smoke (FRLS) type.

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

- Electric cable - 12,000 volts

Phase identification for either triplex or multi conductor cable shall be as follows –

- Phase R: Red
- Phase Y: Yellow
- Phase B: Blue

Main Characteristics of Cable

Type of Cable		One/Three Core
Conductor Material		EC Grade Aluminum or EC Grade Annealed Copper
Insulation		XLPE
Conductor Screen		Cu Wires
Outer Sheath		PE
Nominal Voltage	kV	11
Voltage Class	kV	12
Power Frequency Withstand Voltage	kV	28
Impulse Withstand Voltage	kV	75
Applicable Standard		IEC 60502, IEC 60228

10.4.2 1100-volt Power Cable

The low voltage cables shall be used for distributing power to different auxiliaries in the substation.

The low voltage cables shall be 1100 V grade polyethylene (PE) insulated, and PVC sheathed. Low voltage AC power systems shall have solidly grounded neutral with phase-to-phase voltage level of 400 V and phase to neutral voltage of 230V for AC system and 110V & 48V for the DC systems.

Conductor shall consist of stranded annealed copper wires. The cables so designed and proposed by the Contractor shall comply to IEC standard 60502 or relevant international standards. The size of the single core conductor cable shall not be less than 2.5 sq. mm for lighting circuits and 4 sq. mm for power circuits.

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

Each cable shall have a printed legend on the overall jacket with the manufacturer's name, voltage class, the number, material and size of conductors, type of insulation and a unique number or code indicating the production run or batch.

Main Characteristics

Type of Cable		Single or Multi Core
Conductor Material		Cu Annealed
Insulation		XLPE

Conductor Screen		Cu Wires
Outer Sheath		PE or PVC
Nominal Voltage	kV	0.4
Voltage Class	kV	0.6/1

The colors for core identification and colour sequence shall be in accordance with follows –

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

10.4.3 Control and instrumentation cable

All control and instrumentation cable shall be 650/1100 V grade multi-conductor, color-coded, PVC insulated armored cable as per IEC/IS standard. Each multicore cable shall have not less than 20 percent or 2 spare cores, whichever is the greater.

- Copper conductor shall be stranded circular non-compacted copper conductor of minimum cross-section of 2.5 sq mm.
- The electrically and thermally stable PVC insulation shall be extruded onto the conductor so as to prevent contamination and voids in the insulation.
- Multi conductor cables shall be assembled in accordance with applicable IEC standard. A flame retardate binder tape may be used underneath the overall jacket of multi-conductor cables, if required to achieve the desired flame retardate characteristics. Tapes, if used, shall be non-hygroscopic.
- Anti-termite protection shall be applied to the cable and shall consist or a nonmagnetic barrier.
- The cable core assembly shall be covered with a flame retardate and resistant jacket, which is free stripping from the insulation. The overall jacket shall be clean, dry, and free of grease and shall be suitable for ink or paint application. Cable jacketing and the interstices within the jacket shall be free of water. Evidence of water shall be grounds for rejection of the cable.
- Each cable shall have a printed legend on the overall jacket, with the manufacturer's name, name of the Employer, voltage class, the number and size of conductors, and a unique number or code indicating the production run or batch. The identification shall remain legible for the life of the cable.

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

Copper conductor shall be of stranded circular non-compacted cross-section. The sectional area of the core conductor shall not be less than 2.5 sq.mm and shall conform to the following requirements:

a. Current Transformer Secondary Circuit:

The total burden of instruments and relays connected plus that of cable shall be less than the rated burden of respective current transformer. The Contractor shall calculate the load of CT core considering all connected loads and submit to the employer for approval. In case of CT burden constrain, CT circuit cable cross sectional area shall be increased. In this case the Contractor shall supply and install the cable of required cross-section area without any additional cost to the Employer.

b. Potential transformer secondary circuits:

Allowable voltage drops in the cables under the total burden of instruments and relays connected shall be less than two (2) percent.

c. AC and DC circuits:

Allowable voltage drop in the cable shall be less than 3%.

The size of PE insulated wires connecting the low-tension cubicle to the motor control centers, AC panels, DC panels, crane trolley etc. shall be determined as per the actual calculations adjusting all the site-specific calculations.

The electrically and thermally stable PE insulation shall be extruded onto the conductor so as to prevent contamination and voids, if any, shall be between insulation and conductor.

Single core and multicore conductor cables shall be assembled in accordance with applicable IEC standards.

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

The cable core assembly shall be covered with a flame retardant and resistant jacket.

The overall jacket shall be clean, dry, and free from grease and shall be suitable for paint application.

Cable jacketing shall be free from water. Evidence of water shall be the ground for rejection of the cable.

Anti-termite protection shall be applied to the cable and shall consist of either a nonmagnetic metallic barrier or layer of nylon sheathing.

Each cable shall have a printed legend on the overall jacket, with the manufacturer's name, voltage class, the number, material and size of conductors, type of insulation and a unique number or code indicating the production run or batch. The identification shall remain legible for the life of the cable.

Each multicore cable shall have not less than 20 percent or 4 spare cores whichever is the greater.

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

10.5 Tests

10.5.1 Routine and design tests

Routine test shall be carried out for each drum of cable. Type test shall have to be carried out to prove the general qualities and design of a given type of cable and for the purpose of acceptance of the lot. The following tests shall be included in the routine test by the manufacturer at the factory as minimum requirements for this specification –

- Construction inspection
- Conductor resistance test
- High voltage test
- Insulation resistance test
- Physical and aging test for insulation and jacket

10.5.2 Field tests

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

- Measurement of insulation resistance
- DC dielectric test

10.6 Quality Assurance Program

Along with the Bid the Bidder shall furnish quality assurance program of the manufacturer which includes the Quality System and the Quality Plans, which shall include, among others, information to meet the following requirement, failing which the Bid shall be liable for rejection.

i.) The structure of the organization.
ii.) The duties and responsibilities assigned to staff ensuring quality of works.
iii.) The system for purchasing, taking delivery and verification of materials.
iv.) The system for ensuring quality of workmanship.
v.) The quality assurance arrangement shall conform to relevant requirements of ISO9001.

vi.) Statement giving list of important raw materials, names of manufacturer for the raw materials, list of standards according to which the raw materials are tested, list of 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.

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11 AUTOMATION AND CONTROL SYSTEM

11.1 Substation Automation and Control System

11.1.1 Scope

This section describes the functions to be performed by the SCADA-ready system – software applications and hardware for circuit breakers / transformers for distribution system of the DSUEP project area. These specifications are limited to a localized SCADA-ready system in each 33/11 kV substation under DSUEP. Communication backbone can be laid by NEA at a later stage to facilitate remote operation. Other 33/11 kV substations operated by NEA in province Lumbini, Karnali and Sudurpashchim may also be made SCADA compatible and connected with this system. Communication backbone and SCADA systems in non-DSUEP substations is beyond the scope of this specification.

Bidders are encouraged to supply standard, proven & tested products that meet or exceed the Specification requirements. Unless specified as optional functions/ features all functions / features mandatory for the project area.

The substation automation system shall be offered from a manufacturer who must have designed, manufactured, tested, installed and commissioned substation automation system which must be in satisfactory operation on 33 kV system or higher for at least 2 (Two) years as on the date of bid opening.

The Substation Automation System (SAS) shall be installed to control and monitor all the sub-station equipment from remote control centre (RCC) as well as from local control centre.

The SAS shall contain the following main functional parts:

- Bay control Intelligence Electronic Devices (IEDs) for control and monitoring.
- Station Human Machine Interface (HMI)
- Redundant managed switched Ethernet Local Area Network communication infrastructure with hot standby.
- Gateway for remote control via industrial grade hardware (to RCC) through IEC60870-5-101 protocol.
- Gateway for remote supervisory control (to RSCC), the gateway should be able to communicate with RSCC on IEC 60870-5-101/104 protocol. Communication backbone can be laid by NEA at a later stage to facilitate remote operation.

Peripheral equipment like printers, display units, keyboards, Mouse etc. It shall enable local station control via a PC by means of human machine interface (HMI) and control software package, which shall contain an extensive range of supervisory control and data acquisition (SCADA) functions. It shall include communication gateway, intelligent electronic devices (IED) for bay control and inter IED communication infrastructure. An architecture drawing for SAS is enclosed.

The communication gateway shall facilitate the information flow with remote control centres. The bay level intelligent electronic devices (IED) for protection and control shall provide the direct connection to the switchgear without the need of interposing components and perform control, protection, and monitoring functions.

11.1.2 Design requirements

The Substation Automation System (SAS) shall be suitable for operation and monitoring of the complete substation including future extensions as given in GTS.

The systems shall be of the state-of-the art suitable for operation under electrical environment present in medium voltage substations, follow the latest engineering practice, and ensure long-term compatibility requirements and continuity of equipment supply and the safety of the operating staff.

The offered SAS shall support remote control and monitoring from Remote Control centres via gateways.

The system shall be designed such that personnel without any background knowledge in Microprocessor-based technology are able to operate the system. The operator interface shall be intuitive such that operating personnel shall be able to operate the system easily after having received some basic training.

The system shall incorporate the control, monitoring and protection functions specified, self-monitoring, signalling and testing facilities, measuring as well as memory functions, event recording and evaluation of disturbance records.

Maintenance, modification or extension of components may not cause a shutdown of the whole substation automation system. Self-monitoring of components, modules and communication shall be incorporated to increase the availability and the reliability of the equipment and minimize maintenance.

Bidder shall offer the Bay level unit (a bay comprises of one circuit breaker and associated disconnector, earth switches and instrument transformer), bay mimic along with relay and protection panels housed in air-conditioned Control Room suitably located in switchyard and

Station HMI in Control Room building for overall optimization in respect of cabling and control room building.

11.1.3 System Architecture

The SAS shall be based on a decentralized architecture and on a concept of bay-oriented, distributed intelligence.

Functions shall be decentralized, object-oriented and located as close as possible to the process.

The main process information of the station shall be stored in distributed databases. The typical SAS architecture shall be structured in two levels, i.e., in a station and a bay level.

At bay level, the IEDs shall provide all bay level functions regarding control, monitoring and protection, inputs for status indication and outputs for commands. The IEDs should be directly connected to the switchgear without any need for additional interposition or transducers.

Each bay control IED shall be independent from each other, and its functioning shall not be affected by any fault occurring in any of the other bay control units of the station.

The data exchange between the electronic devices on bay and station level shall take place via the communication infrastructure. This shall be realized using fibre-optic or Ethernet cables, thereby guaranteeing disturbance free communication. The fibre optic cables/Ethernet shall be run in G.I. conduit pipes. Data exchange is to be realized using IEC 61850 protocol with a redundant managed switched Ethernet communication infrastructure

The communication shall be made in fault tolerant ring in redundant mode, excluding the links between individual bay IEDs to switch wherein the redundant connections are not envisaged, such that failure of one set of fiber shall not affect the normal operation of the SAS. However, failure of fiber shall be alarmed in SAS. Each fiber optic cable shall have four (4) spare fibers and Ethernet cable shall have at least (1) one spare cables.

At station level, the entire station shall be controlled and supervised from the station HMI. It shall also be possible to control and monitor the bay from the bay level equipment at all times.

Clear control priorities shall prevent operation of a single switch at the same time from more than one of the various control levels, i.e., RCC, station HMI, bay level or apparatus level. The priority shall always be on the lowest enabled control level.

The station level contains the station-oriented functions, which cannot be realized at bay level, e.g., alarm list or event list related to the entire substation, gateway for the communication with remote control centres.

The GPS time synchronizing signal (as specified in the section relay & protection) for the synchronization of the entire system shall be provided.

The SAS shall contain the functional parts as described in para 1.2 above.

11.1.4 Functional Requirements

The high-voltage apparatus within the station shall be operated from different places:

- Remote control centres
- Station HMI.
- Local Bay controller IED (in the bays)

Operation shall be possible by only one operator at a time.

The operation shall depend on the conditions of other functions, such as interlocking, synchrocheck, etc. (see description in **"Bay level control functions"**).

a. Select before Execute

For security reasons the command is always to be given in two stages: selection of the object and command for operation under all mode of operation except emergency operation. Final execution shall take place only when selection and command are actuated.

b. Command Supervision

i Bay/station interlocking and blocking

Software Interlocking is to be provided to ensure that inadvertent incorrect operation of switchgear causing damage and accidents in case of false operation does not take place.

In addition to software interlocking hardwired interlocking are to be provided for:

a) Bus Earth switch Interlocking

b) Isolator Interlocking

It shall be a simple layout, easy to test and simple to handle when upgrading the station with future bays. For software interlocking the bidder shall describe the scenario while an IED of another bay is switched off or fails.

A software interlock override function shall be provided which can be enabled to bypass the interlocking function.

c. Run Time Command cancellation

Command execution timer (configurable) must be available for each control level connection. If the control action is not completed within a specified time, the command should get cancelled.

d. Self-supervision

Continuous self-supervision function with self-diagnostic feature shall be included.

e. User configuration

The monitoring, controlling and configuration of all input and output logical signals and binary inputs and relay outputs for all built-in functions and signals shall be possible both locally and remotely.

It shall also be possible to interconnect and derive input and output signals, logic functions, using built-In functions, complex voltage and currents, additional logics (AND-gates, OR gates and timers). (Multi-activation of these additional functions should be possible).

The Functional requirement shall be divided into following levels:

a) Bay (a bay comprises of one circuit breaker and associated disconnector, earth switches and instrument transformer) Level Functions

b) System Level Functions

f. Bay level functions

In a decentralized architecture the functionality shall be as close to the process as possible. In this respect, the following functions can be allocated at bay level:

a) Bay control functions including data collection functionality in bay control/protection unit.

b) Bay protection functions

Separate IEDs shall be provided for bay control function and bay protection function.

i Bay control functions

a) Overview

Functions

- Control mode selection
- Select-before-execute principle
- Command supervision:
  - Interlocking and blocking
  - Double command
- Synchrocheck, voltage selection
- Run Time Command cancellation

- Transformer tap changer control (Raise and lower of tap) (for power transformer bays)
- Operation counters for circuit breakers
- Breaker position indication per phase
- Alarm annunciation
- Measurement display
- Local HMI (local guided, emergency mode)
- Interface to the station HMI.
- Data storage for at least 200 events
- Extension possibilities with additional I/O's inside the unit or via fibre-optic/Ethernet communication.

b) Control mode selection

Bay level Operation:

As soon as the operator receives the operation access at bay level the operation is normally performed via bay control IED. During normal operation bay control unit allows the safe operation of all switching devices via the bay control IED.

EMERGENCY Operation:

It shall be possible to close or open the selected Circuit Breaker with ON or OFF push buttons even during the outage of bay IED.

REMOTE mode:

Control authority in this mode is given to a higher level (Remote Control Centre) and the installation can be controlled only remotely. Control operation from lower levels shall not be possible in this operating mode.

c) Synchronism and energizing check

The synchronism and energizing check functions shall be bay-oriented and distributed to the bay control and/or protection devices. These features are:

- Settable voltage, phase angle, and frequency difference.
- Energizing for deadline - live bus, live line - dead bus or deadline – dead bus with no synchro-check function.
- Synchronising between live line and live bus with synchro-check function

Voltage selection

The voltages relevant for the Synchro check functions are dependent on the station topology, i.e., on the positions of the circuit breakers and/or the isolators. The correct voltage for synchronizing and energizing is derived from the auxiliary switches of the circuit breakers, the isolator, and earthing switch and shall be selected automatically by the bay control and protection IEDs.

d) Transformer tap changer control

Raise and lower operation of OLTC taps of transformer shall be facilitated through Bay controller IED.

ii Bay protection functions

a) General

The protection functions are independent of bay control function. The protection shall be provided by separate protection IEDs (numerical relays) and other protection devices as per section Relay & Protection.

IEDs, shall be connected to the communication infrastructure for data sharing and meet the real-time communication requirements for automatic functions. The data presentation and the configuration of the various IEDs shall be compatible with the overall system communication and data exchange requirements.

Event and disturbance recording function

Each IED should contain an event recorder capable of storing at least 100 time-tagged events.

b) Bay Monitoring Function:

Analogue inputs for voltage and current measurements shall be connected directly to the voltage transformers (VT) and the current transformers (CT) without intermediate transducers. The values of active power (W), reactive power (VAR), frequency (Hz), and the rms values for voltage (U) and current (I) shall be calculated in the Bay control/protection unit.

g. System level functions

i Status supervision

The position of each switchgear, e.g. circuit breaker, isolator, earthing switch, transformer tap changer etc., shall be supervised continuously. Every detected change of position shall be immediately displayed in the single-line diagram on the station HMI screen, recorded in the

event list, and a hard copy printout shall be produced. Alarms shall be initiated in the case of spontaneous position changes.

The switchgear positions shall be indicated by two auxiliary switches, normally closed (NC) and normally open (NO), which shall give ambivalent signals. An alarm shall be initiated if these position indications are inconsistent or if the time required for operating mechanism to change position exceeds a predefined limit.

ii Measurements

The analogue values acquired/calculated in bay control/protection unit shall be displayed locally on the station HMI and in the control centre. The abnormal values must be discarded. The analogue values shall be updated every 2 seconds.

Threshold limit values shall be selectable for alarm indications.

iii Event and alarm handling

Events and alarms are generated either by the switchgear, by the control IEDs, or by the station level unit. They shall be recorded in an event list in the station HMI. Alarms shall be recorded in a separate alarm list and appear on the screen. All, or a freely selectable group of events and alarms shall also be printed out on an event printer. The alarms and events shall be time-tagged with a time resolution of 1 ms.

iv Station HMI

a) Substation HMI Operation:

On the HMI the object has to be selected first. In case of a blocking or interlocking conditions are not met, the selection shall not be possible and an appropriate alarm annunciation shall occur. If a selection is valid the position indication will show the possible direction, and the appropriate control execution button shall be pressed in order to close or open the corresponding object.

Control operation from other places (e.g., REMOTE) shall not be possible in this operating mode.

b) Presentation and dialogues

The operator station HMI shall be a redundant with hot standby and shall provide basic functions for supervision and control of the substation. The operator shall give commands to the switchgear on the screen via mouse clicks.

The HMI shall give the operator access to alarms and events displayed on the screen. Aside from these lists on the screen, there shall be a printout of alarms or events in an event log.

An acoustic alarm shall indicate abnormalities, and all unacknowledged alarms shall be accessible from any screen selected by the operator.

The following standard pictures shall be available from the HMI:

- Single-line diagram showing the switchgear status and measured values
- Control dialogues with interlocking or blocking information details. This control dialogue shall tell the operator whether the device operation is permitted or blocked**.**
- Measurement dialogues
- Alarm list, station / bay-oriented
- Event list, station / bay-oriented
- System status

c) HMI design principles

Consistent design principles shall be adopted with the HMI concerning labels, colours, dialogues and fonts. Non-valid selections shall be dimmed out.

The object status shall be indicated using different status colours for:

- Selected object under command
- Selected on the screen
- Not updated, obsolete values, not in use or not sampled
- Alarm or faulty state
- Warning or blocked
- Update blocked or manually updated
- Control blocked
- Normal state

d) Process status displays and command procedures

The process status of the substation in terms of actual values of currents, voltages, frequency, active and reactive powers as well as the positions of circuit breakers, isolators and transformer tap-changers shall be displayed in the station single-line diagram.

In order to ensure a high degree of security against undesired operation, a "select-before-execute" command procedure shall be provided. After the "selection" of a switch, the operator shall be able to recognize the selected device on the screen, and all other switchgear shall be blocked. As communication between control centre and device to be controlled is established, the operator shall be prompted to confirm the control action and only then final execute command shall be accepted**.** After the "execution" of the command the operated switching symbol shall flash until the switch has reached its new position.

The operator shall be in a position to execute a command only, if the switch is not blocked and if no interlocking condition is going to be violated. The interlocking statements shall be checked by the interlocking scheme implemented at bay and station level.

After command execution the operator shall receive a confirmation that the new switching position has been reached or an indication that the switching procedure was unsuccessful with the indication of the reason for non-functioning.

e) System supervision & display

The SAS system shall be comprehensively self-monitored such that faults are immediately indicated to the operator, possibly before they develop into serious situations. Such faults are recorded as a faulty status in a system supervision display. This display shall cover the status of the entire substation including all switchgear, IEDs, communication infrastructure and remote communication links, and printers at the station level, etc.

f) Event list

The event list shall contain events that are important for the control and monitoring of the substation.

The event and associated time (with1 ms resolution) of its occurrence has to be displayed for each event.

The operator shall be able to call up the chronological event list on the monitor at any time for the whole substation or sections of it.

A printout of each display shall be possible on the hard copy printer.

The events shall be registered in a chronological event list in which the type of event and its time of occurrence are specified. It shall be possible to store all events in the computer for at least one month. The information shall be obtainable also from a printed event log.

The chronological event list shall contain:

- Position changes of circuit breakers, isolators and earthing devices

- Indication of protective relay operations
- Fault signals from the switchgear
- Indication when analogue measured values exceed upper and lower limits. Suitable provision shall be made in the system to define two level of alarm on either side of the value or which shall be user defined for each measurands.
- Loss of communication.

Filters for selection of a certain type or group of events shall be available. The filters shall be designed to enable viewing of events grouped per:

- Date and time
- Bay
- Device
- Function e.g. trips, protection operations etc.
- Alarm class

g) Alarm list

Faults and errors occurring in the substation shall be listed in an alarm list and shall be immediately transmitted to the control centre. The alarm list shall substitute a conventional alarm table, and shall constitute an evaluation of all station alarms. It shall contain unacknowledged alarms and persisting faults. The date and time of occurrence shall be indicated.

The alarm list shall consist of a summary display of the present alarm situation. Each alarm shall be reported on one line that contains:

- The date and time of the alarm
- The name of the alarming object
- A descriptive text
- The acknowledgement state.

Whenever an alarm condition occurs, the alarm condition must be shown on the alarm list and must be displayed in a flashing state along with an audible alarm. After acknowledgement of the alarm, it should appear in a steady (i.e. not flashing) state and the audible alarm shall stop. The alarm should disappear only if the alarm condition has physically cleared and the operator has reset the alarm with a reset command. The state of the alarms shall be shown in the alarm

list (Unacknowledged and persistent, Unacknowledged and cleared, Acknowledged and persistent).

Filters for selection of a certain type or group of alarms shall be available as for events.

h) Object picture

When selecting an object such as a circuit breaker or isolator in the single-line diagram, the associated bay picture shall be presented first. In the selected object picture, all attributes like

- Type of blocking
- Authority
- Local / remote control
- RSCC / SAS control
- Errors
- etc.,

shall be displayed.

i) Control dialogues

The operator shall give commands to the system by means of mouse click located on the single-line diagram. Data entry is performed with the keyboard. Dedicated control dialogues for controlling at least the following devices shall be available:

- Breaker and disconnector
- Transformer tap-changer

v User-authority levels

It shall be possible to restrict activation of the process pictures of each object (bays, apparatus...) within a certain user authorisation group. Each user shall then be given access rights to each group of objects, e.g.:

- Display only
- Normal operation (e.g. open/close of switchgear)
- Restricted operation (e.g. by-passed interlocking)
- System administrator

For maintenance and engineering purposes of the station HMI, the following authorisation levels shall be available:

- No engineering allowed
- Engineering/configuration allowed
- Entire system management allowed

The access rights shall be defined by passwords assigned during the log-in procedure. Only the system administrator shall be able to add/remove users and change access rights.

vi Reports

The reports shall provide time-related follow-ups of measured and calculated values. The data displayed shall comprise:

- Trend reports:
  - Day (mean, peak)
  - Month (mean, peak)
  - Semi-annual (mean, peak)
  - Year (mean, peak)
- Historical reports of selected analogue Values:
  - Day (at 15 minutes interval)
  - Week
  - Month
  - Year

It shall be possible to select displayed values from the database in the process display on-line. Scrolling between e.g. days shall be possible. Unsure values shall be indicated. It shall be possible to select the time period for which the specific data are kept in the memory.

Following printouts shall be available from the printer and shall be printed on demand:

- Daily voltage and frequency curves depicting time on X-axis and the appropriate parameters on the Y-axis. The time duration of the curve is 24 hours.
- Weekly trend curves for real and derived analogue values.
- Printouts of the maximum and minimum values and frequency of occurrence and duration of maximum and minimum values for each analogue parameter for each circuit in 24 hr period.
- Equipment operation details shift wise and during 24 hours.

- Printout on adjustable time period as well as on demand for MW, MVAR, Current, Voltage on each feeder and transformer as well as Tap Positions, temperature and status of fans for transformers.
- Printout on adjustable time period as well as on demand system frequency.
- Reports in specified formats which shall be handed over to successful bidder. The bidder has to develop these reports. The reports are limited to the formats for which data is available in the SAS database.

vii Trend display (historical data)

It shall be possible to illustrate all types of process data as trends - input and output data, binary and analogue data. The trends shall be displayed in graphical form as column or curve diagrams with a maximum of 10 trends per screen. Adjustable time span and scaling ranges must be provided.

It shall be possible to change the type of value logging (direct, mean, sum, or difference) on-line in the window. It shall also be possible to change the update intervals on-line in the picture as well as the selection of threshold values for alarming purposes.

viii Automatic disturbance file transfer

All recorded data from the IEDs with integrated sever computer shall be automatically uploaded (event triggered or once per day) to a master server computer and be stored on the hard disc.

ix IED parameter setting

It shall be possible to access all protection and control IEDs for reading the parameters (settings) from the station HMI or from a dedicated monitoring computer. The setting of parameters or the activation of parameter sets shall only be allowed after entering a password.

x Automatic sequences

The available automatic sequences in the system should be listed and described, (e.g. sequences related to the bus transfer). It must be possible to initiate pre-defined automatic sequences by the operator and also define new automatic sequences.

h. Gateway

i Communication Interface

The Substation Automation System shall have the capability to support simultaneous communications with multiple independent remote master stations,

The Substation Automation System shall have communication ports as follows:

a) Two ports for Remote Control Centre

b) Two ports for Regional System Coordination Centre (RSCC)

The communication interface to the SAS shall allow scanning and control of defined points within the substation automation system independently for each control centre. The substation automation system shall simultaneously respond to independent scans and commands from employer's control centres (RCC & RSCC). The substation automation system shall support the use of a different communication data exchange rate (bits per second), scanning cycle, and/or communication protocol to each remote-control centre. Also, each control centre's data scan and control commands may be different for different data points within the substation automation system's database.

ii Remote Control Centre Communication Interface

Employer will supply communication channels between the Substation Automation System and the remote-control centre. The communication channels provided by Employer will consist either of power microwave, optical fibre, VSAT or leased line, the details of which shall be provided during detailed Engineering.

iii **Interface equipment:**

The Contractor shall provide interface equipment for communicating between Substation Automation system and Remote-control centre and between Substation Automation system and Regional System Coordination Centre (RSCC). All necessary hardware and software shall also be in the scope of bidder.

iv Communication Protocol

The communication protocol for gateway to control centre must be open protocol and shall support IEC 60870-5-101/104 and IEC 61850 for all levels of communication for sub-station automation such as Bay to station HMI, gateway to remote station etc.

11.1.5 System hardware:

a. Redundant Station HMI, Remote HMI:

The contractor shall provide redundant station HMI in hot standby mode. The servers used in these workstations shall be of industrial grade.

It shall be capable to perform all functions for entire substation including future requirements as indicated in the SLD. It shall use industrial grade components. Processor and RAM shall be

selected in such a manner that during normal operation not more than 30% capacity of processing and memory are used. Supplier shall demonstrate these features.

The capacity of hard disk shall be selected such that the following requirement should occupy less than 50% of disk space:

a) Storage of all analogue data (at 15 Minutes interval) and digital data including alarm, event and trend data for thirty (30) days,

b) Storage of all necessary software,

c) 10 GB space for OWNER'S use.

Supplier shall demonstrate that the capacity of hard disk is sufficient to meet the above requirement.

i HMI (Human Machine Interface)

The VDU shall show overview diagrams (Single Line Diagrams) and complete details of the switchgear with a colour display. All event and alarm annunciation shall be selectable in the form of lists. Operation shall be by a user friendly function keyboard and a cursor positioning device. The user interface shall be based on WINDOWS concepts with graphics & facility for panning, scrolling, zooming, decluttering etc.

ii Visual Display Units/TFT's (Thin Film Technology)

The display units shall have high resolution and reflection protected picture screen. High stability of the picture geometry shall be ensured. The screen shall be at least 21" diagonally in size and capable of colour graphic displays.

The display shall accommodate resolution of 1280 X 1024 pixels.

iii Printer

It shall be robust & suitable for operation with a minimum of 132 characters per line. The printing operation shall be quiet with a noise level of less than 45 dB suitable for location in the control room. Printer shall accept and print all ASCII characters via master control computer unit interface.

The printer shall have an off line mode selector switch to enable safe maintenance. The maintenance should be simple with provisions for ease of change of print head, ribbon changing, paper insertion etc.

All reports and graphics prints shall be printed on printer

All printers shall be continuously online.

iv Mass Storage Unit

The mass storage unit shall be built-in to the Station HMI. All operational measured values, and indications shall be stored in a mass-storage unit in form of DVD RW the unit should support at least Read (48X), Write (24X), and Re-Write (10X) operations, with Multi-Session capability. It should support ISO9660, Rockridge and Joliet Filesystems. It should support formatting and use under the operating system provided for Station HMI. The monthly back up of data shall be taken on disc. The facility of back up of data shall be inherent in the software.

v Switched Ethernet Communication Infrastructure:

The bidder shall provide the redundant switched optical/Ethernet communication infrastructure for SAS. One switch shall be provided to connect all IEDs for bays of yard to communication infrastructure. Each switch shall have at least two spare ports for connecting bay level IEDs and one spare port for connecting station bus.

b. Bay level unit

The bay unit shall use industrial grade components. The bay level unit, based on microprocessor technology, shall use numerical techniques for the calculation and evaluation of externally input analogue signals. They shall incorporate select-before-operate control principles as safety measures for operation via the HMI. They shall perform all bay related functions, such as control commands, bay interlocking, data acquisition, data storage, event recording and shall provide inputs for status indication and outputs for commands. They shall be directly connected to the switchgear. The bay unit shall acquire and process all data for the bay (Equipment status, fault indications, measured values, alarms etc.) and transmit these to the other devices in sub-station automation system. In addition, this shall receive the operation commands from station HMI and control centre. The bay unit shall have the capability to store all the data for at least 24 hours.

One number Bay level unit shall be provided for supervision and control of each 33 kV bay (a bay comprises of one circuit breaker and associated disconnector, earth switches and instrument transformer). The Bay level unit shall be equipped with analogue and binary inputs/outputs for handling the control, status monitoring and analogue measurement functions. All bay level interlocks are to be incorporated in the Bay level unit so as to permit control from the Bay level unit/ local bay mimic panel, with all bay interlocks in place, during maintenance and commissioning or in case of contingencies when the Station HMI is out of service.

The bay control unit to be provided for the bays shall be preferably installed in the CB relay panel/feeder protection panel for respective bay.

The Bay level unit shall meet the requirements for withstanding electromagnetic interference according to relevant parts of IEC 61850. Failure of any single component within the equipment shall neither cause unwanted operation nor lead to a complete system breakdown.

i Input/Output (I/O) modules

The I/O modules shall form a part of the bay level unit and shall provide coupling to the substation equipment. The I/O modules shall acquire all switchgear information (i.e. data coming directly from the switchgear or from switchgear interlocking devices) and transmit commands for operation of the switchgear. The measured values of voltage and current shall be from the secondaries of instrument transformers. The digital inputs shall be acquired by exception with 1 ms resolution. Contact bouncing in digital inputs shall not be assumed as change of state

c. Switchyard Panel Room:

The switchyard panel room shall be constructed to house Bay level units, bay mimic, relay and protection panels, Communication panels etc.. The layout of equipment/panel shall be subject to Owner's approval. The switchyard panel room shall be provided with necessary illuminations, fire alarm system with at least two detectors with necessary power supply if required and it shall be wired to SAS. The detailed constructional requirement of switchyard panel room is detailed in civil design of technical specification and air conditioning requirement of switchyard panel room shall be as detailed in Air conditioning system of technical specification. The air conditioner provided in switchyard panel room shall be monitored from substation automation system.

d. Extendibility in future

Offered substation automation system shall be suitable for extension in future for additional bays. During such requirement, all the drawings and configurations, alarm/event list etc. displayed shall be designed in such a manner that its extension shall be easily performed by the employer. During such event, normal operation of the existing substation shall be unaffected and system shall not require a shutdown. The contractor shall provide all necessary software tools along with source codes to perform addition of bays in future and complete integration with SAS by the user. These software tools shall be able to configure IED, add additional analogue variable, alarm list, event list, modify interlocking logics etc. for additional bays/equipment which shall be added in future.

11.1.6 Software structure

The software package shall be structured according to the SAS architecture and strictly divided in various levels. Necessary firewall shall be provided at suitable points in software to protect

the system. An extension of the station shall be possible with lowest possible efforts. Maintenance, modification or an extension of components of any feeder may not force a shut-down of the parts of the system which are not affected by the system adaptation.

a. Station level software

i Human-machine interface (HMI)

The base HMI software package for the operator station shall include the main SAS functions and it shall be independent of project specific hardware version and operating system. It shall further include tools for picture editing, engineering and system configuration. The system shall be easy to use, to maintain, and to adapt according to specific user requirements. Systems shall contain a library with standard functions and applications.

b. Bay level software

i System software

The system software shall be structured in various levels. This software shall be placed in a non-volatile memory. The lowest level shall assure system performance and contain basic functions, which shall not be accessible by the application and maintenance engineer for modifications. The system shall support the generation of typical control macros and a process database for user specific data storage. In case of restoration of links after failure, the software along with hardware shall be capable of automatically synchronising with the remaining system without any manual interface. This shall be demonstrated by contractor during integrated system test.

ii Application software

In order to ensure robust quality and reliable software functions, the main part of the application software shall consist of standard software modules built as functional block elements. The functional blocks shall be documented and thoroughly tested. They form part of a library.

The application software within the control/protection devices shall be programmed in a functional block language.

11.1.7 Tests

The substation automation system offered by the bidder shall be subjected to following tests to establish compliance with IEC 61850 for Medium Voltage sub-station equipment installed in sheltered area in the outdoor switchyard and specified ambient conditions:

a. Type Tests:

i Control IEDs and Communication Equipment:

a) Power Input:
   - Auxiliary Voltage
   - Current Circuits
   - Voltage Circuits
   - Indications

b) Accuracy Tests:
   - Operational Measured Values
   - Currents
   - Voltages
   - Time resolution

c) Insulation Tests:
   - Dielectric Tests
   - Impulse Voltage withstand Test

d) Influencing Quantities
   - Limits of operation
   - Permissible ripples
   - Interruption of input voltage

e) Electromagnetic Compatibility Test:
   - 1 MHZ. burst disturbance test
   - Electrostatic Discharge Test
   - Radiated Electromagnetic Field Disturbance Test
   - Electrical Fast transient Disturbance Test
   - Conducted Disturbances Tests induced by Radio Frequency Field
   - Magnetic Field Test
   - Emission (Radio interference level) Test.
   - Conducted Interference Test

f) Function Tests:
   - Indication
   - Commands
   - Measured value Acquisition
   - Display Indications

g) Environmental tests:
   - Cold Temperature
   - Dry Heat

- Wet heat
- Humidity (Damp heat Cycle)
- Vibration
- Bump
- Shock

b. Factory Acceptance Tests:

The supplier shall submit a test specification for factory acceptance test (FAT) and commissioning tests of the station automation system for approval. For the individual bay level IED's applicable type test certificates shall be submitted.

The manufacturing and configuration phase of the SAS shall be concluded by the factory acceptance test (FAT). The purpose is to ensure that the Contractor has interpreted the specified requirements correctly and that the FAT includes checking to the degree required by the user. The general philosophy shall be to deliver a system to site only after it has been thoroughly tested and its specified performance has been verified, as far as site conditions can be simulated in a test lab. During FAT the entire Sub-station Automation System including complete control and protection system to be supplied under present scope shall be tested for complete functionality and configuration in factory itself. The extensive testing shall be carried out during FAT. The purpose of Factory Acceptance Testing is to ensure trouble free installation at site. No major configuration setting of system is envisaged at site.

If the complete system consists of parts from various suppliers or some parts are already installed on site, the FAT shall be limited to sub-system tests. In such a case, the complete system test shall be performed on site together with the site acceptance test (SAT).

i Hardware Integration Tests:

The hardware integration test shall be performed on the specified systems to be used for Factory tests when the hardware has been installed in the factory. The operation of each item shall be verified as an integral part of system. Applicable hardware diagnostics shall be used to verify that each hardware component is completely operational and assembled into a configuration capable of supporting software integration and factory testing of the system. The equipment expansion capability shall also be verified during the hardware integration tests. The vendor specifically demonstrates how to add a device in future in SAS during FAT. The device shall be from a different manufacturer than the SAS supplier.

ii Integrated System Tests:

Integrated system tests shall verify the stability of the hardware and the software. During the tests all functions shall run concurrently and all equipment shall operate a continuous 100 Hours period. The integrated system test shall ensure the SAS is free of improper interactions between software and hardware while the system is operating as a whole.

c. Site Acceptance Tests:

The site acceptance tests (SAT) shall completely verify all the features of SAS hardware and software. The bidder shall submit the detailed SAT procedure and SAT procedure shall be read in conjunction with the specification.

11.1.8 System Operation

Operation of the system by the operator from the remote RCC or at the substation shall take place via industry standard HMI (Human Machine interface) subsystem consisting of graphic colour VDU, a standard keyboard and a cursor positioning device (mouse).

The coloured screen shall be divided into 3 fields:

a) Message field with display of present time and date
b) Display field for single line diagrams
c) Navigation bar with alarm/condition indication

For display of alarm annunciation, lists of events etc a separate HMI View node shall be provided.

All operations shall be performed with mouse and/or a minimum number of function keys and cursor keys. The function keys shall have different meanings depending on the operation. The operator shall see the relevant meanings as function tests displayed in the command field (i.e. operator prompting). For control actions, the switchgear (i.e., circuit breaker etc.) requested shall be selectable on the display by means of the cursor keys. The switching element selected shall then appear on the background that shall be flashing in a different color. The operator prompting shall distinguish between:

- Prompting of indications e.g., fault indications in the switchgear, and
- prompting of operational sequences e.g., execution of switching operations

The summary information displayed in the message field shall give a rapid display of alarm/message of the system in which a fault has occurred and alarm annunciation lists in which the fault is described more fully.

Each operational sequence shall be divided into single operation steps which are initiated by means of the function keys/WINDOW command by mouse. Operator prompting shall be designed in such a manner that only the permissible keys are available in the command field related to the specific operation step. Only those switching elements shall be accessed for which control actions are possible. If the operation step is rejected by the system, the operator prompting shall be supported by additional comments in the message field. The operation status shall be reset to the corresponding preceding step in the operation sequence by pressing one of the function keys. All operations shall be verified. Incorrect operations shall be indicated by comments in the message field and must not be executed.

The offer shall include a comprehensive description of the system. The above operation shall also be possible via WINDOWS based system by mouse.

11.1.9 Power Supply

Power for the substation automation system shall be derived from substation 110V DC system.

Uninterrupted supply shall be provided for servers, gateways station HMI disturbance recorder evaluation unit and its peripheral devices e.g., printer etc. In the event of Power failure, necessary safeguard software shall be built for proper shutdown.

11.1.10 Documentation

The following documents shall be submitted for employer's approval during detailed engineering:

- System Architecture Drawing
- Hardware Specification
- Functional Design Document
- Clear procedure describing how to add an IED/bay/diameter in future covering all major supplier

The following documentation to be provided for the system in the course of the project shall be consistent, CAD supported, and of similar look/feel. All CAD drawings to be provided in "dxf, dwg and pdf" format.

- List of Drawings
- Substation automation system architecture
- Block Diagram
- Guaranteed technical parameters, Functional Design Specification and Guaranteed availability and reliability
- Calculation for power supply dimensioning

- I/O Signal lists
- Schematic diagrams
- List of Apparatus
- List of Labels
- Logic Diagram (hardware & software)
- Switchyard Panel Room layout drawing
- Control Room Lay-out
- Test Specification for Factory Acceptance Test (FAT)
- Product Manuals
- Assembly Drawing
- Operator's Manual
- Complete documentation of implemented protocols between various elements
- Listing of software and loadable in CD ROM
- Other documents as may be required during detailed engineering

11.1.11 Training, Support Services, Maintenance and Spares

a. Training

Contractor personnel who are experienced instructors and who speak understandable English shall conduct training. The contractor shall arrange on its own cost all hardware training platform required for successful training and understanding in Nepal. The Contractor shall provide all necessary training material. Each trainee shall receive individual copies of all technical manuals and all other documents used for training. These materials shall be sent to Employer at least two months before the scheduled commencement of the particular training course. Class materials, including the documents sent before the training courses as well as class handouts, shall become the property of Employer. Employer reserves the right to copy such materials, but for in-house training and use only. Hands-on training shall utilize equipment identical to that being supplied to Employer.

The schedule, location, and detailed contents of each course will be finalized during Employer and Contractor discussions.

b. Computer System Hardware Course

A computer system hardware course shall be offered, but at the system level only. The training course shall be designed to give Employer hardware personnel sufficient knowledge of the overall design and operation of the system so that they can correct obvious problems, configure the hardware, perform preventive maintenance, run diagnostic programs, and communicate with contract maintenance personnel. The following subjects shall be covered:

a) System Hardware Overview: Configuration of the system hardware.
b) Equipment Maintenance: Basic theory of operation, maintenance techniques and diagnostic procedures for each element of the computer system, e.g., processors, auxiliary memories, LANs, routers and printers. Configuration of all the hardware equipment.
c) System Expansion: Techniques and procedures to expand and add equipment such as loggers, monitors, and communication channels.
d) System Maintenance: Theory of operation and maintenance of the redundant hardware configuration, failover hardware, configuration control panels, and failover switches. Maintenance of protective devices and power supplies.
e) Subsystem Maintenance: Theory of design and operation, maintenance techniques and practices, diagnostic procedures, and (where applicable) expansion techniques and procedures. Classes shall include hands-on training for the specific subsystems that are part of Employer's equipment or part of similarly designed and configured subsystems. All interfaces to the computing equipment shall be taught in detail.
f) Operational Training: Practical training on preventive and corrective maintenance of all equipment, including use of special tools and instruments. This training shall be provided on Employer equipment, or on similarly configured systems.

c. Computer System Software Course

The Contractor shall provide a computer system software course that covers the following subjects:

a) System Programming: Including all applicable programming languages and all stand-alone service and utility packages provided with the system. An introduction to software architecture, Effect of tuning parameters (OS software, Network software, database software etc.) on the performance of the system.
b) Operating System: Including the user aspects of the operating system, such as program loading and integrating procedures; scheduling, management, service, and utility functions; and system expansion techniques and procedures
c) System Initialization and Failover: Including design, theory of operation, and practice
d) Diagnostics: Including the execution of diagnostic procedures and the interpretation of diagnostic outputs,
e) Software Documentation: Orientation in the organization and use of system software documentation.
f) Hands-on Training: One week, with allocated computer time for trainee performance of unstructured exercises and with the course instructor available for assistance as necessary.

d. Application Software Course

The Contractor shall provide a comprehensive application software course covering all applications including the database and display building course. The training shall include:

a) Overview: Block diagrams of the application software and data flows. Programming standards and program interface conventions.
b) Application Functions: Functional capabilities, design, and major algorithms. Associated maintenance and expansion techniques.
c) Software Development: Techniques and conventions to be used for the preparation and integration of new software functions.
d) Software Generation: Generation of application software from source code and associated software configuration control procedures.
e) Software Documentation: Orientation in the organization and use of functional and detailed design documentation and of programmer and user manuals.
f) Hands-on Training: One week, with allocated computer time for trainee performance of unstructured exercises and with the course instructor available for assistance as necessary.

e. Requirement of training:

The contractor shall provide training for OWNER'S personnel comprehensively covering following courses.

S. No.	Name of Course
1	Computer System Hardware
2	Computer System Software
3	Application Software

11.1.12 Maintenance

a. Maintenance Responsibility during the Guaranteed Availability Period.

During Guaranteed Availability Period, the Contractor shall take continual actions to ensure the guaranteed availability and shall make available all the necessary resources such as specialist personnel, spare parts, tools, test devices etc. for replacement or repair of all defective parts and shall have prime responsibility for keeping the system operational. During guarantee period as specified in tender document, contractor shall arrange bi-monthly visit of their representative to site to review the performance of system and in case any defect/shortcoming etc. is observed during the period, the same shall be set right by the contractor within 15 days.

11.1.13 Reliability and Availability

The SAS shall be designed so that the failure of any single component, processor, or device shall not render the system unavailable. The SAS shall be designed to satisfy the very high demands for reliability and availability concerning:

- Mechanical and electrical design
- Security against electromagnetic interference (EMI)
- High quality components and boards
- Modular, well-tested hardware
- Thoroughly developed and tested modular software
- Easy-to-understand programming language for application programming
- Detailed graphical documentation and application software
- Built-in supervision and diagnostic functions
- Security
  - Experience of security requirements
  - Process know-how
  - Select before execute at operation
  - Process status representation as double indications
- Distributed solution
- Independent units connected to the local area network
- Back-up functions
- Panel design appropriate to the harsh electrical environment and ambient conditions
- Panel grounding immune against transient ground potential rise

a. Outage terms

i Outage

The state in which substation automation system or a unit of SAS is unavailable for Normal Operation due to an event directly related to the SAS or unit of SAS. In the event, the owner has taken any equipment/ system other than Sub-station Automation System for schedule/forced maintenance, the consequent outage to SAS shall not be considered as outage for the purpose of availability.

ii Actual outage duration (AOD)

The time elapsed in hours between the start and the end of an outage. The time shall be counted to the nearest 1/4th of an hour. Time less than 1/4th of an hour shall be counted as having duration of 1/4th of an hour.

iii Period Hours (PH)

The number of hours in the reporting period. In a full year the period hour are 8760h (8784h for a leap year).

iv Actual Outage hours (AOH)

The sum of actual outage duration within the reporting period

AOH = ∑ AOD

v Availability:

Each SAS shall have a total availability of 99.98 % i.e. the ratio of total time duration minus the actual outage duration to total time duration.

b. Guarantees Required

The availability for the complete SAS shall be guaranteed by the Contractor. Bidder shall include in their offer the detailed calculation for the availability. The contractor shall demonstrate their availability guaranteed by conducting the availability test on the total sub-station automation system as a whole after commissioning of total Sub-station Automation system. The test shall verify the reliability and integrity of all sub-systems. Under these conditions the test shall establish an overall availability of 99.98%. After the lapse of 1000 Hours of cumulative test time, test records shall be examined to determine the conformance with availability criterion. In case of any outage during the availability test, the contractor shall rectify the problem and after rectification, the 1000 Hours period start after such rectification. If test object has not been met the test shall continue until the specified availability is achieved.

The contractor has to establish the availability in a maximum period of three months from the date of commencement of the availability test.

After the satisfactory conclusion of test both contractor and employer shall mutually agree to the test results and if these results satisfy the availability criterion, the test is considered to be completed successfully. After that the system shall be taken over by the employer and then the guarantee period shall start.

11.1.14 Spares

a. Consumables:

All consumables such as paper, cartridges shall be supplied by the contractor till the SAS is taken over by the owner.

b. Availability Spares:

In addition to mandatory spares as listed in section project for SAS, the bidder is required to list the spares, which may be required for ensuring the guaranteed availability during the guaranteed availability period. The final list of spares shall form part of scope of supply and accordingly the price thereof shall be quoted by the bidder and shall be considered in the evaluation of the bids. During the guaranteed availability period, the spare parts supplied by the Contractor shall be made available to the Contractor for usage subject to replenishment at the earliest. Thus, at the end of availability period the inventory of spares with the Employer shall be fully replenished by the Contractor. However, any additional spares required to meet the availability of the system (which are not a part of the above spares supplied by the Contractor) would have to be supplied immediately by the Contractor free of cost to the Employer.

11.1.15 List of Equipment

Quantity of equipment shall be decided by bidder in order to achieve guaranteed reliability and availability as declared by bidder.

i.) Station HMI
ii.) Redundant Station HMI (in Hot-stand-by mode)
iii.) Bay level units along with bay mimic as Project Specification Requirement.
iv.) Bay Level Unit for Auxiliary system (as per requirement)
v.) Colour Laser Printer – 1 No. (For Reports)
vi.) All interface equipment for gateway to RCC and RSCC
vii.) Communication infrastructure between Bay level units, Station HMI, Printers, gateways, redundant LAN etc. as required
viii.) Any other equipment as necessary

11.1.16 List of Analogue and Digital Inputs

Basic Monitoring requirements are:

- Switchgear status indication
- Measurements (U, I, P, Q, f)
- Event
- Alarm
- Winding temperature of transformers
- ambient temperature
- Status of display of Fire protection system and Air conditioning system.
- Acquisition of alarm and fault record from protection relays

- Disturbance records from Bay Control Unit
- Monitoring the state of batteries by displaying DC voltage, charging current and load current etc.
- Tap-position of Transformer

The list of input for typical bays is as below:-

a. Analogue inputs

i) For line

- Current R phase
- Y phase
- B phase
- Voltage R-Y phase
- Y-B phase
- B-R phase

ii) For transformer

- R phase
- Y phase
- B phase
- WTI (for transformer)
- Tap position (for transformer only)

iii) Common

a) Voltage for Bus wherever applicable

-
- Voltage R-Y phase
- Y-B phase
- B-R phase

b) Frequency for Bus

- Ambient temperature (switchyard)
- Switchyard Panel Room Temperature.
- LT system
  - Voltage R-Y, Y-B, B-R of Main Switch Board
  - Voltage R-Y, Y-B, B-R of Diesel Generator
  - Current from LT transformer

- Current from Diesel Generator
- Voltage of 110V DCDB-I
- Current from 110V Battery set
- Current from 110V Battery charger

b. Digital Inputs

The list of input for various bays/SYSTEM is as follows:

Line bays

- Status of CB.
- Status of Isolator, Earth switch
- CB operation/closing lockout
- Trip coil faulty
- LBB optd
- Bus bar protn trip relay optd
- Direct trip- sent
- Direct trip- received
- O/V STAGE – I operated
- O/V STAGE – II operated
- VT FUSE FAIL
- PROTN TRIP
- R-PH TRIP
- Y-PH TRIP
- B-PH TRIP
- START
- Back-up o/c optd
  - Back-up e/f optd
  - 110V DC-I/II source fail

Transformer bays

- Status of each pole of CB, Isolator, Earth switch
- CB trouble
- CB operation/closing lockout
- Trip coil faulty
- LBB optd
- Bus bar protn trip relay optd
- REF OPTD

- DIF OPTD
- OVERFLUX ALARM (MV)
- OVERFLUX TRIP (MV)
- OVERFLUX ALARM (LV)
- OVERFLUX TRIP (LV)
- LV BUS VT ½ FUSE FAIL
- MV BUS VT ½ FUSE FAIL
- OTI ALARM/TRIP
- PRD OPTD
- BUCHOLZ TRIP
- BUCHOLZ ALARM
- OIL LOW ALARM
- back-up o/c (LV) optd
- back-up e/f (LV)optd
- 110v DC- source fail
- back-up o/c (MV) optd
- back-up e/f (MV)optd

Transformer bays

- Status of CB, Isolator, Earth switch
- CB trouble
- CB operation/closing lockout
- Trip coil faulty
- LBB optd
- Bus bar protn trip relay optd
- REF OPTD
- DIF OPTD
- HV BUS VT ½ FUSE FAIL
- OTI ALARM/TRIP
- PRD OPTD
- BUCHOLZ TRIP
- BUCHOLZ ALARM
- OIL LOW ALARM
- 110v DC source fail

Bus bar Protection

- Bus bar trip
- Bus bar zone CT open
- Bus protection relay fail

Switchyard Panel Room:

- AC Compressor ON/OFF
- Fire Detection ON/OFF

The exact number and description of digital inputs shall be as per detailed engineering requirement Apart from the above-mentioned digital inputs, minimum of 150 inputs shall be kept for future use.

11.1.17 List of I/O Points to be transmitted to RSCC

a) MW and MVAR for all lines, transformers

b) Voltage of bus

c) Frequency of 33 kV Bus

d) All Breakers

e) All isolators

f) Tap Position for all transformers

g) Master protection signal for all feeders, transformers Units and Bus Bar

h) Loss of Voltage signal for Bus bar

i) All the points identified in point (d), (e) and (f) above as GPS Time stamped.

j) Temperature value per substation.

k) Any other point decided during detailed engineering

11.2 Communication System

11.2.1 Scope of Work

The communication systems for the plant shall comprise the following:

- One (1) telephone and intercommunication system;
- One (1) optical communication system;
- One (1) radio communication system;
- One (1) clock system;
- One (1) lot of special spare parts.

The entire costs of the Communication System shall be under the SCADA or Automation System in Bid Price.

11.2.2 Telephone System

a. System Configuration

The telephone and intercommunication system shall be in compliance with the related standards, the requirements of the Local Authorities and shall be the well proven product of a competent manufacturer.

The telephone system shall comprise the following:

- Digital PABX with software;
- Workstation with monitor;
- Attendant console;
- Main and sub distribution frames;
- Twenty (20) telephone sets for different applications;
- PAX for intercommunication;
- Ten (10) multifunctional intercommunication desk sets;
- One (1) digital voice recorder;
- Power supply units;
- Telephone cable system.

The PABX/PAX shall be installed in the telecommunication room in the portal building. The workstation and the attendant console shall be located at the reception in the portal building.

b. Particular Design and Construction Requirements

i Digital Automatic Telephone Exchange (PABX)

The telephone system of PABX type shall comprise a digital automatic telephone exchange for 100 extensions with direct access for internal telephone users and external telephone connections. The automatic telephone exchange shall have the following features:

- Flexibility in expansion and increase of its carrying capacity;
- Compatible with ISDN (Integrated Services Network);
- Self-monitoring with protocol print out;
- Open and closed system of numbering with any kind of recording;
- Code dialling with 30 memorised numbers;
- Last number memory and busy call repeat;
- Call forward to another extension;
- Integration with other types of automatic exchanges for all type of links;
- Command signal transmission by all methods;
- Night answer service;
- Establishing of bypass channels;
- Metering of local and trunk calls;
- Breaking down subscribers into 16 extension categories;
- Connection of pay telephones for local and trunk calls;
- Invoicing of additional services;
- Establishing of communication with the LDC;
- Connection to fire and security alarm system.

The PABX shall be provided with a workstation and monitor.
The plant shall be equipped with one (1) desk type attendant console. This console shall handle the external traffic to the plant. The console shall contain the following:

- Extension to switch into line;
- Call indicators;
- Internal call indicator;
- Meters for long distance calls.

The following services shall be provided for the telephone subscribers:

- All types of telephone services including trunk and international calls;
- Connection of all types of telephone sets (push-button and frequency dialling);
- Connection of personal computers and facsimile facilities;

- Extension numbers are permanently allocated; they can be moved to other locations;
- Quick dialling;
- Direct calling;
- Conference call service (up to 8 parties).

Main characteristics

- The automatic exchange shall have the capacity for 100 extensions;
- The automatic telephone exchange shall be provided with stored program control and digital speech channel switching;
- The specific subscriber load shall be up to 0.2 Erlang
- The specific input power per extension shall not exceed 2.0 W.

ii Telephone Sets

The offices, operation and service locations of the plant, control building and the houses of the staff quarter shall be equipped with push button dial telephone sets of modern approved design.

- Ten (10) desk type for offices;
- Five (5) heavy duty wall type for external areas;
- Five (5) flush built-in type for control room desks and UCB;
- Fifty (50) telephone socket outlets.

The above quantities as well as the application of sound hoods shall be adapted at detail design stage according to actual requirements.

- Main characteristics
  - The telephone sets shall be compatible with the digital automatic exchange;
  - The sound brightness shall be at least 80% at noise level of 60 dB;
  - Volume of call signal shall be adjustable and not less than 70 dB.
- Sound hoods made of suitable plastic material shall be installed for the wall mounted telephone extensions in noisy and outdoor areas.

iii Intercommunication System (PAX)

(1) The intercommunication system is intended to provide the station manager and shift engineer direct telephone access to all station areas.

- For this purpose the offices of the station manager and shift engineer shall be equipped with multifunctional telephone sets with attachment.

- These telephone sets shall have direct access to the telephone subscribers in the control room, office, staff quarter and guard house.
- The offices of the heads of department and maintenance engineers shall be equipped with multifunction sets without attachment.

(2) The multifunctional telephone sets shall feature the following:

- Alpha/numeric display;
- Memory for 100 addresses with names, telephone numbers etc.
- Indication of the subscriber's name on the display at internal calls;
- Messages by display
- Reminding of time and place of meeting;
- Programmed keyboard
- Programmable keyboard with light emitting diodes
- Secretary functions
- Loud speaking communication dialling without lifting up the handset;
- Individual and group calls, interphone
- Automatic dialling
- Transfer of calls and interception of calls;
- Internal and external conference coupling;
- Re-dialling;
- Blocking of calls.

(3) Main characteristics

- The multifunctional telephone sets shall be compatible with the digital automatic exchange;
- The sound brightness shall be at least 80% at noise level of 60 dB;
- Volume of call signal shall be adjustable and not less 70 dB.

iv Digital Voice Recorder

(1) The intercommunication system shall include digital voice recording equipment for recording the operator communication. The digital type recorder shall be used for continuous automatic recording of the operator communication with high performance reliability.

- The voice recorder shall provide the following features:
- Round-the-clock operation in the mode of simultaneous recording of all speech channels;
- Automatic start-up of the recorder when talk starts on any input channel;
- Tagging and display of the date and current time;

- Compatibility of signal and impedance levels with communication;
- Compressed storage of data.

(2) Main characteristics

- The recorder shall have at least 4 recording channels;
- Continuous time of recording shall be at least 52 h;
- Power shall be supplied from the 110 V DC auxiliary supply systems.

v Telephone Cable System and Power Supply

(1) The telephone network shall be a star-shaped cable system with a main distribution and sub-distribution frames. The cabling shall be carried out with shielded multi-pair cables well protected against any external influence.

(2) The telephone system shall be equipped with duplicated power supply units. The power shall be taken from the redundant 110 V DC auxiliary supply systems in the portal building.

Back-up supply shall be provided in compliance with the standards.

11.2.3 Optical Communication System

The Optical communication system shall be designed to carry out the following functions:

1. Ensure capacity to transmit the voice signal and data from substation to Regional Dispatch Centre (NEA) via ADSS Cable stringed on 33 kV line.
2. Ensure communication and data transmission between substation and Regional Dispatch Centre.
3. Capability for communication and data transmission between this substation and other substation in future;
4. Other public purpose if required;

The contractor shall supply, install and commission all communication equipment such as OLTE, STM, SDH equipment etc for proper data and voice communication as per specification.

Protocol for communication with NEA Regional Distribution Command Centre and existing substation shall be IEC 60-870-104.

11.2.4 Clock System

a. System Configuration

(1) The clock system shall be in compliance with the related standards and shall be the well proven product of a competent manufacturer.

The clock system shall comprise the following:

- One (1) termination board as interface to the GPS master clock;
- Ten (10) secondary clocks, analogue type;
- Two (2) secondary clocks, digital type;
- Ten (10) secondary clocks, digital calendar type;
- Secondary clock cable system.

(2) The secondary clocks shall be connected to the GPS master clock, provided with the ACS. The master clock shall transmit synchronised second and minute pulses. The GPS master clock shall be installed in the electronic room adjacent to the CCR.

(3) The number of secondary clock circuits shall be determined by the Contractor, based on the particular features of the proposed system.

(4) The design of the secondary clocks shall be appropriate for the different locations. The final selection will be made at detail design stage.

b. Particular Design and Construction Requirements

The scope of work shall comprise a complete functional clock system comprising the following types of secondary clocks:

(1) Analogue clocks

The analogue clocks shall be a standard series product with the following features:

- Heavy duty industrial type metal enclosure of 300 - 400 mm diameter approx. for indoor installation;
- Single/double face display;
- White clock face with black figures and black pointers for hours and minutes;
- Suitable for wall or pendant mounting.

Application: General rooms, corridors, workshops.

(2) Digital clocks

The digital clocks shall be a standard series product with the following features:

- Heavy duty industrial type, rectangular metal enclosure of 800X300 mm approx. for indoor installation;
- Single face display of hours and minutes;
- Black clock face with yellow figures, 175 mm approx. with adjustable brightness;
- Suitable for wall mounting;
- Supply voltage 230 V AC

Application: Machine hall.

The colours of the casing and display shall be coordinated with the architect.

(3) Digital calendar clocks

The digital calendar clocks shall be a standard series product with the following features:

- Heavy duty industrial type, rectangular metal enclosure of 400X180 mm approx. for indoor installation;
- Single face display of day, date, hours and minutes;
- Black clock face with yellow figures, 75 mm approx. with adjustable brightness;
- Suitable for wall mounting;
- Supply voltage 230 V AC

Application: Dedicated offices, control rooms.

The colours of the casing and display shall be coordinated with the architect.

(4) The cabling and wiring shall be executed as an independent system using the cable routes of the other communication systems.

11.2.5 Spare Parts

a. General Spare Parts

Reference is made to the Standard Technical Requirements (Section 3, Part III – EM Works, Vol. 2).

b. Special Spare Parts

The special spare parts specified hereafter are in addition to those mentioned in the Standard Technical Specification.

- One (1) printed board of each type for the telephone system;

One (1) analogue and digital calendar clock each.

c. Recommended Spare Parts

The Tenderer shall recommend the spare parts he considers necessary for a five years operation of the equipment. These spare parts shall be quoted in the price lists but not included in the total price.

11.2.6 Workshop Tests

The communication systems, related equipment and materials shall be type tested standard products of competent manufacturers. Type test certificates shall be submitted to the Employer/Engineer.

Workshop tests shall be carried out in compliance with the certified QC plan and the relevant Standards.

11.2.7 Site Tests

Site tests shall be carried out in compliance with the approved QC plan and the Standards. The following tests are the minimum requirement and shall be applied as appropriate for the different communication systems:

- Inspection of the completed cable systems;
- Continuity tests of cable systems;
- Measurement of insulation resistance;
- Functional and performance tests of each system.

11.3 Security System

11.3.1 Scope of Work

The security systems for the plant shall comprise the following:

- One (1) Closed circuit television system;
- One (1) Access control system;
- One (1) Lot of special spare parts.

The entire costs of the Security System shall be under the SCADA System in Bid Price.

11.3.2 Closed Circuit TV system (CCTV)

a. System Configuration

The CCTV system shall be in compliance with the related standards and shall be the well proven product of a competent manufacturer. The CCTV system shall comprise the followings:

- One (1) matrix video switcher;
- One (1) color digital disc recorder
- One (1) system controller with monitors in the CCR (Central Control Room);
- One (1) system controller with monitor in the guard room;
- Ten (10) indoor cameras;
- Twenty (20) outdoor cameras including gates and yards;
- Power supply units
- CCTV fibre optic cable system.

The matrix video switcher shall be installed in the electronic room adjacent to the CCR. The monitors with control stations shall be located in the CCR and guard room, respectively. The CCTV shall be remotely viewable from Regional Control Centre.

The equipment ratings and the number of cameras shall be determined by the Contractor, based on the particular features of the proposed system.

The CCTV system shall be based on IP technology.

b. Particular Design and Construction Requirements

A CCTV system shall be provided for the surveillance of the plant and the related structures including the entrance to the portal building, the main personnel and vehicle entrances to the plant, the control rooms and required locations.

The Contractor shall position the cameras at strategic locations, mounted on buildings or using masts as required, to achieve the coverage of the a.m. areas.

The CCTV system shall permit persons to be clearly seen at any position within the coverage area. The CCTV images displayed on the monitors and recorded on video discs shall be of adequate quality to enable clear and unambiguous identification of persons and motor vehicles.

c. Central Control and Video Matrix Switching Unit

A microprocessor based central control and video matrix switching unit shall be provided to display selected camera images on manually or automatically selected TV monitors. The equipment may be installed in common cubicles with the communication equipment. Safe power supply shall be provided.

An interface to the Regional Dispatch Centre (RDC) should be provided in the matrix so that the pictures can be received in RDC. The camera control shall be transferrable with an RDC/ CCR selector switch at the monitors.

As a minimum requirement, the following function shall be provided:

- Keyboard control stations with joy stick, installed in the CCR, and the guard room;
- 32 video inputs;
- 6 monitor outputs;
- Superimposing of camera number, time and date on the TV monitor video display;
- Selection of screen format;
- Interface to digital recorder and LDC.

d. Monitors

One 21 inch LED TV monitors shall be provided in the CCCR and One 21 inch LED TV in the guard room, suitable to display the images from any of the cameras in the system.

e. Cameras

Solid state cameras with charge coupled devices (CCD/HD) capable of providing high definition color video images shall be provided. The image sensor size shall be ½ in format with a horizontal resolution of 460 lines.

Camera lenses shall have a high optical performance to ensure clear images at all positions and distances within the range at day and night.

The focal length of the lens shall be selected by the Contractor for each camera to provide adequate coverage and clarity of the image.

Cameras installed in areas with changing light levels shall have lenses with auto iris control facilities.

The remotely controlled color TV cameras shall be suitable for indoor and outdoor installation and shall ensure surveillance of stationary and moving objects.

Camera housings shall be sufficiently robust to protect cameras from incidental blows and shall be constructed to facilitate the installation, removal and service/adjustment of the cameras. The fixings shall be appropriate to withstand the extreme weather conditions with the prevailing wind speeds.

Outdoor cameras shall be protected by corrosion and weatherproof enclosures with protection class IP 65 fitted with automatically controlled anti-condensation heaters.

The cameras shall have the following features:

- Auto-focus with manual override;
- Optical and digital zoom, manual and automatic;
- Day and night selection command;
- Pan - Tilt - Zoom activity (PTZ).

f. Color Digital Recorder

For recording and storing the video surveillance images a colour digital recorder with software shall be provided.

The recorder shall feature nine (9) channels. The number of images per second and the image quality shall be selectable for each connected camera.

11.3.3 Access Control System

a. System Configuration

The access control system shall be in compliance with the related standards and shall be well proven product of a competent manufacturer. The access control system must be high integrity and no loss of functionality in the event of communications interruption.

The access control system shall comprise the following:

- One (1) central access controller with software and printer.
- One (1) workstation;
- Twenty (20) electrical door locks with the with ID card reader and manual unlock push buttons;
- One hundred (100) programmable ID cards
- Power supply units
- Power and control cable system.

- The central access controller shall be installed in the telecommunication room in the portal building. The workstation and the printer shall be located at the reception / guard room.
- The final configuration of the system shall be based on the particular features of the proposed system and the Employer's actual requirements to be defined at detail design stage.
- Systems based on IP technology are also acceptable

b. Particular Design and Construction Requirements

- A particular number of gates and doors shall be controlled and monitored by a computer-based access control system providing the following features:

  – Gates and doors secured with electrical door locks;

  – Access for personnel and visitors with ID card only;

  – Control with ID card readers;

  – Recording and storage of ID, day and time of entries and exits;

  – Release of electrical locks with push buttons installed inside at selected doors.

- The central access controller shall be an industrial type PC operating with standard software packages. The workstation shall be used for parameterizations, preparing of lists and protocols of the entry and exit activities, programming, issuing and administration of the personnel and visitor ID cards.

- Gates and doors shall be fitted with electrical locks. The design and installation of these locks shall be coordinated with the door supplier. The power supply shall be taken from the station AC or DC auxiliary supply systems. The door locks shall by no means require individual batteries.

- The locks shall be controlled by the card readers and appropriate door controllers.

- The gates and doors shall be provided with contact-less, proximity ID card readers suitable for indoor and outdoor installation.

- Inside selected doors surface or flush mounted push buttons shall be installed, enabling the manual release of the electrical door-locks. The main gate shall be suitable for manual control from the guard room.

- The ID cards shall of PVC, provided with embedded antenna and a chip.

- The cable system shall consist of power supply and control cables. Systems may also apply bus systems or LAN.
- The systems shall be self-monitored features, transmitting an alarm to the workstation and the ACS in case of failure, mal-operation or violation of the system.

11.3.4 Spare Parts

a. General Spare Parts

Reference is made to the General Requirements.

b. Special Spare Parts

- One (1) printed board of each type for the CCTV system;
- One (1) camera of each type;
- One (1) printed board of each type for the access control system;
- Two (2) card readers;
- Two (2) push buttons;
- Two (2) electrical locks of each type.

c. Recommended Spare Parts

The Bidder shall recommend the spare parts he considers necessary for a five years operation of the equipment. These spare parts shall be quoted in the price lists but not included in the total price.

11.3.5 Workshop Tests

The security systems, related equipment and materials shall be type tested standard products of competent manufacturers. Type test certificates shall be submitted to the Employer/Engineer.

Workshop tests shall be carried out in compliance with the certified QC plan and the relevant Standards.

11.3.6 Site Tests

Site tests shall be carried out in compliance with the approved QC plan and the Standards. The following tests are the minimum requirement and shall be applied as appropriate for the different communication systems.

- Inspection of the completed cable systems;
- Continuity tests of cable systems;
- Measurement of insulation resistance;

- Functional and performance tests of each system.

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12 GROUNDING AND LIGHTNING PROTECTION

12.1 Scope

This specification covers the design, supply, delivery, installation and testing of the complete Grounding System as described herein. The detail design shall be submitted for the earthing system of each substation.

12.2 Codes and Standards

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

12.3 Equipment to be furnished

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

12.4 Grounding Installation Features

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

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

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

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

12.5 Grounding Conductor

12.5.1 Main ground grid

The main ground system shall consist of a grounding grid buried minimum one meter below grade level. The grounding grid shall consist of GI Strip of suitable dimension based on the approved site-specific detail design.

12.5.2 Ground electrodes

The ground electrodes shall be 16 mm diameter and 1.5-meter long (min.) copper clad steel. These shall be driven into ground and connected to the main ground grid. The conductor of higher size shall be adopted with no additional price should the detail earth design demand.

12.5.3 Risers

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

12.6 Design Requirement

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

The earthing protection shall also be provided for gates and fencing in the substation area.

12.7 Tests

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

12.8 Lightning Protection

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

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

12.9 Drawings

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

12.10 Quality Assurance Program

Along with the Bid the Bidder shall furnish quality assurance program of the manufacturer which includes the Quality System and the Quality Plans, which shall include, among others, information to meet the following requirement, failing which the Bid shall be liable for rejection.

i.) The structure of the organization.
ii.) The duties and responsibilities assigned to staff ensuring quality of works.
iii.) The system for purchasing, taking delivery and verification of materials.
iv.) The system for ensuring quality of workmanship.
v.) The quality assurance arrangement shall conform to relevant requirements of ISO9001.
vi.) Statement giving list of important raw materials, names of manufacturer for the raw materials, list of standards according to which the raw materials are tested, list of 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.

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13 SPECIFICATION OF LIGHTING SYSTEM

13.1 Scope of Works

This specification covers the design, complete supply and installation of the lighting system for the Project including all necessary supervision, labor, tools, equipment and accessories, miscellaneous materials, testing, and putting in acceptable operation of the lighting system.

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

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

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

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

13.2 Codes & Standards

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

13.3 Illumination Level Requirements

Illumination level of the new control building and outdoor switchyard complex above working plane in various areas in lux shall be as specified below.

(a) Control room: 300 lux
(b) Battery room: 150 lux
(c) Store: 150 lux

(d) Other indoor area: 150 lux
(e) Outdoor equipment area: 30 lux
(f) Road: 30 lux
(g) Other outdoor area: 20 lux
(h) Emergency lighting: 10 lux

13.4 Protection of Work

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

13.5 Methods and materials

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

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

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

13.6 Steel conduit

All conduits except otherwise stated shall be rigid steel, hot dipped galvanized. Minimum diameter of all conduits shall be 19mm. Each piece of conduit shall be straight, free from blisters and other defects, cut square and taper reamed and shall be furnished in 3-meter lengths and threaded at each end. Couplings shall be cleanly cut. In no case shall the conduit be filled by more than 40 percent.

13.7 Installation of conduit system

The work covered by this section comprises the installation of the metallic conduit system. Flexible steel conduit shall be used in dry and non-hazardous locations to provide flexible connections between the rigid conduit system and conduit boxes, and between the rigid system and any machine subject to vibration. Flexible conduit shall be galvanized steel. Where

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

Exposed conduits shall be run in straight lines parallel to column lines, walls, or beams. Where conduits are grouped, the bends and fittings shall be installed so as to present an orderly appearance. Unnecessary bending or crossing shall be avoided. Supports for exposed horizontal conduit runs shall be provided every 1.0m for 19mm conduit and not more than every 1.5m for 25mm conduit and larger, where it is difficult to provide supports at intervals other than those specified above, the supports for 19mm conduit may be every 1.5m and supports for 25mm and larger every 2.0m as a special case and the Employer/ Employer's Representative approval must be taken. Supports for exposed vertical conduit runs shall be not more than 1.5m for 19mm and 25mm conduit and not more than 2.5m for 32mm and larger conduit.

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

Conduit joints and connections shall be made thoroughly watertight and rustproof by means of the application of a thread compound, which will not insulate the joint. Each threaded joint shall be thoroughly cleaned to remove all the cutting oil before the compound is applied. Red lead is suitable for application for embedded conduits, and white lead is suitable for application for exposed conduits.

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

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

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

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

Galvanized structural steel members may be drilled or punched for conduit supporting bolts, provided the holes are immediately painted with aluminum paint and galvanized or rust-resisting bolts are used. Conduits and fittings shall be properly protected during the construction period against mechanical injury, from impact from structural steel heavy machinery, or batches of mass concrete pours. Conduits, which extend out of floors, walls, or beams, shall be boxed or otherwise protected and the ends shall be plugged or capped.

In supporting embedded steel conduit, if welding or brazing is used, extreme care should be taken to avoid injury of the surface of the conduit. Welding or brazing shall not be done on the bottom of a conduit or on the inside of a bend, or at any other location that might interfere with the pulling of conductors. The welded or brazed joint shall be painted. Metallic conduit shall be securely fastened to sheet metal boxes and cabinets, each with a locknut and insulated bushing inside the box and a locknut outside. The conduits shall be of such length that when the bushings are screwed tight against the ends of the conduits no appreciable space will be left between the bushings and the locknuts. The locknuts shall be tightened against the box without deforming the box.

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

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

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

13.8 Wire & Cable

The contractor shall furnish and install all wire and cable required for the complete installation. All wire shall be of stranded copper conductor, PVC insulated. The wire shall have a voltage grade of 600V as per IEC.

Minimum cross-section shall be 2.5sqmm. All wire shall be run in conduit. All wiring between distribution boards and lighting panels and all outdoor branch circuit wiring shall be done using power cables as specified herein.

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

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

13.9 Outlet and switch boxes

Furnish and install for each outlet, and outlet box suited to the use for which the outlet is to be put and to the location in which it occurs. All outlet and conduit fittings in exposed conduit runs shall be cast metal with integral threaded hubs with appropriate covers and shall be provided with gasketed covers. Sealing fittings shall be furnished where required.

13.10 Junction and pull boxes

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

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

13.11 Lighting fixtures

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

Lamps - All fixtures shall have installed therein by the Contractor a lamp of wattage as noted in this specification. They shall be of the incandescent filament, fluorescent or high-pressure mercury type as required for each unit. Lamps shall be furnished by the Contractor.

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

13.12 Accessories

Each fixture shall be supplied with necessary straps, supports, or hangers or other miscellaneous materials and devices to install them in a satisfactory manner, and to conform to the architectural treatment in the area in which they are to be installed. All fluorescent fixtures shall be equipped with high power factor, approved ballasts and rapid starts lamps.

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

Fixture type for each area is as indicated in the Drawings. The detail design shall be approved by the Employer.

a) Control Room: Indoor, pendant type fixture with acrylic prismatic lens, complete with two (2)-40W. cool white fluorescent lamp and glow start high PF ballasts
b) Switchgear Room/Toilet: Indoor, industrial pendant type fixture with sheet steel reflector complete with two (2)-40W, cool white fluorescent lamp and glow start high PF ballasts
c) Battery Room: Indoor, pendant or surface mounted moist proof and acid-proof, with sheet steel reflector complete with one (1) 60W fluorescent lamp covered with clear glass globe
d) Substation/outdoor: Outdoor, weather-proof, LED light.
e) Emergency Lights: Indoor, recessed or pendant mounted fixture with porcelain enameled standard dome reflector Substation complete with one (1) - 60W fluorescent lamp

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

All florescent lamps shall be LED with equivalent lux.

13.13 Lighting panels

The Contractor shall furnish and install all 400 / 230 volts lighting panels as required and shall be obviously included in the cost of electrical wiring of the building. Each 400 / 230-Volt lighting panel shall be, three phase, four wire, and solid neutral. Each branch circuit shall have a 20-ampere single pole quick-make quick-break circuit breaker. Each circuit breaker shall empty thermal means of inverse time overload protection supplemented by an instantaneous magnetic short circuit trip. The maximum load on each branch circuit shall be limited to 2400W. The

number of branch circuit in each lighting panel shall be determined based on the load and the above criteria. Mains shall be provided with solderless lugs.

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

13.14 Emergency lighting

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

13.15 Receptacles

The Contractor shall furnish and install all receptacles and specified herein. The receptacles shall be of 230V, 20 Ampere, 3-pole, 3 wire, polarized with third pole grounded. The receptacles shall be provided on the walls of all the rooms at a spacing of 6m. (maximum) between two receptacles with minimum of two (2) receptacles per room.

13.16 Local wall switches

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

- General indoor areas - Local switches mounted indoors shall be single pole and shall be rated 6 amperes at 230 Volts
- Outdoors and wet locations - Local switches installed in outdoor and wet locations shall be weatherproof switches, single pole or as required rated 20 Amperes at 230 Volts

13.17 Grounding

Each lighting fitting shall be provided with a grounding terminal suitable for connection to the earthling conductor. All metal or metal enclosed parts of the housing shall be bonded and connected to the grounding continuity throughout the fixture.

13.18 Tests

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

All equipment shall be demonstrated to operate in accordance with the requirement of this specification and other specifications. Functional tests shall be performed to check each requirement.

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

13.19 Drawings

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

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

13.20 Quality Assurance Program

Along with the Bid the Bidder shall furnish quality assurance program of the manufacturer which includes the Quality System and the Quality Plans, which shall include, among others, information to meet the following requirement, failing which the Bid shall be liable for rejection.

i.) The structure of the organization;
ii.) The duties and responsibilities assigned to staff ensuring quality of works;
iii.) The system for purchasing, taking delivery and verification of materials;
iv.) The system for ensuring quality of workmanship;
v.) The quality assurance arrangement shall conform to relevant requirements of ISO9001;
vi.) Statement giving list of important raw materials, names of manufacturer for the raw materials, list of standards according to which the raw materials are tested, list of 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.

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14INTERCONNECTING BAY/ARRANGEMENT

14.1 Specification of 33 kV Line tapping and Bay Extension

14.1.1 Scope

This specification covers the design, manufacture, assembly, shop test, supply, delivery, installation works and field test of components of 33 kV line tapping as per the Interconnection Single Line Diagram complete with all accessories for efficient and trouble-free operation. For a tapping structure substation bay type arrangement with Vacuum Circuit Breakers shall be implemented, if location available, else the arrangement with Load Break Switch shall be implemented.

14.1.2 Technical Requirements of Interconnecting Components

The technical requirements of the 33 kV components, shall be as mentioned in 6 - 33 kV System, 11 – Automation and Control System and Other relevant sections and sub-sections.

14.1.3 Current Rating Requirements of Interconnecting Components

The current rating shall be selected to be higher than the current carrying capacity of the feeder the system is connected to.

14.1.4 Specific Requirements of Interconnecting Components

The components in the line tapping shall be pole mounted as far as practicable with two, three, two of two and up to four pole structures. The poles shall have concrete base considering the soil bearing capacity.

In case of interconnecting bay of other substation, the price shall include complete works including the civil works (Steel Pipe Structure and foundations for equipment support structure).

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15 STRUCTURE WORKS

15.1 General

The scope of specification covers design, fabrication, trial assembly, supply and erection of galvanized steel structures for towers, girders, lightning masts and equipment support structures. Structures shall be Pipe type structure and lattice type structure (as per– Scope of Works and relevant Drawings) fabricated from structural steel confirming to relevant IS: 802-2015/British standard Codes (BS Codes)/equivalent International Standards.

The line diagram of all structures of 33 kV for switchyards shall be prepared by the Contractor based on the drawings and scope of works.

The type of proposed structure for support system is pipe type for all structures other than the incoming/outgoing gantry as shown in the Drawings. The fabrication drawings, proto corrected drawings along with Bill of Material (BoM) for all the structures (Both Gantry and Equipment support structures) shall be prepared by the Contractor during detailed engineering for submission to the Employer for their approval. Support structure for circuit breaker shall also be designed by the Manufacturer/Contractor.

It is the intent of the Employer to provide structures which allow interchangeability of equipment at a later stage. Accordingly, Contractor is expected to design the equipment support structures with the provision of stool. Stools shall be provided by the Contractor between the equipment and its support structure to match the bus bar height. The top of stool shall be connected to the equipment and the bottom of the stool shall be connected to the base support structure. The scope shall include supply and erection of all types of structures including bolts, nuts, washers, step bolts, inserts in concrete, gusset plates, equipment mounting bolts, structure earthing bolts, foundation bolts, spring washers, fixing plates, ground mounted marshalling boxes (AC/DC Marshalling box and equipment control cabinets), structure mounted marshalling boxes and any other items as required to complete the job.

The connection of all structures to their foundations shall be with base plates and embedded anchor or foundation bolts. All steel structures and anchor/foundation bolts, fasteners (nuts, bolts, and washers) shall be fully galvanized as per relevant IS: 802-2015/British standard Codes (BS Codes)/equivalent International Standards. The weight of the zinc coating shall be at least 610 gram/m^2 for anchor bolts or foundation bolts and for structural members. One additional nut shall be provided below the base plate, which may be used for leveling.

Contractor shall provide suitable arrangement on the equipment support structures wherever to suit fixation of accessories such as marshalling boxes, MOM boxes, Control Cabinets, Junction box, surge counter, etc. in the equipment structure fabrication drawings.

15.2 Design Requirements for Structures

For design of steel structures, loads such as dead loads, live loads, wind loads etc. shall be based on relevant IS: 802-2015/British standard Codes (BS Codes)/equivalent International Standards.

For materials and permissible stresses, relevant British Standard Codes (BS Codes)/Indian Standard Codes (IS Codes) /equivalent International Standards shall be followed in general. However, additional requirements given in following paragraphs shall be also considered.

Minimum thickness of galvanized lattice structure member shall be as follows:

Members	Minimum Thickness (mm)
Leg members, Ground wire	5
Peak members/Main members	5
Other members	4
Redundant members	4

Maximum slenderness ratios for leg members, other stressed members and redundant members for compression force shall be as per relevant IS: 802-2015/British standard Codes (BS Codes)/equivalent International Standards.

Minimum distance from hole center to edge shall be 1.5 x bolt diameter. Minimum distance between center to center of holes shall be 2.5 x bolt diameter.

All bolts shall be M16 or higher as per design requirement.

Step Bolts

In order to facilitate inspection and maintenance, the tower structures shall be provided with climbing devices. Each tower shall be provided with M16 step bolts 175 mm long spaced not more than 450 mm apart, staggered on faces on diagonally opposite legs extending from about 0.5 meters above plinth level to the top of the tower. The step bolt shall confirm to relevant IS: 802-2015/British standard Codes (BS Codes)/equivalent International Standards. Ladders along with safety guard shall be provided for the Lightning Mast Tower.

15.3 Design Criteria

All gantry structures shall be designed for the worst combination of dead loads, live loads, wind loads and seismic forces as per relevant British Standard Codes (BS Codes)/ Indian Standard Codes (IS Codes)/ equivalent International Standards (latest), loads due to deviation of conductor, load due to unbalanced tension in conductor, torsional load due to unbalanced vertical and horizontal forces, erection loads, short circuit forces including "snatch" in the case of bundled conductors etc. Short circuit forces shall be calculated considering a fault level of 25 kA for 33 kV or as applicable. Relevant IS: 802-2015/British standard Codes (BS Codes)/equivalent International Standards may be followed for evaluation of short circuit forces.

Switchyard gantry structures shall be designed for the two conditions i.e., normal condition and short circuit condition. In both conditions, the design of all structures shall be based on the assumption that stringing is done only on one side i.e., all the three (phase) conductors broken on the other side. Factor of safety of 2 under normal conditions and 1.5 under short circuit condition shall be considered on all external loads for the design of switchyard structures.

Vertical load of half the span of conductors or string and the earth wires on either side of the beam shall be taken into account for the purpose of design. Weight of man with tools shall be considered as 150 kg for the design of structures.

The Contractor shall use an allowable soil bearing pressure of 100 kN/m^2 for the design of the foundation for the purpose of bidding, as reference value. After award of contract the Contractor shall carry out detail soil test and detail design of foundation based on the soil test result.

Terminal or line take off gantries shall be designed for a minimum conductor tension of 0.5 metric tonne for 33 kV or as per requirements whichever is higher. The distance between terminal gantry and dead-end tower shall be taken as 80 m for 33 kV switchyard. The design of these terminal gantries shall also be checked considering ± 30 deg. deviation of conductor in both vertical and horizontal planes. For other gantries, the structural layout requirements shall be adopted in design.

The girders/beams shall be connected with lattice/tower columns by bolted joints.

All equipment support structures shall be designed for the worst combination of dead loads, erection load. Wind load/seismic forces, short circuit forces and operating forces act on the equipment and associated bus bars as per relevant IS: 802-2015/British standard Codes (BS Codes)/equivalent International Standards.

If luminaries are proposed to be fixed on gantries/towers, then the proper loading for the same shall be considered while designing. Also, holes for fixing the brackets for luminaries should be provided wherever required.

Foundation bolts shall be designed for the loads for which the structures are designed.

The height of Lightning Mast shall be as per approved structural layout and designed for diagonal wind condition. The lightning mast shall be provided with platform for mounting of lighting fixtures and a structural steel ladder within its base up to the level of platform. The ladder shall be provided with protection rings. The platforms shall also have protection railing. The details of lighting fixtures would be as per approved drawings of electrical fixtures.

15.4 Design, Drawings, Bill of Materials and Documents

The Contractor shall submit design and line diagram of each structure for approval of the Employer. Fabrication drawing based on approved line diagram shall be prepared by the Contractor for approval of the Employer. The BoM (Bill of Material) shall be prepared by the Contractor based on approved fabrication drawing. The Line diagram should indicate not only profile, but section, numbers and sizes of bolts and details of typical joints. In case Employer feels that any design or drawings are to be modified even after its approval, Contractor shall modify the designs and drawings and resubmit the same for approval.

The fabrication drawings shall indicate complete details of fabrication and erection including all erection splicing details and typical fabrication splicing details, lacing details, weld sizes and lengths. Bolt details and all customary details in accordance with standard structural engineering practice. The fabrication drawing and Bill of Material based on design or line diagram shall be submitted to the Employer for approval. Approved bill of materials prepared on the basis of fabrication drawing shall be the basis for payment.

Such approvals shall, however, not relieve the Contractor of his responsibility for safety and durability of the structure and good connection and any loss occurring due to defective fabrication, design or workmanship shall be borne by the Contractor.

The Contractor shall submit editable soft copy of all designs preferably in suitable structure analysis software/excel form and drawings in AutoCAD to the Employer. The Contractor shall submit the copy of relevant portion of IS: 802-2015/British standard Codes (BS Codes)/equivalent International Standards referred to the Employer for reference, if necessary, during detailed engineering stage.

15.5 Fabrication and Erection

The fabrication and erection works shall be carried out generally in accordance with relevant IS: 802-2015/British standard Codes (BS Codes)/equivalent International Standards. All materials shall be completely shop fabricated and finished with proper connection material and erection marks for ready assembly in the field.

The component parts shall be assembled in such a manner that they are neither twisted nor otherwise damaged and shall be so prepared that the specified camber, if any, is provided. In order to minimize distortion in member, the component parts shall be positioned by using the clamps, clips, dogs, jigs and other suitable means and fasteners (bolts and welds) shall be placed in a balanced pattern. If the individual components are to be bolted, paralleled and tapered, drifts shall be used to align the part so that the bolts can be accurately positioned.

Sample towers, beams and lightning masts and equipment support structures may be trial assembled in the fabrication shop to ensure fitment of various members and to avoid problems during erection.

For all structures, BoM along with fabrication drawings in hard and editable soft copies shall be submitted to the Employer as document for information. The responsibility of correctness of such fabrication drawing and BoM shall be fully with the Contractor.

Approval of fabrication drawings and BoM shall, however, not relieve the Contractor of his responsibility for the safety and durability of the structure and good connections and any loss or damage occurring due to defective fabrication, design or workmanship shall be borne by the Contractor.

The Contractor should arrange on his own all plant and equipment, welding set, tools and tackles, scaffolding, trestles equipment and all other accessories and ancillaries required for carrying out erection without causing any stresses in the members, which may cause deformation and permanent damage. Minor modification if any, required during erection shall be done at site with the approval of the Employer.

15.6 Bolting

Every bolt shall be provided with a washer under the nut so that no part of the threaded portion of the bolt is within the thickness of the parts bolted together.

In case of fasteners, the galvanizing shall confirm to relevant IS: 802-2015/British standard Codes (BS Codes)/equivalent International Standards. The spring washer shall be electro galvanized as per relevant IS: 802-2015/British standard Codes (BS Codes)/equivalent International Standards.

15.7 Welding

The work shall be done as per approved fabrication drawings which shall clearly indicate various details of joints to be welded, type of weld, length and size of weld, symbols for welding on erection and shop drawings shall be according to relevant International Standards. Welding shall be carried out in accordance to relevant IS: 802-2015/British standard Codes (BS Codes)/equivalent International Standards.

15.8 Foundation Bolts

Foundation bolts for the towers and equipment supporting structures and elsewhere shall be embedded in first stage concrete while the foundation is cast. The Contractor shall ensure the proper alignment of these bolts to match the holes in the base plate.

The Contractor shall be responsible for the correct alignment and leveling of all steel work on site to ensure that the towers or structures are plumb.

All foundation bolts for lattice structure, pipe structure are to be supplied by the Contractor.

All foundation bolts shall be fully galvanized so as to achieve minimum 610 gram/m^2 of Zinc Coating as per relevant IS: 802-2015/British standard Codes (BS Codes)/equivalent International Standards.

All foundation bolts and its material shall confirm to relevant IS: 802-2015/British standard Codes (BS Codes)/equivalent International Standards. All foundation bolts shall be provided with two number standard nuts, one check nut, one plain washer and MS plate at the bottom of foundation bolt.

15.9 Stability of Structure

The Contractor shall be responsible for the stability of the structure at all stages of its erection at site and shall take all necessary measures by the additions of temporary bracings and guying to ensure adequate resistance to wind and also to loads due to erection equipment and their operations.

15.10 Grouting

The method of grouting the column bases shall be subjected to approval of the Employer and shall be such as to ensure a complete uniformity of contact over the whole area of the steel base. No additional payment for grouting shall be admissible.

15.11 Galvanizing

All structural steel works (Gantry structures, Equipment support structures) and foundation bolts shall be galvanized after fabrication. The galvanization shall be done as per requirement of relevant IS: 802-2015/British standard Codes (BS Codes)/equivalent International Standards.

Zinc required for galvanizing shall have to be arranged by the Contractor/manufacturer. Purity of zinc to be used shall be 99.95 % as per relevant IS: 802-2015/British standard Codes (BS Codes)/equivalent International Standards.

The Contractor shall be required to make arrangement for frequent inspection by the Employer as well as continuous inspection by a resident representative of the Employer, if so desired for fabrication work.

15.12 Touch-up Painting

Minor defects in hot dip galvanized members shall be repaired by applying zinc rich primer and two coats of enamel paint to the satisfaction of the Employer before erection.

15.13 Dispatch Inspection

Each part of the fabricated steel work shall be inspected as per approved quality plans and certified by the Employer or his authorized representative as satisfactory before it is dispatched to the erection site. Such certification shall not relieve the Contractor of his responsibility regarding adequacy and completeness of fabrication.

15.14 Test Certificate

Copies of all test certificates relating to material procured by the Contractor for the works shall be submitted to the Employer.

15.15 Mode of Measurement

The measurement of the structure, fasteners (Nuts, Bolts, and Washers) and foundation bolts including its nuts washers and MS Plate at bottom shall be done as per Bid Price Schedule (Schedules of Rates and Prices). The weight of all structural members and foundation bolts (Bolt, Nuts, washer and MS steel plates welded at bottom of bolt) shall be measured under one head in Metric Tonne or kg. The weight of fasteners and step bolts (Nuts, bolts and washers) used to erect or complete structures shall be measured under another head in Metric Tonne or kg.

15.16 Safety Precautions

The Contractor shall strictly follow all precautions at all stages of fabrication, transportation and erection of steel structures. The stipulations contained in relevant IS: 802-2015/British standard Codes (BS Codes)/equivalent International Standards for safety during erection of structural steel work shall also be adhered to.

15.17 Manufacturing Quality Plan

The material specification shall also be as per British standard Codes (BS Codes)/Indian Standard Codes (IS Codes)/ or equivalent International Standards.

The Contractor shall prepare the manufacturing quality plan to accept or check the material, galvanization and welding as per relevant international standards/BS codes within 1 month after award of work and submit the same to the Employer for approval.

Volume II

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16 SITE CIVIL WORKS

16.1 General

The intent of these specification covers the following:

- Design, engineering, drawing and construction of all civil works at sub-station. All civil works shall also satisfy the general technical requirements specified in other Sections of Specification and as detailed below. They shall be designed to the required service conditions/loads as specified elsewhere in this Specification or implied as per relevant British standard codes (BS Codes)/Indian Standard Code (IS Code)/ equivalent International Standards.
- All civil works shall be carried out as per applicable Standards and Codes. All materials shall be of best quality conforming to relevant International Standards and Codes. In case of any conflict between Standards/ Code and Technical Specification, the provisions of Technical Specification shall prevail.
- The Contractor shall furnish all design, drawings, labour, tools, equipment, materials, temporary works, constructional plant and machinery, fuel supply, transportation and all other incidental items not shown or specified but as may be required for complete performance of the Works in accordance with approved drawings, specifications and direction of the Employer.
- The work shall be carried out according to the design/drawings to be developed by the Contractor and approved by the NEA. For all buildings, structures, foundations etc. necessary layout and details shall be developed by the Contractor keeping in view the functional requirement of the substation facilities and providing enough space and access for operation, use and maintenance. Certain minimum requirements are indicated in this specification for guidance purposes only. However, the Contractor shall quote according to the complete requirements.

16.2 Geotechnical Investigation

16.2.1 General

Soil investigation shall be carried out by the Contractor in each substation locations. It shall also be carried out in line route, if deemed necessary by the Employer. This specification covers all the work done for detailed soil investigation and preparation of a detailed report. The work includes mobilization of necessary equipment, providing necessary engineering supervision and technical personnel, skilled and unskilled labor, etc. as required to carry out field

investigation as well as, laboratory investigation, analysis and interpretation of data and results, preparation of detailed Geo-technical report including specific recommendations for the type of foundations and the allowable safe bearing capacity for different sizes of foundations at different founding strata for the various structures of the substation. The cost shall be included in Schedule 3, Design Services.

All the work has to be carried out as per latest edition of the corresponding relevant British standard codes (BS Codes)/Indian Standard Code (IS Code)/ equivalent International Standards.

17.1.1.1 Bore Holes

Bore holes of Minimum 150 mm diameter in accordance with the provisions of relevant international standards/British standards (BS)/IS.

Number of boring shall be at least 4 borings at the locations specified below:

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

The soil investigation shall be up to 15-meter depth (Minimum) or to refusal which ever occur earlier. In any case number of boreholes shall not be less than four. By refusal it shall mean that a standard penetration blow count (N) of 100 is recorded for 30 cm penetration. Number of boreholes may be increased in case soil strata is varying from borehole to borehole in order to have fair idea of soil profile. In case of deep pile foundations soil investigation is to be carried out up to 25 m depth from ground level or refusal whichever is earlier. In case rock is encountered, coring in all the boreholes shall be carried out up to 3 meter in rock.

Performing Standard Penetration Tests at approximately 1.5 m interval in the borehole starting from 0.5 m below ground level onwards and at every change of stratum. The disturbed samples from the standard penetrometer shall also be collected for necessary tests. Standard Penetration Test shall be performed as per relevant British standard codes (BS Codes)/Indian Standard Code (IS Code)/ equivalent International Standards.

Undisturbed samples shall be collected in accordance with the recommendation of relevant British standard codes (B S Codes)/Indian Standard Code (IS Code)/ equivalent International Standards. Or an alternative recognize method as agreed by Employer. Undisturbed samples

shall be taken in cohesive material or weak cemented granular material wherever possible at 1 m interval or at each change in stratum.

The depth of Water Table, if encountered, shall be recorded in each borehole. In case the soil investigation is carried out in winter/summer, the water table for rainy season shall be collected from reliable sources and recorded in the report.

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

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

The logging of the boreholes shall be compiled immediately after the boring is completed and a copy of the bore log shall be handed over to the Engineer-in-change.

17.1.1.2 Trial Pits

The Contractor shall excavate two number trial pits per substation as and where directed by Employer, of Plan area 10 m^2 and not exceeding 4 m depth. Undisturbed samples shall be taken from the trial pits as per the direction of the Employer. All Trial Pits shall be re-filled with approved material after the tests are complete and shall be well compacted in layers of not exceeding 300 mm in thickness in loose stage measurement.

17.1.1.3 Electrical Resistivity Test

This test shall be conducted to determine the Electrical resistivity of soil required for designing safety-grounding system for the entire station area. The specifications for the equipment and other accessories required for performing electrical resistivity test, the test procedure, and reporting of field observations shall confirm to relevant British standard codes (BS Codes)/Indian Standard Code (IS Code)/ equivalent International Standards. The test shall be conducted using Wagner's four electrode method as specified in relevant British standard codes (BS Codes)/Indian Standard Code (IS Code)/ equivalent International Standards. Unless otherwise specified at each test location, the test shall be conducted along two perpendicular lines parallel to the coordinate axis. On each line, a minimum of 8 to 10 readings shall be taken by changing the spacing of the electrodes from an initial small value of 0.2 m up to a distance of 50 m.

17.1.1.4 Water Sample

Incase ground water table is encountered; representative samples of ground water shall be taken when ground water is first encountered before the addition of water to aid drilling of

boreholes. The samples shall be of sufficient quantity for chemical analysis to be carried out and shall be stored in air-tight containers.

17.1.1.5 Back Filling of Bore Holes

On completion of each hole, the Contractor shall backfill all bore holes as directed by the Employer. The backfill material can be the excavated material.

17.1.1.6 Laboratory Test

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

All samples brought from field, whether disturbed or undisturbed shall be extracted/prepared and examined by competent technical personnel, and the test shall be carried out as per the procedures laid out in the relevant British Standard Codes (BS Codes)/Indian Standard Code (IS Code)/ equivalent International Standards.

The following laboratory tests shall be carried out:

- Visual and Engineering Classification
- Atterberg limits Tests.
- Natural moisture content, Optimum moisture content, bulk density and specific gravity.
- Grain size distribution analysis.
- Swell pressure and free swell index determination.
- California bearing ratio.
- Consolidated drained test with pore pressure measurement.

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

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

- UCC test.
- Point load index test.

16.2.2 Test Results and Reports

The Contractor shall submit the detailed report in two (2) copies wherein information regarding the geological detail of the site, summarized observations and test data, bore logs, and

conclusions and recommendations on the type of foundations with supporting calculations for the recommendations. The Contractor shall also submit the bearing capacity calculation in editable soft copy to Employer. Initially the contractor shall submit draft report and after the draft report is approved, the final report in two (2) copies shall be submitted. The field and laboratory test data shall bear the signatures of the Investigation Agency, Contractor and also site representative of Employer.

The report shall include, but not limited to the following:

a) A plan showing the locations of the exploration work i.e. bore holes, trial pits. Plate load test, electrical resistivity test, CBR sample location etc.
b) Bore Logs: Bore logs of each bore holes clearly identifying the stratification and the type of soil stratum with depth. The values of Standard Penetration Test (SPT) at the depths where the tests were conducted on the samples collected at various depths shall be clearly shown against that particular stratum.

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

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

a) Geological formation of the area, past observations or historical data, if available, for the area and for the structures in the nearby area, fluctuations of water table etc.
b) Recommended type of foundations for various structures. If piles are recommended the type, size and capacity of pile and groups of piles shall be given after comparing different types and sizes of piles and pile groups.
c) Allowable bearing pressure on the soil at various depths for different sizes of the foundations based on shear strength and settlement characteristics of soil with supporting calculations. Minimum factor of safety for calculating net safe bearing capacity shall be taken as 2.0 (two). Recommendation of liquefaction characteristics of soil if applicable shall be provided.
d) Recommendations regarding slope of excavations and dewatering schemes, if required.
e) Comments on the chemical nature of soil and ground water with due regard to deleterious effects of the same on concrete and steel and recommendations for protective measures.

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

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

h) In case of foundation in rocky strata, type of foundation and recommendation regarding rock anchoring etc. should also be given.

16.3 Site Clearing, Contour Survey and Site Levelling

16.3.1 Scope

This clause covers clearance of site, contour survey, site levelling, maintaining finished ground level by cutting/filling, supplying and compaction of fill material if required. Cutting/felling of trees and their disposal has not been envisaged under the present scope.

16.3.2 General

Site shall be cleared, surveyed and levelled/sloped by the Contractor as per approved general arrangement drawing or levelling area decided during detailed engineering after award of work.

Work covered under this clause comprises the site clearance, survey work/setting out and making profiles, Earth work in Excavation and filling in specified area with all lifts and leads and earth work in filling with borrowed earth with all leads and lifts (Borrow areas including payment of royalty for borrowed earth shall be arranged by the Contractor at his own cost). During detailed engineering stage, the Contractor will prepare the levelling proposal for optimum levelling and submit to Employer for approval. The earthwork is calculated by making cross-section of contour plan at 5m interval along longitudinal and transverse direction separately, final quantity of earthwork is the average of quantity at longitudinal and transvers direction. Contractor shall submit the hard copy and editable soft copy of levelling proposal (levelling quantity calculation in Excel form and levelling drawing in Auto CAD) to Employer for approval.

Filling material shall conform to relevant British standard codes (BS Codes)/ IS/ equivalent International Standards. Unsuitable filling material if any shall be removed and replaced by suitable fill material. The filling shall be compacted in layers to achieve 95 % of standard Proctor's density at Optimum moisture contents (OMC). Cohesion less material shall be compacted to 70 % relative density (minimum). Levelling/Filling shall be carried out as per

relevant British standard codes (BS Codes)/IS/ equivalent International Standards. The cost shall be included in Schedule 3, Design Services.

16.3.3 Site Clearing

The work shall consist of numbering of trees, removing and disposing of all materials such as trees, bushes, woods, shrubs, grass, stumps, rubbish, rank vegetation, roots, foreignmaterials,150 mm of topsoil etc., which in the opinion of the Employer are unsuitable for incorporation in the works, from within the limits and areas as may be specified by the Employer.

All trees shall also be cut, and useful portion of the trees so cut shall be stacked at a suitable place directed by the Employer and shall be considered incidental to clearing and grubbing operations.

The roots of trees shall be dug up to 60 cm below the ground level or 15 cm below formation level whichever is deeper and after removal of all vegetable and organic matter from the holes so formed by removal of the roots, holes and hollows shall be filled with good earth in layer of 20 cm, well rammed, consolidated and levelled.

The serviceable and unserviceable materials obtained from the site clearance shall be removed from the area and disposed of to a place as per the directions of the Employer.

Clearing and grubbing item is not payable and the same shall be deemed to be included in the earth work in site levelling.

16.3.4 Contour Survey and Site Levelling

The land for construction of substation will be handed over to the successful Bidder as on where basis progressively after award of work. The Contractor shall carry out survey work by taking spot level with respect to temporary benchmark transferred from permanent bench mark in the locality if available either on bride/railway platform or government buildings of local authorities. The Contractor shall submit the spot levels in editable soft copy in spreadsheet format and contour map with contour interval of 0.25 m in editable AutoCAD or similar software drawing and in pdf.

The Contractor will level the area required for construction of substation work either at single level, multi-level or gradual slope with the finished ground level as approved by the Employer during detailed engineering based on highest flood level. The levelling area shall be decided by Employer during detailed Engineering stage.

The layout and levels of all structure etc. shall be made by the Contractor at his own cost from the plot and benchmarks set by the Contractor and approved by the Employer. The Contractor

shall provide all assistance in instruments, materials and personnel to Employer for checking the detailed layout and shall be solely responsible for the correctness of the layout and levels.

The filling of the substation shall be such that, it is higher than the ground level by at least 1.5 m in all locations and by more than 2 m as well, if required by the Employer.

16.3.5 Slope Protection Work in Filling Area

This clause covers slope protection work in filling area if height of filling is very high. Requirement of slope protection work is decided by the Employer.

A. Grouted Stone Pitching

It covers the furnishing of materials and construction of a protective covering in stone pitching on exposed surfaces such as earth slopes. The area shall be prepared by excavating, shaping and trimming to accommodate the stonework and shall be thoroughly compacted. A trench shall be excavated as directed by the Engineer along the toe of any slope to be pitched or along the unprotected edge of the pitching in the bed of streams. The spaces between the stones shall be filled with 1:3 cement sand mortar. Before the mortar is applied the surfaces of the stones shall be thoroughly cleaned of adhering dust and vegetation and then moistened.

The mortar shall be placed in a continuous operation for any day's run at any one location. The mortar shall be worked into the pitching so as to ensure that all spaces or voids between the stones are completely filled with mortar and to the depth of stone pitching.

After the grout has been placed, the stones shall be thoroughly brushed so that their top surfaces are exposed. The grouted pitching shall be cured for a period of not less than four days after grouting with wet sacking or other approved wet cover and shall not be subjected to loading until adequate strength has been developed. Where required, or instructed by the Engineer, weep holes shall be formed in the pitching.

i Materials

Stone: Stone for pitching shall be sound, tough and durable, with no stone less than 100 mm in minimum dimension, except that smaller pieces or spalls may be used for filling spaces between the larger stones. Stone shall be of such a shape as to form a stable protection structure of the required section. All stone intended for use on any particular pitching job shall receive the prior approval of the Employer.

Mortar: Mortar for all stonework shall consist of cement and clean, sharp, coarse sand. The mortar shall consist of one part cement and 3 parts sand used in pitching stone masonry work.

Water: Water used for mixing mortar shall be in accordance with of NBC 110-2050.

B. Bio Engineering Work (Grass plantation on sloped Surface)

i Site Planting and Sowing

General

The Contractor shall plant or sow grasses as required by the Engineer. This shall be done according to the specifications described hereunder, as and when required. The Contractor shall supply all necessary expertise, resources and facilities to ensure that these requirements are met.

It is the Contractor's responsibility to ensure that all planting stock, whether provided from a nursery or through a separate instruction, is of high quality and is vigorous enough to grow on the site to be planted.

All seeds and other planting stock must be of species indigenous to Nepal unless otherwise specified. All species must be covered in the current approved lists of species produced from time to time by the Geo-Environmental. They must be appropriate for the precise site conditions in which they are to be planted and the Contractor must ensure that they apply to the specific altitude and other environmental characteristics of the site in question.

The timing of many bio-engineering operations is of the utmost importance. Activities such as planting and seed sowing must be carried out within the critical few weeks when they will yield the desired results. All other operations must be carried out in a timely manner to permit this to happen. The Contractor is responsible to keep works to the strict schedule required and under no circumstances to permit delays.

Sowing of Grasses on Site

The sowing of grasses is intended to create a strengthened slope surface which is resistant to erosion. The Contractor is required to carry out the sowing of grass seeds according to the Employer's representative's specific instructions.

It is assumed that the site will already have been prepared for seed sowing, under a separate instruction; but it is nevertheless the responsibility of the Contractor to ensure that the condition of the site is good enough for the successful establishment of grasses.

The Contractor is required to supervise all field operations very closely. The sowing of grass seeds is a delicate business and should be approached in the same way as for agricultural crops. The Contractor should employ experienced agricultural labourers for this work.

Seeds will have been collected and stored under a separate instruction well before the time of sowing. However, it is the Contractor's responsibility to check that it has been carefully stored and remains fully viable.

Immediately before sowing, the ground surface should be lightly scarified to ease early root penetration. Seeds should then be laid thinly over the surface. Under no circumstances should they be broadcast, because the lightness of perennial grass seeds and the steepness of the slopes to be treated give a poor cover using such a technique. The Contractor responsible for ensuring that the correct quantities of seeds are used, while giving a good, even cover.

A cover of 25 grams of grass seed per square meter of surface should be achieved unless otherwise specified.

After sowing, a mulch of prepared and dried cut herbs should be laid over the whole seeded area in a thin layer. If the mulch is too thick it will prevent light from getting to the seed and will inhibit germination. Herbs suitable for this and locally available in large quantities are:

- tite pate (Artemisia vulgans);
- tapre (Cassia species);
- banmara (Eupatorium adenophorum).

However, freshly cut herbs should not be used because of the danger of resprouting and weeding.

If specified, the mulch should be secured with jute netting of mesh size 300 x 500 mm and the netting fixed in place using suitable live pegs or hardwood cuttings (e.g. simali, Vitexnegundo) at one meter centers.

ii Compost and Mulch Production

The Contractor is to produce compost and mulch for nursery or site operations. It is to be produced in a timely manner, in the quantities required. Compost is normally required to sustain the long term fertility of nursery beds. Mulch may also be used in the nursery, but is normally produced to enhance site planting works, particularly the direct seeding of grass.

Compost and mulch should be made from annual and perennial weeds of poor rooting characteristics, such as ban mara (Eupatorium adenopherum) and tite pate (Artemesiavulgans). The greenery should be collected when there is most material available but before it forms seeds.

Collected material should be chopped finely and stored in a mound, compost bay or pit. The maximum size for chopped compost is 50 mm; the maximum size for chopped mulch is 150 mm.

Both compost and mulch should be kept moist but not waterlogged and in an aerated condition. They should be completely turned once a month on a regular schedule. Compost can have cow manure mixed in to assist the process of decomposition.

Neither compost nor mulch should be applied until they are fully rotted. By this time they should be black and the parts of individual plants should be indistinguishable. Early application can lead to a nutrient loss in the soil if microbes extract nitrogen to decompose the added organic material.

16.3.6 Site Protection/Site Aftercare and Maintenance

The Contractor is to protect a planted site for the period specified. Protection is to include the prevention of damage to all manner of site works and plants by local people and domestic or wild animals. It also includes an active role in tending the plants and improving their growth. The period of maintenance by the Contractor will be for six months

The Contractor shall maintain planted bio-engineering sites as required by the Engineer. This shall be done according to the specifications described hereunder, as and when required. The Contractor shall supply all necessary expertise and resources to ensure that these requirements are met.

The Contractor shall carry out weeding as required throughout the site. All annual weeds and other unwanted plants shall be cut just above the ground and the aerial parts will be used to make compost or mulch. Weeds must not be pulled out by the roots since this disturbs the ground surface.

Weeding should be carried out throughout the growing season. It must be undertaken with particular diligence at the end of the monsoon, so that there is the minimum amount of competition during the subsequent dry season.

The Contractor shall carry out mulching as required throughout the site. All plants required under the bio-engineering specifications will be mulched using material prepared as specified in above, or the aerial parts of weeds cut on the site or brought from elsewhere for the purpose. The desired plants should be kept mulched at all times but especial care must be taken in the spring, when the soil moisture deficit is at its greatest.

The Contractor shall replace failed, damaged, diseased and very weak plants, using fresh, healthy plants of the same species, at the correct time of year for planting. This replanting operation will normally be carried out during the monsoon in the year following the first planting works. Vegetation structures will be enriched by the planting of additional cuttings or seedlings, as instructed by the Engineer. Failed seeding areas will be re-seeded at the appropriate time of year.

In replanting and enrichment works, the Engineer may specify the use of different species. This will be done where failures of poor performance of plants may be attributed to poor stock or an incorrect initial choice of species.

Other maintenance operations are to be undertaken by the Contractor according to the instructions of the Engineer.

16.4 Site Preparation, Excavation, Backfill and Disposal of Surplus

16.4.1 Scope

This clause covers clearing of the site, maintaining the finished ground level with available surplus excavated suitable back fill material generated from foundation works etc.

16.4.2 General

The Contractor shall develop the site area to meet the requirement of the intended purpose. The site preparation shall conform to the requirements of relevant sections of this specification or as per stipulations of relevant British standard codes (BS Codes)/ IS/ equivalent International Standards.

The fill material shall be suitable for the above requirement. The fill shall be with such a material that the site so designed shall not be affected by erosion from wind and water from its final compacted position or the in-situ position of undisturbed soil.

Material unsuitable for founding of foundations shall be removed and replaced by suitable fill material to be approved by the Employer.

Backfill material around foundations or other works shall be suitable for the purpose for which it is used and compacted to the density described under Compaction. Excavated material not suitable or not required for backfill shall be disposed off in areas as directed by employer up to a maximum lead of 2 km.

16.4.3 Site Preparation

The layout and levels of all structure etc. shall be made by the Contractor at his own cost from the general grids of the plot and benchmarks set by the Contractor and approved by the Employer. The Contractor shall give all help in instruments, materials and personnel to the Employer for checking the detailed layout and shall be solely responsible for the correctness of the layout and levels.

16.4.4 Excavation and Backfill

A. Scope

This clause covers excavation for foundation works of Towers, Equipment support structures, Transformer foundations, External Lighting poles, Cable trenches, Buildings, Fire Wall, Water tanks etc., backfilling of Foundations Works.

- Excavation and backfill for foundations shall be in accordance with the relevant British standard codes (BS Codes)/ IS code/equivalent International Standards.
- Whenever water table is met during the excavation, it shall be dewatered and water table shall be maintained below the bottom of the excavation level during excavation, concreting and backfilling.
- When embankments are to be constructed on slopes of 15% or greater, benches or steps with horizontal and vertical faces shall be cut in the original slope prior to placement of embankment material. Vertical faces shall measure not more than 1 m in height.
- Embankments adjacent to abutments, culverts, retaining walls and similar structures shall be constructed by compacting the material in successive uniform horizontal layers not exceeding 15 cm in thickness. (of loose material before compaction). Each layer shall be compacted as required by means of mechanical tampers approved by the Purchaser. Rocks larger than 10 cm in any direction shall not be placed in embankment adjacent to structures.
- Earth embankments of roadways and site areas adjacent to buildings shall be placed in successive uniform horizontal layers not exceeding 20 cm in thickness in loose stage measurement and compacted to the full width specified. The upper surface of the embankment shall be shaped so as to provide complete drainage of surface water at all times.
- Do not disturb material below the bottom of footing grade. Do not backfill to compensate for excavation that has extended below grade. If excavation occurs below the proposed footing grade, fill the area with M15 concrete at the time the footing is placed. The additional concrete placed will be at the Contractor's expense.

16.4.5 Compaction

The density to which fill materials shall be compacted shall be as per relevant BS/IS and as per direction of Employer. All compacted sand filling shall be confined as far as practicable. Backfilled earth shall be compacted to minimum 95% of the Standard Proctor's density at OMC.

The sub grade for the roads and embankment filling shall be compacted to minimum 95 % of the Standard Proctor's density at OMC. Cohesion less material sub grade shall be compacted to 70 % relative density (minimum).

At all times unfinished construction shall have adequate drainage upon completion of the road's surface course, adjacent shoulders shall be given a final shaping, true alignment and grade.

Each layer of earth embankment when compacted shall be as close to optimum moisture content as practicable. Embankment material which does not contain sufficient moisture to obtain proper compaction shall be wetted. If the material contains any excess moisture, then it shall be allowed to dry before rolling. The rolling shall begin at the edges overlapping half the width of the roller each time and progress to the centre of the road or towards the building as applicable. Rolling will also be required on rock fills. No compaction shall be carried out in rainy weather.

16.4.6 Requirement for Fill Material Under Foundation

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

16.4.7 Disposal of Surplus Earth

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

16.5 Antiweed Treatment and Stone Spreading

16.5.1 Scope of Work

The Contractor shall furnish all labour, equipment and materials required for complete performance of the work in accordance with the drawings, specification.

Stone spreading along with cement concrete layer shall be done in the areas of the switchyard under present scope of work within fenced area. However the stone spreading along with cement concrete layer in future areas within fenced area shall also be provided in case step potential without stone layer is not well within safe limits.

16.5.2 General Requirement

The material required for site surfacing/stone filling shall be free from all types of organic materials and shall be of standard quality, and as approved by the Employer.

The material to be used for stone filling/site surfacing shall be stone aggregate of 40 mm nominal size (ungraded single size) conforming to Table 2 of IS:383- 1970. Hardness, flakiness shall be as required for wearing courses are given below:

I. Sieve Analysis limits (Gradation) (IS: 383 - Table - 2)

Sieve size	% Passing for single sided aggregate of nominal size 40 mm by weight
63 mm	100
40 mm	85-100
20 mm	0-20
10 mm	0-5

II. Hardness: Abrasion value (15:2386Part-IV) - not more than 40% Impact value (IS:2386 Part-IV) - not more than 30%.

III. Flakiness Index: As per IS: 2386 Part -I maximum value is 25%.

After all the structures/equipment are erected, anti-weed treatment shall be applied in the switchyard wherever stone spreading along with cement concrete is to be done and the area shall be thoroughly de-weeded including removal of roots. The recommendation of local agriculture or horticulture department may be sought wherever feasible while choosing the type of chemical to be used. The anti-weed chemical shall be procured from reputed manufacturers. The doses and application of chemical shall be strictly done as per manufacturer's recommendation. Nevertheless, the effectiveness of the chemical shall be demonstrated by the contractor in a test area of 10 M X 10 M (approx.) and shall be sprinkled with water at least once in the afternoon every day after forty-eight hours of application of chemical. The treated area shall be monitored over a period of two to three weeks for any growth of weeds by the Employer. The final approval shall be given by Employer based on the results.

Employer shall decide final formation level so as to ensure that the site appears uniform devoid of undulations. The final formation level shall however be very close to the formation level indicated in the approved drawing.

After anti weed treatment is complete, the surface of the switchyard area shall be maintained, rolled/compacted to the lines and grades as decided by Employer. The sub grade shall be consolidated by using half ton roller with suitable water sprinkling arrangement to form a smooth and compact surface. The roller shall run over the sub grade till the soil is evenly and densely consolidated and behaves as an elastic mass.

In areas that are considered by the Employer to be too congested with foundations and structures for proper rolling of the site surfacing material by normal rolling equipment, the material shall be compacted by hand, if necessary. Due care shall be exercised so as not to damage any foundation structures or equipment during rolling compaction.

The sub grade shall be in moist condition at the time the cement concrete is placed. If necessary, it should be saturated with water for not less than 6 hours but not exceeding 20 hours before placing of cement concrete. If it becomes dry prior to the actual placing of cement concrete, it shall be sprinkled with water and it shall be ensured that no pools of water or soft patches are formed on the surface.

Over the prepared sub grade, 75 mm thick base layer of cement concrete in 1:5:10 (1 cement :5 sand: 10 Stone aggregates) shall be provided in the area excluding roads, drains, cable trenches as per detailed engineering drawing. For easy drainage of water, the slope of 1:1000 is to be provided from the ridge to the nearest drain. The ridge shall be suitably located at the centre of the area between the nearest drains. The above slope shall be provided at the top of base layer of cement concrete in 1:5:10. A layer of cement slurry of mix 1:6 (1 cement: 6 sand) shall be laid uniformly over cement concrete layer. The cement consumption for cement slurry shall not be less than 150 kg. Per 100 sq.m.

A final layer of 100mm thickness of uncrushed/crushed/broken stone of 40 mm nominal size (ungraded size) shall be spread uniformly over cement concrete layer after curing is complete.

16.6 Site Drainage

Preparation of overall drainage layout, design, drawing and providing rainwater drainage system within the switchyard fencing under the present scope including connection at one or more points to the outfall point located outside the substation boundary wall is in the scope of contractor. Invert level of drainage system at outfall point shall be decided in such a way that the water can easily be discharged outside the substation boundary wall. In case outfall point is more than 50-meter away from boundary wall, only 50-meter drain outside the boundary wall is

in the scope of contractor. Outfall point shall be got approved from Employer before commencement of construction. While designing the drainage system following points shall be taken care of:

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

(b) In switchyard, PCC shall be laid. In any case, if PCC is not possible perforated PVC pipe shall be laid in every 0.5 m, aligned with slight sloping towards side drains of both sides, placed on alternating fashion, i.e., for a perforated PVC sloped towards left, two adjacent perforated PVC pipes shall be sloped towards right

(c) Drain shall be constructed at suitable locations in such a way that switchyard is not flooded, and roads are not affected with ponding of surface water. In the switchyard maximum spacing between two drains shall not be more than 60 meters. It will be ensured that no area is left undrained. In case of switchyard, the drains at minimum shall be on both longitudinal sides.

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

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

(f) Open surface drains shall be constructed with Brick Masonry. 100 mm thick PCC (1:3:6) shall be laid over 150mm thick layer of stone soling.

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

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

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

(j) For pipe drains, road crossings etc. higher strength pipe of class NP3 shall be provided. For rail crossings, RCC pipes of class NP4 shall be provided. For design of RCC pipes for drains and culverts, relevant British standard codes (BS Codes)/IS codes/equivalent International Standards shall be followed.

(k) Suitable number of portable pumps of 5 hp capacity for drainage of water shall be provided by the Contractor.

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

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

(n) The drainage scheme and associated drawings shall be got approved from Employer before commencement of construction.

16.7 Roads

All the roads as shown in the General Arrangement drawing for the substation issued along with the tender documents are in the present scope. Adequate turning space for vehicles shall be provided and bend radii shall be set accordingly. Road to the Transformer shall be as short and straight as possible.

If any roads has been unearthed for or due to laying of underground cable or any works of the sub-project, then reconstruction of such works to the previous level as per the standard and norms in Nepal lies in the scope of the Contractor and this work shall be done with utmost priority, i.e., the Employer will be able to stop payment if the delay on reconstructing such roads, especially highways and feeder roads, is observed or the work is not satisfactory.

All concrete roads within substation boundary wall shall be with 3.5 m RCC concrete pavement of suitable thickness and 1.3 m wide earthen shoulder on either side of the road. Below RCC concrete pavement, water bound macadam of adequate thickness as per design (WBM)/stone soling shall be laid.

All roads shall be designed as per relevant British standard codes (B S Codes)/IS Codes/equivalent International Standards. All drawings of road and culverts shall be prepared by the contractor and shall got approved from Employer before commencement of construction.

All the culverts and allied structures (required for road/rail, drain, trench crossings etc.) shall be designed as per relevant British standard codes (BS Codes)/IS Codes/equivalent International Standards.

16.8 Transformers, Rail Track/Rai cum Road

The Contractor shall design, prepare drawing and provide a RCC Rail cum road system integrated with the Transformer foundation to enable installation and the replacement of any failed unit. The transfer track system shall be suitable to permit the movement of any failed unit fully assembled (including OLTC, bushings) with oil. This system shall enable the removal of any failed unit from its foundation to the nearest road. If trench/drain crossings are required, then suitable R.C.C. culverts shall be provided in accordance with relevant BS/IS/equivalent International Standards.

The Contractor shall provide a pylon support system for supporting the firefighting system.

Each Transformer including oil conservator tank and cooler banks etc. shall be placed in a self-sufficient pit surrounded by retaining walls (Pit walls). The clear distance of the retaining wall of

the pit from the Transformer shall be 20 % of the Transformer height or 0.8 m whichever is more. The oil collection pit thus formed shall have a void volume equal to 200 % volume for 400 kV. The minimum height of the retaining walls shall be 15 cm above the finished level of the ground to avoid outside water pouring inside the pit. The bottom of the pit shall have a uniform slope towards the sump pit. While designing the oil collection pit, the movement of the Transformer must be taken into account.

Each oil collection pit shall be drained towards a sump pit within the collection pit whose role is to drain water and oil due to leakage within the collection pit so that collection pit remains dry. The pit shall be filled with boulders and oil shall travel from void in between the boulders.

16.8.1 Materials

Complete foundation shall be made of reinforced cement concrete and shall be designed as per guidelines for design of foundations given in the specification.

16.8.2 Drainage

One 0.5 hp pump for each pit shall be supplied and installed by the Contractor to evacuate the firefighting and rainwater from the sump pit in to the nearest drain.

16.9 Fire Protection Walls

16.9.1 General

Fire protection walls shall be provided, if required, in accordance with Local Advisory Committee (LAC) recommendations. The scope of works covers design, preparation of drawing and construction of RCC fire protection walls. While designing the wall, following points may be taken care of:

A. Fire Resistance

The firewall shall have a minimum fire resistance of 3 hours. The partitions, which are made to reduce the noise level, shall have the same fire resistance. The walls of the building, which are used as firewalls, shall also have a minimum fire resistance of 3 hours.

The firewall shall be designed to protect against the effect of radiant heat and flying debris from an adjacent fire.

B. Dimensions

The firewall shall extend 600 mm on each side of the Transformer /Reactors and 600 mm above the conservator tank or safety vent.

These dimensions might be reduced in special cases, as per the approval of Employer where there is lack of space. A minimum of 2 meter clearance shall be provided between the equipment e.g. Transformer /Reactors and firewalls.

The building walls, which act as firewalls, shall extend at least 1 m above the roof in order to protect it.

C. Materials

The firewall will be made of reinforced cement concrete as per the relevant British standard codes (B S Codes)/ IS/equivalent International Standards.

16.10 Cable Trenches and Cable Trench Crossings

The work covered under this clause comprises of design, drawing and construction cable trenches and cable trench crossings. While designing, following points may be taken care of:

a) The cable trenches and pre-cast removable RCC cover (with lifting arrangement) shall be constructed using RCC of M25 (Minimum) grade as per relevant British standard codes (B S Codes)/IS code/ equivalent International Standards.
b) The cable trench walls shall be designed for the following loads.
    - Dead load of 155 kg/m length of cable support + 75 kg on one tier at the outer edge of tier.
    - Earth pressure + uniform surcharge pressure of $2T/m^2$.
c) Cable trench covers shall be designed for self-weight of top slab + concentrated load of 150 kg at center of span on each panel.
d) Necessary sumps shall be provided and each sump shall be provided with pumps of 5 HP capacity shall be supplied for pumping out water collected in cable trench. Cable trenches shall not be used as storm water drains.
e) The top of trenches shall be kept at least 100 mm above the finished ground level. The top of cable trench shall be such that the surface rainwater do not enter the trench.
f) All metal parts inside the trench shall be connected to the earthing system.
g) Trench wall shall not foul with the foundation. Suitable clear gap shall be provided.
h) The trench bed shall have a slope of 1/500 along the run and 1/250 perpendicular to the run.
i) Cable trenches shall be blocked at the ends if required with brick masonry in cement sand mortar 1:6 and plaster with 12 mm thick 1:6 cement sand mortar.
j) Cable trench crossings shall be designed for critical load likely to be passed over the crossing. The cable trench crossing may be of either RCC box culvert type or RCC hume pipes embedded in plain concrete as per design of contractor.

16.11 Foundation/RCC Construction

16.11.1 General

Work covered under this Clause of the Specification comprises the design ,drawing and construction of foundations and other RCC constructions for switchyard tower structures, bus supports, equipment supports, cable trenches, Transformer /Reactors, jacking pad, pulling blocks, fire protection walls, control cubicles, marshalling kiosks, auxiliary equipment, GIS building, Control Building, Diesel Generator(DG) building or for any other equipment or service and any other foundation required to complete the work. This clause is as well applicable to the other RCC constructions.

Concrete shall conform to the requirements mentioned in relevant British standard codes (B S Codes)/IS Codes/equivalent International Standards and all the tests shall be conducted as per relevant British standard codes (BS Codes)/ IS Codes/equivalent International Standards. However, a minimum grade of M25 (design Mix) concrete shall be used for all foundations and structural/load bearing members as per relevant British standard codes (BS Codes)/IS Codes/equivalent International Standards.

If the site is sloppy, the foundation height will be adjusted to maintain the exact level of the top of structures to compensate such slopes. The switchyard foundation's plinths and building plinths shall be minimum 300mm and 500 mm above finished ground level respectively. Minimum 75 mm thick lean concrete (1:4:8) shall be provided below all underground structures, foundations, trenches etc. to provide a base for construction.

The design and detailing of foundations shall be done based on the approved soil data and sub-soil conditions as well as for all possible critical loads and the combinations thereof. The Spread footings foundation or pile foundation as may be required based on soil/sub-soil conditions and superimposed loads shall be provided.

All foundations of transformers in Terai region shall be suitable for 24 MVA, 33/11 kV transformers.

All foundations of transformers in Hilly region and Mountain region shall be suitable for 8 MVA, 33/11 kV transformers.

16.11.2 Design

All foundations except for external lighting poles shall be of reinforced cement concrete. The external lighting pole shall be embedded in plain cement concrete (1:2:4) foundation. The design and construction of RCC structures shall be carried out as per relevant BS/IS and minimum grade of concrete shall be M-25 (design Mix). Higher grade of concrete than specified

above may be used at the discretion of Contractor without any additional financial implication to the Employer.

Limit state method or any other method as per relevant British standard codes (BS Codes)/IS Codes/equivalent International Standards of design shall be adopted unless otherwise specified in the specification.

For detailing of reinforcement relevant BS/IS/equivalent International Standards followed. Cold twisted deformed bars conforming to relevant British standard codes (B S Codes)/IS Codes/equivalent International Standards. Two layers of reinforcement (on inner and outer face) shall be provided for wall and slab sections having thickness of 150 mm and above. Clear cover to reinforcement shall be as per relevant British standard codes (B S Codes)/ IS Codes/equivalent International Standards.

RCC water retaining structures like storage tanks, etc. shall be designed as uncracked section in accordance with relevant British standard codes (BS Codes)/IS codes/equivalent International Standards. However, water channels shall be designed as cracked section with limited steel stresses as per relevant BS/IS.

The procedure used for the design of the foundations shall be the most critical loading combination of the steel structure and or equipment and/or superstructure and other conditions which produces the maximum stresses in the foundation or the foundation component and as per the relevant British standard codes (BS Codes)/IS Codes/equivalent International Standards of foundation design. Detailed design calculations shall be submitted by the bidder showing complete details.

Design shall consider any sub-soil water pressure that may be encountered following relevant standard strictly.

Necessary protection to the foundation work, if required shall be provided to take care of any special requirements for aggressive alkaline soil, black cotton soil or any other type of soil which is detrimental/harmful to the concrete foundations.

RCC columns shall be provided with rigid connection at the base.

All sub-structures shall be checked for sliding and overturning stability during both construction and operating conditions for various combinations of loads. Factors of safety for these cases shall be taken as mentioned in relevant British standard codes (BS Codes)/IS Codes/equivalent International Standards or as stipulated elsewhere in the Specifications. For checking against overturning, weight of soil vertically above footing shall be taken and inverted frustum of pyramid of earth on the foundation should not be considered.

Earth pressure for all underground structures shall be calculated using co-efficient of earth pressure at rest, co-efficient of active or passive earth pressure (whichever is applicable). However, for the design of substructures of any underground enclosures, earth pressure at rest shall be considered.

In addition to earth pressure and ground water pressure etc., a surcharge load of 2T/Sq.m shall also be considered for the design of all underground structures including channels, sumps, tanks, trenches, substructure of any underground hollow enclosure etc., for the vehicular traffic in the vicinity of the structure.

Following conditions shall be considered for the design of water tank in pumps house, channels, sumps, trenches and other underground structures:

a) Full water pressure from inside and no earth pressure and ground water pressure and surcharge pressure from outside (application only to structures which are liable to be filled up with water or any other liquid).
b) Full earth pressure, surcharge pressure and ground water pressure from outside and no water pressure from inside.
c) Design shall also be checked against buoyancy due to the ground water during construction and maintenance stages. Minimum factor of safety of 1.5 against buoyancy shall be ensured ignoring the superimposed loadings.

Base slab of any underground enclosure shall also be designed for empty condition during construction and maintenance stages with maximum ground water table (GWT). Minimum factor of safety of 1.5 against buoyancy shall be ensured ignoring the super-imposed loadings.

The foundations shall be proportioned so that the estimated total and differential movements of the foundations are not greater than the movements that the structure or equipment is designed to accommodate.

The foundations of Transformer and circuit breaker shall be of block type foundation. Minimum reinforcement shall be governed by relevant British standard codes (BS Codes)/IS codes/equivalent International Standards.

The tower and equipment foundations shall be checked for a factor of safety as per relevant British standard codes (BS Codes)/IS/equivalent International Standards for two conditions i.e., Normal condition and short circuit condition against sliding, overturning and pull out. The same factors shall be used as partial safety factor overloads in limit state design also.

16.11.3 Admixtures and Additives

Only approved admixtures shall be used in the concrete for the Works. When more than one admixture is to be used, each admixture shall be batched in its own batch and added to the mixing water separately before discharging into the mixer. Admixtures shall be delivered in suitably labelled containers to enable identification.

Admixtures in concrete shall conform to relevant British standard codes (BS Codes)/IS Codes/ equivalent International Standards. The water proofing cement additives shall conform to relevant BS/IS. Employer shall approve concrete Admixtures/Additives.

The Contractor may propose, and the Employer may approve the use of a water-reducing set-retarding admixture in some of the concrete. The use of such an admixture will not be approved to overcome problems associated with inadequate concrete plant capacity or improperly planned placing operations and shall only be approved as an aid to overcoming unusual circumstances and placing conditions.

The water-reducing setting-retarding admixture shall be an approved brand as per relevant British standard codes (BS Codes)/IS Codes/equivalent International Standards. The water proofing cement additives shall be used as required/advised by Employer.

16.12 Boundary and Chain-Link Fencing and Gates

16.12.1 General

Work covered under this clause comprises of design, drawing, supply, fabrication, erection, painting or galvanization as specified etc. of boundary wall, main entrance gate, switch yard Fencing and switch yard entrance gate, construction of foundation of steel posts and toe wall. In addition to the switchyard, the fencing shall be developed for complete substation yard and a gate shall be installed. The tender level drawings of the boundary wall, main entrance gate, chain-link and switchyard entrance gate is provided in the Construction Standard Guideline Drawings of the Substation.

While providing switch yard fencing and gate, following points may be taken care of:

16.12.2 Areas requiring Fencing

Boundary wall fencing shall be provided to complete substation yard, as per the drawings, with foundations as essential.

Fencing shall be provided for complete switchyard. Separate gate shall be provided for men and equipment.

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

16.12.3 Product materials

Boundary wall fencing shall make use of industry standard works as per the relevant National Codes/British standard codes (B S Codes)/IS Codes/equivalent International Standards.

The minimum requirements are as follows for the internal fencing works:

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

16.12.4 Posts for Internal Fencing

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

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

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

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

16.12.5 Fence Fabric and Fence Panel for Internal Fencing

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

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

16.12.6 Installation for Internal Fencing

Fence shall be installed along the switchyard line.

Post holes shall be excavated by approved method.

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

Posts shall be set in 1:2:4 Plain Cement Concrete block of minimum 0.40x0.40x1.2m depth. 75mm thick plain cement concrete 1:4:8 shall be provided below concrete blocks. Posts shall be braced and held in plumb position and true alignment and elevation until concrete has set. Fence fabric shall not be installed until concrete has cured a minimum of 7 days.

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

16.12.7 Gate for Internal Fencing

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

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

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

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

Steel roller shall be provided with the gate.

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

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

16.13 Water Supply

16.13.1 General Requirements

Water shall be made available by Contractor at any feasible point within substation boundary by Bore well so that minimum pipe will be required for supply of water from that point to the buildings. The point for Bore Well shall got approved by employer. Contractor shall state the total water requirement both in terms of quantity and head to Employer.

The contractor shall carry out all the plumbing/erection works required for supply of water in GIS hall and control building beyond the single point as at (i) above.50 mm dia. CPVC pipe shall be provided by the Contractor from the bore-well to the roof water tank. From this contractor shall provide 25 mm dia. CPVC pipe for internal water supply on buildings and 12.5 mm dia. CPVC pipe for branch connections.

The details of tanks, pipes, fittings, fixtures etc. for water supply are given elsewhere in the specification under respective sections.

A scheme shall be prepared by the contractor indicating the layout and details of water supply which shall be got approved by Employer before actual start of work including all other incidental items not shown or specified but as may be required for complete performance of the works. All drawings shall be prepared by the contractor for approval of Employer.

16.13.2 Digging of one number of bore well for water supply

Digging of 1 bore well of 150 mm diameter to a depth of 50 m with 3HP submersible pump set with sufficient head to deliver water upto roof top water tank, supply of required materials includes80mm G.I delivery pipe and erection of pump set including accessories, testing and commissioning of pump sets.

Digging depth may be less than 50 m if quality and quantity of water available is satisfactory to higher depth.

Contractor shall supplying and installation of 3 HP 3 phase, multi stage 64 m (minimum) head pump suitable to 150 mm bore well with 80 mm GI pipe from pump delivery point to ground level .

Bore well shall be fixed with of 150 mm dia. class 3 PVC pipe partly slotted 1.5 mm below submersible pump and remaining portion upto ground level with covering the slotted portion by Nylon mesh firmly tied with Nylon/copper wire.

16.14 Sewerage System

Sewerage system shall be provided for GIS building and control building.

The Contractor shall construct septic tank and soak pit for required numbers of user but minimum of 50 users. If septic and soak pit system is not acceptable by local Nepal Authority, contractor will have to install suitable sewerage system as per local statutory requirement.

The system shall be designed as per relevant British standard codes (B S Codes)/IS codes/equivalent International Standards. All drawings shall be prepared by the contractor for approval of Employer.

16.15 Buildings – General Requirements

16.15.1 General

The scope includes the design, engineering and construction including anti-termite treatment, Plinth protection, DPC, Peripheral drain, Sanitary, Water supply, Electrification etc. of Control Building, Office Building, Staff Quarter and Guard House.

The contractor shall appoint a reputed architect for design of architecturally pleasing building.

16.15.2 Design Requirements

Dimension for Control Building, Office Building, Staff Quarter and Guard House shall be decided by contractor but having minimum dimension as per drawing attached with tender document, construction standard guidelines- substation-drawings.

a) The buildings shall be designed:
   i. To the requirements of the International standards/British Standards/ Indian Standards.
   ii. for the specified climatic and loading conditions.
   iii. to adequately suit the requirements of the equipment and apparatus contained in the buildings and in all respects to be compatible with the intended use and occupancy.
   iv. with a functional and economical space arrangement.
   v. For a life expectancy of structure, systems and components not less than that of the equipment which is contained in the building, provided regular maintenance is carried out.
   vi. to be aesthetically pleasing. Different buildings shall show a uniformity and consistency in architectural design.
   vii. to allow for easy access to equipment and maintenance of the equipment with, wherever required, fire retarding materials for walls, ceilings and doors, which would prevent supporting or spreading of fire.
   viii. With materials preventing dust accumulation.

ix. All structures shall be designed for the worst combination of dead loads, live loads, wind loads as per IS-875, seismic forces as per IS-1893.

x. The design of R.C.C. structures for the Control Building, Office Building, Staff Quarter and Guard House shall be done in accordance with IS: 456.

xi. For buildings in snowfall area, gable roof with appropriate slope approved by the Employer shall be constructed.

xii. Permissible stresses for different load combinations shall be taken as per relevant IS Codes.

b) Suitable expansion joints shall be provided in the longitudinal direction wherever necessary with provision of twin columns.

c) Individual members of the buildings frame shall be designed for the worst combination of forces such as bending moment, axial force, shear force, torsion etc.

d) Permissible stresses for different load combinations shall be taken as per relevant IS Codes/BS code.

e) The building lighting shall be designed in accordance with the requirements of relevant section.

f) The building auxiliary services like air conditioning and ventilation systems, fire protection and detection systems and all other miscellaneous services shall be designed in accordance with the requirements specified in relevant section or elsewhere in this Specification.

g) Chequered plate walkway shall be provided, if required.

16.15.3 Design Loads

Building structures shall be designed for the most critical combinations of dead loads, super-imposed loads, equipment loads, crane load (if any), wind loads and seismic loads.

Dead loads shall include the weight of structures complete with finishes, fixtures and partitions and should be taken as per IS:1911/BS/international standard.

Super-imposed loads in different areas shall include live loads, minor equipment loads, cable trays, small pipe racks/hangers and erection, operation and maintenance loads wherever these loads are expected. Equipment loads shall constitute, if applicable, all load of equipment to be supported on the building frame.

The wind loads shall be computed as per IS 875 - 1987/BS/international standard, Seismic Coefficient method/Response Spectrum method shall be used for the seismic analysis as per IS 1893 with importance factor 1.5.

Wind and Seismic forces shall not be considered to act simultaneously.

Floors/slabs shall be designed to carry loads imposed by equipment, cables and other loads associated with building. Floors shall be designed for live loads as per relevant IS/BS/international standard. Cable load shall also be considered additionally for floors where these loads are expected.

In addition, beams shall be designed for any incidental point loads to be applied at any point along the beams. The floor loads shall be subject to Employer's approval.

For consideration of loads on structures, IS:875/BS/international standard, the following minimum superimposed live loads shall, however, be considered for the design.

a)	Roof		1.5 kN/m^2	for accessible roofs
			0.75 kN/m^2	for in-accessible roofs
b)	RCC-Floor	(i)	5 kN/m2	for offices
		(ii)	10 kN/$m^{2(min.)}$	for equipment floors or actual requirement,

if higher than 10 kN/sqm based on equipment component weight and layout plans.

c)	Stairs and balconies	5 kN/m2
d)	Toilet Rooms	2 kN/m2
e)	Chequered	4 kN/m2 plate floor
f)	Walkways	3 kN/m2

Any additional load coming in the structure shall be calculated as per IS: 875/BS/international standard.

16.15.4 Submission

The following information shall be submitted for review and approval to the Employer:

i. Soft as well as hard copies of structural design calculations and drawing (including construction/fabrication) for all reinforced concrete and structural steel structures.
ii. Fully, dimensioned concept plan including floor plans, cross sections, longitudinal sections, elevations and perspective view of each building. These drawings shall be drawn at a scale not smaller than 1:50 and shall identify the major building components.
iii. Fully dimensioned drawings showing details and sections drawn to scales of sufficient size to clearly show sizes and configuration of the building components and the relationship between them.

iv. Product information of building components and materials, including walls partitions flooring ceiling, roofing, door and windows and building finishes.

v. A detailed schedule of building finishes including colour schemes.

vi. A door and window schedule showing door types and locations, door lock sets and latch sets and other door hardware.

Approval of the above information shall be obtained before ordering

16.15.5 Flooring, Walls and Roof

Flooring in various rooms of Control Building, Office Building, Staff Quarter and Guard House shall be as per detailed schedule given in Table -1, Internal Finish Schedule.

In Control Building, Office Building, Staff Quarter and Guard House walls shall be 230mm thick unless specified otherwise in the approved drawings.

RCC roofing shall be provided for Control Building, Office Building, Staff Quarter and Guard House. For buildings in snowfall area, gable roof with appropriate slope approved by the Employer shall be constructed.

16.15.6 Plastering

All internal and external walls shall have minimum 15mm thick 1:4 cement sand plaster. The ceiling shall have 12.5mm thick 1:3 cement sand plaster.

16.15.7 External Finishing

External plaster 18mm thick shall be of 1:4 cement sand plaster in two layers. External surface of the Control Building, Office Building, Staff Quarter and Guard House shall be painted with exterior paint Weather Shield Max or Excel Total All as per manufacturer's specification.

16.15.8 Internal Finish Schedule

The finishing schedule is given in subsequent clauses and Table -1, Internal Finish Schedule. Areas not specified in finish schedule shall be provided with vitrified tile flooring, and Premium Acrylic emulsion paint oil bound washable distemper over two mm thick putty. Paints used in the work shall be of best quality. Standard Practice as per prevalent national laws and as approved by the Employer shall apply for finishing in details for Guard House, Staff Quarter, Office Building and Control Buildings. Internal finish Schedule for Control Building, Office Building, Staff Quarter and Guard House building are given in Table - 1 below:

Table 1: Internal Finish Schedule

S.N.	LOCATION	FLOORING and SKIRTING 150MM HIGH	WALL (INTERNAL)	CEILING	DOOR, WINDOWS and VENTILATOR
1.	SCADA and Administration Room	Screeding and Punning	Non-VOC acrylic emulsion paint over 2 mm POP putty upto false ceiling over approved primer coat	Plaster finish ceiling painted with non-VOC acrylic emulsion paint to give an even shade	Windows/ ventilator shall be of UPVC frame using UPVC section with 5 mm clear float glass, U-shaped both side plastic gasket, steel hook locks and screws all accessories. All doors shall be flush door shutters with 38mm thick sal wood frame with 3 mm thick teak plywood on both side of shutter.
2.	Conference/Meeting Room	Screeding and Punning	Non-VOC acrylic emulsion paint over 2 mm POP putty upto false ceiling over approved primer coat	Plaster finish ceiling painted with non-VOC acrylic emulsion paint to give an even shade	Windows/ ventilator shall be of UPVC frame using UPVC section with 5 mm clear float glass, U-shaped both side plastic gasket, steel hook locks and screws all accessories. All doors shall be flush door shutters with 38mm thick sal wood frame with 3 mm thick teak plywood on both side of shutter.
3.	In-charge Room	Screeding and Punning	Non-VOC acrylic emulsion paint over 2 mm POP putty upto false ceiling over approved primer coat	Plaster finish ceiling painted with non-VOC acrylic emulsion paint to give an even shade	Windows/ ventilator shall be of UPVC frame using UPVC section with 5 mm clear float glass, U-shaped both side plastic gasket, steel hook locks and screws all accessories. All doors shall be flush door shutters with 38mm thick sal wood frame with 3 mm thick teak plywood on both side of shutter.

S.N.	LOCATION	FLOORING and SKIRTING 150MM HIGH	WALL (INTERNAL)	CEILING	DOOR, WINDOWS and VENTILATOR
4.	Other Office Room	Screeding and Punning	Non-VOC acrylic emulsion paint over 2 mm POP putty upto false ceiling over approved primer coat	Plaster finish ceiling painted with non-VOC acrylic emulsion paint to give an even shade	Windows/ ventilator shall be of UPVC frame using UPVC section with 5 mm clear float glass, U-shaped both side plastic gasket, steel hook locks and screws all accessories. All doors shall be flush door shutters with 38mm thick sal wood frame with 3 mm thick teak plywood on both side of shutter.
5.	ACDC and DCDB Room	Screeding and Punning	Non-VOC acrylic emulsion paint over 2 mm POP putty upto false ceiling over approved primer coat	Plaster finish ceiling painted with non-VOC acrylic emulsion paint to give an even shade	Windows/ ventilator shall be of UPVC frame using UPVC section with 5 mm clear float glass, U-shaped both side plastic gasket, steel hook locks and screws all accessories. All doors shall be flush door shutters with 38mm thick sal wood frame with 3 mm thick teak plywood on both side of shutter.
6.	11 kV Panel/Relay Room	Screeding and Punning	Premium Acrylic emulsion paint on smooth surface applied with plaster of paris (2 mm thick)	Plaster finish ceiling painted with non-VOC acrylic emulsion paint to give an even shade	Windows/ ventilator shall be of UPVC frame using UPVC section with 5 mm clear float glass, U-shaped both side plastic gasket, steel hook locks and screws all accessories. All doors shall be flush door shutters with 38mm thick sal wood frame with 3 mm thick teak plywood on both side of shutter.
7.	AHU Room	Screeding and Punning	Premium Acrylic emulsion paint on smooth surface	Acrylic emulsion paint over a coat of cement primer on	Windows/ ventilator shall be of UPVC frame using UPVC section with 5 mm clear float glass,

S.N.	LOCATION	FLOORING and SKIRTING 150MM HIGH	WALL (INTERNAL)	CEILING	DOOR, WINDOWS and VENTILATOR
			applied with plaster of paris (2 mm thick)	smooth surface applied with readymade putty 2 mm thick	U-shaped both side plastic gasket, steel hook locks and screws all accessories. All doors shall be flush door shutters with 38mm thick sal wood frame with 3 mm thick teak plywood on both side of shutter.
8.	Battery Room	Acid resistant non-skid tiles on flooring and up to 2100 mm height on wall.	Acid alkali resistant painting above 2100 mm height.	Plaster finish ceiling painted with non-VOC acrylic emulsion paint to give an even shade	Windows/ ventilator shall be of UPVC frame using UPVC section with 5 mm clear float glass, U-shaped both side plastic gasket, steel hook locks and screws all accessories. All doors shall be flush door shutters with 38mm thick sal wood frame with 3 mm thick teak plywood on both side of shutter.
9	Lobby	Screeding and Punning	Non-VOC acrylic emulsion paint over 2 mm POP putty upto false ceiling over approved primer coat	Plaster finish ceiling painted with non-VOC acrylic emulsion paint to give an even shade	Windows/ ventilator shall be of UPVC frame using UPVC section with 5 mm clear float glass, U-shaped both side plastic gasket, steel hook locks and screws all accessories. All doors shall be flush door shutters with 38mm thick sal wood frame with 3 mm thick teak plywood on both side of shutter.
10	Corridor	Screeding and Punning	Non-VOC acrylic emulsion paint over 2 mm POP putty upto false ceiling over approved primer coat	Plaster finish ceiling painted with non-VOC acrylic emulsion paint to give an even shade	Windows/ ventilator shall be of UPVC frame using UPVC section with 5 mm clear float glass, U-shaped both side plastic gasket, steel hook locks and screws all accessories. All doors shall

S.N.	LOCATION	FLOORING and SKIRTING 150MM HIGH	WALL (INTERNAL)	CEILING	DOOR, WINDOWS and VENTILATOR
					be flush door shutters with 38mm thick sal wood frame with 3 mm thick teak plywood on both side of shutter.
11	Portico for RCC Building	Screeding and Punning	Granite cladding	Plaster finish ceiling painted with non-VOC acrylic emulsion paint to give an even shade	All doors shall be flush door shutters with 38mm thick sal wood frame with 3 mm thick teak plywood on both side of shutter.
12	Toilet / kitchen	Ceramic Tiles	DADO glazed tiles 2100mm high, above that non-VOC acrylic emulsion paint over 2 mm thick POP putty along with primer coat.	Plaster finish ceiling painted with non-VOC acrylic emulsion paint to give an even shade	Windows/ ventilator shall be of UPVC frame using UPVC section with 5 mm clear float glass, U-shaped both side plastic gasket, steel hook locks and screws all accessories. All doors shall be flush door shutters with 38mm thick sal wood frame with 3 mm thick teak plywood on both side of shutter.
14	Diesel Generator (DG) room	Ceramic Tiles	DADO glazed tiles 2100mm high, above that non VOC acrylic emulsion paint over 2 mm thick POP putty along with primer coat.	Plaster finish ceiling painted with non-VOC acrylic emulsion paint to give an even shade	Windows/ ventilator shall be of UPVC frame using UPVC section with 5 mm clear float glass, U-shaped both side plastic gasket, steel hook locks and screws all accessories. All doors shall be flush door shutters with 38mm thick sal wood frame with 3 mm thick teak plywood on both side of shutter.
15	RCC Staircase	Punning	Non VOC acrylic emulsion paint over 2 mm POP putty	Plaster finish ceiling painted with non-VOC acrylic emulsion	Windows/ ventilator shall be of UPVC frame using UPVC section with 5 mm clear float glass,

S.N.	LOCATION	FLOORING and SKIRTING 150MM HIGH	WALL (INTERNAL)	CEILING	DOOR, WINDOWS and VENTILATOR
			upto false ceiling over approved primer coat	paint to give an even shade	U-shaped both side plastic gasket, steel hook locks and screws all accessories. All doors shall be flush door shutters with 38mm thick sal wood frame with 3 mm thick teak plywood on both side of shutter.

16.15.9 Cable Trench in Control Building

All cable trenches in Control Building shall be covered with minimum 6mm thick MS chequered plate with suitable stiffeners.

16.15.10 Doors, Windows and Ventilators

The details of doors, windows and ventilators of the buildings shall be as per finish schedule Table-1, Internal Finish Schedule conforming to relevant IS code. Rolling steel shutters and rolling steel grills shall be provided as per layout and requirement of buildings.

16.15.11 Plumbing and Sanitation

All plumbing and sanitation works shall be executed to comply with the requirements of the appropriate bye-laws, rules and regulations of the Local Authority having jurisdiction over such matters. The Contractor shall arrange for all necessary formalities to be met with regards to the inspection, testing, obtaining approval and giving notices etc.

'SINTEX' or an equivalent make PVC Roof water tank(s) with metal stand of adequate capacity depending on the number of users for 24 hours storage shall be provided. However, a minimum of 2 nos. 1500 liter capacity shall be provided.

Chlorinated Polyvinyl chloride (CPVC) pipes having thermal stability for hot and cold water supply including all CPVC plain and brass threading conforming to relevant British standard codes (B S Codes)/IS/equivalent International Standards shall be used for internal piping works for water supply.

For internal soil, waste and vent pipe Unplasticised rigid PVC pipes of 75mm for waste and 110mm dia. for soil shall be provided conforming to 15:13592 type B and all its fittings like bends, sockets, door bend, Y-tee etc. as per requirement with seal ring conforming to IS: 5382 including jointing with cement solvent conforms to 15:14182.All underground or under floor pipes shall be encased with 1:4:8 concrete. Minimum concrete cover shall be 75 mm thick.

There shall be separate provision of toilet for Male and Female and In addition to general requirements of each toilets, 2 nos. urinals with flushing system shall be provided for common Male toilet.

Each toilet shall have the following minimum fittings:

a. WC (Western type) 390 mm high along with toilet paper roll holder and all other fittings in all toilets.
b. Urinal (430 x 260 x 350 mm size) with all fittings and built-in-sensor for automatic flush after use.
c. Wash basin (550 x 400 mm) with all fittings.

d. Bathroom mirror (600 x 450 x 6 mm thick) with hard board backing.
e. CP brass towel rail (600 x 20 mm) with CP brass brackets.
f. Soap holder and liquid soap dispenser.
g. Automatic Hand Dryer.

Water cooler for drinking water with adequate water storage facility shall be provided which shall preferably be located near pantry and away from the toilet block.

One no. stainless steel kitchen sink with Drain board (510 x 1040 x 178 mm bowl depth) for pantry shall be provided.

All fittings, fasteners, gratings shall be chromium plated.

All sanitary fixtures and fittings shall be of approved quality and type, manufactured by reputed manufacturers. All items brought to site must bear identification marks of the Manufacturer.

Contractor shall provide necessary nos. of septic tank and soak pit of adequate capacity to treat the sewage/sullage from the buildings.

Contractor shall undertake all other activities required to complete and commission the building.

16.15.12 External Painting

External surfaces of all the buildings shall be painted with acrylic exterior flat paint as per manufacturer's specification and approval of Employer.

16.15.13 Plinth Protection

750 mm wide plinth protection around the all buildings shall be provided. Plinth protection shall comprise of 50 mm thick plain cement concrete laid over 75 mm thick well compacted stone aggregates with interstices filled with local sand.

16.15.14 Building Storm Water Drainage

The building design shall provide for the collection of storm water from the roof. This water shall be drained to the main drainage system of the Sub-station.
UPVC Rainwater down comer pipes conforming to relevant International standards/British Standards with water tight lead joints conforms to relevant British standard codes (B S Codes)/IS code/ equivalent International Standards shall be provided to drain off the rain water from the roofs. These pipes shall be suitably concealed with masonry work or cement concrete or cladding material. The number and size of downcomer pipes shall be governed by relevant British standard codes (B S Codes)/ IS code/equivalent International Standards.

All drains around the buildings shall have minimum 40 mm thick grating covers; and in areas where heavy equipment loads are envisaged, Pre-Cast RCC covers shall be provided in place of steel grating.

Suitable arrangements for draining out water collected from equipment blowdowns, leakages, floor washings, firefighting etc. shall be provided for each floor.

16.15.15 False Ceiling

Providing and fixing 15mm thick approximately 600 X 600mm Mineral fiber board panel false ceiling and making cut-outs for electrical fixtures, AC diffusers, openable access etc. complete with silhouette profile system with 15mm wide flange incorporating 6mm central recess white / black main runners at 1200mm center-center and not greater than 600mm from the adjacent wall. The cross tees shall be provided to make a module of approximately 600mm X 600mm by fitting 600 mm long cross tees centrally placed between 1200 mm long cross tees. Cross tees also have 15mm wide flange incorporating 6mm central recess white/black. The module formed above shall be anchored to the slab with channels or angles, suspenders as per manufacturer's specifications.

16.15.16 Underdeck Insulation

The underdeck insulation shall be provided in snow fall region identified in the scope of supply. The method of fixing shall consist of slotted M.S. angles of appropriate size (minimum 65x50x2mm) fixed to soffit of RCC roof slab at 600mm centers in both directions by Rawl plugs of adequate strength. The slots shall have 14g G.I. tie wire drawn through them.

50mm thick insulation mat Fiber-glass Crown - 100 or equivalent shall, be made out of fiber-glass or approved equivalent conforming to relevant international standard, backed with 34g aluminium foil and 22g x 12mm mesh wire netting. The net shall be stretched tightly across the slotted angles or slotted plates holding it in place by means of wires. The joints of the wire netting shall be butted and tightly laced down with 14g G.I. wire. The system needs to be approved from Employer.

16.15.17 Electrification

All electrification shall be executed as per details specified elsewhere in the technical specification and construction standard guidelines- substation- drawings. All details shall be as per relevant British standard codes (B S Codes)/ IS codes/equivalent International Standards.

16.15.18 Water Proofing Treatment For RCC Roof/Terrace

Roof of the buildings shall consist of Cast-in-situ RCC slab treated with a water proofing system which shall be an integral cement based treatment conforming to relevant British standard

codes (B S Codes)/IS Codes/equivalent International Standards. The water proofing treatment shall be of following operations:

i. Applying and grouting a slurry coat of neat cement using 2.75 kg/m^2 of cement admixed with proprietary water proofing compounds conforming to relevant British standard codes (B S Codes)/IS Codes/equivalent International Standards over the RCC slab including cleaning the surface before treatment.
ii. Laying brick bats using broken brick/brick bats of 25mm to 100mm size with 50% of cement mortar 1:5 (1 cement: 5 coarse sand) admixed with proprietary water proofing compound conforming to relevant British standard codes (B S Codes)/IS Codes/equivalent International Standards over 20mm thick layer of cement mortar of min 1:5 (Cement: 5 coarse sand) admixed with proprietary water proofing compound conforming to relevant British standard codes (B S Codes)/IS Codes/equivalent International Standards to required slope and treating similarly the adjoining walls up to 300mm height including rounding of junctions of walls and slabs.
iii. After two days of proper curing applying a second coat of cement slurry admixed with proprietary water proofing compound conforming relevant British standard codes (B S Codes)/IS Codes/equivalent International Standards.
iv. Finishing the surface with 20mm thick joint less cement mortar of mix 1:4 (1 cement: 4 course sand) admixed with proprietary water proofing compound conforming to relevant British standard codes (B S Codes)/IS Codes/equivalent International Standards and finally finishing the surface with trowel with neat cement slurry and making of 300 x 300 mm square.
v. The whole terrace so finished shall be flooded with water for a minimum period of two weeks for curing and for final test. All above operations to be done in order and as directed and specified by the Employer.
vi. Average thickness of water proofing shall be 120 mm and minimum thickness at khurra shall be 65 mm.

16.16 Mode of Measurement

16.16.1 Geotechnical investigation

The Contractor shall conduct the study with approval from the Employer for the investigation location. This shall include carrying out field tests, laboratory tests, compilation of results and preparation of soil report with recommendations for type of foundations shallow or pile type, suitability of soil for construction of substation etc.

The geotechnical investigation work shall be measured on lump sum basis for each sub-project.

16.16.2 Site Clearing, Contour survey and site leveling.

The site clearing work and contour survey work shall not be measured and paid separately and shall be deemed to be included in the item of site leveling work.

Measurement of Earth work in all kind of soil including rock in the item of cutting and filling and item of earth work in the filling with borrowed earth shall be made in Cubic meters.

16.16.3 Earthwork

This shall include excavation in all kinds of soil including rock, all leads and lifts including back filling with suitable earth, compacting, dewatering (if required) and disposal of surplus earth or rock to a suitable location within a lead up to 2 km. The surplus earth if disposed within substation boundary shall be spread in uniform layers each compacted with two passes of suitable compacting equipment. The quantity of excavation for foundations of towers, equipment support structures, all transformers/Reactors, firewall, cable trenches, buildings, External lighting poles, control cubicles, marshalling box shall only be measured. The quantity of excavation for roads, rail cum road, drains, culverts, rainwater harvesting, septic tank, soak pit, external water supply system, site surfacing, chain link fencing (including gate) shall not be measured separately and shall be deemed to be included in the composite rates quoted by the bidder for the respective works. All other excavation required for the completion of the work including plinth protection, flooring, sewerage system, manholes, pipes, earth mat etc. shall also not be paid for. The measurement of excavation of all concrete works shall be made considering dimension of the pit leaving 150mm gap around the base pad (lean concrete) or actually excavated pit, whichever is less. The quantity shall be measured in cubic meters.

16.16.4 PCC

Providing and laying Plain Cement Concrete of all types and at all locations including all leads and lifts. The quantity shall be measured in cubic meters as per lines and levels indicated in the drawings.

PCC 1:2:4 (1 cement: 2 sand: 4 coarse aggregate 20 mm nominal size) shall be measured in flooring of buildings, plinth protection, fencing, Transformer foundation, rail track, drain, culverts, septic tank, chain link fencing, fencing gate ,external lighting poles etc. as indicated in the approved drawings.

PCC 1:3:6 (1 cement: 3 coarse sand: 6 stone aggregate, 40mm nominal size) shall be measured below all foundations of towers, equipment support structures, buildings, firefighting water tanks, covered car parking, cable trench, roads, under flooring, rail-cum-road, transformer foundation, reactor foundation, drain, cable trench crossings, culverts, fence, gate, etc. as indicated in the approved drawings.

PCC 1:5:10 (1 Cement: 5 sand: 10 Stone aggregate, 40mm nominal size) shall be provided for site surfacing in switchyard, roof water proofing etc.

All other PCC required for the completion of the work including hold fasts of doors/windows/rolling shutters, fixing of plumbing pipes, bedding concrete for sewer lines, embedment of electrical conduits etc. shall not be measured and deemed included in the composite rates quoted by the bidder for respective works. Water proofing compound wherever specified shall be added without any extra cost.

16.16.5 RCC

Measurement of reinforced cement concrete at all locations shall be made and shall include all leads, lifts, formwork, grouting of pockets and underpinning, (but shall exclude reinforcement and miscellaneous structural steel like inserts etc.), of M25 design mix (Minimum). This shall also include pre-cast RCC work and addition of water proofing compound wherever required for which no additional payment shall be made. The quantity shall be measured in cubic meters as per lines and levels indicated in the drawings. No deduction shall be made for volume occupied by reinforcement/inserts/sleeves and for openings having cross-sectional area up to 0.1 Sq.m.

16.16.6 Steel Reinforcement

Reinforcement steel shall be measured in length (actual or theoretical as per drawing whichever is less) including hooks, if any, separately for different diameters as actually used in RCC work, excluding overlaps. From the length so measured, the weight of reinforcement shall be calculated in metric tonnes on the basis of sectional weights as adopted by British Standards/equivalent International standards. Wastage, overlaps, couplings, welded joints, spacer bars, chairs, stays, hangers and annealed steel wire or other methods for binding and placing shall not be measured and cost of these items shall be deemed to be included in the rates for reinforcement.

16.16.7 Stone filling over grating in Transformer foundation

Measurement of stone (40mm nominal size) filling over gratings of Transformer foundations shall be made as per theoretical volume of the space to be filled in the transformer foundation as per approved drawings. This shall be measured in Cu.m.

16.16.8 Miscellaneous structural steel

Measurement for Supply, fabrication, transportation and erection of all miscellaneous structural steel work for all gratings with supports for transformers/reactors, Cable trenches with covers (Chequered plate covers, cable supports, earthing cleats and edge protection angles etc.), all other steel fittings and fixtures, inserts and embedment in concrete of Transformer foundation

and cable trenches shall be made as per approved drawings. The unit rate for this item shall be inclusive of cutting, grinding, drilling, bolting, welding, pre- heating of the welded joints, applying a priming coat of steel primer and anti-corrosive bitumastic paint/ synthetic enamel paint in general but with Zinc Phosphate Primer(Two packs) for grating and support for grating in Transformer

/reactor foundation. (wherever specified), setting of all types of embedment in concrete, etc. Steel required for foundation bolts, nuts and bolt, doors, windows, ventilators, louvers, rolling shutters, chain link fencing, gratings in drains, soil pipes, plumbing pipes, floor traps, embedment's required for rainwater harvesting, septic tank, soak pit etc. shall not be considered for payment and measurements. Quantity shall be measured in metric tonnes.

16.16.9 Roads

The measurement for the concrete road shall be made on the basis of area in square meter (m^2) of top concrete completed surface of the road and shall be deemed to include all items such as excavation, compaction, rolling, watering, WBM, shoulder, etc. complete as per approved drawing but excluding concreting and reinforcement which shall be paid separately under respective items of BPS.

16.16.10 Anti-weed Treatment and Stone Spreading

The measurement shall be done for the actual area in square meters of stone spreading provided in the switchyard. It includes providing and spreading of 100 mm thickness of uncrushed/crushed/broken stone of 40mm nominal size as per relevant BS codes/equivalent International standards for the specified area. Application of anti-weed treatment including material shall not be measured separately and item would be deemed to be included in the quoted rate of stone spreading in switchyard.

16.16.11 Chain Link Fencing and gate

The measurement shall be made in running meters of the fence provided as per approved drawing. The rate shall be including the post, fencing, MS Flat, painting, brick work and plaster of toe wall etc. complete but excluding the concrete. The switch yard gate shall be measured in numbers including all items except concrete and reinforcement.

16.16.12 Cable Trenches and Cable trench Crossings

Earthwork, PCC, RCC, reinforcement steel, RCC hume pipes and miscellaneous steel required for construction of Cable Trenches and cable trench crossings shall be measured under respective items of Bid price schedule (BPS) as described in clauses of aforesaid paras. No

additional payment for brick work, plaster and PVC pipes used for cable trench crossings and sealing of trench mouth .

16.16.13 Drains and Culverts

PCC (1:2:4, 1:3:6 and 1:4:8) for drains and culverts shall be measured under respective items of Bid price schedule (BPS) as described in clauses of aforesaid paras. All other items like excavation, backfilling, brick work, grating, plaster and stone pitching except RCC hume pipes required for completion of drains and culverts shall be deemed to be included in the quoted rate of drain. The quantity for each type of drain section shall be measured in running meters. However, RCC hume pipes used in culverts shall be measured under respective item of Bid price schedule (BPS) as described in clause of hume pipes.

16.16.14 Hume Pipe

Hume pipe shall be measured diameter-wise and laid as per approved drawings and shall be measured in running meters. The item shall be inclusive of excavation, laying, back filling, jointing etc. but excluding concrete and reinforcement (if any). The same shall apply for perforated PVC pipe in Switchyard Drainage System.

16.16.15 Rail cum Road

The measurement for the rail cum road shall be made in square meters of top concrete completed surface of the rail cum road and shall include all items such as excavation, compaction, rolling, watering, WBM etc. complete as per approved drawing but excluding concrete, reinforcement, structural steel and rails with rail fixing details which shall be measured separately under respective item of BPS and described in above paragraphs.

16.16.16 Water supply system

The water supply system shall be measured in lump sum basis including supply system from bore-well to buildings and internal distribution on buildings. It shall include all the items such as excavation, piping, pipe fittings, water tank, painting, brickwork, sand filling, concrete, valves, chambers cutting chases in walls, openings in RCC and repairs, etc. required to complete the job.

16.16.17 Digging of Bore well

Digging of Bore well shall be measured in running meter starting from ground level including PVC pipe, GI pipe, 1.5 HP submersible pump set with necessary cables, control boards, protective devices etc. all complete.

16.16.18 External Sewage System

It shall be measured in lump sum basis. It shall include all the items such as excavation, piping, pipe fittings, manholes, gully trap, gully chamber casing in concrete and repairs, septic tank, soak pit etc. required to complete the job but concrete and reinforcement used for septic tank and soak pit shall be paid separately.

16.16.19 Control Building, Office Building, Staff Quarter and Guard House

Payment for this item shall be made as per the quantity basis including internal foundations, cable trenches, internal and external finishes as well as internal Firefighting works, water proofing treatment for roof/terrace etc. complete in all respect. However, the quantity of excavation, concrete, reinforcement shall be measured in respective items of BPS and described in above paras. The structural steel used for cable tray support, earthing cleat, chequered plates for internal cable trenches of building shall be measured and paid under miscellaneous steel item of BPS and described above paras. The rest of the entire work required to complete the building in all respect as per drawings prepared by contractor and approved by Employer shall be deemed to be included in this rate.

16.16.20 Slope Protection Work

Slope protection work by stone pitching and by Bio engineering grass plantation shall be measured in square meter including all work required to complete the work as per technical specification.

16.17 Miscellaneous Requirements

Dense concrete with controlled water cement ratio as per BS code/IS code/equivalent international standard shall be used for all underground concrete structures such as cable and pipe trenches etc. for achieving water-tightness.

All joints including construction and expansion joints for the water retaining structures shall be made water tight by using PVC ribbed water stops with central bulb. However, kicker type (externally placed) PVC water stops shall be used for the base slab and in other areas where it is required to facilitate concreting. The minimum thickness of PVC water stops shall be 5 mm and minimum width shall be 230 mm.

All steel sections and fabricated structures which are required to be transported on sea shall be provided with anti-corrosive paint to take care of sea worthiness.

All mild steel parts used in the water retaining structures shall be hot-double dip galvanized. The minimum coating of the zinc shall be 750 gm/m^2 for galvanized structures and shall comply with relevant BS/IS. Galvanizing shall be checked and tested in accordance with relevant

BS/IS. The galvanizing shall be followed by the application of an etching primer and dipping in black bitumen in accordance with BS:3416.

Bricks having minimum 75 kg/cm^2 compressive strength can only be used for masonry work. Contractor shall ascertain himself at site regarding the availability of bricks of minimum 75 kg/cm^2 compressive strength before submitting his offer.

Doors and windows on external walls of the buildings (other than areas provided, with insulated metal claddings) shall be provided with RCC sun-shade over the openings with 300 mm projection on either side of the openings. Projection of sunshade from the wall shall be minimum 450 mm over window openings and 750 mm over door openings.

All stairs shall have maximum riser height of 150 mm and a minimum tread width of 300 mm. Minimum width of stairs shall be 1500 mm for service buildings and 1000 mm for residential buildings. Service ladder shall be provided for access to all roofs. RCC fire escape staircase if required as per local bye laws, shall be provided in GIS buildings.

Angles 50x50x6 mm (minimum) with lugs shall be provided for edge protection all round cut outs/openings in floor slab, edges of drains supporting grating covers, edges of RCC cable/pipe trenches supporting covers, edges of manholes supporting covers, supporting edges of manhole precast cover and any other place where breakage of corners of concrete is expected.

Anti-termite chemical treatment for buildings shall be given to all column pits, wall trenches, foundations, filling below the floors etc. as per relevant International/BS.

Hand-railing minimum 1200mm high shall be provided around all floor/roof openings, projections/balconies, walk ways, platforms, steel stairs etc. All handrails and ladder pipes shall be 32 mm nominal bore MS pipes (medium class) and shall be galvanized (medium-class as per relevant BS). All rungs for ladder shall also be galvanized as per relevant BS.

For RCC stairs, stainless steel hand railing shall be provided.

For all civil works covered under this specification, design Mix of Minimum M25 grade as per relevant International/BS/IS shall be used. Reinforcement steel shall be of minimum Fe 500 grade.

The material specification, workmanship and acceptance criteria shall be as per relevant clauses of applicable International/BS/IS standard.

Items/components of buildings not explicitly covered in the specification and BPS but required for completion of the project shall be deemed to be included in the scope.

Requirement of sulphate resistant cement (SRC) for sub structural works shall be decided in accordance with the International/BS/IS Standards based on the findings of the detailed soil investigation to be carried out by the Bidder.

Foundation system adopted by Bidder shall ensure that relative settlement and other criteria shall be as per provision in relevant BS/IS/Equivalent International Standards.

Construction joints shall be as per International/BS/IS standard

All building/construction materials shall conform to the best quality specified in relevant International /BS/IS standard.

16.18 Interfacing

The proper coordination and execution of all interfacing civil works activities like fixing of conduits in roofs/walls/floors, fixing of foundation bolts, fixing of lighting fixtures, fixing of supports/embedments, provision of cut outs etc. shall be the sole responsibility of the Contractor. He shall plan all such activities in advance and execute in such a manner that interfacing activities do not become bottlenecks and dismantling, breakage etc. is reduced to minimum.

16.19 Statutory rules

Contractor shall comply with all the applicable statutory rules pertaining to relevant acts of GoN.

Provisions for fireproof doors, no. of staircases, fire escape stairs, fire separation wall, plastering on structural members (in fire prone areas) etc. shall be made according to the recommendations of Engineer In charge.

Statutory clearance and norms of Local Pollution Control Board shall be followed as per Water Resources Act for effluent quality from plant.

16.20 Field quality plan

All tests as required in accordance to BS codes or equivalent International standards have to be carried out. The contractor shall prepare field quality plan for civil works as per relevant BS Codes/IS Codes/equivalent International Standards during detailed engineering stage and submit to Employer for approval within ONE month after award of work.

16.21 Standard codes

For design and engineering relevant British Standard Codes (BS Codes)/Indian Standard Codes (IS Codes)/equivalent international standards shall be referred by the contractor. Relevant portion of British Standard Codes (BS Codes)/Indian Standard Codes (IS

Codes)/equivalent international standards referred by the contractor for the design shall be made available to Employer if necessary, during detailed engineering stage.

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Section 4: Tender Forms

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Technical Data Schedule shall be submitted along with Technical Proposal

Name of Tenderer _____

Signature of Tenderer_____

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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
A2	**ACSR Conductor and Hardware**			
1	**ACSR Conductor**		To be filled Separately for all types used	
	Manufacturer			
	Country of Origin			
	Years of Manufacturing Experience			
	Applicable standard		IS 398	
	Type		ACSR DOG/ ACSR WOLF	
	Nominal Aluminum Area	sq mm	100/150	
2	**Mid Span Compression Connectors**		To be filled Separately for all types used	
	Manufacturer			
	Country of Origin			
	Years of Manufacturing Experience			
	Applicable Standard			
	Model No.			
	Type		Compression	
	Current Rating	A	500	
	Material			
	Outer Sleeve			
	Inner Sleeve			
	Dimension of Compression Joint for Aluminum part			
	Outer	mm		
	Inner	mm		

Name of Tenderer _____

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Dimension of Compression Joint for Steel part			
	Outer	mm		
	Inner	mm		
	Minimum Failing Load	kN		
	Electrical Resistance at 20 deg. C			
	Size	mm		
	weight	Kg		
	Markings			
3	**Parallel Groove (PG) Clamps**			
	Manufacturer			
	Country of Origin			
	Years of Manufacturing Experience			
	Applicable Standard			
	Type/Model No.			
	Main Conductor		WOLF	
	Branch Conductor		WOLF	
	Current Rating	A	500	
	Type of Connection			
	Construction			
	Body Material			
	Screw Material			
	Bolts size	mm		
	Tightening torque	Nm		
	Size	mm		
	weight	Kg		
	Markings			
4	**Information to be Submitted with the Tender**			

Name of Tenderer _____

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	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			
	Submitted for the required ratings			
	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 _____

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
A3	**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	36	
	Rated voltage	kV	33	
	Creepage distance (minimum)	mm	600	
	Wet power frequency withstand voltage	kV	75	
	Impulse withstand voltage	kV	170	
	Puncture power frequency voltage (minimum)	kV	180	
	Visible discharge voltage (Effective)	kV	27	
	Cantilever strength	kN	10	
	GI pin head		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	
	Rated Voltage	kV	11	

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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
	Porcelain Diameter (minimum)	mm	255	
	Spacing	mm	145	
	Creepage Distance (minimum)	mm	320	
	Power Frequency Puncture withstand Voltage		1.3 x Actual dry flashover voltage	
	Wet Power Frequency Withstand Voltage	kV	45	
	Impulse Withstand Voltage	kV	75	
	Puncture Power Frequency Voltage (minimum)	kV	105	
	Visible Discharge Voltage	kV	9	
	Mechanical Strength	kN	70	
	Ball and Socket Size		16 mm	
	Applicable Standard for Special Characteristics		IS: 3188-1980	
3	**Disc Insulator Fittings**			
	Manufacturer			
	Country of Origin			
	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**			

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
	Manufacturer			
	Country of Origin			
	Years of Manufacturing Experience			
	Model No.			
	Applicable Standard		IS: 2486	
	Type of steel used		Hot rolled steel	
	Head type		Large L300N	
	Total length	mm	450	
	Stalk length	mm	300	
	Shank length	mm	150	
	Minimum failing load	kN	10	
5	Pin Insulator Tie			
	Submitted for the required ratings			
	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		

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
	Holding Rating of Double support Top tie for "DOG"	kg		
	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	**Information to be Submitted with the Tender**			

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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
	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	
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		

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
A4	**HT 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	10454	
	Length of threaded portion	mm	300	
	Thimble shape		Suitable for Stay wire of 7/8, 19/8 and as per approved design	
	Thimble section		18 SWG min.	
	Stay plate section	mm	600 x 600 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	
	Steel Wire Size	(Nos of wire/SWG)	7/8, 19/8 or as per approved design	

Name of Tenderer _____

Signature of Tenderer_____

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	No. of Wire	Nos	7	
	Diameter of Each wire	mm	4	
	Strand Diameter (Overall)	mm	12	
	Overall Cross Sectional Area	sq mm	88	
	Tensile grade		Gr. 700	
	Minimum Tensile Strength of Steel	N/sq mm	700	
	Ultimate Tensile Strength (min.)	N/sq mm	700	
	Min. Breaking load of single wire	kN	8.8	
	Min. Breaking load of strand	kN	54.9	
	Approximate Weight	kg/km	690	
	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			
	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	
	Cable Hole Diameter	mm	25	
	Creepage Distance (minimum)	mm	57	
	Minimum failing load	kN	88	

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	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	
	Submitted for the required ratings	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			

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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		

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Signature of Tenderer_____

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
A5	**ADSS Cable**			
1	**ADSS Cable Properties**		Fill Separately, if required for Approach Cable	
	Manufacturer			
	Country of Origin			
	Years of Manufacturing Experience			
	Model No.			
	Applicable Standards		IEC 60794	
	Marking as per specifications	yes/no	Yes	
	Fiber Count	no.	48	
	Cable Structure			
	Fiber no. per tube	no.		
	Loose tube	no.		
	Central Strength member	material	FRP	
	Inner Sheath	mm	≥1.0	
	Outer Sheath		≥1.5	
	Cable diameter	mm		
	Cable weight	mm		
	Maximum Span	m	200	
	Minimum Bending Radius			
	Installation		25 x cable diameter	
	Operation		12.5 x cable diameter	
	Cable weight	mm		
	Outer Sheath	%	≥1.2	
2	**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
	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	
3	**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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Signature of Tenderer_____

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
A	**Power Transformer**			
1	**General**			
	Manufacturer			
	Place of manufacture/ testing			
	Applicable Standards		IEC 60076	
	Type		Three Phase	
2	**Ratings**			
	Rated power of Transformer (ONAN)	mVA	As per Price Schedule	
	Rated power of Transformer (ONAF)	mVA	As per Price Schedule	
	Rated frequency	Hz	50	
	Ambient temperature	°C	45 or as per scope of supply	
	Maximum service altitude	meter	As per Scope of Supply	
	Temperature rise limit at all tap-changer settings and 10 % over- or under-excitation			
	- oil / top	K	50	
	- windings / average	K	55	
	Manufacturer for winding temperature indicator		Messko, Germany or Equivalent	
	Manufacturer for oil temperature indicator		Messko, Germany or Equivalent	
	Hottest Spot Temperature in Winding Limited to	K		
	Rated voltages (no-load):			
	- HV winding	kV	33	
	- LV winding	kV	11	
	Maximum Voltage			
	- HV winding	kV	36	
	- LV winding	kV	12	
	Type of tank			

Name of Tenderer _____

Signature of Tenderer_____

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Tank fully vacuum-proof		Yes	
	Number of windings		2	
	Vector group		Dyn11	
	Magnetic flux density at core and yoke at nominal voltage and frequency	T	>1.6	
	Short Circuit Level		25 kA at 33 kV	
	Short circuit capacity		(according to IEC 60076-5)	
	Sound pressure			
	Transformer and tap changing equipment energized and at noload [G]			
	Pressure relief device min pressure settings			
	No-load current (Io/In)	%	< 1% of rated current	
3	**Core design:**			
	- core form			
	- type		CRGO	
	- source			
	- losses			
4	**Tap Changer:**			
	Type of tap changer (On/Off Load)		Off Load (1, 3 MVA); On load (8, 16 MVA)	
	Tapping range	%	+10% to -10%	
	Number of steps	steps	Off Load 9 and On Load 17	
	Principal tapping	kV	33	
	Control Suitable for		Remote, Local, Auto, Manual, Parallel and Master Slave Operation	

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
	Rated Voltage for Drive Motor			
	Manufacturer		Maschinenfabrik Reinhausen (MR) Germany or ABB Sweden or equivalent	
5	**Insulation oil:**			
	- manufacturer			
	- type		Mineral Oil	
	- specification of oil		As per IEC 60296	
	Approximate Volume of Oil	liters		
	Type of Oil Preservation System		Conservator Type with Urethane air cell	
	Volume of Conservator			
	Volume of Oil between highest and lowest levels			
6	**Windings**			
	Winding Material		Copper	
	Winding insulation design:			
	- HV winding		Uniform	
	- LV winding		Uniform	
	Insulation Level/ HV winding			
	- lightning impulse level	kV	170	
	- power frequency withstand voltage	kV	70	
	Insulation Level/ LV winding			
	Submitted for the required ratings	kV	75	
	- power frequency withstand voltage	kV	28	

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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
	- insulation levels shall be coordinated with actually transferred over-voltages	yes/no	Yes	
	Method of transformer neutral earthing:			
	Primary (HV)		Not Applicable	
	Secondary (LV)		Solid Grounded	
	Maximum Current Density at Rated Power			
	In HV Windings	A/sq mm	2.5	
	In LV Windings	A/sq mm	2.5	
7	**Clearances**			
	Minimum Clearance in air HV/LV	mm	As per IEC	
	Minimum Clearance between phases	mm	As per IEC	
	Minimum Clearance between phaes and ground	mm	As per IEC	
8	**Cooling and Operation Details**			
	Cooling method		ONAN/ONAF	
	Noise level (LpA) at a measuring distance of 2 m (all forced cooling in operation)	dB (A)	As per NEMA standard	
	Full power output at all tap positions under specified conditions	yes/no	Yes	
	Continuous operation within specified temperature rise limit at over- and under-excitation	%	As per IEC 60076	
	No. of Connected Fans	Nos		

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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
	No. of Standby Fans	Nos		
	Rated Voltage for Fans	V	400/230	
	Adjustable Control Gear			
9	**Bushings**			
	HV bushings			
	- manufacturer			
	- type			
	- rated current	A	As per Price Schedule from values provided in IEC 60137	
	- power frequency test voltage	kV	77	
	- lightning impulse level	kV	170	
	- minimum creepage distance	mm	25 mm/kV	
	LV bushings (outdoor type)			
	- manufacturer			
	- type		Oil to Air	
	- rated current	A	As per Price Schedule from values provided in IEC 60137	
	- power frequency test voltage	kV	30	
	- lightning impulse level	kV	75	
	- minimum creepage distance	mm	25 mm/kV	
10	**Bushing and Neutral Current Transformers**			
	Type and Voltage Class			
	Number of Cores			
	HV	Nos	1/phase	
	LV	Nos	1/phase	

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Signature of Tenderer_____

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	NCT	Nos	2	
	Accuracy Class		PS	
	Burden	VA		
	Maximum Resistance of Secondary Winding	Ohm		
	Knee Point Voltage			
	Magnetising Current at Knee Point Voltage			
11	**Guaranteed Losses**			
	No-load losses at rated voltage and frequency	kW		
	Load losses at 75 °C and rated current and at HV principal tapping			
i.	for ONAN cooling	kW		
ii.	for ONAF cooling	kW		
	Power Consumption of Cooling Plant at full load	kW		
12	**Impedance at 75 °C and rated current and frequency**		Min 5% for 1, Min 7% for 3, MVA and min 8% for 6/8 and 16 MVA	
	- tap changer in position "1"	%		
	- tap changer in position "9"	%		
	- tap changer in position "17"	%		
	Short circuit impedance at 75 °C and 100% of rated power:			
13	**Efficiency at 75 °C winding temperature**			
	- at 100% load	kW		
	- at 75% load	kW		
	- at 50% load	kW		

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Load % of full load and power factor at which maximum efficiency occurs			
14	**Voltage regulation at 75 °C and rated power**			
	- at unity power factor	%		
	- at 0.85 power factor	%		
15	**No load current in percentage of rated current referred to HV and 50 Hz**			
	- at 100% rated voltage	A		
	- at 90% rated voltage	A		
	- at 110% rated voltage	A		
16	**Tests**			
	Routine tests according to IEC 60076 and Specifications		On each unit	
	Lightning impulse test (lines only)		On each unit	
	Full wave			
	- HV winding	kV	As per IEC 60076	
	- LV winding	kV	As per IEC 60076	
	Chopped wave			
	- HV winding	kV	As per IEC 60076	
	-LV winding	kV	As per IEC 60076	
	Separate source AC voltage withstand test		On each unit	
	- HV winding	kV	As per IEC 60076	
	- LV winding	kV	As per IEC 60076	
	Induced AC withstand voltage tests (ACSD), acc. to IEC 60076-3, sub-clause 12 (phase-to-ground and phase-to-phase)		On one unit	

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	- test voltage / HV winding	kV	As per IEC	
	- test voltage / LV winding	kV	As per IEC 60076	
	Test temperature rise (at all kinds of cooling and at overloads as below)		On one unit	
	Test of noise level (special test)		On one unit	
	All other type tests and special tests according to the Specification		On one unit	
15	**Masses and Dimensions**			
	Transformer masses:			
	- total mass	kg		
	- transportation mass	kg		
	- untanking mass	kg		
	- mass of insulation oil	kg		
	Overall dimensions including bushings:			
	- height	mm		
	- depth	mm		
	- width	mm		
	Shipping dimensions:			
	- height	mm		
	- depth	mm		
	- width	mm		
	Height of crane hooks	mm		
	Minimum space requirement for the transformer bays (civil works):			
	- depth			
	- width			
16	**Information to be Submitted with the Tender**			

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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			
	Detailed descriptions or leaflets of:			
	- Arrangement and insulation of windings			
	- Core and tank			
	- Conservator and breather			
	- Tap changer			
	- Measuring/ monitoring instruments			
	- Transformer auxiliaries			
	- Control and marshalling cubicle			
	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	
17	**Informative Data**			
	Transformer			
	Manufacturer			

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	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		
	Manufacturers of Accessories			
	Conservator for transformer			
	Current transformer			
	Temperature sensors Pt 100 for oil and winding			
	Contact thermometers for oil and winding			
	Control cubicle			
	Gas relay			
	Oil level gauge			
	Wheels			
	Pressure relief / Explosion vent			

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
C	**33 kV System**			
1	**General**			
	Manufacturer			
	Place of manufacture			
	Standards		IEC 62271	
	Type of switchgear, designation			
	Type tested:			
	-each component		Yes	
2	**Common Characteristics**			
	Rated voltage	kV	36	
	Nominal system voltage	kV	33	
	Rated frequency	Hz	50	
	Rated power frequency withstand voltage	kV	70	
	Rated lightining impulse withstand voltage	kV peak	170	
	Rated current of busbar feeder	A	800	
	Rated short time withstand current (1 s)	kA rms	25	
	Rated peak withstand current	kA peak	62.5	
	Maximum permissible ambient temperature	°C	As per IEC	
	Remote Operability, Unmanned Substation		Yes	
3	**Circuit Breaker**			
	Designation			
	Manufacturer			
	Standards		IEC 62271	

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Type		Three Pole, VCB, Outdoor	
	Pole Breaking		Three, Gang Operated	
	Rated voltage	kV	36	
	Nominal system voltage	kV	33	
	Rated Frequency	Hz	50	
	Rated withstand voltages phase to earth:			
	-lightining impulse	kV	170	
	-power frequency	kV	70	
	Rated current	A	630/800/1250	
	Rated short circuit breaking current	rms KA	25	
	Rated making current	peak kA	62.5	
	First pole to clear factor		1.3	
	Breaking time	ms	60	
	Opening time	ms	40	
	Closing time	ms	100	
	Close open time	ms	120	
	Rated cable and line charging breaking current	A		
	Operating mechanism			
	- type		Motor-Spring	
	- number per three phase circuit breaker	pcs	1 for each phase	
	- rated operating sequence		O-0.3s-CO-3min-CO	
	- number of closing coils	pcs	1	
	- number of tripping coils	pcs	2	
	- rated control voltage	VDC	110	
	-operating noise level (one CB) at 1m distance	dB (A)	As per NEMA	

Name of Tenderer _____

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Number of CO operations before overhaul			
	- at no load mechanical	CO	10000	
	- at rated current	CO		
	- at rated short circuit circuit current	CO		
	Operating voltage of closing and tripping coil	VDC	110	
	Operating voltage range of closing coil	% of rated voltage	85 - 110%	
	Operating voltage range of tripping coil	% of rated voltage	70 - 110%	
	Spring charging motor capacity	kW		
	Spring charging motor rated voltage	V DC	110	
	Closing and Tripping current	A		
	Creepage Distance	mm/kV	25	
	Thickness of sheet steel of cubicle	mm	2	
	Number of auxiliary contacts	No	6NO, 6NC, 6MBB	
	Temperature rise above 45 deg C ambient at normal rated current			
	Contacts	deg Celsius		
	Submitted for the required ratings	deg Celsius		
	No. of operation	No	5000	
4	**Load Break Switch**			
	Designation			
	Manufacturer			

Name of Tenderer _____

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Standards		IEC 62271-103	
	Type		Load Break Switch, Outdoor (IP67)	
	Pole Breaking		Three, Gang Operated	
	Rated voltage	kV	36	
	Nominal system voltage	kV	33	
	Rated Frequency	Hz	50	
	Rated withstand voltages phase to earth:			
	-lightining impulse	kV	170	
	-power frequency	kV	70	
	Rated current	A	40/630/800/1250	
	Rated short circuit breaking current	rms KA	25	
	Rated making current	peak kA	62.5	
	Mounting		Pole/Gantry Mounted	
	Temperature rise above 45 deg C ambient at normal rated current			
	Contacts	deg Celsius		
	Terminals	deg Celsius		
5	**Disconnecting and Earth Switch**			
	Type		3 pole, single throw, outdoor, center rotating	
	Designation			

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Manufacturer			
	Standards		IEC 62271-102	
	Rated voltage	kV	36	
	Nominal system voltage	kV	33	
	Rated Frequency	Hz	50	
	Rated withstand voltages phase to earth:			
	-lightining impulse	kV	170	
	-power frequency	kV	70	
	Rated current	A	630/800/1250	
	Rated short circuit breaking current	rms KA	25	
	Operating mechanism			
	- type		Motor+manual	
	- number of drives per 3 phase	nos	1	
	- drive gear	yes/no	yes	
	- operating time	s		
	- closing time	s		
	- control voltage	VDC	220	
	Number of CO operations before overhaul	CO	2000	
	Type of Interlock furnished		Electrical and Mechanical	
	Temperature rise above 45 deg C ambient at normal rated current			
	Contacts	deg Celsius		
	Terminals	deg Celsius		
	Clearance			
	Between live parts and ground	mm		

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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
	Between fixed contact and blade in open position	mm		
	Material			
	Materials for main contacts		Copper Alloy	
	Materials for Terminals			
	Electrical endurance class of Earth Switch according to IEC		E0	
6	**33 kV Power Fuse**			
	Designation			
	Manufacturer			
	Standards		IEC 60282-2	
	Type		Single Pole, Single Throw, Drop Out, Hook Stick Operated, Outdoor Type	
	Rated voltage	kV	36	
	Nominal system voltage	kV	33	
	Rated Frequency	Hz	50	
	Rated withstand voltages phase to earth:			
	-lightining impulse	kV	170	
	-power frequency	kV	70	
	Rated current	A	4	
	Rated short circuit breaking current	rms KA	25	
	Fuse Rating	A		
	Fuse Type			
	Mounting Position		Vertical	
	Number of Pole		Three	
	Type of Contact			
	Materials of Contact Service			

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
	Air gap between pole of phase	mm		
	Creepage Distance	mm/kV	25	
7	**Current Transformer**			
	Type		Ring Type	
	Designation			
	Manufacturer			
	Standards		IEC 61869	
	Number of cores	pcs	As per requirement	
	Rated current	A	As per SLD	
	Accuracy/Class		0.2,5P20,PS	
	Rated burden	VA		
	Rated power frequency withstand voltage	kV	70	
	Rated lightining impulse withstand voltage	kV	170	
	Overload Factor	%	200	
	Creepage Distance	mm/kV	25	
	Insulation Class		E	
8	**Potential Transformer**			
	Type		Inductive type, Outdoor, with Fuse	
	Designation			
	Manufacturer			
	Standards		IEC 61869	
	Number of cores	pcs	As per requirement	
	Rated voltage			
	- Primary winding	kV	33/√3	
	- Secondary winding	V	0.11/√3	
	Maximum Primary Voltage	kV	36/√3	
	Rated power frequency withstand voltage			
	- Primary winding	kVrms	75	

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Signature of Tenderer_____

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	- Secondary winding	kVrms		
	Rated lightining impulse withstand voltage	kV	170	
	Accuracy/Class		0.2, 3P	
	Burden	VA		
	Total thermal rating	VA		
	- rated burden	VA		
	- rated voltage factor			
	Creepage Distance	mm/kV	25	
	Over Voltage Factor			
	30 seconds		1.1	
	Continuous		1.5	
	Temperature rise above 45 deg C ambient at normal rated current			
	- with 1.1 times rated primary voltage continuously	deg C		
	- with 1.5 times rated voltage for 30 seconds	deg C		
9	**Lightning Arrester**			
	Type		Outdoor, Gapless, Zinc-oxide, procelian housed, Pedestal Mounted	
	Designation			
	Manufacturer			
	Standards		IEC 60099	
	Rated voltage	kV	30	
	Energy Absorption Capacity	kJ/kV	min 6	
	Nominal Discharge Current	kA	10	
	Minimum Power frequency spark over voltage	kV		

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Maximum 1/50 impulse spark over voltage	kV		
	Maximum front wave spark over voltage	kV		
	Maximum switch surge spark over voltage	kV		
	Insulation Level			
	Impulse withstand voltage	kV	170	
	Power frequency withstand voltage	kV	70	
	Creepage Distance	mm/kV	25	
	Surge Counter with Insulated Base Furnished	m/s^2	yes	
10	**Information to be Submitted with the Tender**			
	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 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	

Name 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
	Outline Drawings and associated GA attached	yes/no	yes	
11	**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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S.N.	Description	Unit	Employer's Requirement	Bid Offer
C2	**33 kV Switchgear - Indicating Instruments**			
1	**General**			
	Manufacturer			
	Place of manufacture			
	Applicable Standards			
	Type			
	Model No.			
	Applicable Standard			
2	**Control switches**			
	Manufacturer and Country of origin			
	Type	Flush type		
	Current Rating	A		
	Catalog Furnished	yes/no	yes	
	Applicable standard		IEC	
3	**Push Bottom**			
	Manufacturer and Country of origin			
	Type			
	Contact rating continuous	Amp		
	Making current	Amp		
	Breaking current	Amp		
	Catalog Furnished	yes/no	yes	
4	**Indicating Lamps**			
	Manufacturer			
	Voltage ratings	V		
	Wattage	W	<0.5	
5	**Ammeter**		**Required (separate)**	

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
	Manufacturer and Country of origin			
	Type		Digital	
	Accuracy Class		0.5	
	Scale		Linear	
	Range of indication	A	0-300	
	Overloaded range	%	1.5	
	VA burden			
	Auxiliary DC supply	V	110	
	Catalog furnished	yes/no	yes	
	Transducer operated	yes/no	yes	
6	**Voltmeter**		**Required (separate)**	
	Manufacturer and Country of origin			
	Type		Digital	
	Accuracy class		0.5	
	Scale		Linear	
	Range of indication	kV	0-36	
	Over scale range	%	1.1	
	VA burden			
	Auxiliary DC supply	V	110	
	Catalog furnished	yes/no	yes	
	Transducer operated	yes/no	yes	
7	**Apparent power meter (kVA)**		**Required (separate)**	
	Manufacturer and Country of origin			
	Type		digital	
	Rated voltage	kV	33/√3:0.11/√3	
	Rated current	A	300-150-75/1	
	Current range (Transducer operated)	mA		

Name of Tenderer _____

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Accuracy class		0.5	
	Scale			
	Type of scale		linear	
	Range of indication		0-10	
	VA burden	VA		
	Current coil			
	Submitted for the required ratings			
	Auxiliary DC supply	V	110	
	Catalog furnished	yes/no	yes	
	Transducer operated	yes/no	yes	
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		
	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	

Name of Tenderer _____

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	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		

Name 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
C3	**33 kV Switchgear - Protective Relays**			
1	**General**			
	Manufacturer			
	Place of manufacture			
	Standards			
	Type			
2	**Construction of Control and Relay Panel**			
	Type		Simplex	
	Manufacturer's type designation			
	Applicable Standard			
	Location		Indoor	
	Mounting		Floor/Trench mounted	
	Lifting hooks	yes/no	yes	
	Control panel furnished as per specification	yes/no	yes	
	Enclosure protection class	IP	IP54	
	Type of Sheets used			
	Thickness of sheet metal used			
	Load Bearing parts	mm	>3	
	Non-load bearing parts	mm	>2	
	Painting		Light grey RAL 7032	
	All instruments, meters, relays and control switches flush or semi flush type		flush	
3	**Ground Bus**			
	Material		Copper	

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
	Size	mm x mm		
4	**Internal Wiring**			
	Type of Insulation			
	Voltage Grade of Wires	V	600	
	Cross Section of Wires	sq.mm	min. 2.5	
	Current Circuit			
	Voltage and auxiliary circuit			
5	**Phase Over Current Relay (50/51)**		**Required (separate)**	
	Manufacturer and Country of origin			
	Type		Static, Non directional	
	Manufacturer's type designation			
	Applicable standards		IEC	
	Triple pole or single pole		Single*3	
	Current setting range	% of rated current	5-200%	
	Operating time at 10 times current settings	m sec	3	
	Reset time	ms		
	Characteristics		IDMT (Standard inverse)	
	Instantaneous unit provided	yes/no	yes	
	Operating range			
	NO Contacts			
	Insulation test as per IEC	yes/ no	yes	
	Indication			
	Hand reset flags provided	yes/no	yes	
	Light emitting diode provided	yes/no	yes	

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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
	Auxiliary DC supply	V	110	
	Technical Literature submitted	yes/no	yes	
	Test Certificate submitted	yes/no	yes	
6	**Earth fault relay (50/51N)**		**Required (separate)**	
	Manufacturer and Country of origin			
	Type		Static, Non directional	
	Manufacturer's type designation			
	Applicable standard		IEC	
	Triple pole or single pole		Single*3	
	Continuous overload capacity	xIn		
	Current setting range	% of rated current	5-80%	
	operating time at 10 times current setting	msec	3	
	Characteristics		IDMT (Standard inverse)	
	Submitted for the required ratings	yes/no	yes	
	Operating range			
	NO Contacts			
	Insulation test as per IEC	yes/ no	yes	
	Indication			
	Hand reset flags provided	yes/no	yes	
	Light emitting diode provided	yes/no	yes	
	Auxiliary DC supply	V	110	
	Technical Literature submitted	yes/no	yes	
	Test certificate submitted	yes/no	yes	

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
7	**Neutral Time Overcurrent Relay (51N)**			
	Manufacturer and Country of origin			
	Type			
	Manufacturer's type designation			
	Applicable standard		IEC	
	Triple pole or single pole		Single*3	
	Current setting range	% of rated current		
	operating time at 10 times current setting	sec	3	
	Reset time	ms		
	Characteristics			
	Instantaneous unit provided	yes/no		
	Current setting range	% of rated current		
	Operating range			
	Insulation test as per IEC	yes/ no	yes	
	Indication			
	Hand reset flags provided	yes/no	yes	
	Light emitting diode provided	yes/no	yes	
	Auxiliary DC supply	V	110	
	Technical Literature submitted	yes/no	yes	
	Test certificate submitted	yes/no	yes	
8	**Restricted Ground Earth Fault Relay (64REF)**			
	Manufacturer and 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
	Type			
	Manufacturer's type designation			
	Applicable standard		IEC	
	Triple pole or single pole		Single	
	Continuous overload capacity	xIn		
	Current setting range	% of rated current		
	operating time at 10 times current setting	sec		
	Characteristics			
	Instantaneous unit provided	yes/no		
	Current setting range	% of rated current		
	Voltage Setting Range	% of rated voltage		
	Operating range			
	Insulation test as per IEC	yes/ no	yes	
	Indication			
	Hand reset flags provided	yes/no	yes	
	Light emitting diode provided	yes/no	yes	
	Auxiliary DC supply	V	110	
	Technical Literature submitted	yes/no	yes	
	Test certificate submitted	yes/no	yes	
9	**Differential Relay (87)**		**Required (separate)**	
	Manufacturer and Country of origin			
	Standard reference			
	Type			

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
	Type of Mounting		Flush	
	Operating time setting	ms	<30	
	Sensitivity setting		10-50%xIn	
	Bias setting			
	CT ratio Compensating range			
	Burden for Current Circuit	VA		
	DC Burden	VA		
	Tripping Current	A		
	Making Current	A		
	Closing load (At 110V DC)	A		
	Ambient Temperature Range	Deg C		
	Auxiliary DC supply	V	110	
	Technical Literature submitted	yes/no	yes	
	Test certificate submitted	yes/no	yes	
10	**Auxiliary Tripping and Lockout Relay**		**Required (separate)**	
	Manufacturer and Country of origin			
	Type			
	Manufacturer's type designation			
	Applicable standard		IEC	
	Operating Time	ms	<15	
	Does the lockout relay reset by the manually operated or electrically operated reset device			
	Is the cut off contact provided to interrupt the operating coil	yes/no	yes	
	Contact rating at 125V DC	A		
	Auxiliary DC supply	V	110	

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Signature of Tenderer_____

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Technical Literature submitted	yes/no	yes	
	Test certificate submitted	yes/no	yes	
11	**Break Fail Lockout Relay, 86K**		**Required (separate)**	
	DC Voltage Rating	V	110	
	Nos of electrically separate NO and NC Contacts			
12	**Break Failure Lockout Relay BF**		**Required (separate)**	
	DC Voltage Rating	V	110	
	Nos of electrically separate NO and NC Contacts			
	Technical Literature submitted	yes/no	yes	
	Test certificate submitted	yes/no	yes	
13	**Overvoltage Relay(59)**			
	Manufacturer and country of origin			
	Type		Static, Non-directional	
	Applicable standard		IEC	
	Instantaneous unit provided	yes/no	yes	
	Insulation test according to IEC	yes/no	yes	
	Indication			
	Hand reset flags provided	yes/no	yes	
	Light emitting diode provided	yes/no	yes	
	Auxiliary DC supply	V	110	
14	**Information to be Submitted with the Tender**			

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	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	
	Is Manufacturer ISO 9001 holder?	yes/no	yes	
	Technical literature submitted	yes/no	yes	
	Type test certificate submitted	yes/no	yes	
15	**Informative Data, To be filled separately for each equipment**			
	Manufacturer			
	Place of manufacturing			
	Dimension (W x D x H)	mm		
	Weight	kg		

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	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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S.N.	Description	Unit	Employer's Requirement	Bid Offer
D	**12 kV Switchgear**			
1	**General**			
	Manufacturer			
	Place of manufacture			
	Standards		IEC 62271 and relevant IEC Standards	
	Type		3 phase, Indoor	
	Number of cubicles	Nos.		
	Rated voltage	kV	11	
	Maximum operating voltage	kV	12	
	Rated frequency	Hz	50	
	Rated busbar current	A		
	Temperature rise at ambient air of +40 oC	K	As per IEC	
	Rated short time current (1 s)	kA rms	25	
	Rated peak withstand current	kA peak		
	Rated power frequency withstand voltage (1 min)	kV rms		
	Rated lightning impulse withstand voltage	kV peak		
	Rated supply voltage of auxiliary circuits	V	110	
	Type and material of support insulators		Epoxy	
	Thickness of sheet steel	mm		
	Protection class			
2	**Busbars**			
	Manufacturer			
	Place of Manufacturing			
	Type designation			
	Type of conductors			
	Material		Copper	

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Cross-section	sq.mm		
	Cross-section of branch off	sq. mm		
	Clearance between phases	mm		
	Phase-earth clearance	mm		
	Temperature rise of busbars at rated current	K		
	Distance between busbars	mm		
	Distance between busbars and ground	mm		
	Busbar Insulation Type			
3	**Cubicles**			
	Manufacturer			
	Place of Manufacturing			
	Reference standard			
	Type designation			
4	**Circuit Breaker (CB)**			
	Type		Vacuum, Draw Out Type	
	Rated frequency	Hz	50	
	Rated voltage	kV	11	
	Maximum operating voltage	kV	12	
	Rated current at ambient temperature of +50 ac	A	30	
	Rated breaking current:			
	- symmetrical component	kA	25	
	- asymmetrical component	%		
	Rated peak-making current	kA peak		
	Rated short time current (1 s)	kA rms	25	
	Rated small inductive breaking current	A	As per IEC	
	Recovery voltage parameters			

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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
	- rate of rise	kV rms	As per IEC	
	-peak	kV peak	As per IEC	
	Rated power frequency withstand voltage	kV voltage		
	Rated lightning impulse withstand voltage	kV		
	Rated operating sequence		CO-3min-CO	
	Opening time at rated breaking current (till eparation of arcing contacts)	ms	As per IEC	
	Total breaking time	ms	As per IEC	
	Closing time at rated making current	ms	As per IEC	
	Dead time	ms	As per IEC	
	Phase-ground creepage distance	mm		
	Submitted for the required ratings		Copper Alloy	
	Mass of circuit breaker (for each type and size)	kg		
	Number of CO operations before overhaul	Nos		
	- at no load mechanical	Nos	3000	
	- at rated current	Nos		
	- at rated short circuit current	Nos		
	Operating Mechanism			
	Type		Motorized	
	- number of drives per 3 phases	Nos	1	
	- control voltage	V	110 DC	
	- motor rating	W		
	Closing Coil/ Tripping Coil			
	Rated voltage and frequency	V/Hz	110 V DC	

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Maximum operating voltage	V		
	Minimum operating voltage	V		
	Rated power	W		
	Number of auxiliary contacts			
	- closing			
	- opening			
5	**Disconnecting and Earthing Switch**		To be filled for DS/ES and ES Only as well	
	Type		Motorized	
	Rated current	A	630	
	Rated short time withstand current (1 s)	kA rms	25	
	Operating time, closing I opening	s		
	Operating mechanism:			
	- number of drives per 3 phases	Nos.	1	
	- control voltage	V	110 DC	
	- motor rating	W		
	Number of CO operations before overhaul	Nos.		
6	**Current Transformers**			
	Type		Ring Type	
	Designation			
	Manufacturer			
	Standards		IEC 61869	
	Number of cores	pcs	As per requirement	
	Rated current	A	As per SLD	
	Accuracy/Class		0.2,5P20,PS	
	Rated burden	VA		
	Rated power frequency withstand voltage	kV	28	

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
	Rated lightining impulse withstand voltage	kV	75	
	Overload Factor	%	200	
	Creepage Distance	mm/kV	25	
7	**Voltage Transformer**			
	Type		Indoor use, within Cubicle, with Fuse	
	Designation			
	Manufacturer			
	Standards		IEC 61869	
	Number of cores	pcs	As per requirement	
	Rated voltage			
	- Primary winding	kV	11/√3	
	- Secondary winding	V	0.11/√3	
	Maximum Primary Voltage	kV	12/√3	
	Rated power frequency withstand voltage			
	- Primary winding	kVrms	28	
	- Secondary winding	kVrms		
	Rated lightining impulse withstand voltage	kV	75	
	Accuracy/Class		0.2, 3P	
	Burden	VA		
	Total thermal rating	VA		
	- rated burden	VA		
	- rated voltage factor			
	Creepage Distance	mm/kV	25	
	Over Voltage Factor			
	30 seconds		1.1	
	Continuous		1.5	
	Temperature rise above 45 deg C ambient at normal rated current			

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	- with 1.1 times rated primary voltage continuously	deg C		
	- with 1.5 times rated voltage for 30 seconds	deg C		
8	**Surge Arrester**			
	Type		Indoor, within Cubicle	
	Designation			
	Manufacturer			
	Standards		IEC 60099	
	Rated voltage	kV	9	
	Nominal Discharge Current	kA	10	
	Minimum Power frequency spark over voltage	kV		
	Maximum 1/50 impulse spark over voltage	kV		
	Maximum front wave spark over voltage	kV		
	Maximum switch surge spark over voltage	kV		
	Insulation Level			
	Impulse withstand voltage	kV	75	
	Power frequency withstand voltage	kV	28	
	Creepage Distance	mm/kV	25	
	Surge Counter with Insulated Base Furnished		yes	
9	**Information to be Submitted with the Tender**			

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Layout and dimension drawings showing the main dimensions and physical arrangement of major components with detailed descriptions and leaflets shall be submitted for:			
	- Busbar systems			
	Cubicle dimensions:			
	-width	mm		
	-depth	mm		
	- height	mm		
	Mass of heaviest cubicle	kg		
	Mass of switchgear	kg		
	Overall dimension of the complete cubicle:			
	Weight of complete cubicle with circuit breaker, etc.	kg		
	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
10	**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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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
D2	**12 kV Switchgear - Indicating Instruments**			
1	**General**			
	Manufacturer			
	Place of manufacture			
	Standards			
	Type			
2	**Ammeter**		Required (Separate for each incomer & feeder panel)	
	Manufacturer and country of origin			
	Type		digital	
	Numbers		1/phase	
	Range of indication	A	0-1200-for incomer 0-600-for outgoing	
	Accuracy class		0.5	
	Scale		Linear	
	Overload range	%	1.5	
	Auxiliary DC Supply	V	110	
	VA Burden	VA		
	Catalogue furnished	yes/no	yes	
3	**Voltmeter**		Required (Separate)	
	Manufacturer and country of origin			
	Type		digital	
	Numbers		1/phase	
	Range of indication	kV	0-15	
	Accuracy class		0.5	
	Scale		Linear	
	Overload range	%	1.1	
	Auxiliary DC Supply	V	110	

Name 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
	VA Burden	VA		
	Catalogue furnished	yes/no	yes	
4	**Apparent Power meter**		Required (Separate for each incomer & feeder panel)	
	Manufacturer and country of origin			
	Type			
	Rated voltage	kV	11√3:0.11√3	
	Rated Current	A	300-200-100/1	
	Accuracy class		0.5	
	Range of indication	mVA	0-15 or 10	
	Auxiliary DC Supply	V	110	
	VA burden	VA		
	Current coil			
	Voltage coil			
	Catalogue furnished	yes/no	yes	
5	**kWh Meter**		Required (Separate for each incomer & feeder panel)	
	Manufacturer and country of origin			
	Type		static 3-phase, 4 wire	
	Accuracy class		0.2/0.5	
	Rated voltage	kV	11√3:0.11√3	
	Rated Current	A	300-200-100/1	
	VA burden	VA		
	Current coil			
	Voltage coil			
	Auxiliary DC Supply	V	110	

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Reverse rotation locking mechanism provided	yes/no	yes	
6	**Annunciators**			
	Manufacturer and country of origin			
	Type			
	Number of active points	No	4	
	Type of mounting		Flush	
	Replacement of individual inscription plates and lamps from front panel possible	yes/no	yes	
	Sequence of operation as per specification	yes/no	yes	
7	Information to be Submitted with the Tender			
	Submitted for the required ratings			
	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	

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
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		

Name of Tenderer _____

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
D3	**12 kV Switchgear - Protective Relays**			
1	**General**			
	Manufacturer			
	Place of manufacture			
	Standards			
	Type			
2	**Construction of Control and Relay Panel**			
	Type			
	Manufacturer's type designation			
	Applicable Standard			
	Location		Indoor	
	Mounting		Floor/Trench mounted	
	Lifting hooks	yes/no	yes	
	Control panel furnished as per specification	yes/no	yes	
	Enclosure protection class	IP	IP54	
	Type of Sheets used			
	Thickness of sheet metal used			
	Load Bearing parts	mm	>3	
	Non-load bearing parts	mm	>2	
	Painting		Light grey RAL 7032	
	All instruments, meters, relays and control switches flush or semi flush type		flush	
3	**Instantaneous Time Overcurrent relay**		50/51 in SLD	

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
	Manufacturer and country of origin			
	Type		static Non-directional	
	Manufacturer's type designation			
	Applicable standard			
	No of poles		Single*3	
	Current setting range	% of rated current	5-200%	
	Operating range			
	Operating time at 10 times current setting	sec	3	
	Reset time	ms		
	Characteristics		IDMT (standard inverse)	
	Instantaneous unit provided	yes/no	yes	
	Operating range			
	NO Contacts			
	Insulation test according to IEC	yes/no	yes	
	Indication			
	Hand reset flags provided	yes/no	yes	
	Light emitting diode provided	yes/no	yes	
	Auxiliary DC supply	V	110	
	Technical literature provided	yes/no	yes	
4	**Residual Ground Overcurrent Relay**		50/51N in SLD	
	Manufacturer and country of origin			
	Type		Static, Non-directional	
	Applicable standard		IEC	

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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
	Continuous overload capacity	xIn		
	Current setting range	% of In	5-80%	
	Operating range			
	Operating time at 10 times current setting	sec	3	
	Characteristics		IDMT (standard inverse)	
	Instantaneous unit provided	yes/no	yes	
	NO Contacts			
	Insulation test according to IEC	yes/no	yes	
	Indication			
	Hand reset flags provided	yes/no	yes	
	Light emitting diode provided	yes/no	yes	
	Auxiliary DC supply	V	110	
5	**Overvoltage Relay**		59 in SLD	
	Manufacturer and country of origin			
	Type		Static, Non-directional	
	Applicable standard		IEC	
	Submitted for the required ratings	yes/no	yes	
	Insulation test according to IEC	yes/no	yes	
	Indication			
	Hand reset flags provided	yes/no	yes	
	Light emitting diode provided	yes/no	yes	
	Auxiliary DC supply	V	110	
6	**Information to be Submitted with the Tender**			

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	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	
	Is Manufacturer ISO 9001 holder?	yes/no	yes	
	Technical literature submitted	yes/no	yes	
	Type test certificate submitted	yes/no	yes	
7	**Informative Data, To be filled separately for each equipment**			
	Manufacturer			
	Place of manufacturing			
	Dimension (W x D x H)	mm		

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Signature of Tenderer_____

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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		

Name of Tenderer _____

Signature of Tenderer_____

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
E	**Station Transformer**			
1	**General**			
	Manufacturer			
	Place of manufacture/ testing			
	Applicable Standards		IEC	
	Type		Three Phase	
2	**Ratings**			
	Rated Power of Transformer (ONAN)	kVA	100	
	Rated frequency	Hz	50	
	Ambient temperature	°C	45 or as per scope of supply	
	Maximum service altitude	meter	As per Scope of Supply	
	Temperature rise limit at all tap-changer settings and 10 % over- or under-excitation			
	- oil / top	K	50	
	- windings / average	K	55	
	Rated voltages (no-load):			
	- HV winding	kV	33	
	- LV winding	kV	0.4/0.23	
	Maximum Voltage			
	- HV winding	kV	36	
	- LV winding	kV	0.44	
	Number of windings		2	
	Vector group		Dyn11	
	Magnetic flux density at core and yoke at nominal voltage and frequency	T	1.6	
	Short Circuit Level		25 kA at 33 kV	
	Short circuit capacity		1 s (according to IEC 60076-5)	

Name of Tenderer _____

Signature of Tenderer_____

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Sound pressure			
3	**Core design:**			
	- core form			
	- type			
	- source			
	- losses			
4	**Insulation oil:**			
	- manufacturer			
	- type		Mineral Oil	
	- specification of oil		As per IEC 60296	
	Approximate Volume of Oil	liters		
5	**Windings**			
	Winding Material		Copper	
	Winding insulation design:			
	- HV winding		Uniform	
	- LV winding		Uniform	
	Insulation Level/ HV winding			
	- lightning impulse level	kV	170	
	- power frequency withstand voltage	kV	70	
	Insulation Level/ LV winding			
	- power frequency withstand voltage	kV	3	
	Method of transformer neutral earthing:			
	Primary (HV)		Not Applicable	
	Secondary (LV)		Directly Grounded	
	Maximum Current Density at Rated Power			
	In HV Windings	A/sq mm	2.5	
	In LV Windings	A/sq mm	2.5	

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
6	**Clearances**			
	Minimum Clearance in air HV/LV	mm	As per IEC	
	Minimum Clearance between phases	mm	As per IEC	
	Minimum Clearance between phaes and ground	mm	As per IEC	
7	**Cooling and Operation Details**			
	Cooling method		ONAN	
	Noise level (LpA) at a measuring distance of 2 m (all forced cooling in operation)	dB (A)	As per NEMA standard	
8	**Bushings**			
	HV bushings			
	- manufacturer			
	- type			
	- rated current	A	As per Price Schedule from values provided in IEC 60137	
	- power frequency test voltage	kV	77	
	Submitted for the required ratings	kV	170	
	- minimum creepage distance	mm	25 mm/kV	
	LV bushings (outdoor type)			
	- manufacturer			
	- type			

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	- rated current	A	As per Price Schedule from values provided in IEC 60137	
	- lightning impulse level	kV	20	
	- power frequency test voltage	kV	10	
	- minimum creepage distance	mm	25 mm/kV	
9	**Tap Changing System:**			
	Type of tap changer (On/Off Load)		Off load	
	Tapping range	%	+5% to -5%	
	Number of steps	steps	5	
	Principal tapping	kV	0.4	
10	**Guaranteed Losses**			
	No-load losses at rated voltage and frequency	kW		
	Load losses at 75 °C and rated current and at HV principal tapping	kW		
	Power Consumption of Cooling Plant at full load	kW		
11	**Impedance at 75 °C and rated current and frequency**		Min 4%	
	- tap changer in principal tapping	%		
	- tap changer in -5% tapping	%		
	- tap changer in +5% tapping	%		
	Short circuit impedance at 75 °C and 100% of rated power:			
12	**Efficiency at 75 °C winding temperature**			

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	- at unity pf and rated current 125%	%		
	- at unity pf and rated current 110%	kW		
	- at unity pf and rated current 100%	kW		
	- at unity pf and rated current 75%	kW		
	- at unity pf and rated current 50%	kW		
	- at unity pf and rated current 25%	kW		
13	**Voltage regulation at 75 °C and rated power**			
	- at unity power factor	%		
	- at 0.8 power factor	%		
14	**Tests**			
	Routine tests according to IEC 60076 and Specifications		On each unit	
	Lightning impulse test (lines only)		On each unit	
	Full wave			
	- HV winding	kV	As per IEC 60076	
	- LV winding	kV	As per IEC 60076	
	Chopped wave			
	- HV winding	kV	As per IEC 60076	
	-LV winding	kV	As per IEC 60076	
	Separate source AC voltage withstand test		On each unit	
	- HV winding	kV	As per IEC 60076	
	- LV winding	kV	As per IEC 60076	

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Induced AC withstand voltage tests (ACSD), acc. to IEC 60076-3, sub-clause 12 (phase-to-ground and phase-to-phase)		On one unit	
	- test voltage / HV winding	kV	As per IEC	
	- test voltage / LV winding	kV	As per IEC 60076	
	Test temperature rise (at all kinds of cooling and at overloads as below)		On one unit	
	Test of noise level (special test)		On one unit	
	All other type tests and special tests according to the Specification		On one unit	
15	**Masses and Dimensions**			
	Transformer masses:			
	- total mass	kg		
	- transportation mass	kg		
	- untanking mass	kg		
	- mass of insulation oil	kg		
	Overall dimensions including bushings:			
	- height	mm		
	- depth	mm		
	- width	mm		
	Shipping dimensions:			
	- height	mm		
	- depth	mm		
	- width	mm		
	Minimum space requirement for the transformer bays (civil works):			
	- depth			

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	- width			
16	**Information to be Submitted with the Tender**			
	Dimension drawing showing the main dimensions and physical arrangements of major components			
	Detailed descriptions or leaflets of:			
	- Arrangement and insulation of windings			
	- Core and tank			
	- Conservator and breather			
	- Tap changer			
	- Measuring/ monitoring instruments			
	- Transformer auxiliaries			
	- Control and marshalling cubicle			
	Delivery of equipment following award of contract and approval of drawing	months		
	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	

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Outline Drawings and associated GA attached	yes/no	yes	
17	**Informative Data**			
	Transformer			
	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		
	Manufacturers of Accessories			
	Temperature sensors Pt 100 for oil and winding			
	Contact thermometers for oil and winding			
	Control cubicle			
	Gas relay			
	Oil level gauge			
	Wheels			
	Pressure relief / Explosion vent			

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
E2	**LOW VOLTAGE DISTRIBUTION SYSTEM**			
1	**General**			
	Manufacturer			
	Place of Manufacturer			
	Standards			
	Type			
	Type tested	yes/no	Yes	
	Rated Voltage	V	1100	
	Maximum operating Voltage	V		
	Rated Frequency	Hz	50	
	Bus Bar Material		Copper	
	Bus Bar Insulation Material		Air	
	Rated short time withstand Current(1s)	kA rms	25	
	Rated peak withsatnd current	kA peak	50	
	Rated power frequency withstand voltage	kV	2.5	
	Protection Class	IP	42 or better	
	Thickness of sheet steel	mm	2	
	Dimensions of standard Cubicle:			
	Width	mm		
	Depth	mm		
	Height	mm		
	Mass per cubicle	kg approx		
2	**Main Distribution Board**			
	Number of cubicles	Nos	2	
	Designation			
	Type			
	Standards			
	Rating of main CB	A	2000	

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
	Busbar rating	A	2000	
	Rated short time withstand Current(1s)	kA rms	20	
	Rated peak withsatnd current	kA peak	50	
	Dimensions:			
	Length	mm		
	Width	mm		
	Height	mm		
	Total weight	kg		
3	**Distribution Boards**			
	Number of cubicles	Nos		
	Designation			
	Type			
	Standards			
	Rating of main CB	A	1000	
	Busbar rating	A	1000	
	Rated short time withstand Current(1s)	kA rms		
	Rated peak withsatnd current	kA peak		
	Dimensions:			
	Length	mm		
	Width	mm		
	Height	mm		
	Total weight	kg		
4	**Information to be Submitted with the Tender**			
	Layout and dimension drawing for each distribution board			
	Technical leaflets for:			

Name of Tenderer _____

Signature of Tenderer_____

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Switchgear and distribution boards			
	Circuit Breaker			
	Contactors			
	Protection relays and auxiliary devices			
	Typical single line diagrams			
5	**Informative Data**			
	Manufacturer			
	Place of manufacturing			
	Submitted for the required ratings	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
F	**Battery and Battery Charger**			
1	**Battery**			
	Manufacturer			
	Designation			
	Applicable Standard		IEC	
	Rated Voltage	V DC	110	
	Rated Capacity	Ah	250	
	Type of battery		Maintenance Free, Valve Regulated Lead Acid	
	Number of Cells	nos		
	Number of Units	nos		
	Number of Cells in a Unit	nos		
	Nominal Voltage Rateing	nos		
	Nominal Capacity at 27 deg C at 10h discharge time to cell end voltage 1.75	Ah		
	Amperre capacity at 27 deg C at 10h discharge time to cell end voltage 1.75	A		
	Battery Construction type			
	Type of plates			
	- Positive (Flat or Tubular)			
	- Negative			
	Type of Rack			
	Rack Dimension			
	Float Charging Voltage	V		
	Equalizing Charging Voltage	V		
	Internal resistance of one cell	ohm		
	Short Circuit Current withstand capacity	A		
	Float Charging Current	A		
	Charging current of a fully discharged battery at 8 hour charging rate	A		

Name of Tenderer _____

Signature of Tenderer_____

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	End Voltage of each cell	V		
	Charging efficiency of the battery	%		
	Max. duration in month, the battery can be kept without charging	month		
	Battery life, guaranteed value,	years		
2	**Battery Charger**			
	Manufacturer			
	Designation			
	Type of battery		Constant voltage	
	Output rating	A	50	
	Range of DC voltage variation	±V		
	Maximum AC input	kVA		
	Input Voltage/phase	V	400 V, 3 phase	
	Ripple	%	<2%	
	Emergency of charger at 100% output	%		
	Temperature rise above ambient of 45 degree C			
	a) Solid state elements	oC		
	b) Wound elements	oC		
	Voltage regulation	%	±1	
	Float voltage adjustment			
	Equalizing voltage adjustment			
	Auto equalizing charge provided ?	yes/no	Yes	
	Timer for equalizing charge provided ?	yes/no	Yes	
	End switching to limit equipment	type		

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
	Manual over-ride switch for selection of float/equalizing charge provided ?	yes/no	Yes	
3	**Information to be submitted along with Tender**			
	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	
4	Informative Data			
	Manufacturer			
	Submitted for the required ratings			
	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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S.N.	Description	Unit	Employer's Requirement	Bid Offer
F2	**DC Distribution Board**			
1	**General**			
	Manufacturer			
	Place of Manufacturer			
	Standards			
	Type			
2	**Switchboard**			
	Manufacturer			
	Place of manufacture			
	Standards			
	Rated voltage	V	110	
	Maximum permissible voltage	V		
	Rated current	A		
	Rated short-time withstand current	kA	25	
	Rated power frequncy withstand voltage	kV		
	Protection class	IP	IP 42 or better	
	Thickness of sheet steel	mm	2	
	Dimensions:			
	- height	mm		
	- width	mm		
	- depth	mm		
	Mass	kg		
4.2	**Incomers Circuit Breakers**			
	Manufacturer			
	Place of manufacture			
	Type designation			
	Operating mechanism			
	Standards			
	Number of poles			
	Rated current	A		
	Rated breaking current	kA	25	

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
4.3	**Outgoing Feeder Circuit Breakers**			
	Manufacturer			
	Place of manufacture			
	Type designation			
	Operating mechanism			
	Standards			
	Number of poles			
	Rated current	A		
	Rated breaking current	kA		
4.4	**Busbars**			
	Material		Copper	
	Cross-section	mm²		
	Rated current	A		
	Rated short-time withstand current	kA	25	
4.5	**Measuring Instruments**			
	Class of accuracy			
	Size	mm		
4.6	**Battery Protection Boxes and Sub-Distribution Boards**			
	110 V DC circuit breakers (to be filled for each type and size)			
	Type			
	Manufacturer			
	Place of manufacture			
	Standards			
	Rated voltage	V		
	Rated current	A		

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
	Rated short-time withstand current	kA		
	Rated power frequncy withstand voltage	kV		
	Protection class	IP	IP 42 or better	
	Submitted for the required ratings	mm	2	
	Dimensions:			
	- height	mm		
	- width	mm		
	- depth	mm		
	Mass	kg		
4.7	**Information to be Submitted with the Tender**			
	Layout and Dimension Drawings for Equipment Rooms and Components			
	Detailed Description and |Leaflets of the Proposed Equipments			
4.8	**Informative Data**			
	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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S.N.	Description	Unit	Employer's Requirement	Bid Offer
G1	**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		
	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.		

Name of Tenderer _____

Signature of Tenderer_____

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	iii) Maximum DC Resistance at 20 deg. C	Ohm/km		
	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			
	Material			

Name of Tenderer _____

Signature of Tenderer_____

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Thickness	mm		
	Metallic Layer/Screen			
	Type			
	Material			
	Thickness	mm		
	Overall Diameter of the Cable	mm		
	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		

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
	Continuous Current Carrying Capacity under 3-6 Cables per tray touching each other in Covered cable trenches	A		
	Continuous Current Carrying Capacity under ambient temperature for Cable laid in ground	A		
	Short circuit current			
	Short circuit current for 0.1 sec	kA		
	Submitted for the required ratings	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			

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
	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			
	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**			

Name of Tenderer _____

Signature of Tenderer_____

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	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	
	Conductor material		EC Grade Annealed Copper	
	Insulation material		Polyethylene	
	Sheath material			
	Shield material			
	Armour material			
	Number of cores	pcs		
	Conductor cross section	sq mm		
	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	

Name of Tenderer _____

Signature of Tenderer_____

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	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		
	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			

Name of Tenderer _____

Signature of Tenderer_____

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	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			
7	**Information to be submitted along with bid**			
	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	
8	**Informative Data**			
	Manufacturer			
	Place of manufacturing			
	Dimension (W x D x H)	mm		
	Standard drum length	m		
	Weight	kg		

Name of Tenderer _____

Signature of Tenderer_____

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	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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S.N.	Description	Unit	Employer's Requirement	Bid Offer
G2	**Underground Power Cable**			
1	**Underground Power Cable**			
	Manufacturer			
	Country of Origin			
	Year of manufacturing experience			
	Model No.			
	Applicable Standard		IEC 60502, IEC 60228	
	Cable Type Designation			
	Rated Voltage	kV	33	
	Maximum System Voltage	kV	36	
	Rated Voltage between conductor and screen	kV		
	Rated Voltage between two conductors	kV		
	Power Frequency Withstand Voltage	kV	70	
	Impulse Withstand Voltage (BIL)	kV	170	
	Conductor			
	Conductor Material		EC Grade Aluminum	
	Cross section of the Conductor	sq. mm.		
	Is Conductor Stranded?	yes/no	yes	
	Stranded Conductor			
	Number of strands in each core			
	Size of strand	Sq. mm.		
	vii) Maximum DC Resistance at 20 deg. C	Ohm/km		
	viii) Class of Stranding			
	Number of Cores		One Core	
	Insulation			

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
	Insulation material and Type Designation		XLPE	
	XLPE Compound manufacturer			
	Minimum thickness of insulation	mm		
	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			
	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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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
	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		
	Continuous Current Carrying Capacity under ambient temperature for Cable laid in ground	A		

Name of Tenderer _____

Signature of Tenderer_____

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Short circuit current			
	Short circuit current for 0.1 sec	kA		
	Submitted for the required ratings	kA		
	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	Yes	
	Moisture Resistant	Yes	Yes	
	Please indicate in YES or NO whether the following tests have been carried out			
	Ageing Test	yes/no	Yes	
	Loss of Mass Test	yes/no	Yes	
	Cold Impact Test	yes/no	Yes	

Name of Tenderer _____

Signature of Tenderer_____

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Heat Shock Test	yes/no	Yes	
	Fire Retardant Test	yes/no	Yes	
2	**Information to be submitted along with bid**			
	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	
3	**Informative Data**			
	Manufacturer			
	Place of manufacturing			
	Dimension (W x D x H)	mm		
	Standard drum length	m		
	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
H1	**Substation Auxiliaries**			
H1.1	**Security System**			
1	**Closed Circuit Television System (CCTV)**			
1.1	**Matrix Control System**			
	Manufacturer			
	Type			
	Description			
	Technical data			
	- CPU type			
	- Type of keyboard			
	- Number of videos I/O	pcs		
	- Auto/manual camera selection	yes/no		
	- Type of interface to ACS		LAN	
	- Supply voltage	V	230AC	
	- Power demand	W		
	Dimensions			
	- height	mm		
	- width	mm		
	- depth	mm		
	Mass	kg		
1.2	**Digital Video Recorder**			
	Manufacturer			
	Type			
	Description			
	Technical data			
	- Record rate	ips		
	- Recording resolution			
	- Storage capacity	GB		
	- Supply voltage	V		
	- Power demand	W		
1.3	**Monitors**			
	Manufacturer			
	Type			

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Description			
	Technical data			
	- Size	inch		
	- Sync format			
	- Resolution	pixel		
	- Supply voltage	V	230 AC	
	- power demand	W		
1.4	Cameras			
	Manufacturer			
	Type			
	Description			
	Installation			
	- wall mounted			
	- pole mounted			
	- indoor			
	- outdoor			
	Lens			
	- digital zoom	yes/no		
	- auto-focus with manual override	yes/no		
	Day/night mode	lux		
	Protection class			
	Temperature range	°C		
	Relative humidity	%		
2	**Information to be submitted along with bid**			
	Layout and Dimension Drawings for Equipment Rooms and Components			
	Detailed Description and |Leaflets of the Proposed Equipments			
3	**Informative Data**			
	Manufacturer			

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Place of manufacturing			
	Dimension (W x D x H)	mm		
	Standard drum length	m		
	Weight	kg		
	Shipping Data			
	Weight of heaviest package	kg		
	Dimension of largest package (W x D x H)	mm		

Name of Tenderer _____

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
H2	**Substation Automation System**			
1	**Server**			
	Manufacturer/Country			
	Type/Model			
	Processor			
	Processor Speed			
	HDD and RAM			
	Operating System			
2	**Gateway**			
	Manufacturer/Country			
	Type/Model			
	Processor			
	Processor Speed			
	HDD and RAM			
	Operating System			
3	**Operator Workstation**			
	Manufacturer/Country			
	Type/Model			
	Processor			
	Processor Speed			
	HDD and RAM			
	Operating System			
4	**Eternet Switch**			
	Manufacturer/Country			
	Type/Model			
	Mounting Arrangement			
5	**Time Synchronizing Equipment**			
	Manufacturer/Country			
	Type/Model			
	Mounting Arrangement			
6	**Printer**			
	Manufacturer/Country			
	Type/Model			

Name of Tenderer _____

Signature of Tenderer_____

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Mounting Arrangement			
7	**Monitor**			
	Manufacturer/Country			
	Type/Model			
	Mounting Arrangement			
	Include other miscellaneous items if required			
8	**Information to be submitted along with bid**			
	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	
9	**Informative Data**			
	Manufacturer			
	Place of manufacturing			
	Dimension (W x D x H)	mm		
	Standard drum length	m		
	Weight	kg		
	Shipping Data			
	Weight of heaviest package	kg		
	Dimension of largest package (W x D x H)	mm		

Name of Tenderer _____

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
E	**Protection System**		Fill for all relays and accessories, even if not mentioned	
1	**General Information**			
1.1	**General**			
	Manufacturer			
	Place of manufacturer			
	Standards		IEC	
	Protection- type, designation		Numerical	
	Years in service	years		
	Protection Devices			
	Type tested acc. To relevant IEC Standards	yes/no		
	Module, 19 ' plug-in design	yes/no		
	Fully degital processing	yes/no		
	Internal/ external bus communication	yes/no		
	Protection class	IP		
1.2	**Interfaces**			
	Type of communication protocol/ standards		IEC-60870-5-104	
	Bus interface for data transfer to CCS	yes/no		
	Serial interface for connection of laptop	yes/no		
	Serial interface for connection of portable protocol printer			
1.3	**Tripping/ Signalling Contacts**			
	Switching voltage	V DC		
	permissibel continuous current	A		
	Number of auxiliary contacts NO/NC	pcs		

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
1.4	**Digital Tripping Matrix**			
	Software Matrix			
1.5	**Special Protection Features**			
	Trip-cicuits supervision	yes/no		
	Local/ remote reset	yes/no		
1.6	**Test Equipment**			
	Manual test set	yes/no		
	Automatic test set	yes/no		
	Built-in test features	yes/no		
1.7	**Rated Input Data**			
	Measuring Circuits:			
	- Rated current IN	A	1/5	
	- Rated voltage UN	V	230	
	- Rated frequency fN	Hz		
1.8	**Auxiliary Power Supply**			
	Redundant auxiliary DC-supply for each system	yes/no	yes	
	- Supply voltage	V DC	110	
	- DC/DC converter	V/V		
1.9	**Cubicle Data**			
	Thickness of sheet steel	mm		
	Dimensions:			
	- height	mm		
	- depth	mm		
	- width	mm		
	Front glass door	yes/no		
	Rear door	yes/no		
	Hinged swing frame for relay installation	yes/no		
	Protection class	IP	55	
	Mass	kg		
1.10	**Climatic Conditions**			
	Ambient temperature	°C		
	Operation temperature range	°C		

Name of Tenderer _____

Signature of Tenderer_____

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Relative humidity range	%		
2	**Power Transformer**			
2.1	**(27) Under Voltage Protection**			
	Type designation		Numerical	
	Measurement principle			
	Setting:			
	- under voltage U< at fN	X UN		
	- delay time	s		
	- min response time	ms		
	- frequency independent	Hz		
2.2	Submitted for the required ratings			
	Type designation		Numerical	
	Measurement principle			
	Setting·			
	- current (in steps 0 1 IN)	X IN		
	- delay time	s		
	- reset ratio (for max. function)	%		
	(for min function)	%		
	- trip-time (with no delay)	ms		
	- wide frequency range	xfN		
2.3	**(51/51 N) Time-delayed Overcurrent Protection**			
	Type designation		Numerical	
	Measurement principle			
	Setting:			
	- current	xIN		
	- delay time	s		
	- reset ratio for I>>	%		
	- trip time (with no delay)	ms		
2.4	**(59/59N) Overvoltage Protection**			

Name of Tenderer _____

Signature of Tenderer_____

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Type designation		Numerical	
	Measurement principle			
	Setting			
	- inclination characteristic			
	- range of voltage setting	% VN		
	- time delay	s		
	- reset ratio	%		
	- pick-up - Alarm stage	%		
	- Tripping stage	%		
	- drop-out to pick-up ratio	%		
	- min. response time	ms		
2.5	**(81) Under-Over frequency Protection**			
	Type designation		Numerical	
	Measurement principle			
	Setting:			
	frequency range	Hz		
	time	s		
	min. voltage	V		
	accuracy of pick-up value reset ratio	%		
	Measurement principle	%		
	Setting:			
2.6	**(87T) Transformer Differential Protection**			
	Type designation		Numerical	
	Measurement principle			
	Setting			
	g, basic setting	X IN		
	- v, pick-up ratio	V		
	Trip-time (max)			
	- for Idiff>21N	ms		
	- for Idiff <21N	ms		
	Accuracy of pick-up of g	%		

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Frequency range	Hz		
2.7	**Dimensions and Masses**			
	Number of cubicles per unit	pcs		
	Dimensions of cubicle assembly:			
	- height	mm		
	- depth	mm		
	- width	mm		
	Total mass	Kg		
3	**33 kV AIS**			
3.1	**(21) Line Distance Protection**			
	Type designation		Numerical	
	Measurement principle			
	Setting circular characteristic, R-X diagram			
	- impedance	X UN/IN		
	- time delay range stage 1 (t1)	s		
	range stage 2 (t1, t2, t3)	s		
3.2	**(50/50N) Instantaneous Overcurrent Protection**			
	Type designation		Numerical	
	Measurement principle			
	Setting			
	- current (in steps 0.1 IN)	X IN		
	- delay time			
	- reset ratio (for max. function)	%		
	(for min. function)	%		
	trip-time (with no delay)	ms		
	wide frequency range	X fN		

Name of Tenderer _____

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
3.3	**(51/51 N) Time-delayed Overcurrent Protection**			
	Type designation		Numerical	
	Measurement principle			
	Setting:			
	- current	X IN		
	- delay time	s		
	- reset ratio for I>>	%		
	- trip time (with no delay)	ms		
3.4	**87BB Busbar Differential Protection**			
	Type designation		Numerical	
	Measurement principle			
	Protection settings, setting ranges			
	- Differential current			
	- in steps of			
	- accuracy			
	- Stabilizing factor k			
	- in steps of			
	- special applica tions			
	- Accuracy			
	- Differential current	X IN		
	- alarm			
	- Integration time 50 Hz	ms		
	- Operation times	ms		
	- tripping time (incl. aux. output voltage)	ms		
	- they are valid for fault currents ≥			
4	**Station Auxilliary System**			
4.1	**(50/SON) Instantaneous Overcurrent Protection**			
	Type designation		Numerical	

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Measurement principle			
	Setting:			
	- current (in steps 0.1 IN)	X IN		
	- delay time	s		
	- reset ratio (for max. function)	%		
	(for min. function)	%		
	- trip-time (with no delay)	ms		
	- wide frequency range	X fN		
4.2	**(51/51 N) Time-delayed Overcurrent Protection**			
	Type designation		Numerical	
	Measurement principle			
	Setting:			
	- current	X IN		
	- delay time s	s		
	- reset ratio for I>>	%		
	- trip time (with no delay)	ms		
5	**Dimensions and Masses**			
	Number of cubicles	pcs		
	Dimensions of cubicle assembly:			
	- height	mm		
	- depth	mm		
	- width	mm		
	Total mass	Kg		
6	**Information to be Submitted with the Tender**			
	1) Detailed description and leaflets for each proposed protection device and ancillary equipment			

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	2) Layout and dimension drawings of cubicles/cubicle assemblies			
	3) Typical diagrams for:			
	- power supply			
	- trip circuit with supervision			
	- trip circuit with supervision			
7	**Information to be submitted along with bid**			
	ISO 9001 holder (including design)	m/s^2	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**			
	Manufacturer			
	Place of manufacturing			
	Dimension (W x D x H)	mm		
	Standard drum length	m		
	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
H4	**Communication System**			
1	**SDH Equipment**		STM-4 MADM upto 3 MSP protected directions	
	Base Equipment		Common cards, Cross Connect/control cards, optical base cards, power supply cards, power cabling, other hardware and accessories including sub racks, patch cord, DDF etc fully equiped	
	Optical Interface Cards/SFP#			
	Tributary Cards			
2	**Termination Equipment**			
	Include other miscellaneous items if required			
3	**Information to be submitted along with bid**			
	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	

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Copies of relevant standards attached	yes/no	yes	
	Outline Drawings and associated GA attached	yes/no	yes	
4	**Informative Data**			
	Manufacturer			
	Place of manufacturing			
	Dimension (W x D x H)	mm		
	Standard drum length	m		
	Weight	kg		
	Shipping Data			
	Weight of heaviest package	kg		
	Dimension of largest package (W x D x H)	mm		

Name of Tenderer _____

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
H	**Earthing and Lightning System**			
1	**Above Ground Earthing System**			
	Manufacturer			
	Type of conductors		Copper	
	Materials			
	Dimensions	mm		
	Cross sections	sq. mm		
2	**Potential Gradient Control System**			
	Manufacturer			
	Conductor Material		Copper	
	Cross section	sq. mm		
3	**Lightning Protection System**			
3.1	**General**			
	Manufacturer			
	Type of lightning protection system			
	Standards			
3.2	**Air Terminals**			
	Manufacturer			
	Materials			
	Dimensions Diameter/Length	sq. mm		
3.3	**Roof Conductors**			
	Manufacturer			
	Conductor Material			
	Cross section	sq. mm		
3.4	**Down Conductors**			
	Manufacturer			
	Conductor Material			
	Cross section	sq. mm		

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
3.5	**Termination and Jointing Materials**			
	Manufacturer			
	Types			
	Designations			
4	**Ground Conductor**			
	Main ground grid conductor material			
	Main ground grid conductor size	sq.mm		
	Depth of buried main ground conductor			
	Material of riser			
	Cross-section of riser conductor	sq.mm		
	Type of joint above and below ground level			
	Ground electrode			
	Material			
	Diameter	mm		
	Length	m	as per IEEE80	
	Fence grounding included			
	Cross section of conductor rise for fence ground	sq.mm		
	Fence separately grounded by electrode	yes/no	yes	
	Calculation for grounding grid length and conductor size furnished	yes/no	yes	
	Earthing system designed for	ohm	<1	
5	**Information to be submitted along with bid**			

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Layout and Dimension Drawings for Equipment Rooms and Components			
	Detailed Description and |Leaflets of the Proposed Equipments			
6	**Informative Data**			
	Manufacturer			
	Place of manufacturing			
	Dimension (W x D x H)	mm		
	Standard drum length	m		
	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
I	**Lighting System**			
1	**Lighting Fixtures**			
1.1	**LED Lighting Fixture Type 1**			
	Type		LED	
	Designation			
	Class of light distribution			
	Rated voltage	V		
	Rated power	W		
	Efficiency	%		
	Installation method			
	Protection class	IP		
	Overall dimensions	mm		
	Mass	kg		
1.2	**LED Lighting Fixture Type 2**			
	Manufacturer			
	Type		LED	
	Designation			
	Class of light distribution			
	Rated voltage	V		
	Rated power	W		
	Efficiency	%		
	Installation method			
	Protection class	IP		
	Overall dimensions	mm		
	Mass	kg		
1.3	**LED Lighting Fixture Type 3**			
	Manufacturer			
	Type		LED	
	Designation			
	Class of light distribution			
	Rated voltage	V		
	Rated power	W		

Name of Tenderer _____

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S.N.	Description	Unit	Employer's Requirement	Bid Offer
	Efficiency	%		
	Installation method			
	Protection class	IP		
	Overall dimensions	mm		
	Mass	kg		
1.4	**Mercury Vapour Lamp Type 4**			
	Manufacturer			
	Type		LED	
	Designation			
	Class of light distribution			
	Rated voltage	V		
	Rated power	W		
	Efficiency	%		
	Installation method			
	Protection class	IP		
	Overall dimensions	mm		
	Mass	kg		
1.5	**Recessed LED Lamp Type 5**			
	Manufacturer			
	Type		LED	
	Designation			
	Class of light distribution			
	Rated voltage	V		
	Rated power	W		
	Efficiency	%		
	Installation method			
	Protection class	IP		
	Overall dimensions	mm		
	Mass	kg		
1.6	**Street Lighting Fixture Type 6**			
	Manufacturer			
	Type		LED	

Name 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
	Designation			
	Submitted for the required ratings			
	Rated voltage	V		
	Rated power	W		
	Efficiency	%		
	Installation method			
	Protection class	IP		
	Overall dimensions	mm		
	Mass	kg		
1.7	**Low Energy Lamp Type 7**			
	Manufacturer			
	Type		LED	
	Designation			
	Class of light distribution			
	Rated voltage	V		
	Rated power	W		
	Efficiency	%		
	Installation method			
	Protection class	IP		
	Overall dimensions	mm		
	Mass	kg		
1.8	**High Capacity Floodlight Fixture Type 8**			
	Manufacturer			
	Type		LED	
	Designation			
	Class of light distribution			
	Rated voltage	V		
	Rated power	W		
	Efficiency	%		
	Installation method			
	Protection class	IP		
	Overall dimensions	mm		
	Mass	kg		

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
1.9	**Compact LED Lamp Type 9**			
	Manufacturer			
	Type		LED	
	Designation			
	Class of light distribution			
	Rated voltage	V		
	Rated power	W		
	Efficiency	%		
	Installation method			
	Protection class	IP		
	Overall dimensions	mm		
	Mass	kg		
1.10	**Security Lighting Fixture "EXIT" and "ESCAPE DIRECTION" Type 10**			
	Manufacturer			
	Type		LED	
	Designation			
	Class of light distribution			
	Rated voltage	V		
	Rated power	W		
	Efficiency	%		
	Installation method			
	Protection class	IP		
	Overall dimensions	mm		
	Mass	kg		
1.11	**Portable Floodlight Type 11**			
	Manufacturer			
	Type		LED	
	Designation			
	Battery rating			
	Rated voltage	V		
	Rated power	W		
	Service time until recharging	%		

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
	Type of chanrging station			
	Protection class	IP		
	Overall dimensions	mm		
	Mass	kg		
1.12	**Portable LED Lamp Type 12**			
	Manufacturer			
	Type		LED	
	Designation			
	Class of light distribution			
	Rated voltage	V		
	Rated power	W		
	Efficiency	%		
	Installation method			
	Protection class	IP		
	Overall dimensions	mm		
	Mass	kg		
2	**LAMPS**			
2.1	**Low Energy/Compact LED Lamp**			
	Manufacturer			
	Type			
	Rated voltage			
	Rated power			
	Luminous flux			
2.2	**High Pressure Mercury Vapour Lamp**			
	Manufacturer			
	Type			
	Rated voltage	V		
	Rated power	W		
	Luminous flux	lm		
2.3	**LED Tube**			
	Halogen Lamp			

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
	Manufacturer			
	Type			
	Rated voltage	V		
	Rated power	W		
	Luminous flux	lm		
3	**400/230 V Lighting Distribution Boards**			
	Manufacturer			
	Type			
	Standards			
	Rated Voltage	V		
	Rated frequency	Hz		
3.1	**Busbars**			
	Type			
	Material			
	Rated current	A		
	Rated short -time withstand current (1 s)	kA		
	Rated peak current	kA		
3.2	**Circuit Breakers**			
	Manufacturer			
	Type			
	Rated Voltage	V		
	Rated current	A		
	Rated short circuit breaking current	kA		
	Rated short circuit making capacity	kA		
	Rated short -time withstand current (1 s)	kA		
3.3	**Cubicles**			
	Sheet steel thickness	mm		
	Protection class	IP		
	Dimensions			

Name 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
	- height	mm		
	- width	mm		
	- depth	mm		
	Mass	kg		
4	**Socket Outlets 400 V and 230 V**			
	Manufacturer			
	Type			
	Protection Class	IP		
		m/s^2		
5	**Switches**			
	Manufacturer			
	Type			
	Protection Class	IP		
6	**Information to be submitted along with bid**			
	Layout and Dimension Drawings for Equipment Rooms and Components			
	Detailed Description and |Leaflets of the Proposed Equipments			
7	**Informative Data**			
	Manufacturer			
	Place of manufacturing			
	Dimension (W x D x H)	mm		
	Standard drum length	m		
	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_____

Nepal Electricity Authority
Distribution and Consumer Services Directorate
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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
K	**Miscellaneous**			
1	**Air Conditioner**			
1.1	**General**			
	Manufacturer			
	Type			
	Designation			
	Place of Origin			
1.2	**Capacity**			
	Cooling	BTU/hr	1800	
	Heating	BTU/hr	19500	
	Compressor		Rotary	
1.3	**Power Supply**			
	Power Supply	V/Ph/Hz	230/Single/50	
	Power Input (Cooling/heating)			
	Current			
1.4	**Energy Star Rating**			
	Energy Star Rating		> 5	
1.5	**Performance**			
	EER	BTU/hr./W	10/10	
	Air Circulation (Indoor/outdoor)	CFm	> 460/1485	
	Moisture Removal	l/hr	> 2.5	
	Noise Level (indoor/outdoor)	dB	< 46	
1.6	**Operation**			
	Panel Display		LCD	
	Remote Controller		LCD	
1.7	**Features**			
	Auto Air Swing		√	
	Speed Setting	Cooling/Fan	3/3	

Name of Tenderer _____

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Distribution and Consumer Services Directorate

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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
	Operation Control		Microprocessor controlled codeless remote	
	Auto Restart		√	
	Sleep Mode		√	
	On Timer		√	
	OFF Timer		√	
	Dehumidification		√	
	Chaos Logic		√	
	Fuzzy Logic		√	
	Jet Cool		√	
	Evaporator Type		2 Row	
	Evaporator Fin Type		Blue fin/Gold fin	
	Condenser Fin Type		Blue fin/Gold fin	
	Refrigerant		Eco-friendly (non-CFC)	
	Anti-bacteria Filter		√	
1.8	**Dimensions and Net Weight**			
	Indoor (LxWxH)	mm		
	Outdoor (LxWxH)	mm		
	Indoor	kg		
	Outdoor	kg		
	Warranty		Minimum two years (min. five years on compressor)	
1.9	**Additional Requirement**			
	copper pipe with superlon insulation for suction line	m	4	
	copper pipe with superlon insulation for discharge line	m	4	
	PVC pipe for drain	m	1	
	Base plate for hanging yes			

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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
2	**Flexible Pipe**			
	Manufacturer			
	Country of Origin			
	Years of Manufacturing Experience			
	Applicable standard			
	Manufacturer Type Designation			
	Type		Corrugated hard polyethylene	
	Thickness of pipe	mm		
	Outer diameter of the pipe	mm		
	Tensile Strength	N/ sq mm		
	Compressive Strength	N/ sq mm		
	Submitted for the required ratings	N/ sq mm		
3	**Information to be submitted along with bid**			
	Layout and Dimension Drawings for Equipment Rooms and Components			
	Detailed Description and |Leaflets of the Proposed Equipments			
4	**Informative Data**			
	Manufacturer			
	Place of manufacturing			
	Dimension (W x D x H)	mm		
	Standard drum length	m		
	Weight	kg		
	Shipping Data			

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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
	Weight of heaviest package	kg		
	Dimension of largest package (W x D x H)	mm		

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
	Weight of heaviest package	kg		
	Dimension of largest package (W x D x H)	mm		

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B2	Technical Data Schedule
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Construction Standard Guidelines - 33 kV Lines

SN	Drawing Number	Drawing Title
1	CSG-OHL-CS	Conductor Spacing
2	CSG-OHL-CC	Conductor Clearance
3	CSG-OHL-PF	Pole Foundation
4	CSG-OHL-PB	Pole Burial
5	CSG-OHL-PP	Pole Protection Shallow River Beds
6	CSG-OHL-STAY-A	HT and LT Stay, Type - A
7	CSG-OHL-STAY-B	HT and LT Stay, Type - B
8	CSG-OHL-STAY-C	HT and LT Stay, Type - C
9	CSG-OHL-STAY-HW	Hardware for Stay Sets
10	CSG-OHL-STAY-ANCHOR-01	Stays and Anchors
11	CSG-OHL-STAY-ANCHOR-02	Stays Anchoring
12	CSG-OHL-STAY-LEADS-01	Stay Leads
13	CSG-OHL-STAY-LEADS-02	Minimum Lead for Side Angle Stays
14	CSG-OHL-STAY-LEADS-03	Minimum Lead for Side Angle Stays
15	CSG-OHL-STAY-LEADS-04	Minimum Lead for Side Angle Stays
16	CSG-OHL-STAY-LEADS-05	Minimum Lead for Side Angle Stays
17	CSG-OHL-DOG-SC-50M	Sag Chart 100 sq. mm. ACSR
18	CSG-OHL-DOG-SC-75M	Sag Chart 100 sq. mm. ACSR
19	CSG-OHL-INS-TIES-01	Insulator Ties
20	CSG-OHL-INS-TIES-02	Insulator Ties
21	CSG-TS-NOTES	Tension Splicing Instructions
22	CSG-UGC-NOTES	Construction Notes for Underground Cables
23	CSG-OHL-11SC-NOTES	Notes on Fabrication of Steel Tubular Pole and Accessories
24	CSG-OHL-11SC-SPSA-BOM	33 kV Single Pole Single Arm Structure, STSA
25	CSG-OHL-11SC-SPSA-POLE	33 kV Single Pole Single Arm Structure, STSA
26	CSG-OHL-11SC-SPSA-CA	Single Pole Single Arm, Cross Arm for 33 kV
27	CSG-OHL-11SC-SPSA-SB	Single Pole Single Arm, Single Bracing Set for 33 kV
28	CSG-OHL-11SC-SPSA-STAY	Single Pole Single Arm, Stay Set for 33 kV
29	CSG-OHL-11SC-SPDE-BOM	Single Pole Single Dead End Structure
30	CSG-OHL-11SC-SPDE-POLE	Single Pole Single Dead End Structure
31	CSG-OHL-11SC-SPDE-CA	Single Pole Single Dead End Structure, Cross Arm for 33 kV
32	CSG-OHL-11SC-SPDE-SB	Single Pole Single Dead End Structure, Single Bracing Set for 33 kV
33	CSG-OHL-11SC-SPDE-STAY	Single Pole Single Dead End Structure, Stay Set for 33 kV
34	CSG-OHL-11SC-SPDDE-BOM	Single Pole Double Dead End Structure
35	CSG-OHL-11SC-SPDDE-POLE	Single Pole Double Dead End Structure
36	CSG-OHL-11SC-SPDDE-CACL	Single Pole Double Dead End Structure, Cross Arm for 33 kV
37	CSG-OHL-11SC-SPDDE-SB	Single Pole Double Dead End Structure, Single Bracing Set for 33 kV
38	CSG-OHL-11SC-SPDDE-DB	Single Pole Double Dead End Structure, Single Bracing Set for 33 kV

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Construction Standard Guidelines - 33 kV Lines

SN	Drawing Number	Drawing Title
39	CSG-OHL-11SC-SPDDE-STAY	Single Pole Double Dead End Structure, Stay Set for 33 kV
40	CSG-OHL-11SC-DPA-BOM	33 kV Double Pole Arm Structure
41	CSG-OHL-11SC-DPA-POLE	33 kV Double Pole Arm Structure
42	CSG-OHL-11SC-DPA-CLCA	33 kV Double Pole Arm Structure, Clamp and Cross Arm Structure
43	CSG-OHL-11SC-DPA-STAY	33 kV Double Pole Arm Structure, Stay Set
44	CSG-OHL-11SC-DPDA-BOM	Double Pole Single Arm Dead End Structure
45	CSG-OHL-11SC-DPDA-POLE	Double Pole Single Arm Dead End Structure
46	CSG-OHL-11SC-DPDA-CLCA	Double Pole Single Arm Dead End Structure, Clamp and Cross Arm Structure
47	CSG-OHL-11SC-DPDA-STAY	Double Pole Single Arm Dead End Structure, Stay Set
48	CSG-OHL-11SC-DDPDA-BOM	Double Pole Double Dead End Arm Structure
49	CSG-OHL-11SC-DDPDA-POLE	Double Pole Double Dead End Arm Structure
50	CSG-OHL-11SC-DDPDA-CLCA	Double Pole Double Arm, Dead End Structure, Clamp and Cross Arm
51	CSG-OHL-11SC-DDPDA-CB	Double Pole Double Arm, Dead End Structure, Bracing Assembly
52	CSG-OHL-11SC-DDPDA-UACB	Double Pole Double Arm, Dead End Structure, For Upper Cross Arm Channel for Cross Bracing Assembly
53	CSG-OHL-11SC-DDPDA-LACB	Double Pole Double Arm, Dead End Structure, For Lower Cross Arm Channel for Cross Bracing Assembly
54	CSG-OHL-11SC-DDPDA-CACB	Double Pole Double Arm, Dead End Structure, For Cross Arm Channel for Cross Bracing Assembly
55	CSG-OHL-11SC-DDPDA-STAY	Double Pole Double Arm, Dead End Structure, Stay Set
56	CSG-OHL-13DC-NOTES	Notes on Fabrication of Steel Tubular Pole and Accessories
57	CSG-OHL-13DC-SPSA-BOM	33 kV Single Pole Single Arm Structure, STSA
58	CSG-OHL-13DC-SPSA-POLE	33 kV Single Pole Single Arm Structure, STSA
59	CSG-OHL-13DC-SPSA-CA	Single Pole Single Arm, Cross Arm for 33 kV
60	CSG-OHL-13DC-SPSA-SB	Single Pole Single Arm, Single Bracing Set for 33 kV
61	CSG-OHL-13DC-SPSA-STAY	Single Pole Single Arm, Stay Set for 33 kV
62	CSG-OHL-13DC-SPDE-BOM	Single Pole Single Dead End Structure
63	CSG-OHL-13DC-SPDE-POLE	Single Pole Single Dead End Structure
64	CSG-OHL-13DC-SPDE-CA	Single Pole Single Dead End Structure, Cross Arm for 33 kV
65	CSG-OHL-13DC-SPDE-SB	Single Pole Single Dead End Structure, Single Bracing Set for 33 kV
66	CSG-OHL-13DC-SPDE-STAY	Single Pole Single Dead End Structure, Stay Set for 33 kV
67	CSG-OHL-13DC-SPDDE-BOM	Single Pole Double Dead End Structure
68	CSG-OHL-13DC-SPDDE-POLE	Single Pole Double Dead End Structure
69	CSG-OHL-13DC-SPDDE-CACL	Single Pole Double Dead End Structure, Cross Arm for 33 kV
70	CSG-OHL-13DC-SPDDE-SB	Single Pole Double Dead End Structure, Single Bracing Set for 33 kV
71	CSG-OHL-13DC-SPDDE-DB	Single Pole Double Dead End Structure, Single Bracing Set for 33 kV
72	CSG-OHL-13DC-SPDDE-STAY	Single Pole Double Dead End Structure, Stay Set for 33 kV
73	CSG-OHL-13DC-DPA-BOM	33 kV Double Pole Arm Structure
74	CSG-OHL-13DC-DPA-POLE	33 kV Double Pole Arm Structure
75	CSG-OHL-13DC-DPA-CLCA	33 kV Double Pole Arm Structure, Clamp and Cross Arm Structure

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Construction Standard Guidelines - 33 kV Lines

SN	Drawing Number	Drawing Title
76	CSG-OHL-13DC-DPA-STAY	33 kV Double Pole Arm Structure, Stay Set
77	CSG-OHL-13DC-DPDA-BOM	Double Pole Single Arm Dead End Structure
78	CSG-OHL-13DC-DPDA-POLE	Double Pole Single Arm Dead End Structure
79	CSG-OHL-13DC-DPDA-CLCA	Double Pole Single Arm Dead End Structure, Clamp and Cross Arm Structure
80	CSG-OHL-13DC-DPDA-STAY	Double Pole Single Arm Dead End Structure, Stay Set
81	CSG-OHL-13DC-DDPDA-BOM	Double Pole Double Dead End Arm Structure
82	CSG-OHL-13DC-DDPDA-POLE	Double Pole Double Dead End Arm Structure
83	CSG-OHL-13DC-DDPDA-CLCA	Double Pole Double Arm, Dead End Structure, Clamp and Cross Arm
84	CSG-OHL-13DC-DDPDA-CB	Double Pole Double Arm, Dead End Structure, Bracing Assembly
85	CSG-OHL-13DC-DDPDA-UACB	Double Pole Double Arm, Dead End Structure, For Upper Cross Arm Channel for Cross Bracing Assembly
86	CSG-OHL-13DC-DDPDA-LACB	Double Pole Double Arm, Dead End Structure, For Lower Cross Arm Channel for Cross Bracing Assembly
87	CSG-OHL-13DC-DDPDA-CACB	Double Pole Double Arm, Dead End Structure, For Cross Arm Channel for Cross Bracing Assembly
88	CSG-OHL-13DC-DDPDA-STAY	Double Pole Double Arm, Dead End Structure, Stay Set
89	CSG-OHL-INS-INS-01	33 kV Insulator
90	CSG-OHL-INS-INS-02	33 kV Insulator Pin
91	CSG-OHL-INS-INS-03	Hardware for Tension Set
92	CSG-OHL-INS-INS-04	Tension Set
93	CSG-OHL-INS-INS-05	Compression Tools
94	CSG-OHL-INS-INS-06	Stay Insulator
95	CSG-OHL-INS-INS-07	Shackle Insulator

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1	CSG-SLD-01	Single Line Diagram for 33/11 kV, 1 MVA, Substation
2	CSG-SLD-03	Single Line Diagram for 33/11 kV, 3 MVA, Substation
3	CSG-SLD-08	Single Line Diagram for 33/11 kV, 8 MVA, Substation
4	CSG-SLD-16	Single Line Diagram for 33/11 kV, 16 MVA, Substation
5	CSG-SLD-24	Single Line Diagram for 33/11 kV, 24 MVA, Substation
6	CSG-SLD-LVD	Single Line Diagram of Auxiliary System
7	CSG-SLD-INT	Interconnection Diagram
8	CSG-SLD-SCH-SAS	Substation Architecture System
9	CSG-SW-LAY-A	Layout of 33 kV switchyard for 33/11 kV Substation - One bay
10	CSG-SW-LAY-A-SEC-01	Section Views of Layout of 33 kV switchyard for 33/11 kV Substation - One bay
11	CSG-SW-LAY-A-SEC-02	Section Views of Layout of 33 kV switchyard for 33/11 kV Substation - One bay
12	CSG-SW-LAY-B	Layout of 33 kV switchyard for 33/11 kV Substation - Two bay
13	CSG-SW-LAY-B-SEC	Section Views of Layout of 3 kV switchyard for 33/11 kV Substation - Two bay
14	CSG-SW-LA	Lightning Arrestor
15	CSG-SW-CT	Current Transformer
16	CSG-SW-PT	Potential Transformer
17	CSG-SW-BUS	BUS PI, for use other than gantry bus bar
18	CSG-SW-BPI	Bus Post Insulator
19	CSG-SW-DSES	Disconnecting Switch with Earth Switch
20	CSG-SW-FOND-TYP-01	Typical Footing for CT/PT/LA
21	CSG-SW-FOND-TYP-02	Typical Footing for DSES
22	CSG-SW-FOND-TYP-03	Typical Footing for Circuit Breaker
23	CSG-SW-FOND-TYP-04	Typical Footing for Station Transformer
24	CSG-SW-GAN-LBS	Gantry for Load Break Switch
25	CSG-SW-GAN-LBS-FOND	Typical Footing for Load Break Switch Gantry Foundation
26	CSG-SW-LM	Lightning Mast
27	CSG-SW-XFORM	Power Transformer
28	CSG-SW-GAN-BB	Bus Bar Gantry
29	CSG-SW-GAN-BAY-ONE	One Bay 33 kV Gantry
30	CSG-SW-GAN-BAY-TWO	Two Bay 33 kV Gantry
31	CSG-SW-GAN-BAY-TWO-FOND	Two Bay 33 kV Gantry Foundation
32	CSG-SW-CAB-TRE-01	Typical Switchyard Cable Trench Layout
33	CSG-SW-CAB-TRE-02	Typical Control Building Cable Trench Layout
34	CSG-SW-CAB-TRE-03	Typical Cable Trench Section
35	CSG-SW-EARTH	Typical Earth Pit
36	CSG-SW-LIGHT	Typical Street Light Pole
37	CSG-BLDG-CTRL-PL	Control Building Plan
38	CSG-BLDG-CTRL-ELEV-SEC	Control Building Elevation and Section

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Construction Standard Guidelines - Substation

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39	CSG-BLDG-OFF-PL	Office Building Plan
40	CSG-BLDG-OFF-ELEV	Office Building Elevation
41	CSG-BLDG-OFF-SEC	Office Building Section
42	CSG-BLDG-SQRT-PL	Staff Quarter Plan
43	CSG-BLDG-SQRT-ELEV	Staff Quarter Elevation
44	CSG-BLDG-SQRT-SEC	Staff Quarter Section
45	CSG-BLDG-GH-PL-SEC-01	Guard House Plan
46	CSG-BLDG-GH-ELEV-01	Guard House Elevation
47	CSG-BLDG-GH-PL-SEC-02	Guard House Plan for Snowfall Area
48	CSG-BLDG-GH-ELEV-02	Guard House Elevation for Snowfall Area
49	CSG-ROAD-DRAIN-SEC	Typical Section of Drainage Canal
50	CSG-ROAD-PAV-TYP	Typical Road Pavement Plan
51	CSG-ROAD-PAV-SEC-01	Typical Road Pavement Plan and Section of Side Drain
52	CSG-ROAD-PAV-SEC-02	Typical Section showing Arrangement of Cable Pipe and Drain
53	CSG-FEN-SW-ELEV	Switchyard Fencing Wall Section
54	CSG-FEN-BWALL-ELEV-01	Typical Plan and Elevation of Boundary Wall
55	CSG-FEN-BWALL-ELEV-02	Typical Plan and Elevation of Boundary Wall
56	CSG-FEN-BWALL-SEC-01	Typical Section of Boundary Wall
57	CSG-FEN-BWALL-SEC-02	Typical Section of Boundary Wall
58	CSG-FEN-SWG	Typical Drawing of Switchyard Fence Gate
59	CSG-FEN-MEG	Typical Drawing of Main Entry Gate
60	CSG-BLDG-CTRL-ELE	Control Building Light Plan
61	CSG-BLDG-CTRL-POW	Control Building Power and AC Circuit Plan
62	CSG-BLDG-CTRL-COMM	Control Building Communication Plan
63	CSG-BLDG-CTRL-FIREF	Control Building Fire Fighting Plan
64	CSG-BLDG-GH-ELE	Guard House Light Plan
65	CSG-BLDG-GH-POW	Guard House Power and AC Circuit Plan
66	CSG-BLDG-GH-COMM	Guard House Communication Plan
67	CSG-BLDG-GH-FIREF	Guard House Fire Fighting Plan
68	CSG-BLDG-OFF-ELE-GF	Office Building Light Plan Ground Floor
69	CSG-BLDG-OFF-ELE-FF	Office Building Light Plan First Floor
70	CSG-BLDG-OFF-POW-GF	Office Building Power and AC Circuit Plan Ground Floor
71	CSG-BLDG-OFF-POW-FF	Office Building Power and AC Circuit Plan First Floor
72	CSG-BLDG-OFF-COMM-GF	Office Building Communication Plan Ground Floor
73	CSG-BLDG-OFF-COMM-FF	Office Building Communication Plan First Floor
74	CSG-BLDG-OFF-FIREF-GF	Office Building Fire Fighting Plan Ground Floor
75	CSG-BLDG-OFF-FIREF-FF	Office Building Fire Fighting Plan First Floor
76	CSG-BLDG-SQRT-ELE	Staff Quarter Light Plan

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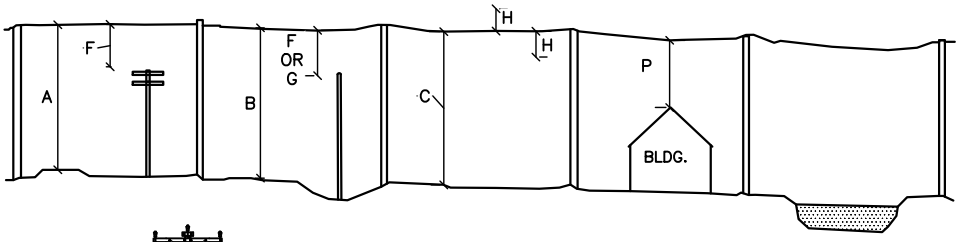
Construction Standard Guidelines - Substation

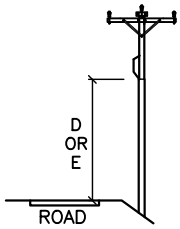
SN	Drawing Number	Drawing Title
77	CSG-BLDG-SQRT-POW	Staff Quarter Power and AC Circuit Plan
78	CSG-BLDG-SQRT-COMM	Staff Quarter Communication Plan
79	CSG-BLDG-SQRT-FIREF	Staff Quarter Fire Fighting Plan
80	CSG-SEP-01	Typical Drawings of Septic Tank for Staff Quarter and Office Building
81	CSG-SEP-02	Typical Drawings of Septic Tank for Control Building and Guard House
82	CSG-SEP-03	Typical Drawings of Underground Water Tank

Name of Tenderer _____

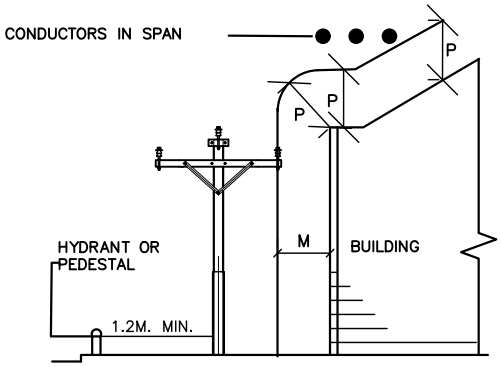
Signature of Tenderer_____

CONDUCTOR CLEARANCE





POLES ADJACENT TO ROADS



POLES ADJACENT TO BUILDINGS

LOCATION	VOLTAGE	CLEARANCE (METER)
M	0–11,000V	1.25
	11,000–33,000 V	2.00
P	0–11,000V	2.44
	11,000–33,000 V	3.65

–CLEARANCE M ALSO SPECIFIED HORIZONTAL CLEARANCE FROM BALCONIES

CROSSING OVER		VOLTAGE OF CIRCUIT CROSING	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 V.	5.50
LINE ALONG SIDE OF			
D	MAIN HIGHWAYS STREETS OR ALLEYS	STAY & CABLE MESSENGER	5.50
		0–650 V.	5.50
		651–33,000 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 LOWER LEVEL / CONDUCTORS AT HIGHER LEVEL		SERVICE DROP 0–650 V	OPEN SUPPLY WIRES			STAYS AND SUPPLY CABLES ON GROUNDED MESSENGER
			0–650 V	651–11000 V	33000 V	
F	COMMUNICATION WIRES	0.60 M.	1.38	2.15	–	0.60
	COMMUNICATION CABLES AND MESSENGER	0.6 M. OVER 1.2 M.UNDER				
G	SUPPLY CABLES ON EFFECTIVE GROUNDED MESSENGER	0.6 M. OVER 1.2 M.UNDER	0.60	0.60	–	0.60
H	OPEN SUPPLY 0–650 V.	–	1.3	1.8	2.70	0.60
	WIRES 651–11,000 V.	–	–	1.2	–	1.20
	GUYS SERVICE DROPS 0–650 V.	0.6	0.6	1.2	–	–

–VOLTAGE SHOWN ARE PHASE TO GROUND VALUES.

CLIENT

NEPAL ELECTRICITY AUTHORITY
DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
DURBARMARGA, KATHMANDU, NEPAL

CONSULTANT

NEA ENGINEERING COMPANY LTD.
KATHMANDU, NEPAL

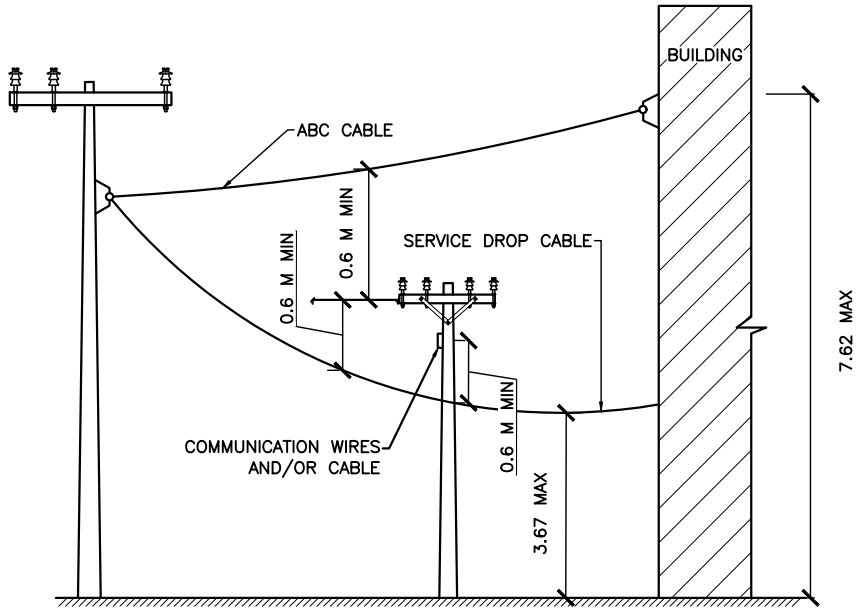
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

DRAWING NO.	CSG–OHL–CS
DRAWN	AKC
DESIGNED	DDT
DRAFTING CHECK	BP
DESIGN CHECK	
APPROVED	

CONDUCTOR SPACING

FOR TENDER PURPOSE ONLY

CONDUCTOR SPACING



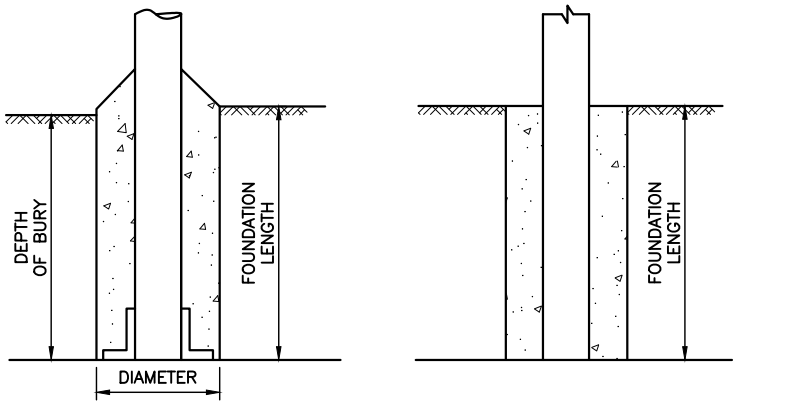
SERVICE DROP: INSTALL SERVICE OVER COMMUNICATION FACILITIES WHERE PRACTICAL AND ATTACHED TO POLE WHEN AVAILABLE; OTHERWISE CROSS UNDER COMMUNICATION FACILITIES WITH PROPER CLEARANCE

SERVICE DROP (0–600 V) CROSSING OVER	CLEARANCE
DRIVE WAY TO RESIDENCE,GARAGE,OR OVER PARKING LOT EXCLUDING TRACKS IN URBAN AREA	3.67m
DRIVE WAY AND COMMERCIAL PARKING LOT OR AREA SUBJECTED TO TRUCK TRAFFIC	4.57m

CLIENT	CONSULTANT	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT	
NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DRAWING NO. CSG–OHL–CC DRAWN AKC DESIGNED DDT DRAFTING CHECK BP DESIGN CHECK APPROVED	CONDUCTOR CLEARANCE FOR TENDER PURPOSE ONLY

POLE LENGTH (m.)	DEPTH OF BURIAL (m.)	FOUNDATION LENGTH (m.)	Soil allowable Bearing Capacity (kg/sq cm)						
			0.5	0.75	1.0	2.0	3.0	4.0	5.0
			SQUARE FOUNDATION BREADTH IN MM						
8	1.35	1.45	900	790	670	470	380	N/R	N/R
9	1.5	1.6	950	790	690	490	390	N/R	N/R
10	1.67	1.77	950	790	690	490	390	N/R	N/R
11	1.8	1.9	1000	820	710	500	410	N/R	N/R
13	2.17	2.3	1000	820	710	500	410	N/R	N/R
14.5	2.4	2.5	1500	1230	1065	750	615	N/R	N/R

N/R=NOT REQUIRED



FOUNDATION FOR STEEL TELESCOPIC POLES AND CONCRETE POLES

FOUNDATION

CONCRETE TO BE USED FOR FOUNDATIONS:

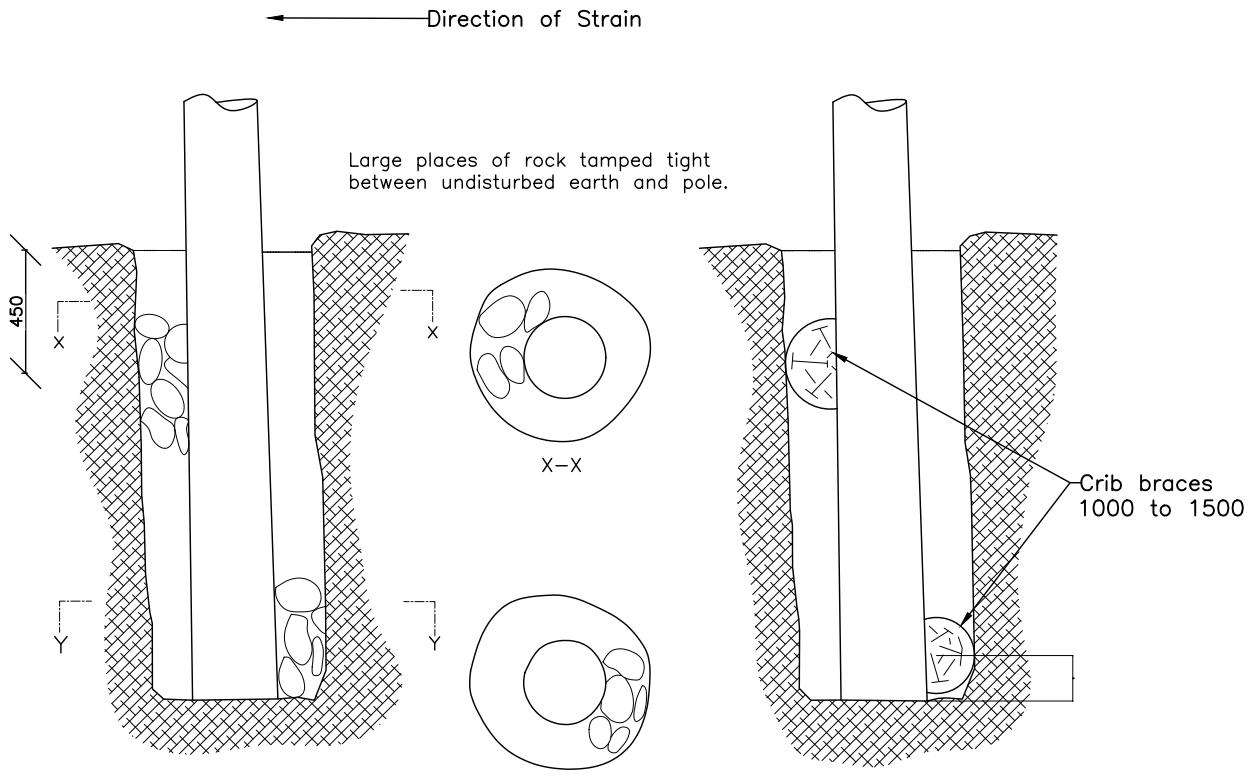
1 PART CEMENT
2 PART SAND
4 PART AGGREGATE
} BY VOLUME

CONCRETE GRADE: M15

WATER– CEMENT RATIO:
32 LITERS–50Kg. APPROX.

NOTE: IN CASE OF NON–GALVANIZED STEEL POLE THE FOUNDATION ABOVE GROUND LEVEL SHALL BE 0.4M MORE THAN THAT IS SHOWN IN THE DRAWING.

CLIENT	CONSULTANT	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT	
NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DRAWING NO. CSG–OHL–PF	POLE FOUNDATION
		DRAWN AKC	
		DESIGNED DDT	
		DRAFTING CHECK BP	
		DESIGN CHECK	
		APPROVED	FOR TENDER PURPOSE ONLY

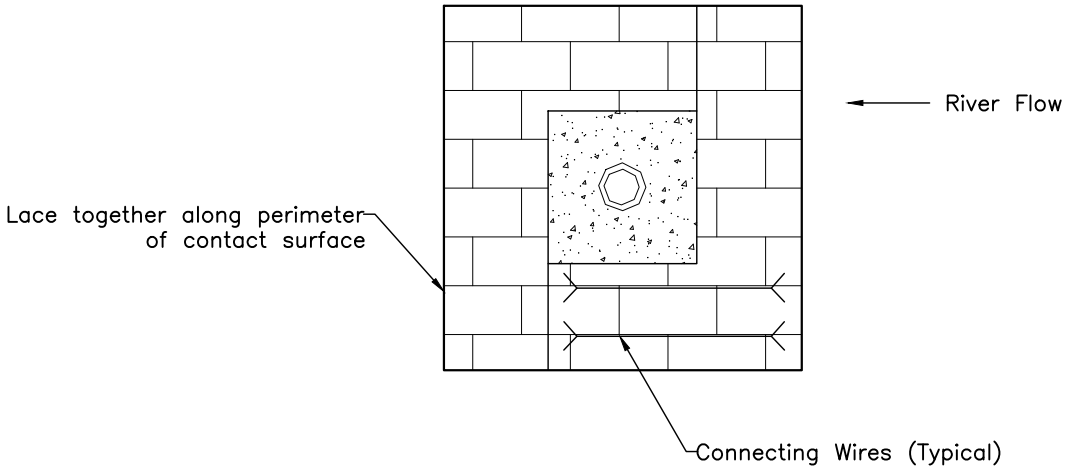


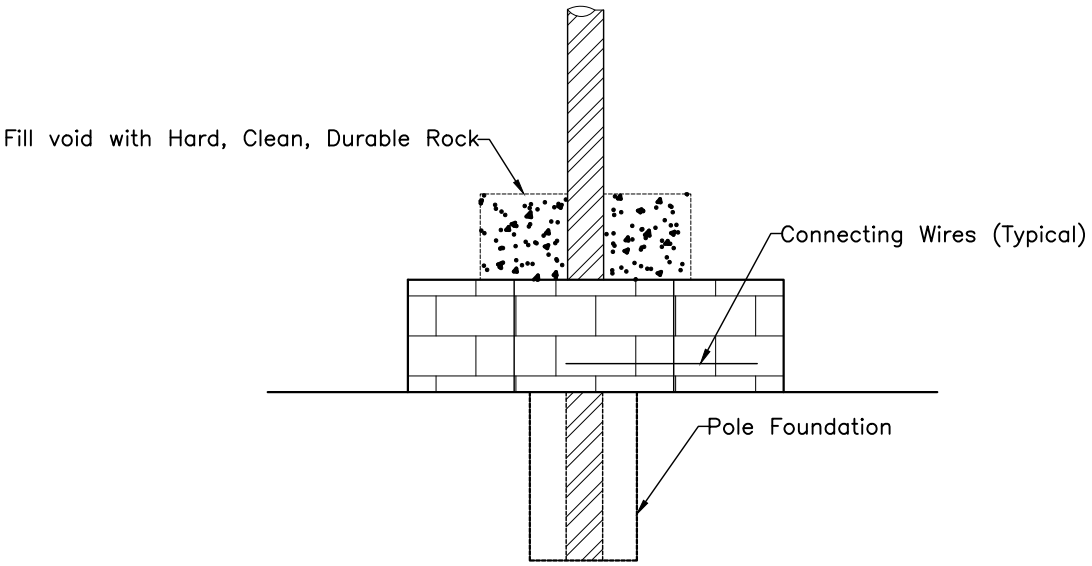
FOR USE WHERE GROUND IS SOLID OR COMPACT

FOR USE WHERE GROUND IS SOFT

NOTE : CRIBBING FOR POLES WITHOUT CONCRETE FOUNDATIONS.

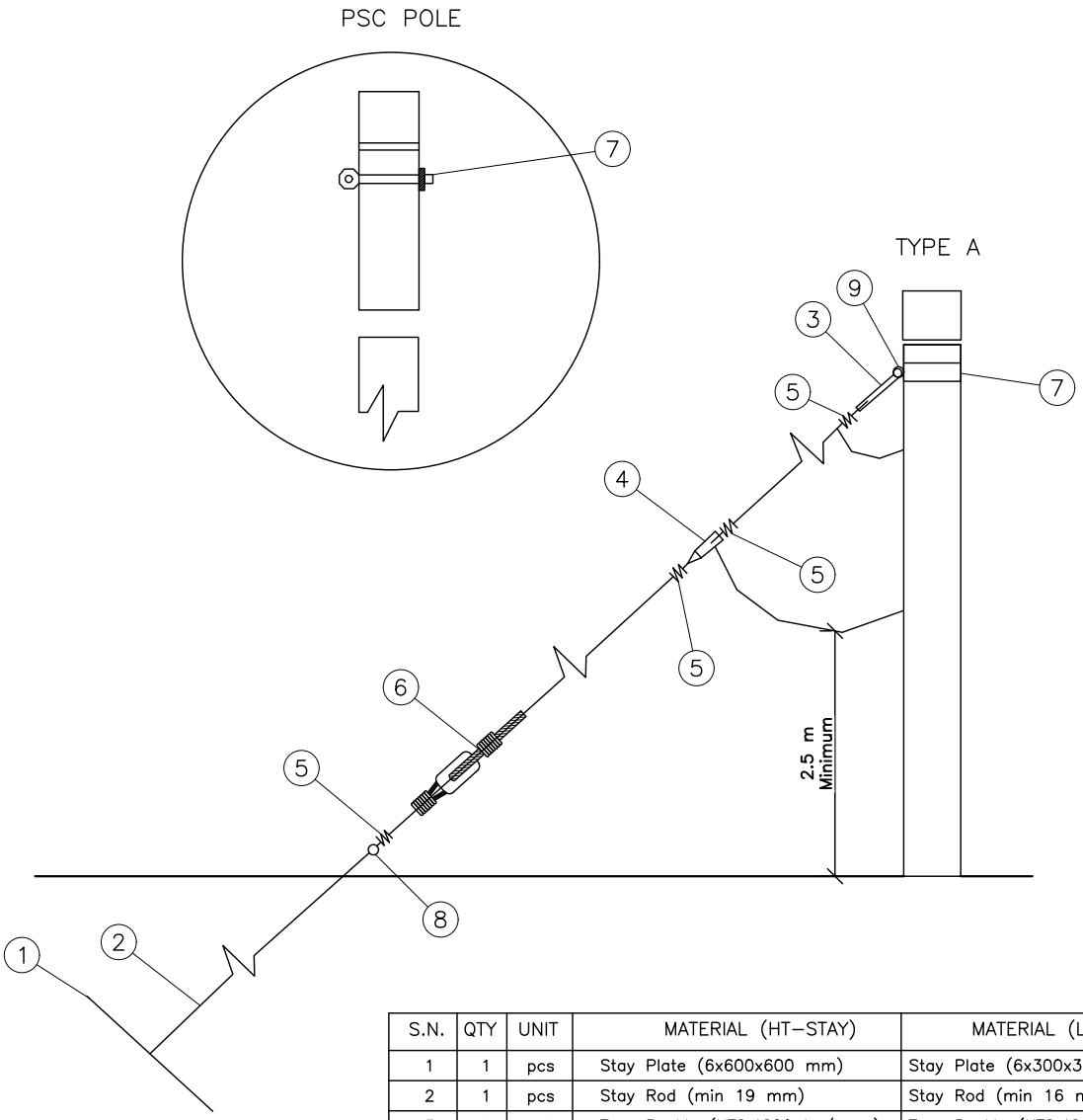
CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
		DRAWING NO. CSG–OHL–PB
		DRAWN AKC
		DESIGNED DDT
		DRAFTING CHECK BP
		DESIGN CHECK
		APPROVED
		POLE BURIAL
		FOR TENDER PURPOSE ONLY





NOTE: IN CASE OF DOUBLE POLE STRUCTURE, SAME SHALL APPLY

CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
		DRAWING NO. CSG–OHL–PP
		DRAWN AKC
		DESIGNED DDT
		DRAFTING CHECK BP
		DESIGN CHECK
		APPROVED
		POLE PROTECTION FOR SHALLOW RIVER BEDS
		FOR TENDER PURPOSE ONLY



S.N.	QTY	UNIT	MATERIAL (HT–STAY)	MATERIAL (LT–STAY)
1	1	pcs	Stay Plate (6x600x600 mm)	Stay Plate (6x300x300 mm)
2	1	pcs	Stay Rod (min 19 mm)	Stay Rod (min 16 mm)
3	1	set	Turn Buckle (UTS:4200 kg/sq.m)	Turn Buckle (UTS:4200 kg/sq.m)
4	1	pcs	Stay Insulator	Stay Insulator
5	1	set	Binding Wires	Binding Wires
6	7	kg	Stay Wire (7/12 SWG)	Stay Wire (7/12 SWG)
7	1	set	Pole Clamp all complete	Pole Clamp all complete
8	1	set	Thimble (Required Size)	Thimble (Required Size)

In case of PSC Poles, Eye Bolt and Washer is required for No. 7.
9 – Double Eye (Twisted), if required for STP shall be considered to be in 7 in Bid.
No holes shall be made in STP for stay Installation.

NOTE :

1. ANCHOR ROD EYE SHALL NOT EXTEND ABOVE SOIL MORE THAN 150mm.

CLIENT

NEPAL ELECTRICITY AUTHORITY
DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
DURBARMARGA, KATHMANDU, NEPAL

CONSULTANT

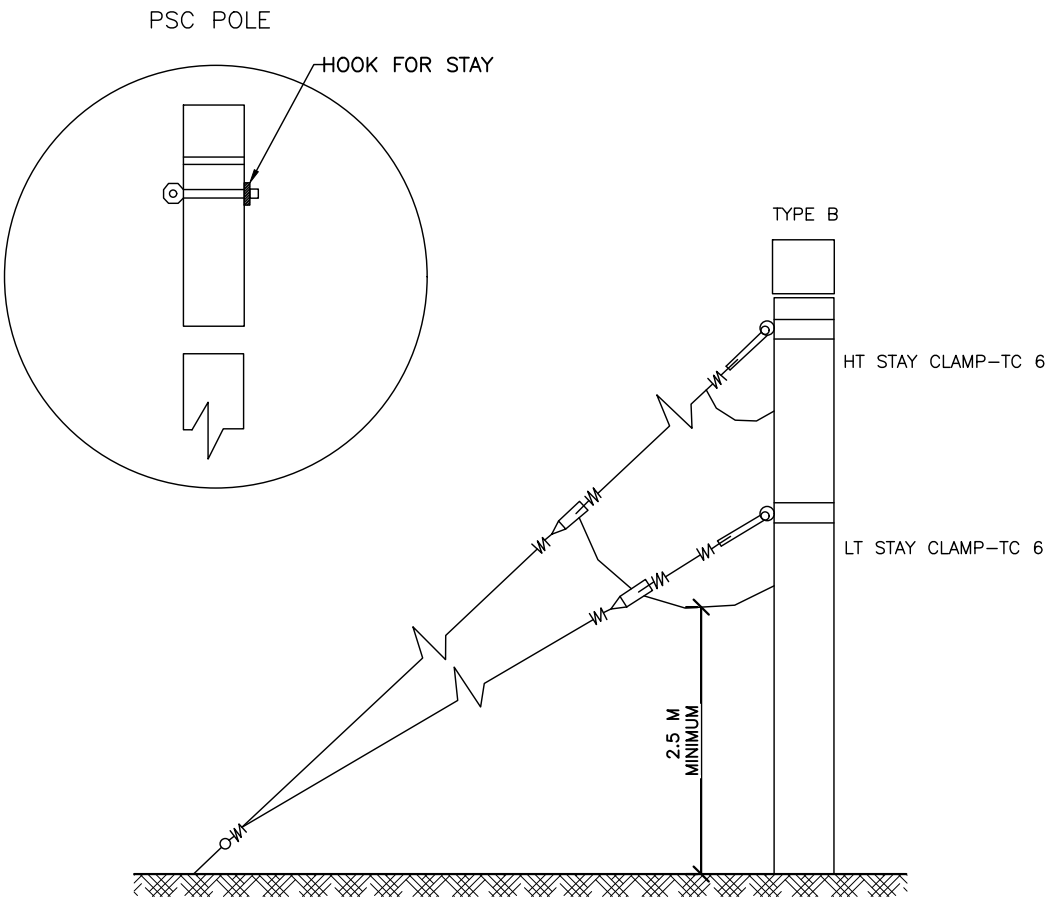
NEA ENGINEERING COMPANY LTD.
KATHMANDU, NEPAL

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

DRAWING NO.	CSG–OHL–STAY–A
DRAWN	AKC
DESIGNED	DDT
DRAFTING CHECK	BP
DESIGN CHECK	
APPROVED	

HT AND LT STAY – TYPE A

FOR TENDER PURPOSE ONLY

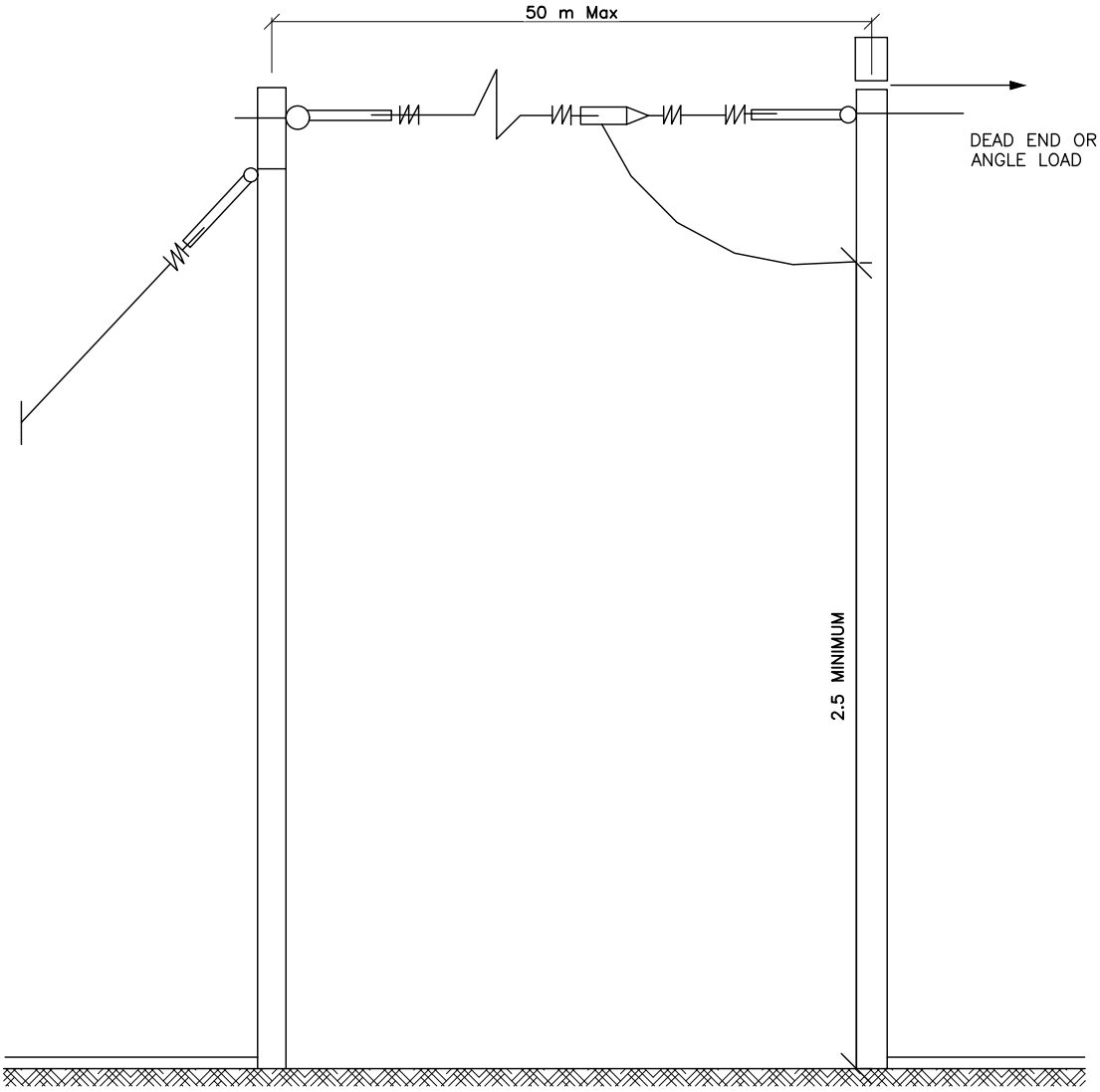


S.N.	QTY	UNIT	MATERIAL (HT–STAY)	MATERIAL (LT–STAY)
1	1	pcs	Stay Plate (6x600x600 mm)	Stay Plate (6x300x300 mm)
2	2	pcs	Stay Rod (min 19 mm)	Stay Rod (min 16 mm)
3	2	set	Turn Buckle (UTS:4200 kg/sq.m)	Turn Buckle (UTS:4200 kg/sq.m)
4	1	pcs	Stay Insulator	Stay Insulator
5	2	set	Binding Wires	Binding Wires
6	14	kg	Stay Wire (7/12 SWG)	Stay Wire (7/12 SWG)
7	2	set	Pole Clamp all complete	Pole Clamp all complete
8	2	set	Thimble (Required Size)	Thimble (Required Size)
In case of PSC Poles, Eye Bolt and Washer is required for No. 7. 9 – Double Eye (Twisted), if required for STP shall be considered to be in 7 in Bid. No holes shall be made in STP for stay Installation.				

NOTE :

1. STAY ROD EYE SHALL NOT EXTEND ABOVE SOIL MORE THAN 150mm.

CLIENT	CONSULTANT	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DRAWING NO. CSG–OHL–STAY–B DRAWN AKC DESIGNED DDT DRAFTING CHECK BP DESIGN CHECK APPROVED HT AND LT STAY – TYPE B FOR TENDER PURPOSE ONLY



S.N.	QTY	UNIT	MATERIAL (HT–STAY)	MATERIAL (LT–STAY)
1	1	pcs	Stay Plate (6x600x600 mm)	Stay Plate (6x300x300 mm)
2	1	pcs	Stay Rod (min 19 mm)	Stay Rod (min 16 mm)
3	1	set	Turn Buckle (UTS:4200 kg/sq.m)	Turn Buckle (UTS:4200 kg/sq.m)
4	1	pcs	Stay Insulator	Stay Insulator
5	1	set	Binding Wires	Binding Wires
6	40	kg	Stay Wire (7/12 SWG)	Stay Wire (7/12 SWG)
7	1	set	Pole Clamp all complete	Pole Clamp all complete
8	1	set	Thimble (Required Size)	Thimble (Required Size)
In case of PSC Poles, Eye Bolt and Washer is required for No. 7. 9 – Double Eye (Twisted), if required for STP shall be considered to be in 7 in Bid. No holes shall be made in STP for stay Installation.				

NOTE :

1. SPAN OF STAY SHALL BE LIMITED TO A MAXIMUM LENGTH OF 50 METERS.

CLIENT

NEPAL ELECTRICITY AUTHORITY
DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
DURBARMARGA, KATHMANDU, NEPAL

CONSULTANT

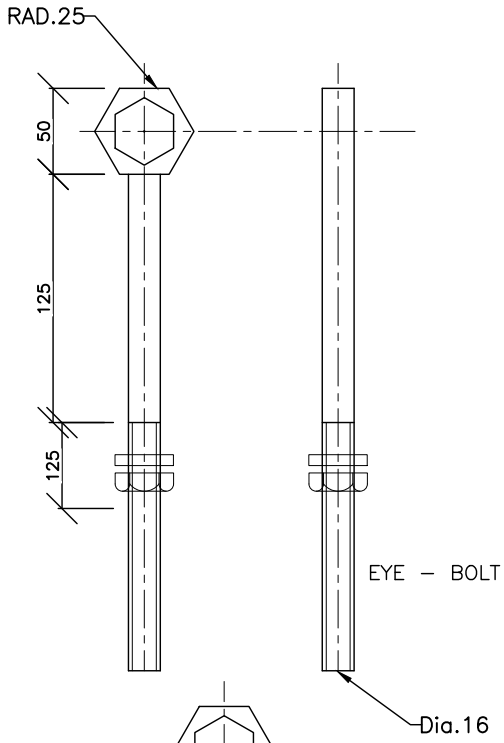
NEA ENGINEERING COMPANY LTD.
KATHMANDU, NEPAL

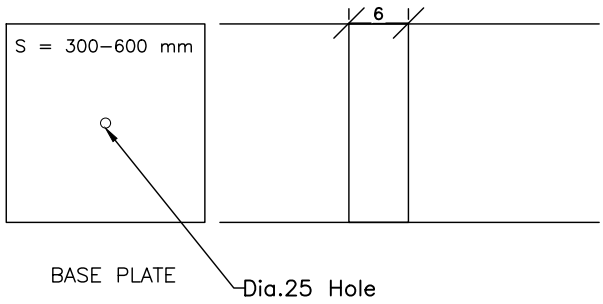
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

DRAWING NO.	CSG–OHL–STAY–C
DRAWN	AKC
DESIGNED	DDT
DRAFTING CHECK	BP
DESIGN CHECK	
APPROVED	

HT AND LT STAY – TYPE C

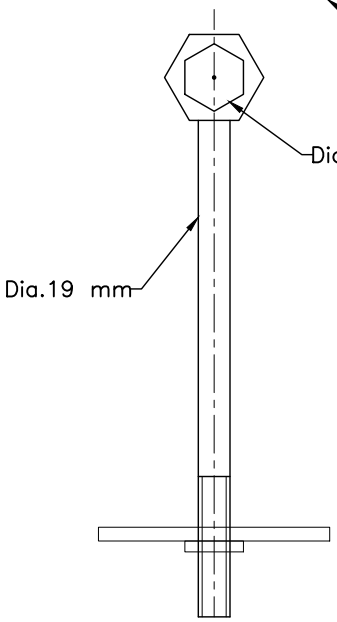
FOR TENDER PURPOSE ONLY



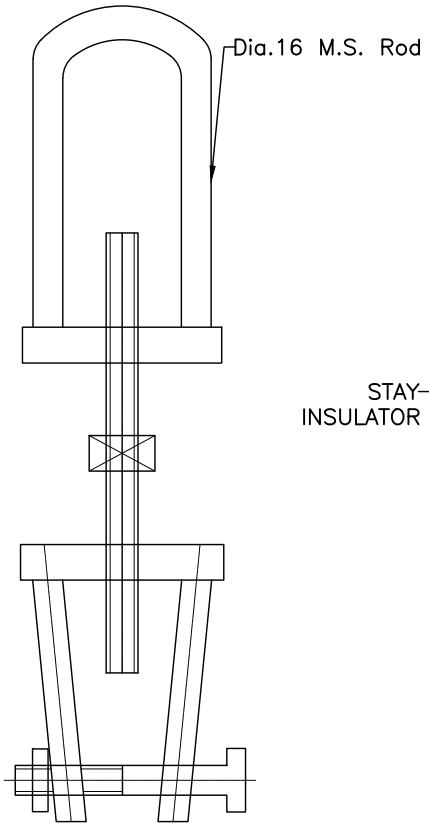




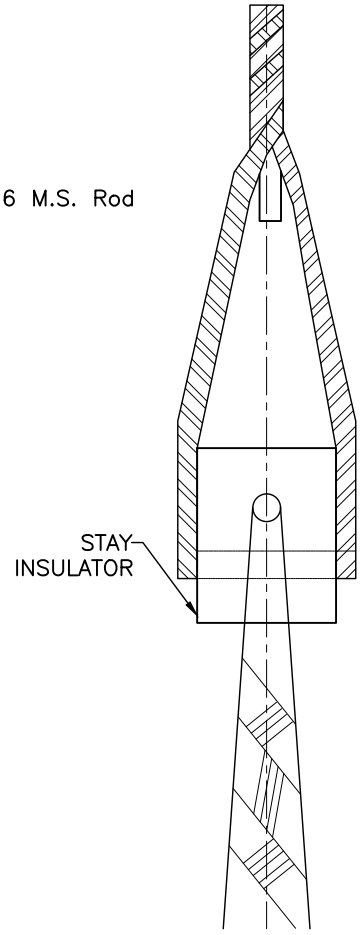
STAY INSULATOR



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	

CLIENT

NEPAL ELECTRICITY AUTHORITY
DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
DURBARMARGA, KATHMANDU, NEPAL

CONSULTANT

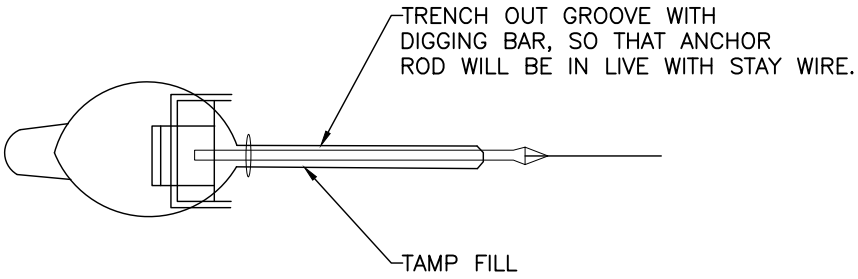
NEA ENGINEERING COMPANY LTD.
KATHMANDU, NEPAL

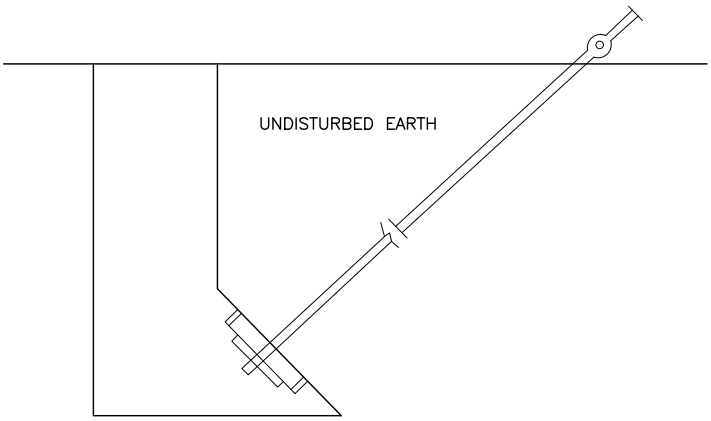
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

DRAWING NO.	CSG–OHL–STAY–HW
DRAWN	AKC
DESIGNED	DDT
DRAFTING CHECK	BP
DESIGN CHECK	
APPROVED	

HARDWARE FOR STAY SETS

FOR TENDER PURPOSE ONLY

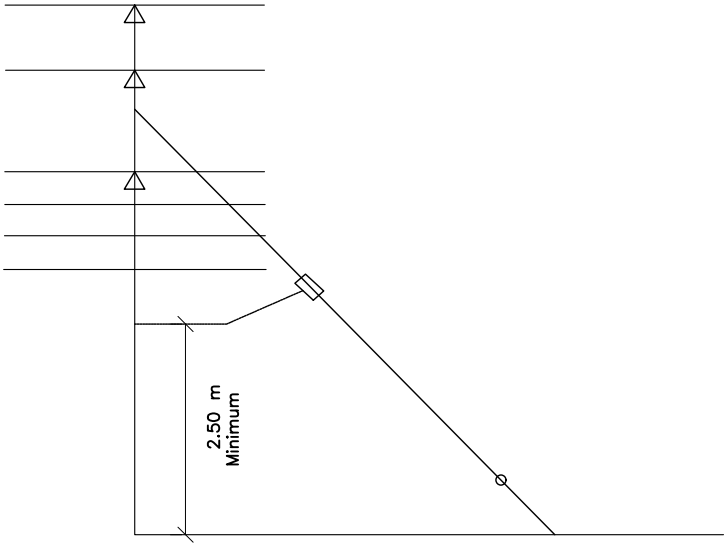


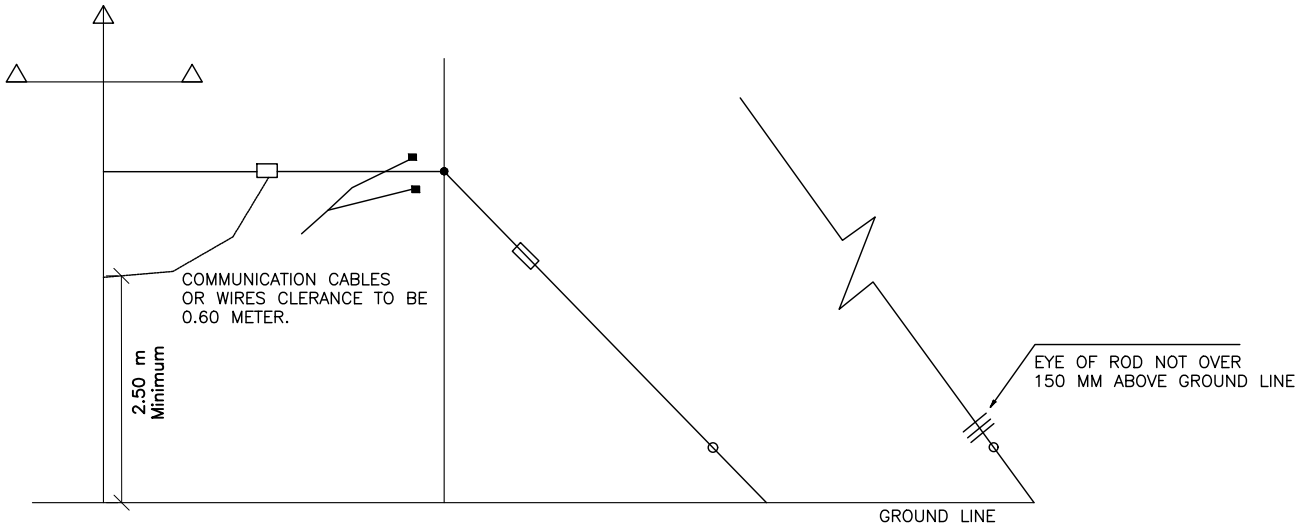


MAKE UNDERCUT AT BOTTOM OF ANCHOR HOLE,
PLATE TO BEAR AGAINST UNDISTURBED EARTH.

1. BACKFILL SHALL BE THOROUGHLY TAMPED.
2. BACKFILL FOR ANCHORS PLACED IN SOFT OR UNSTABLE SOIL SHALL BE 50MM GRAVEL PLACED TO DEPTH OF 1000MM ABOVE ANCHOR PLATE.

CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
		DRAWING NO. CSG–OHL–STAY–ANCHOR–01
		DRAWN AKC
		DESIGNED DDT
		DRAFTING CHECK BP
		DESIGN CHECK
		APPROVED
		STAYS AND ANCHORS
		FOR TENDER PURPOSE ONLY





CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
		DRAWING NO. CSG–OHL–STAY–ANCHOR–02
		DRAWN AKC
		DESIGNED DDT
		DRAFTING CHECK BP
		DESIGN CHECK
		APPROVED
		STAYS AND ANCHORS
		FOR TENDER PURPOSE ONLY

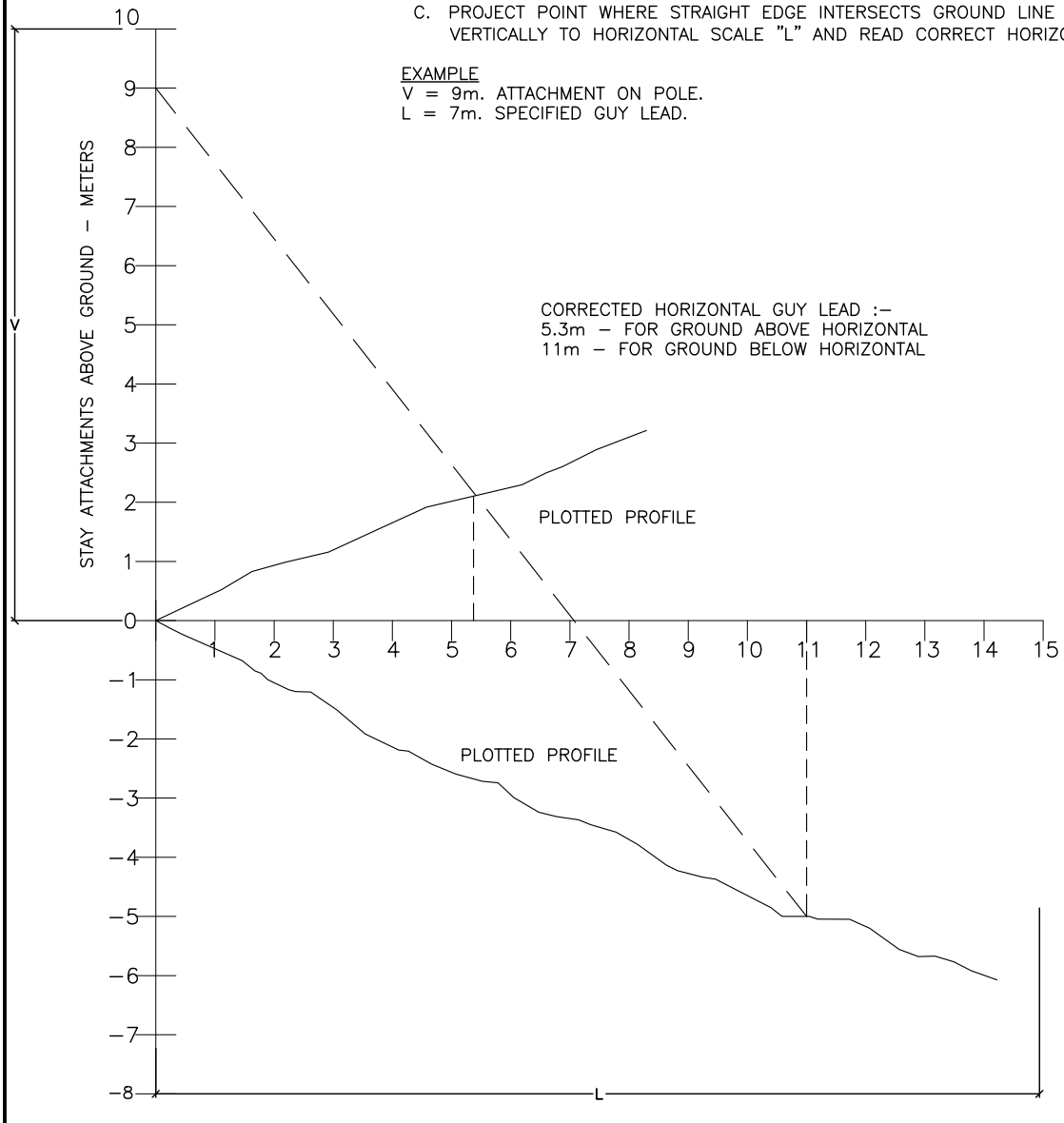
NOTES :

A. PLOT APPROXIMATE GROUND LINE PROFILE UNDER PROPOSED STAY.

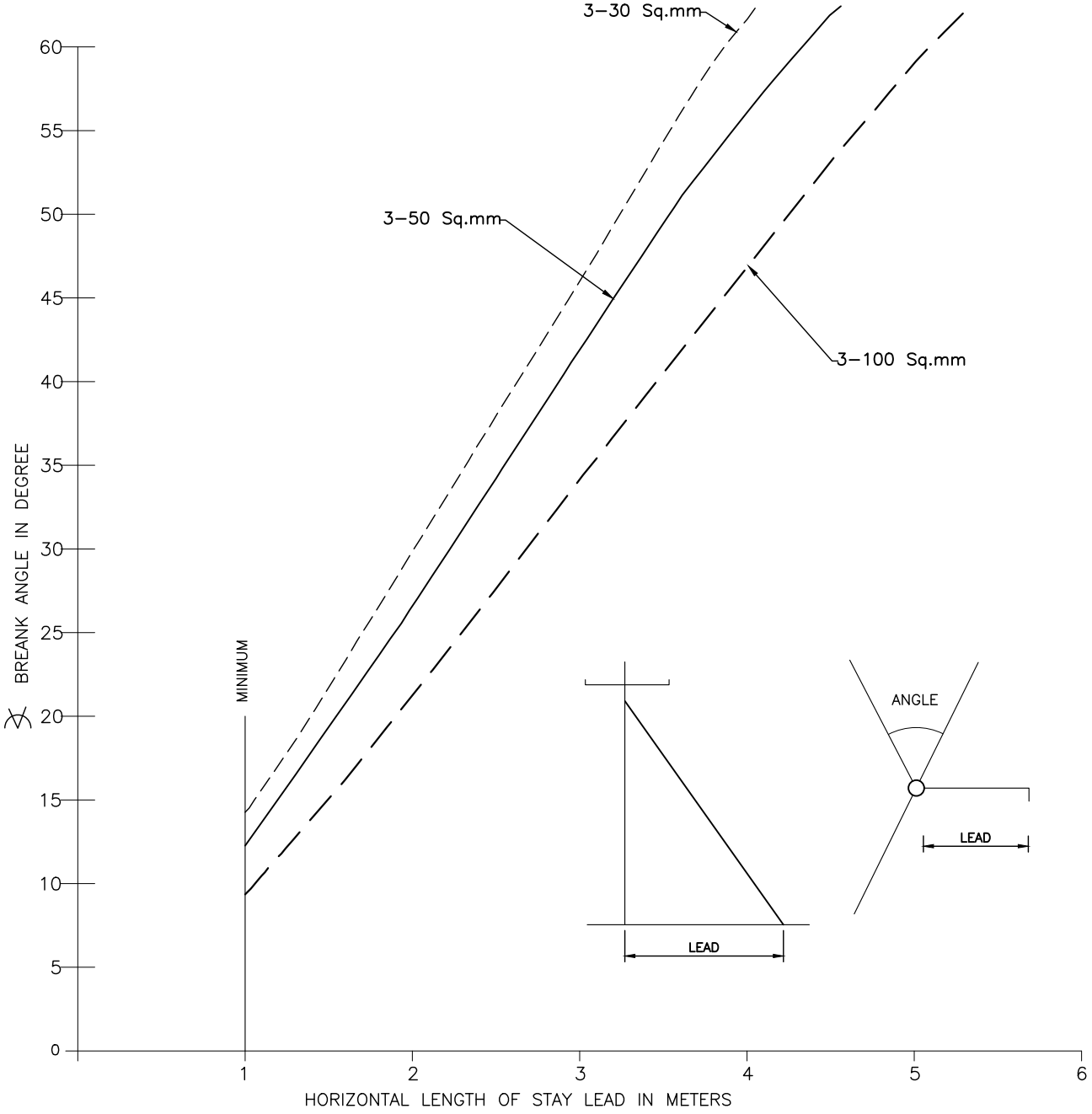
B. SELECT A POINT ON VERTICAL SCALE "V" CORRESPONDING TO GUY ATTACHEMENT ON POLE, SELECT A POINT ON HORIZONTAL SCALE "L" CORRESPONDING TO SPECIFIED STAY LEAD. LAY A STRAIGHT EDGE SO THAT IT PASSES THROUGH THESE TWO POINTS.

C. PROJECT POINT WHERE STRAIGHT EDGE INTERSECTS GROUND LINE PROFILE VERTICALLY TO HORIZONTAL SCALE "L" AND READ CORRECT HORIZONTAL STAY LEAD.

EXAMPLE
V = 9m. ATTACHMENT ON POLE.
L = 7m. SPECIFIED GUY LEAD.

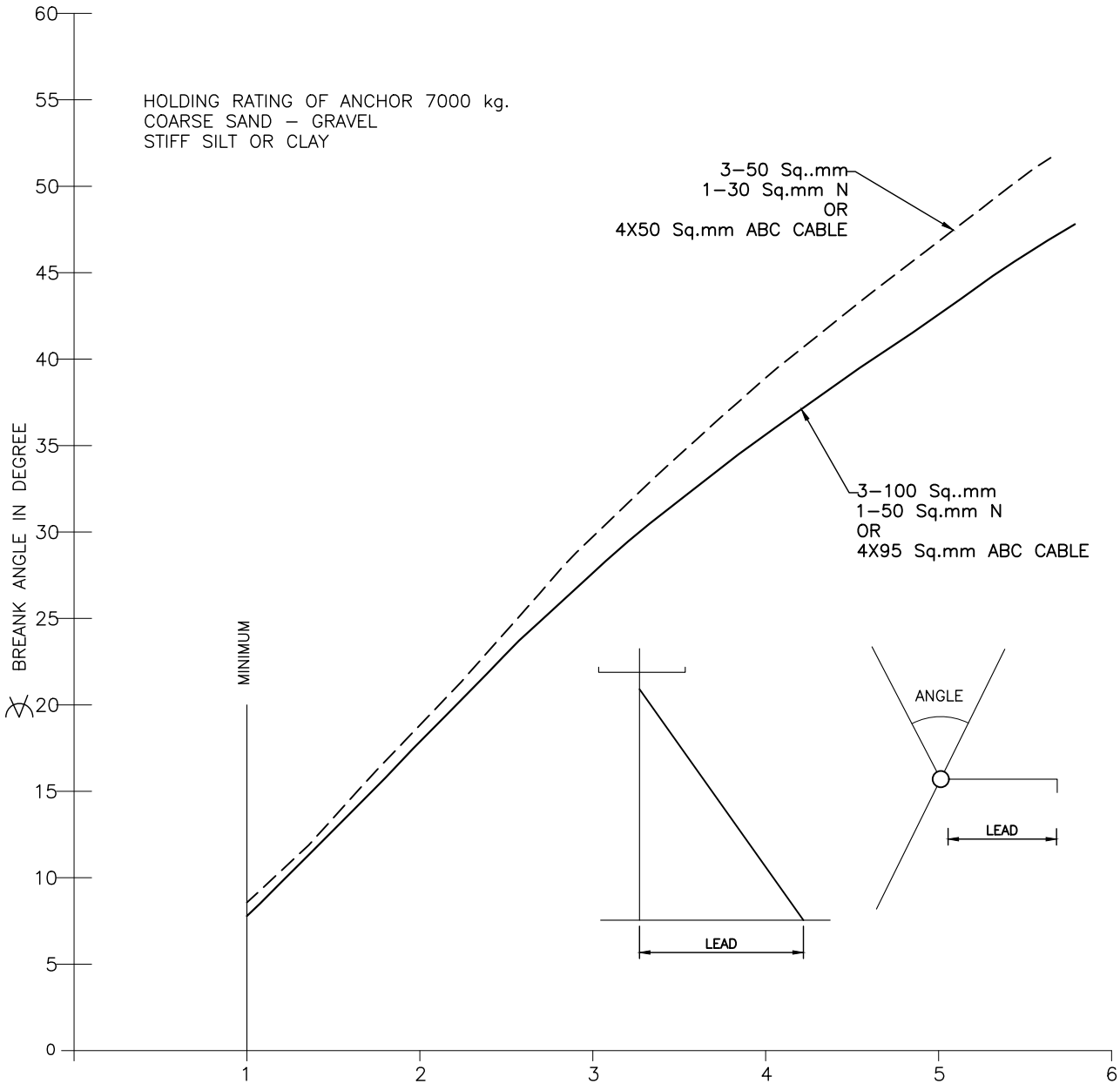


CLIENT	CONSULTANT	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DRAWING NO. CSG–OHL–STAY–LEADS–01 DRAWN AKC DESIGNED DDT DRAFTING CHECK BP DESIGN CHECK APPROVED LEADS FOR STAYS FOR TENDER PURPOSE ONLY



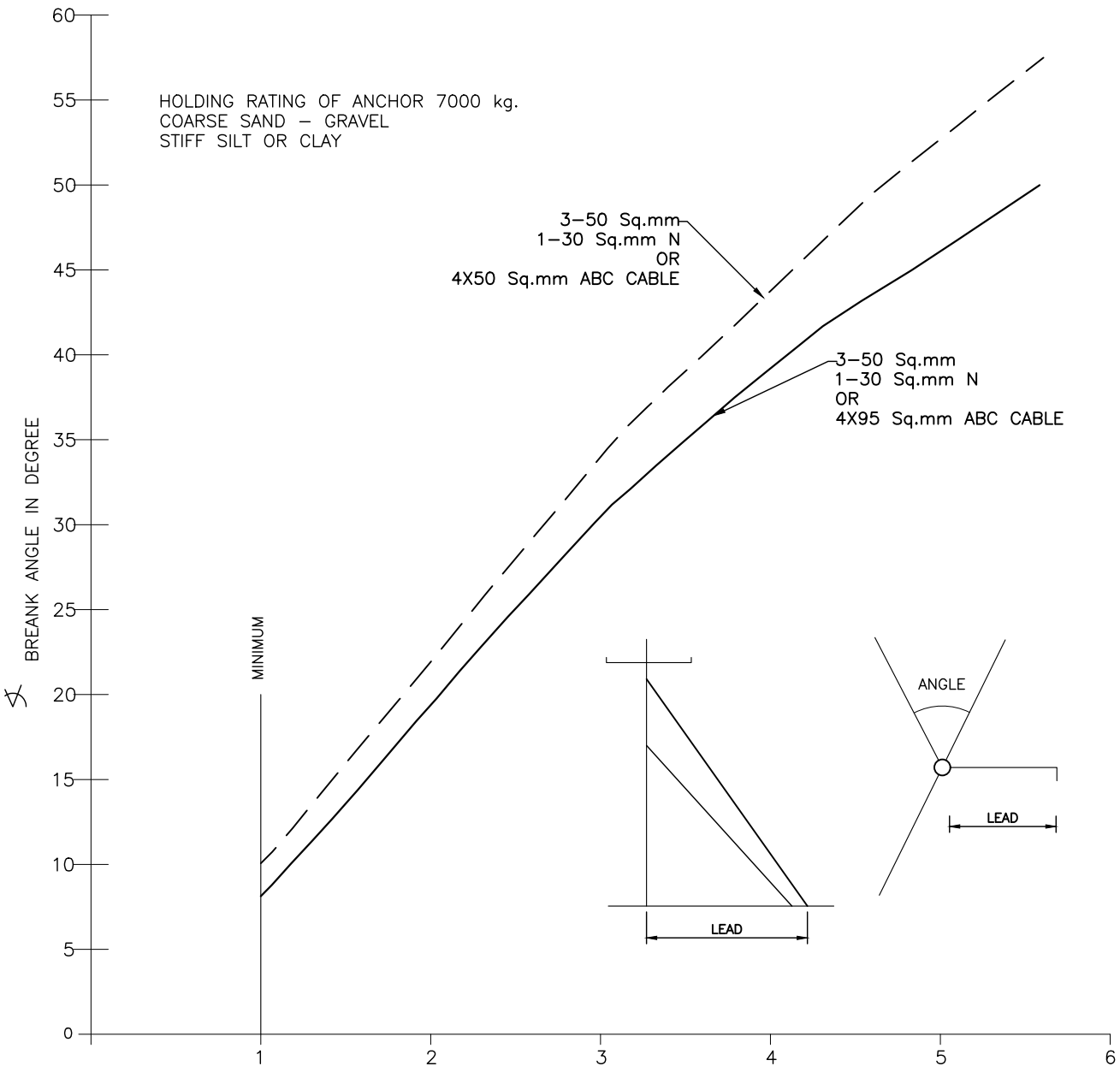
33/11 kV ONLY – 11/10 METER POLE
70 METER SPAN MAXIMUM

CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
		DRAWING NO. CSG–OHL–STAY–LEADS–02
		DRAWN AKC
		DESIGNED DDT
		DRAFTING CHECK BP
		DESIGN CHECK
		APPROVED
		MINIMUM LEAD FOR SIDE ANGLE STAYS
		FOR TENDER PURPOSE ONLY



11 AND 0.4 – COMPOSITE – 11/10 METER POLE
50 METER SPAN MAXIMUM
3 – 100 Sq.mm

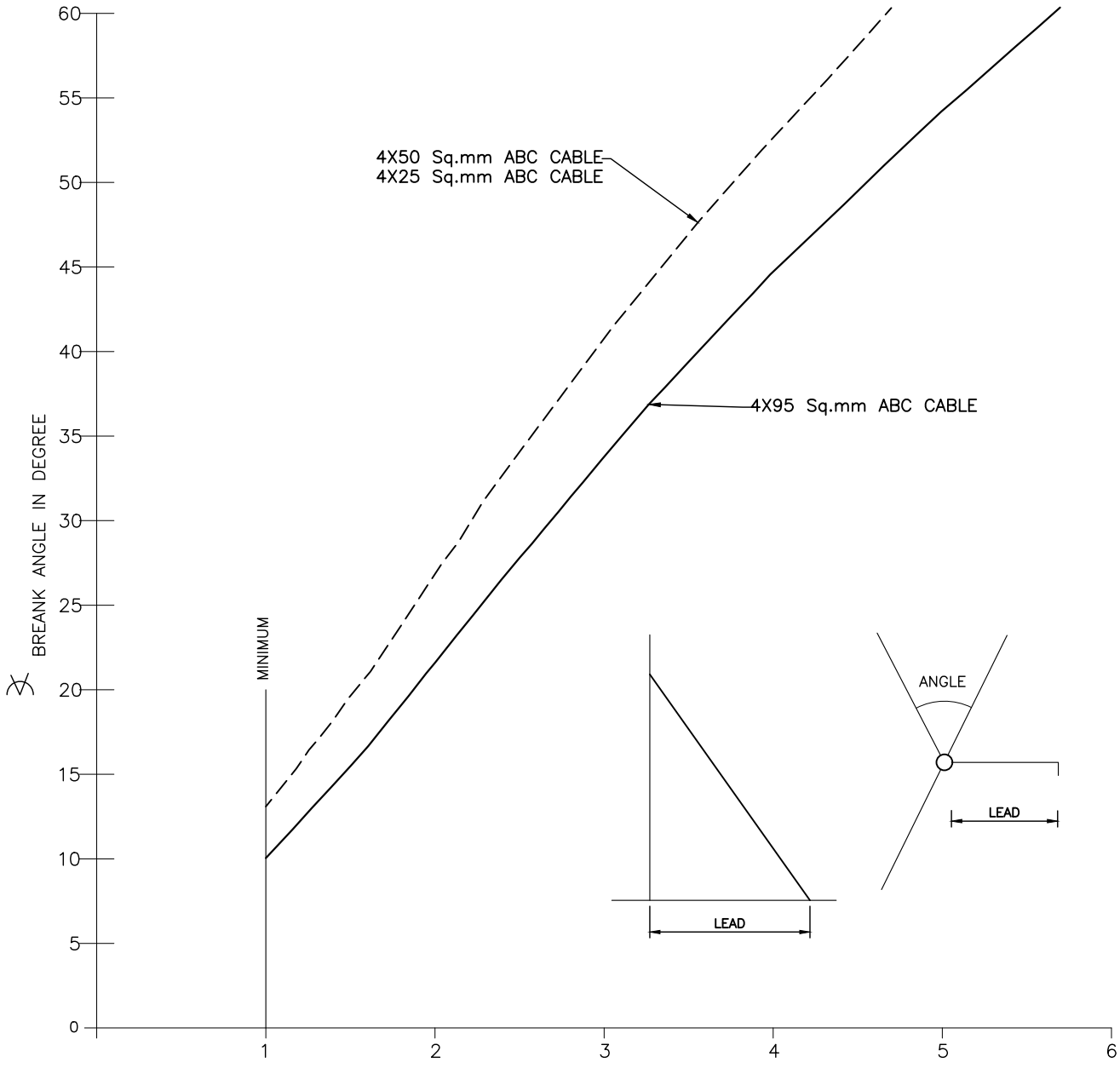
CLIENT: NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT: NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
		DRAWING NO. CSG–OHL–STAY–LEADS–03
		DRAWN AKC
		DESIGNED DDT
		DRAFTING CHECK BP
		DESIGN CHECK
		APPROVED
		MINIMUM LEAD FOR SIDE ANGLE STAYS
		FOR TENDER PURPOSE ONLY



HORIZONTAL LENGTH OF STAY LEAD IN METERS

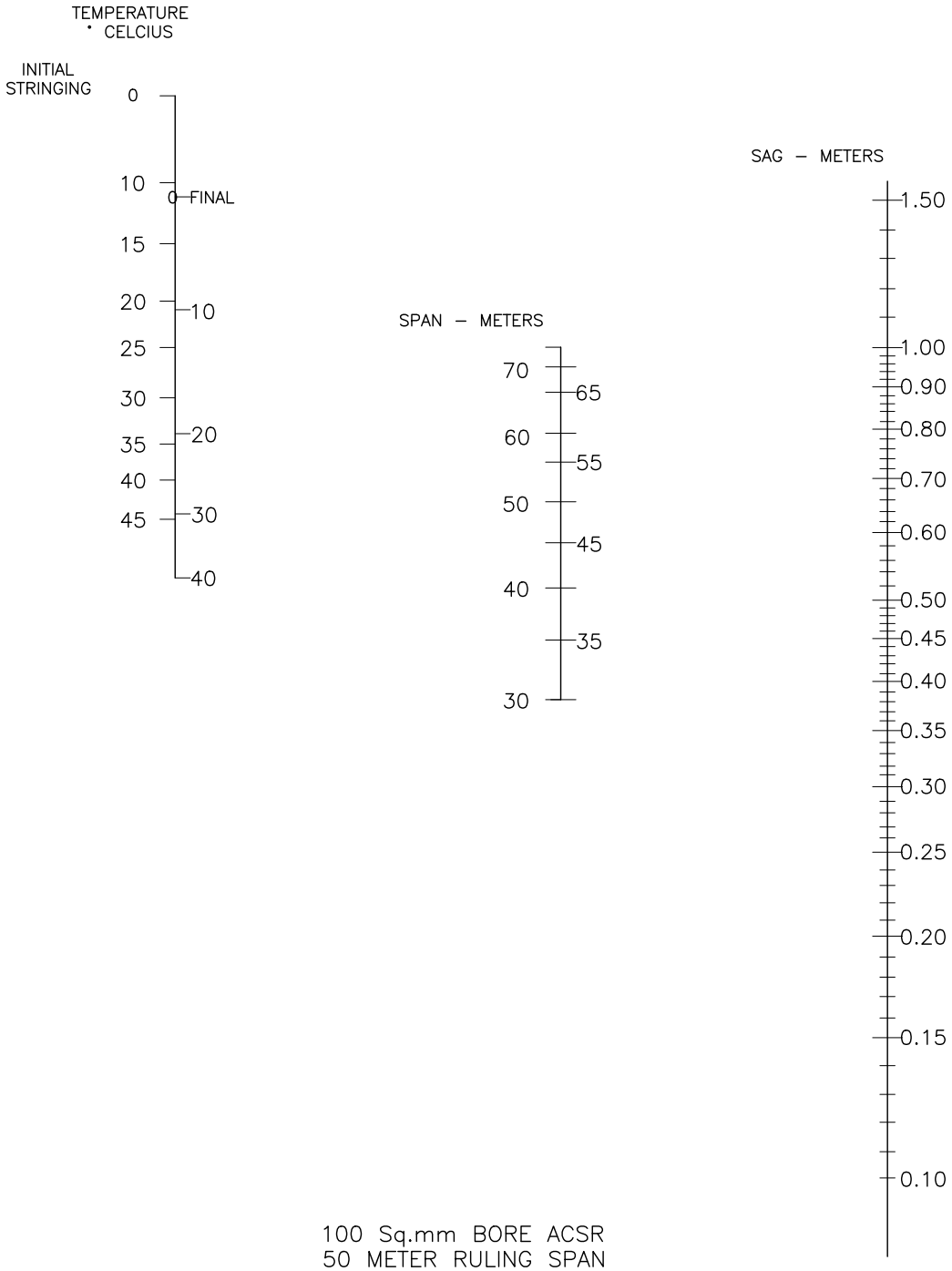
33, 11 AND 0.4 – COMPOSITE – 11/10 METER POLE
50 METER SPAN MAXIMUM
3 – 50 Sq.mm
1 – 30 Sq.mm

CLIENT	CONSULTANT	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DRAWING NO. CSG–OHL–STAY–LEADS–04 DRAWN AKC DESIGNED DDT DRAFTING CHECK BP DESIGN CHECK APPROVED MINIMUM LEAD FOR SIDE ANGLE STAYS FOR TENDER PURPOSE ONLY



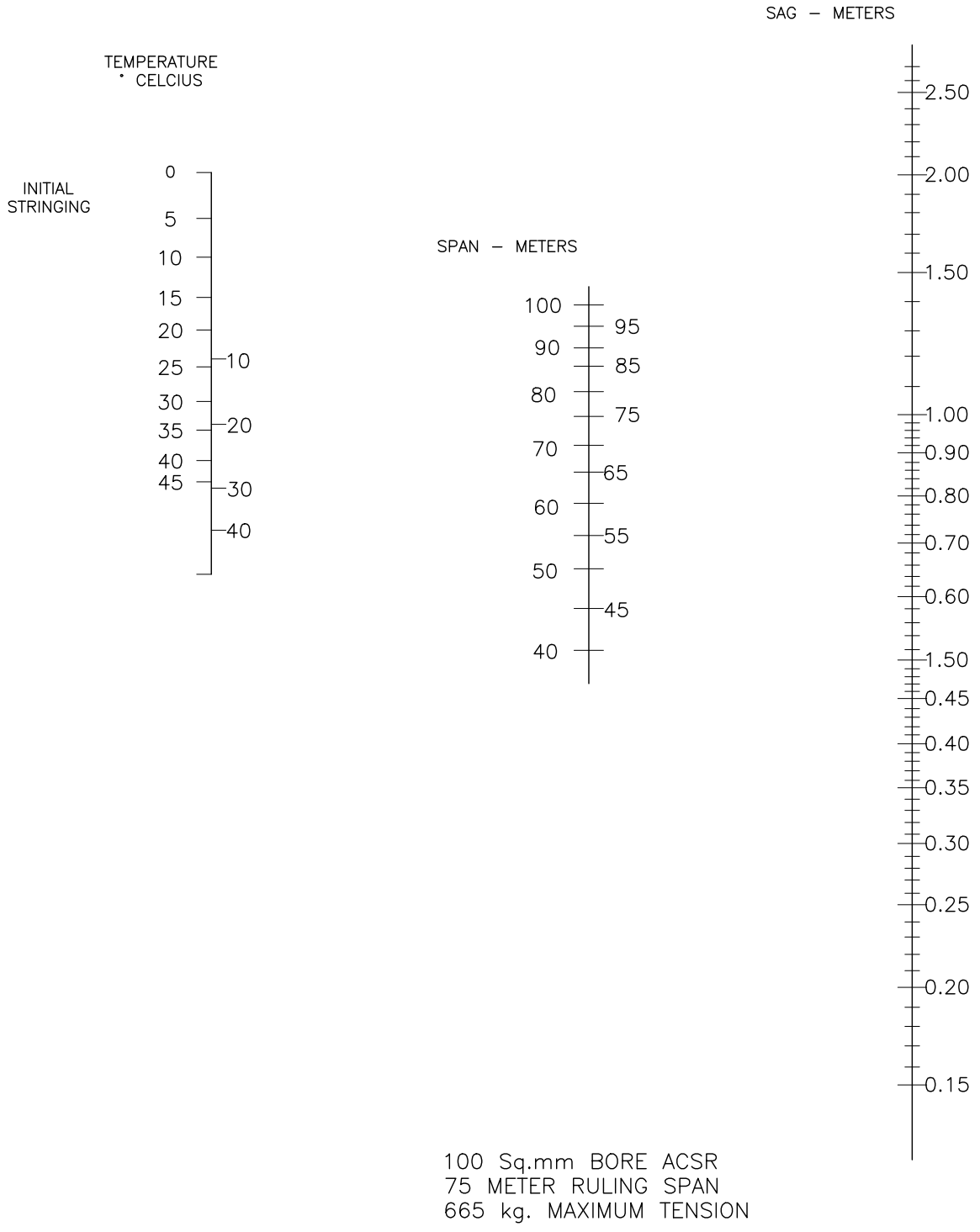
400/230V ONLY – 8 METER POLE
50 METER SPAN MAXIMUM

CLIENT	CONSULTANT	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DRAWING NO. CSG–OHL–STAY–LEADS–05 DRAWN AKC DESIGNED DDT DRAFTING CHECK BP DESIGN CHECK APPROVED MINIMUM LEAD FOR SIDE ANGLE STAYS FOR TENDER PURPOSE ONLY



100 Sq.mm BORE ACSR
50 METER RULING SPAN
553 kg. MAXIMUM TENSION

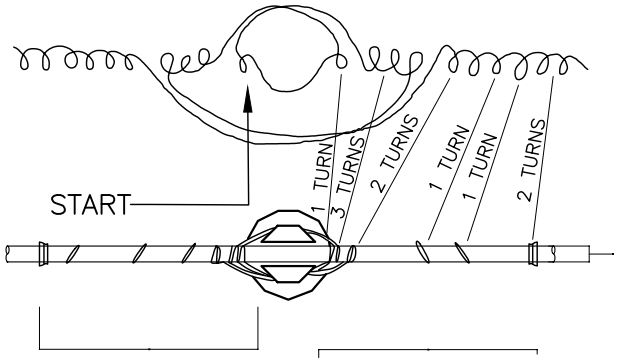
CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
		DRAWING NO. CSG–OHL–DOG–SC–50M
		DRAWN AKC
		DESIGNED DDT
		DRAFTING CHECK BP
		DESIGN CHECK
		APPROVED
		SAG CHART 100 SQ.MM ACSR
		FOR TENDER PURPOSE ONLY



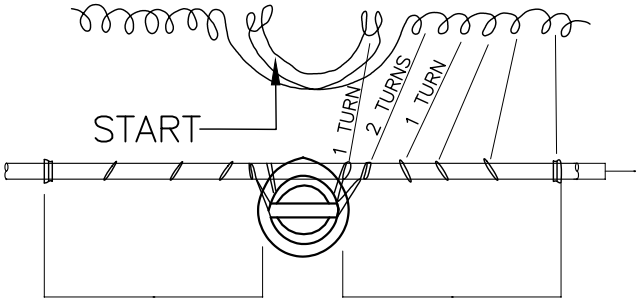
100 Sq.mm BORE ACSR
75 METER RULING SPAN
665 kg. MAXIMUM TENSION

CLIENT	CONSULTANT	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DRAWING NO. CSG–OHLDOG–SC–75M DRAWN AKC DESIGNED DDT DRAFTING CHECK BP DESIGN CHECK APPROVED SAG CHART 100 SQ.MM ACSR FOR TENDER PURPOSE ONLY

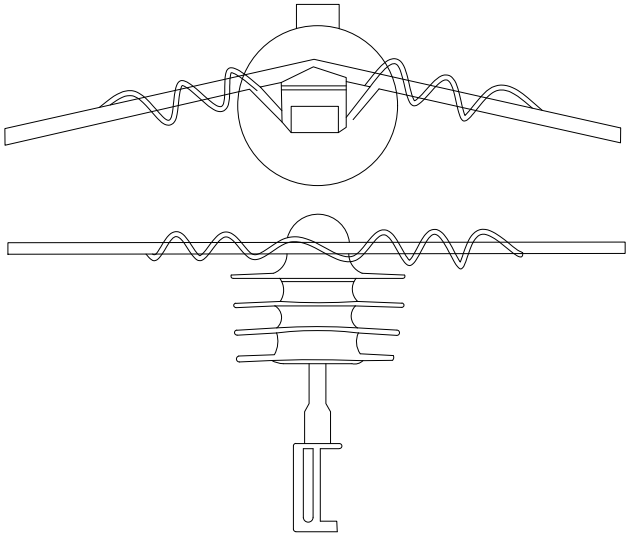
TOP GROVE



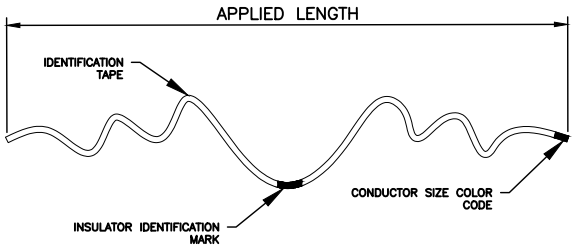
SIDE GROVE



TOP GROVE



SIDE GROVE



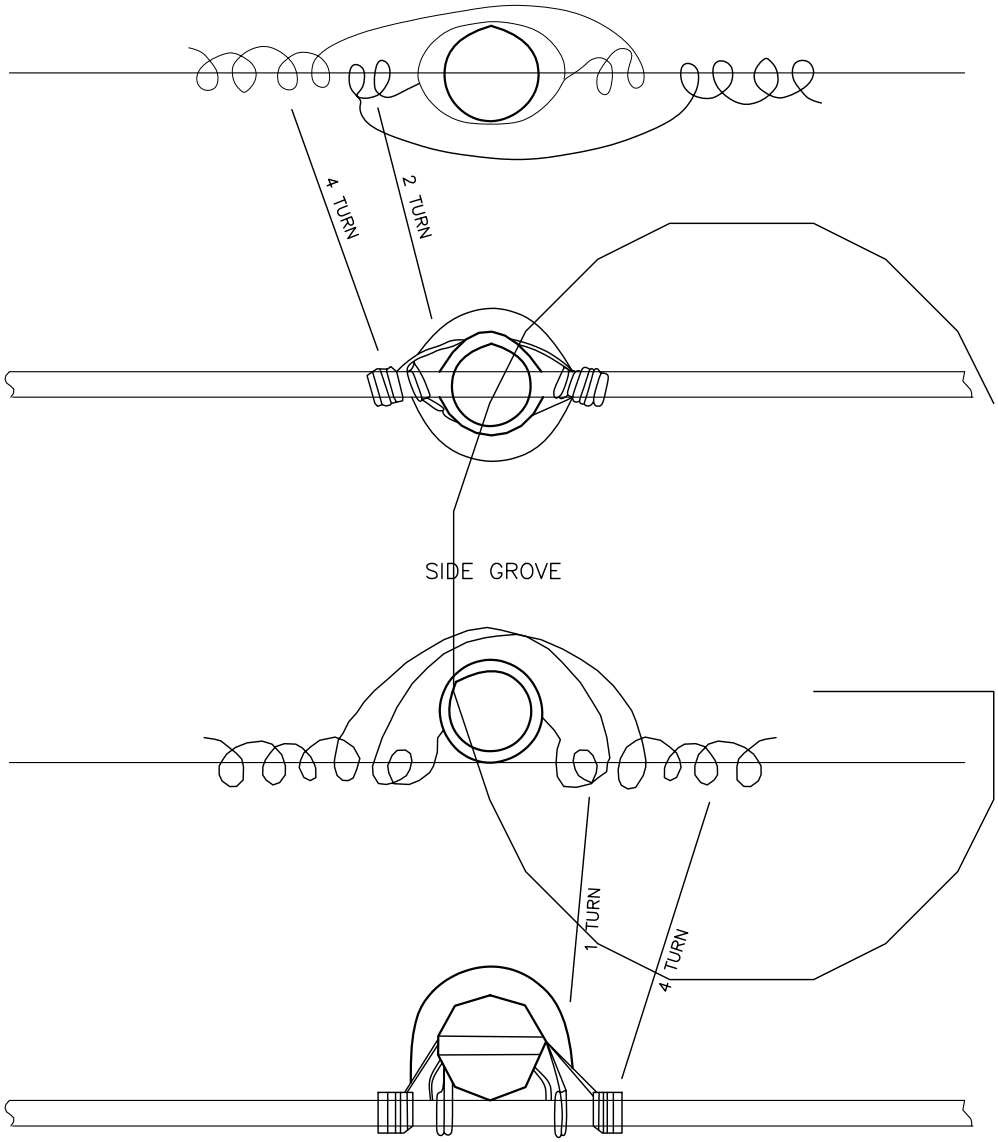
S.No.	SPECIFICATION	DESIGNATION	11 kV PIN INSULATOR TIE	33 kV PIN INSULATOR TIE
1	TOP TIE			
A	150 sq.mm.	TT–1	BLUE	BLUE
B	100 sq.mm.	TT–2	RED	RED
C	50 sq.mm.	TT–3	YELLOW	YELLOW
2	SIDE TIE			
A	150 sq.mm.	ST–1	GREEN	GREEN
B	100 sq.mm.	ST–2	BLACK	BLACK
C	50 sq.mm.	ST–3	PINK	YELLOW
3	DOUBLE PIN TOP TIE			
A	150 sq.mm.	ST–1	BLUE	
B	100 sq.mm.	ST–2	RED	
C	50 sq.mm.	ST–3	YELLOW	

NOTES

1. HAND TIES TO BE ONLY WHEN PERFORMED TIES NOT AVAILABLE.
2. CLINCH AST TWO TURNS TIGHT WITH PLIERS.
3. SOFT DRAWIN – TIE WIRE, TO BE USED FOR ALL TIES.
4. COVERED TIE WIRE SHALL ONLY BE USED WITH COVERED CONDUCTOR

CLIENT	CONSULTANT	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT	
NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DRAWING NO. CSG–OHL–INS–TIES–01	INSULATOR TIES
		DRAWN AKC	
		DESIGNED DDT	
		DRAFTING CHECK BP	
		DESIGN CHECK	
		APPROVED	FOR TENDER PURPOSE ONLY

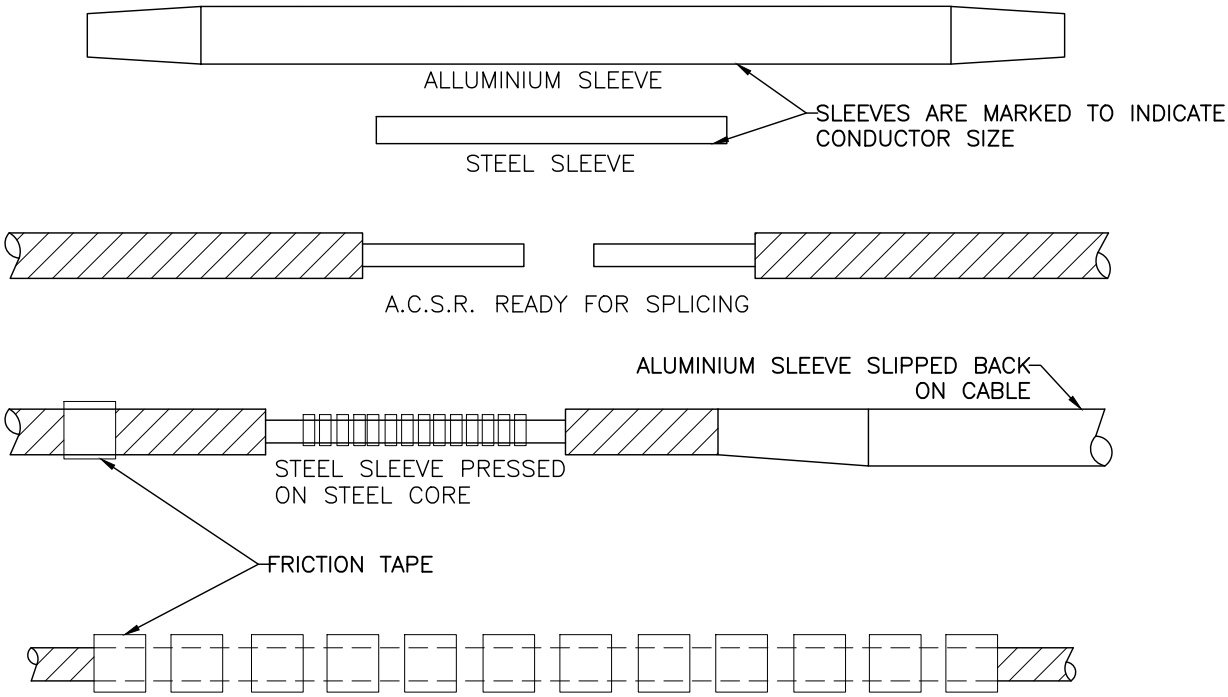
JUMPER TIES



NOTES

1. TIE WIRE ASSEMBLY SHOULD BE TIGHT AS CAN BE WRAPPED.
2. TURNS MAY 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 STRUCTURE.
4. COVERED TIE WIRE SHALL ONLY BE USED WITH COVERED CONDUCTOR.

CLIENT	CONSULTANT	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT	
NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DRAWING NO. CSG–OHL–INS–TIES–02 DRAWN AKC DESIGNED DDT DRAFTING CHECK BP DESIGN CHECK APPROVED	INSULATOR TIES FOR TENDER PURPOSE ONLY



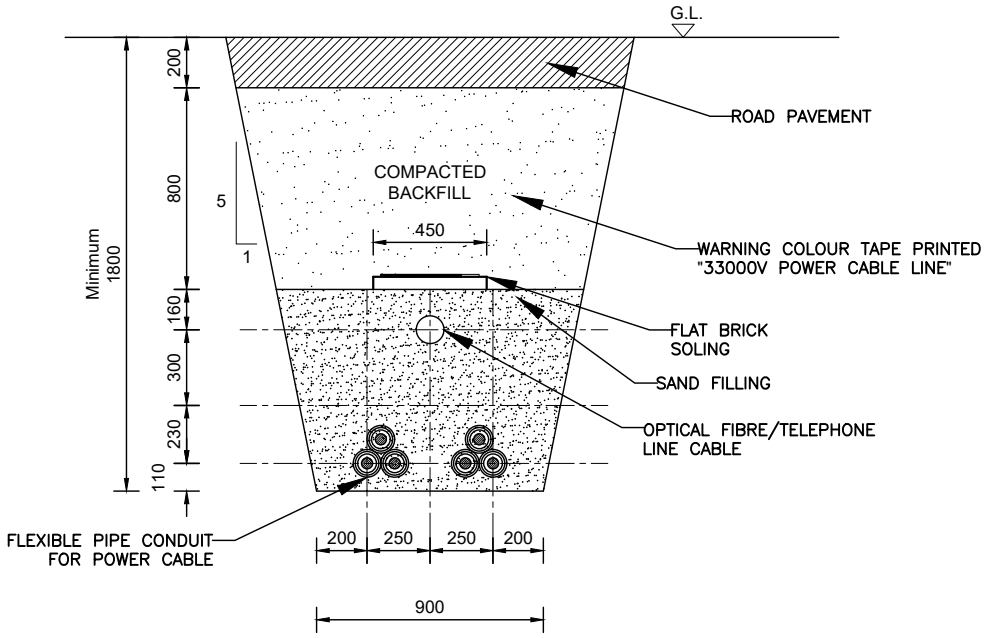
S.NO.	SPECIFICATION	DESIGNATION
A.	TENSION CONNECTOR	
1	DOG	A–1T
2	RACCOON	A–2T
B.	REPAIR CONNECTOR	
1	DOG	A–1R
2	RACCOON	A–2R

1. SELECT PROPER SPLICE FOR THE CONDUCTOR TO BE SPLICED. INSURE BORES OF INNER AND THE SLEEVE 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. 1
4. CUT BACK AND REMOVE ALUMINUM STRAND AT CONDUCTOR END A DISTANCE OF THE LENGTH OF THE INNER STEEL 2 SLEEVES PLUS 10MM.
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 LEVEL ABOUT 1.5MM SPACE BETWEEN.
6. STRAIGHTEN STEEL SLEEVE BY HAMMERING CAREFULLY ANAINST A SUITABLE BLOCK.
7. PLACE A PIEOE OF FRICTION TAPE ON THE CABLE TO MARK THE POSITION OF THE END OF THE ALLUMINIUM SLEEVE SUCH THAT IT WILL BE CENTERED ON THE SPLICE.
8. CLEAN CONDUCTOR BY WIREBRUSHING PAINT THE STEEL SLLEVE AND THE ADJACENT CABLE THAT WILL BE COVERED BY THE ALUMINUM SLEEVE WITH A SUITABLE CORROSION INHIBITOR.
9. SLIP THE ALUMINUM 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.

CLIENT	CONSULTANT	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT	
NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DRAWING NO. CSG–TS–NOTES DRAWN AKC DESIGNED DDT DRAFTING CHECK BP DESIGN CHECK APPROVED	TENSION SPLICING INSTRUCTIONS FOR ACSR CONDUCTORS FOR TENDER PURPOSE ONLY

UNDERGROUND CABLE
CONSTRUCTION NOTES

1) CABLES SHALL BE LAID LOOSELY IN THE TRENCH AND IN PARALLEL.
2) CABLES SHALL NOT CROSS OR LAY ON TOP OF ONE ANOTHER.
3) BACKFILL SHALL BE CLEAN AND FREE OF STONES AND SHARP OBJECTS 150MM BELOW AND 200MM ABOVE THE CABLE.
4) IF TELEPHONE IS PERMITTED IN THE SAME TRENCH IT MUST MAINTAIN A SEPARATION OF 300MM ABOVE THE CABLE.
5) OTHER UTILITIES SUCH AS GAS, WATER, SEWER ETC, IF PARALLEL TO DIRECT BURIED ELECTRIC CABLES, SHOULD MAINTAIN A HORIZONTAL SEPARATION OF 2000MM.



33KV XLPE POWER CABLE TRENCH SECTION

CLIENT: NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT: NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
		DRAWING NO. CSG–UGC–NOTES
		DRAWN AKC
		DESIGNED DDT
		DRAFTING CHECK BP
		DESIGN CHECK
		APPROVED
		CONSTRUCTION NOTES FOR UNDERGROUND CABLES
		FOR TENDER PURPOSE ONLY

11M STEEL TUBULAR POLE

NOTES:

1. ALL DIMENSIONS ARE IN MM OTHERWISE MENTIONED.
2. ALL STEEL TUBING SHALL BE IN ACCORDANCE TO BS 6323 PART 1 TO 8 AND IS 2713.
3. ALL JOINTS ARE FRICTION JOINTS WITHOUT ENVOLVEMENT OF THROUGH BOLTS AND SITE WELDING EXCEPT REQUIRED BY TRANSPORTATION LIMITATION IN HILLY AREAS.
4. FOLLOWING TOLERENCES ARE MAINTAINED:
   a. DIAMETER: ± 1%
   b. WEIGHT: ± 10% ON EACH POLE & ± 7.5% ON A BULK LOAD UP TO 20tons.
   c. THICKNESS: ± 10% ON EACH SHEET.
   d. EACH SECTION SHALL NOT EXCEED ±40 mm AND −0 mm, OVERALL LENGTH OF ASSEMBLED POLE ± 75 mm
   e. STRAIGHTNESS: NOT EXCEED $\frac{1}{600}$ OF HEIGHT
5. ALL WELDINGS SHALL BE SHOP WELD. FILLET WELD PARALLEL TO LONGITUDINAL AXIS IS PERFORMED. NO CIRCUMFERENCIAL WELD SHALL BE MADE.
6. MARKING:

I) AT A POSITION APPROXIMATELY 3.5 m. FROM THE BUTT END, WHICH SHALL BE CLEARLY AND INDELIBLY MARKED WITH:

A. DATE OF MANUFACTURE AND IDENTIFICATION MARK "ABC, 20 ASHAR 2078".

B. LENGTH OF POLE "11m" AND ITS DESIGN WORKING LOADS AS "H=350kgf" & "V=350 kgf".

II) THE POLE SHALL BE MARKED WITH A PERMANENT HORIZONTAL LINE AT A POINT 1/6TH OF THE POLE HEIGHT FROM THE BUTT END OF THE ASSEMBLED POLE & THE MATING DEPTH OF THE RELEVANT SECTIONS OF POLE SHALL ALSO BE INDELIBLY MARKED.

III) THE POLE SHALL BE MARKED WITH CONTRACT NUMBER, POLE NUMBER, PROJECT NAME AND LOCATION (X and Y in UTM Zone 44N) AT 6M FROM TOP.

CLIENT: NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT: NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
		DRAWING NO. CSG−OHL−11SC−NOTES
		DRAWN AKC
		DESIGNED DDT
		DRAFTING CHECK BP
		DESIGN CHECK
		APPROVED
		NOTES ON FABRICATION OF 11 M STEEL TUBULAR POLE AND ACCESSORIES FOR 33 kV
		FOR TENDER PURPOSE ONLY

SINGLE POLE SINGLE ARM STRUCTURE (SPSA) LOW ANGLE (0 TO 7 DEG)

S.NO.	UNIT	QTY	MATERIAL
1	Nos.	3	PIN INSULATOR (33KV)
2	Nos.	3	INSULATOR PIN FOR 33KV PIN
3	Nos.	3	PREFORM PN TIES (TOP TIES)
4	Nos.	1	STEEL CROSSARM CHANNEL (100X50X7.5X4.7X1900) MM.
5	Set.	1	POLE CLAMP WITH NUT, BOLT AND WASHERS (TC1), CLAMP SECTION (50X6)MM.
6	Nos.	1	STEEL CROSSARM CHANNEL (100X50X7.5X1900)MM.
7	Set.	2	POLE CLAMP WITH NUT, BOLT AND WASHERS (TC2),CLAMP SECTION (50X6)MM.
8	Nos.	2	FLAT CROSSARM BRACE 33kV (50X6X666)MM.
9	Nos	1	BOLTS WITH SUITABLE NUTS AND WASHERS (M16X50)MM
10	Nos	6	BOLTS WITH SUITABLE NUTS AND WASHERS (M16X100)MM
11	Nos.	1	STEEL TUBULAR POLE 11M.

CLIENT

NEPAL ELECTRICITY AUTHORITY
DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
DURBARMARGA, KATHMANDU, NEPAL

CONSULTANT

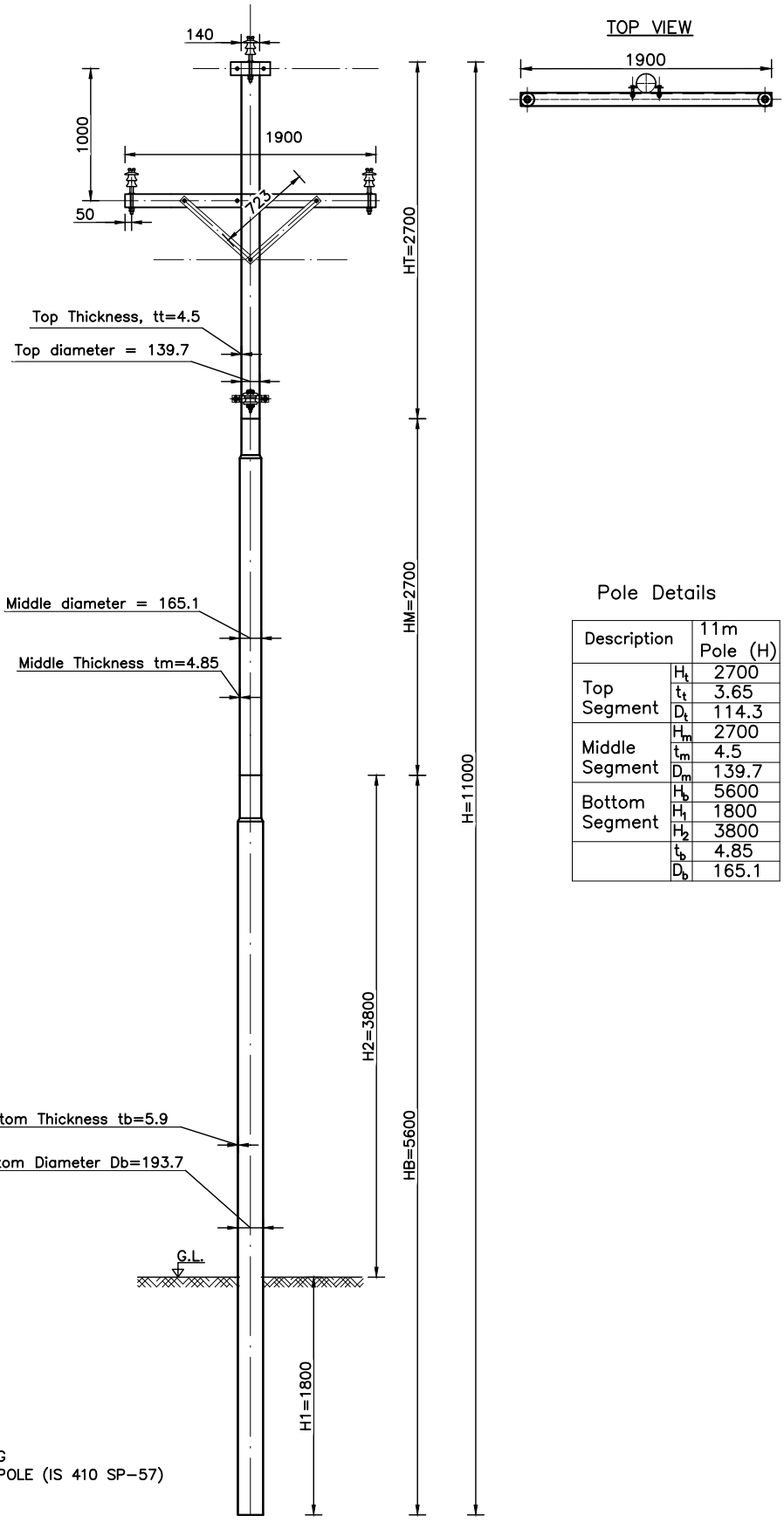
NEA ENGINEERING COMPANY LTD.
KATHMANDU, NEPAL

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

DRAWING NO.	CSG–OHL–11SC–BOM
DRAWN	AKC
DESIGNED	DDT
DRAFTING CHECK	BP
DESIGN CHECK	
APPROVED	

BILL OF QUANTITY FOR SINGLE POLE SINGLE ARM STRUCTURE (SPSA) FOR 11 M SINGLE CIRCUIT 33 kV LINE

FOR TENDER PURPOSE ONLY



Pole Details

Description		11m Pole (H)
Top Segment	H_t	2700
	t_t	3.65
	D_t	114.3
Middle Segment	H_m	2700
	t_m	4.5
	D_m	139.7
Bottom Segment	H_b	5600
	H_1	1800
	H_2	3800
	t_b	4.85
	D_b	165.1

APPROX WEIGHT ,256KG
STEEL TUBULAR (S.T) POLE (IS 410 SP-57)

CLIENT

NEPAL ELECTRICITY AUTHORITY
DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
DURBARMARGA, KATHMANDU, NEPAL

CONSULTANT

NEA ENGINEERING COMPANY LTD.
KATHMANDU, NEPAL

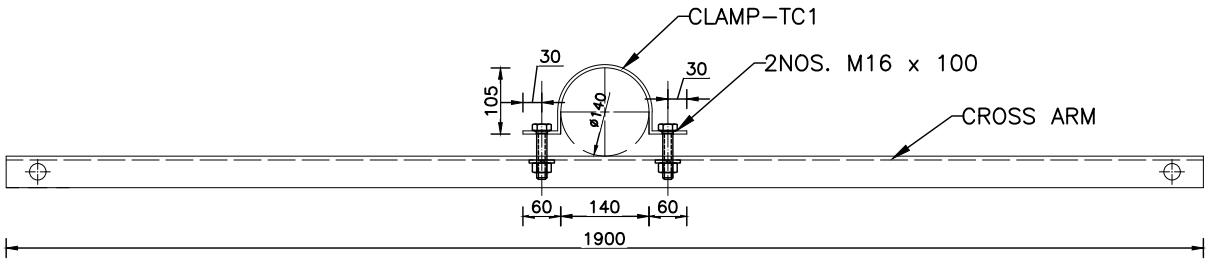
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

DRAWING NO.	CSG-OHL-11SC-SPSA-POLE
DRAWN	AKC
DESIGNED	DDT
DRAFTING CHECK	BP
DESIGN CHECK	
APPROVED	

POLE STRUCTURE FOR SINGLE POLE SINGLE ARM STRUCTURE (SPSA) FOR 11 M SINGLE CIRCUIT 33 kV LINE

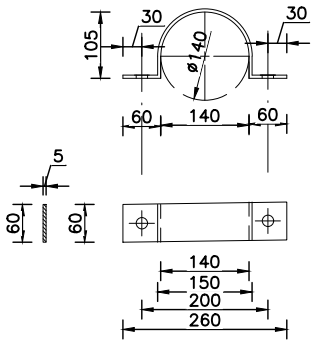
FOR TENDER PURPOSE ONLY

Cross Arm for 33kV ISMC100 (100x50x7.5x4.7x1900 mm)



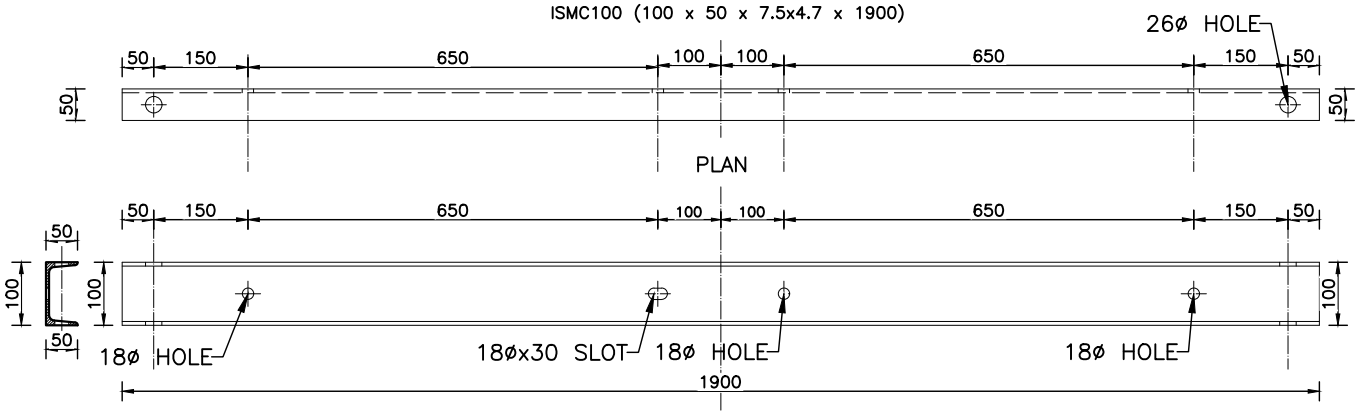
LOWER CROSS ARM ASSEMBLY

CLAMP–TC1



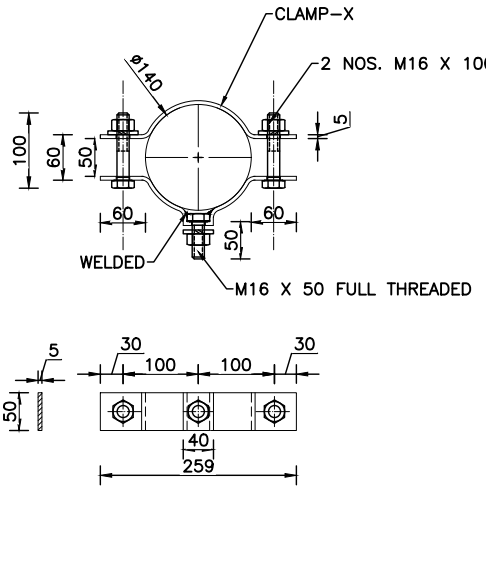
LOWER CHANNEL

ISMC100 (100 x 50 x 7.5x4.7 x 1900)

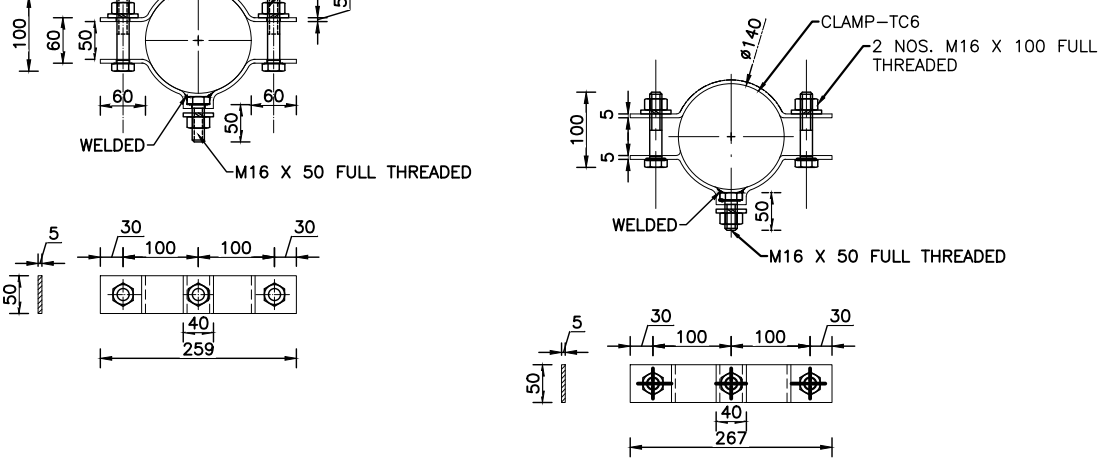


CLIENT	CONSULTANT	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT	
NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DRAWING NO. CSG–OHL–11SC–SPSA–CA DRAWN AKC DESIGNED DDT DRAFTING CHECK BP DESIGN CHECK APPROVED	CROSS ARM STRUCTURE FOR SINGLE POLE SINGLE ARM STRUCTURE (SPSA) FOR 11 M SINGLE CIRCUIT 33 kV LINE FOR TENDER PURPOSE ONLY

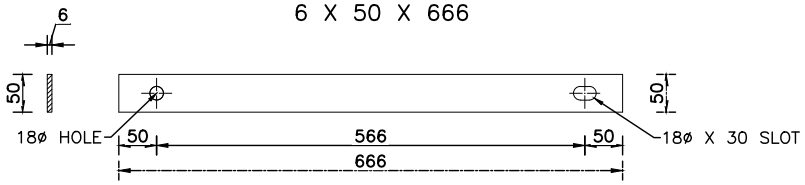
SINGLE BRACING ASSEMBLY – BR1



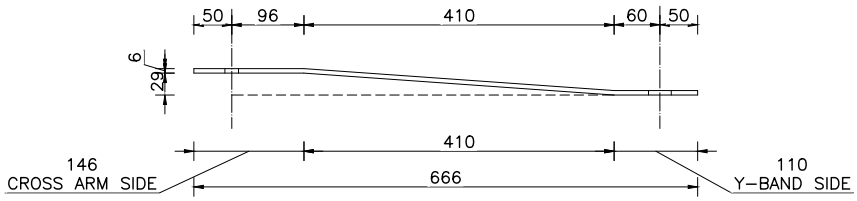
MS BRACING PLATE
6 X 50 X 666



SHACKLE INSULATOR (FOR COMMUNICATION LINE)



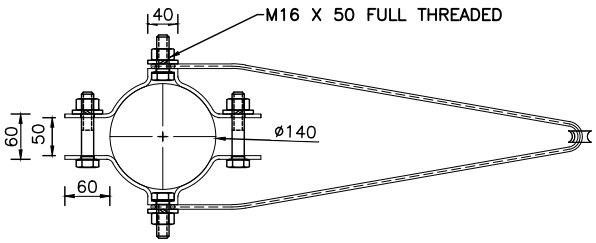
PLAN

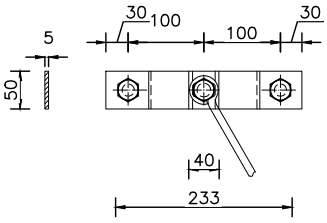


ELEVATION

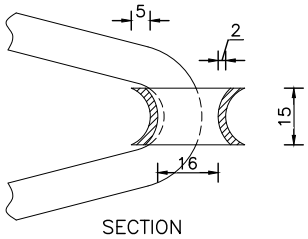
CLIENT	CONSULTANT	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DRAWING NO. CSG–OHL–11SC–SPSA–SB DRAWN AKC DESIGNED DDT DRAFTING CHECK BP DESIGN CHECK APPROVED
		SINGLE BRACING SET FOR SINGLE POLE SINGLE ARM STRUCTURE (SPSA) FOR 11 M SINGLE CIRCUIT 33 kV LINE
		FOR TENDER PURPOSE ONLY

STAY CLAMP – ST1

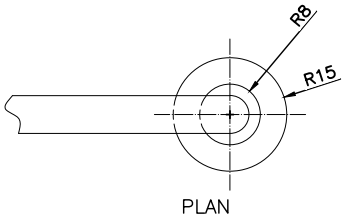




THIMBLE

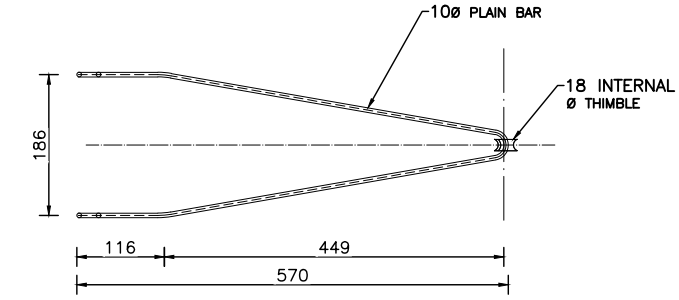


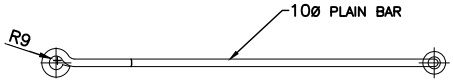
SECTION



PLAN

V – HANGER





STAY SET ASSEMBILY

S.NO.	UNIT	QTY	MATERIAL
1	Nos.	1	HT STAY PLATE (600X600X6)MM MINIMUM
2	Nos.	1	HT STAY ROD (MINIMUM 1600MM)
3	METRS.	1	STAY WIRE (7/10 SWG MINIMUM)
4	Nos.	1	STAY/GUY INSULATOR
5	Nos.	3	BOLTS WITH SUITABLE NUTS AND WASHERS (M16X50)MM
6	Nos.	3	BOLTS WITH SUITABLE NUTS AND WASHERS (M16X100)MM
7	Set.	1	POLE CLAMP WITH NUT,BOLT AND WASHERS FOR TOP BRACING (TC3) CLAMP SECTION(50x6.0)MM
8	Set.	1	"V" HANGLE
9	Nos.	1	STAY TURN BUCKLE INCLUDING THIMBLE (18 SWG MINIMUM)
10	Nos.	1	STAY GRIP
11	Nos.	1	BOW SET

CLIENT

NEPAL ELECTRICITY AUTHORITY
DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
DURBARMARGA, KATHMANDU, NEPAL

CONSULTANT

NEA ENGINEERING COMPANY LTD.
KATHMANDU, NEPAL

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

DRAWING NO.	CSG–OHL–11SC–SPSA–STAY
DRAWN	AKC
DESIGNED	DDT
DRAFTING CHECK	BP
DESIGN CHECK	
APPROVED	

STAY SET FOR
SINGLE POLE SINGLE ARM
STRUCTURE (SPSA)
FOR 11 M SINGLE CIRCUIT
33 kV LINE

FOR TENDER PURPOSE ONLY

DEAD END STRUCTURE (SPDE)

S.NO.	UNIT	QTY	MATERIAL
1	Set.	3	DISC INSULATOR (A SET OF THREE)
2	Nos.	3	BACK STRAP
3	Set.	3	TENSION SET WITH BALL AND SOCKET EYE
4	Set.	3	DISC INSULATOR 33kV (A SET OF THREE)
5	Set.	3	BACK STRAP
6	Nos.	3	TENSION SET WITH BALL AND SOCKET EYE
7	Nos.	3	PG CLAMP FOR DOG
8	Nos.	1	STEEL CROSSARM CHANNEL (100X50X7.5X4.7X1800)MM
9	Set.	1	POLE CLAMP WITH NUT, BOLT AND WASHERS (TC1), CLAMP SECTION (50X6)mm FOR TOP ARM
10	Nos.	1	STEEL CROSSARM CHANNEL (100X50X7.5X1900)MM
11	Set.	1	POLE CLAM WITH NUT, BOLT AND WASHERS (TC2) CLAMP SECTION (50*6)mm FOR BOTTOM ARM
12	Set.	1	POLE CLAM WITH NUT, BOLT AND WASHERS (TC2) CLAMP SECTION (50*6)mm FOR STAY
13	Set.	1	POLE CLAM WITH NUT, BOLT AND WASHERS (TC2) CLAMP SECTION (50*6)mm FOR BRACING
14	Nos.	2	FLAT CROSSARM BRACE 33kV (50x6x666)mm
15	Nos.	3	BOLTS WITH SUITABLE NUTS AND WASHERS (M16X50)MM
16	Nos.	8	BOLTS WITH SUITABLE NUTS AND WASHERS (M16X100)MM
17	Set	1	HT STAY SET (AS REQUIRED)
18	Nos.	1	11 METER STEEL TUBULAR POLE

CLIENT

NEPAL ELECTRICITY AUTHORITY
DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
DURBARMARGA, KATHMANDU, NEPAL

CONSULTANT

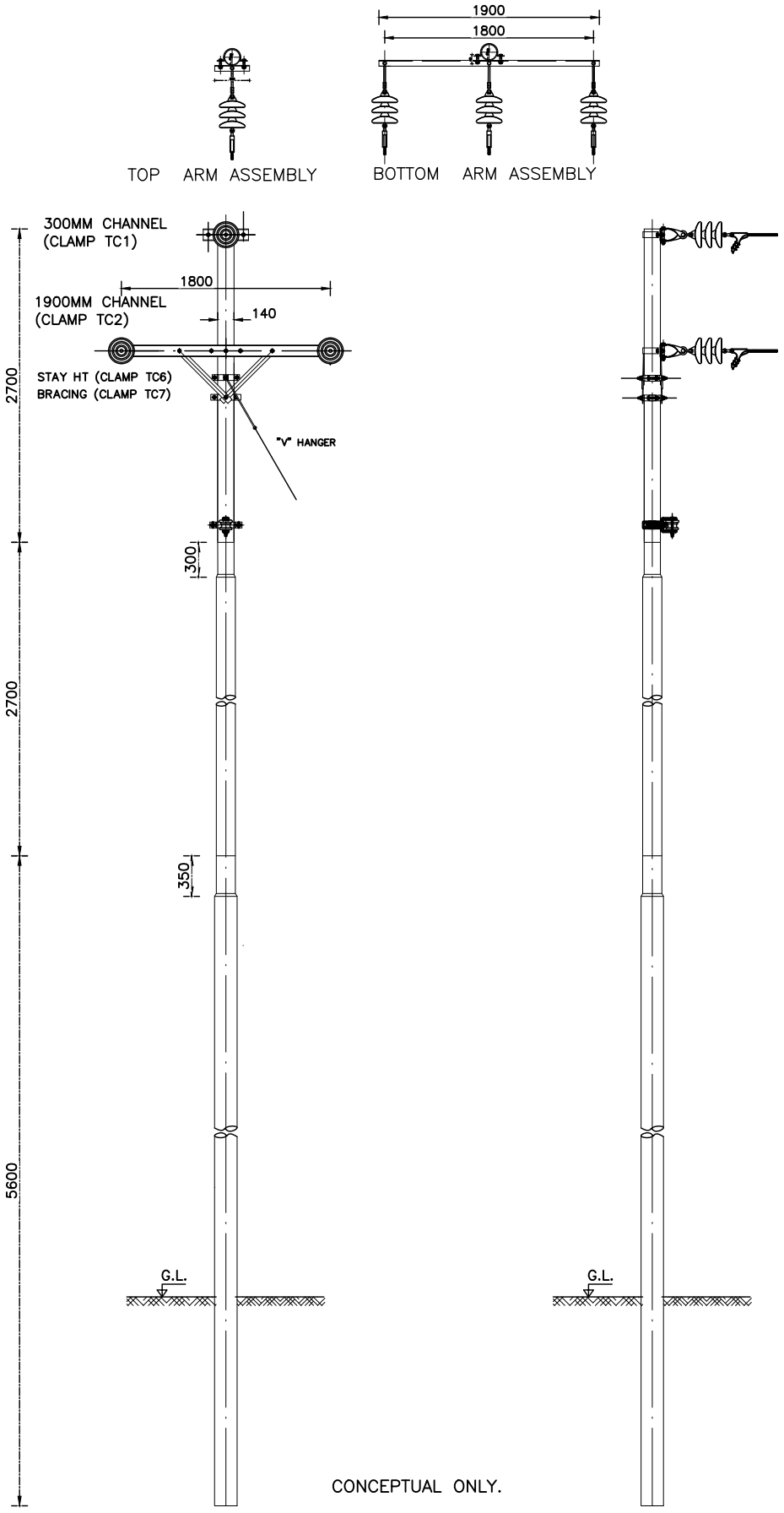
NEA ENGINEERING COMPANY LTD.
KATHMANDU, NEPAL

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

DRAWING NO.	CSG–OHL–11SC–SPDE–BOM
DRAWN	AKC
DESIGNED	DDT
DRAFTING CHECK	BP
DESIGN CHECK	
APPROVED	

BILL OF QUANTITY FOR
SINGLE POLE SINGLE DEAD END
STRUCTURE (SPDE)
FOR 11 M SINGLE CIRCUIT
33 kV LINE

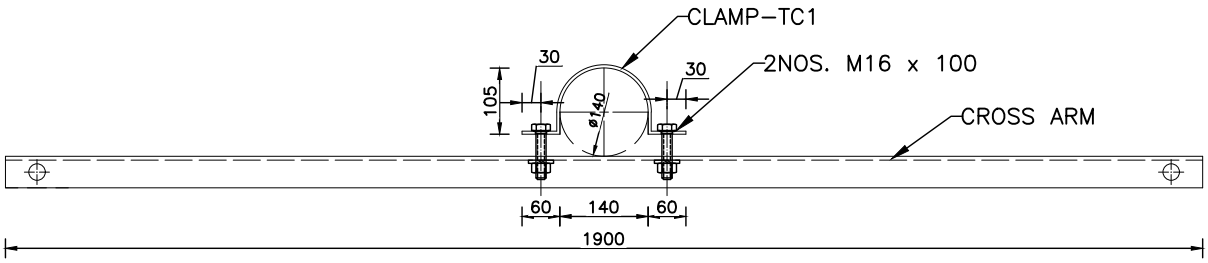
FOR TENDER PURPOSE ONLY



CONCEPTUAL ONLY.

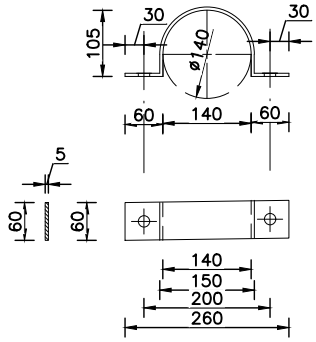
CLIENT	NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL
CONSULTANT	NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT	
DRAWING NO.	CSG–OHL–11SC–SPDE–POLE
DRAWN	AKC
DESIGNED	DDT
DRAFTING CHECK	BP
DESIGN CHECK	
APPROVED	
POLE STRUCTURE FOR SINGLE POLE SINGLE DEAD END STRUCTURE (SPDE) FOR 11 M SINGLE CIRCUIT 33 kV LINE	
FOR TENDER PURPOSE ONLY	

Cross Arm for 33kV ISMC100 (100x50x7.5x4.7x1900 mm)



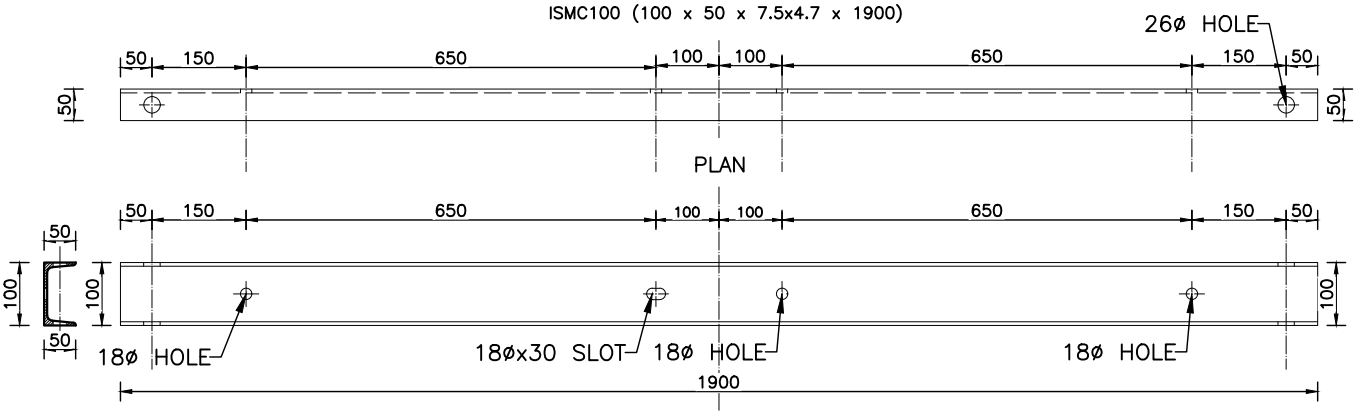
LOWER CROSS ARM ASSEMBLY

CLAMP–TC1



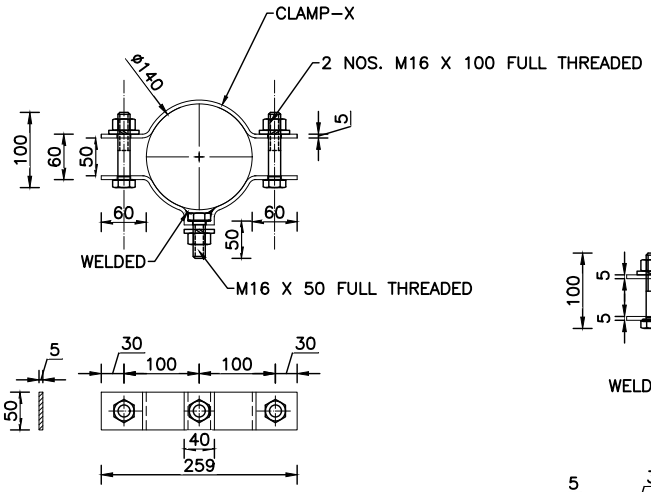
LOWER CHANNEL

ISMC100 (100 x 50 x 7.5x4.7 x 1900)

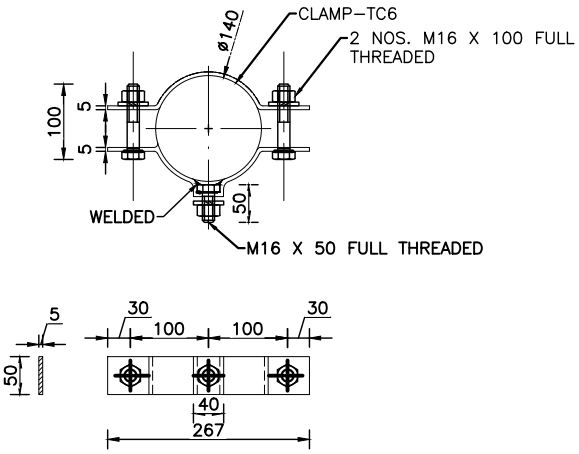


CLIENT	CONSULTANT	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DRAWING NO. CSG–OHL–11SC–SPDE–CA DRAWN AKC DESIGNED DDT DRAFTING CHECK BP DESIGN CHECK APPROVED
		CROSS ARM STRUCTURE FOR SINGLE POLE SINGLE DEAD END STRUCTURE (SPDE) FOR 11 M SINGLE CIRCUIT 33 kV LINE
		FOR TENDER PURPOSE ONLY

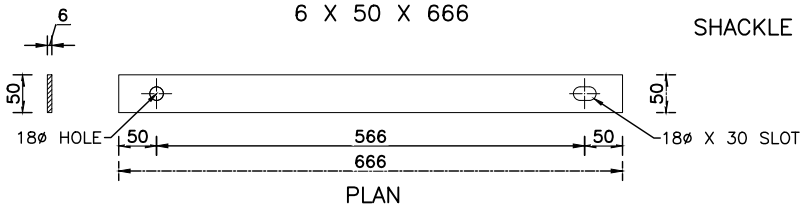
SINGLE BRACING ASSEMBLY – BR1



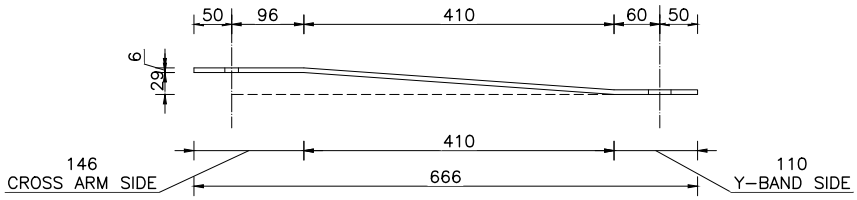
MS BRACING PLATE
6 X 50 X 666



SHACKLE INSULATOR (FOR COMMUNICATION LINE)



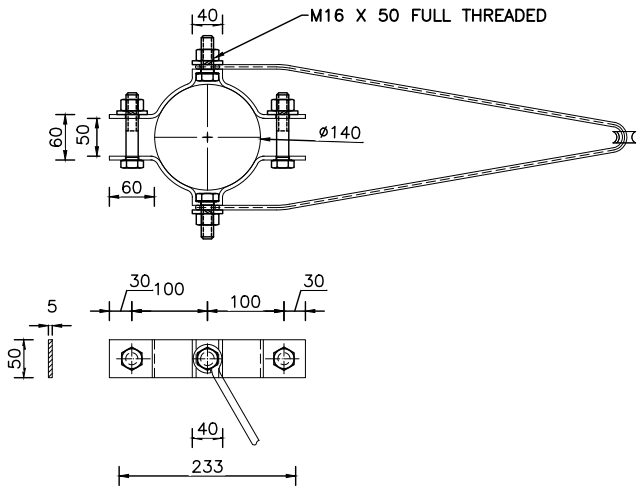
PLAN



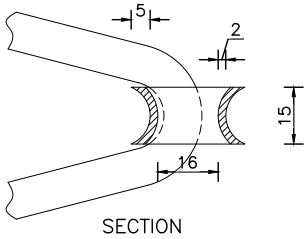
ELEVATION

CLIENT	CONSULTANT	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT	
NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DRAWING NO. CSG–OHL–11SC–SPDE–SB DRAWN AKC DESIGNED DDT DRAFTING CHECK BP DESIGN CHECK APPROVED	SINGLE BRACING SET FOR SINGLE POLE SINGLE DEAD END STRUCTURE (SPDE) FOR 11 M SINGLE CIRCUIT 33 kV LINE FOR TENDER PURPOSE ONLY

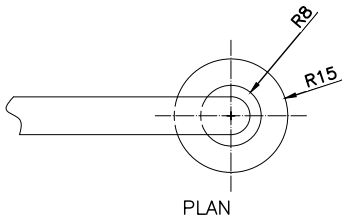
STAY CLAMP – ST1



THIMBLE

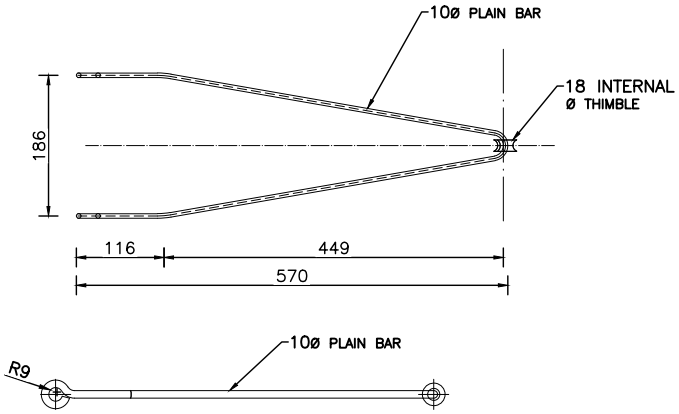


SECTION



PLAN

V – HANGER



STAY SET ASSEMBILY

S.NO.	UNIT	QTY	MATERIAL
1	Nos.	1	HT STAY PLATE (600X600X6)MM MINIMUM
2	Nos.	1	HT STAY ROD (MINIMUM 1600MM)
3	METRS.	1	STAY WIRE (7/10 SWG MINIMUM)
4	Nos.	1	STAY/GUY INSULATOR
5	Nos.	3	BOLTS WITH SUITABLE NUTS AND WASHERS (M16X50)MM
6	Nos.	3	BOLTS WITH SUITABLE NUTS AND WASHERS (M16X100)MM
7	Set.	1	POLE CLAMP WITH NUT,BOLT AND WASHERS FOR TOP BRACING (TC3) CLAMP SECTION(50x6.0)MM
8	Set.	1	"V" HANGLE
9	Nos.	1	STAY TURN BUCKLE INCLUDING THIMBLE (18 SWG MINIMUM)
10	Nos.	1	STAY GRIP
11	Nos.	1	BOW SET

CLIENT

NEPAL ELECTRICITY AUTHORITY
DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
DURBARMARGA, KATHMANDU, NEPAL

CONSULTANT

NEA ENGINEERING COMPANY LTD.
KATHMANDU, NEPAL

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

DRAWING NO.	CSG–OHL–11SC–SPDE–STAY
DRAWN	AKC
DESIGNED	DDT
DRAFTING CHECK	BP
DESIGN CHECK	
APPROVED	

STAY SET FOR
SINGLE POLE SINGLE DEAD END
STRUCTURE (SPDE)
FOR 11 M SINGLE CIRCUIT
33 kV LINE

FOR TENDER PURPOSE ONLY

SINGLE POLE DOUBLE DEAD END STRUCTURE (SPDDE)

S.NO.	UNIT	QTY	MATERIAL
1	Nos.	3	PIN INSULATOR (33kv)
2	Nos.	3	INSULATOR PIN (33kv)
3	Nos.	3	PREFORM PN TIES (TOP TIES)
4	Set.	6	DISC INSULATOR 33kV (A SET OF THREE)
5	Set.	6	BACK STRAP
6	Nos.	6	TENSION SET WITH BALL AND SOCKET EYE
7	Nos.	3	PG CLAMP FOR ACSR WOLF
8	Nos.	1	STEEL CROSSARM CHANNEL (100X50X7.5X4.7X1800)MM
9	Nos.	2	STEEL CROSSARM CHANNEL (100X50X7.5X1900)MM
10	Set.	1	POLE CLAMP WITH NUT, BOLT AND WASHERS, BOTTOM BRACING (TC1),CLAMP SECTION (50*6)mm
11	Set.	2	POLE CLAMP WITH NUT, BOLT AND WASHERS, BOTTOM BRACING (TC2),CLAMP SECTION (50*6)mm
12	Nos.	2	FLAT CROSS ARM BRACE 33KV (50X6X666)MM
13	Set	4	BOLTS WITH SUITABLE NUTS AND WASHERS (16X50)MM
14	Nos.	6	BOLTS WITH SUITABLE NUTS AND WASHERS (16X100)MM
15	Nos.	2	BOLTS WITH SUITABLE NUTS AND WASHERS (16X235)MM
16	Nos.	3	STRAP FOR INSULATOR STRING (33kV) (100X5X350)MM
17	Lot	1	HT STAY SET (AS REQUIRED)
18	Nos.	1	11 METER STEEL TUBULAR POLE

CLIENT

NEPAL ELECTRICITY AUTHORITY
DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
DURBARMARGA, KATHMANDU, NEPAL

CONSULTANT

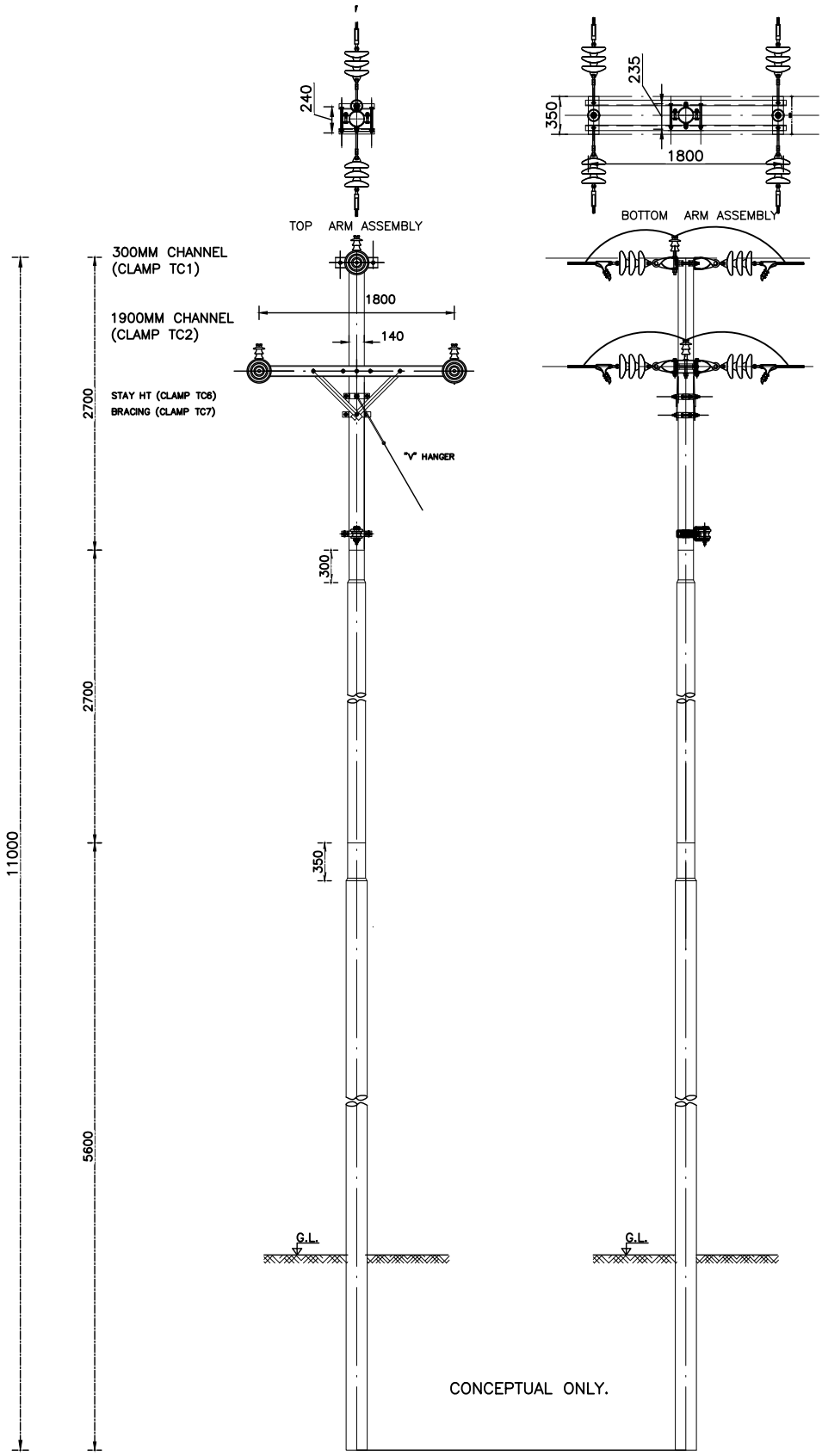
NEA ENGINEERING COMPANY LTD.
KATHMANDU, NEPAL

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

DRAWING NO.	CSG-OHL-11SC-SPDDE-BOM
DRAWN	AKC
DESIGNED	DDT
DRAFTING CHECK	BP
DESIGN CHECK	
APPROVED	

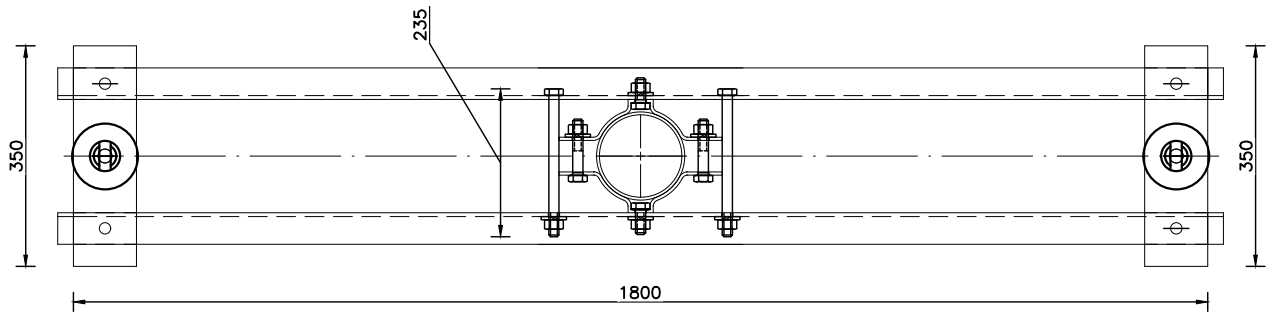
BILL OF QUANTITY FOR
SINGLE POLE DOUBLE DEAD END
STRUCTURE (SPDDE)
FOR 11 M SINGLE CIRCUIT
33 kV LINE

FOR TENDER PURPOSE ONLY

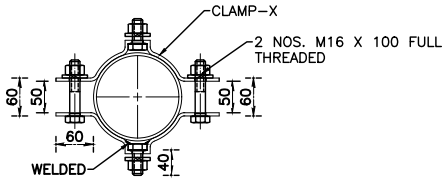


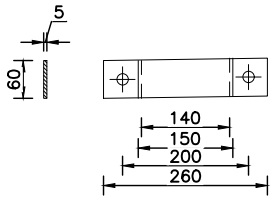
CLIENT	CONSULTANT	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DRAWING NO. CSG–OHL–11SC–SPDDE–POLE DRAWN AKC DESIGNED DDT DRAFTING CHECK BP DESIGN CHECK APPROVED
		POLE STRUCTURE FOR SINGLE POLE DOUBLE DEAD END STRUCTURE (SPDDE) FOR 11 M SINGLE CIRCUIT 33 kV LINE
		FOR TENDER PURPOSE ONLY

Cross Arm for 33kV ISMC100 (100x50x7.5x4.7x1800 mm)



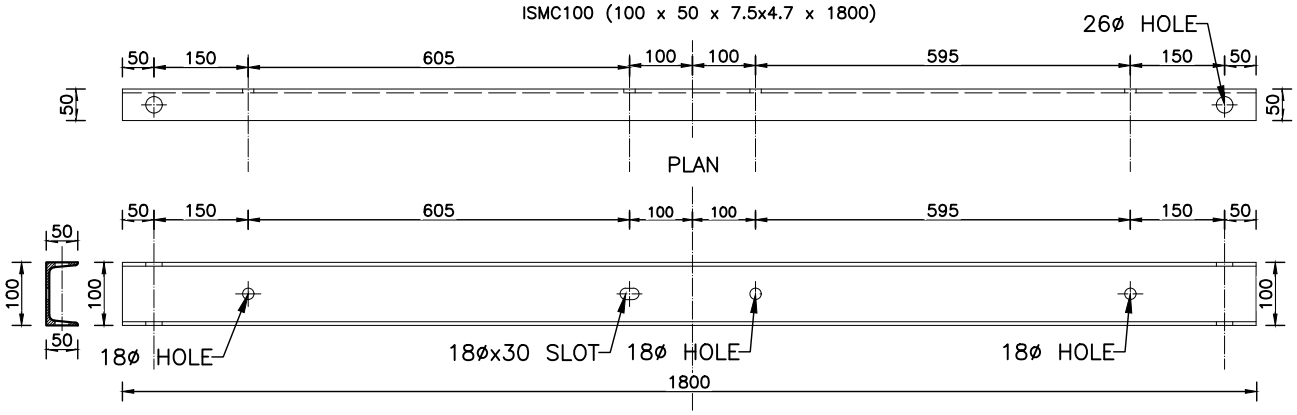
LOWER CROSS ARM ASSEMBLY





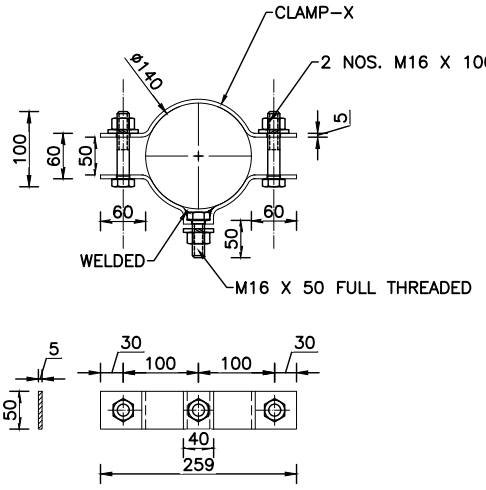
LOWER CHANNEL

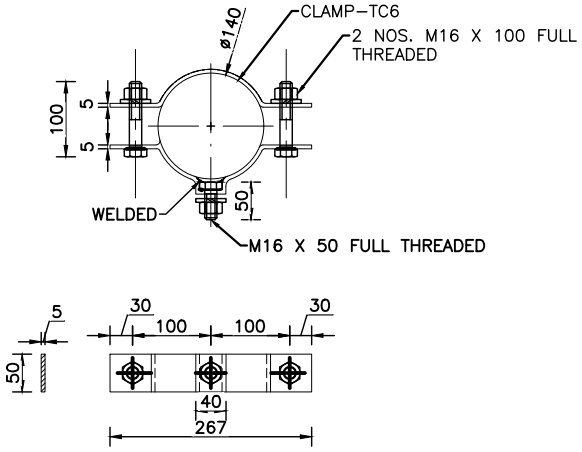
ISMC100 (100 x 50 x 7.5x4.7 x 1800)



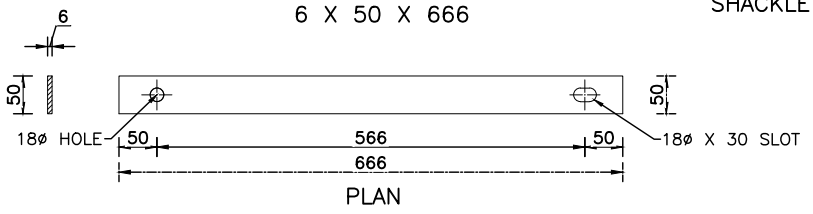
CLIENT	CONSULTANT	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT	
NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DRAWING NO. CSG–OHL–11SC–SPDDE–CACL DRAWN AKC DESIGNED DDT DRAFTING CHECK BP DESIGN CHECK APPROVED	CROSS ARM AND CLAMP STRUCTURE FOR SINGLE POLE DOUBLE DEAD END STRUCTURE (SPDDE) FOR 11 M SINGLE CIRCUIT 33 kV LINE FOR TENDER PURPOSE ONLY

SINGLE BRACING ASSEMBLY – BR1



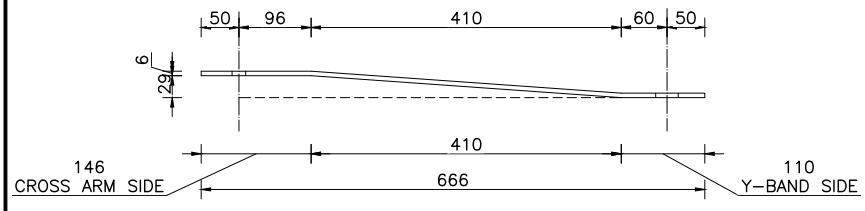


MS BRACING PLATE
6 X 50 X 666



PLAN

SHACKLE INSULATOR (FOR COMMUNICATION LINE)

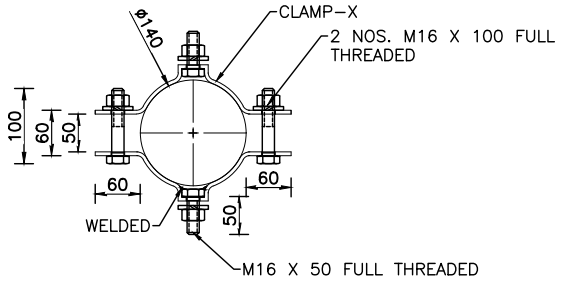


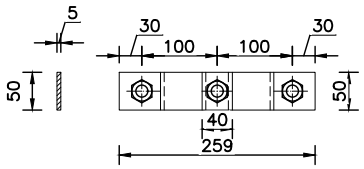
ELEVATION

CLIENT	CONSULTANT	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DRAWING NO. CSG–OHL–11SC–SPDDE–SB DRAWN AKC DESIGNED DDT DRAFTING CHECK BP DESIGN CHECK APPROVED
		SINGLE BRACING SET FOR SINGLE POLE DOUBLE DEAD END STRUCTURE (SPDDE) FOR 11 M SINGLE CIRCUIT 33 kV LINE
		FOR TENDER PURPOSE ONLY

DOUBLE BRACING ASSEMBLY– BR2

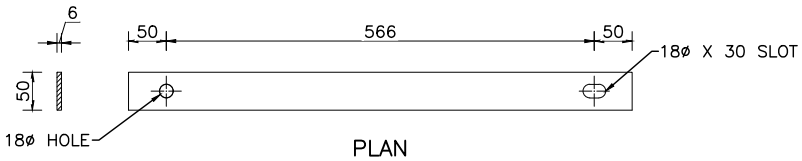
Y–TYPE BAND



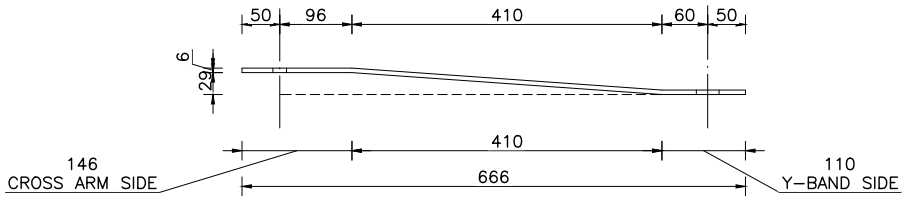


PLAN PLAN

MS BRACING PLATE
6 x 50 x 666



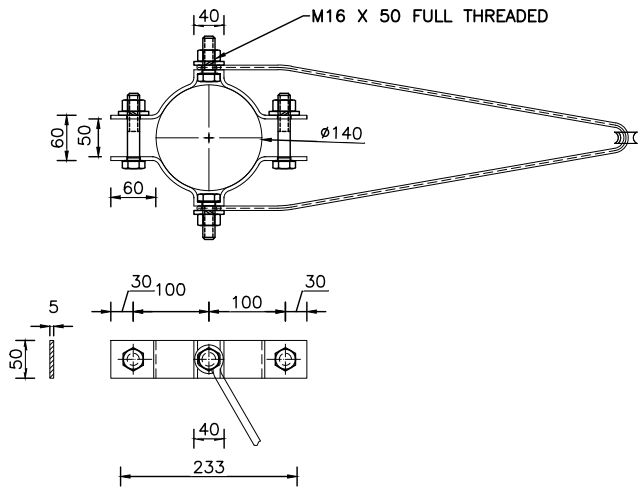
PLAN



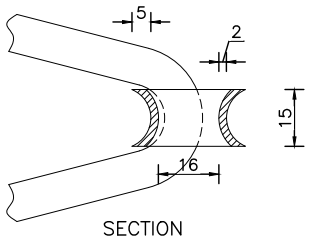
ELEVATION

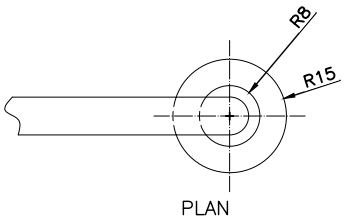
CLIENT	CONSULTANT	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT	
NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DRAWING NO. CSG–OHL–11SC–SPDDE–DB DRAWN AKC DESIGNED DDT DRAFTING CHECK BP DESIGN CHECK APPROVED	DOUBLE BRACING SET FOR SINGLE POLE DOUBLE DEAD END STRUCTURE (SPDDE) FOR 11 M SINGLE CIRCUIT 33 kV LINE FOR TENDER PURPOSE ONLY

STAY CLAMP – ST1

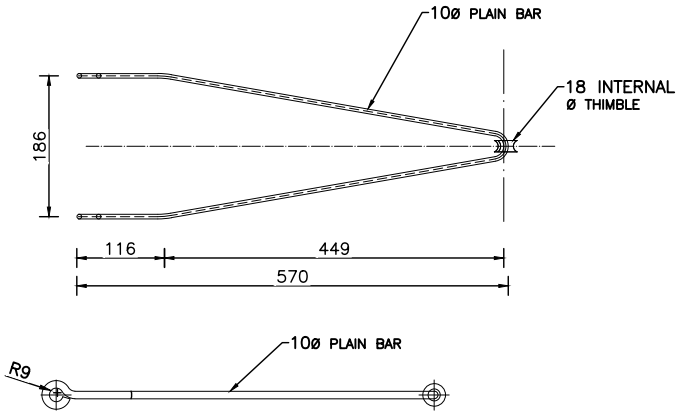


THIMBLE





V – HANGER



STAY SET ASSEMBILY

S.NO.	UNIT	QTY	MATERIAL
1	Nos.	1	HT STAY PLATE (600X600X6)MM MINIMUM
2	Nos.	1	HT STAY ROD (MINIMUM 1600MM)
3	METRS.	1	STAY WIRE (7/10 SWG MINIMUM)
4	Nos.	1	STAY/GUY INSULATOR
5	Nos.	3	BOLTS WITH SUITABLE NUTS AND WASHERS (M16X50)MM
6	Nos.	3	BOLTS WITH SUITABLE NUTS AND WASHERS (M16X100)MM
7	Set.	1	POLE CLAMP WITH NUT,BOLT AND WASHERS FOR TOP BRACING (TC3) CLAMP SECTION(50x6.0)MM
8	Set.	1	"V" HANGLE
9	Nos.	1	STAY TURN BUCKLE INCLUDING THIMBLE (18 SWG MINIMUM)
10	Nos.	1	STAY GRIP
11	Nos.	1	BOW SET

CLIENT

NEPAL ELECTRICITY AUTHORITY
DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
DURBARMARGA, KATHMANDU, NEPAL

CONSULTANT

NEA ENGINEERING COMPANY LTD.
KATHMANDU, NEPAL

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

DRAWING NO.	CSG–OHL–11SC–SPDDE–STAY
DRAWN	AKC
DESIGNED	DDT
DRAFTING CHECK	BP
DESIGN CHECK	
APPROVED	

STAY SET FOR
SINGLE POLE DOUBLE DEAD END
STRUCTURE (SPDDE)
FOR 11 M SINGLE CIRCUIT
33 kV LINE

FOR TENDER PURPOSE ONLY

DOUBLE POLE ASSEMBILY (DPA)

S.NO.	UNIT	QTY	MATERIAL
1	Nos.	3	PIN INSULATOR (33kV)
2	Nos.	3	INSULATOR PIN FOR 33kV PIN
3	Nos.	3	PREFORM PN TIES (TOP TIES)
4	Nos.	1	STEEL CROSSARM CHANNEL (100X50X7.5X4.7X3300)MM
5	Nos.	4	BOLTS WITH SUITABLE NUTS AND WASHERS (16X100)MM
6	Set.	2	POLE CLAMP WITH NUT,BOLT AND WASHERS FOR TOP BRACING (TC1) CLAMP SECTION(50x6.0)MM
7	Set.	2	HT STAY SET (AS REQUIRED)
8	Nos.	2	11 METER STEEL TUBULAR POLE

CLIENT

NEPAL ELECTRICITY AUTHORITY
DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
DURBARMARGA, KATHMANDU, NEPAL

CONSULTANT

NEA ENGINEERING COMPANY LTD.
KATHMANDU, NEPAL

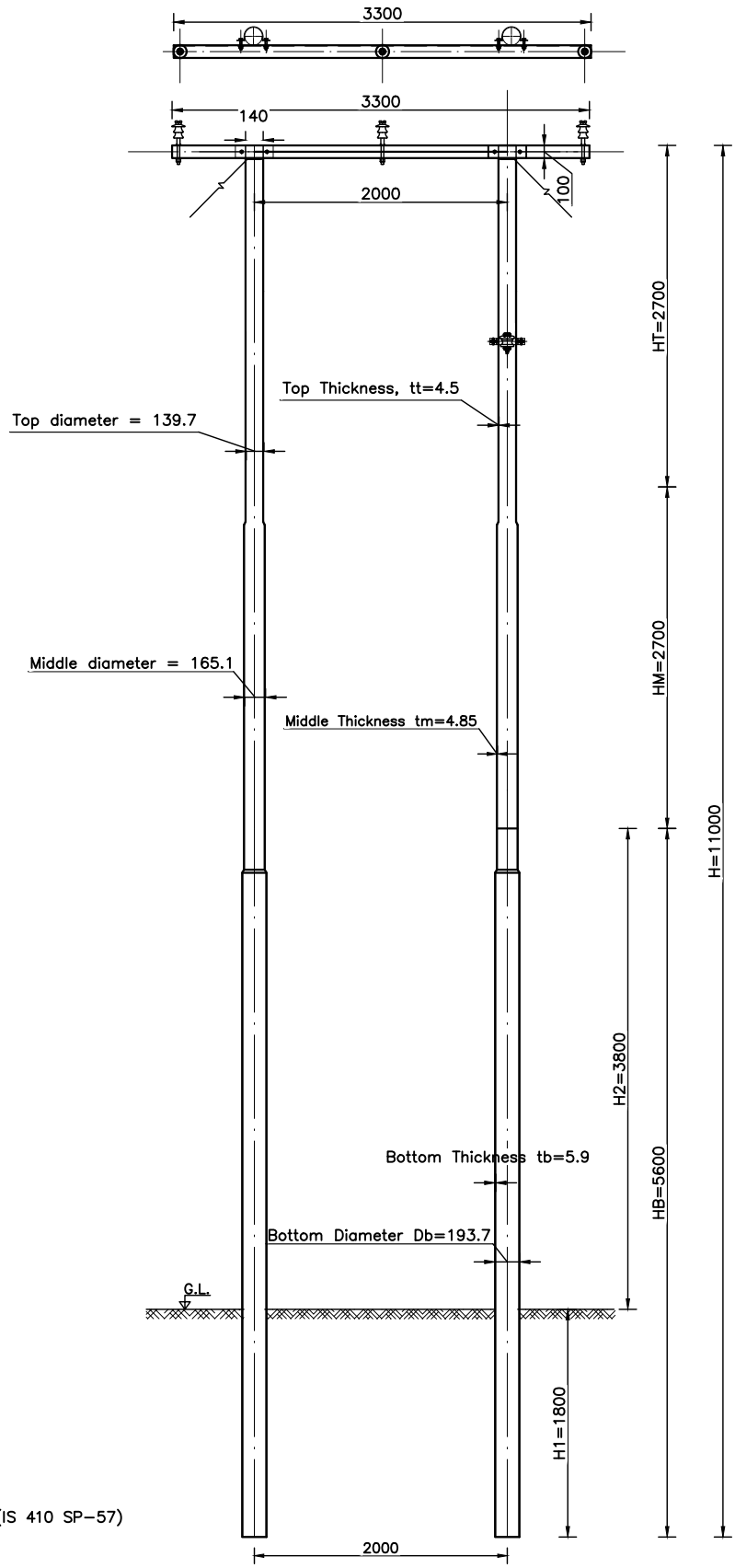
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

DRAWING NO.	CSG–OHL–11SC–DPA–BOM
DRAWN	AKC
DESIGNED	DDT
DRAFTING CHECK	BP
DESIGN CHECK	
APPROVED	

BILL OF QUANTITY FOR
DOUBLE POLE ASSEMBLY
STRUCTURE (DPA)
FOR 11 M SINGLE CIRCUIT
33 kV LINE

FOR TENDER PURPOSE ONLY

TOP VIEW

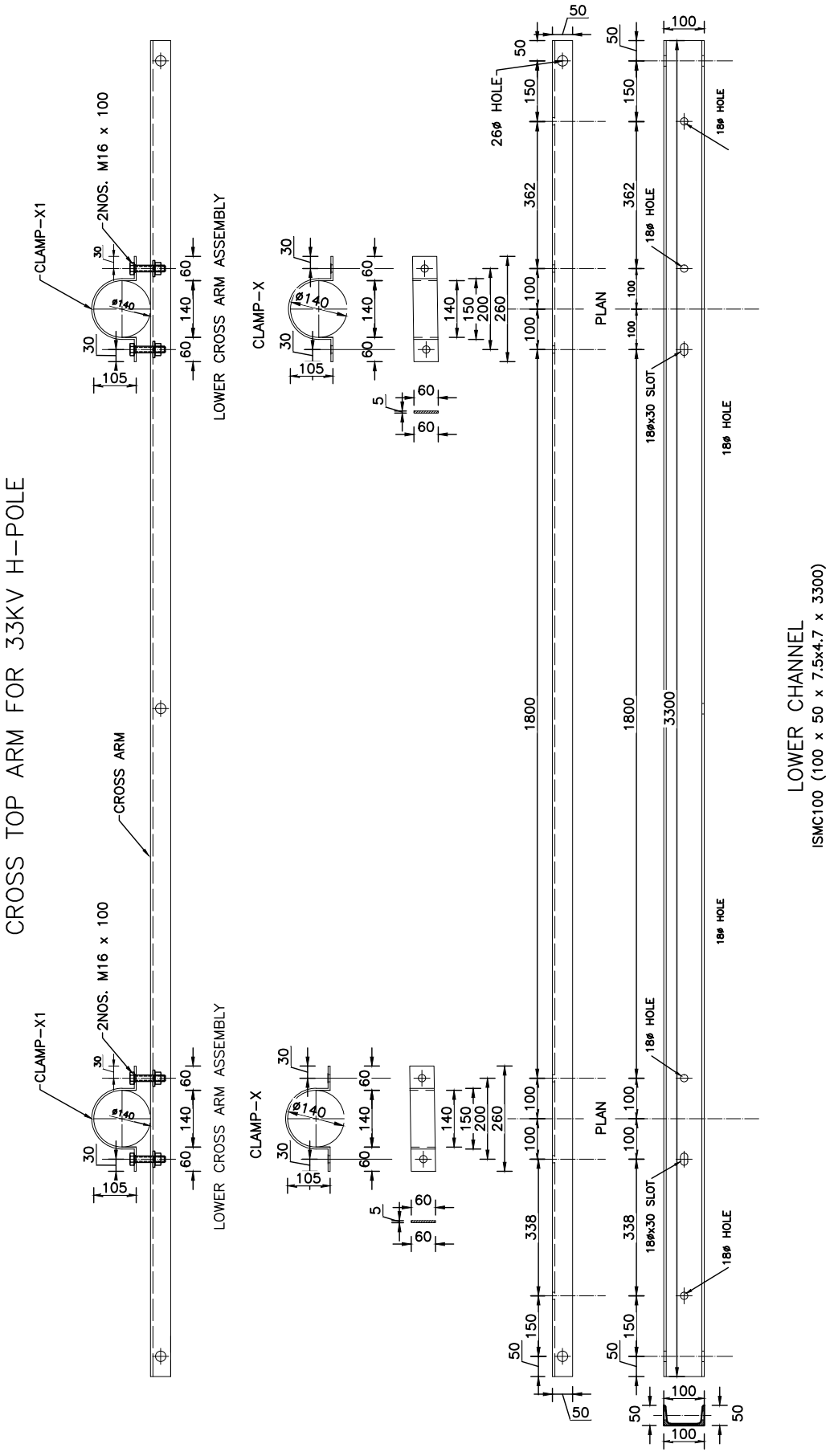


Pole Details

Description		11m Pole (H)
Top Segment	H_t	2700
	t_t	3.65
	D_t	114.3
Middle Segment	H_m	2700
	t_m	4.5
	D_m	139.7
Bottom Segment	H_b	5600
	H_1	1800
	H_2	3800
	t_b	4.85
	D_b	165.1

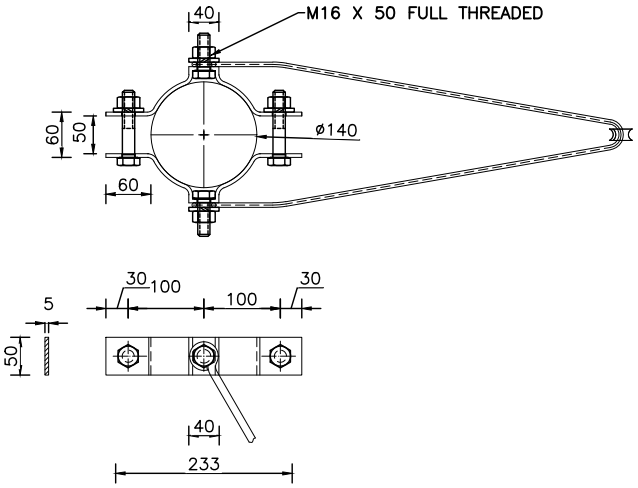
APPROX WEIGHT ,256KG
STEEL TUBULAR (S.T) POLE (IS 410 SP-57)

CLIENT	CONSULTANT	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT	
NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DRAWING NO. CSG-OHL-11SC-DPA-POLE DRAWN AKC DESIGNED DDT DRAFTING CHECK BP DESIGN CHECK APPROVED	POLE STRUCTURE FOR DOUBLE POLE ASSEMBLY STRUCTURE (DPA) FOR 11 M SINGLE CIRCUIT 33 kV LINE FOR TENDER PURPOSE ONLY

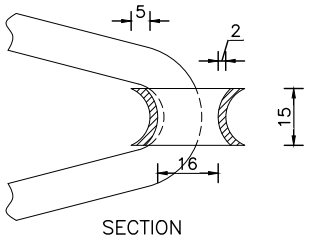


CLIENT	CONSULTANT	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DRAWING NO. CSG-OHL-11SC-DPA-CLCA DRAWN AKC DESIGNED DDT DRAFTING CHECK BP DESIGN CHECK APPROVED
		CLAMP AND CROSS ARM STRUCTURE FOR DOUBLE POLE ASSEMBLY STRUCTURE (DPA) FOR 11 M SINGLE CIRCUIT 33 kV LINE
		FOR TENDER PURPOSE ONLY

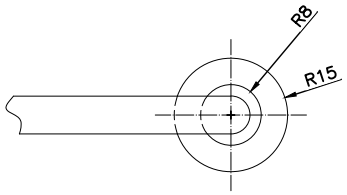
STAY CLAMP – ST1



THIMBLE

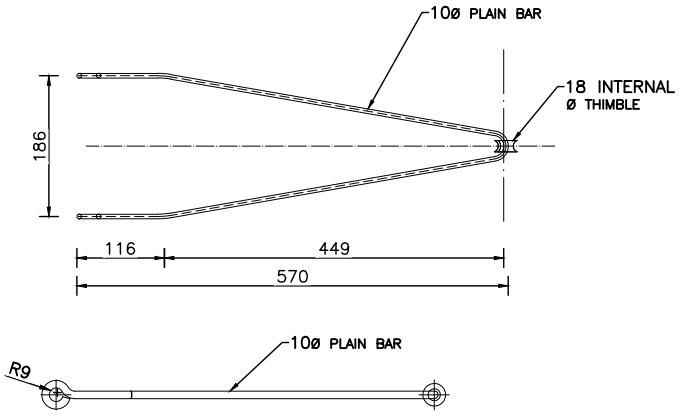


SECTION



PLAN

V – HANGER



STAY SET ASSEMBILY

S.NO.	UNIT	QTY	MATERIAL
1	Nos.	1	HT STAY PLATE (600X600X6)MM MINIMUM
2	Nos.	1	HT STAY ROD (MINIMUM 1600MM)
3	METRS.	1	STAY WIRE (7/10 SWG MINIMUM)
4	Nos.	1	STAY/GUY INSULATOR
5	Nos.	3	BOLTS WITH SUITABLE NUTS AND WASHERS (M16X50)MM
6	Nos.	3	BOLTS WITH SUITABLE NUTS AND WASHERS (M16X100)MM
7	Set.	1	POLE CLAMP WITH NUT,BOLT AND WASHERS FOR TOP BRACING (TC3) CLAMP SECTION(50x6.0)MM
8	Set.	1	"V" HANGLE
9	Nos.	1	STAY TURN BUCKLE INCLUDING THIMBLE (18 SWG MINIMUM)
10	Nos.	1	STAY GRIP
11	Nos.	1	BOW SET

CLIENT

NEPAL ELECTRICITY AUTHORITY
DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
DURBARMARGA, KATHMANDU, NEPAL

CONSULTANT

NEA ENGINEERING COMPANY LTD.
KATHMANDU, NEPAL

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

DRAWING NO.	CSG–OHL–11SC–DPA–STAY
DRAWN	AKC
DESIGNED	DDT
DRAFTING CHECK	BP
DESIGN CHECK	
APPROVED	

STAY SET FOR
DOUBLE POLE ASSEMBLY
STRUCTURE (DPA)
FOR 11 M SINGLE CIRCUIT
33 kV LINE

FOR TENDER PURPOSE ONLY

DOUBLE POLE DEAD END ARM STRUCTURE (DPDA)

S.NO.	UNIT	QTY	MATERIAL
1	Set.	3	DISC INSULATOR 33kV (A SET OF THREE)
2	Set.	3	BACK STRAP
3	Set.	3	TENSION SET WITH BALL AND SOCKET EYE
4	Set.	3	PG CLAMP FOR DOG
5	Nos.	1	STEEL CROSSARM CHANNEL (100X50X7.5X4.7X3300)MM
6	Set.	2	POLE CLAMP WITH NUT,BOLT AND WASHERS (TC1) CLAMP SECTION(50x6)MM
7	Set.	2	POLE CLAMP WITH NUT,BOLT AND WASHERS (TC2) CLAMP SECTION(50x6)MM
8	Nos.	4	BOLTS WITH SUITABLE NUTS AND WASHERS (16X50)MM
9	Nos.	8	BOLTS WITH SUITABLE NUTS AND WASHERS (16X100)MM
10	Nos.	3	BOLTS WITH SUITABLE NUTS AND WASHERS (16X160)MM
11	Set	2	HT STAY SET (AS REQUIRED)
12	Nos.	2	11 METER STEEL TUBULAR POLE

CLIENT

NEPAL ELECTRICITY AUTHORITY
DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
DURBARMARGA, KATHMANDU, NEPAL

CONSULTANT

NEA ENGINEERING COMPANY LTD.
KATHMANDU, NEPAL

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

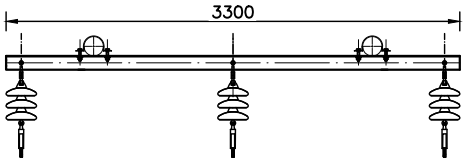
DRAWING NO.	CSG–OHL–11SC–DPDA–BOM
DRAWN	AKC
DESIGNED	DDT
DRAFTING CHECK	BP
DESIGN CHECK	
APPROVED	

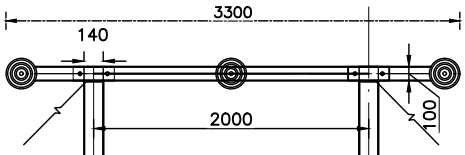
BILL OF QUANTITY FOR
DOUBLE POLE SINGLE DEAD END
STRUCTURE (DPDA)
FOR 11 M SINGLE CIRCUIT
33 kV LINE

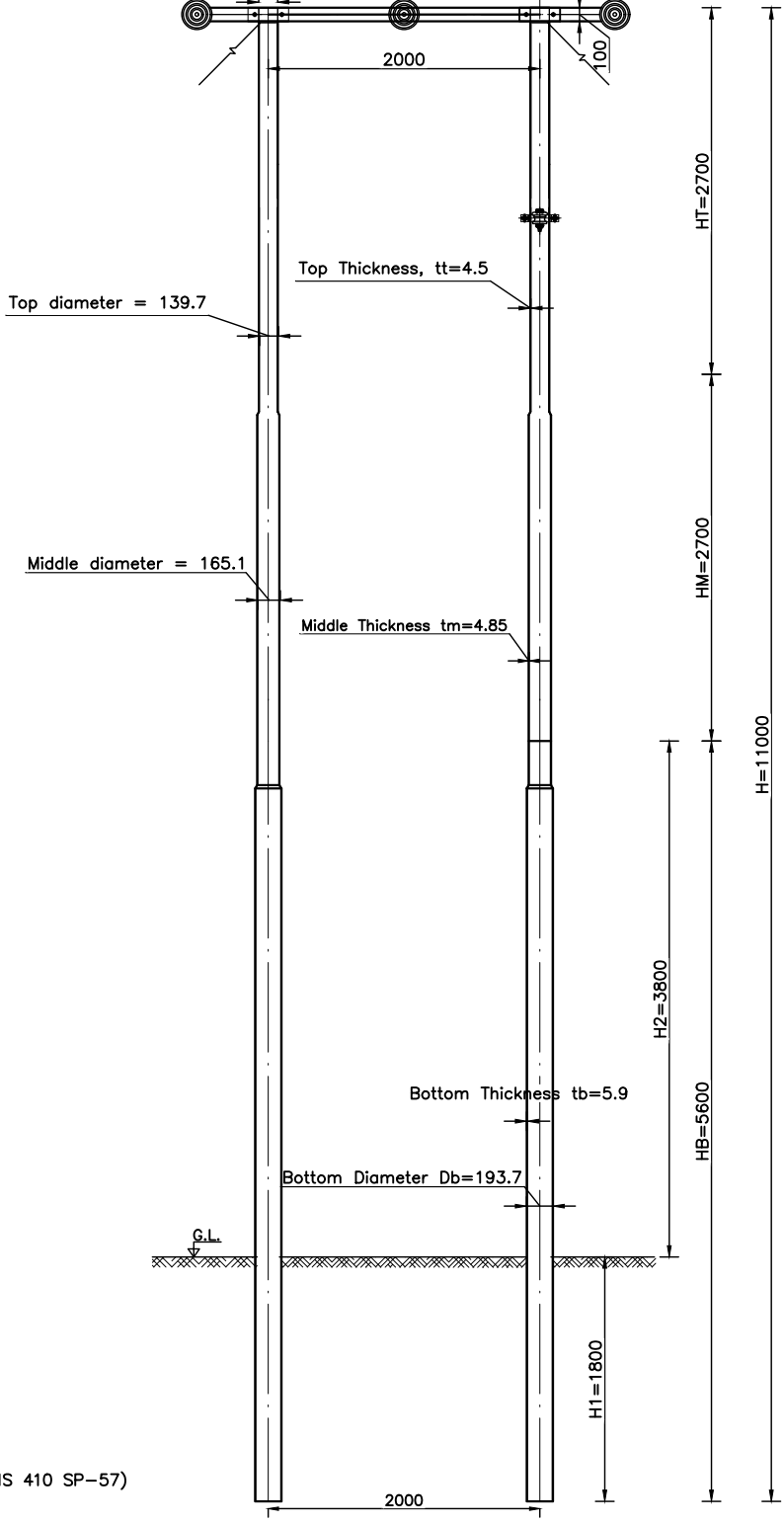
FOR TENDER PURPOSE ONLY

DOUBLE POLE SINGLE ARM DEAD END STRUCTURE

TOP VIEW







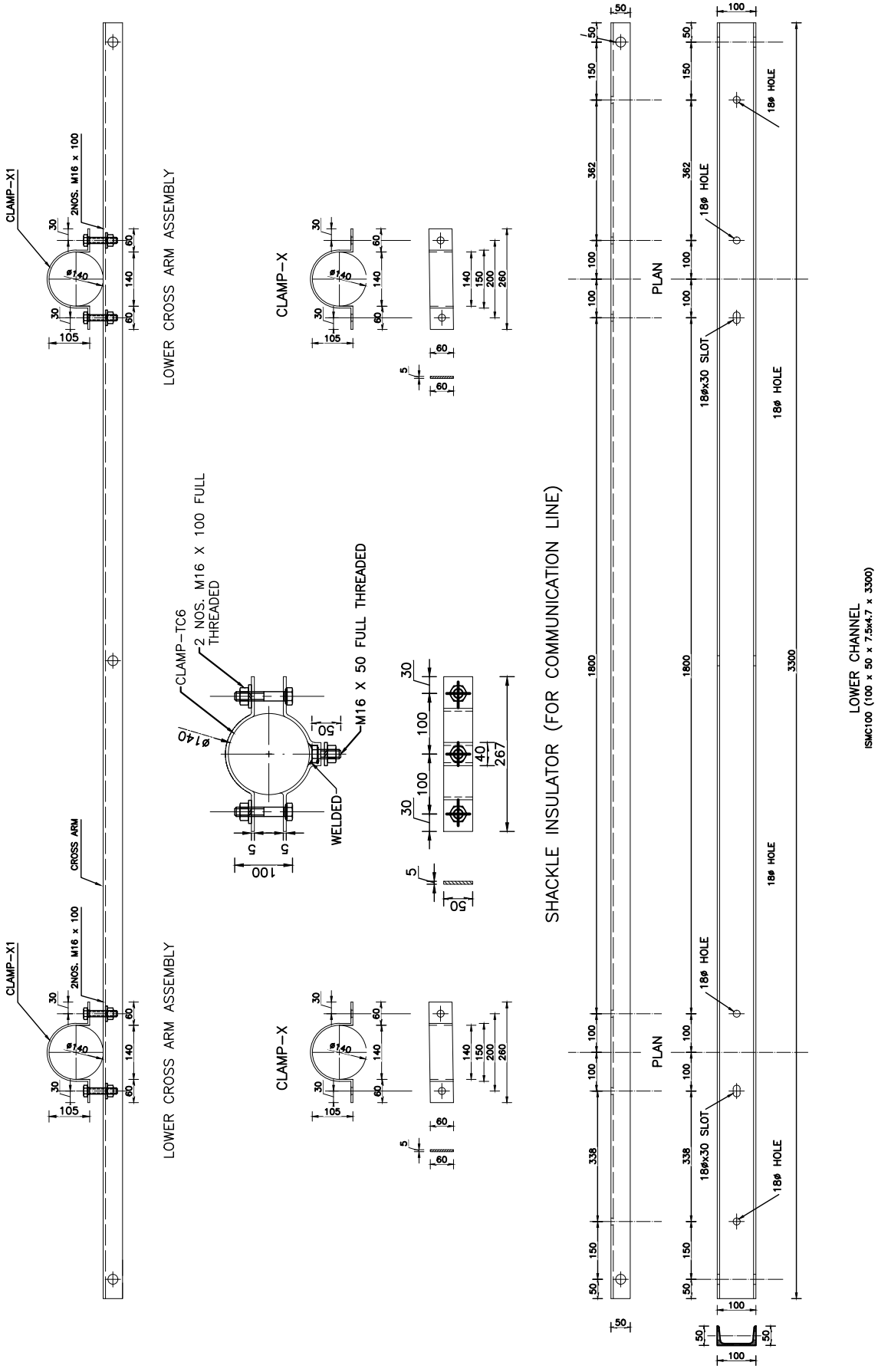
Pole Details

Description		11m Pole (H)
Top Segment	H_t	2700
	t_t	3.65
	D_t	114.3
Middle Segment	H_m	2700
	t_m	4.5
	D_m	139.7
Bottom Segment	H_b	5600
	H_1	1800
	H_2	3800
	t_b	4.85
	D_b	165.1

APPROX WEIGHT ,256KG
STEEL TUBULAR (S.T) POLE (IS 410 SP-57)

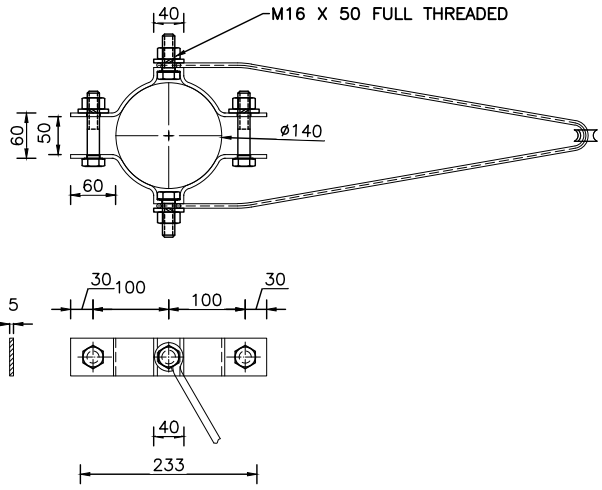
CLIENT	CONSULTANT	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DRAWING NO. CSG-OHL-11SC-DPDA-POLE DRAWN AKC DESIGNED DDT DRAFTING CHECK BP DESIGN CHECK APPROVED
		POLE STRUCTURE FOR DOUBLE POLE SINGLE DEAD END STRUCTURE (DPDA) FOR 11 M SINGLE CIRCUIT 33 kV LINE
		FOR TENDER PURPOSE ONLY

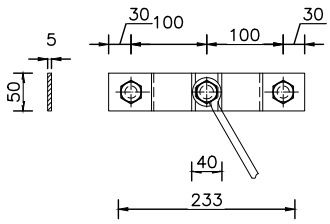
CROSS TOP ARM FOR 33KV H-POLE



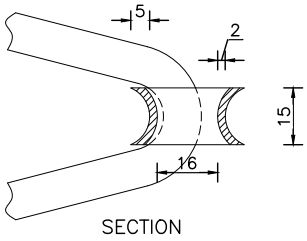
CLIENT	CONSULTANT	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DRAWING NO. CSG-OHL-11SC-DPDA-CLCA DRAWN AKC DESIGNED DDT DRAFTING CHECK BP DESIGN CHECK APPROVED
		CLAMP AND CROSS ARM STRUCTURE FOR DOUBLE POLE SINGLE DEAD END STRUCTURE (DPDA) FOR 11 M SINGLE CIRCUIT 33 kV LINE
		FOR TENDER PURPOSE ONLY

STAY CLAMP – ST1

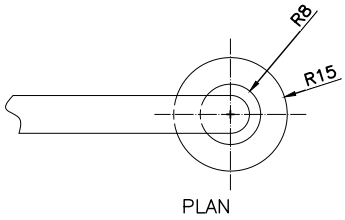




THIMBLE

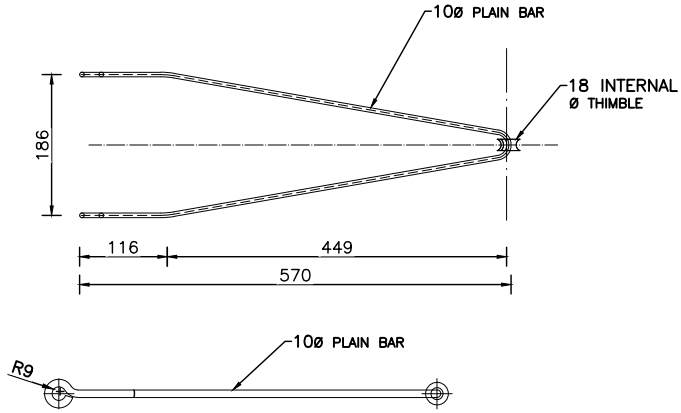


SECTION



PLAN

V – HANGER



STAY SET ASSEMBILY

S.NO.	UNIT	QTY	MATERIAL
1	Nos.	1	HT STAY PLATE (600X600X6)MM MINIMUM
2	Nos.	1	HT STAY ROD (MINIMUM 1600MM)
3	METRS.	1	STAY WIRE (7/10 SWG MINIMUM)
4	Nos.	1	STAY/GUY INSULATOR
5	Nos.	3	BOLTS WITH SUITABLE NUTS AND WASHERS (M16X50)MM
6	Nos.	3	BOLTS WITH SUITABLE NUTS AND WASHERS (M16X100)MM
7	Set.	1	POLE CLAMP WITH NUT,BOLT AND WASHERS FOR TOP BRACING (TC3) CLAMP SECTION(50x6.0)MM
8	Set.	1	"V" HANGLE
9	Nos.	1	STAY TURN BUCKLE INCLUDING THIMBLE (18 SWG MINIMUM)
10	Nos.	1	STAY GRIP

CLIENT

NEPAL ELECTRICITY AUTHORITY
DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
DURBARMARGA, KATHMANDU, NEPAL

CONSULTANT

NEA ENGINEERING COMPANY LTD.
KATHMANDU, NEPAL

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

DRAWING NO.	CSG–OHL–11SC–DPDA–STAY
DRAWN	AKC
DESIGNED	DDT
DRAFTING CHECK	BP
DESIGN CHECK	
APPROVE	

STAY SET FOR
DOUBLE POLE SINGLE DEAD END
STRUCTURE (DPDA)
FOR 11 M SINGLE CIRCUIT
33 kV LINE

FOR TENDER PURPOSE ONLY

DOUBLE POLE DEAD END ARM STRUCTURE (DDPDA)

S.NO.	UNIT	QTY	MATERIAL
1	Nos.	3	PIN INSULATOR (33kv)
2	Nos.	3	INSULATOR PIN (33kv)
3	Nos.	3	PREFORM PN TIES (TOP TIES)
4	Set.	6	DISC INSULATOR 33kV (A SET OF THREE)
5	Set.	6	BACK STRAP
6	Nos.	6	TENSION SET WITH BALL AND SOCKET EYE
7	Nos.	3	PG CLAMP FOR ACSR WOLF
8	Nos.	1	STEEL CROSSARM CHANNEL (100X50X7.5X4.7X2416)MM
9	Nos.	6	STRAP FOR INSULATOR (33kV) (100X5X350)MM
10	Nos.	2	BRACING ANGLE (40X40X50X2416)MM
11	Nos.	2	CROSS BRACING ANGLE (40X40X5X2872)MM
12	Nos.	13	BOLTS WITH SUITABLE NUTS AND WASHERS (16X50)MM
13	Nos.	12	BOLTS WITH SUITABLE NUTS AND WASHERS (16X100)MM
14	Nos.	6	BOLTS WITH SUITABLE NUTS AND WASHERS (16X150)MM
15	Set	6	POLE CLAMP WITH NUT, BOLT AND WASHERS, TOP BRACING (TC1), CLAMP SECTION (50X6.0) MM
16	Set	2	POLE CLAMP WITH NUT, BOLT AND WASHERS, TOP BRACING (TC4), CLAMP SECTION (50X6.0) MM
17	Set	2	POLE CLAMP WITH NUT, BOLT AND WASHERS, TOP BRACING (TC5), CLAMP SECTION (50X6.0) MM
18	Nos.	2	STEEL CROSSARM CHANNEL (100X50X7.5X4.7X2919)MM
19	Set	4	HT STAY SET (AS REQUIRED)
20	Nos.	2	11 METER STEEL TUBULAR POLE
21	Nos.	1	BRACING AND BRACING SUPPORT CROSS ARM

CLIENT

NEPAL ELECTRICITY AUTHORITY
DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
DURBARMARGA, KATHMANDU, NEPAL

CONSULTANT

NEA ENGINEERING COMPANY LTD.
KATHMANDU, NEPAL

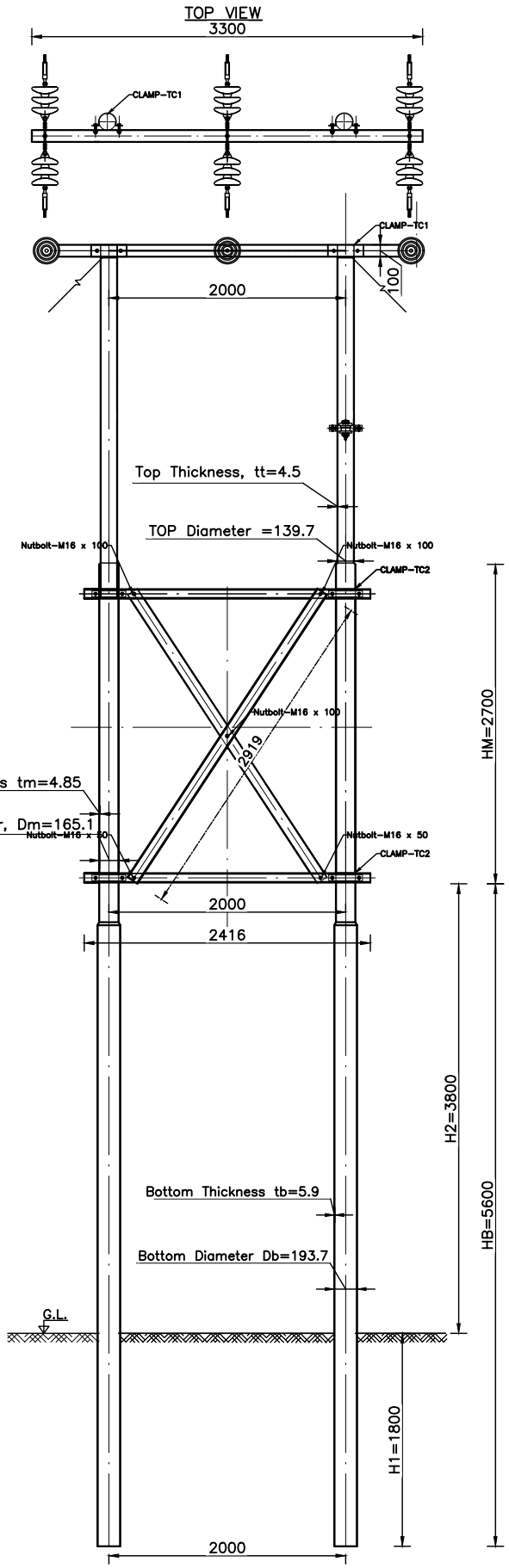
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

DRAWING NO.	CSG–OHL–11SC–DDPDA–BOM
DRAWN	AKC
DESIGNED	DDT
DRAFTING CHECK	BP
DESIGN CHECK	
APPROVED	

BILL OF QUANTITY FOR DOUBLE POLE DOUBLE ARM DEAD END STRUCTURE (DDPDA) FOR 11 M SINGLE CIRCUIT 33 kV LINE

FOR TENDER PURPOSE ONLY

DOUBLE POLE DOUBLE ARM DEAD END STRUCTURE



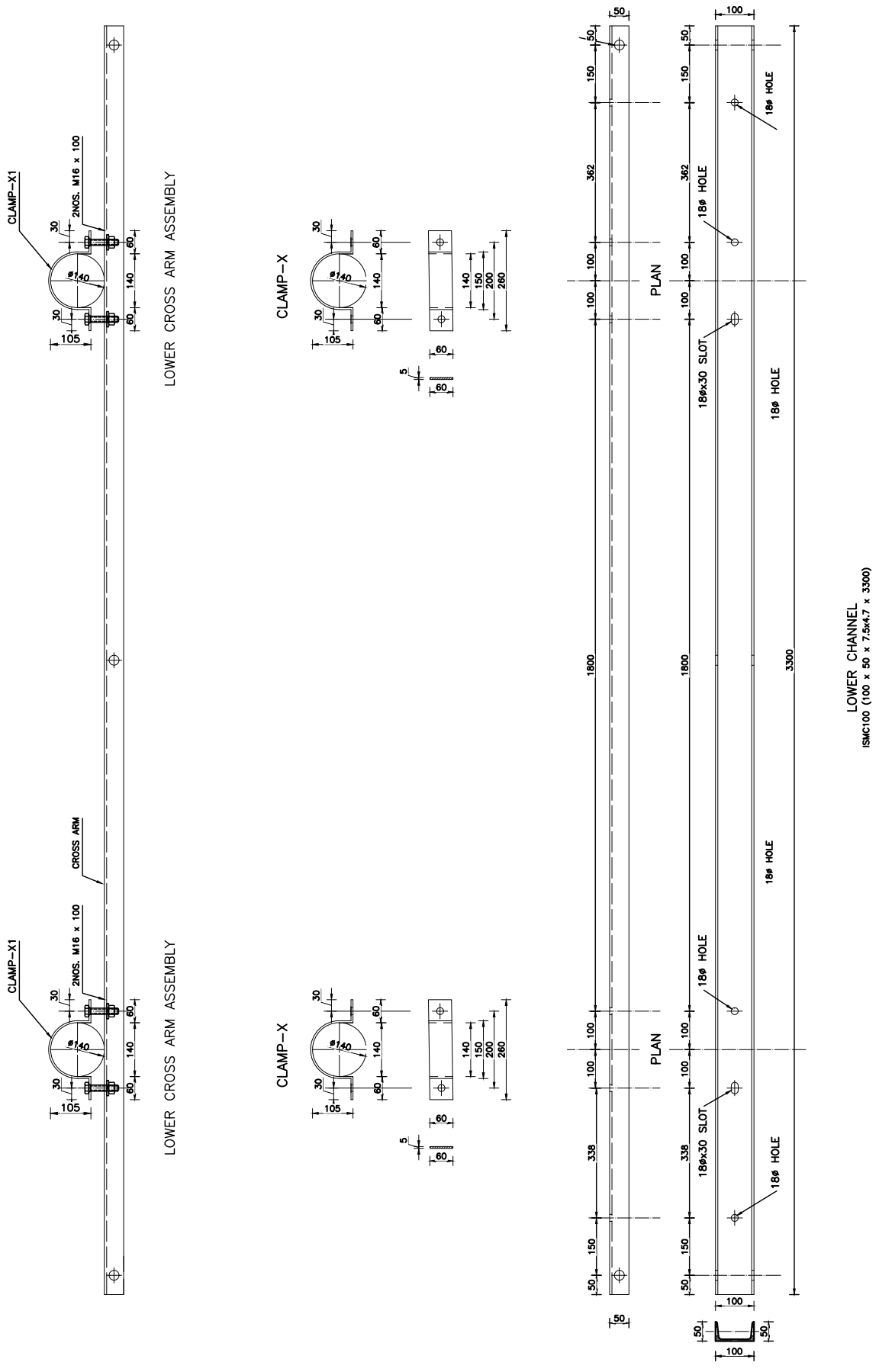
Pole Details

Description		11m Pole (H)
Top Segment	H_t	2700
	t_t	3.65
	D_t	114.3
Middle Segment	H_m	2700
	t_m	4.5
	D_m	139.7
Bottom Segment	H_b	5600
	H_1	1800
	H_2	3800
	t_b	4.85
	D_b	165.1

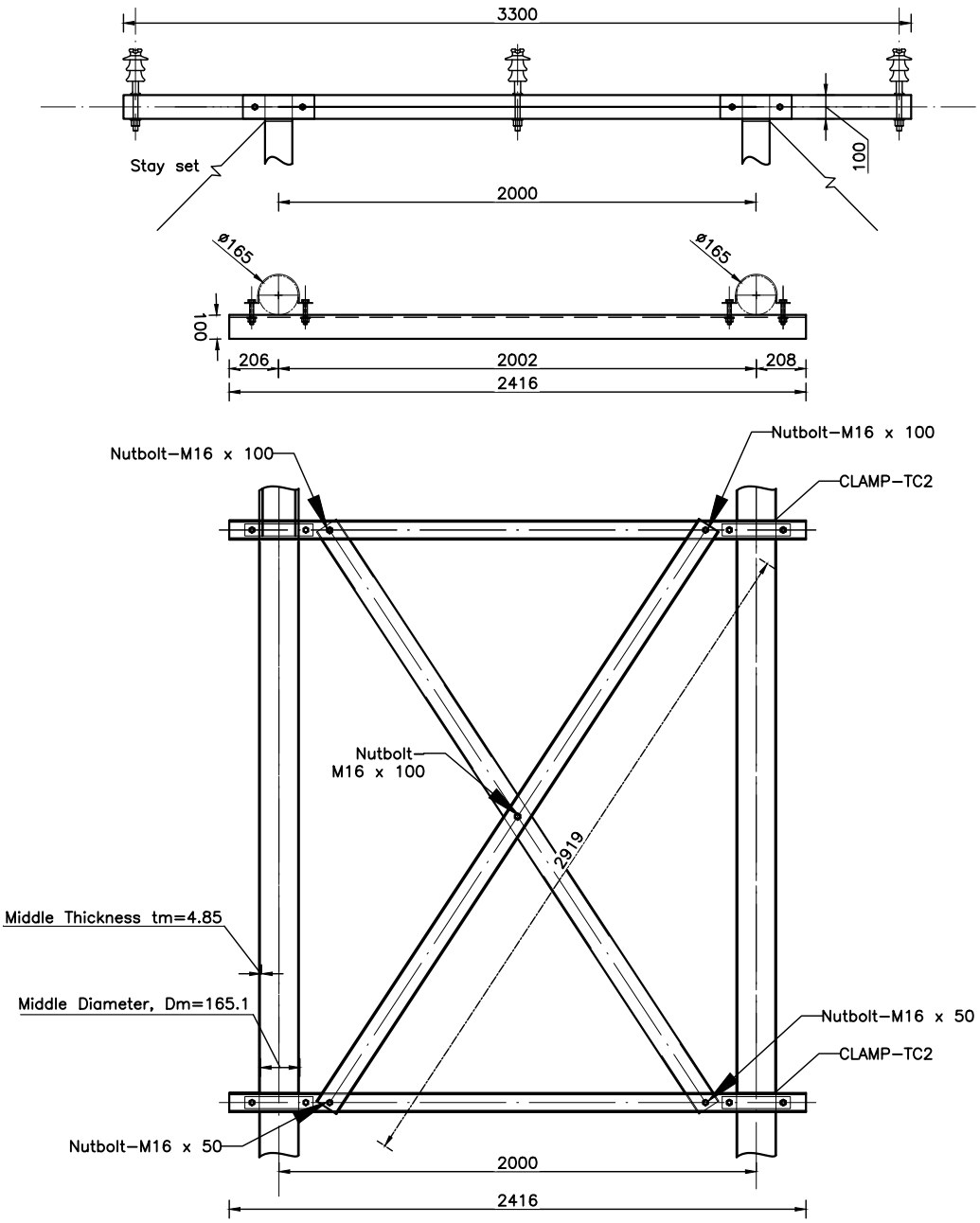
APPROX WEIGHT ,256KG
STEEL TUBULAR (S.T) POLE (IS 410 SP-57)

CLIENT	CONSULTANT	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT	
NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DRAWING NO. CSG-OHL-11SC-DDPDA-POLE DRAWN AKC DESIGNED DDT DRAFTING CHECK BP DESIGN CHECK APPROVED	POLE STRUCTURE FOR DOUBLE POLE DOUBLE ARM DEAD END STRUCTURE (DDPDA) FOR 11 M SINGLE CIRCUIT 33 kV LINE FOR TENDER PURPOSE ONLY

CROSS TOP ARM FOR 33KV H-POLE

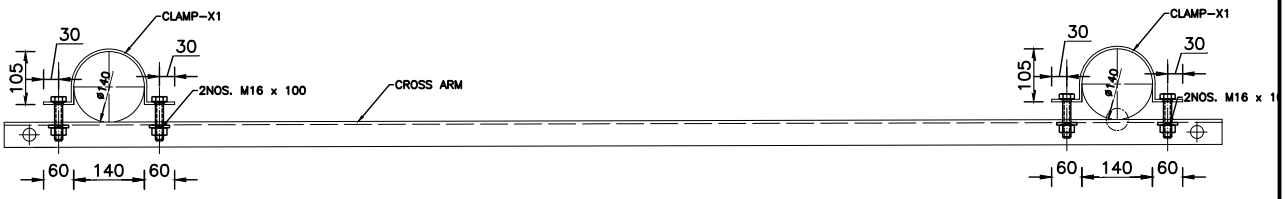


CLIENT	NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL
CONSULTANT	NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT	
DRAWING NO.	CSG-OHL-11SC-DDPDA-CLCA
DRAWN	AKC
DESIGNED	DDT
DRAFTING CHECK	BP
DESIGN CHECK	
APPROVED	
CLAMP AND CROSS ARM STRUCTURE FOR DOUBLE POLE DOUBLE ARM DEAD END STRUCTURE (DDPDA) FOR 11 M SINGLE CIRCUIT 33 kV LINE	
FOR TENDER PURPOSE ONLY	



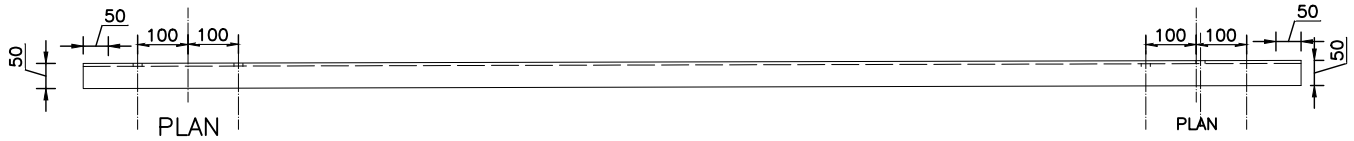
CLIENT	CONSULTANT	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DRAWING NO. CSG–OHL–11SC–DDPDA–CB DRAWN AKC DESIGNED DDT DRAFTING CHECK BP DESIGN CHECK APPROVED
		BRACING ASSEMBLY FOR DOUBLE POLE DOUBLE ARM DEAD END STRUCTURE (DDPDA) FOR 11 M SINGLE CIRCUIT 33 kV LINE
		FOR TENDER PURPOSE ONLY

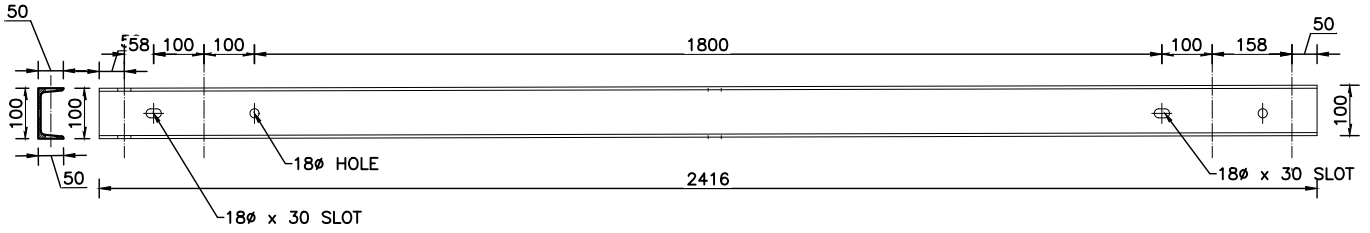
CROSS ARM FOR CROSS BRACING OF 33KV H–POLE



CROSS ARM FOR CROSS BRACING ASSEMBLY





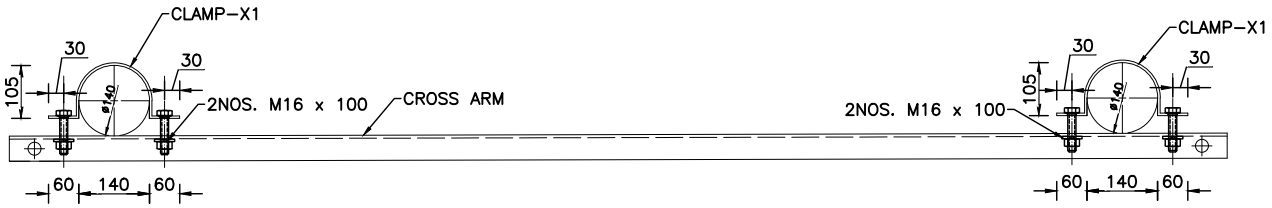


UPPER CROSS ARM CHANNEL FOR CROSS BRACING ASSEMBLY

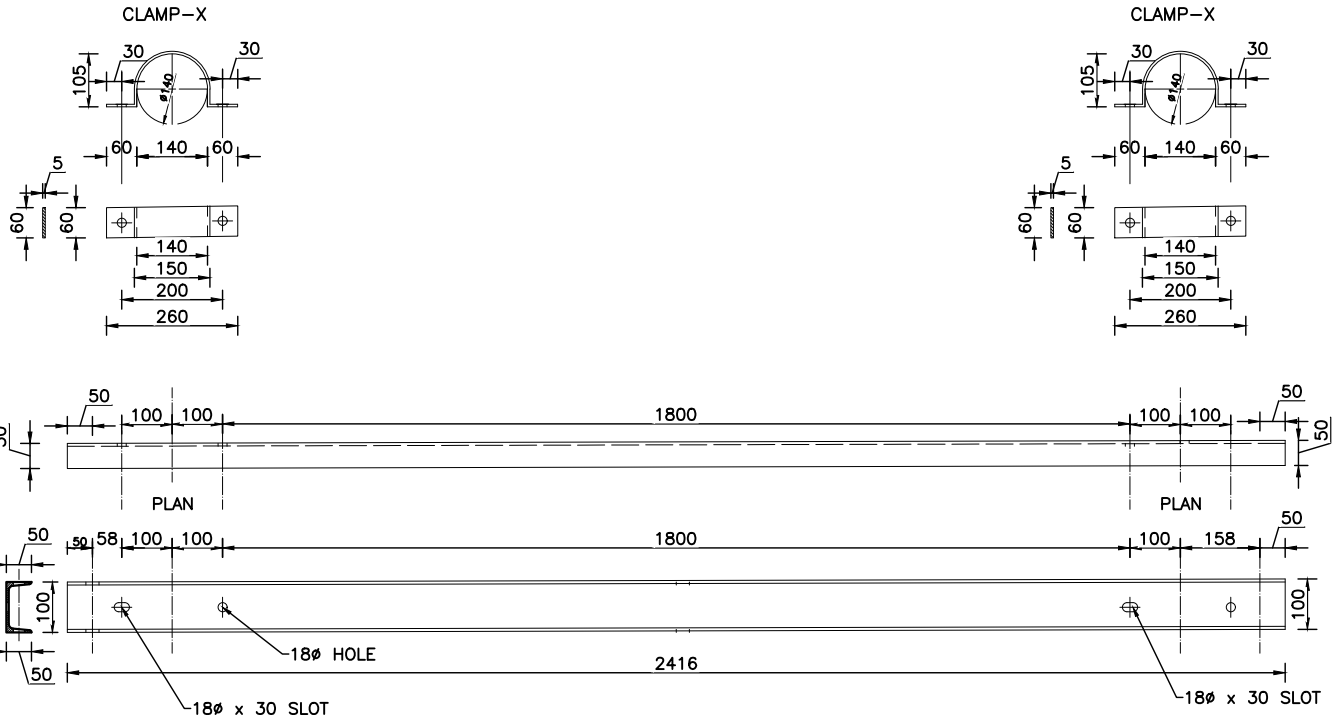
ISMC100 (100 x 50 x 7.5x4.7 x 2416)

CLIENT	CONSULTANT	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DRAWING NO. CSG–OHL–11SC–DDPDA–UACB DRAWN AKC DESIGNED DDT DRAFTING CHECK BP DESIGN CHECK APPROVED
		UPPER ARM CROSS BRACING ASSEMBLY FOR DOUBLE POLE DOUBLE ARM DEAD END STRUCTURE (DDPDA) FOR 11 M SINGLE CIRCUIT 33 kV LINE
		FOR TENDER PURPOSE ONLY

CROSS ARM FOR CROSS BRACING OF 33KV H-POLE



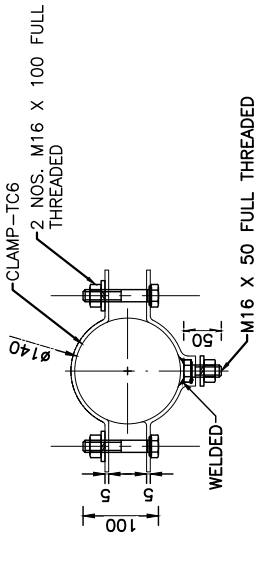
LOWER CROSS ARM FOR CROSS BRACING ASSEMBLY

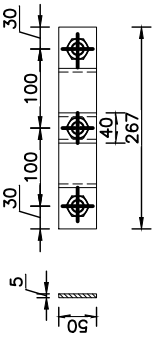


LOWER CROSS ARM CHANNEL FOR CROSS BRACING ASSEMBLY

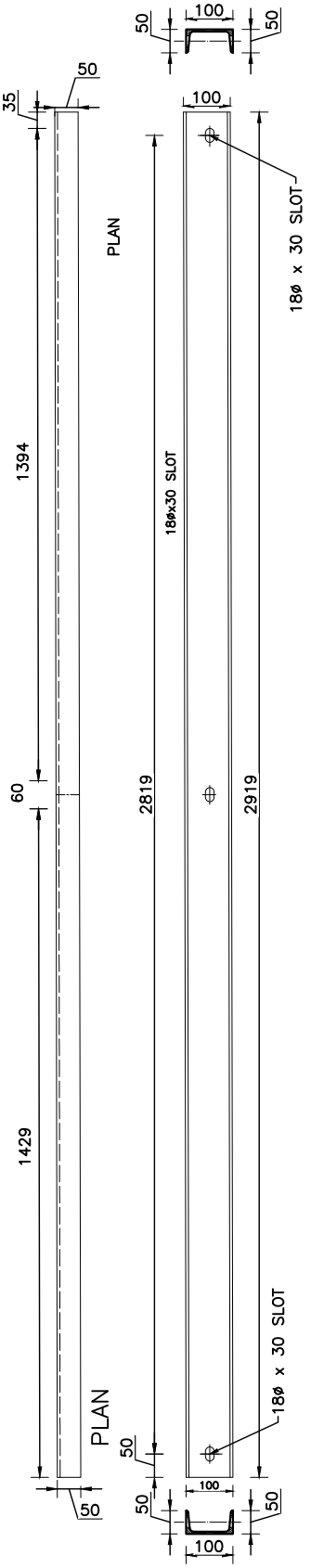
ISMC100 (100 x 50 x 7.5x4.7 x 2416)

CLIENT	CONSULTANT	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DRAWING NO. CSG-OHL-11SC-DDPDA-LACB DRAWN AKC DESIGNED DDT DRAFTING CHECK BP DESIGN CHECK APPROVED
		LOWER ARM CROSS BRACING ASSEMBLY FOR DOUBLE POLE DOUBLE ARM DEAD END STRUCTURE (DDPDA) FOR 11 M SINGLE CIRCUIT 33 kV LINE
		FOR TENDER PURPOSE ONLY





SHACKLE INSULATOR (FOR COMMUNICATION LINE)

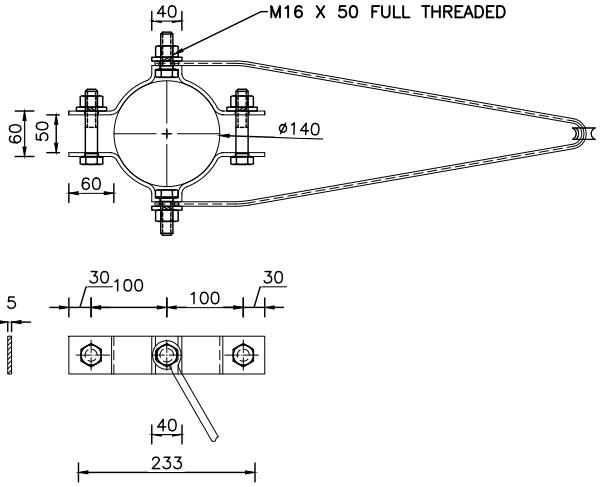


LOWER CROSS ARM CHANNEL FOR CROSS BRACING ASSEMBLY

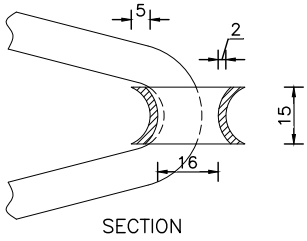
ISMC100 (100 x 50 x 7.5x4.7 x 2916)

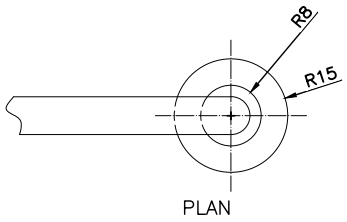
CLIENT	CONSULTANT	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DRAWING NO. CSG–OHL–11SC–DDPDA–CACB DRAWN AKC DESIGNED DDT DRAFTING CHECK BP DESIGN CHECK APPROVED
		CROSS ARM CHANNEL FOR CROSS BRACING ASSEMBLY OF DOUBLE POLE DOUBLE ARM DEAD END STRUCTURE (DDPDA) FOR 11 M SINGLE CIRCUIT 33 kV LINE
		FOR TENDER PURPOSE ONLY

STAY CLAMP – ST1

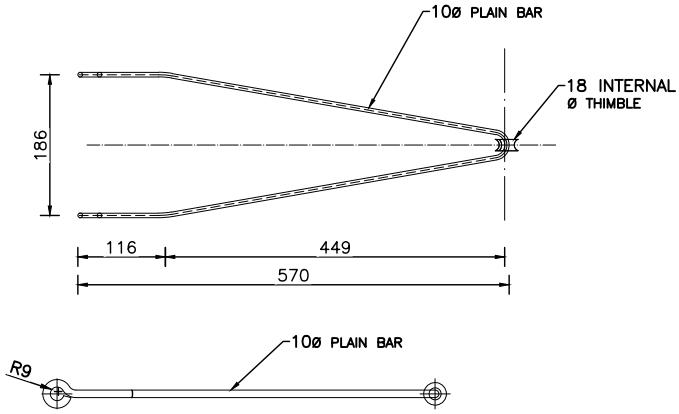


THIMBLE





V – HANGER



STAY SET ASSEMBILY

S.NO.	UNIT	QTY	MATERIAL
1	Nos.	1	HT STAY PLATE (600X600X6)MM MINIMUM
2	Nos.	1	HT STAY ROD (MINIMUM 1600MM)
3	METRS.	1	STAY WIRE (7/10 SWG MINIMUM)
4	Nos.	1	STAY/GUY INSULATOR
5	Nos.	3	BOLTS WITH SUITABLE NUTS AND WASHERS (M16X50)MM
6	Nos.	3	BOLTS WITH SUITABLE NUTS AND WASHERS (M16X100)MM
7	Set.	1	POLE CLAMP WITH NUT,BOLT AND WASHERS FOR TOP BRACING (TC3) CLAMP SECTION(50x6.0)MM
8	Set.	1	"V" HANGLE
9	Nos.	1	STAY TURN BUCKLE INCLUDING THIMBLE (18 SWG MINIMUM)
10	Nos.	1	STAY GRIP
11	Nos.	1	BOW SET

CLIENT

NEPAL ELECTRICITY AUTHORITY
DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
DURBARMARGA, KATHMANDU, NEPAL

CONSULTANT

NEA ENGINEERING COMPANY LTD.
KATHMANDU, NEPAL

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

DRAWING NO.	CSG–OHL–11SC–DDPDA–STAY
DRAWN	AKC
DESIGNED	DDT
DRAFTING CHECK	BP
DESIGN CHECK	
APPROVED	

STAY SET FOR
DOUBLE POLE DOUBLE ARM
DEAD END STRUCTURE (DDPDA)
FOR 11 M SINGLE CIRCUIT
33 kV LINE

FOR TENDER PURPOSE ONLY

13M STEEL TUBULAR POLE

NOTES:

1. ALL DIMENSIONS ARE IN MM OTHERWISE MENTIONED.
2. ALL STEEL TUBING SHALL BE IN ACCORDANCE TO BS 6323 PART 1 TO 8 AND IS 2713.
3. ALL JOINTS ARE FRICTION JOINTS WITHOUT ENVOLVEMENT OF THROUGH BOLTS AND SITE WELDING EXCEPT REQUIRED BY TRANSPORTATION LIMITATION IN HILLY AREAS.
4. FOLLOWING TOLERENCES ARE MAINTAINED:
   a. DIAMETER: ± 1%
   b. WEIGHT: ± 10% ON EACH POLE & ± 7.5% ON A BULK LOAD UP TO 20tons.
   c. THICKNESS: ± 10% ON EACH SHEET.
   d. EACH SECTION SHALL NOT EXCEED + 10 mm AND −0 mm, OVERALL LENGTH OF ASSEMBLED POLE ± 75 mm
   e. STRAIGHTNESS: NOT EXCEED $\frac{1}{600}$ OF HEIGHT
5. ALL WELDINGS SHALL BE SHOP WELD. FILLET WELD PARALLEL TO LONGITUDINAL AXIS IS PERFORMED. NO CIRCUMFERENCIAL WELD SHALL BE MADE.
6. MARKING:

I) AT A POSITION APPROXIMATELY 3.5 m. FROM THE BUTT END, WHICH SHALL BE CLEARLY AND INDELIBLY MARKED WITH:

A. DATE OF MANUFACTURE AND IDENTIFICATION MARK "ABC, 20 ASHAR 2078".

B. LENGTH OF POLE "13m" AND ITS DESIGN WORKING LOADS AS "H=350kgf" & "V=350 kgf".

II) THE POLE SHALL BE MARKED WITH A PERMANENT HORIZONTAL LINE AT A POINT 1/6TH OF THE POLE HEIGHT FROM THE BUTT END OF THE ASSEMBLED POLE & THE MATING DEPTH OF THE RELEVANT SECTIONS OF POLE SHALL ALSO BE INDELIBLY MARKED.

III) THE POLE SHALL BE MARKED WITH CONTRACT NUMBER, POLE NUMBER, PROJECT NAME AND LOCATION (X and Y in UTM Zone 44N) AT 6M FROM TOP.

7. IN CASE OF USE OF POLES OTHER THAN 11m and 13m, POLES CONFIRMING TO IS 2713 SHALL APPLY ALONG WITH ALL CONSIDERATIONS MENTIONED HERE.

CLIENT: NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT: NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
		DRAWING NO. CSG−OHL−13DC−NOTES
		DRAWN AKC
		DESIGNED DDT
		DRAFTING CHECK BP
		DESIGN CHECK
		APPROVED
		NOTES ON FABRICATION OF 13 M STEEL TUBULAR POLE AND ACCESSORIES FOR 33 kV
		FOR TENDER PURPOSE ONLY

SINGLE POLE SINGLE ARM STRUCTURE (SPSA) LOW ANGLE (0 TO 7 DEG)

S.NO.	UNIT	QTY	MATERIAL
1	Nos.	6	PIN INSULATOR (33KV)
2	Nos.	6	INSULATOR PIN FOR 33KV PIN
3	Nos.	6	PREFORM PN TIES (TOP TIES)
4	Set.	3	POLE CLAMP WITH NUT, BOLT AND WASHERS (TC1), CLAMP SECTION (50X6)MM.
5	Nos.	3	STEEL CROSSARM CHANNEL (100X50X7.5X4.7x1700)MM.
6	Set.	3	POLE CLAMP WITH NUT, BOLT AND WASHERS (TC2),CLAMP SECTION (50X6)MM.
7	Nos.	6	FLAT CROSSARM BRACE 33kV (50X6X666)MM.
8	Nos	3	BOLTS WITH SUITABLE NUTS AND WASHERS (16X50)MM
9	Nos	12	BOLTS WITH SUITABLE NUTS AND WASHERS (16X100)MM
10	Nos.	1	STEEL TUBULAR POLE 13M.

CLIENT

NEPAL ELECTRICITY AUTHORITY
DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
DURBARMARGA, KATHMANDU, NEPAL

CONSULTANT

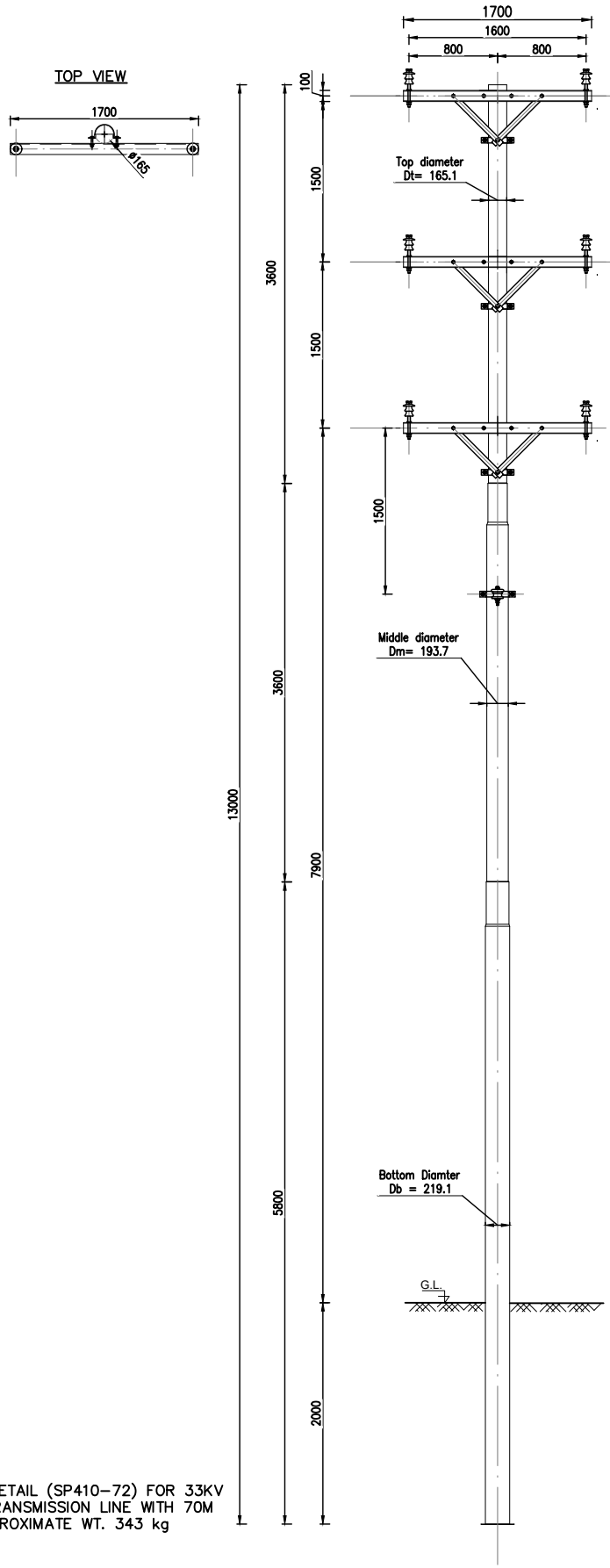
NEA ENGINEERING COMPANY LTD.
KATHMANDU, NEPAL

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

DRAWING NO.	CSG–OHL–13DC–BOM
DRAWN	AKC
DESIGNED	DDT
DRAFTING CHECK	BP
DESIGN CHECK	
APPROVED	

BILL OF QUANTITY FOR
SINGLE POLE SINGLE ARM
STRUCTURE (SPSA)
FOR 13 M DOUBLE CIRCUIT
33 kV LINE

FOR TENDER PURPOSE ONLY



Pole Details

Description		13m Pole (H)
Top Segment	H_t	3600
	t_t	4.5
	D_t	165.1
Middle Segment	H_m	3600
	t_m	4.85
	D_m	193.7
Bottom Segment	H_b	5800
	t_b	5.9
	D_b	219.1
Planting Depth	D_b	2000

13M STEEL POLE DETAIL (SP410-72) FOR 33KV DOUBLE CIRCUIT TRANSMISSION LINE WITH 70M RULING SPAN; APPROXIMATE WT. 343 kg

CLIENT

NEPAL ELECTRICITY AUTHORITY
DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
DURBARMARGA, KATHMANDU, NEPAL

CONSULTANT

NEA ENGINEERING COMPANY LTD.
KATHMANDU, NEPAL

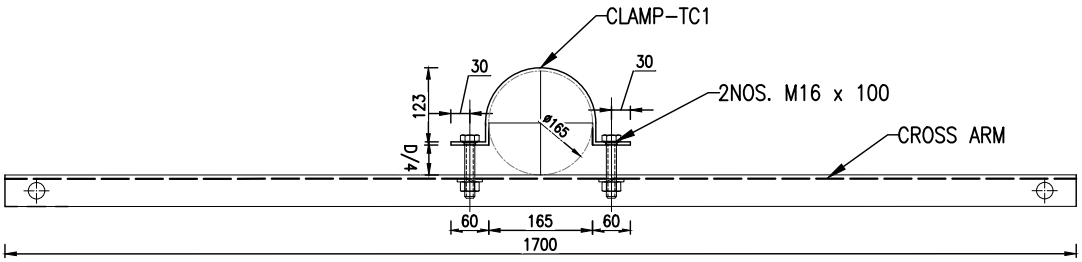
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

DRAWING NO.	CSG-OHL-13DC-SPSA-POLE
DRAWN	AKC
DESIGNED	DDT
DRAFTING CHECK	BP
DESIGN CHECK	
APPROVED	

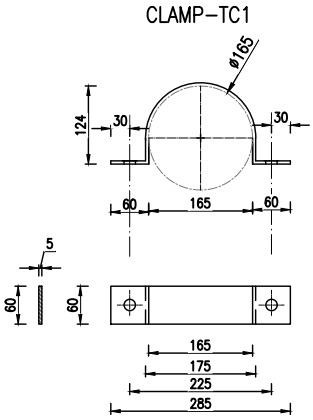
POLE STRUCTURE FOR SINGLE POLE SINGLE ARM STRUCTURE (SPSA) FOR 13 M DOUBLE CIRCUIT 33 kV LINE

FOR TENDER PURPOSE ONLY

Cross Arm for 33kV ISMC100 (100x50x7.5x4.7x1700 mm) x 3 SETS

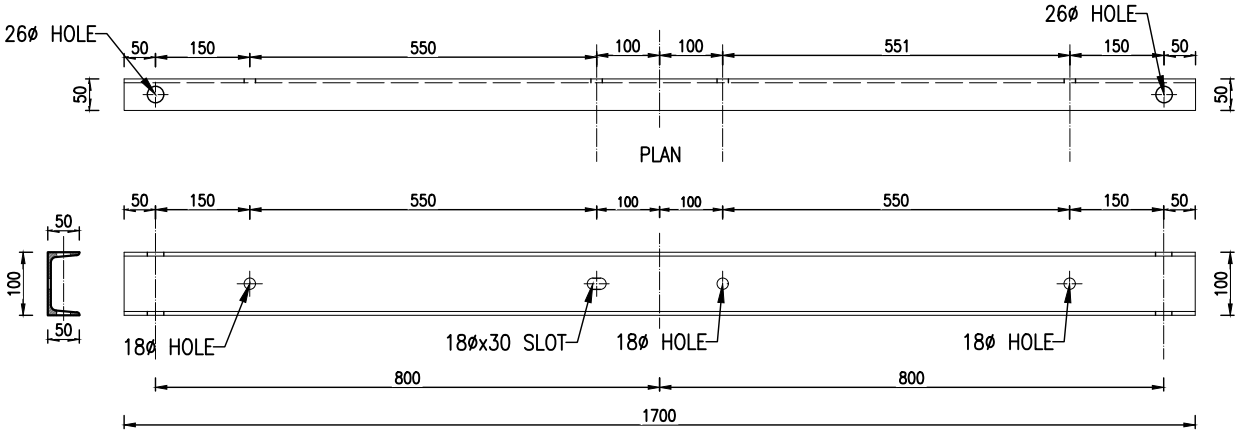


LOWER CROSS ARM ASSEMBLY



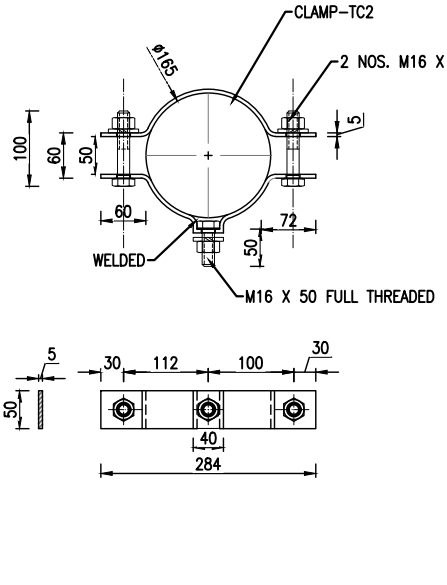
LOWER CHANNEL

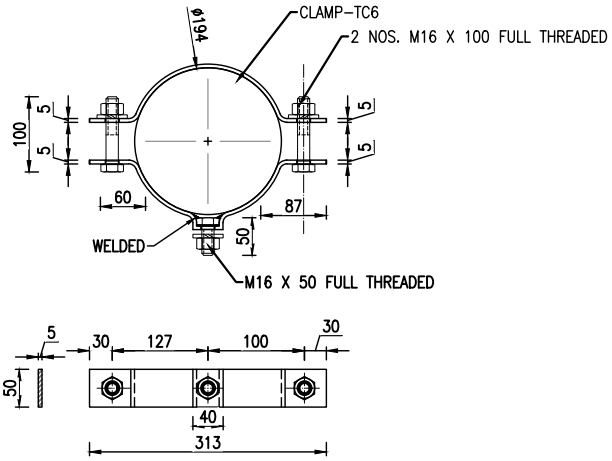
ISMC100 (100 x 50 x 7.5x4.7 x 1700)



CLIENT	CONSULTANT	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT	
NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DRAWING NO.	CSG-OHL-13DC-SPSA-CA
		DRAWN	AKC
		DESIGNED	DDT
		DRAFTING CHECK	BP
		DESIGN CHECK	
		APPROVED	
		CROSS ARM STRUCTURE FOR SINGLE POLE SINGLE ARM STRUCTURE (SPSA) FOR 13 M DOUBLE CIRCUIT 33 kV LINE	
		FOR TENDER PURPOSE ONLY	

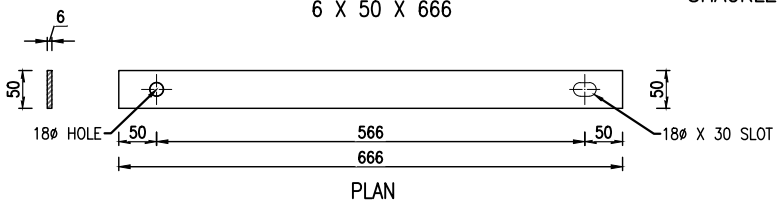
SINGLE BRACING ASSEMBLY – BR1 x 3 SETS



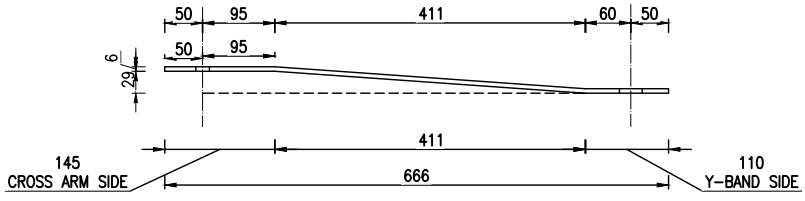


MS BRACING PLATE
6 X 50 X 666

SHACKLE INSULATOR (FOR COMMUNICATION LINE)



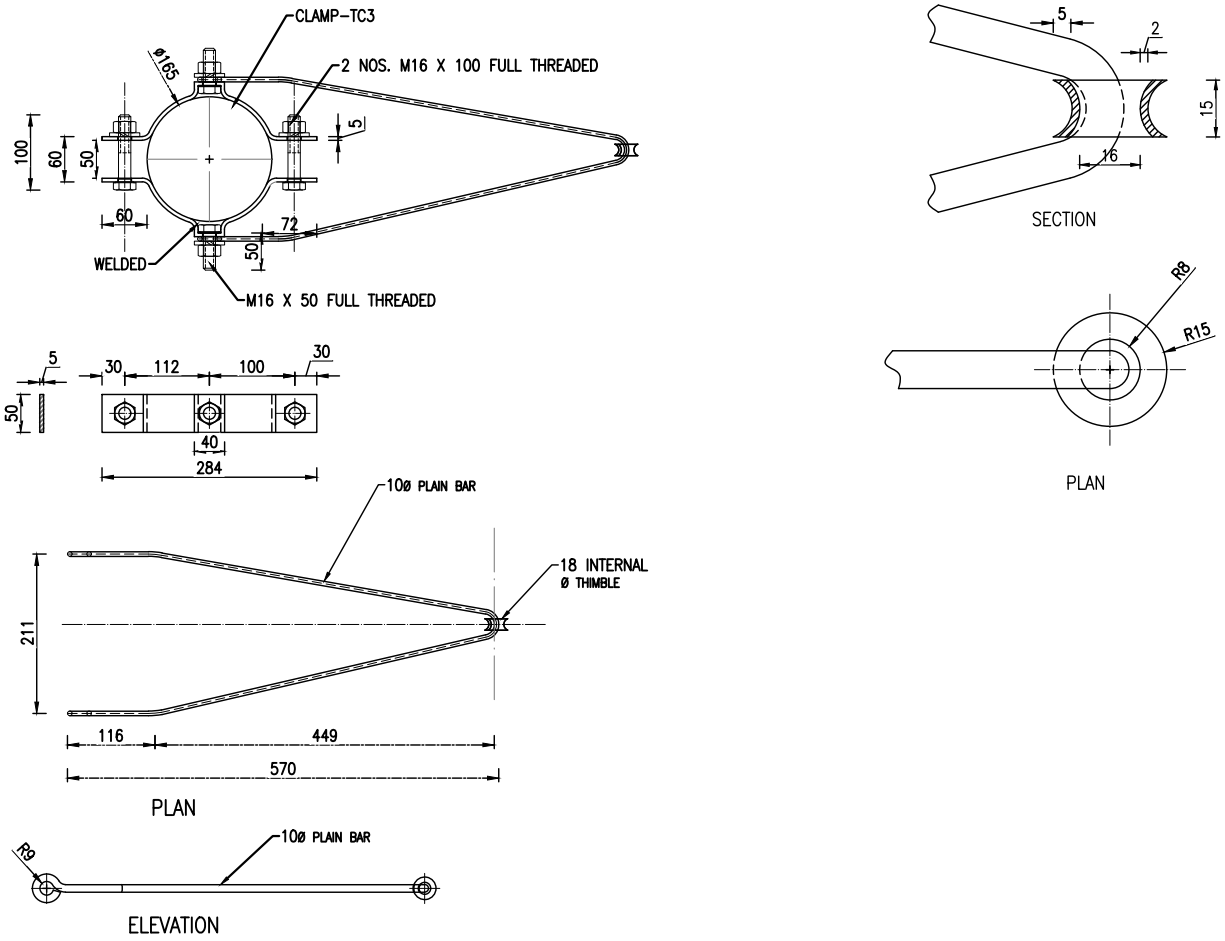
PLAN



ELEVATION

CLIENT	CONSULTANT	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT		
NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DRAWING NO.	CSG–OHL–13DC–SPSA–SB	SINGLE BRACING SET FOR SINGLE POLE SINGLE ARM STRUCTURE (SPSA) FOR 13 M DOUBLE CIRCUIT 33 kV LINE
		DRAWN	AKC	
		DESIGNED	DDT	
		DRAFTING CHECK	BP	
		DESIGN CHECK		
		APPROVED		FOR TENDER PURPOSE ONLY

STAY CLAMP – ST1



STAY SET ASSEMBILY

S.NO.	UNIT	QTY	MATERIAL
1	Nos.	1	HT STAY PLATE (600X600X6)mm
2	Nos.	1	HT STAY ROD (12mm X 1600mm long)
3	Kg.	10	STAY WIRE (7/10 SWG Minimum)
4	Nos.	1	STAY INSULATOR
5	Nos.	2	BOLTS WITH SUITABLE NUTS AND WASHERS (M16X50)MM
6	Nos.	2	BOLTS WITH SUITABLE NUTS AND WASHERS (16X100)MM
7	Nos.	1	POLE CLAMP WITH NUT,BOLT AND WASHERS FOR TOP BRACING (TC3) CLAMP SECTION(50x6.0)MM
8	Set.	1	"V" HANGLE
9	Set.	1	STAY TURN BUCKLE INCLUDING THIMBLE (18SWG MINIMUM)
10	Nos.	1	BOW SET WITH THIMBLE (1000mm Length).
11	Nos.	1	STAY GRIP

CLIENT

NEPAL ELECTRICITY AUTHORITY
DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
DURBARMARGA, KATHMANDU, NEPAL

CONSULTANT

NEA ENGINEERING COMPANY LTD.
KATHMANDU, NEPAL

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

DRAWING NO.	CSG–OHL–13DC–SPSA–STAY
DRAWN	AKC
DESIGNED	DDT
DRAFTING CHECK	BP
DESIGN CHECK	
APPROVED	

STAY SET FOR
SINGLE POLE SINGLE ARM
STRUCTURE (SPSA)
FOR 13 M DOUBLE CIRCUIT
33 kV LINE

FOR TENDER PURPOSE ONLY

SINGLE POLE DEAD END STRUCTURE (SPDE)

S.NO.	UNIT	QTY	MATERIAL
1	Set.	6	DISC INSULATOR (A SET OF THREE)
2	Nos.	6	BACK STRAP
3	Set.	6	TENSION SET WITH BALL AND SOCKET EYE
4	Set.	3	POLE CLAMP WITH NUT, BOLT AND WASHERS (TC1), CLAMP SECTION (50X6)mm FOR TOP ARM
5	Nos.	3	STEEL CROSSARM CHANNEL (100X50X7.5X4.7X1700)MM
6	Set.	3	POLE CLAM WITH NUT, BOLT AND WASHERS (TC2) CLAMP SECTION (50*6)mm FOR BOTTOM ARM
7	Nos.	6	FLAT CROSSARM BRACE 33kV (50x6x666)mm
8	Nos.	9	BOLTS WITH SUITABLE NUTS AND WASHERS (M16X50)MM
9	Nos.	12	BOLTS WITH SUITABLE NUTS AND WASHERS (M16X100)MM
10	Set	1	HT STAY SET (AS REQUIRED)
11	Nos.	1	13 METER STEEL TUBULAR POLE

CLIENT

NEPAL ELECTRICITY AUTHORITY
DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
DURBARMARGA, KATHMANDU, NEPAL

CONSULTANT

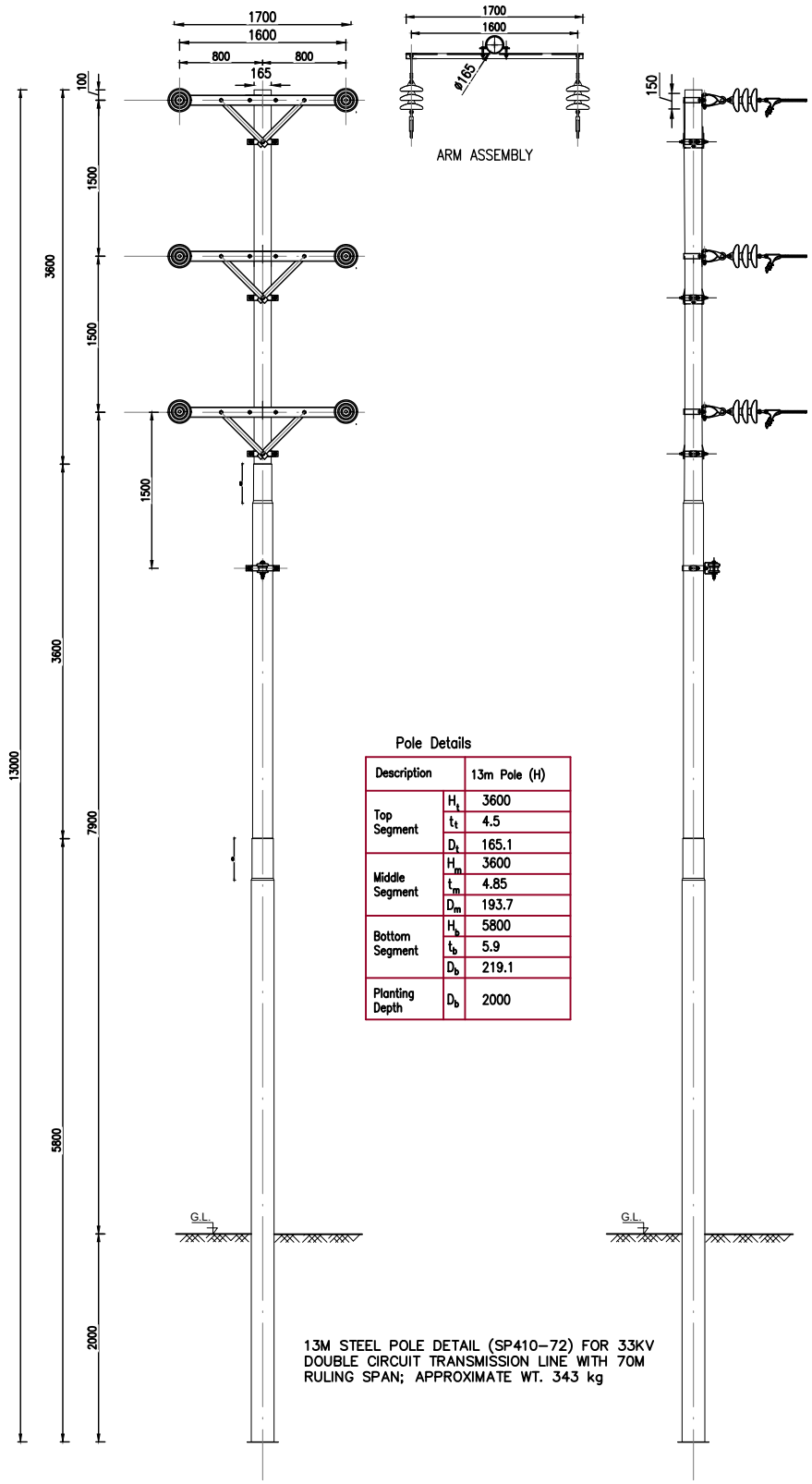
NEA ENGINEERING COMPANY LTD.
KATHMANDU, NEPAL

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

DRAWING NO.	CSG–OHL–13DC–SPDE–BOM
DRAWN	AKC
DESIGNED	DDT
DRAFTING CHECK	BP
DESIGN CHECK	
APPROVED	

BILL OF QUANTITY FOR
SINGLE POLE SINGLE DEAD END
STRUCTURE (SPDE)
FOR 13 M DOUBLE CIRCUIT
33 kV LINE

FOR TENDER PURPOSE ONLY



Pole Details

Description		13m Pole (H)
Top Segment	H_t	3600
	t_t	4.5
	D_t	165.1
Middle Segment	H_m	3600
	t_m	4.85
	D_m	193.7
Bottom Segment	H_b	5800
	t_b	5.9
	D_b	219.1
Planting Depth	D_b	2000

13M STEEL POLE DETAIL (SP410-72) FOR 33KV DOUBLE CIRCUIT TRANSMISSION LINE WITH 70M RULING SPAN; APPROXIMATE WT. 343 kg

CLIENT

NEPAL ELECTRICITY AUTHORITY
DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
DURBARMARGA, KATHMANDU, NEPAL

CONSULTANT

NEA ENGINEERING COMPANY LTD.
KATHMANDU, NEPAL

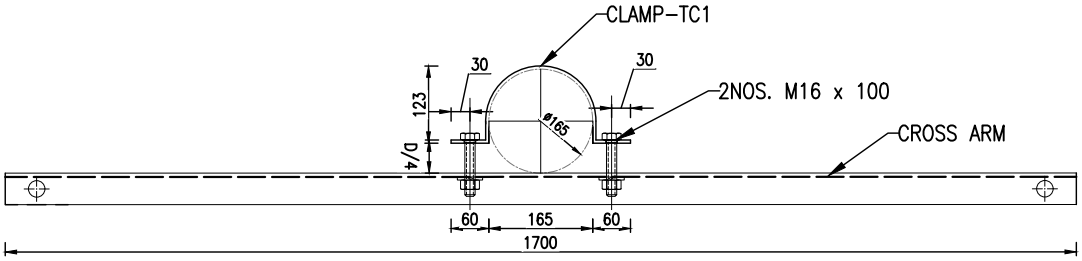
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

DRAWING NO.	CSG-OHL-13DC-SPDE-POLE
DRAWN	AKC
DESIGNED	DDT
DRAFTING CHECK	BP
DESIGN CHECK	
APPROVED	

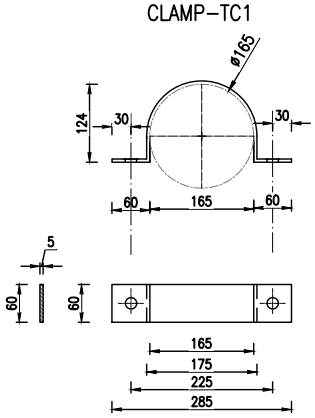
POLE STRUCTURE FOR
SINGLE POLE SINGLE DEAD END
STRUCTURE (SPDE)
FOR 13 M DOUBLE CIRCUIT
33 kV LINE

FOR TENDER PURPOSE ONLY

Cross Arm for 33kV ISMC100 (100x50x7.5x4.7x1700 mm) x 3 SETS

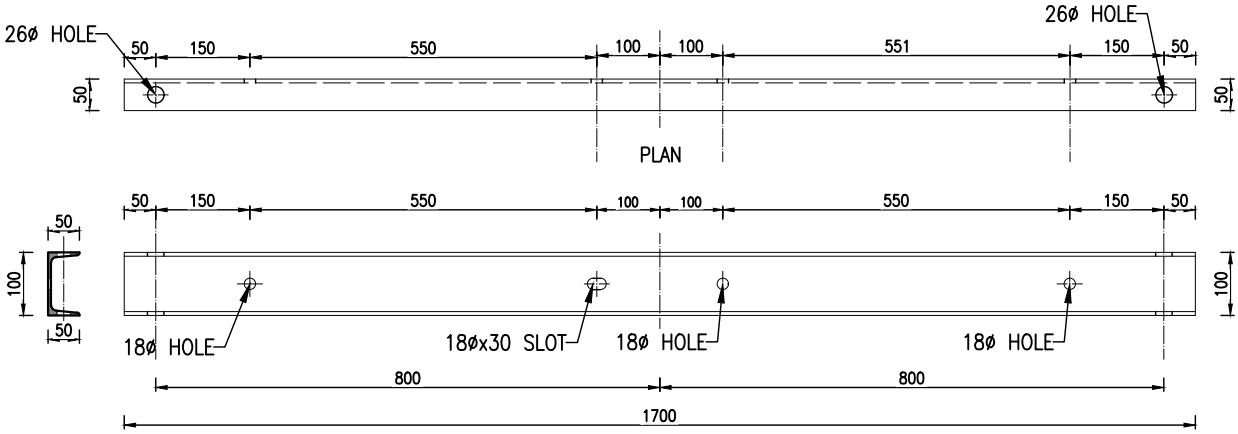


LOWER CROSS ARM ASSEMBLY



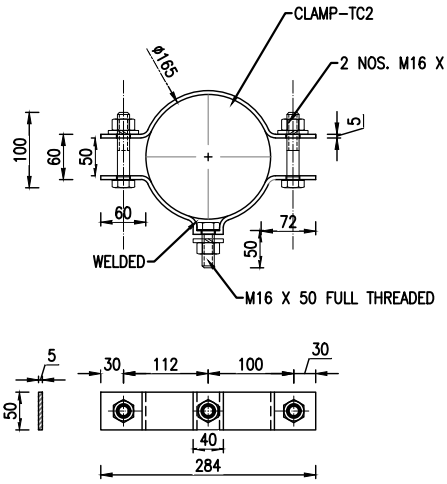
LOWER CHANNEL

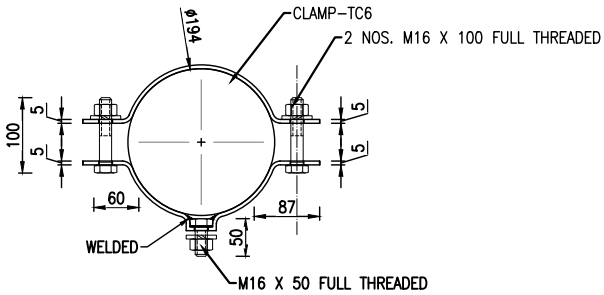
ISMC100 (100 x 50 x 7.5x4.7 x 1700)

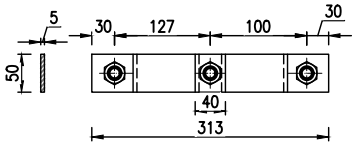


CLIENT	CONSULTANT	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT	
NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DRAWING NO. CSG-OHL-13DC-SPDE-CA DRAWN AKC DESIGNED DDT DRAFTING CHECK BP DESIGN CHECK APPROVED	CROSS ARM STRUCTURE FOR SINGLE POLE SINGLE DEAD END STRUCTURE (SPDE) FOR 13 M DOUBLE CIRCUIT 33 kV LINE FOR TENDER PURPOSE ONLY

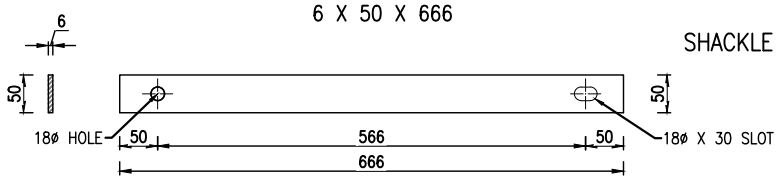
SINGLE BRACING ASSEMBLY – BR1 x 3 SETS



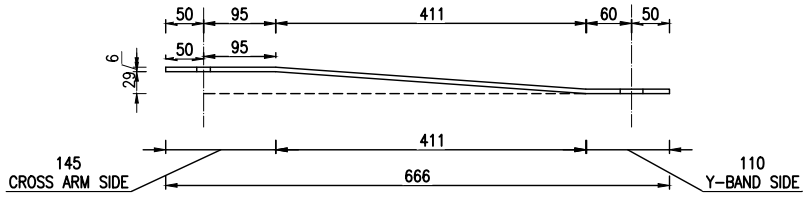




MS BRACING PLATE
6 X 50 X 666



PLAN

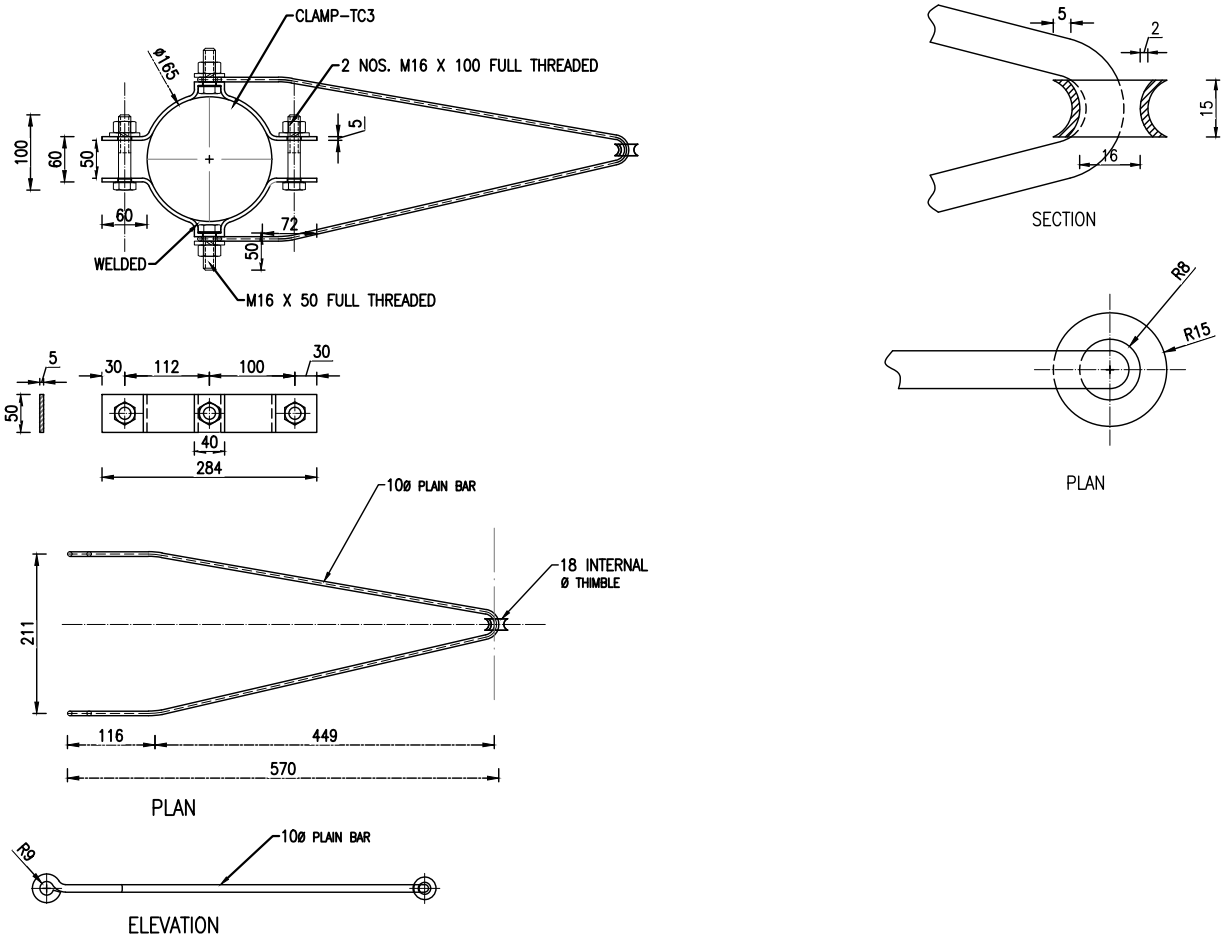


ELEVATION

SHACKLE INSULATOR (FOR COMMUNICATION LINE)

CLIENT	CONSULTANT	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DRAWING NO. CSG–OHL–13DC–SPDE–SB DRAWN AKC DESIGNED DDT DRAFTING CHECK BP DESIGN CHECK APPROVED SINGLE BRACING SET FOR SINGLE POLE SINGLE DEAD END STRUCTURE (SPDE) FOR 13 M DOUBLE CIRCUIT 33 kV LINE FOR TENDER PURPOSE ONLY

STAY CLAMP – ST1



STAY SET ASSEMBILY

S.NO.	UNIT	QTY	MATERIAL
1	Nos.	1	HT STAY PLATE (600X600X6)mm
2	Nos.	1	HT STAY ROD (12mm X 1600mm long)
3	Kg.	10	STAY WIRE (7/10 SWG Minimum)
4	Nos.	1	STAY INSULATOR
5	Nos.	2	BOLTS WITH SUITABLE NUTS AND WASHERS (M16X50)MM
6	Nos.	2	BOLTS WITH SUITABLE NUTS AND WASHERS (16X100)MM
7	Nos.	1	POLE CLAMP WITH NUT,BOLT AND WASHERS FOR TOP BRACING (TC3) CLAMP SECTION(50x6.0)MM
8	Set.	1	"V" HANGLE
9	Set.	1	STAY TURN BUCKLE INCLUDING THIMBLE (18SWG MINIMUM)
10	Nos.	1	BOW SET WITH THIMBLE (1000mm Length).
11	Nos.	1	STAY GRIP

CLIENT

NEPAL ELECTRICITY AUTHORITY
DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
DURBARMARGA, KATHMANDU, NEPAL

CONSULTANT

NEA ENGINEERING COMPANY LTD.
KATHMANDU, NEPAL

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

DRAWING NO.	CSG–OHL–13DC–SPDE–STAY
DRAWN	AKC
DESIGNED	DDT
DRAFTING CHECK	BP
DESIGN CHECK	
APPROVED	

STAY SET FOR
SINGLE POLE SINGLE DEAD END
STRUCTURE (SPDE)
FOR 13 M DOUBLE CIRCUIT
33 kV LINE

FOR TENDER PURPOSE ONLY

SINGLE POLE DOUBLE DEAD END STRUCTURE (SPDDE)

S.NO.	UNIT	QTY	MATERIAL
1	Nos.	6	PIN INSULATOR (33kv)
2	Nos.	6	INSULATOR PIN (33kv)
3	Nos.	6	PREFORM PN TIES (TOP TIES)
4	Set.	12	DISC INSULATOR 33kV (A SET OF THREE)
5	Set.	12	BACK STRAP
6	Nos.	12	TENSION SET WITH BALL AND SOCKET EYE
7	Nos.	6	PG CLAMP FOR ACSR WOLF
8	Nos.	6	STEEL CROSSARM CHANNEL (100X50X7.5X1700)MM
9	Set.	3	POLE CLAMP WITH NUT, BOLT AND WASHERS, BOTTOM BRACING (TC1),CLAMP SECTION (50*6)mm
10	Set.	3	POLE CLAMP WITH NUT, BOLT AND WASHERS, BOTTOM BRACING (TC2),CLAMP SECTION (50*6)mm
11	Nos.	6	FLAT CROSS ARM BRACE 33KV (50X6X666)MM
12	Set	9	BOLTS WITH SUITABLE NUTS AND WASHERS (16X50)MM
13	Nos.	12	BOLTS WITH SUITABLE NUTS AND WASHERS (16X100)MM
14	Nos.	6	BOLTS WITH SUITABLE NUTS AND WASHERS (16X235)MM
16	Nos.	6	STRAP FOR INSULATOR STRING (33kV) (100X5X350)MM
17	Lot	1	HT STAY SET (AS REQUIRED)
18	Nos.	1	13 METER STEEL TUBULAR POLE

CLIENT

NEPAL ELECTRICITY AUTHORITY
DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
DURBARMARGA, KATHMANDU, NEPAL

CONSULTANT

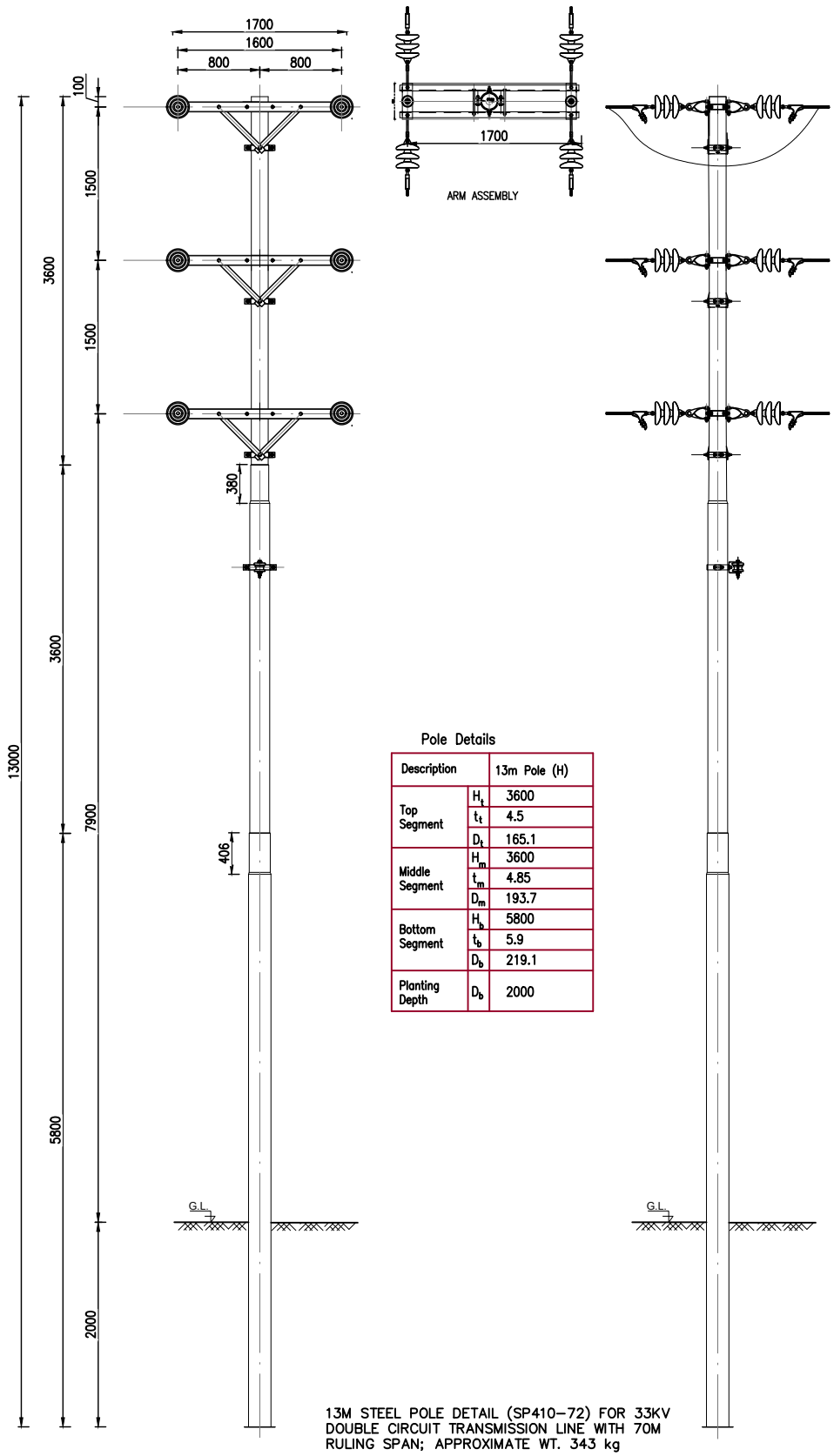
NEA ENGINEERING COMPANY LTD.
KATHMANDU, NEPAL

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

DRAWING NO.	CSG–OHL–13DC–SPDDE–BOM
DRAWN	AKC
DESIGNED	DDT
DRAFTING CHECK	BP
DESIGN CHECK	
APPROVED	

BILL OF QUANTITY FOR
SINGLE POLE DOUBLE DEAD END
STRUCTURE (SPDDE)
FOR 13 M DOUBLE CIRCUIT
33 kV LINE

FOR TENDER PURPOSE ONLY



Pole Details

Description		13m Pole (H)
Top Segment	H_t	3600
	t_t	4.5
	D_t	165.1
Middle Segment	H_m	3600
	t_m	4.85
	D_m	193.7
Bottom Segment	H_b	5800
	t_b	5.9
	D_b	219.1
Planting Depth	D_b	2000

13M STEEL POLE DETAIL (SP410–72) FOR 33KV DOUBLE CIRCUIT TRANSMISSION LINE WITH 70M RULING SPAN; APPROXIMATE WT. 343 kg

CLIENT

NEPAL ELECTRICITY AUTHORITY
DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
DURBARMARGA, KATHMANDU, NEPAL

CONSULTANT

NEA ENGINEERING COMPANY LTD.
KATHMANDU, NEPAL

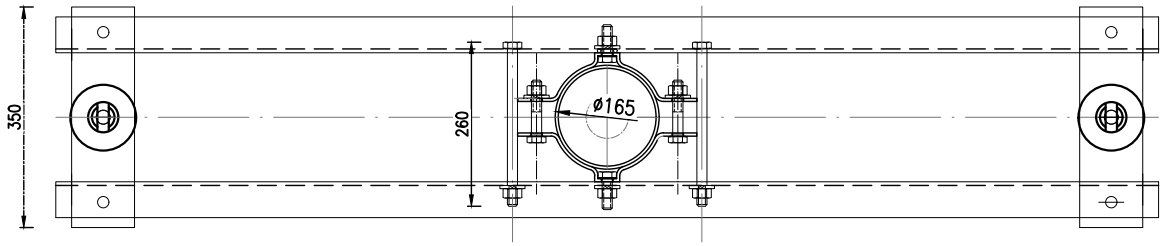
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

DRAWING NO.	CSG–OHL–13DC–SPDDE–POLE
DRAWN	AKC
DESIGNED	DDT
DRAFTING CHECK	BP
DESIGN CHECK	
APPROVED	

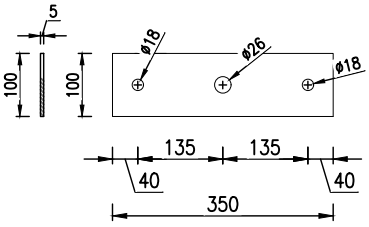
POLE STRUCTURE FOR
SINGLE POLE DOUBLE DEAD END
STRUCTURE (SPDDE)
FOR 13 M DOUBLE CIRCUIT
33 kV LINE

FOR TENDER PURPOSE ONLY

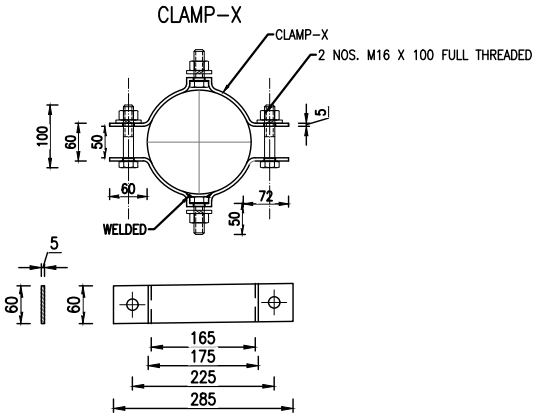
Cross Arm for 33kV ISMC100 (100x50x7.5x4.7x1700 mm)



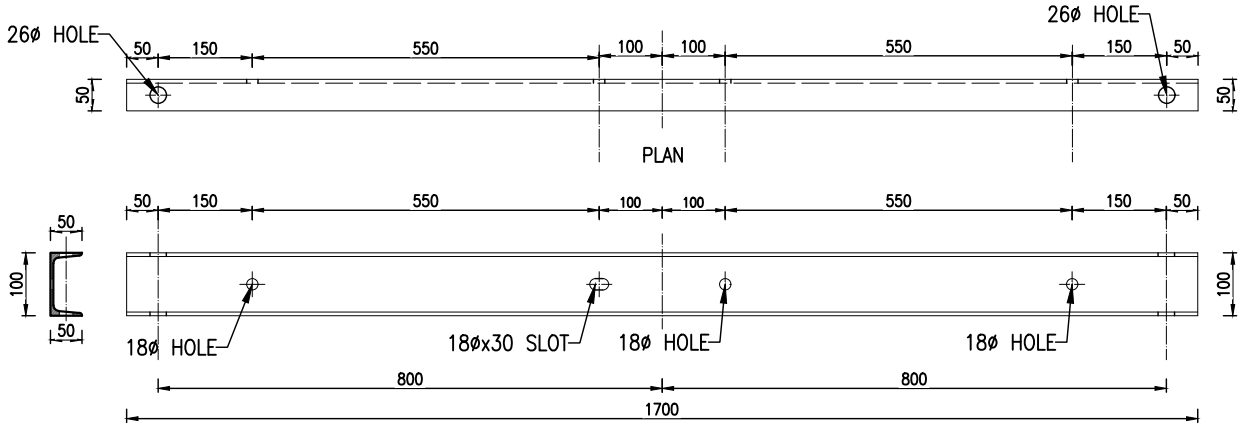
LOWER CROSS ARM ASSEMBLY



STRAP FOR INSULATOR STRING
(50X6X350)MM



LOWER CHANNEL
ISMC100 (100 x 50 x 7.5x4.7 x 1700)

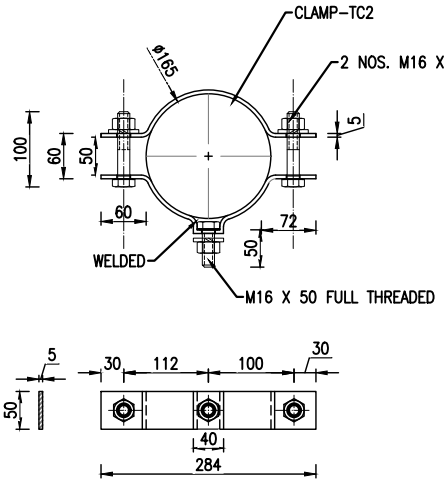


CLIENT	CONSULTANT	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT	
NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DRAWING NO.	CSG-OHL-13DC-SPDDE-CACL
		DRAWN	AKC
		DESIGNED	DDT
		DRAFTING CHECK	BP
		DESIGN CHECK	
		APPROVED	

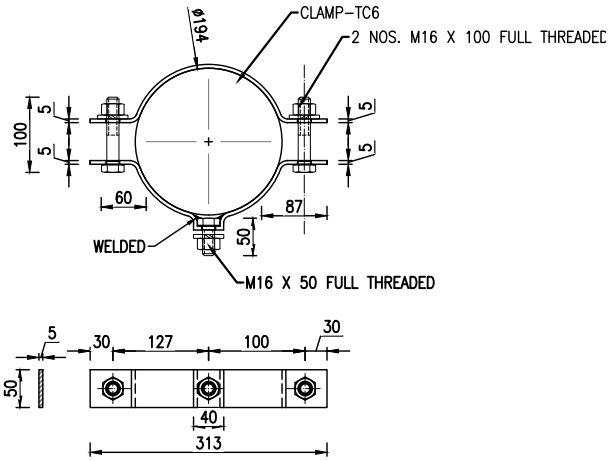
CROSS ARM AND CLAMP STRUCTURE
FOR SINGLE POLE DOUBLE DEAD END
STRUCTURE (SPDDE)
FOR 13 M DOUBLE CIRCUIT
33 kV LINE

FOR TENDER PURPOSE ONLY

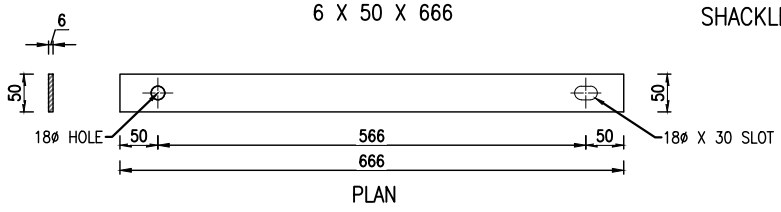
SINGLE BRACING ASSEMBLY – BR1 x 3 SETS



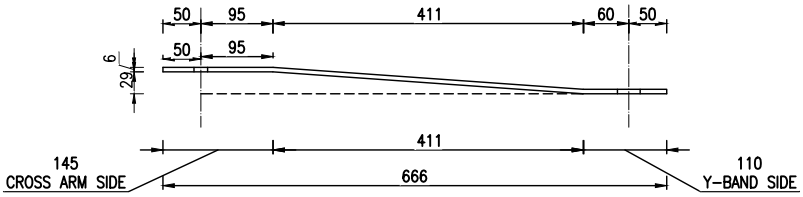
MS BRACING PLATE
6 X 50 X 666



SHACKLE INSULATOR (FOR COMMUNICATION LINE)



PLAN



ELEVATION

CLIENT	NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL
CONSULTANT	NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

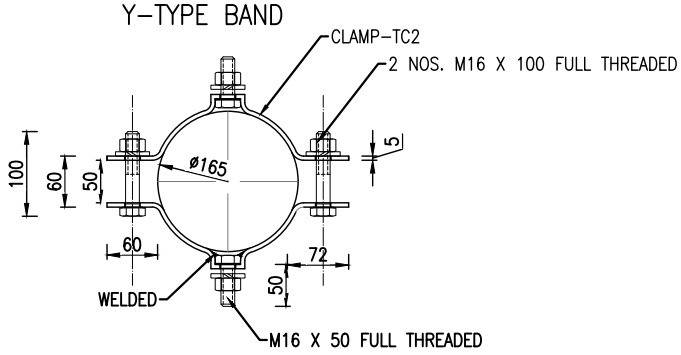
DRAWING NO.	CSG–OHL–13DC–SPDDE–SB
DRAWN	AKC
DESIGNED	DDT
DRAFTING CHECK	BP
DESIGN CHECK	
APPROVED	

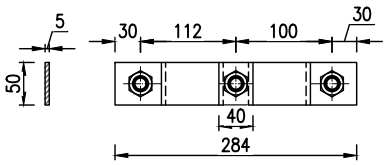
SINGLE BRACING SET FOR
SINGLE POLE DOUBLE DEAD END
STRUCTURE (SPDDE)
FOR 13 M DOUBLE CIRCUIT
33 kV LINE

FOR TENDER PURPOSE ONLY

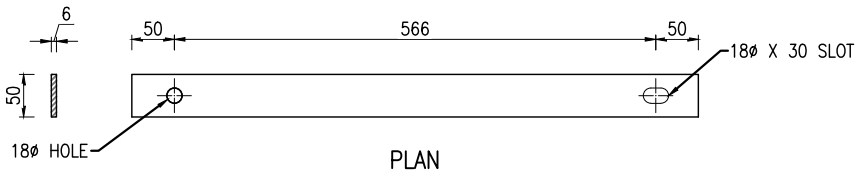
DOUBLE BRACING ASSEMBLY– BR2

Y–TYPE BAND

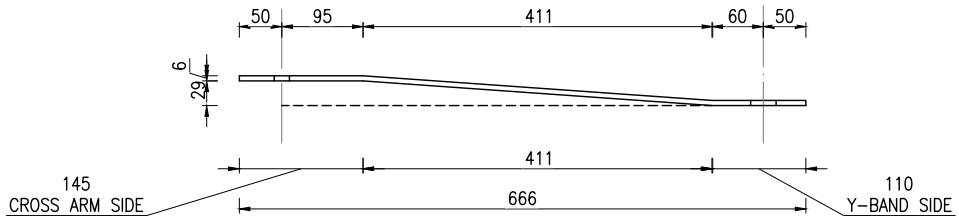




MS BRACING PLATE
6 x 50 x 666



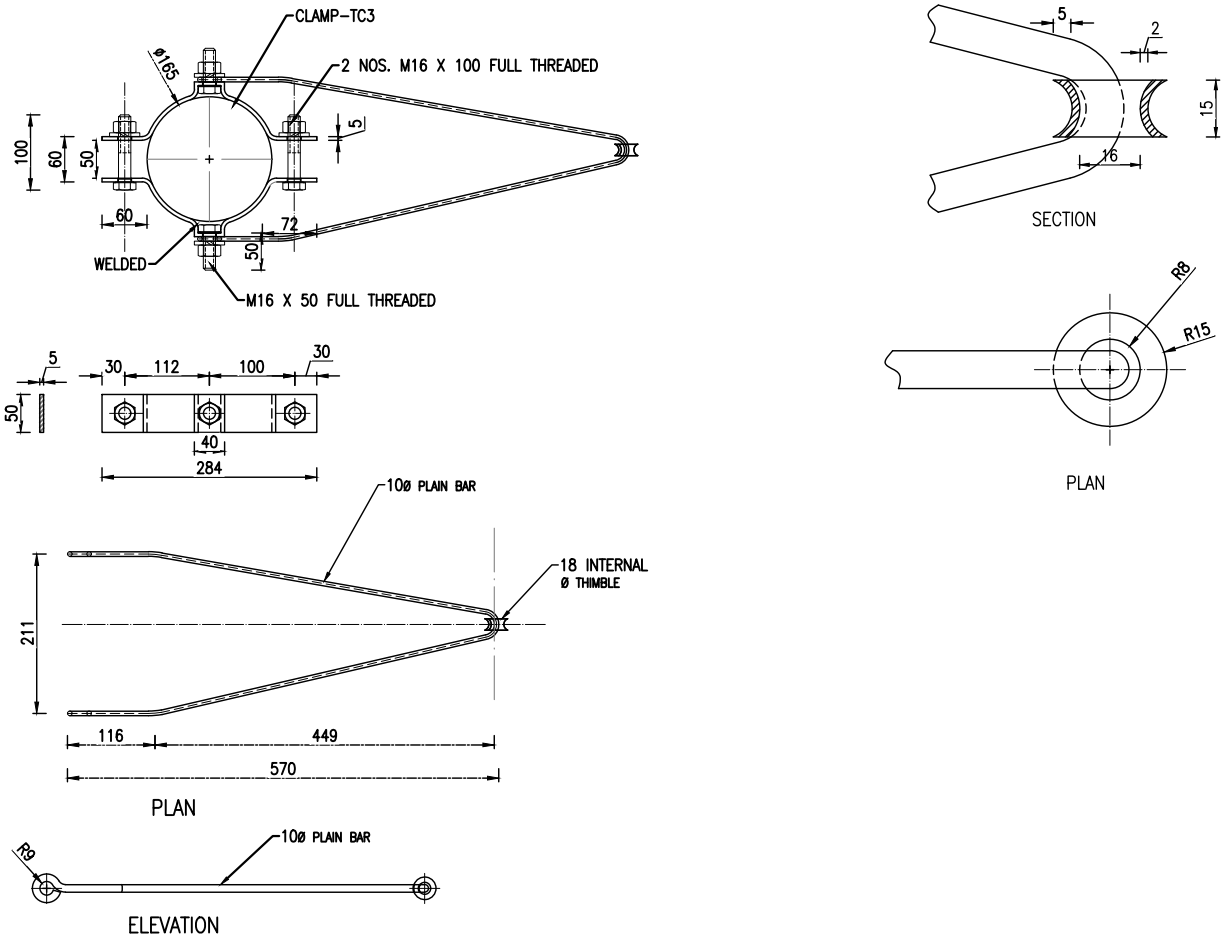
PLAN



ELEVATION

CLIENT	CONSULTANT	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT		
NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DRAWING NO.	CSG–OHL–13DC–SPDDE–DB	DOUBLE BRACING SET FOR SINGLE POLE DOUBLE DEAD END STRUCTURE (SPDDE) FOR 13 M DOUBLE CIRCUIT 33 kV LINE
		DRAWN	AKC	
		DESIGNED	DDT	
		DRAFTING CHECK	BP	
		DESIGN CHECK		
		APPROVED		FOR TENDER PURPOSE ONLY

STAY CLAMP – ST1



STAY SET ASSEMBILY

S.NO.	UNIT	QTY	MATERIAL
1	Nos.	1	HT STAY PLATE (600X600X6)mm
2	Nos.	1	HT STAY ROD (12mm X 1600mm long)
3	Kg.	10	STAY WIRE (7/10 SWG Minimum)
4	Nos.	1	STAY INSULATOR
5	Nos.	2	BOLTS WITH SUITABLE NUTS AND WASHERS (M16X50)MM
6	Nos.	2	BOLTS WITH SUITABLE NUTS AND WASHERS (16X100)MM
7	Nos.	1	POLE CLAMP WITH NUT,BOLT AND WASHERS FOR TOP BRACING (TC3) CLAMP SECTION(50x6.0)MM
8	Set.	1	"V" HANGLE
9	Set.	1	STAY TURN BUCKLE INCLUDING THIMBLE (18SWG MINIMUM)
10	Nos.	1	BOW SET WITH THIMBLE (1000mm Length).
11	Nos.	1	STAY GRIP

CLIENT

NEPAL ELECTRICITY AUTHORITY
DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
DURBARMARGA, KATHMANDU, NEPAL

CONSULTANT

NEA ENGINEERING COMPANY LTD.
KATHMANDU, NEPAL

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

DRAWING NO.	CSG–OHL–13DC–SPDDE–STAY
DRAWN	AKC
DESIGNED	DDT
DRAFTING CHECK	BP
DESIGN CHECK	
APPROVED	

STAY SET FOR
SINGLE POLE DOUBLE DEAD END
STRUCTURE (SPDDE)
FOR 13 M DOUBLE CIRCUIT
33 kV LINE

FOR TENDER PURPOSE ONLY

DOUBLE POLE ASSEMBILY (DPA)

S.NO.	UNIT	QTY	MATERIAL
1	Nos.	6	PIN INSULATOR (33kV)
2	Nos.	6	INSULATOR PIN FOR 33kV PIN
3	Nos.	6	PREFORM PN TIES (TOP TIES)
4	Nos.	3	STEEL CROSSARM CHANNEL (100X50X7.5X4.7X2500)MM
5	Nos.	12	BOLTS WITH SUITABLE NUTS AND WASHERS (16X100)MM
6	Set.	6	POLE CLAMP WITH NUT,BOLT AND WASHERS FOR TOP BRACING (TC1) CLAMP SECTION(50x6.0)MM
7	Set.	2	HT STAY SET (AS REQUIRED)
8	Nos.	2	13 METER STEEL TUBULAR POLE

CLIENT

NEPAL ELECTRICITY AUTHORITY
DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
DURBARMARGA, KATHMANDU, NEPAL

CONSULTANT

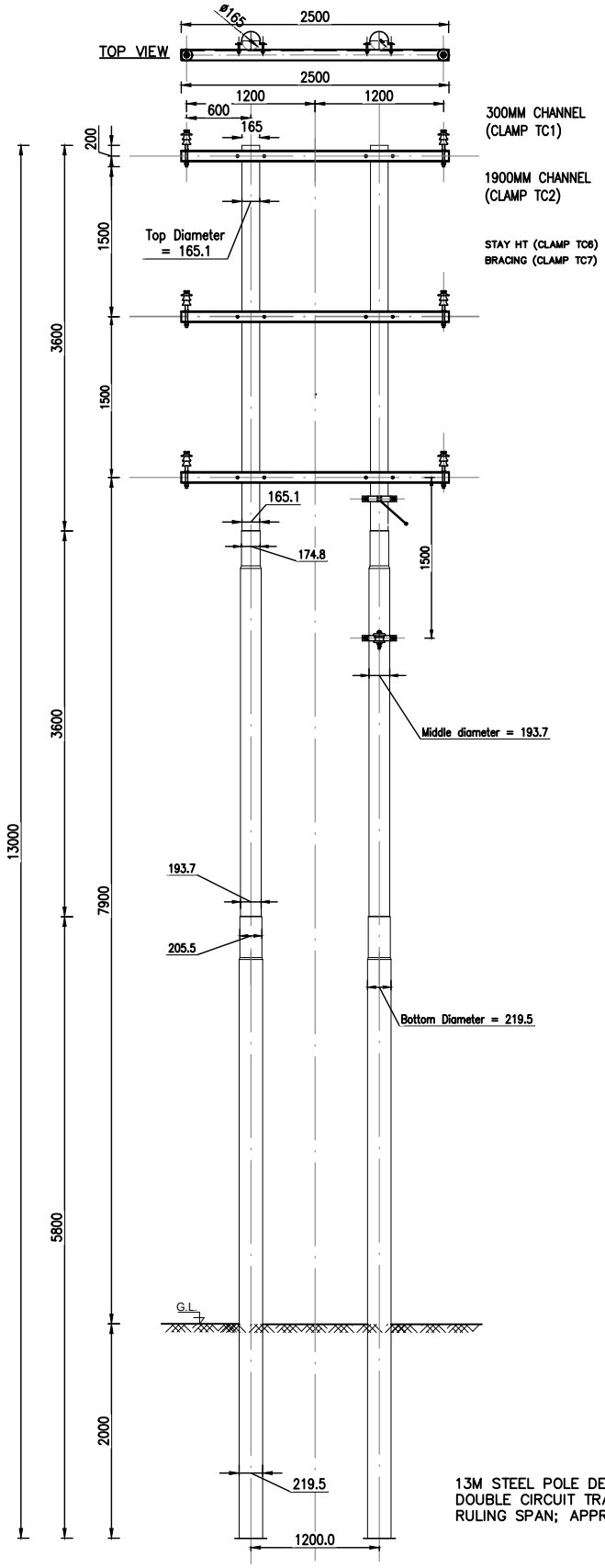
NEA ENGINEERING COMPANY LTD.
KATHMANDU, NEPAL

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

DRAWING NO.	CSG–OHL–13DC–DPA–BOM
DRAWN	AKC
DESIGNED	DDT
DRAFTING CHECK	BP
DESIGN CHECK	
APPROVED	

BILL OF QUANTITY FOR
DOUBLE POLE ASSEMBLY
STRUCTURE (DPA)
FOR 13 M DOUBLE CIRCUIT
33 kV LINE

FOR TENDER PURPOSE ONLY



Pole Details

Description		13m Pole (H)
Top Segment	H_t	3600
	t_t	4.5
	D_t	165.1
Middle Segment	H_m	3600
	t_m	4.85
	D_m	193.7
Bottom Segment	H_b	5800
	t_b	5.9
	D_b	219.1
Planting Depth	D_b	2000

13M STEEL POLE DETAIL (SP410–72) FOR 33KV DOUBLE CIRCUIT TRANSMISSION LINE WITH 70M RULING SPAN; APPROXIMATE WT. 343 kg

CLIENT

NEPAL ELECTRICITY AUTHORITY
DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
DURBARMARGA, KATHMANDU, NEPAL

CONSULTANT

NEA ENGINEERING COMPANY LTD.
KATHMANDU, NEPAL

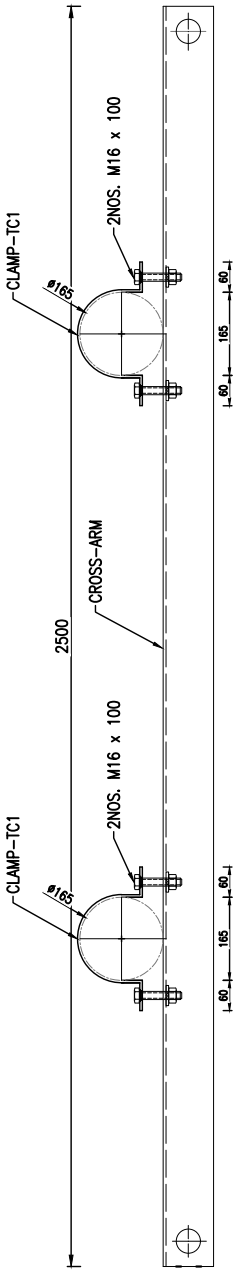
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

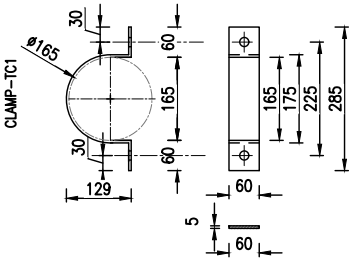
DRAWING NO.	CSG–OHL–13DC–DPA–POLE
DRAWN	AKC
DESIGNED	DDT
DRAFTING CHECK	BP
DESIGN CHECK	
APPROVED	

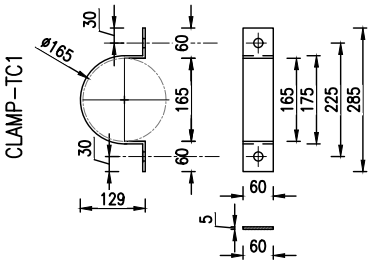
POLE STRUCTURE FOR DOUBLE POLE ASSEMBLY STRUCTURE (DPA) FOR 13 M DOUBLE CIRCUIT 33 kV LINE

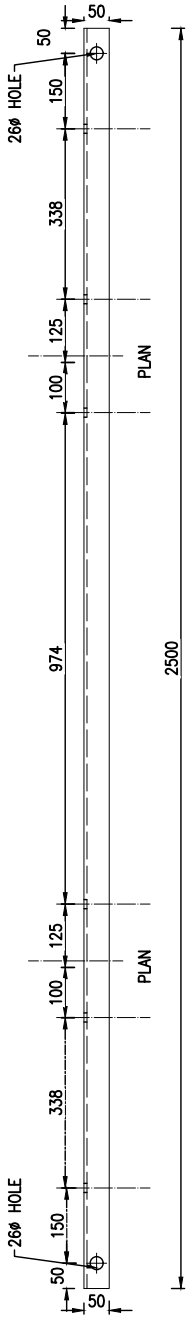
FOR TENDER PURPOSE ONLY

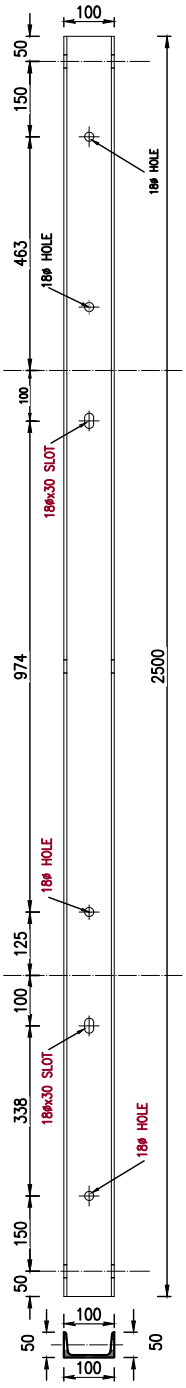
CROSS TOP ARM FOR 33KV H-POLE







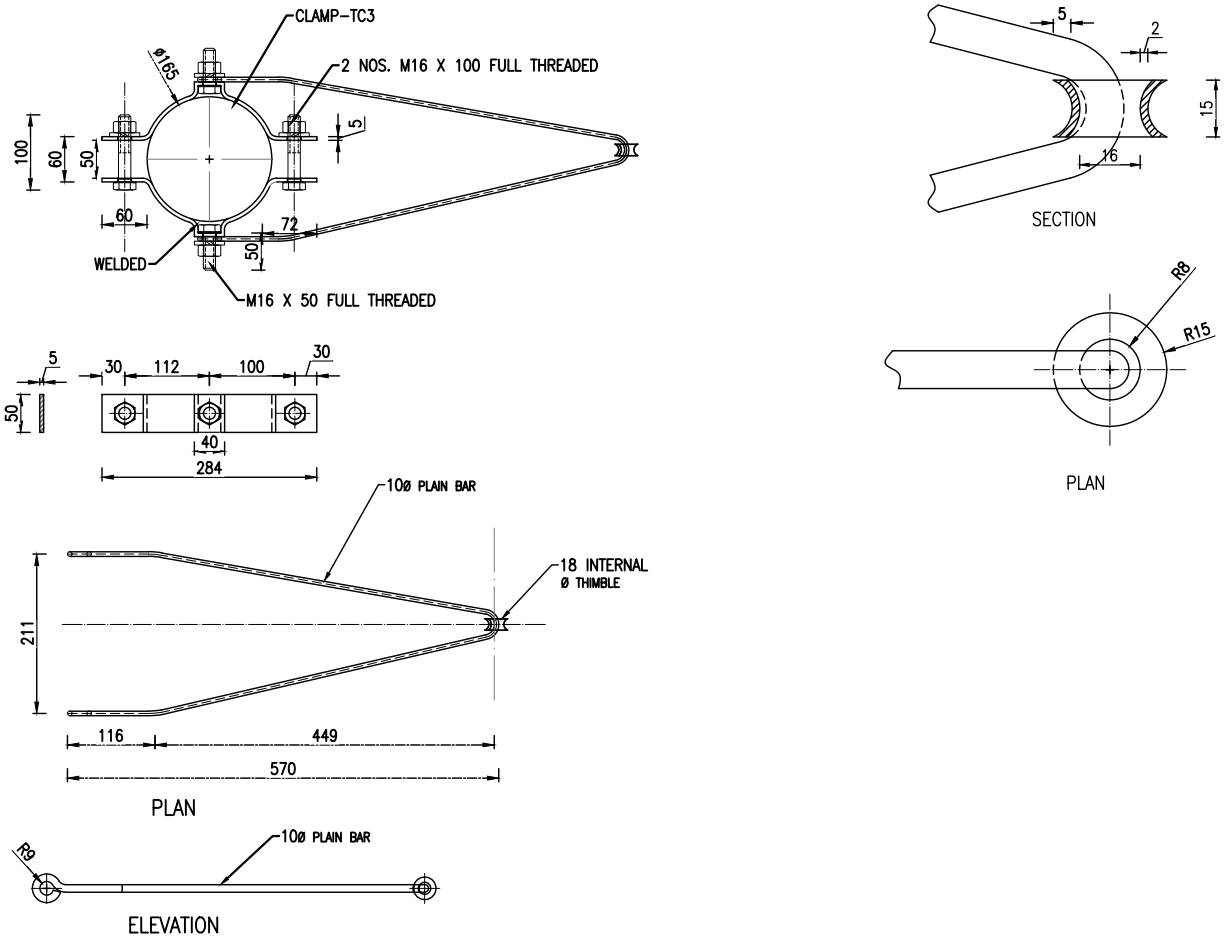




LOWER CHANNEL
ISMC100 (100 x 50 x 7.5x4.7 x 2500)

CLIENT	CONSULTANT	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DRAWING NO. CSG–OHL–13DC–DPA–CLCA DRAWN AKC DESIGNED DDT DRAFTING CHECK BP DESIGN CHECK APPROVED
		CLAMP AND CROSS ARM STRUCTURE FOR DOUBLE POLE ASSEMBLY STRUCTURE (DPA) FOR 13 M DOUBLE CIRCUIT 33 kV LINE
		FOR TENDER PURPOSE ONLY

STAY CLAMP – ST1



STAY SET ASSEMBILY

S.NO.	UNIT	QTY	MATERIAL
1	Nos.	1	HT STAY PLATE (600X600X6)mm
2	Nos.	1	HT STAY ROD (12mm X 1600mm long)
3	Kg.	10	STAY WIRE (7/10 SWG Minimum)
4	Nos.	1	STAY INSULATOR
5	Nos.	2	BOLTS WITH SUITABLE NUTS AND WASHERS (M16X50)MM
6	Nos.	2	BOLTS WITH SUITABLE NUTS AND WASHERS (16X100)MM
7	Nos.	1	POLE CLAMP WITH NUT,BOLT AND WASHERS FOR TOP BRACING (TC3) CLAMP SECTION(50x6.0)MM
8	Set.	1	"V" HANGLE
9	Set.	1	STAY TURN BUCKLE INCLUDING THIMBLE (18SWG MINIMUM)
10	Nos.	1	BOW SET WITH THIMBLE (1000mm Length).
11	Nos.	1	STAY GRIP

CLIENT

NEPAL ELECTRICITY AUTHORITY
DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
DURBARMARGA, KATHMANDU, NEPAL

CONSULTANT

NEA ENGINEERING COMPANY LTD.
KATHMANDU, NEPAL

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

DRAWING NO.	CSG–OHL–13DC–DPA–STAY
DRAWN	AKC
DESIGNED	DDT
DRAFTING CHECK	BP
DESIGN CHECK	
APPROVED	

STAY SET FOR
DOUBLE POLE ASSEMBLY
STRUCTURE (DPA)
FOR 13 M DOUBLE CIRCUIT
33 kV LINE

FOR TENDER PURPOSE ONLY

DOUBLE POLE DEAD END ARM STRUCTURE (DPDA)

S.NO.	UNIT	QTY	MATERIAL
1	Set.	6	DISC INSULATOR 33kV (A SET OF THREE)
2	Set.	6	BACK STRAP
3	Set.	6	TENSION SET WITH BALL AND SOCKET EYE
4	Nos.	3	STEEL CROSS ARM CHANNEL (100X50X7.5X4.7X2500)MM
5	Set.	6	POLE CLAMP WITH NUT, BOLT AND WASHERS (TC1), CLAMP SECTION (50X6)MM
6	Nos.	12	BOLTS WITH SUITABLE NUTS AND WASHERS (M16X100)MM
7	Set	2	HT STAY SET (AS REQUIRED)
8	Nos.	2	13 METER STEEL TUBULAR POLE

CLIENT

NEPAL ELECTRICITY AUTHORITY
DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
DURBARMARGA, KATHMANDU, NEPAL

CONSULTANT

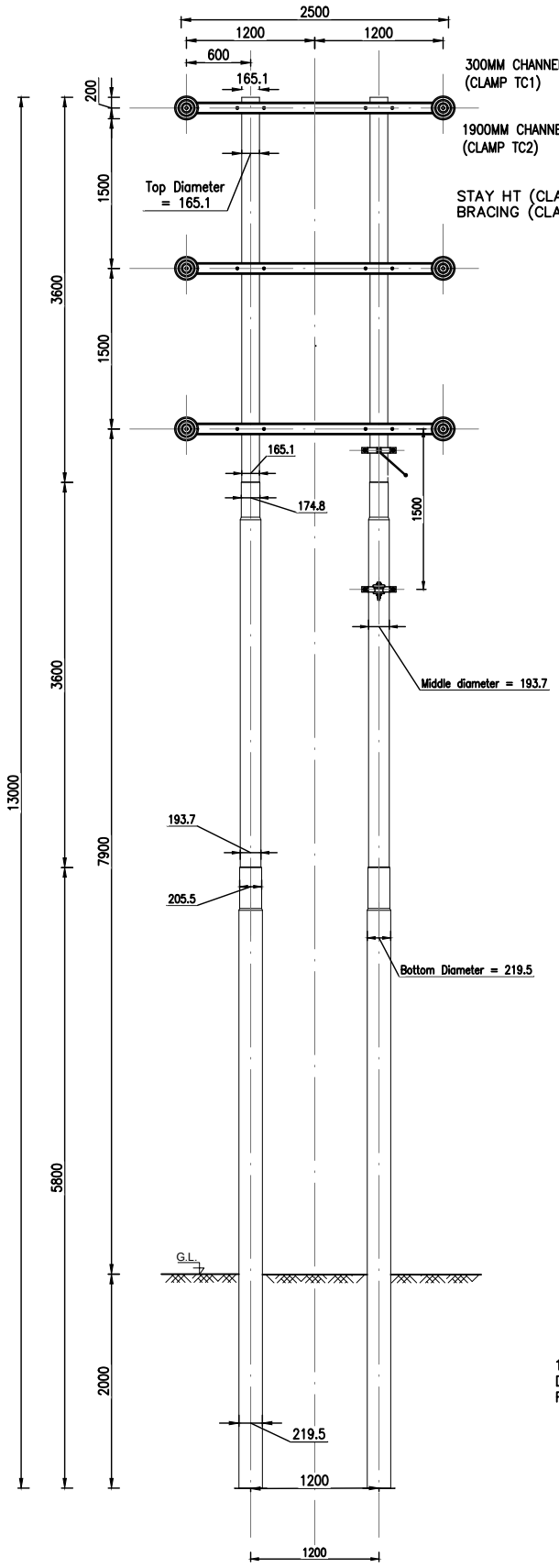
NEA ENGINEERING COMPANY LTD.
KATHMANDU, NEPAL

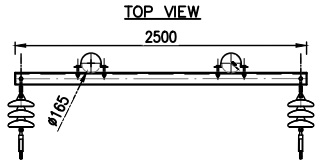
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

DRAWING NO.	CSG–OHL–13DC–DPDA–BOM
DRAWN	AKC
DESIGNED	DDT
DRAFTING CHECK	BP
DESIGN CHECK	
APPROVED	

BILL OF QUANTITY FOR
DOUBLE POLE SINGLE DEAD END
STRUCTURE (DPDA)
FOR 13 M DOUBLE CIRCUIT
33 kV LINE

FOR TENDER PURPOSE ONLY





Pole Details

Description		13m Pole (H)
Top Segment	H_t	3600
	t_t	4.5
	D_t	165.1
Middle Segment	H_m	3600
	t_m	4.85
	D_m	193.7
Bottom Segment	H_b	5800
	t_b	5.9
	D_b	219.1
Planting Depth	D_b	2000

13M STEEL POLE DETAIL (SP410-72) FOR 33KV DOUBLE CIRCUIT TRANSMISSION LINE WITH 70M RULING SPAN; APPROXIMATE WT. 343 kg

CLIENT

NEPAL ELECTRICITY AUTHORITY
DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
DURBARMARGA, KATHMANDU, NEPAL

CONSULTANT

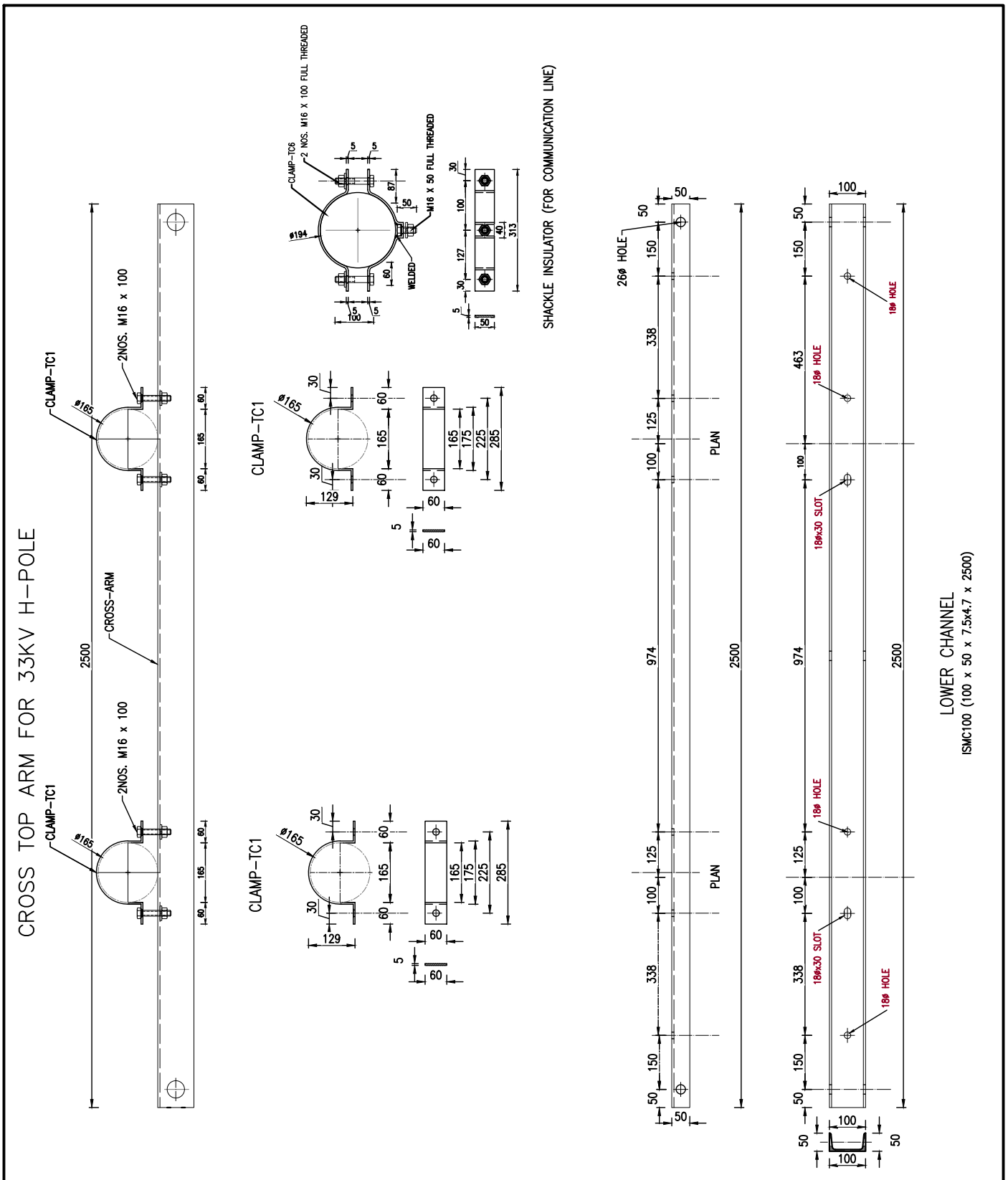
NEA ENGINEERING COMPANY LTD.
KATHMANDU, NEPAL

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

DRAWING NO.	CSG-OHL-13DC-DPDA-POLE
DRAWN	AKC
DESIGNED	DDT
DRAFTING CHECK	BP
DESIGN CHECK	
APPROVED	

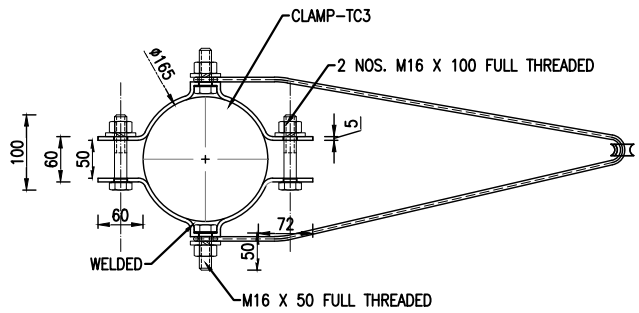
POLE STRUCTURE FOR
DOUBLE POLE SINGLE DEAD END
STRUCTURE (DPDA)
FOR 13 M DOUBLE CIRCUIT
33 kV LINE

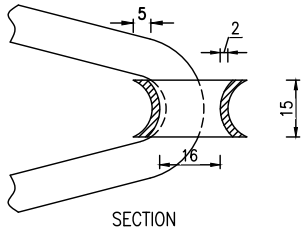
FOR TENDER PURPOSE ONLY

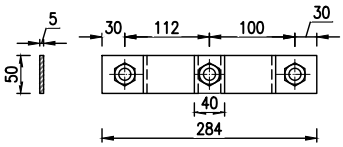


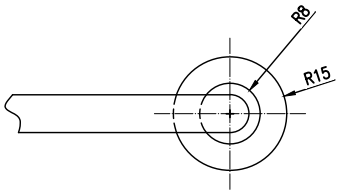
CLIENT	CONSULTANT	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DRAWING NO. CSG–OHL–13DC–DPDA–CLCA DRAWN AKC DESIGNED DDT DRAFTING CHECK BP DESIGN CHECK APPROVED
		CLAMP AND CROSS ARM STRUCTURE FOR DOUBLE POLE SINGLE DEAD END STRUCTURE (DPDA) FOR 13 M DOUBLE CIRCUIT 33 kV LINE
		FOR TENDER PURPOSE ONLY

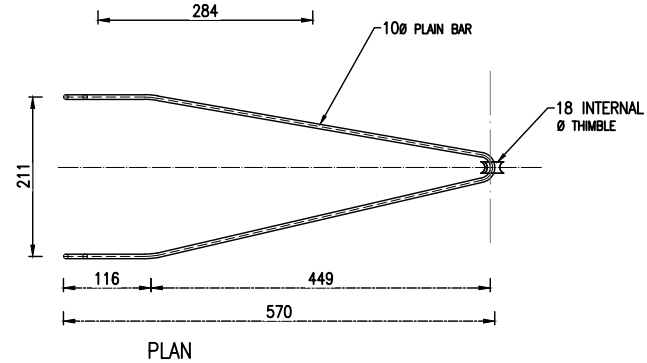
STAY CLAMP – ST1

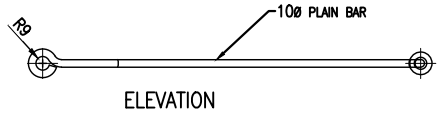












STAY SET ASSEMBILY

S.NO.	UNIT	QTY	MATERIAL
1	Nos.	1	HT STAY PLATE (600X600X6)mm
2	Nos.	1	HT STAY ROD (12mm X 1600mm long)
3	Kg.	10	STAY WIRE (7/10 SWG Minimum)
4	Nos.	1	STAY INSULATOR
5	Nos.	2	BOLTS WITH SUITABLE NUTS AND WASHERS (M16X50)MM
6	Nos.	2	BOLTS WITH SUITABLE NUTS AND WASHERS (16X100)MM
7	Nos.	1	POLE CLAMP WITH NUT,BOLT AND WASHERS FOR TOP BRACING (TC3) CLAMP SECTION(50x6.0)MM
8	Set.	1	"V" HANGLE
9	Set.	1	STAY TURN BUCKLE INCLUDING THIMBLE (18SWG MINIMUM)
10	Nos.	1	BOW SET WITH THIMBLE (1000mm Length).
11	Nos.	1	STAY GRIP

CLIENT

NEPAL ELECTRICITY AUTHORITY
DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
DURBARMARGA, KATHMANDU, NEPAL

CONSULTANT

NEA ENGINEERING COMPANY LTD.
KATHMANDU, NEPAL

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

DRAWING NO.	CSG–OHL–13DC–DPDA–STAY
DRAWN	AKC
DESIGNED	DDT
DRAFTING CHECK	BP
DESIGN CHECK	
APPROVED	

STAY SET FOR
DOUBLE POLE SINGLE DEAD END
STRUCTURE (DPDA)
FOR 13 M DOUBLE CIRCUIT
33 kV LINE

FOR TENDER PURPOSE ONLY

DOUBLE POLE DOUBLE DEAD END ARM STRUCTURE (DDPDA)

S.NO.	UNIT	QTY	MATERIAL
1	Nos.	6	PIN TYPE INSULATOR FOR 33KV
2	Nos.	6	INSULATOR PIN FOR PIN INSULATOR OF 33KV
3	Nos.	6	PREFORMED PIN TIES, TOP TIES
4	Nos.	12	DISC TYPE INSULATOR, SET OF THREE FOR 33KV
5	Nos.	12	BACK STRAP
6	Nos.	12	TENSION SET WITH BALL AND SOCKET EYE
4	Nos.	6	PG CLAMP FOR ACSR WOLF
5	Nos.	6	STEEL CROSS ARM CHANNEL (100X50X7.5X4.7X1700)MM
6	Nos.	6	STRAP FOR INSULATOR STRING FOR 33KV (100X5X350)MM
5	Set.	6	POLE CLAMP WITH NUT,BOLT AND WASHERS (TC1),CLAMP SETCTION (50X6)MM
5	Set.	2	POLE CLAMP WITH NUT,BOLT AND WASHERS TOP BRACING (TC4), CLAMP SECTION (50X6)MM
6	Set.	2	POLE CLAMP WITH NUT,BOLT AND WASHERS BOTTOM BRACING (TC5), CLAMP SECTION (50X6)MM
5	Nos.	1	STEEL CROSSARM CHANNEL (100X50X7.5X4.7X1600)MM
6	Nos.	1	STEEL CROSSARM CHANNEL (100X50X7.5X4.7X1640)MM
5	Nos.	2	STEEL CROSSARM CHANNEL (100X50X7.5X4.7X2610)MM
8	Nos.	20	BOLTS WITH SUITABLE NUT AND WASHERS (M16X100)MM

CLIENT

NEPAL ELECTRICITY AUTHORITY
DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
DURBARMARGA, KATHMANDU, NEPAL

CONSULTANT

NEA ENGINEERING COMPANY LTD.
KATHMANDU, NEPAL

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

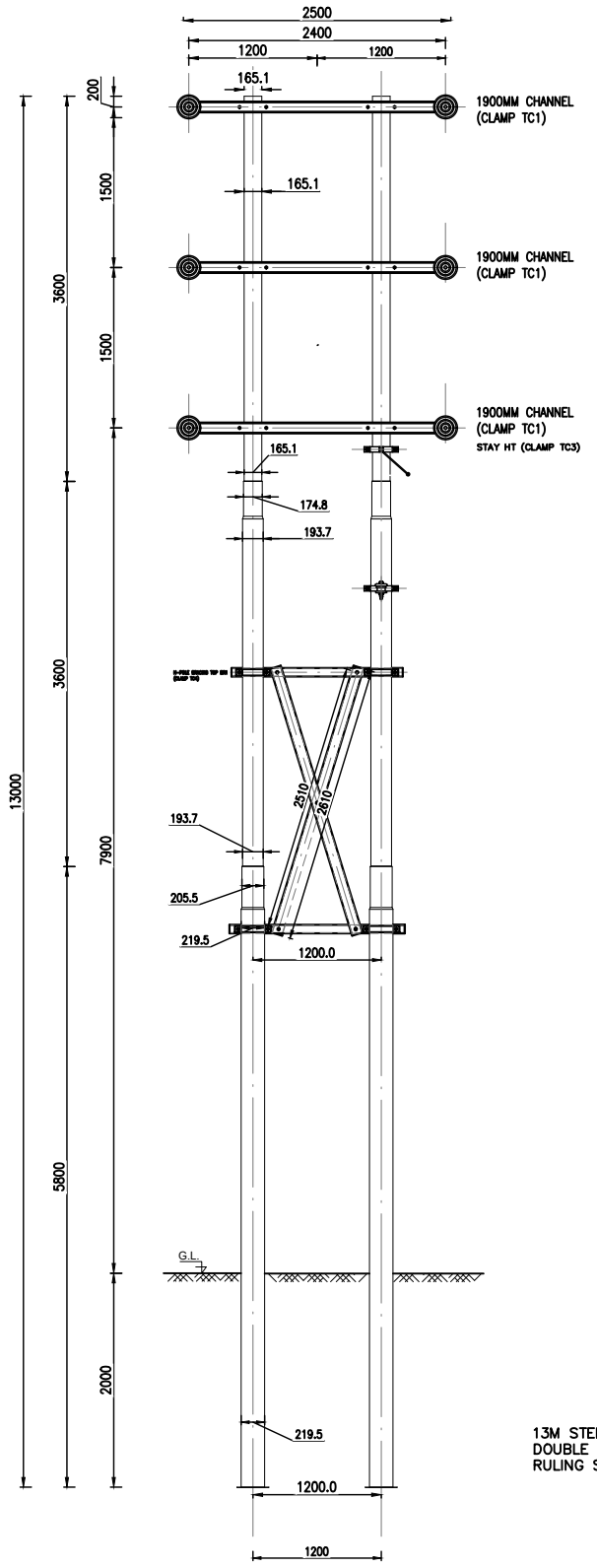
DRAWING NO.	CSG–OHL–13DC–DDPDA–BOM
DRAWN	AKC
DESIGNED	DDT
DRAFTING CHECK	BP
DESIGN CHECK	
APPROVED	

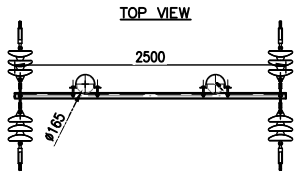
BILL OF QUANTITY FOR
DOUBLE POLE DOUBLE ARM
DEAD END STRUCTURE (DDPDA)
FOR 13 M DOUBLE CIRCUIT
33 kV LINE

FOR TENDER PURPOSE ONLY

Pole Details

Description		13m Pole (H)
Top Segment	H_t	3600
	t_t	4.5
	D_t	165.1
Middle Segment	H_m	3600
	t_m	4.85
	D_m	193.7
Bottom Segment	H_b	5800
	t_b	5.9
	D_b	219.1
Planting Depth	D_b	2000





13M STEEL POLE DETAIL (SP410-72) FOR 33KV DOUBLE CIRCUIT TRANSMISSION LINE WITH 70M RULING SPAN; APPROXIMATE WT. 343 kg

FRONT ELEVATION OF
13 M STEEL POLE DETAIL (SP410-72) FOR 33KV
DOUBLE CIRCUIT TRANSMISSIONLINE WITH 70M
RULING SPAN
Scale=1:50

CLIENT

NEPAL ELECTRICITY AUTHORITY
DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
DURBARMARGA, KATHMANDU, NEPAL

CONSULTANT

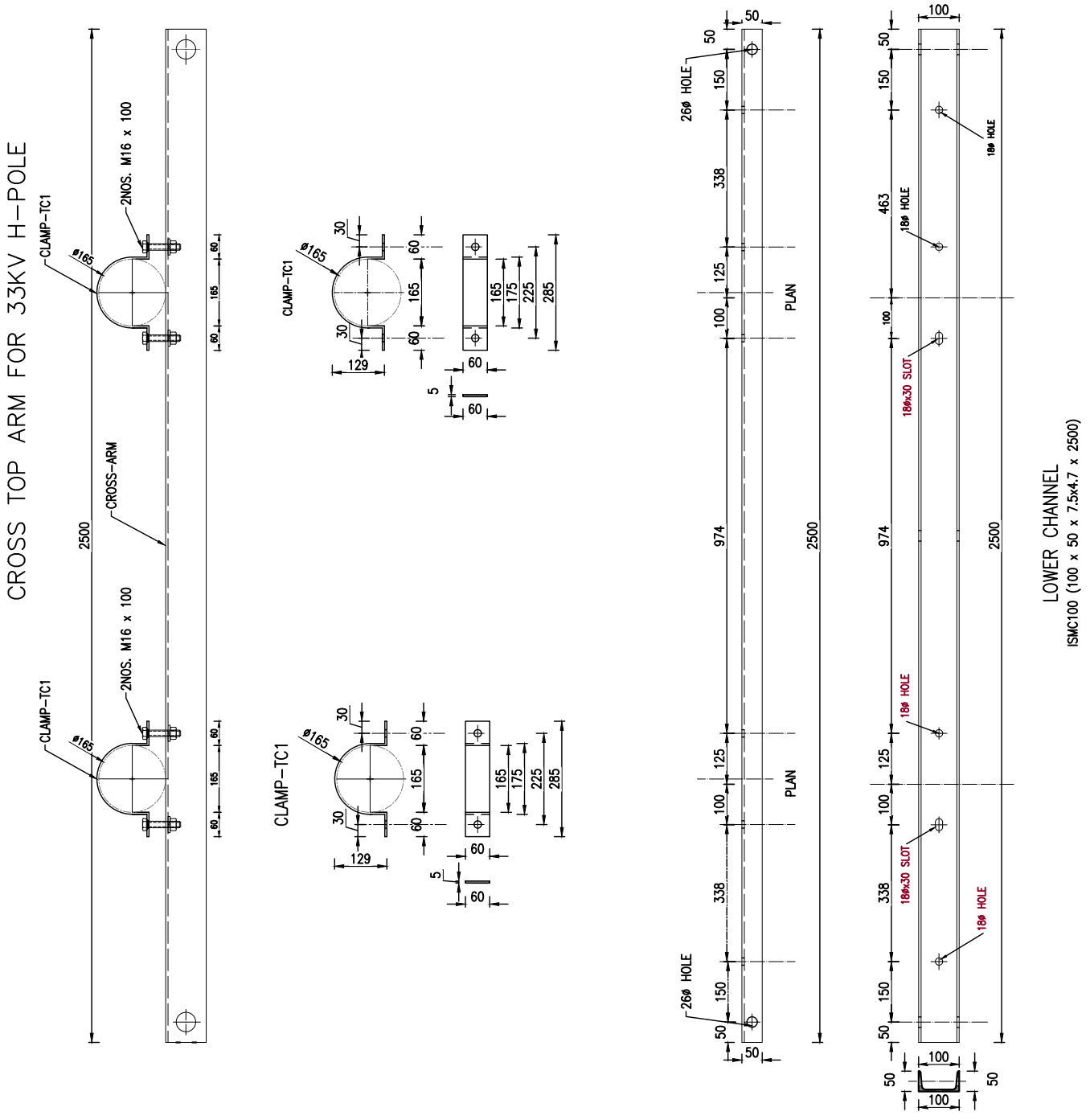
NEA ENGINEERING COMPANY LTD.
KATHMANDU, NEPAL

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

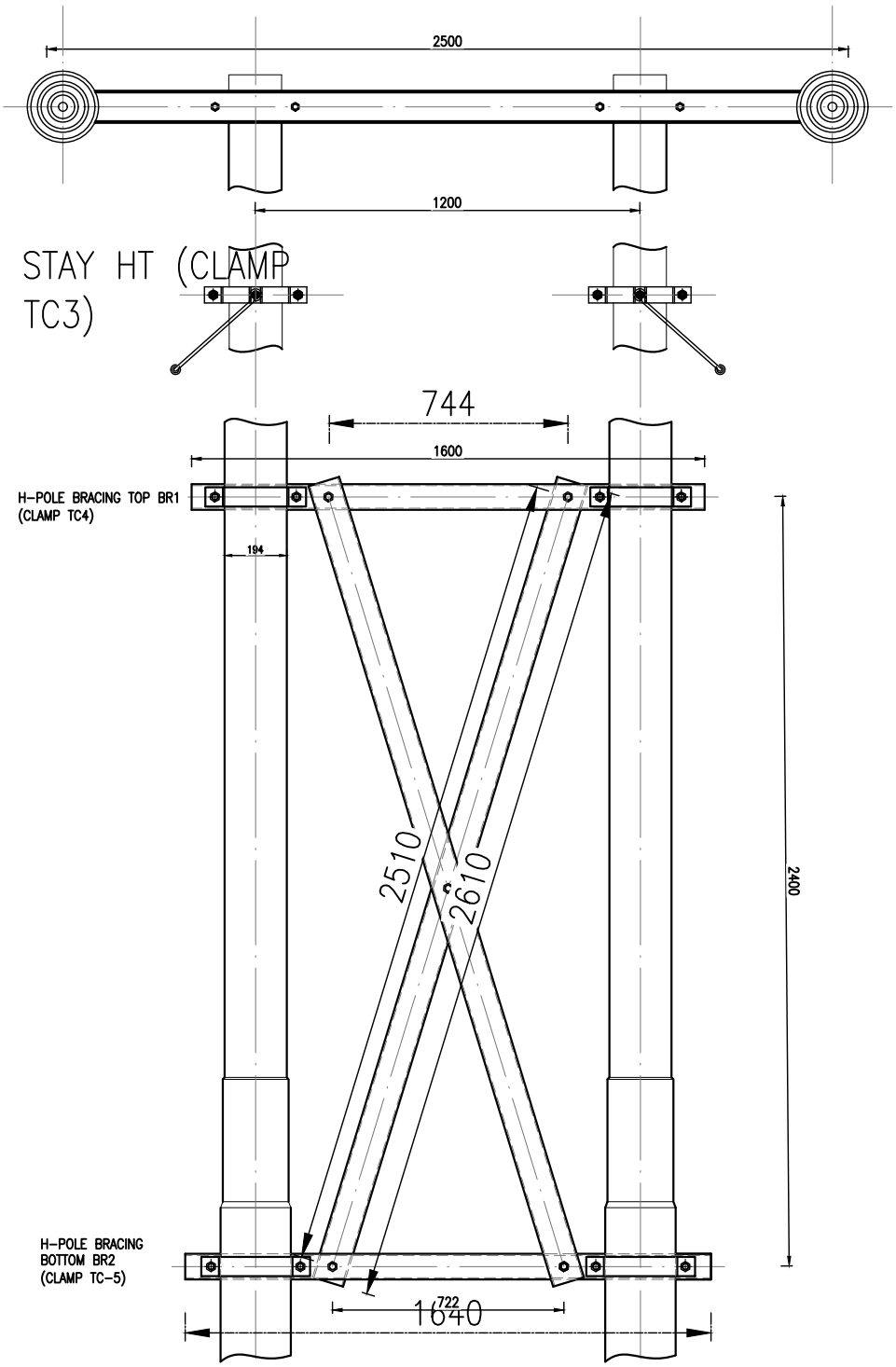
DRAWING NO.	CSG-OHL-13DC-DDPDA-POLE
DRAWN	AKC
DESIGNED	DDT
DRAFTING CHECK	BP
DESIGN CHECK	
APPROVED	

POLE STRUCTURE FOR
DOUBLE POLE DOUBLE ARM
DEAD END STRUCTURE (DDPDA)
FOR 13 M DOUBLE CIRCUIT
33 kV LINE

FOR TENDER PURPOSE ONLY

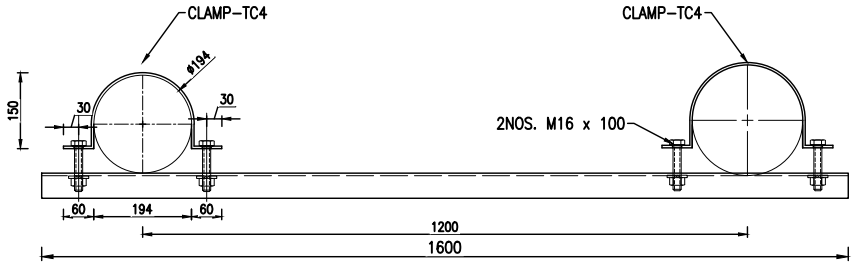


CLIENT	CONSULTANT	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DRAWING NO. CSG–OHL–13DC–DDPDA–CLCA DRAWN AKC DESIGNED DDT DRAFTING CHECK BP DESIGN CHECK APPROVED
		CLAMP AND CROSS ARM STRUCTURE FOR DOUBLE POLE DOUBLE ARM DEAD END STRUCTURE (DDPDA) FOR 13 M DOUBLE CIRCUIT 33 kV LINE
		FOR TENDER PURPOSE ONLY

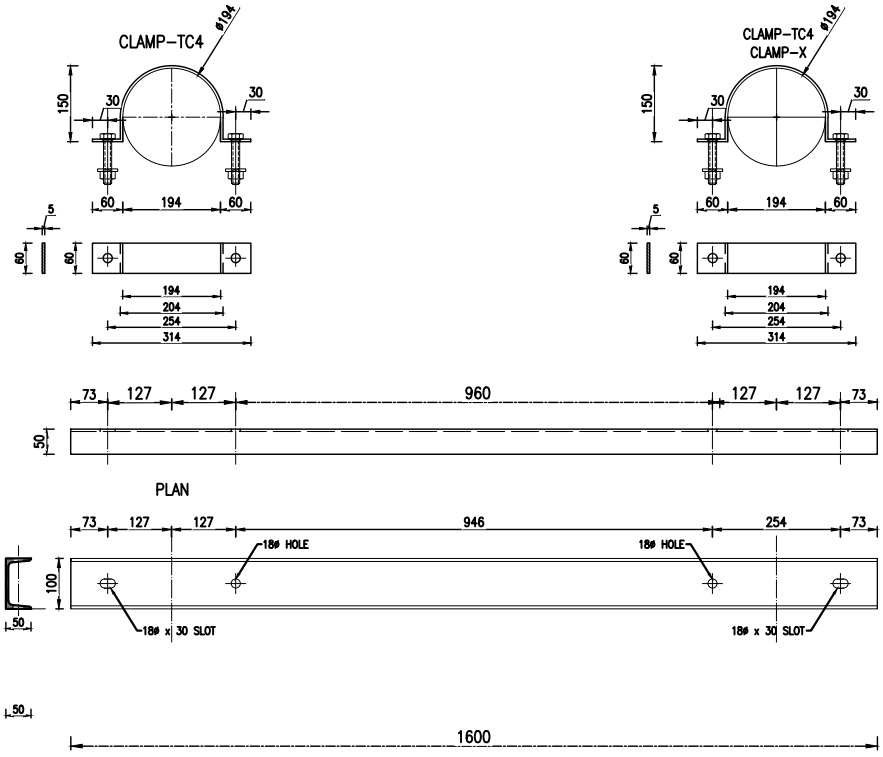


CLIENT	CONSULTANT	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DRAWING NO. CSG-OHL-13DC-DDPDA-CB DRAWN AKC DESIGNED DDT DRAFTING CHECK BP DESIGN CHECK APPROVED
		BRACING ASSEMBLY FOR DOUBLE POLE DOUBLE ARM DEAD END STRUCTURE (DDPDA) FOR 13 M DOUBLE CIRCUIT 33 kV LINE
		FOR TENDER PURPOSE ONLY

CROSS ARM FOR CROSS BRACING OF 33KV H-POLE BR1



CROSS ARM FOR CROSS BRACING ASSEMBLY

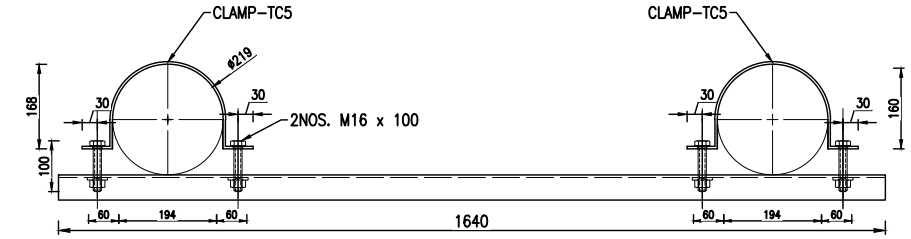


UPPER CROSS ARM CHANNEL FOR CROSS BRACING ASSEMBLY

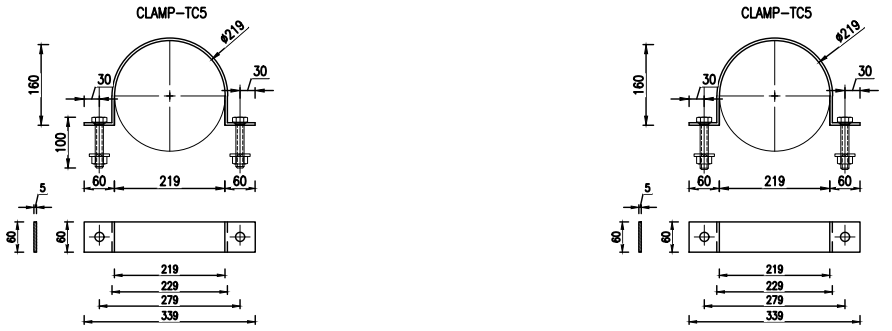
ISMC100 (100 x 50 x 7.5x4.7 x1600)

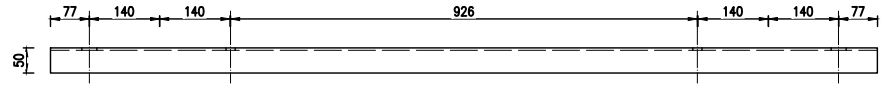
CLIENT	CONSULTANT	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DRAWING NO. CSG-OHL-13DC-DDPDA-UACB DRAWN AKC DESIGNED DDT DRAFTING CHECK BP DESIGN CHECK APPROVED
		UPPER ARM CROSS BRACING ASSEMBLY FOR DOUBLE POLE DOUBLE ARM DEAD END STRUCTURE (DDPDA) FOR 13 M DOUBLE CIRCUIT 33 kV LINE
		FOR TENDER PURPOSE ONLY

CROSS ARM FOR CROSS BRACING OF 33KV H-POLE BR2

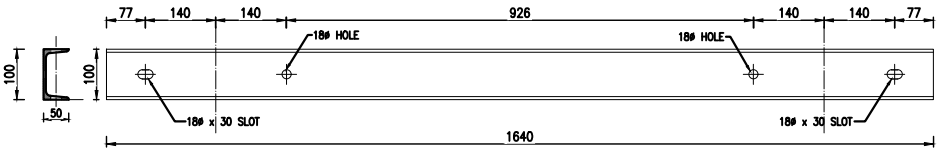


CROSS ARM FOR CROSS BRACING ASSEMBLY



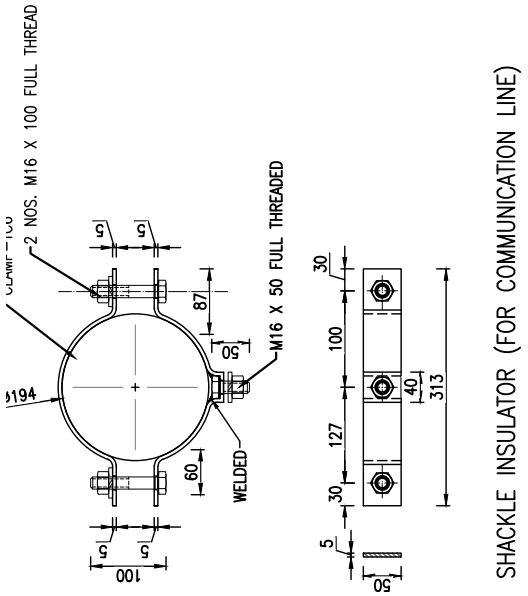


PLAN

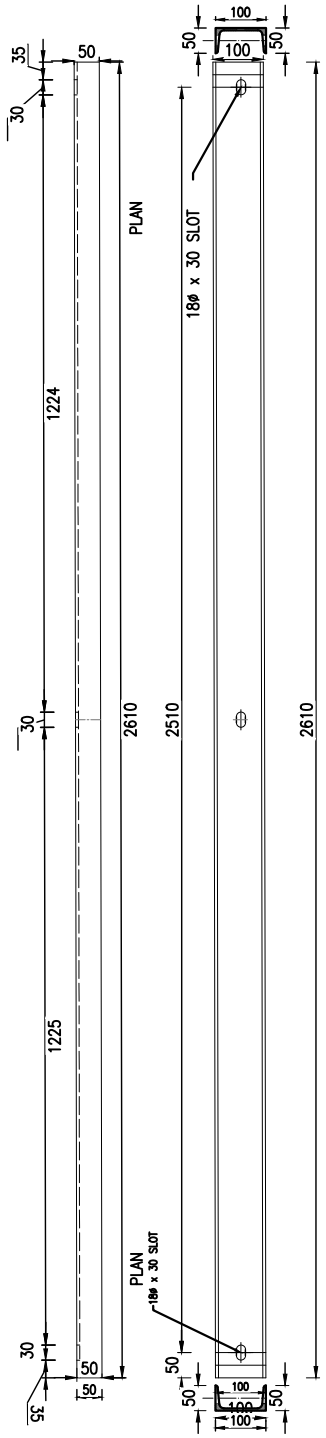


LOWER CROSS ARM CHANNEL FOR CROSS BRACING ASSEMBLY
ISMC100 (100 x 50 x 7.5x4.7 x1640)

CLIENT	CONSULTANT	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DRAWING NO. CSG-OHL-13DC-DDPDA-LACB DRAWN AKC DESIGNED DDT DRAFTING CHECK BP DESIGN CHECK APPROVED LOWER ARM CROSS BRACING ASSEMBLY FOR DOUBLE POLE DOUBLE ARM DEAD END STRUCTURE (DDPDA) FOR 13 M DOUBLE CIRCUIT 33 kV LINE FOR TENDER PURPOSE ONLY



SHACKLE INSULATOR (FOR COMMUNICATION LINE)



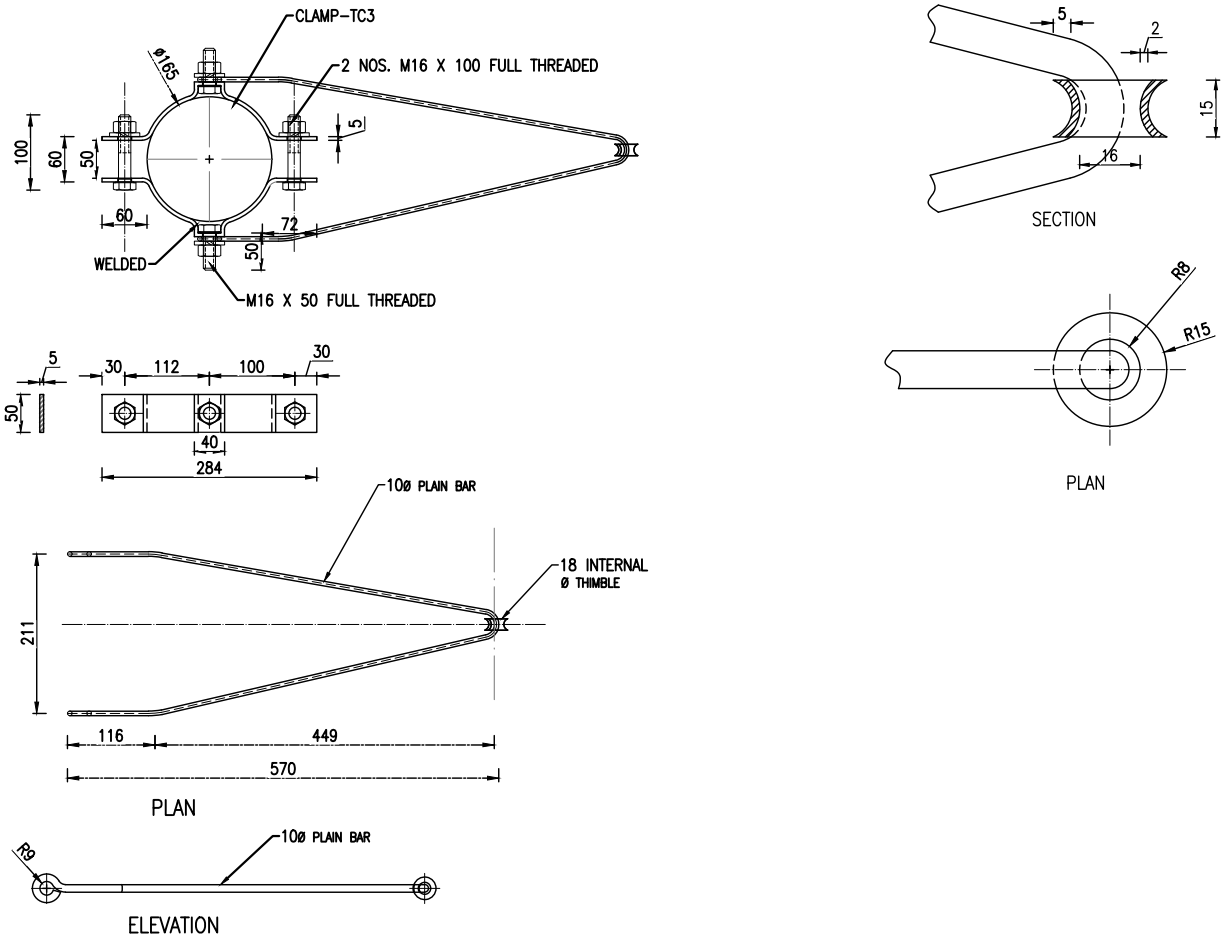
CROSS ARM CHANNEL FOR CROSS BRACING ASSEMBLY
ISMC100 (100 x 50 x 7.5x4.7 x 2610)

CLIENT	CONSULTANT	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DRAWING NO. CSG–OHL–13DC–DDPDA–CACB DRAWN AKC DESIGNED DDT DRAFTING CHECK BP DESIGN CHECK APPROVED

CROSS ARM CHANNEL FOR CROSS BRACING ASSEMBLY OF DOUBLE POLE DOUBLE ARM DEAD END STRUCTURE (DDPDA) FOR 13 M DOUBLE CIRCUIT 33 kV LINE

FOR TENDER PURPOSE ONLY

STAY CLAMP – ST1



STAY SET ASSEMBILY

S.NO.	UNIT	QTY	MATERIAL
1	Nos.	1	HT STAY PLATE (600X600X6)mm
2	Nos.	1	HT STAY ROD (12mm X 1600mm long)
3	Kg.	10	STAY WIRE (7/10 SWG Minimum)
4	Nos.	1	STAY INSULATOR
5	Nos.	2	BOLTS WITH SUITABLE NUTS AND WASHERS (M16X50)MM
6	Nos.	2	BOLTS WITH SUITABLE NUTS AND WASHERS (16X100)MM
7	Nos.	1	POLE CLAMP WITH NUT,BOLT AND WASHERS FOR TOP BRACING (TC3) CLAMP SECTION(50x6.0)MM
8	Set.	1	"V" HANGLE
9	Set.	1	STAY TURN BUCKLE INCLUDING THIMBLE (18SWG MINIMUM)
10	Nos.	1	BOW SET WITH THIMBLE (1000mm Length).
11	Nos.	1	STAY GRIP

CLIENT

NEPAL ELECTRICITY AUTHORITY
DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
DURBARMARGA, KATHMANDU, NEPAL

CONSULTANT

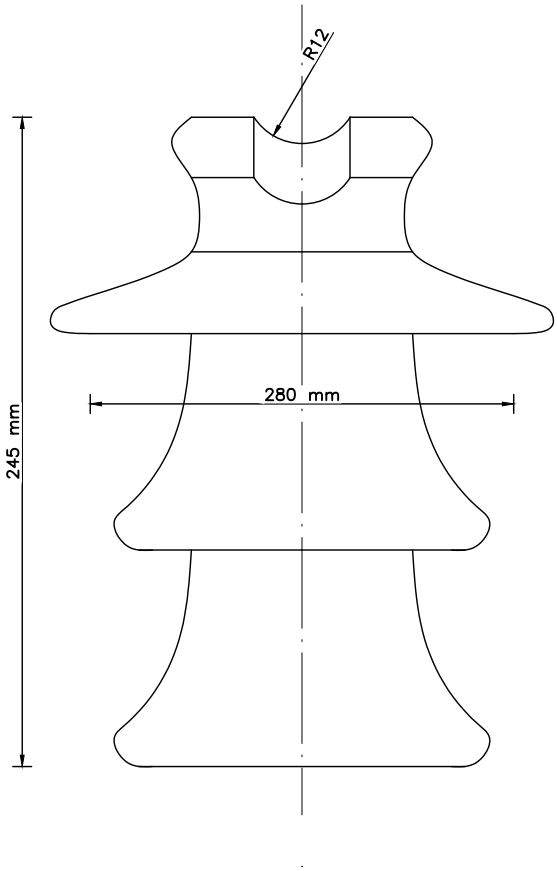
NEA ENGINEERING COMPANY LTD.
KATHMANDU, NEPAL

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

DRAWING NO.	CSG–OHL–13DC–DDPDA–STAY
DRAWN	AKC
DESIGNED	DDT
DRAFTING CHECK	BP
DESIGN CHECK	
APPROVED	

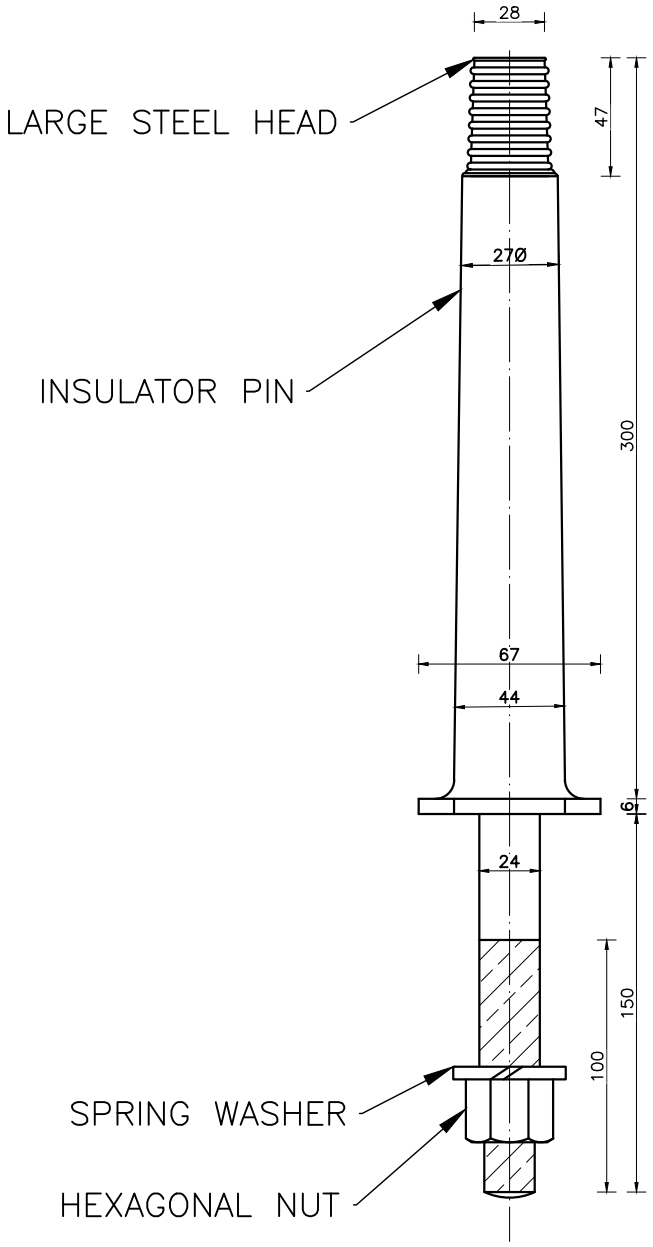
STAY SET FOR
DOUBLE POLE DOUBLE ARM
DEAD END STRUCTURE (DDPDA)
FOR 13 M DOUBLE CIRCUIT
33 kV LINE

FOR TENDER PURPOSE ONLY



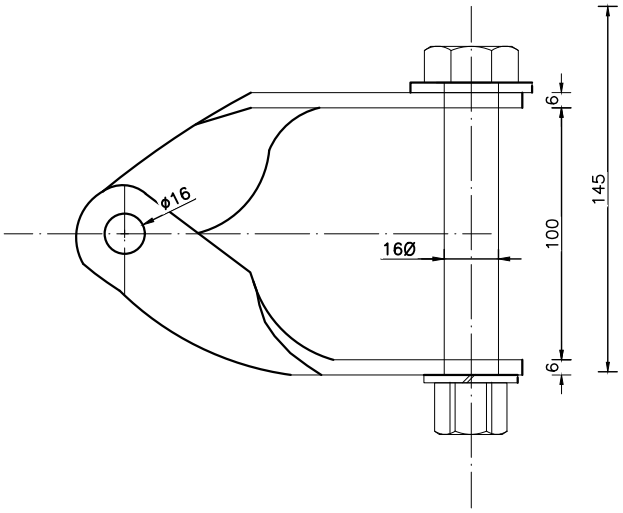
PIN INSULATOR

CLIENT	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT	
NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	DRAWING NO. CSG–OHL–INS–01	33 kV PIN INSULATOR
CONSULTANT NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DRAWN AKC	
	DESIGNED DDT	
	DRAFTING CHECK BP	
	DESIGN CHECK	
	APPROVED	FOR TENDER PURPOSE ONLY

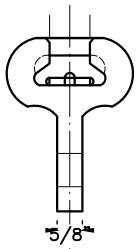


CLIENT	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT	
NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	DRAWING NO. CSG–OHL–INS–02	33 kV INSULATOR PIN
CONSULTANT NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DRAWN AKC	
	DESIGNED DDT	
	DRAFTING CHECK BP	
	DESIGN CHECK	
	APPROVED	FOR TENDER PURPOSE ONLY

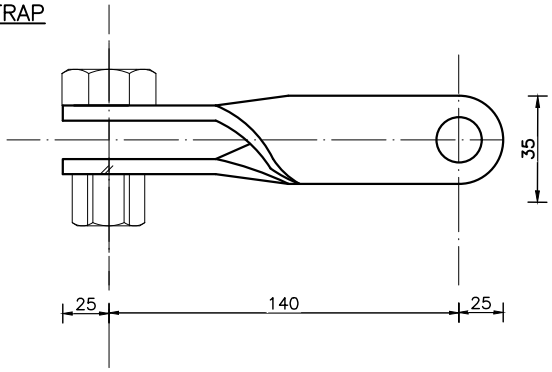
17.5 ø HOLE FOR 16 ø COTTER PIR

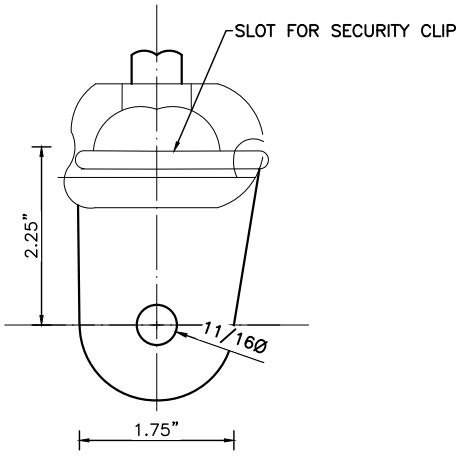


16MM B SOCKET

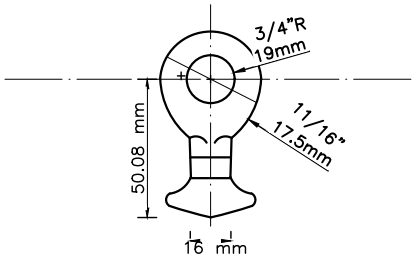


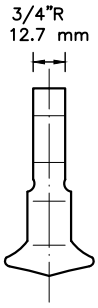
BRICK STRAP





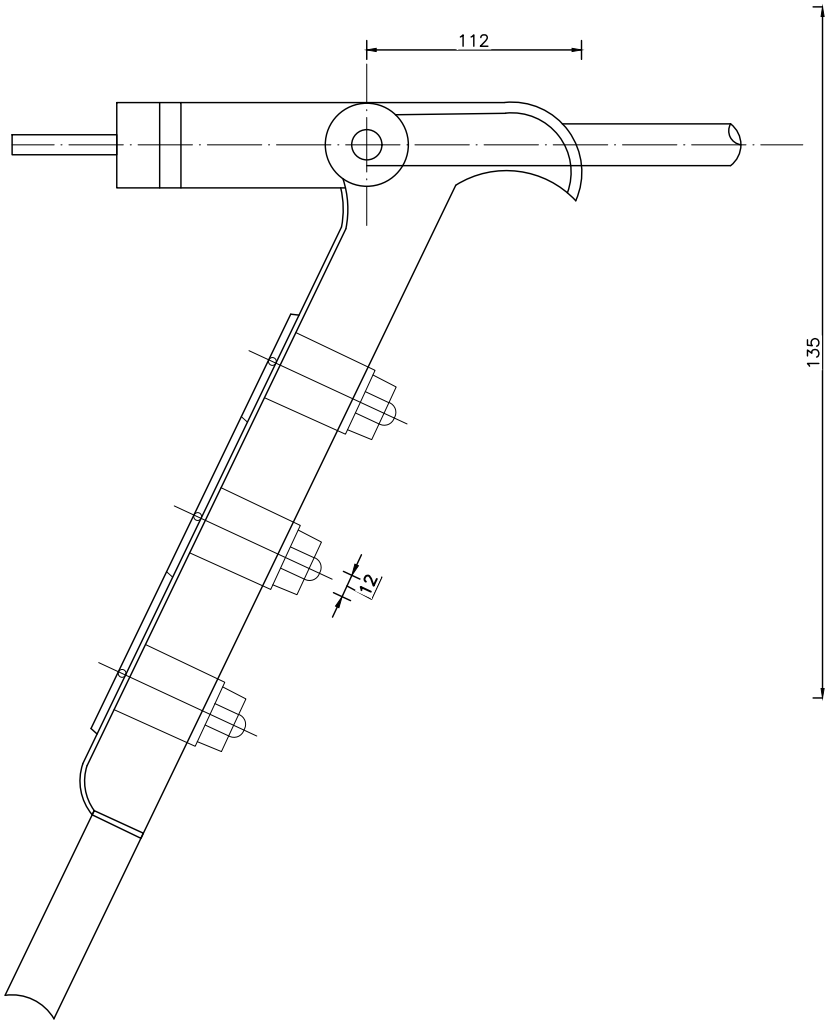
SOCKET EYES



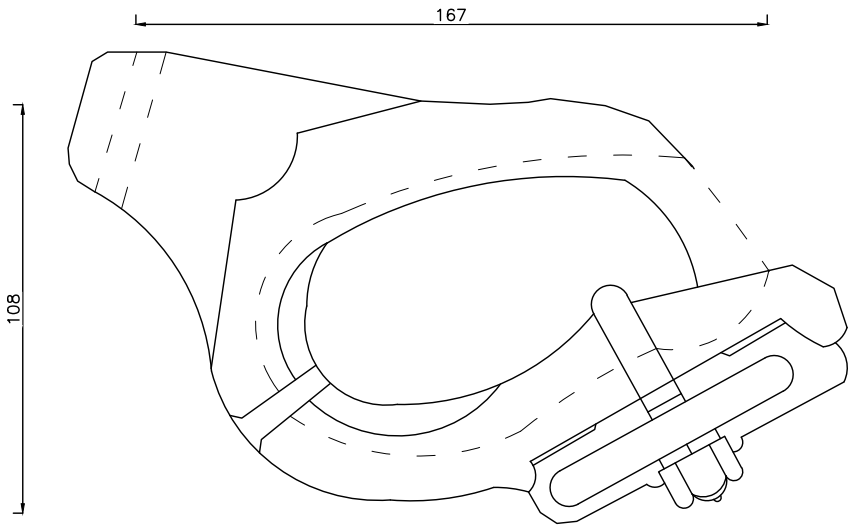


BALL EYES

CLIENT	CONSULTANT	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DRAWING NO. CSG–OHL–INS–03 DRAWN AKC DESIGNED DDT DRAFTING CHECK BP DESIGN CHECK APPROVED HARDWARE FOR TENSION SET FOR TENDER PURPOSE ONLY



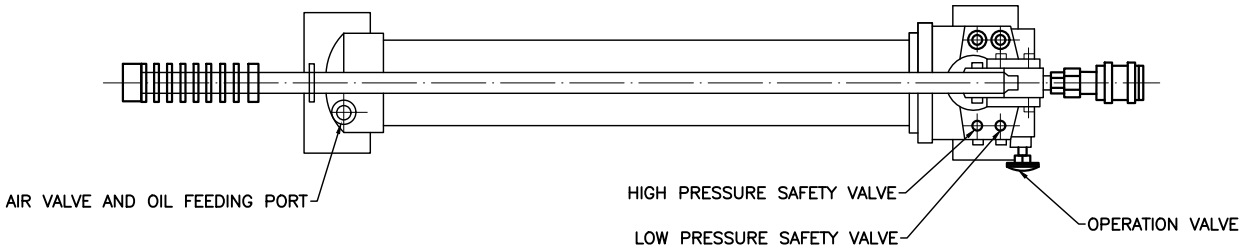
TYPE A (Straight Type)

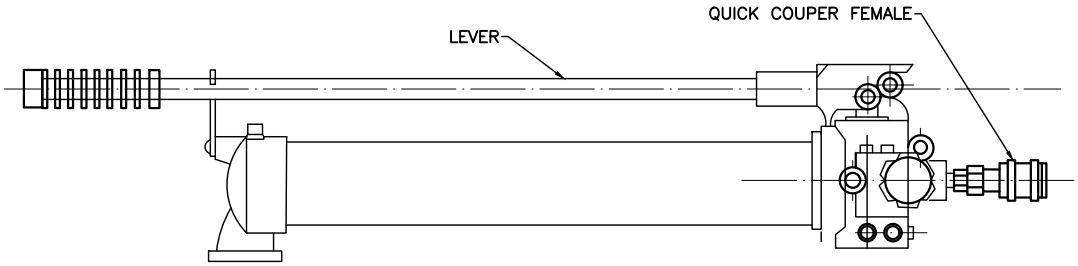


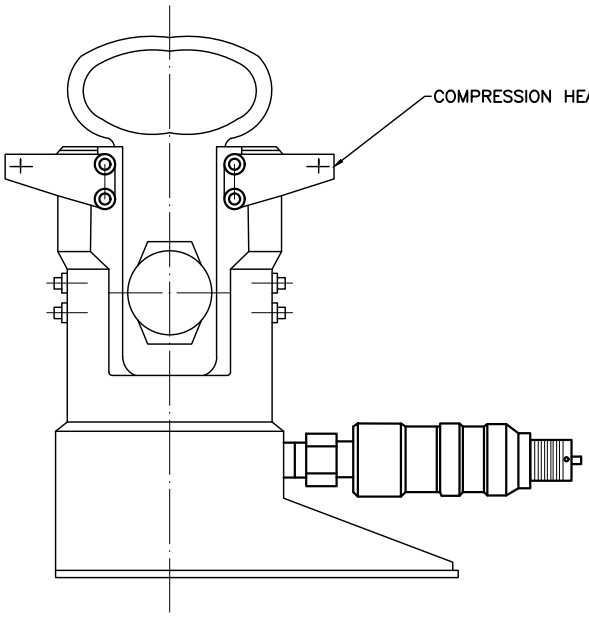
'U' bolt

TYPE B (SNAIL TYPE)

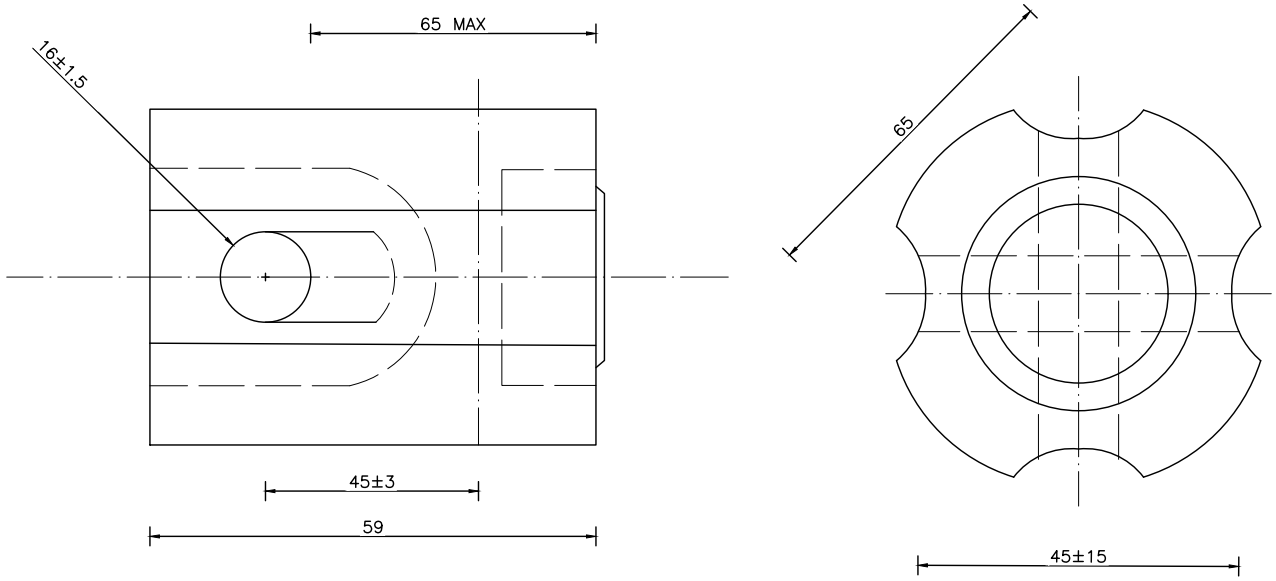
CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
		DRAWING NO. CSG–OHL–INS–04
		DRAWN AKC
		DESIGNED DDT
		DRAFTING CHECK BP
		DESIGN CHECK
		APPROVED
		TENSION SET
		FOR TENDER PURPOSE ONLY



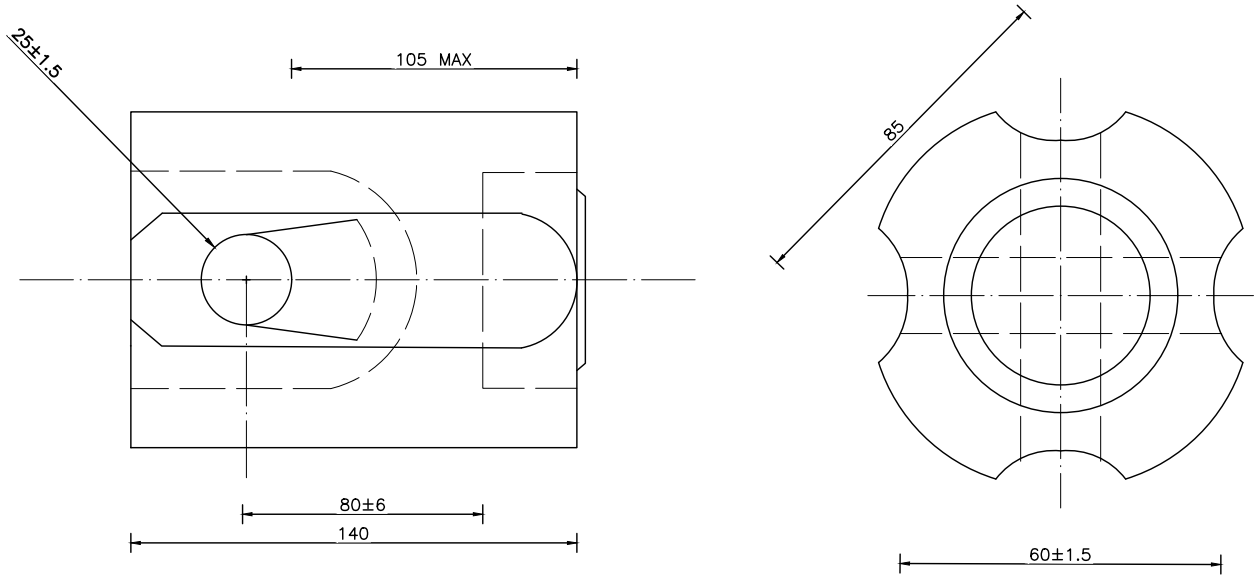




CLIENT: NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT: NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
		DRAWING NO. CSG–OHL–INS–05
		DRAWN AKC
		DESIGNED DDT
		DRAFTING CHECK BP
		DESIGN CHECK
		APPROVED
		COMPRESSION TOOLS
		FOR TENDER PURPOSE ONLY

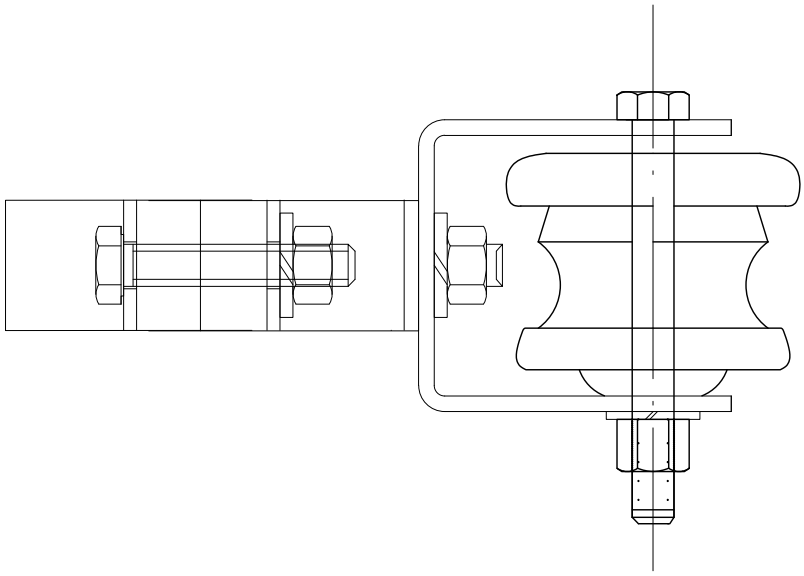


TYPE–2



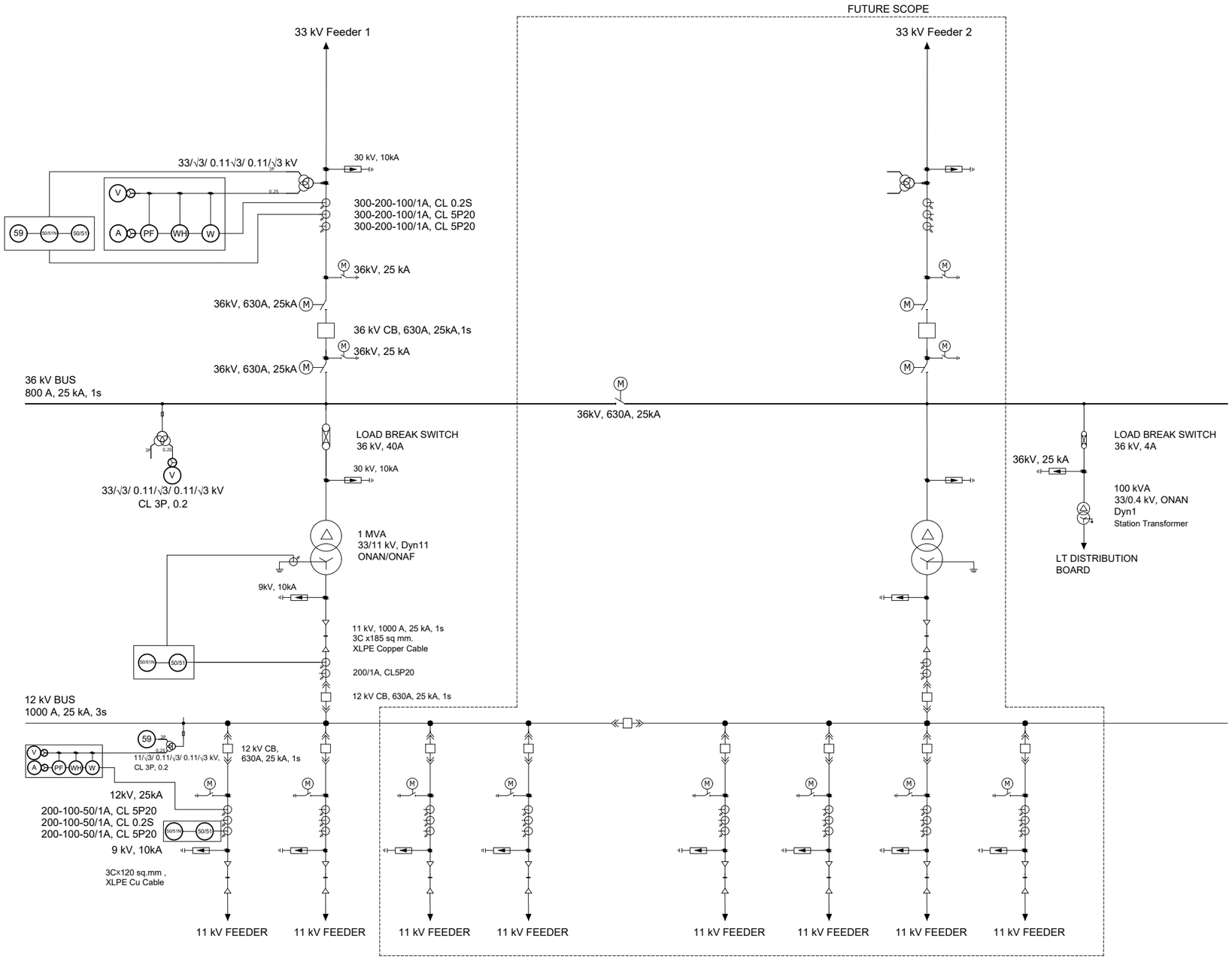
APPLICABLE STANDARD IS :5300

CLIENT	CONSULTANT	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DRAWING NO. CSG–OHL–INS–06 DRAWN AKC DESIGNED DDT DRAFTING CHECK BP DESIGN CHECK APPROVED STAY INSULATOR FOR TENDER PURPOSE ONLY



SHACKLE INSULATOR

CLIENT: NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT: NEA ENGINEERING COMPANY LTD. KATHMANDU, NEPAL	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
		DRAWING NO. CSG–OHL–INS–07
		DRAWN AKC
		DESIGNED DDT
		DRAFTING CHECK BP
		DESIGN CHECK
		APPROVED
		SHACKLE INSULATOR
		FOR TENDER PURPOSE ONLY



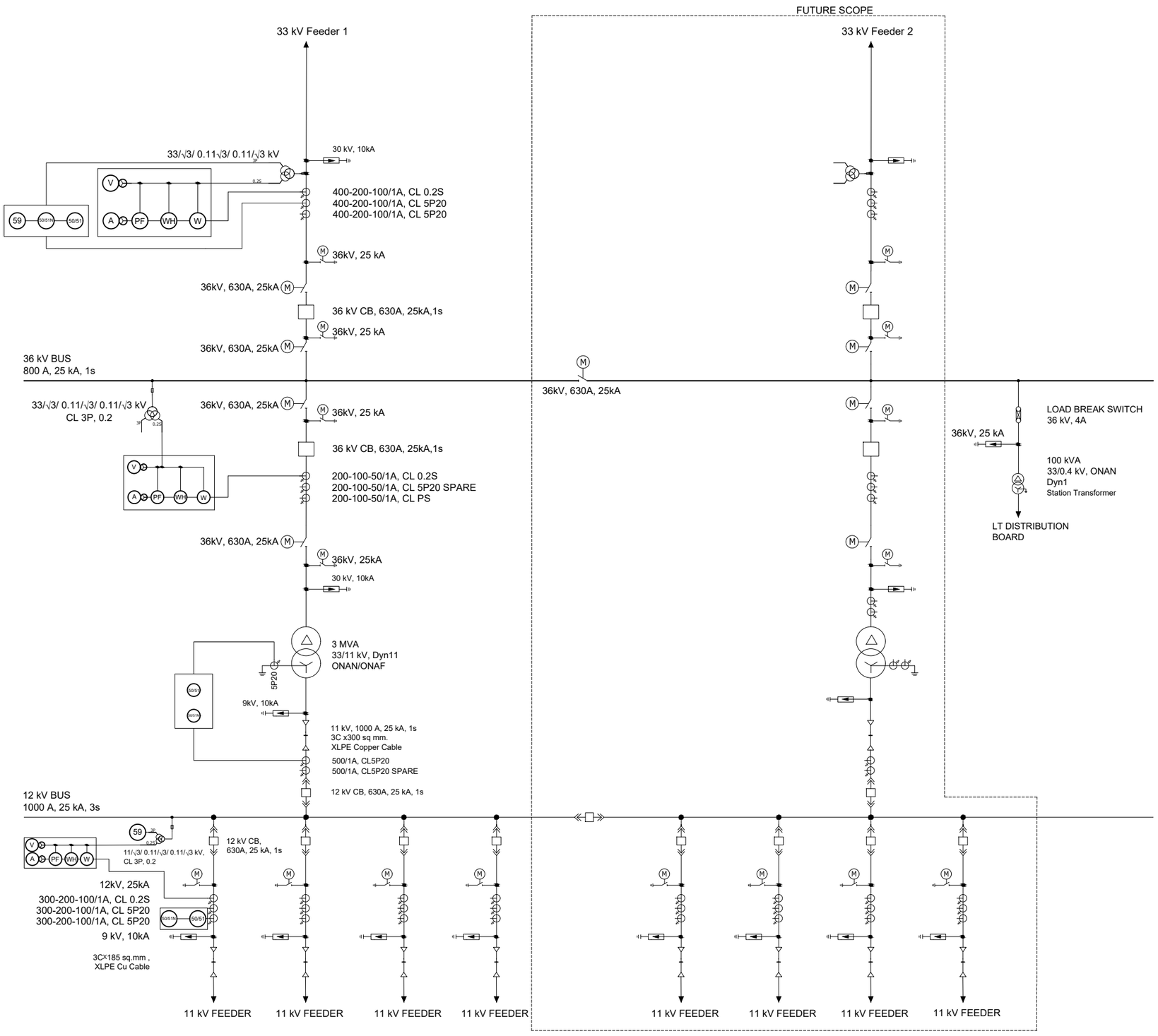
LEGENDS

SYMBOL	EQUIPMENT
	Transformer
	Circuit Breaker
	Draw Out Type Circuit Breaker
M	Disconnecting Switch
M	Earth Switch
	Surge Arrester
	Voltage Transformer
	Cable
	Load Break Switch
	Current Transformer
A	Ammeter
V	Voltmeter
W	Wattmeter
WH	Energy Meter
PF	Power Factor Meter
	Phase Values Selector Switch
59	Over voltage Realy
50/51	Instantaneous Time O/C Relay
50/51N	Residual Ground O/C Relay
51N	Neutral Time O/C Relay
87	Differential Relay
64REF	Restricted Ground Earth Fault Relay

NOTES

1. The current ratings are indicative only.
2. New 33 kV Feeders in different pole shall be separated by Sectionalizer in 33 kV bus bar.
3. The 33 kV bus bar shall be rated at least for more than 120% of maximum capacity of the double circuit 33 kV incoming feeders.
4. The Physical Layout of 1 MVA and 3 MVA substation shall be made suitable for upgradation to 8 MVA including all the foundations.
5. Transformer of 6/8 MVA and higher capacity shall be equipped with Volts per Hertz Relay (24), Apparatus thermal device, Temperature Switch (26), Pressure Switch Detector (63), Liquid Switch, Level Switch (71), and Transmitter (96)
6. Transformer less than 6/8 MVA will be equipped with OFF LOAD Tap Changer and 6/8 MVA and higher capacity shall be equipped ON LOAD Tap Changer.

CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-SLD-01	TITLE ELECTRICAL SINGLE LINE DIAGRAM OF 33/11 kV 1 MVA SUBSTATION



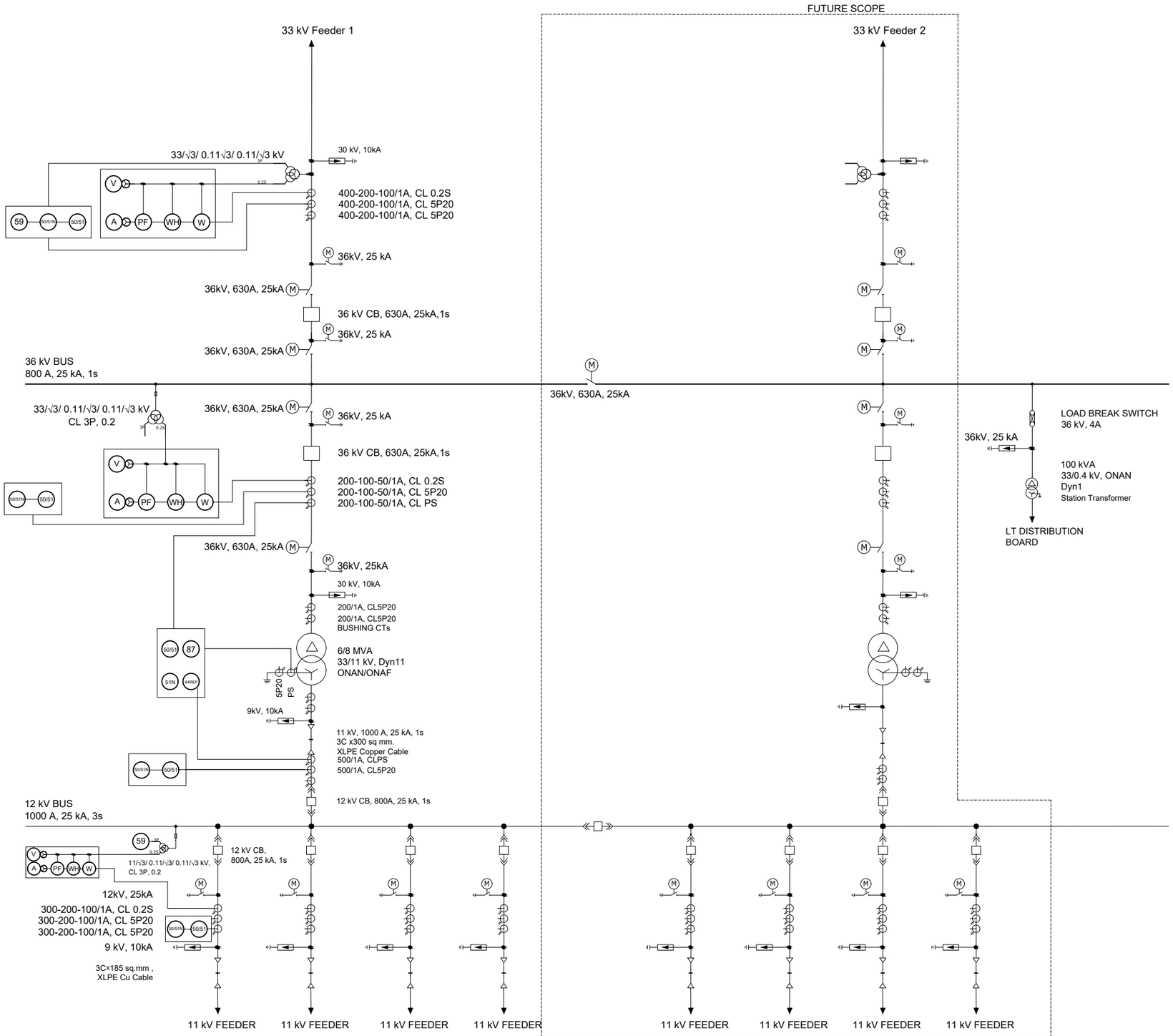
LEGENDS

SYMBOL	EQUIPMENT
	Transformer
	Circuit Breaker
	Draw Out Type Circuit Breaker
	Disconnecting Switch
	Earth Switch
	Surge Arrester
	Voltage Transformer
	Cable
	Load Break Switch
	Current Transformer
A	Ammeter
V	Voltmeter
W	Wattmeter
WH	Energy Meter
PF	Power Factor Meter
	Phase Values Selector Switch
59	Over voltage Realy
50/51	Instantaneous Time O/C Relay
50/51N	Residual Ground O/C Relay
51N	Neutral Time O/C Relay
87	Differential Relay
64REF	Restricted Ground Earth Fault Relay

NOTES

1. The current ratings are indicative only.
2. New 33 kV Feeders in different pole shall be separated by Sectionalizer in 33 kV bus bar.
3. The 33 kV bus bar shall be rated at least for more than 120% of maximum capacity of the double circuit 33 kV incoming feeders.
4. The Physical Layout of 1 MVA and 3 MVA substation shall be made suitable for upgradation to 8 MVA including all the foundations.
5. Transformer of 6/8 MVA and higher capacity shall be equipped with Volts per Hertz Relay (24), Apparatus thermal device, Temperature Switch (26), Pressure Switch Detector (63), Liquid Switch, Level Switch (71), and Transmitter (96)
6. Transformer less than 6/8 MVA will be equipped with OFF LOAD Tap Changer and 6/8 MVA and higher capacity shall be equipped ON LOAD Tap Changer.

CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-SLD-03	TITLE ELECTRICAL SINGLE LINE DIAGRAM OF 33/11 kV 3 MVA SUBSTATION



LEGENDS

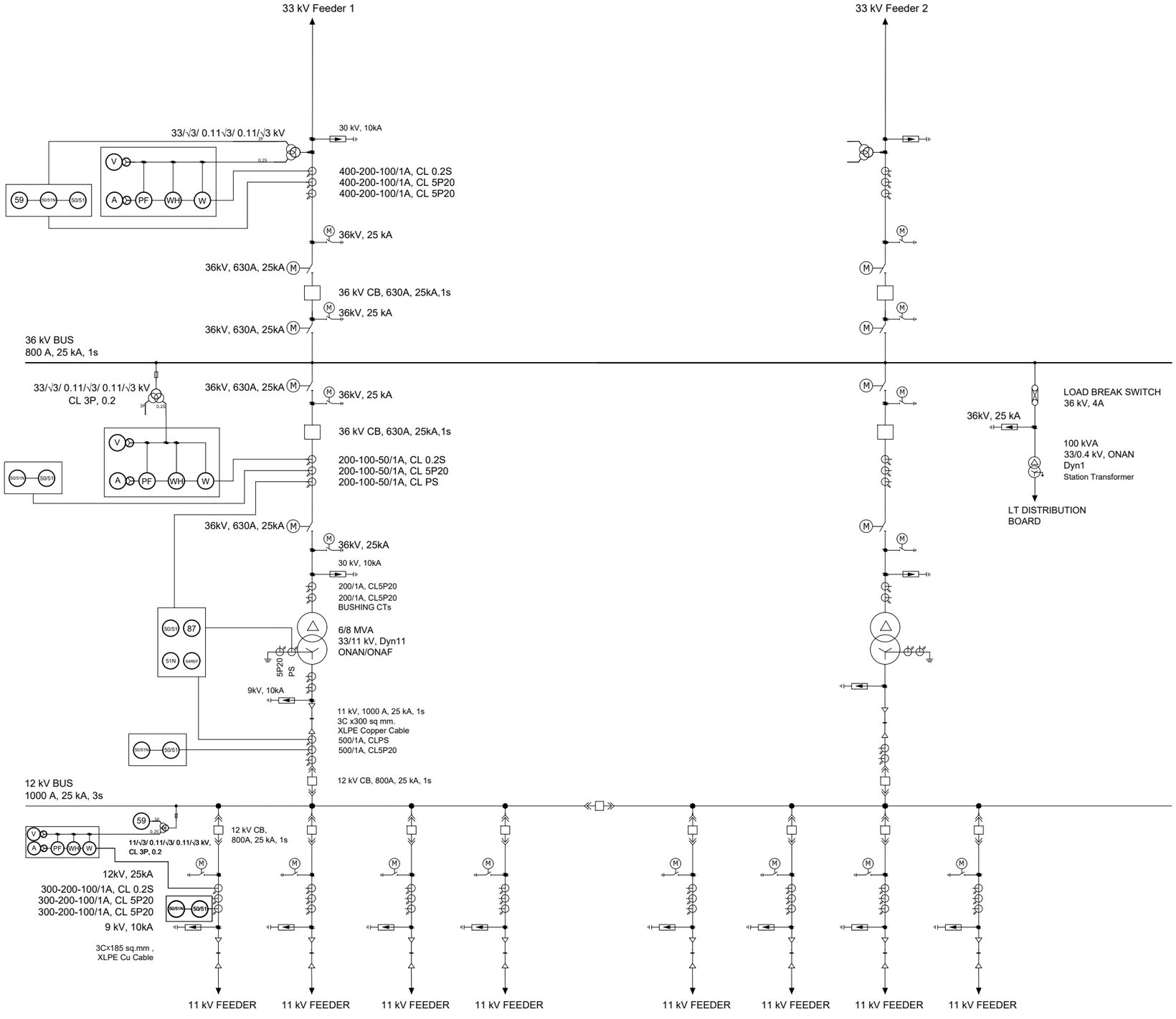
SYMBOL	EQUIPMENT
	Transformer
	Circuit Breaker
	Draw Out Type Circuit Breaker
	Disconnecting Switch
	Earth Switch
	Surge Arrester
	Voltage Transformer
	Cable
	Load Break Switch
	Current Transformer
A	Ammeter
V	Voltmeter
W	Wattmeter
WH	Energy Meter
PF	Power Factor Meter
	Phase Values Selector Switch
59	Over voltage Realy
50/51	Instantaneous Time O/C Relay
50/51N	Residual Ground O/C Relay
51N	Neutral Time O/C Relay
87	Differential Relay
64REF	Restricted Ground Earth Fault Relay

NOTES

1. The current ratings are indicative only.
2. New 33 kV Feeders in different pole shall be separated by Sectionalizer in 33 kV bus bar.
3. The 33 kV bus bar shall be rated at least for more than 120% of maximum capacity of the double circuit 33 kV incoming feeders.
4. The Physical Layout of 1 MVA and 3 MVA substation shall be made suitable for upgradation to 8 MVA including all the foundations.
5. Transformer of 6/8 MVA and higher capacity shall be equipped with Volts per Hertz Relay (24), Apparatus thermal device, Temperature Switch (26), Pressure Switch Detector (63), Liquid Switch, Level Switch (71), and Transmitter (96)
6. Transformer less than 6/8 MVA will be equipped with OFF LOAD Tap Changer and 6/8 MVA and higher capacity shall be equipped ON LOAD Tap Changer.

CLIENT: NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT: NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT: DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-SLD-08

TITLE: ELECTRICAL SINGLE LINE DIAGRAM OF 33/11 kV 8 MVA SUBSTATION



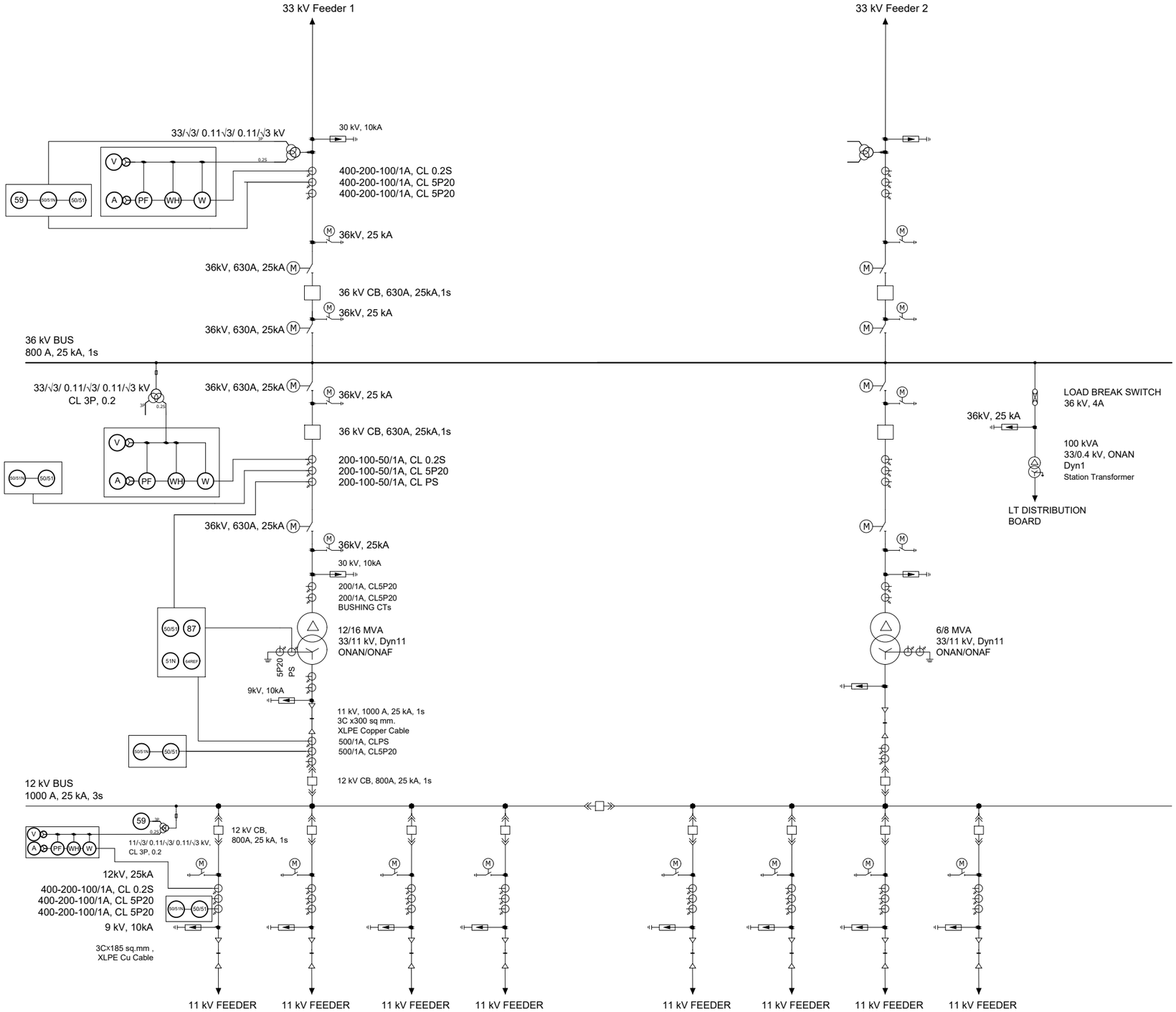
LEGENDS

SYMBOL	EQUIPMENT
	Transformer
	Circuit Breaker
	Draw Out Type Circuit Breaker
M	Disconnecting Switch
M	Earth Switch
	Surge Arrester
	Voltage Transformer
	Cable
	Load Break Switch
	Current Transformer
A	Ammeter
V	Voltmeter
W	Wattmeter
WH	Energy Meter
PF	Power Factor Meter
	Phase Values Selector Switch
59	Over voltage Realy
50/51	Instantaneous Time O/C Relay
50/51N	Residual Ground O/C Relay
51N	Neutral Time O/C Relay
87	Differential Relay
64REF	Restricted Ground Earth Fault Relay

NOTES

1. The current ratings are indicative only.
2. New 33 kV Feeders in different pole shall be separated by Sectionalizer in 33 kV bus bar.
3. The 33 kV bus bar shall be rated at least for more than 120% of maximum capacity of the double circuit 33 kV incoming feeders.
4. The Physical Layout of 1 MVA and 3 MVA substation shall be made suitable for upgradation to 8 MVA including all the foundations.
5. Transformer of 6/8 MVA and higher capacity shall be equipped with Volts per Hertz Relay (24), Apparatus thermal device, Temperature Switch (26), Pressure Switch Detector (63), Liquid Switch, Level Switch (71), and Transmitter (96)
6. Transformer less than 6/8 MVA will be equipped with OFF LOAD Tap Changer and 6/8 MVA and higher capacity shall be equipped ON LOAD Tap Changer.

CLIENT: NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT: NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT: DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-SLD-16	TITLE: ELECTRICAL SINGLE LINE DIAGRAM OF 33/11 kV 16 MVA SUBSTATION



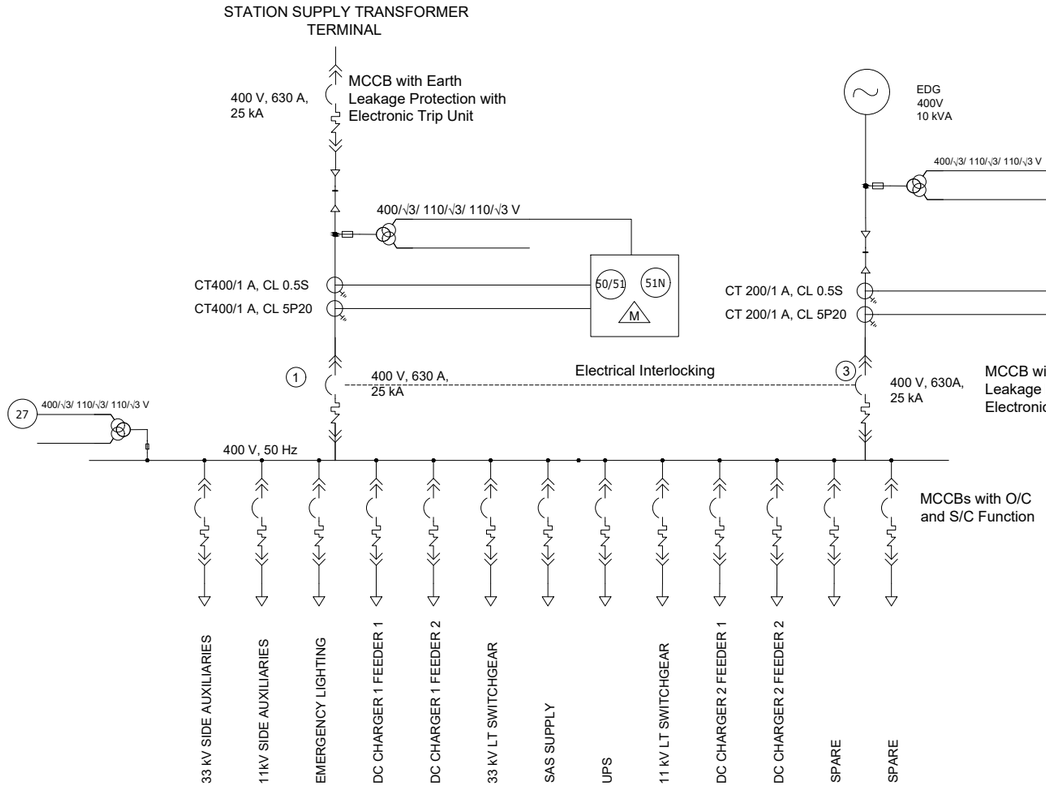
LEGENDS

SYMBOL	EQUIPMENT
	Transformer
	Circuit Breaker
	Draw Out Type Circuit Breaker
	Disconnecting Switch
	Earth Switch
	Surge Arrester
	Voltage Transformer
	Cable
	Load Break Switch
	Current Transformer
A	Ammeter
V	Voltmeter
W	Wattmeter
WH	Energy Meter
PF	Power Factor Meter
	Phase Values Selector Switch
59	Over voltage Realy
50/51	Instantaneous Time O/C Relay
50/51N	Residual Ground O/C Relay
51N	Neutral Time O/C Relay
87	Differential Relay
64REF	Restricted Ground Earth Fault Relay

NOTES

1. The current ratings are indicative only.
2. New 33 kV Feeders in different pole shall be separated by Sectionalizer in 33 kV bus bar.
3. The 33 kV bus bar shall be rated at least for more than 120% of maximum capacity of the double circuit 33 kV incoming feeders.
4. The Physical Layout of 1 MVA and 3 MVA substation shall be made suitable for upgradation to 8 MVA including all the foundations.
5. Transformer of 6/8 MVA and higher capacity shall be equipped with Volts per Hertz Relay (24), Apparatus thermal device, Temperature Switch (26), Pressure Switch Detector (63), Liquid Switch, Level Switch (71), and Transmitter (96)
6. Transformer less than 6/8 MVA will be equipped with OFF LOAD Tap Changer and 6/8 MVA and higher capacity shall be equipped ON LOAD Tap Changer.

CLIENT: NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT: NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT: DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-SLD-24	TITLE: ELECTRICAL SINGLE LINE DIAGRAM OF 33/11 kV 24 MVA SUBSTATION



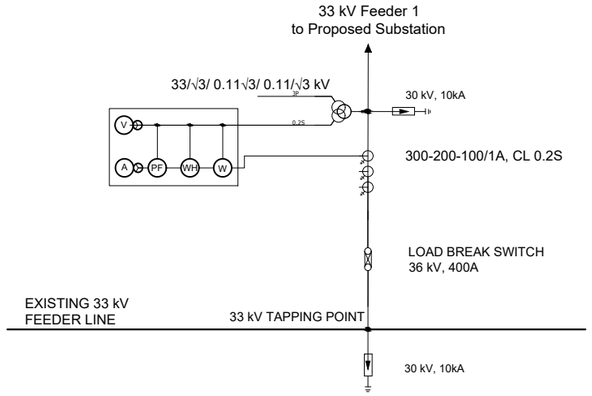
LEGENDS

Symbol	Description
	MCCB
	Sealing end for power cable
	Current Transformer
V	AC Voltmeter
A	AC Ammeter
M	Multifunction meter
27	Undervoltage Relay
50/51	Overcurrent Relay
59	Overvoltage Relay
81O/U	Over/Under Frequency Relay
51N	Non-directional Earth Fault Protection
O/C, S/C	Over Current, Short Circuit

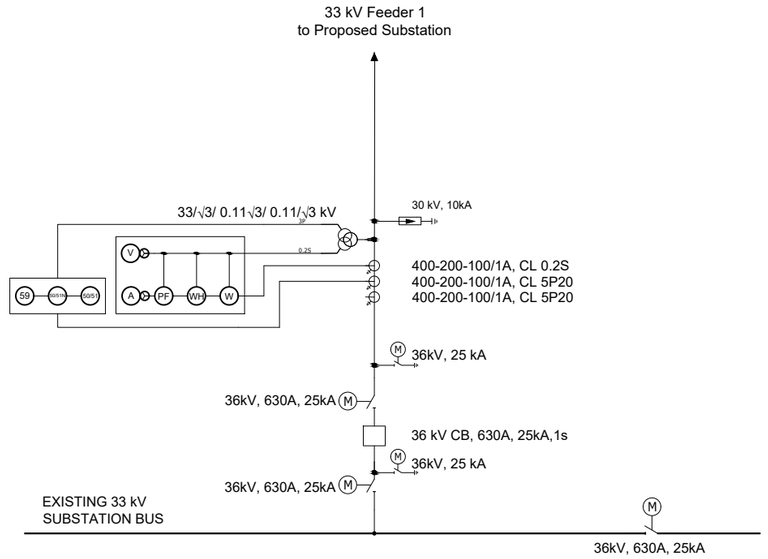
NOTES

1. The current ratings are indicative only.

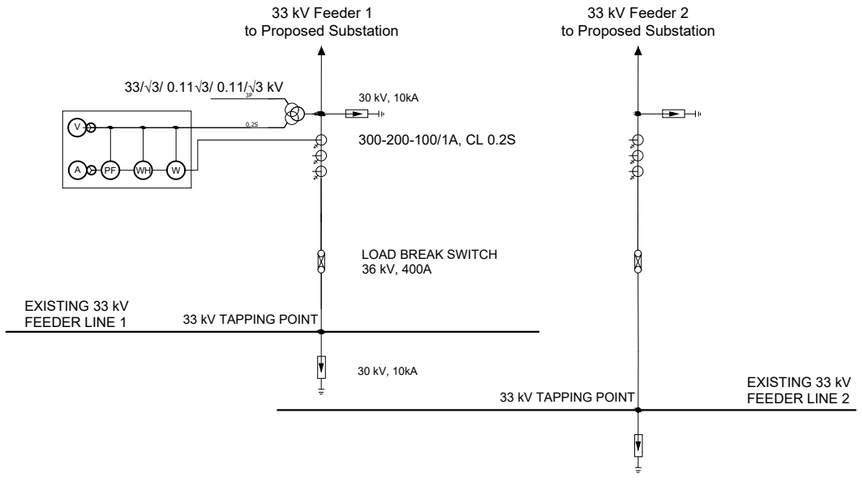
CLIENT: NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT: NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT: DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN / DESIGNED DRAFTING CHECK / DESIGN CHECK APPROVED / DRAWING NO. CSG-SLD-LVD	TITLE: LOW VOLTAGE DISTRIBUTION SYSTEM



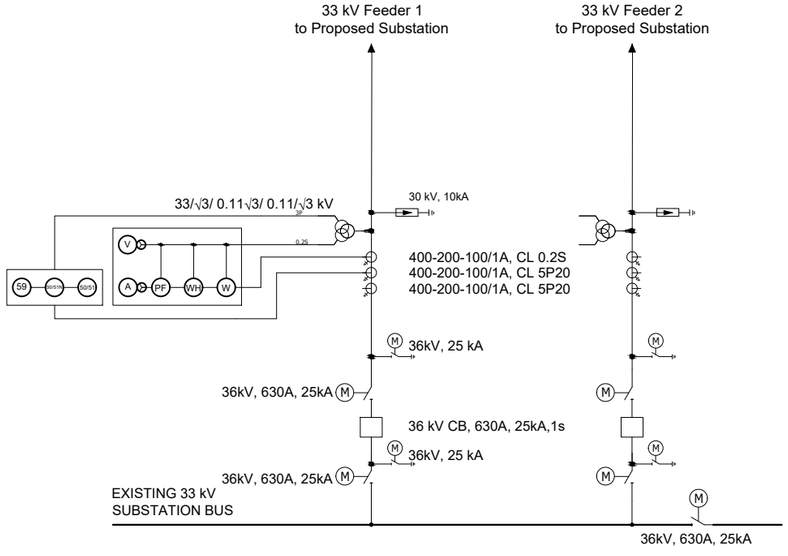
TAPPING ARRANGEMENT OF 33 kV FEEDER



ARRANGEMENT OF 33 kV BAY EXTENSION



TAPPING ARRANGEMENT OF 33 kV FEEDER FOR DOUBLE CIRCUIT LINE



ARRANGEMENT OF 33 kV BAY EXTENSION FOR DOUBLE CIRCUIT LINE

	LEGENDS
SYMBOL	EQUIPMENT
	Potential Transformer for Metering
	Circuit Breaker
	Draw Out Type Circuit Breaker
M	Disconnecting Switch
M	Earth Switch
	Surge Arrester
	Voltage Transformer
	Cable
	Load Break Switch
	Current Transformer
A	Ammeter
V	Voltmeter
W	Wattmeter
WH	Energy Meter
PF	Power Factor Meter
	Phase Values Selector Switch
59	Over voltage Realy
50/51	Instantaneous Time O/C Relay
50/51N	Residual Ground O/C Relay
51N	Neutral Time O/C Relay
87	Differential Relay
64REF	Restricted Ground Earth Fault Relay

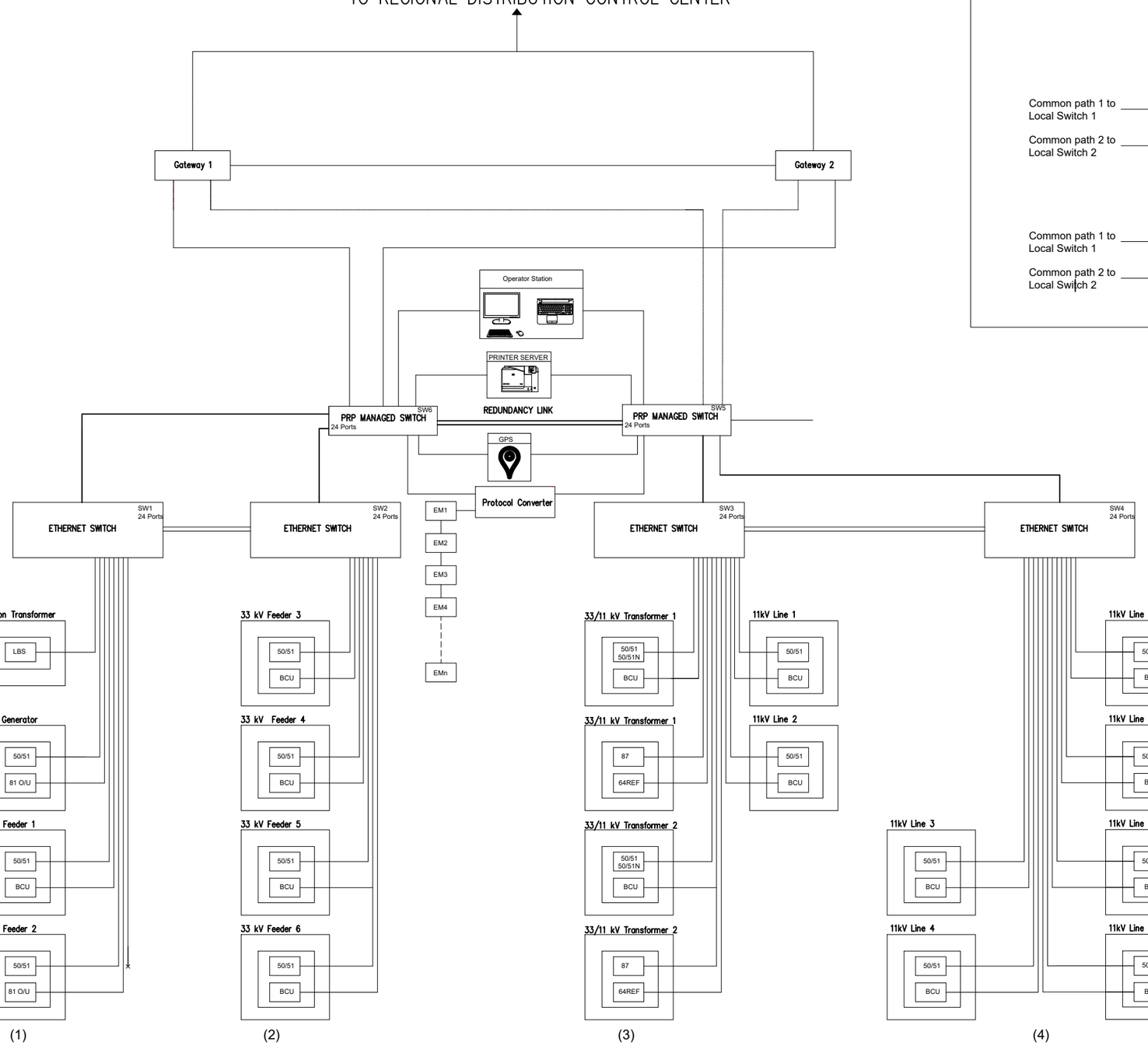
NOTES

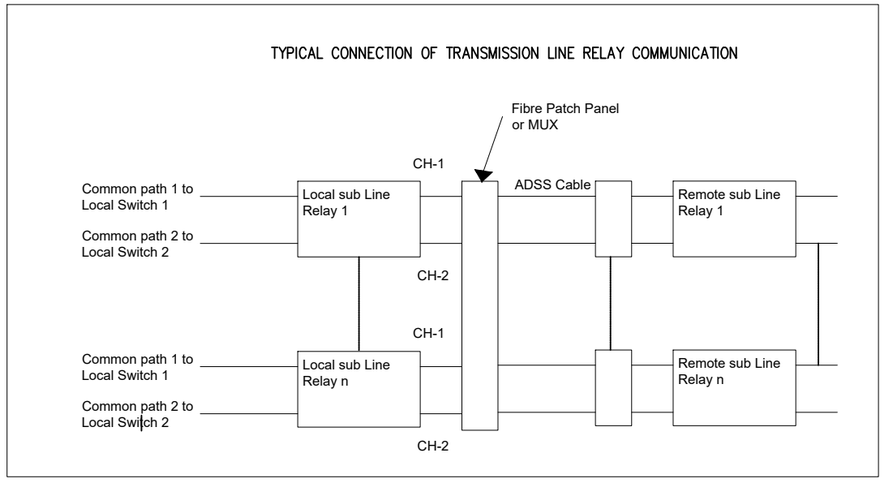
1. The current ratings are indicative only.
2. New 33 kV Feeders in different pole shall be separated by Sectionalizer in 33 kV bus bar.
3. The 33 kV bus bar shall be rated at least for more than 120% of maximum capacity of the doubel circuit 33 kV incoming feeders.

CLIENT: NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT: NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT: DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-SLD-INT

TITLE: INTERCONNECTION SLD FOR 33 kV LINE FEEDING POINTS

33 kV SUBSTATION AUTOMATION SYSTEM ARCHITECTURE

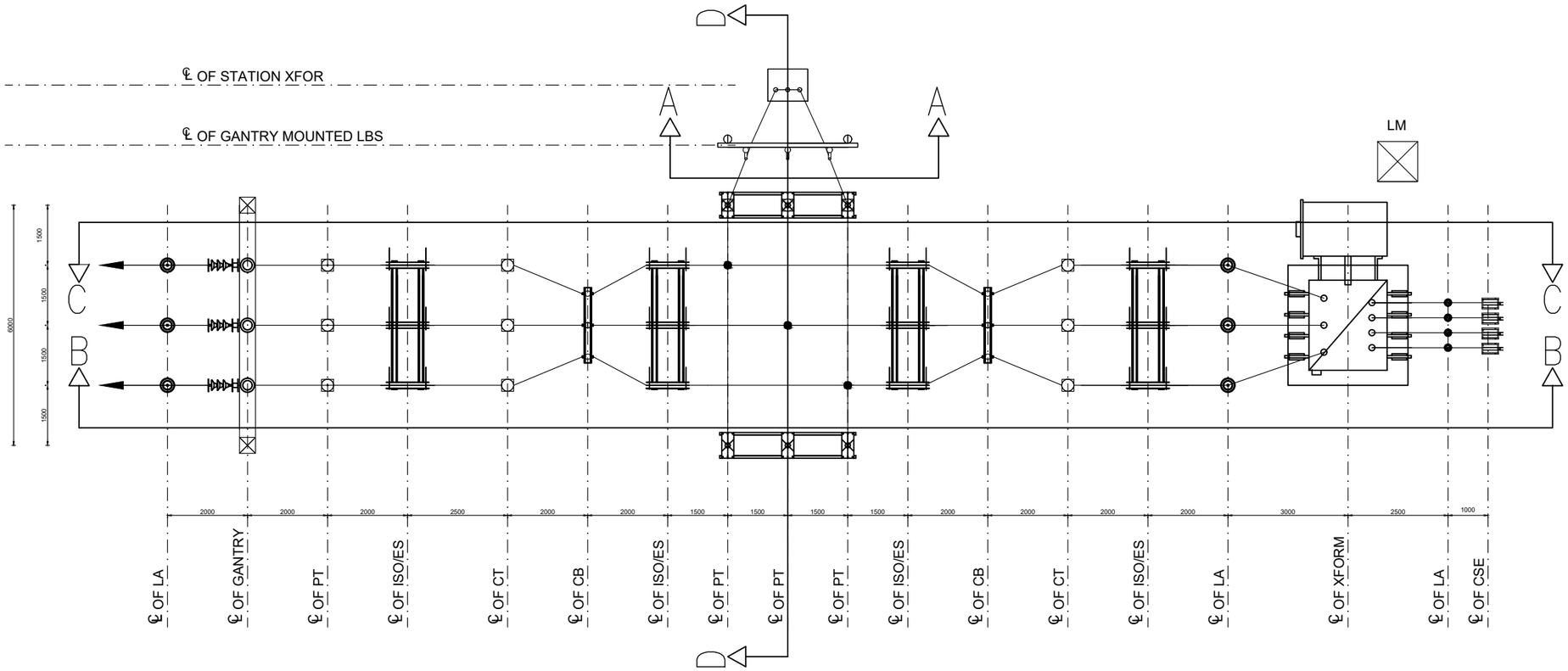


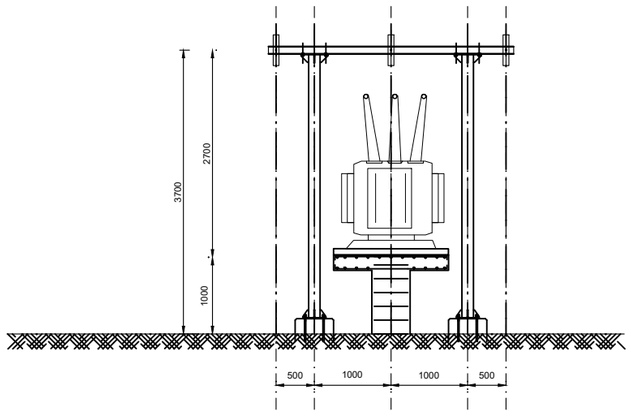


NOTES

Typical Connections are Shown.
All Load Break Switch in the Substation and Tapping Points shall be connected to SAS
SW – SWITCH
All Substations shall be operated from Regional Control Center.
EN – ENERGY METER

CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-SLD-SCH-SAS	TITLE SUBSTATION AUTOMATION SYSTEM ARCHITECUTRE FOR 33/11 kV SUBSTATION





SECTION A–A

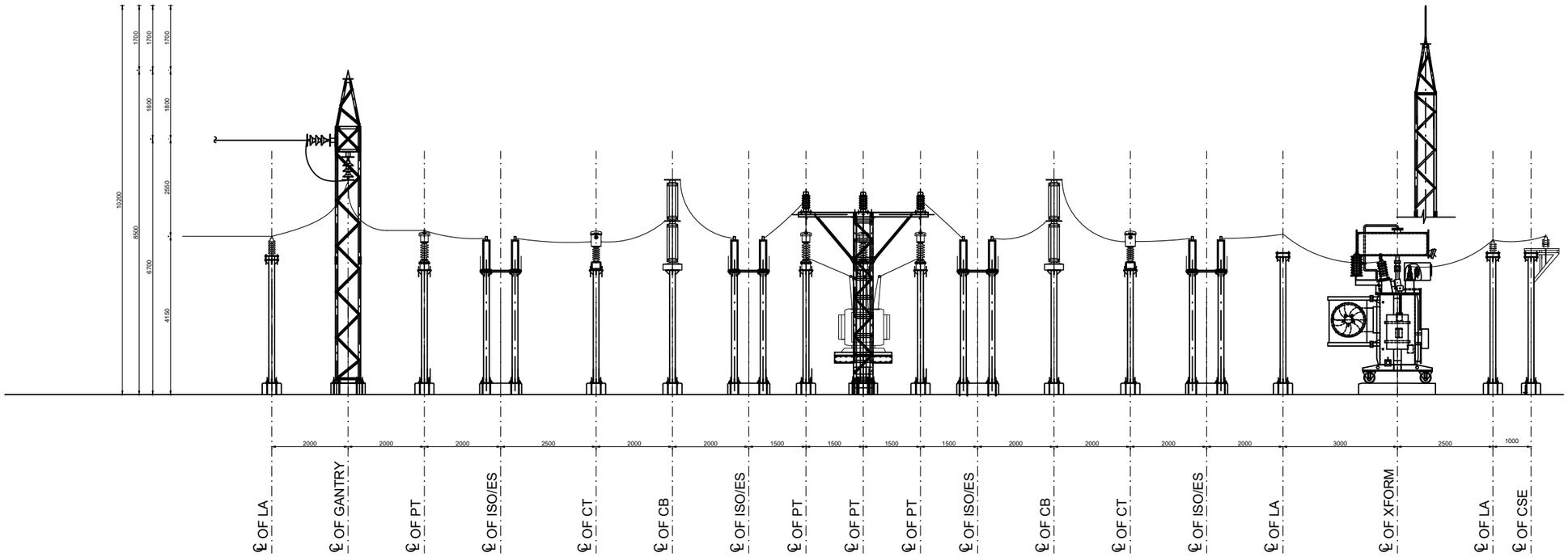
ABBREVIATION

SN	Acronym	Full Form
1	CSE	Cable Sealing End
2	CB	Circuit Breaker
3	CT	Current Transformer
4	ISO	ISOLATOR
5	ISO/ES	ISOLATOR WITH EARTHING SWITCH
6	LA	LIGHTNING ARRESTER
7	LM	LIGHTNING MAST
8	LBS	LOAD BREAK SWITCH
9	PT	POTENTIAL TRANSFORMER
10	XFORM	TRANSFORMER

NOTES

1. Refer to respective SLDs for details
2. The 33 kV switchyard layouts for other schemes such as, two incoming feeder, one transformer shall be developed accordingly.

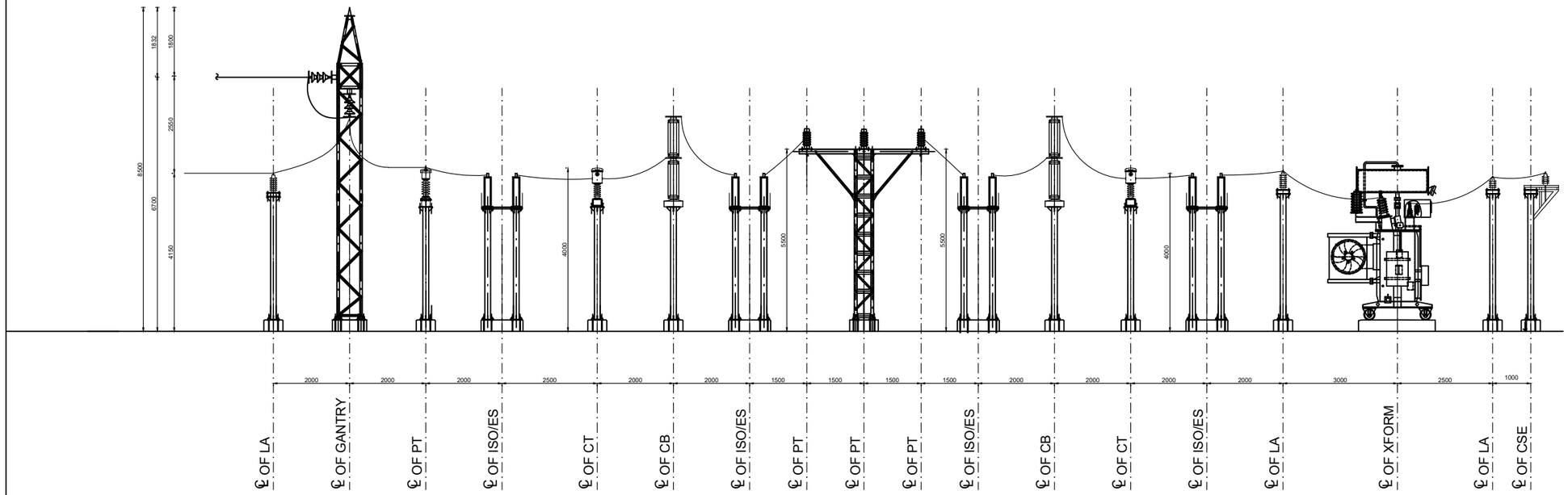
CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN	DESIGNED	TITLE TYPICAL 33 kV SWITCHYARD LAYOUT FOR 33/11 kV SUBSTATION WITH ONE INCOMING FEEDER
			DRAFTING CHECK	DESIGN CHECK	
			APPROVED	DRAWING NO. CSG-SW-LAY-A	



SECTION B–B

ABBREVIATION

SN	Acronym	Full Form
1	CSE	Cable Sealing End
2	CB	Circuit Breaker
3	CT	Current Transformer
4	ISO	ISOLATOR
5	ISO/ES	ISOLATOR WITH EARTHING SWITCH
6	LA	LIGHTNING ARRESTER
7	LM	LIGHTINING MAST
8	LBS	LOAD BREAK SWITCH
9	PT	POTENTIAL TRANSFORMER
10	XFORM	TRANSFORMER

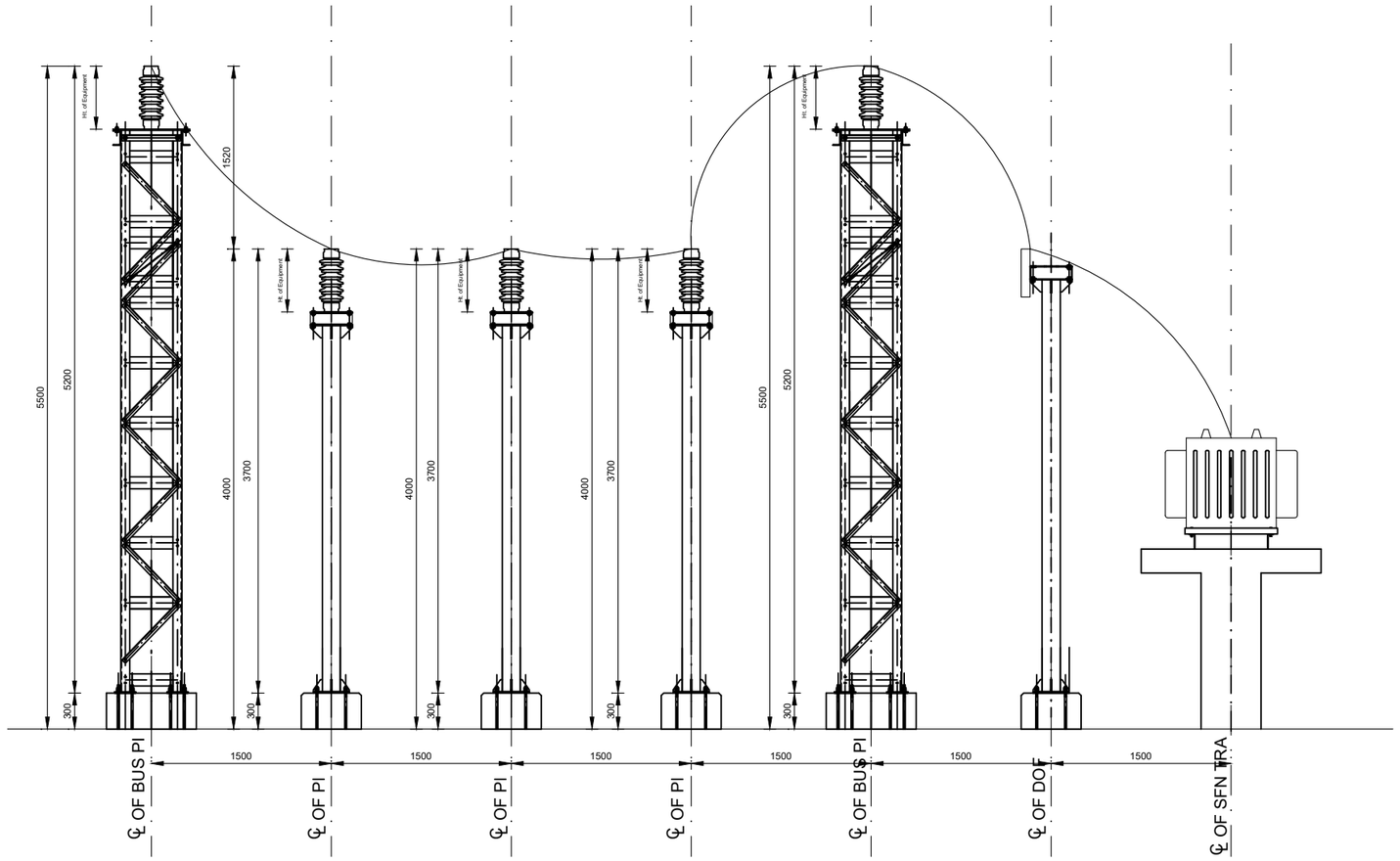


SECTION C–C

NOTES

1. Refer to respective SLDs for details.
2. Location of Lightning Mast and Lightning Protection arrangement shall be site specific and shall be finalized during detail design phase.
3. Altitude Correction Factor must be applied as per the IEC Standard.

CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN	DESIGNED	TITLE SECTION VIEWS OF 33 kV SWITCHYARD LAYOUT FOR 33/11 kV SUBSTATION WITH ONE INCOMING FEEDER
			DRAFTING CHECK	DESIGN CHECK	
			APPROVED	DRAWING NO. CSG-SW-LAY-A-SEC-01	



SECTION D–D

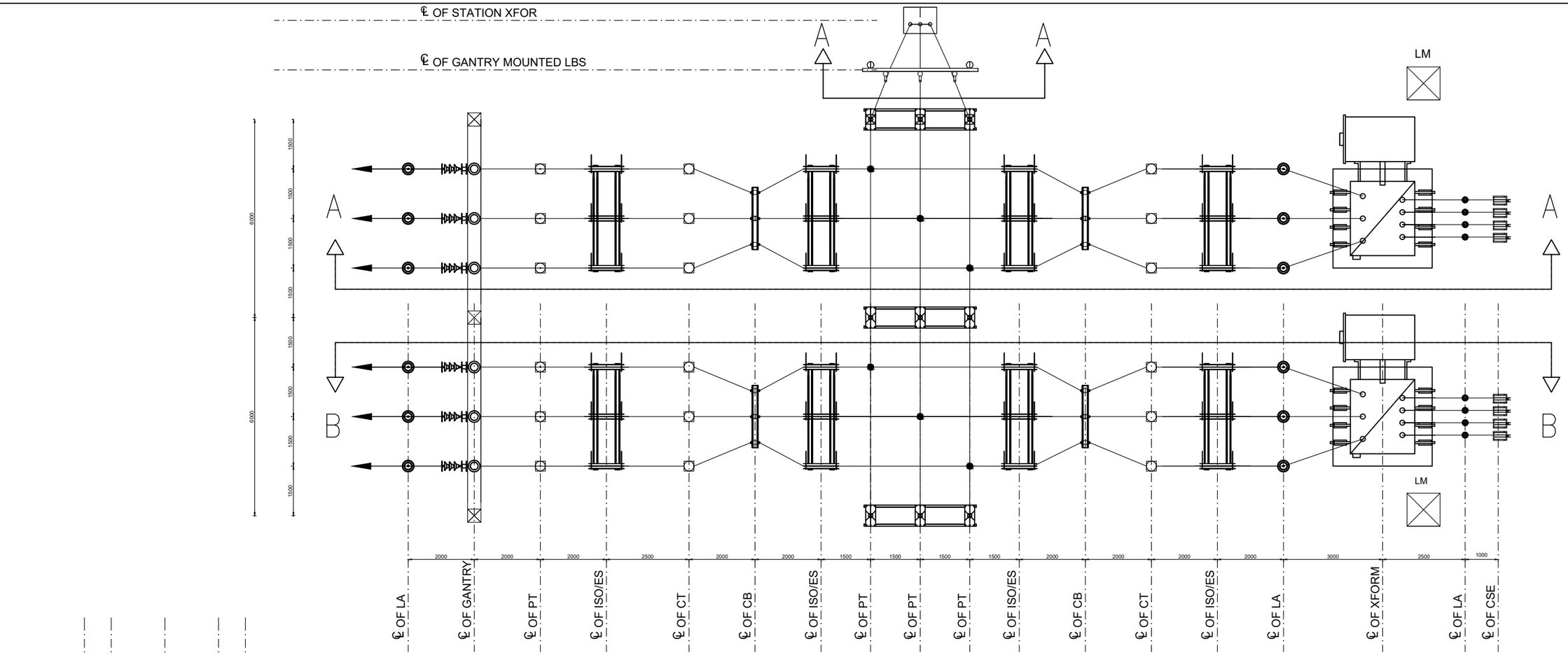
ABBREVIATION

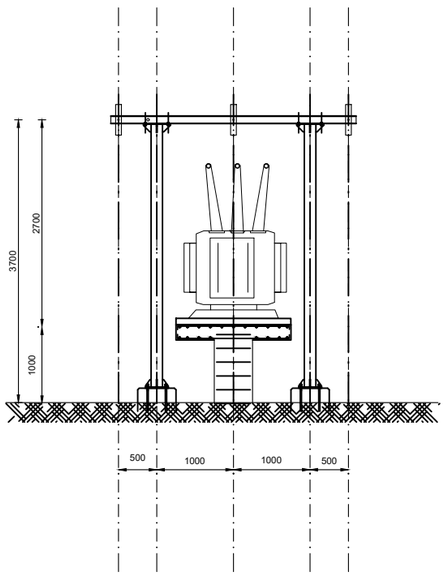
SN	Acronym	Full Form
1	CSE	Cable Sealing End
2	CB	Circuit Breaker
3	CT	Current Transformer
4	ISO	ISOLATOR
5	ISO/ES	ISOLATOR WITH EARTHING SWITCH
6	LA	LIGHTNING ARRESTER
7	LM	LIGHTINING MAST
8	LBS	LOAD BREAK SWITCH
9	PT	POTENTIAL TRANSFORMER
10	XFORM	TRANSFORMER

NOTES

1. Refer to respective SLDs for details.
2. Location of Lightning Mast and Lightning Protection arrangement shall be site specific and shall be finalized during detail design phase.
3. Altitude Correction Factor must be applied as per the IEC Standard.

CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-SW-LAY-A-SEC-02	TITLE SECTION VIEWS OF 33 kV SWITCHYARD LAYOUT FOR 33/11 kV SUBSTATION WITH ONE INCOMING FEEDER





SECTION A–A

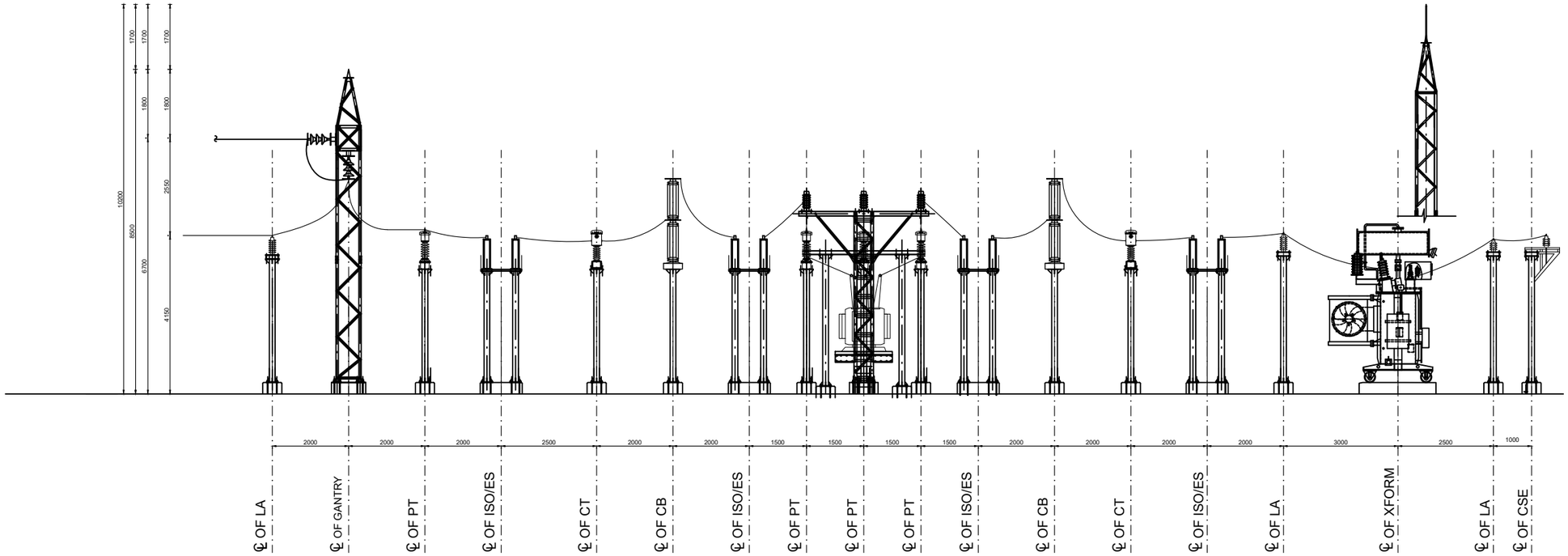
ABBREVIATION

SN	Acronym	Full Form
1	CSE	Cable Sealing End
2	CB	Circuit Breaker
3	CT	Current Transformer
4	ISO	ISOLATOR
5	ISO/ES	ISOLATOR WITH EARTHING SWITCH
6	LA	LIGHTNING ARRESTER
7	LM	LIGHTNING MAST
8	LBS	LOAD BREAK SWITCH
9	PT	POTENTIAL TRANSFORMER
10	XFORM	TRANSFORMER

NOTES

1. Refer to respective SLDs for details
2. The 33 kV switchyard layouts for other schemes such as, two incoming feeder, one outgoing feeder, two transformers shall be developed accordingly.

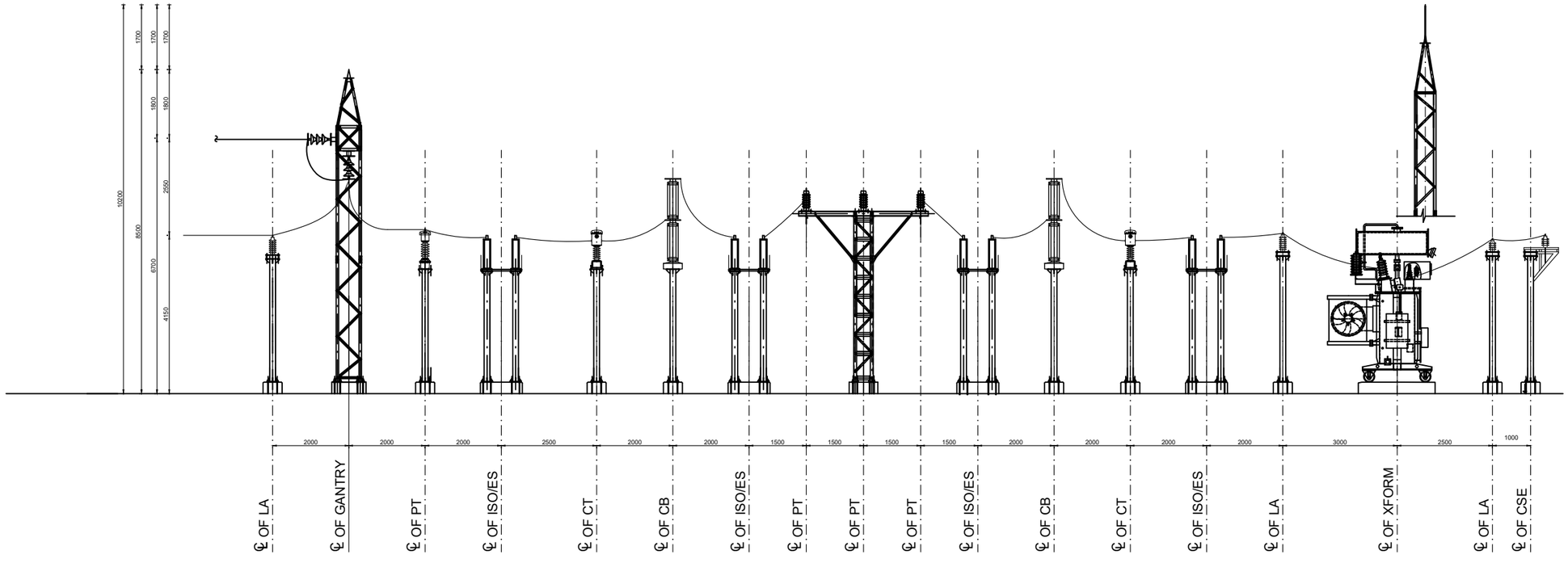
CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN	DESIGNED	TITLE 33 kV SWITCHYARD LAYOUT FOR 33/11 kV SUBSTATION WITH TWO INCOMING FEEDERS
			DRAFTING CHECK	DESIGN CHECK	
			APPROVED	DRAWING NO. CSG-SW-LAY-B	



SECTION B–B

ABBREVIATION

SN	Acronym	Full Form
1	CSE	Cable Sealing End
2	CB	Circuit Breaker
3	CT	Current Transformer
4	ISO	ISOLATOR
5	ISO/ES	ISOLATOR WITH EARTHING SWITCH
6	LA	LIGHTNING ARRESTER
7	LM	LIGHTINING MAST
8	LBS	LOAD BREAK SWITCH
9	PT	POTENTIAL TRANSFORMER
10	XFORM	TRANSFORMER

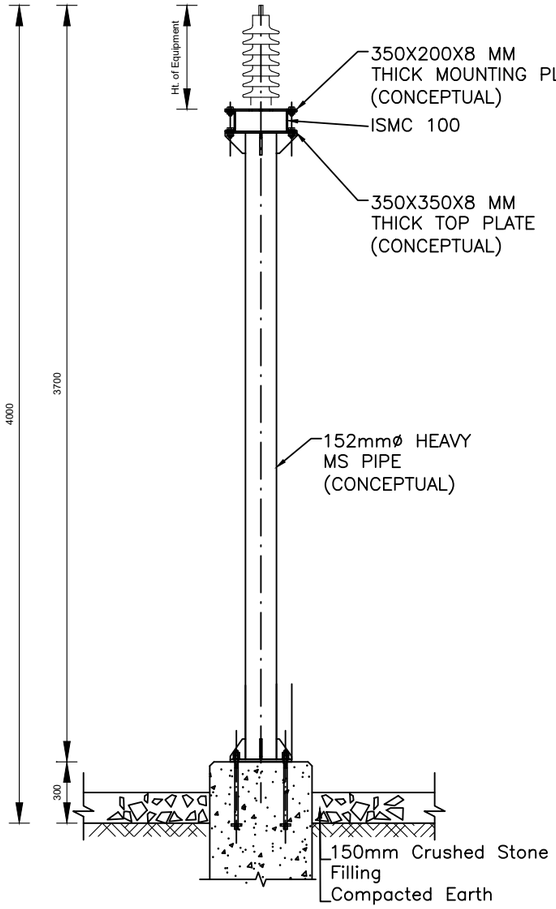


SECTION C–C

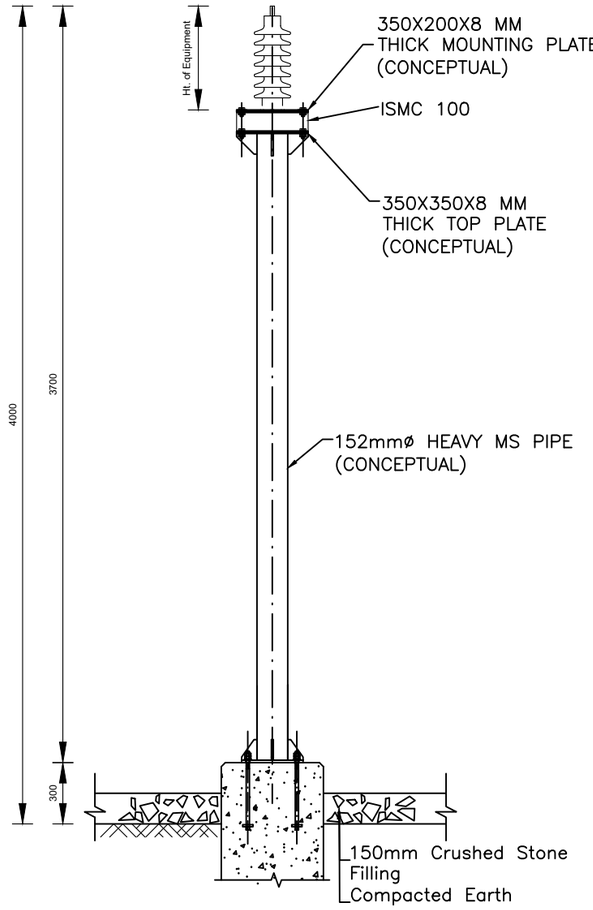
NOTES

1. Refer to respective SLDs for details.
2. Location of Lightning Mast and Lightning Protection arrangement shall be site specific and shall be finalized during detail design phase.
3. Altitude Correction Factor must be applied as per the IEC Standard.

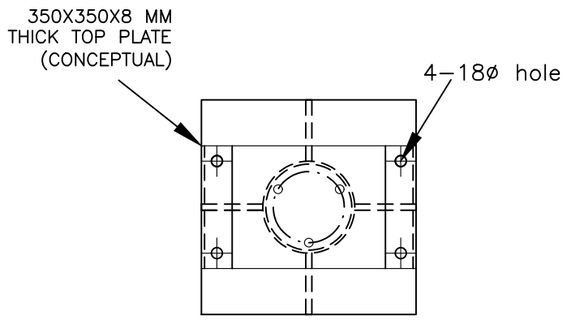
CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN	DESIGNED	TITLE SECTION VIEWS OF 33 kV SWITCHYARD LAYOUT FOR 33/11 kV SUBSTATION WITH TWO INCOMING FEEDERS
			DRAFTING CHECK	DESIGN CHECK	
			APPROVED	DRAWING NO. CSG-SW-LAY-B-SEC	



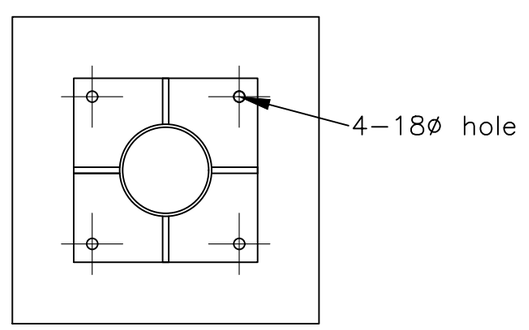
FRONT VIEW OF THE LA GANTRY



SIDE VIEW OF THE LA GANTRY

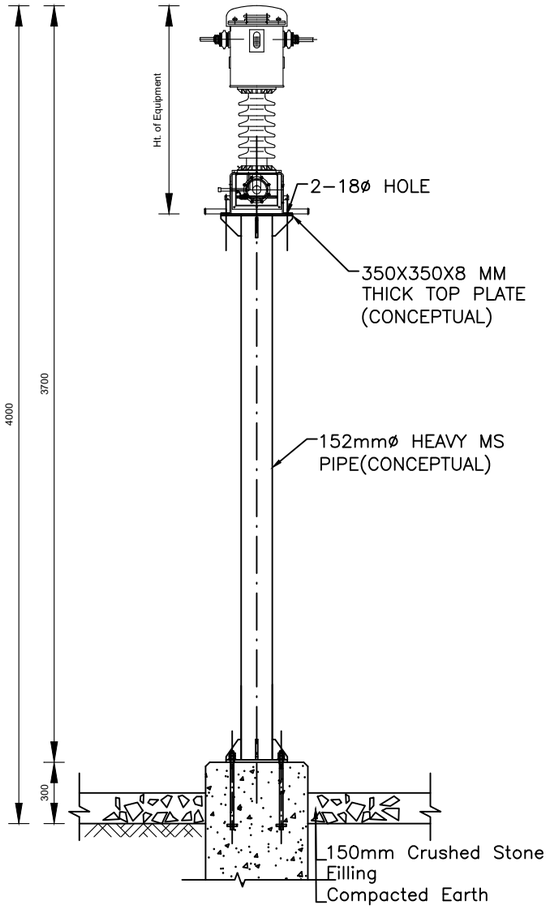


VEIW FROM TOP OF
THE LA GANTRY

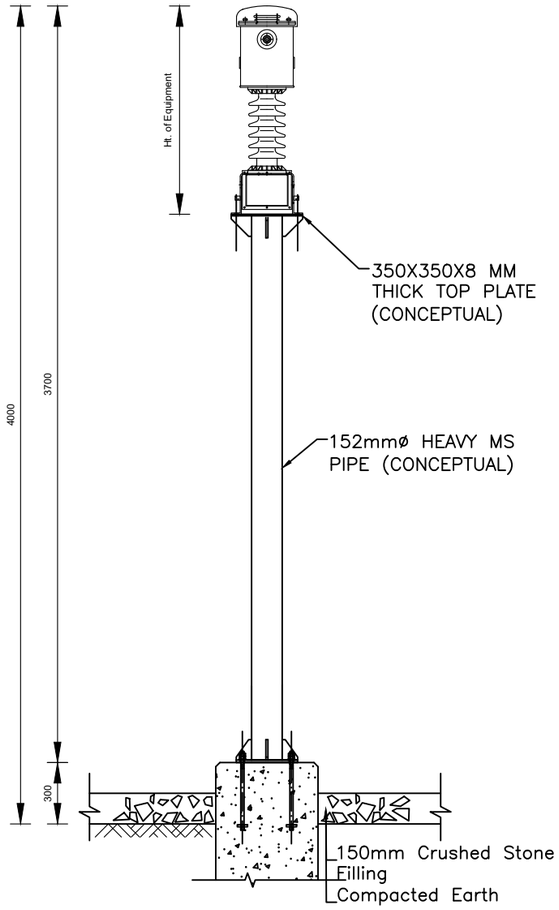


BASE PLATE PLAN

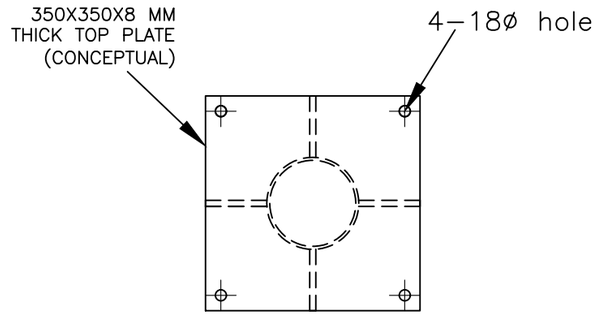
CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-SW-LA	TITLE 33 kV SWITCHYARD LAYOUT FOR 33/11 kV SUBSTATION LIGHTNING ARRESTOR



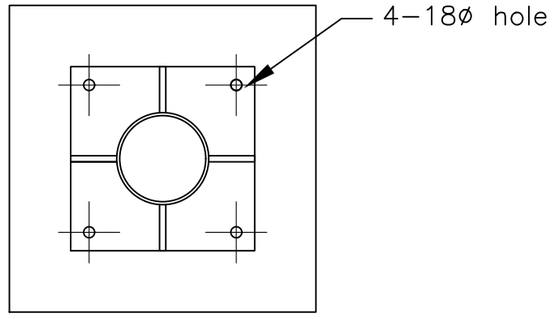
FRONT VIEW OF THE CT GANTRY



SIDE VIEW OF THE CT GANTRY

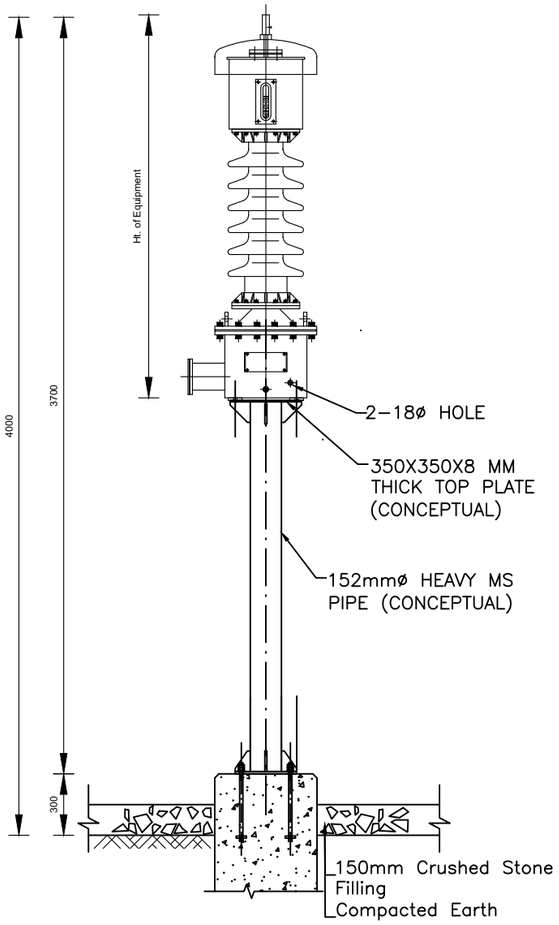


VEIW FROM TOP OF
THE CT GANTRY

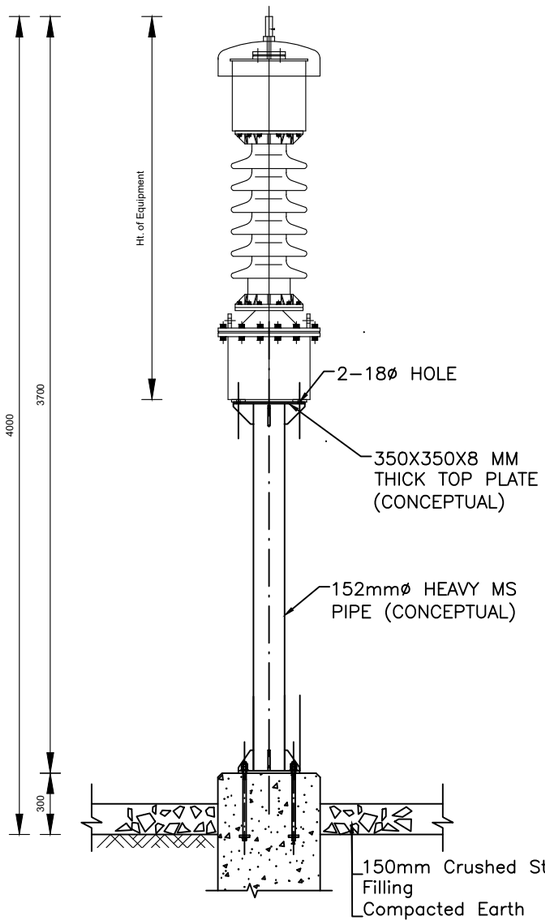


BASE PLATE PLAN

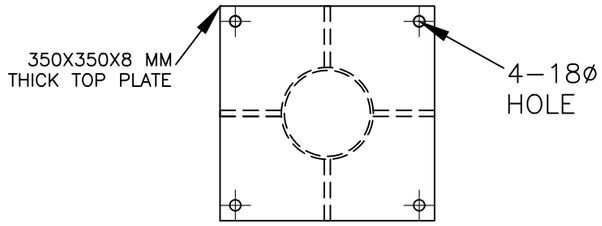
CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-SW-CT	TITLE 33 kV SWITCHYARD LAYOUT FOR 33/11 kV SUBSTATION CURRENT TRANSFORMER



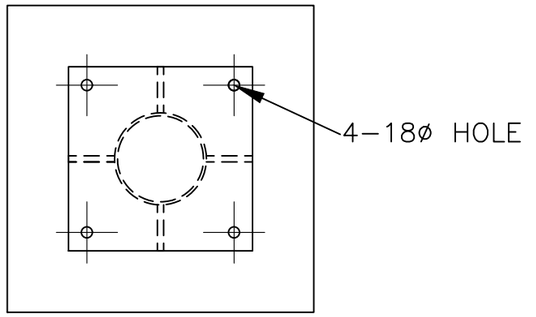
FRONT VIEW OF THE PT GANTRY



SIDE VIEW OF THE PT GANTRY



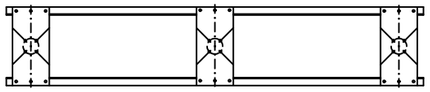
VEIW FROM TOP OF
THE PT GANTRY



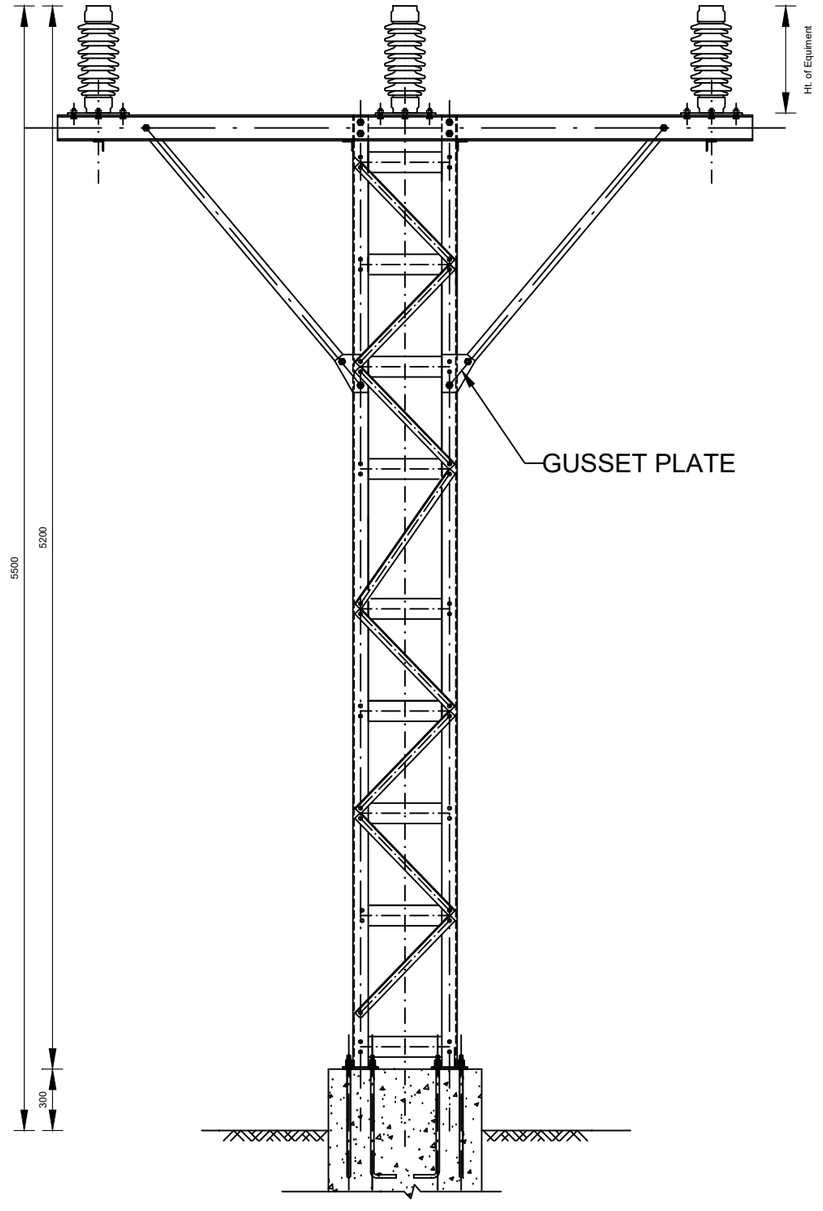
BASE PLATE PLAN

CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-SW-PT	TITLE 33 kV SWITCHYARD LAYOUT FOR 33/11 kV SUBSTATION POTENTIAL TRANSFORMER

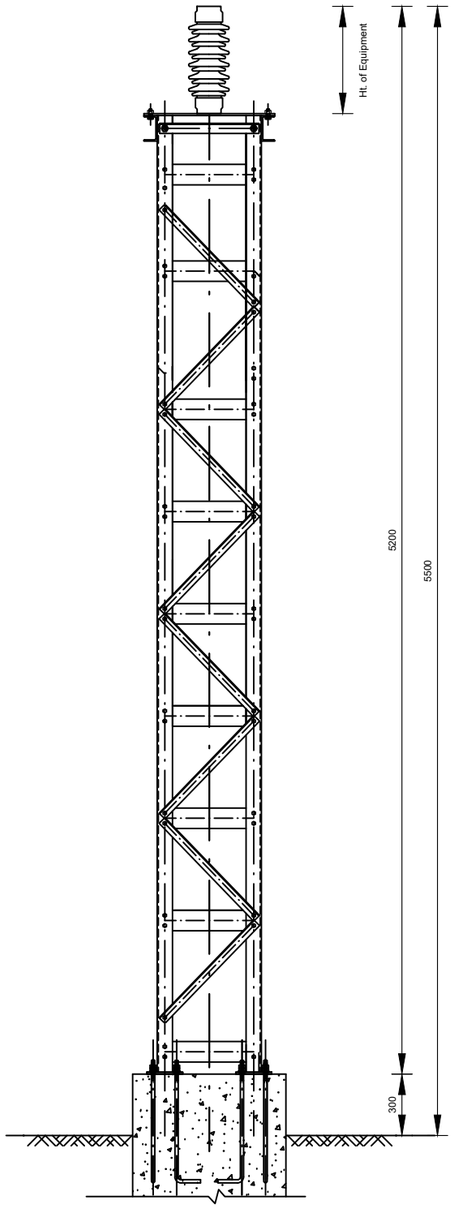
33KV BUSPI GANTRY



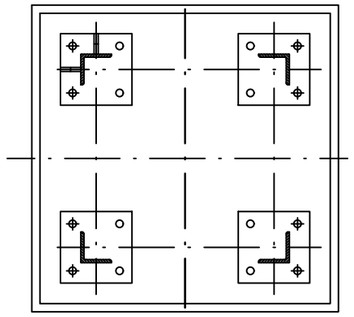
VIEW FROM TOP OF BUS PI GANTRY



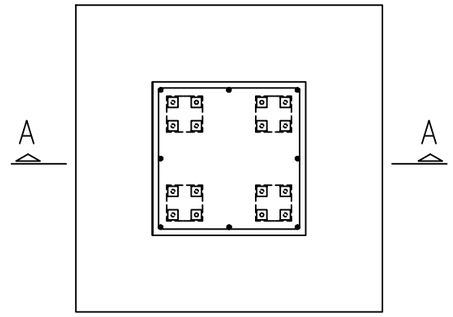
VIEW FROM FRONT OF BUS PI GANTRY



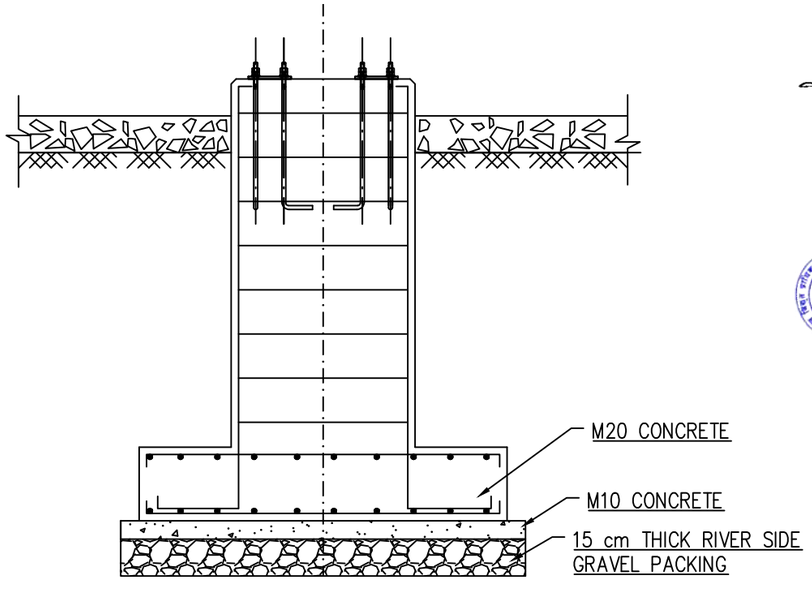
VIEW FROM SIDE OF BUS PI GANTRY



BASE PLATE PLAN

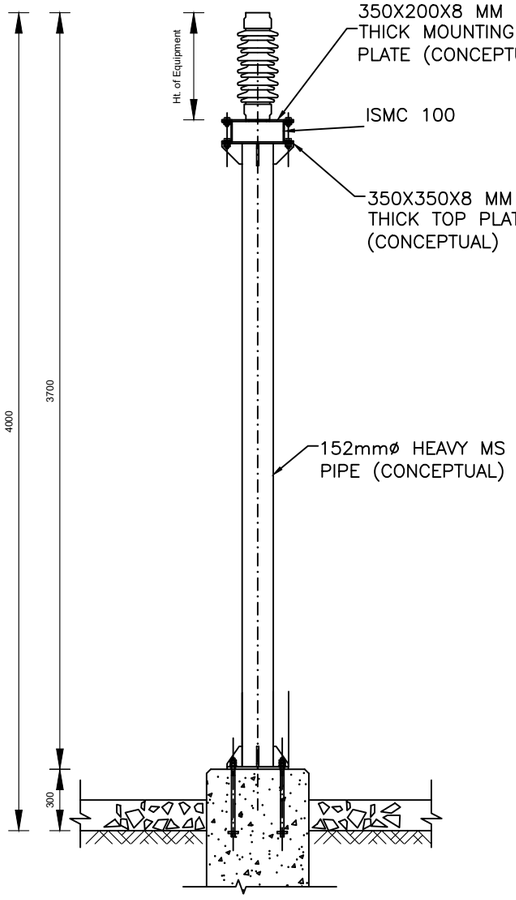


PLAN
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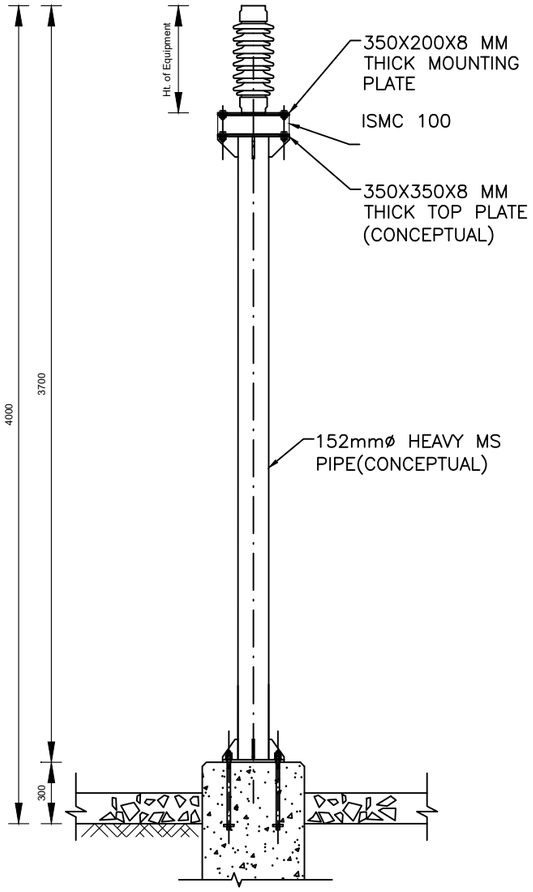


SECTION A–A
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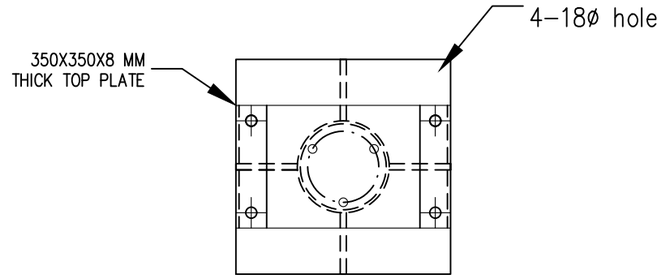
CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-SW-BUS	TITLE 33 kV SWITCHYARD LAYOUT FOR 33/11 kV SUBSTATION BUS PI



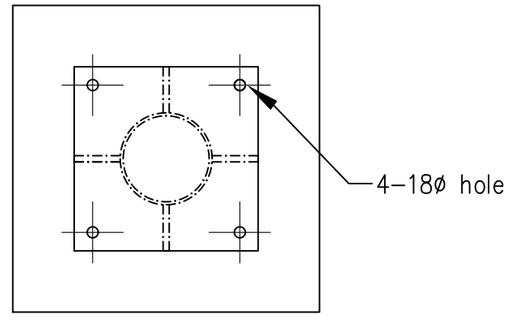
FRONT VIEW OF THE PI GANTRY



SIDE VIEW OF THE PI GANTRY

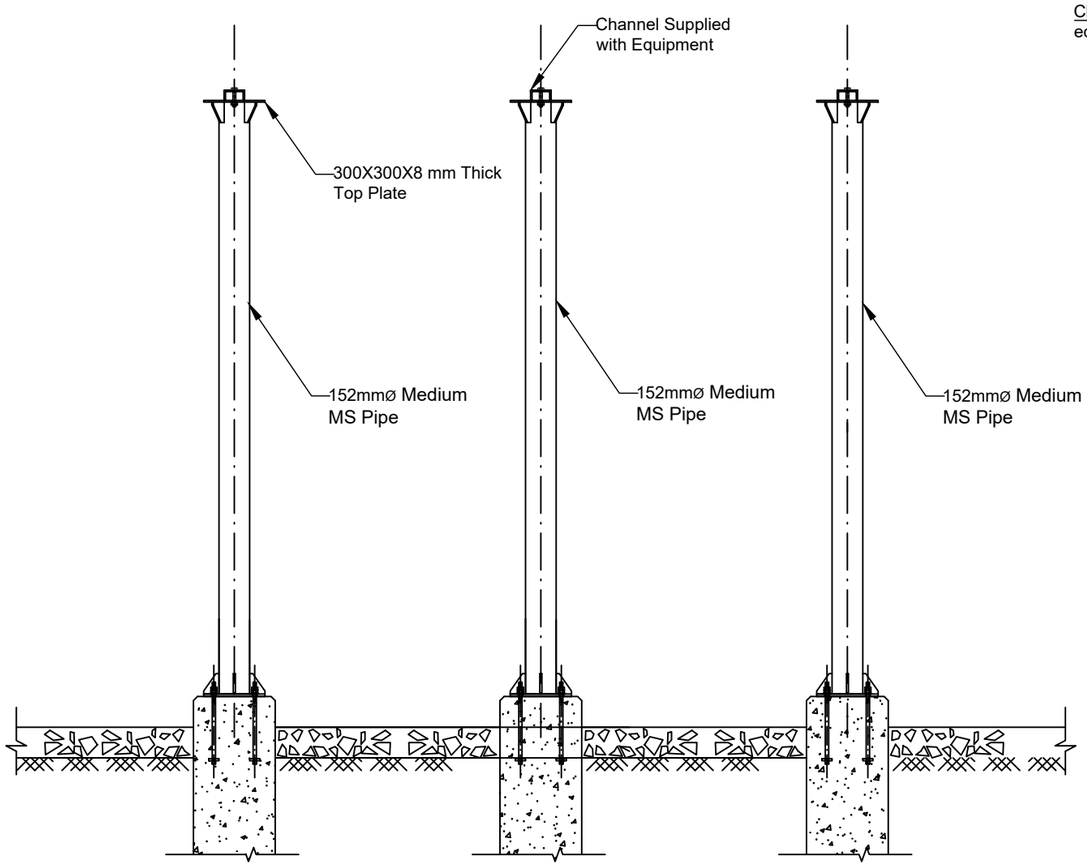


VEIW FROM TOP OF
THE PI GANTRY

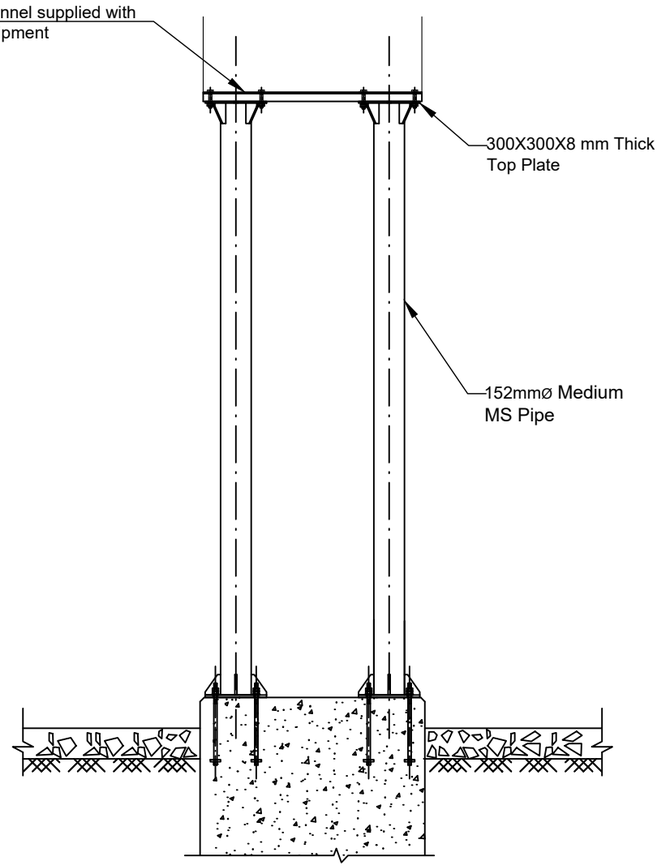


BASE PLATE PLAN

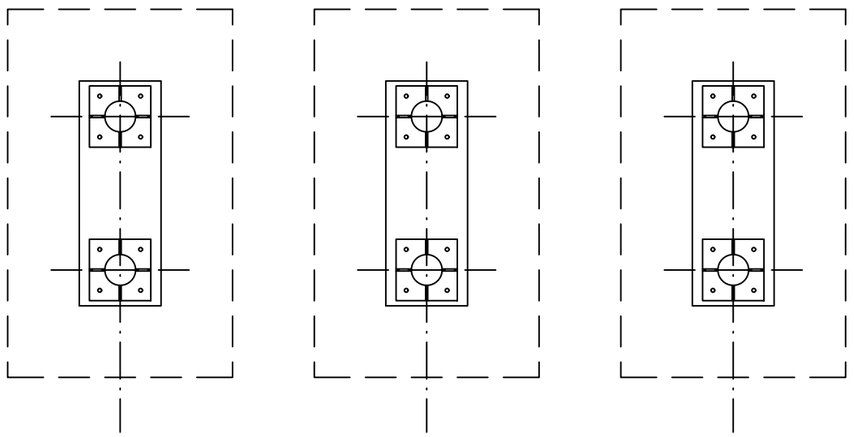
CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-SW-BPI	TITLE 33 kV SWITCHYARD LAYOUT FOR 33/11 kV SUBSTATION BUS POST INSULATOR



VEIW FROM FRONT OF THE DISCONNECTOR SWITCH GANTRY WITH ES



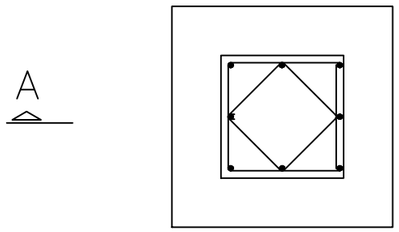
SIDE VEIW FROM THE DISCONNECTOR SWITCH GANTRY WITH ES



LAYOUT PLAN

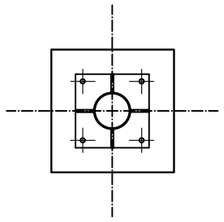
CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-SW-DSES	TITLE 33 kV SWITCHYARD LAYOUT FOR 33/11 kV SUBSTATION DISCONNECTOR SWITCH WITH EARTH SWITCH

TYPICAL FOOTING DETAIL FOR CT/PT/PI/LA

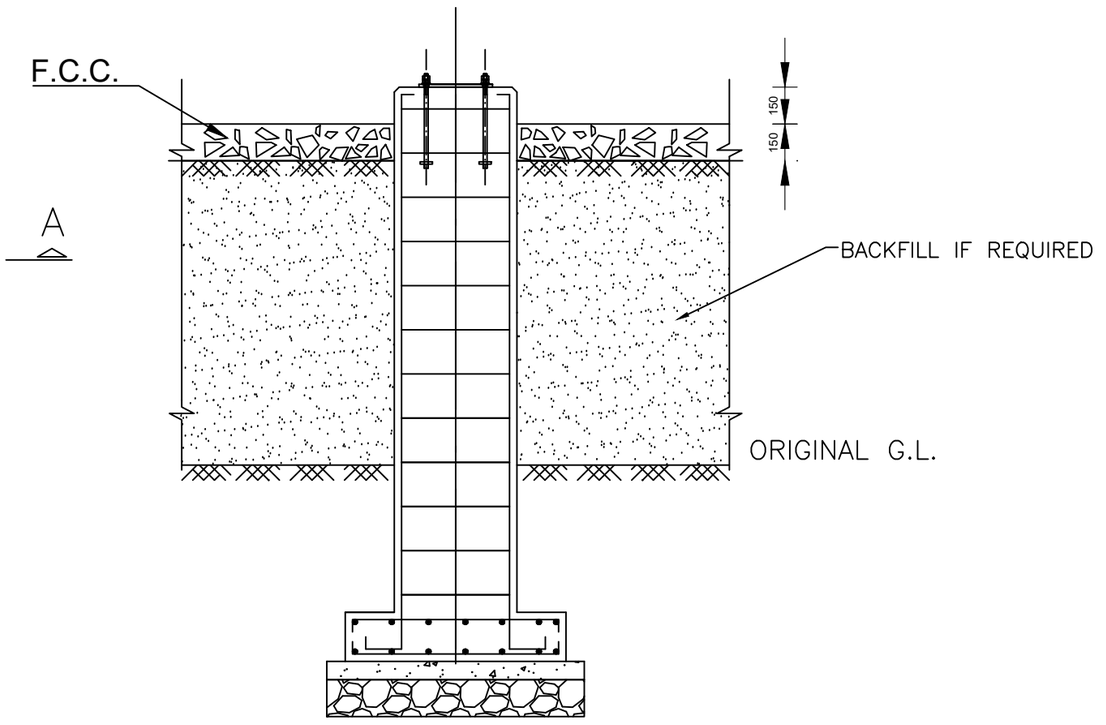


PLAN

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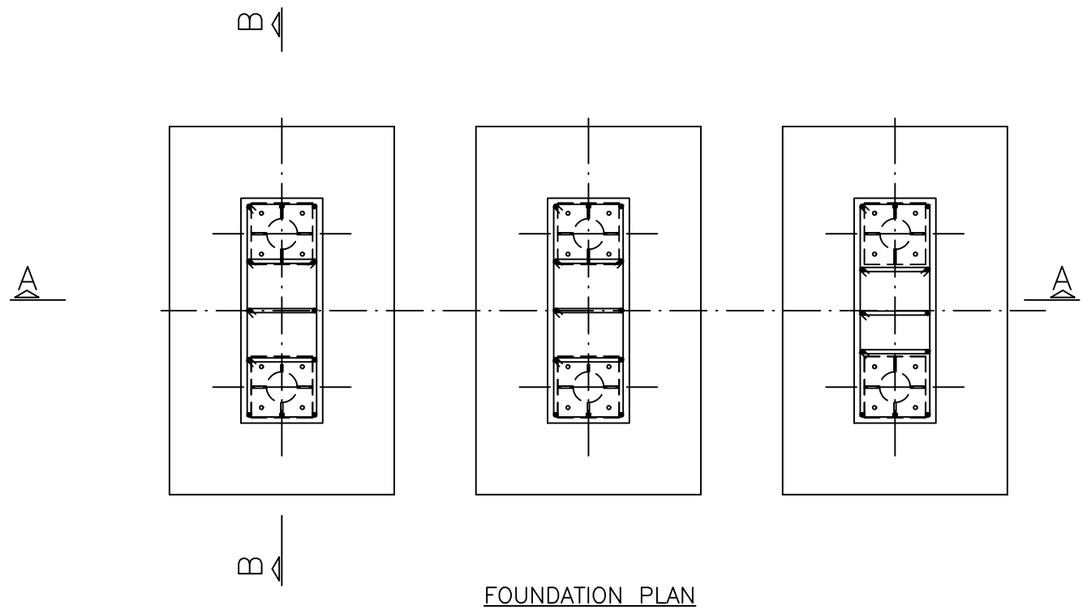
BASE PLATE PLAN



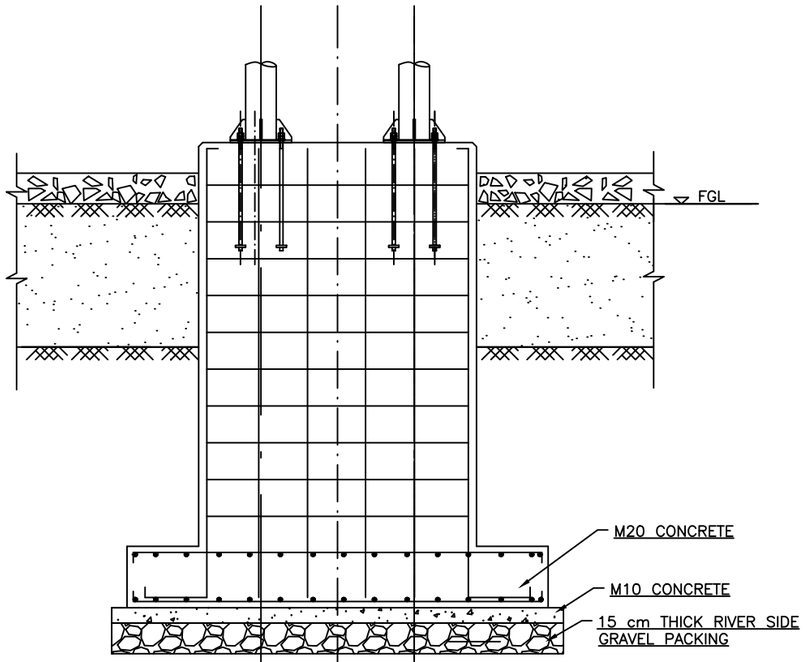
SECTION – AA

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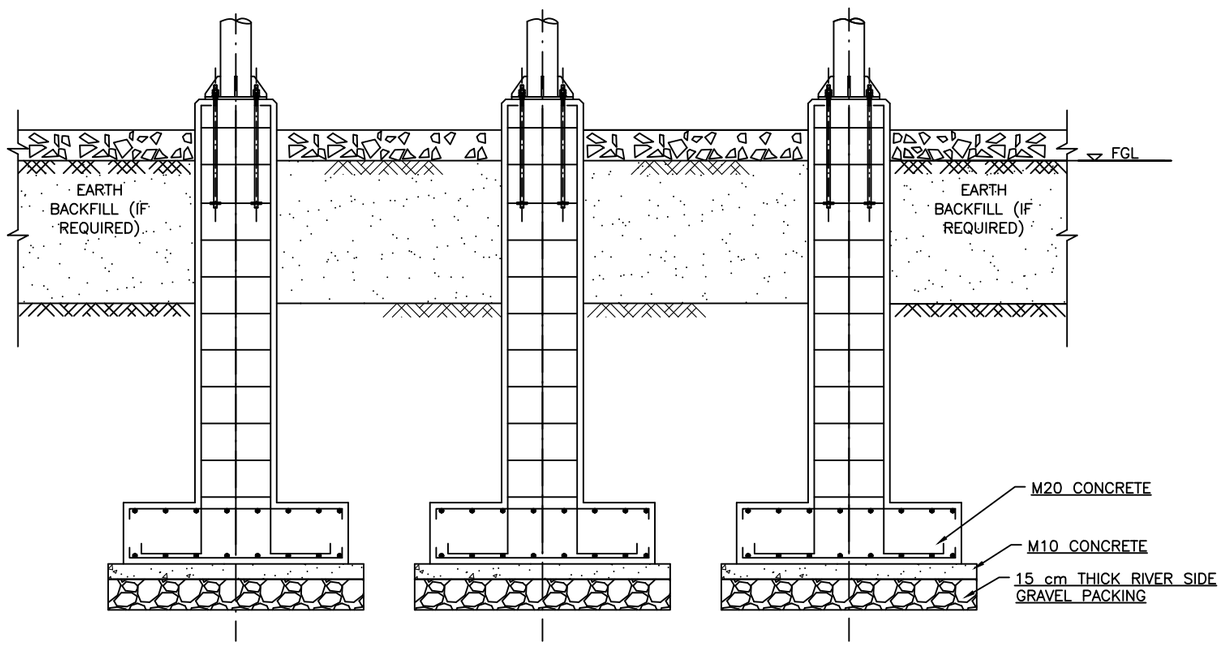
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FOUNDATION PLAN



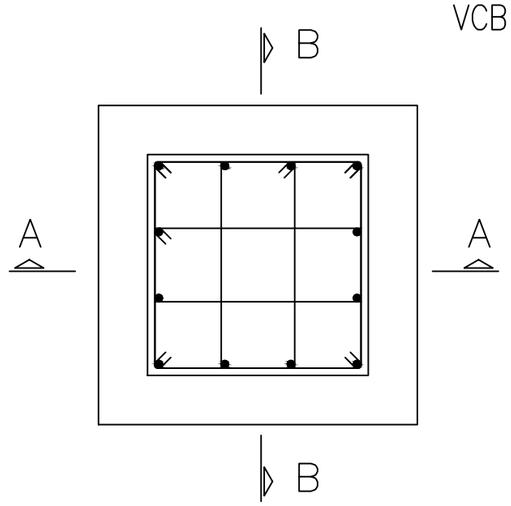
SECTION – BB



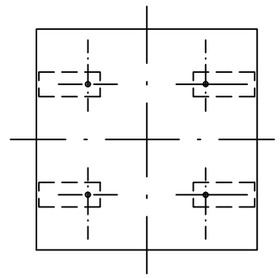
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CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN	DESIGNED	TITLE 33 kV SWITCHYARD LAYOUT FOR 33/11 kV SUBSTATION DISCONNECTOR SWITCH WITH EARTH SWITCH
			DRAFTING CHECK	DESIGN CHECK	
			APPROVED	DRAWING NO. CSG-SW-FOND-TYP-02	

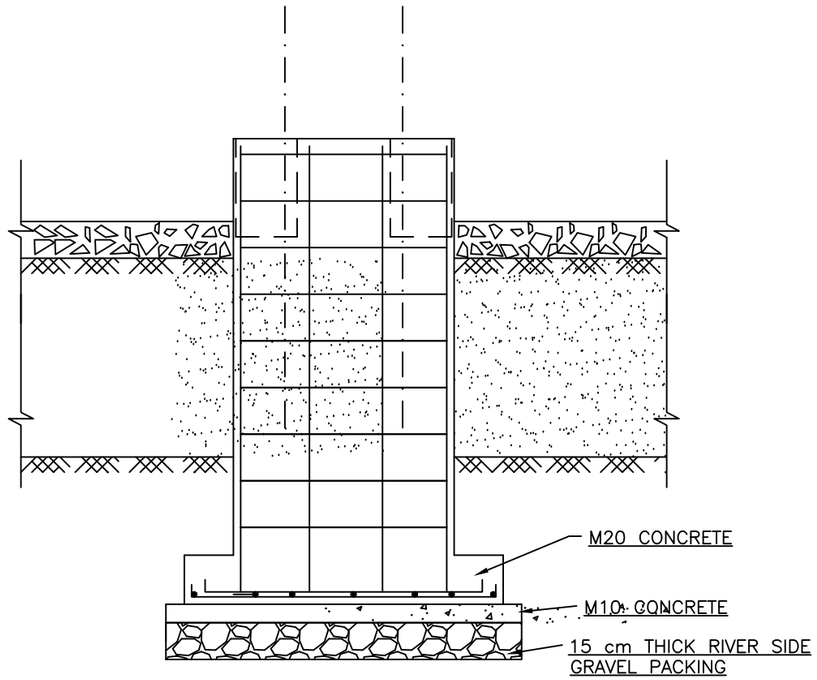
VCB FOUNDATION



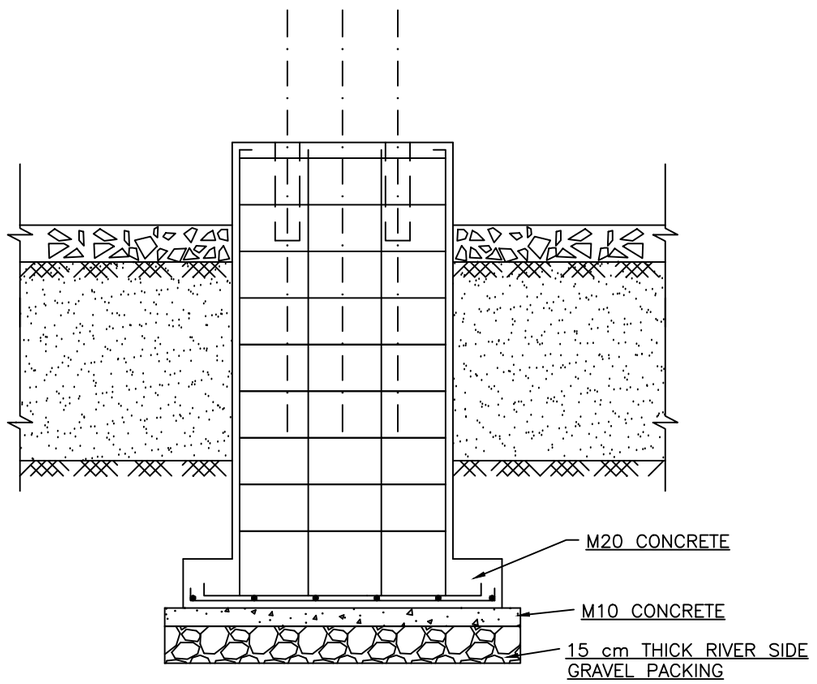
PLAN



DETAIL OF FOUNDATION BOLT



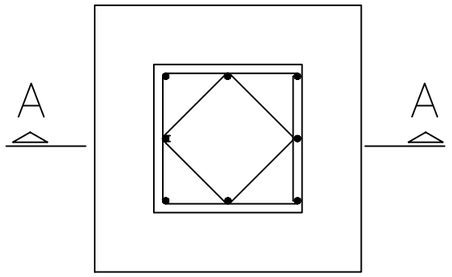
SECTION – AA



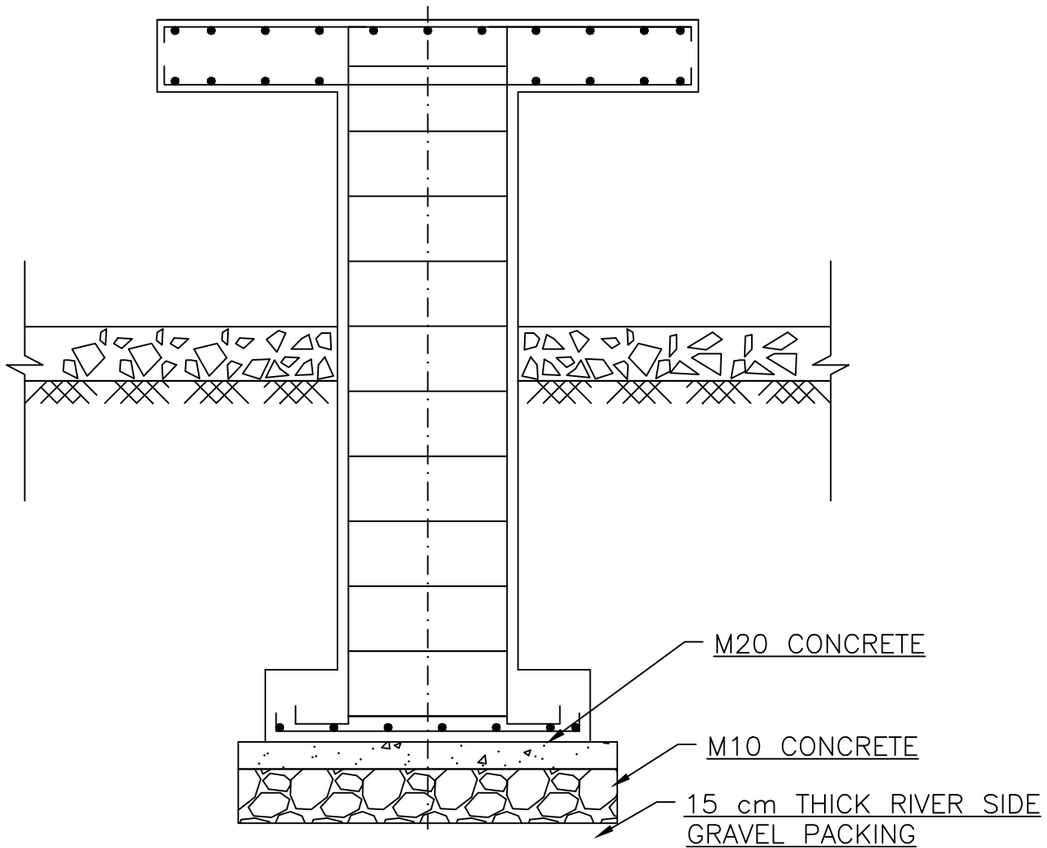
SECTION – BB

CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-SW-FOND-TYP-03	TITLE 33 kV SWITCHYARD LAYOUT FOR 33/11 kV SUBSTATION CIRCUIT BREAKER FOUNDATION

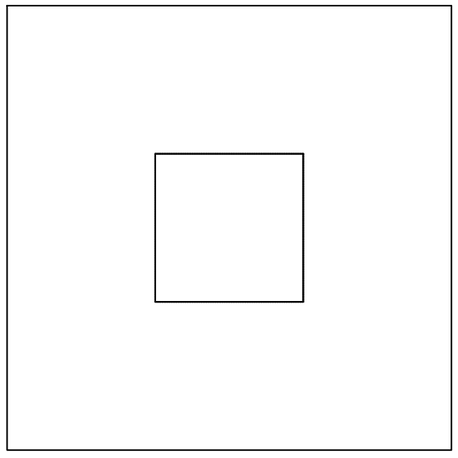
TYPICAL FOOTING DETAIL OF STATION TRANSFORMER



PLAN
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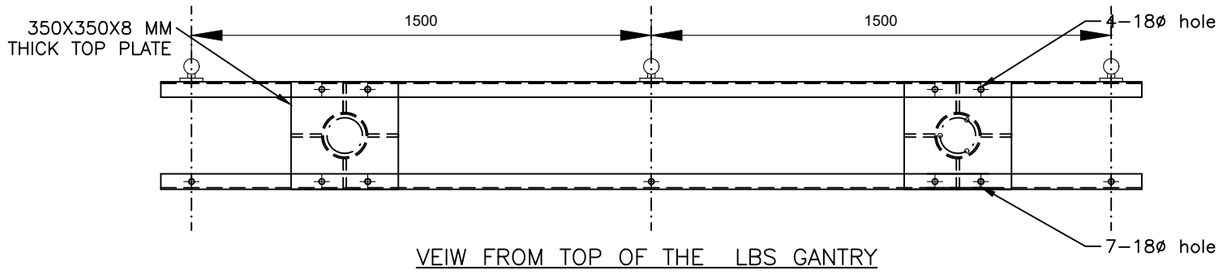


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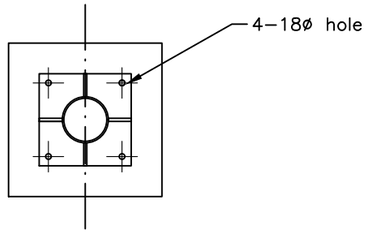


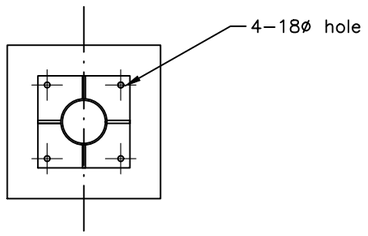
TOP PLATEFORM PLAN

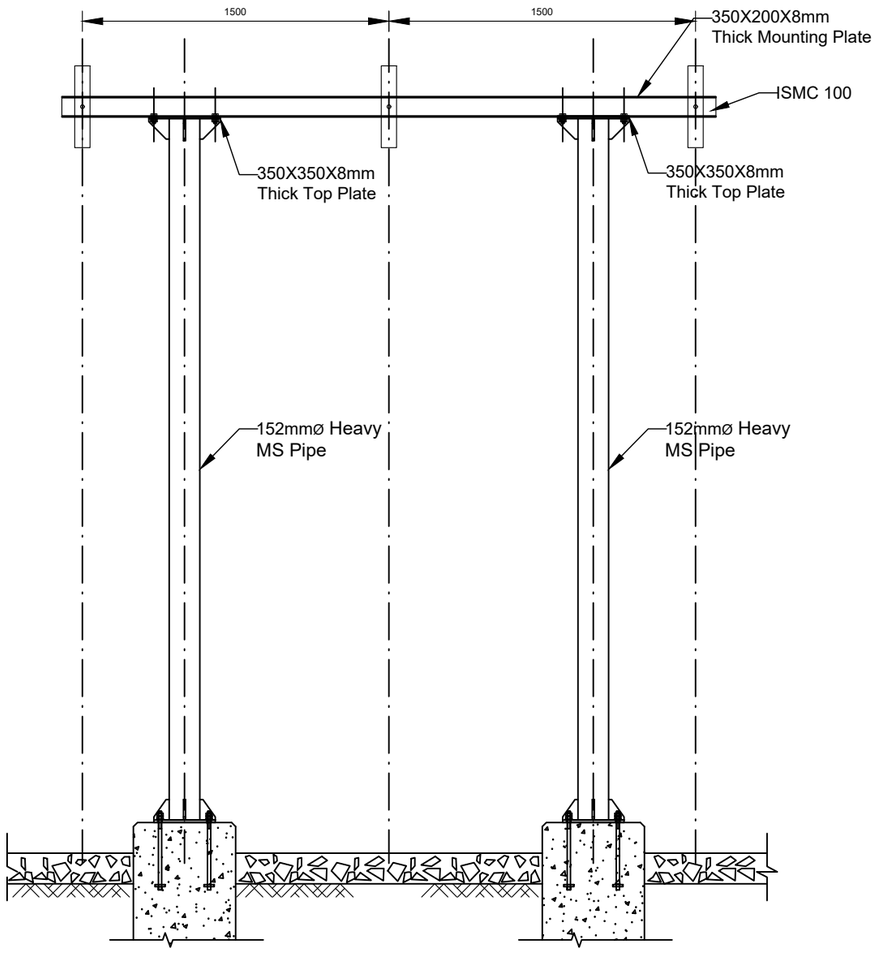
CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-SW-FOND-TYP-04	TITLE 33 kV SWITCHYARD LAYOUT FOR 33/11 kV SUBSTATION STATION TRANSFORMER FOUNDATION



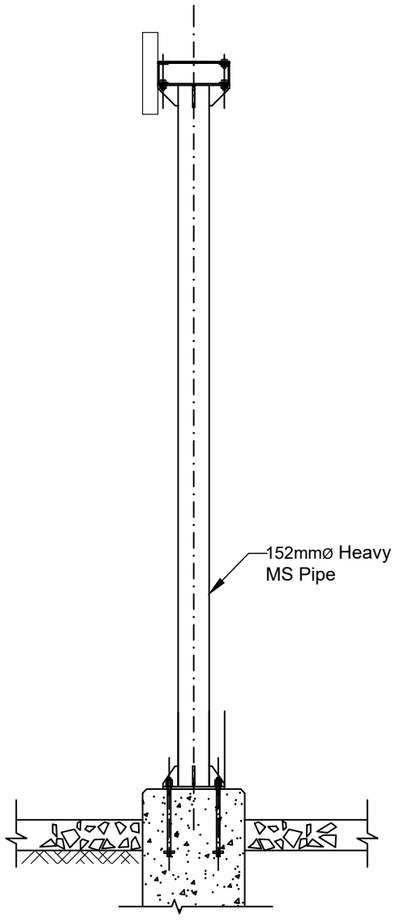
VEIW FROM TOP OF THE LBS GANTRY







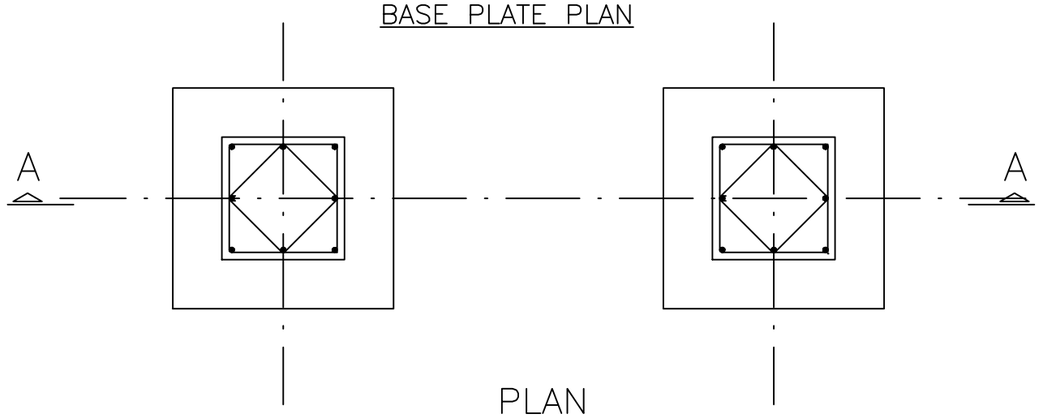
FRONT VIEW OF
LBS GANTRY



SIDE VIEW OF
LBS GANTRY

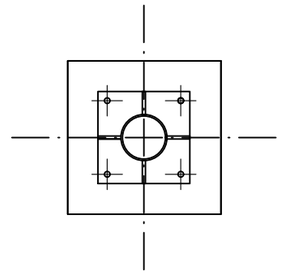
CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-SW-GAN-LBS	TITLE 33 kV SWITCHYARD LAYOUT FOR 33/11 kV SUBSTATION LOAD BREAK SWITCH GANTRY

BASE PLATE PLAN

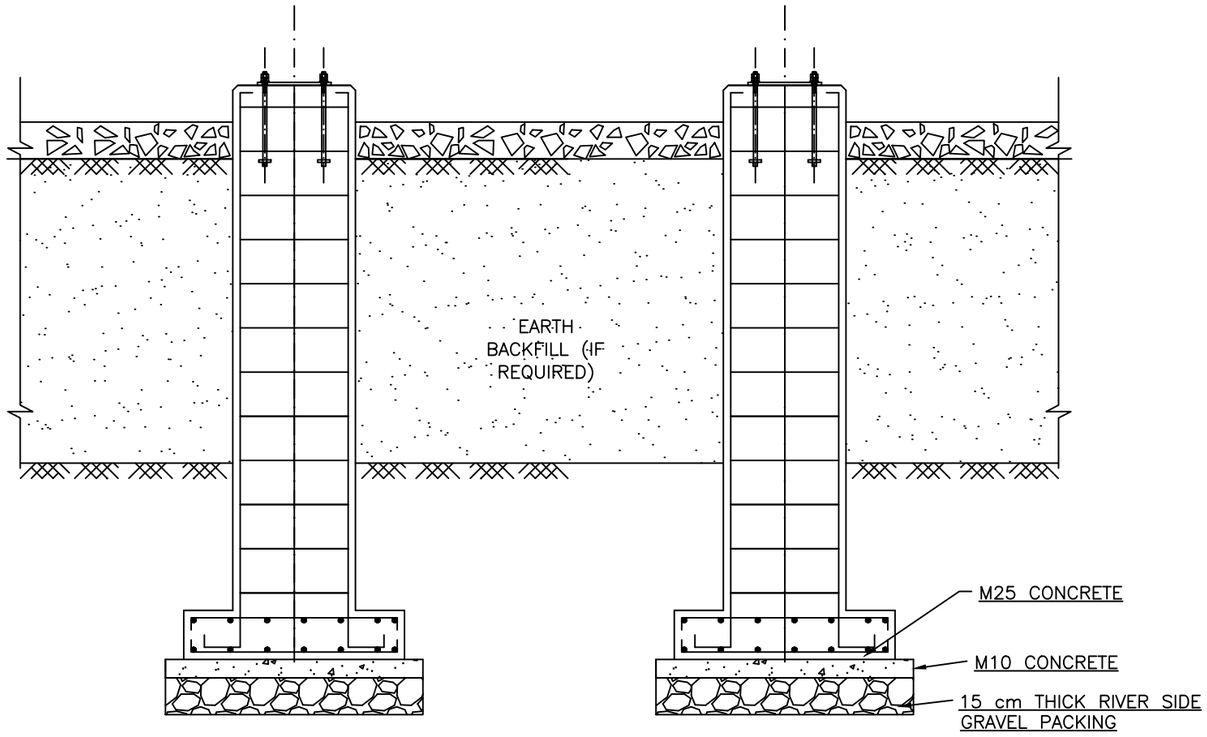


PLAN

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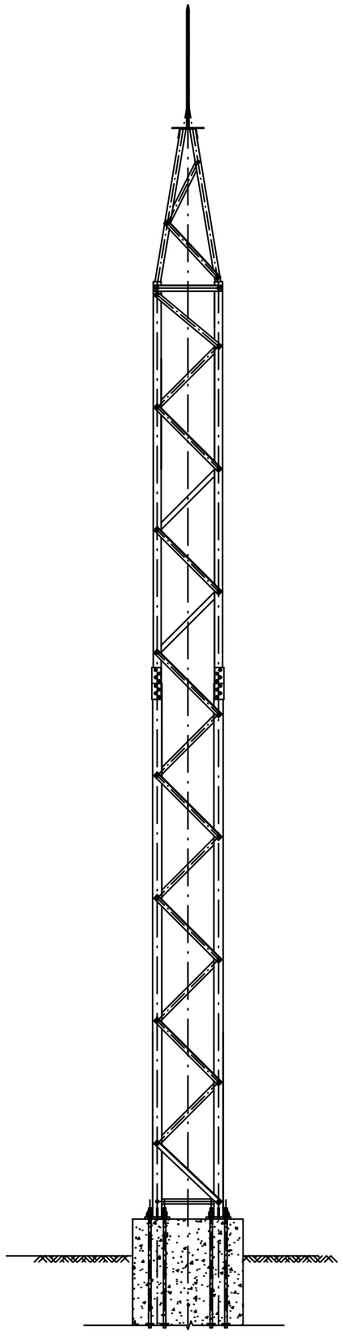
BASE PLATE PLAN



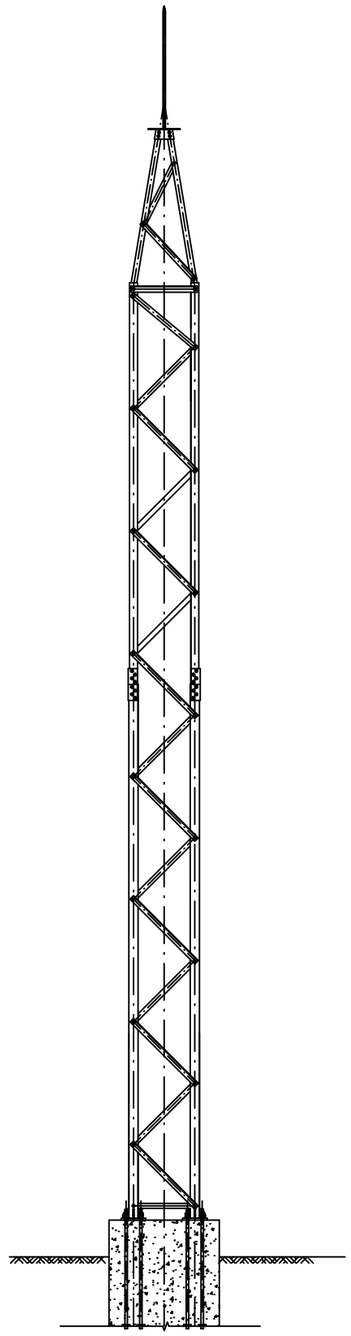
SECTION – AA

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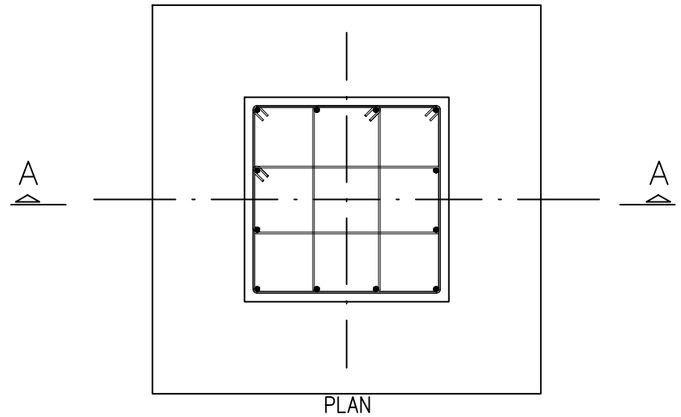
CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-SW-GAN-LBS-FOND	TITLE 33 kV SWITCHYARD LAYOUT FOR 33/11 kV SUBSTATION LOAD BREAK SWITCH GANTRY



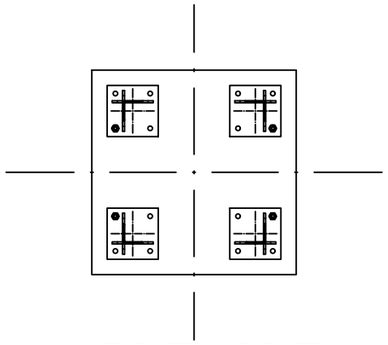
VEIW FROM FRONT OF THE EARTHING MAST GANTRY



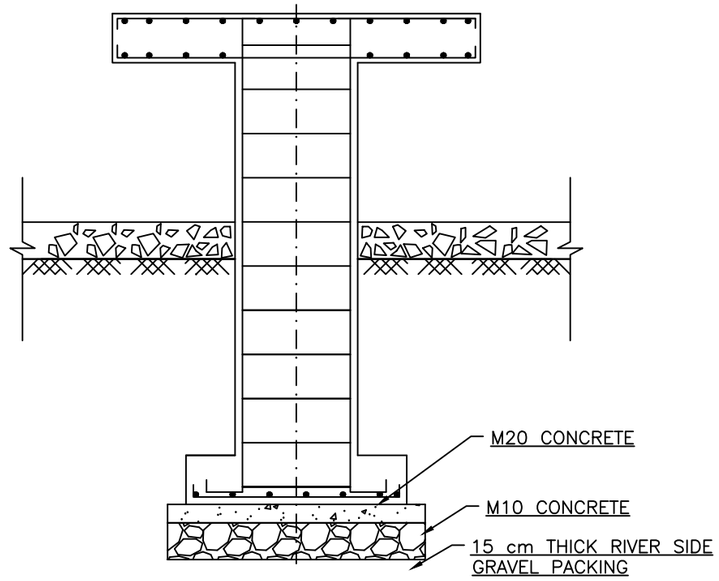
VEIW FROM SIDE OF THE EARTHING MAST GANTRY



PLAN
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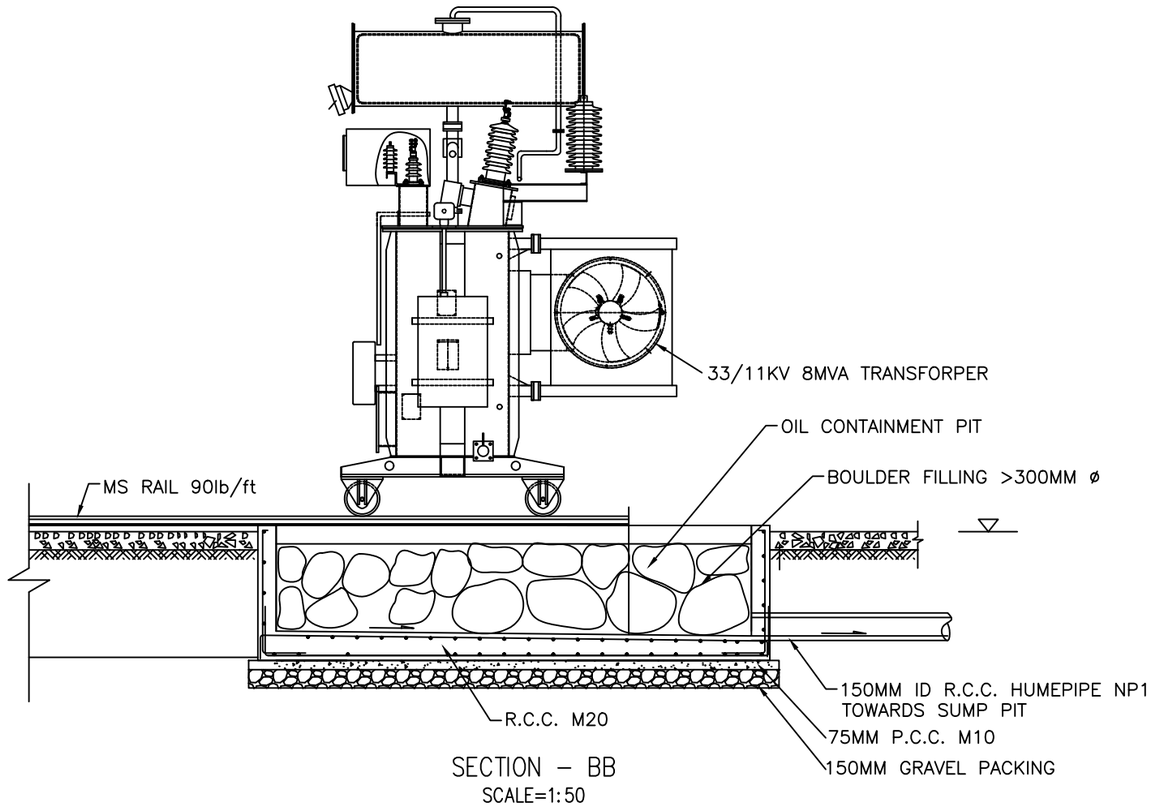


BASE PLATE LAYOUT DETAIL
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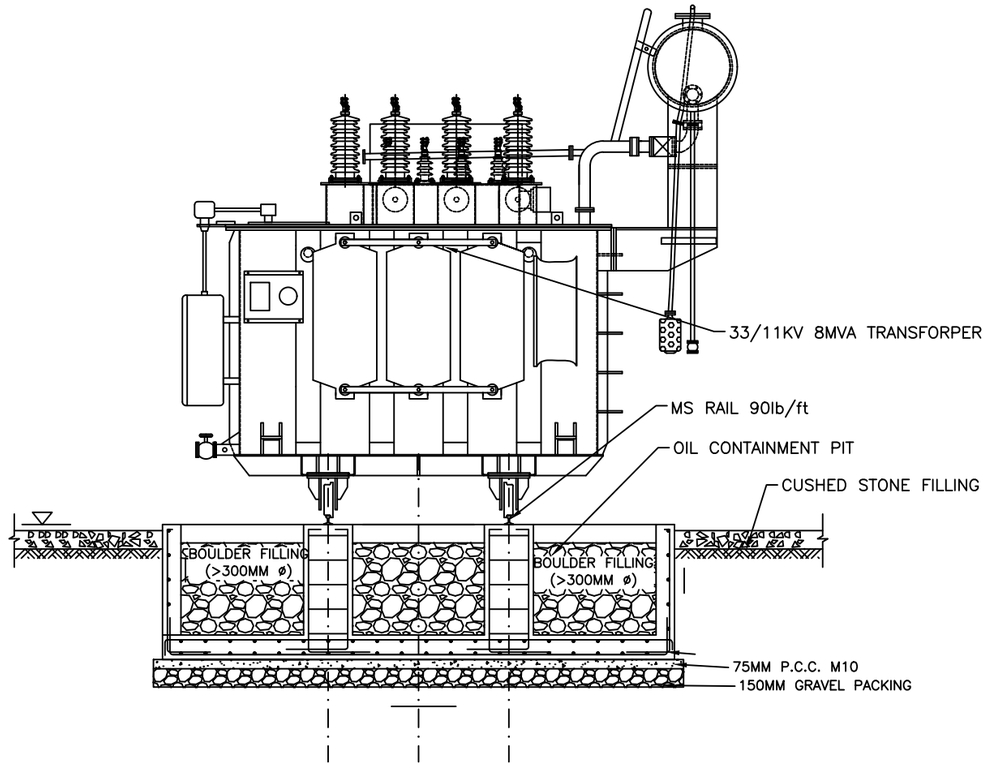


SECTION – AA
SCALE = 1:25

CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-SW-LM	TITLE 33 kV SWITCHYARD LAYOUT FOR 33/11 kV SUBSTATION STATION TRANSFORMER FOUNDATION & LIGHTNING MAST



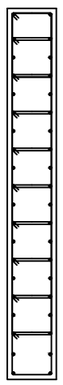
SECTION – BB
SCALE=1:50



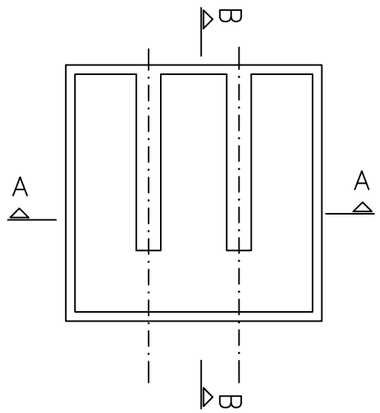
SECTION – AA
SCALE=1:50

NOTES

1. All Transformer Foundations in Terai Region shall be designed for 24 MVA, 33/11 kV Transformer.
2. All Transformer Foundations in Hilly Region shall be designed for 16 MVA, 33/11 kV Transformer.
3. All Transformer Foundations in Mountain Region shall be designed for 8 MVA, 33/11 kV transformer.



SECTIONAL PLAN OF SINGLE PEDESTAL
OF TRANSFORMER
SCALE=1:50



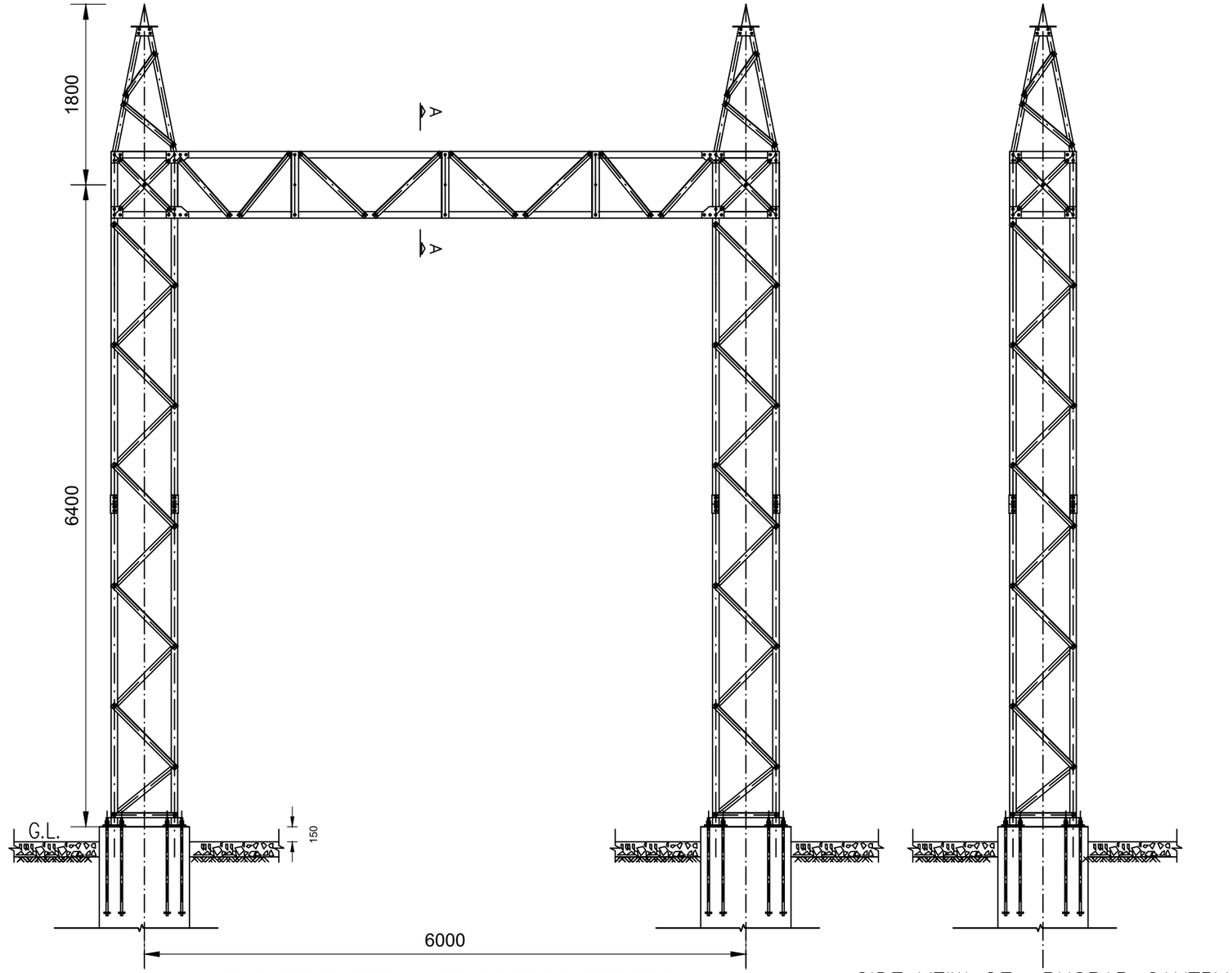
PLAN
SCALE = 1:100

GENERAL NOTES:

1. Dimensions to be read only.
2. Concrete grade for all foundation should be equivalent to M25
3. Lap length should be 'ld' or 50 ø whichever is greater.
4. Development length should be :
   ldt=50ø in tension
   ldc=40ø in compression.
   ld= 10ø in hook of ties or stirrups.
   ld= 8ø in hook at the end of the longitudinal bars.
5. Clear cover should be :
   c=25 mm. for beam. c=35 mm. for column.
   c=50 mm. for foundation. c=15 mm. for slab.
6. Reinforcing steel shall be new hot rolled deformed bars conforming to IS,1786–1979 or IS 1139:1966 and shall have a minimum yield stress of 500 N/mm2 (for rest.)

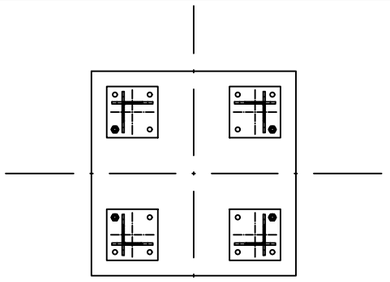
CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-SW-XFORF-01	TITLE 33 kV SWITCHYARD LAYOUT FOR 33/11 kV SUBSTATION POWER TRANSFORMER FOOTING

BUS BAR GANTRY

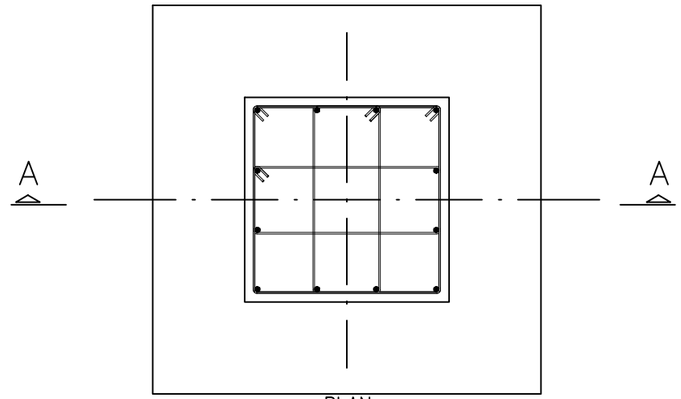


VEIW FROM FRONT OF BUSBAR GANTRY

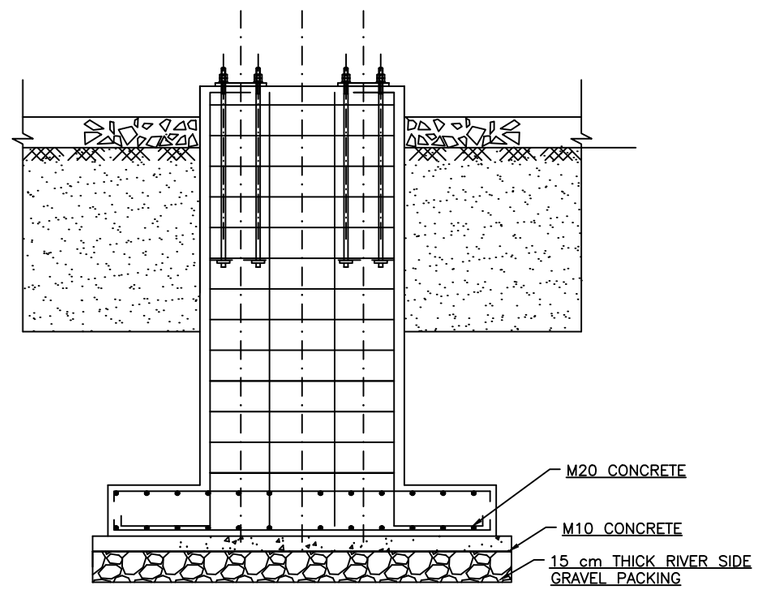
SIDE VEIW OF BUSBAR GANTRY



BASE PLATE LAYOUT DETAIL
SCALE = 1:30

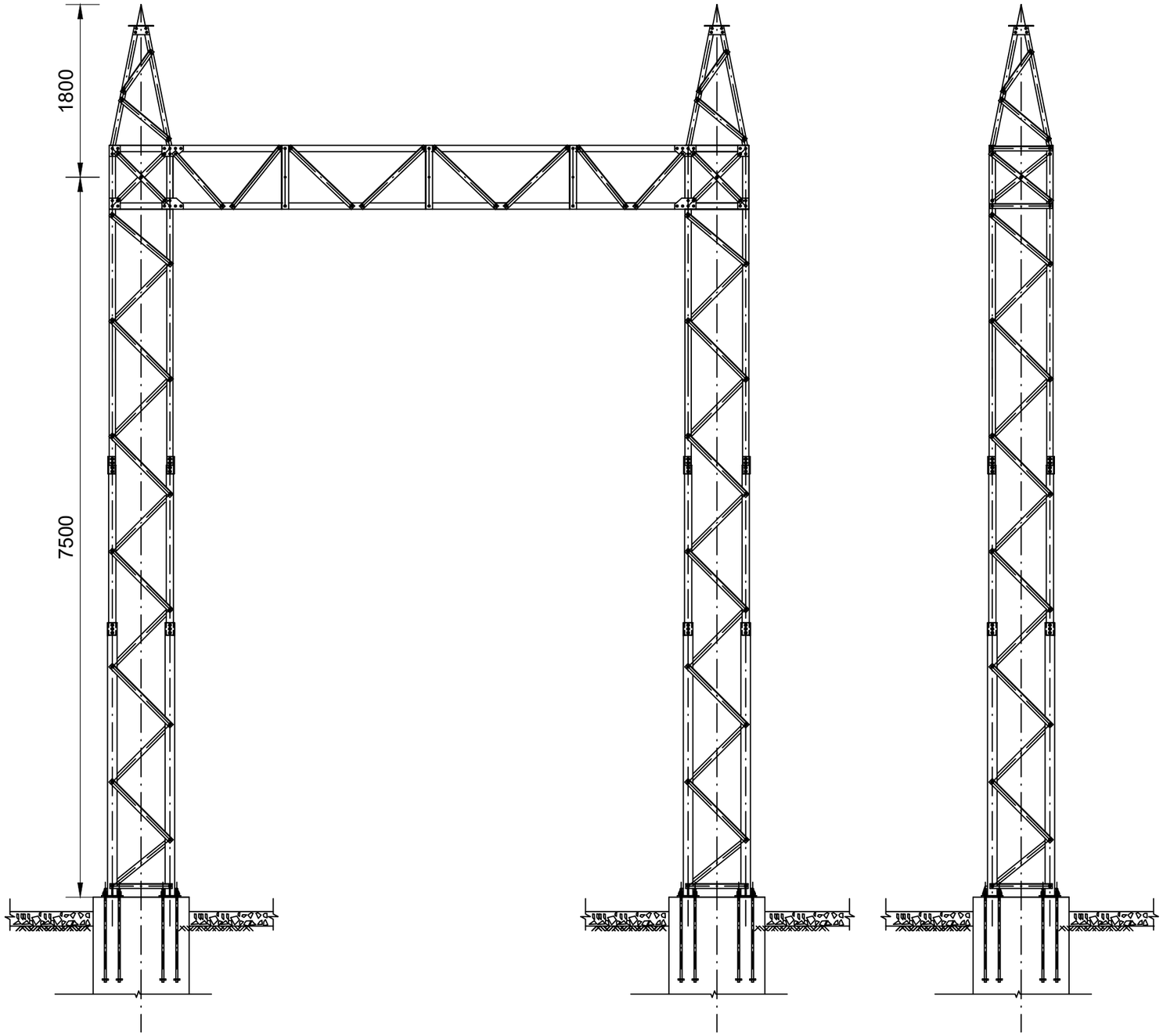


PLAN
SCALE = 1:30



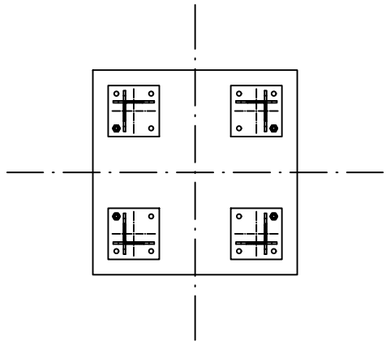
SECTION – AA
SCALE = 1:30

CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-SW-GAN-BB	TITLE 33 kV SWITCHYARD LAYOUT FOR 33/11 kV SUBSTATION BUS BAR GANTRY



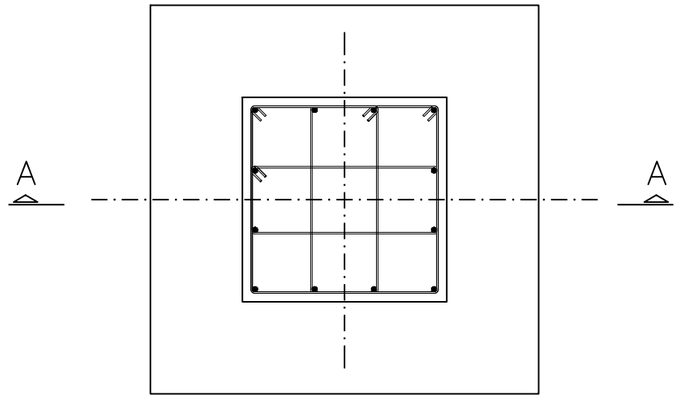
VEIW FROM FRONT OF THE TAKE OFF GANTRY

SIDE VEIW OF THE TAKE OFF GANTRY



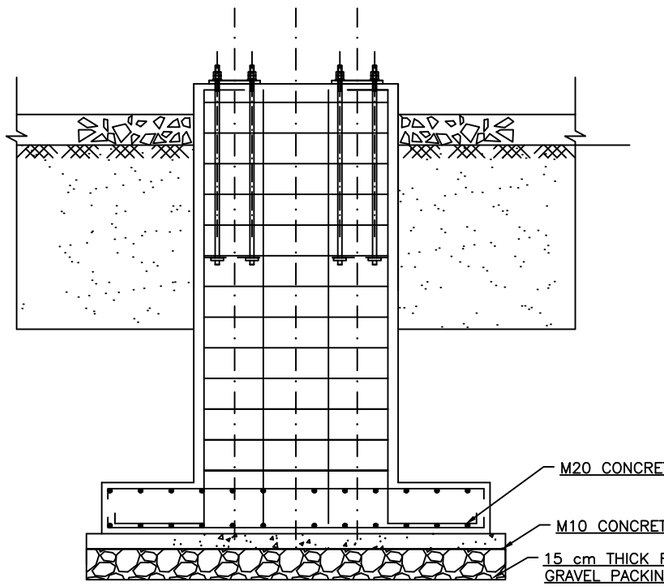
BASE PLATE LAYOUT DETAIL

SCALE = 1:30



PLAN

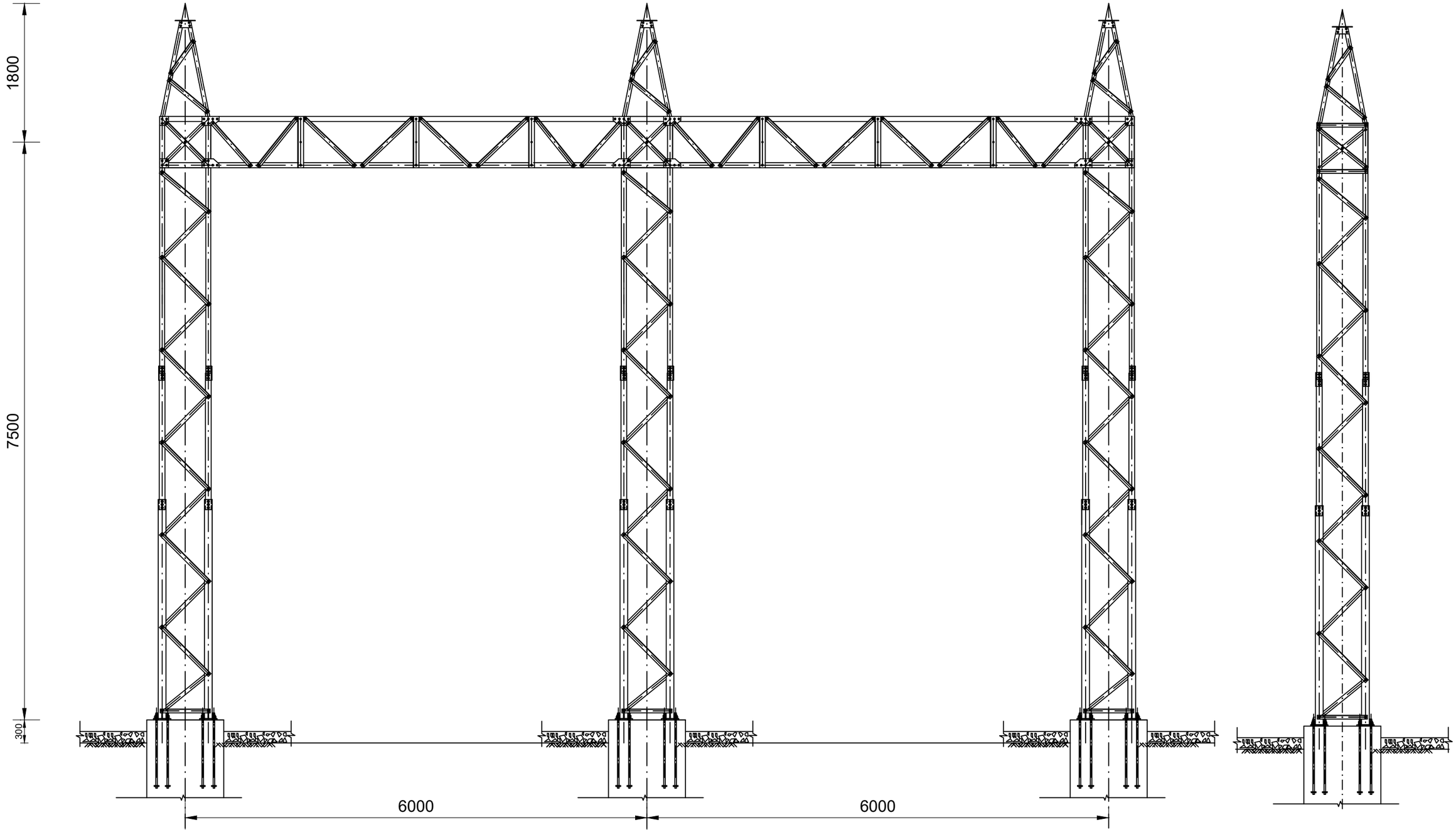
SCALE = 1:30



SECTION – AA

SCALE = 1:30

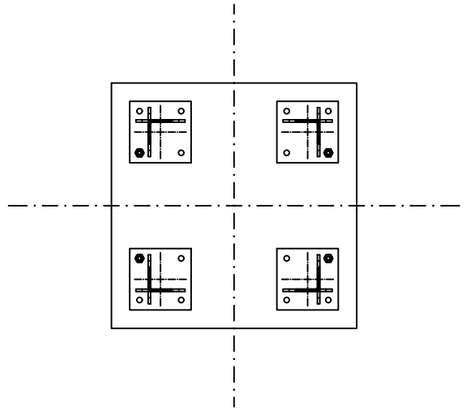
CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-SW-GAN-BAY-ONE	TITLE 33 kV SWITCHYARD LAYOUT FOR 33/11 kV SUBSTATION TAKE OFF/INCOMING BAY - ONE BAY



VEIW FROM FRONT OF THE TAKE OFF GANTRY

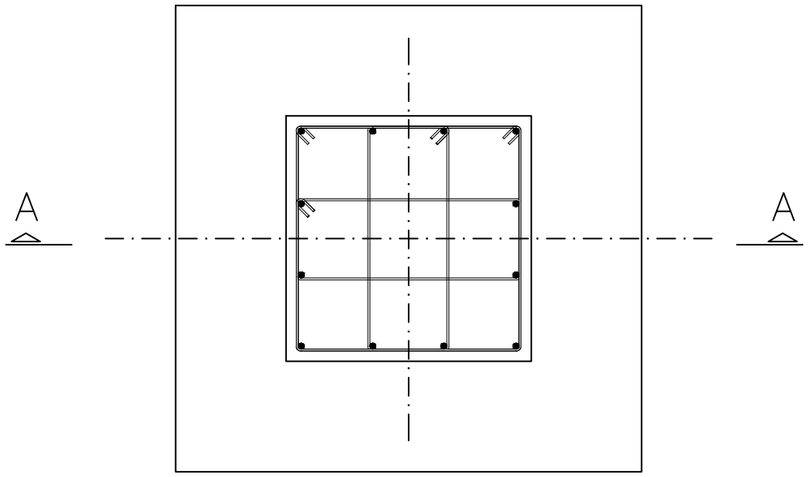
VEIW FROM SIDE OF THE TAKEOFF GANTRY

CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-SW-GAN-BAY-TWO	TITLE 33 kV SWITCHYARD LAYOUT FOR 33/11 kV SUBSTATION TAKE OFF/INCOMING BAY - TWO BAY



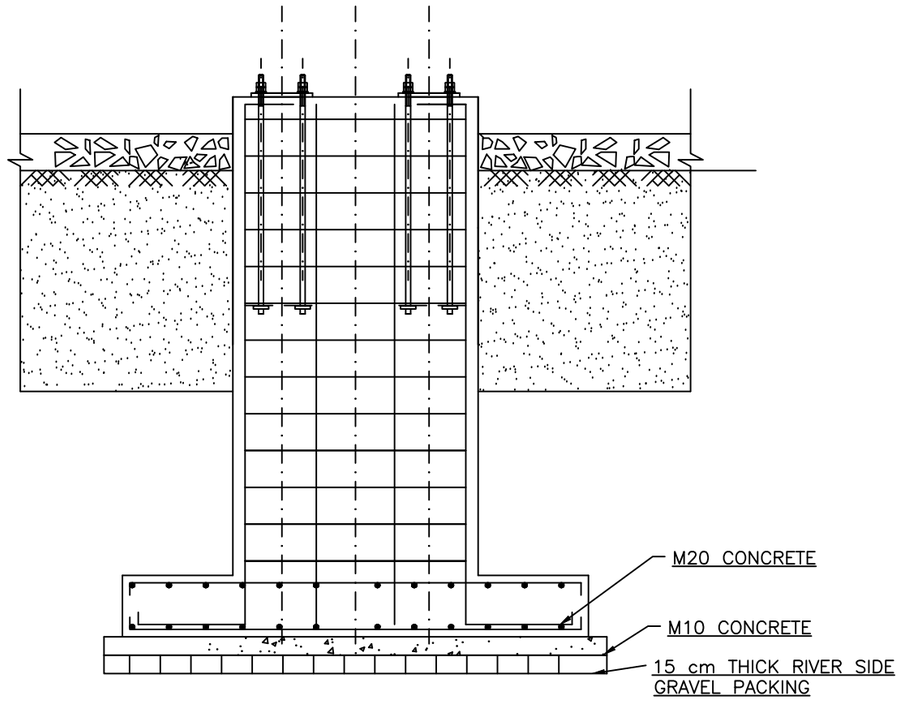
BASE PLATE LAYOUT DETAIL

SCALE = 1:25



PLAN

SCALE = 1:25

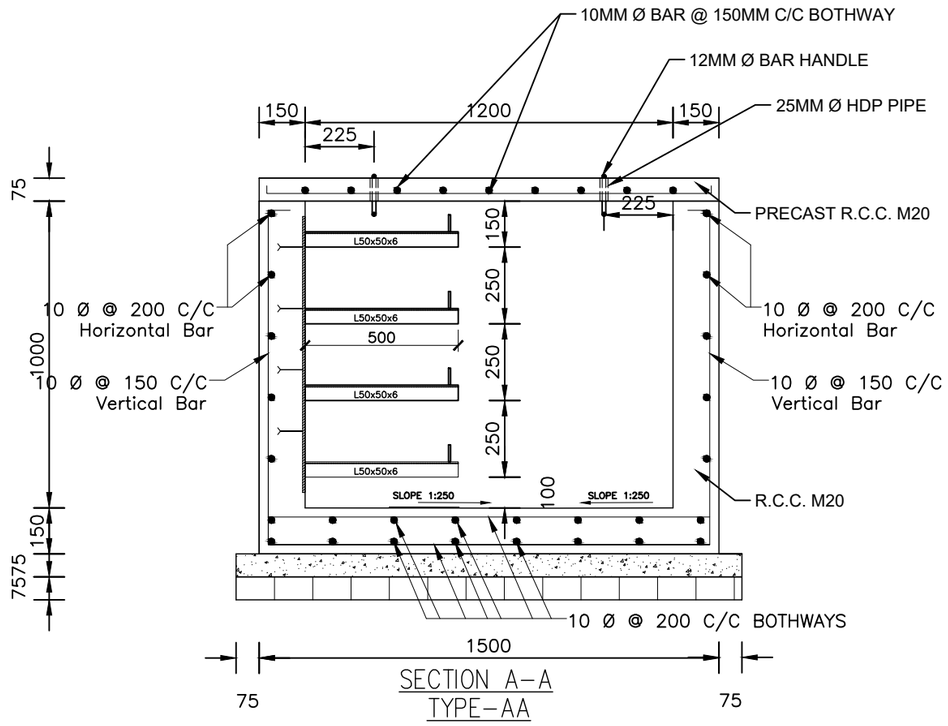


SECTION – AA

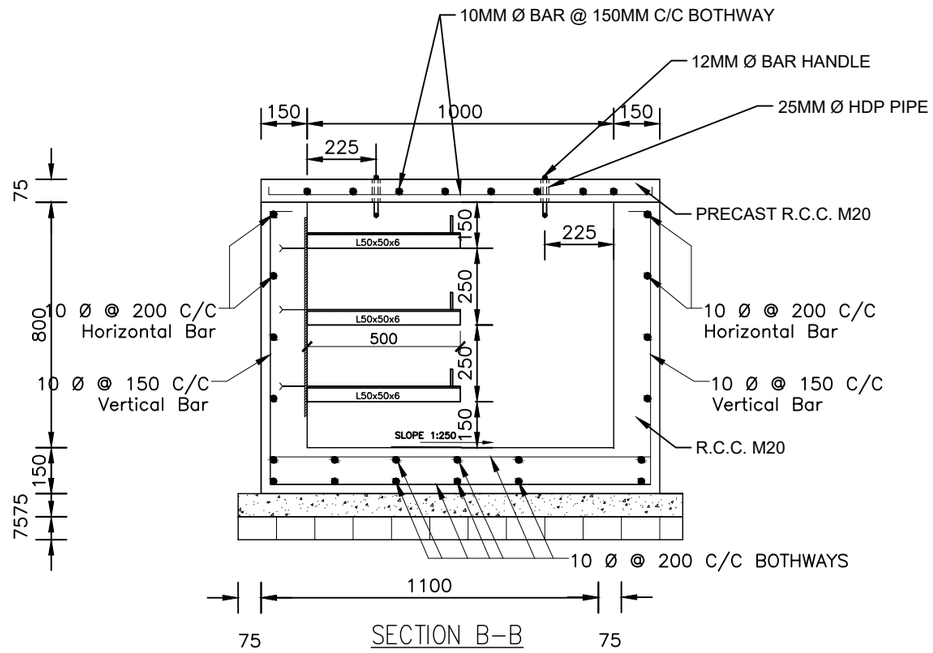
SCALE = 1:25

CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-SW-GAN-BAY-2-FOND	TITLE 33 kV SWITCHYARD LAYOUT FOR 33/11 kV SUBSTATION TAKE OFF/INCOMING BAY - TWO BAY

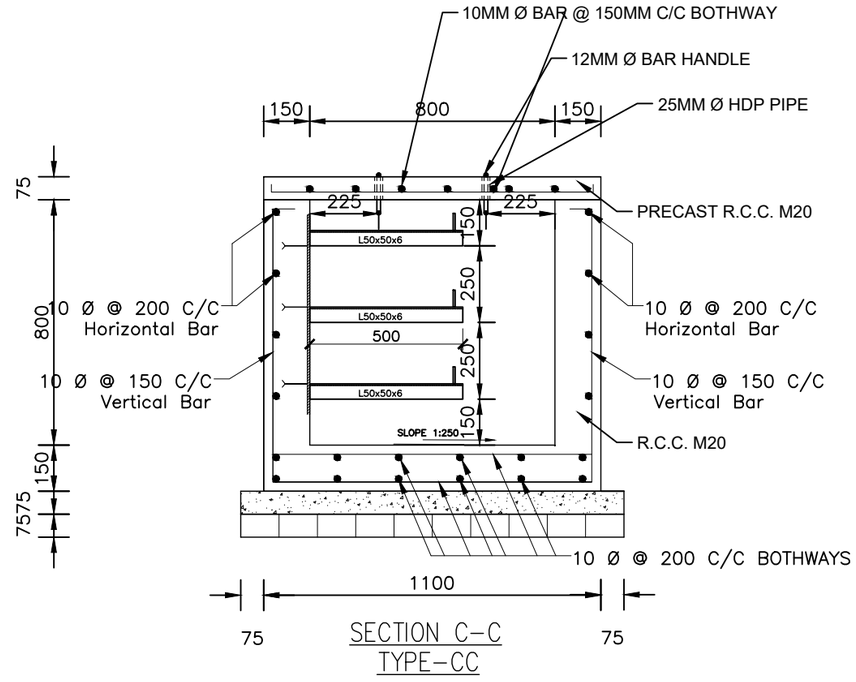
CABLE TRENCH SECTIONS FOR SWITCHYARD



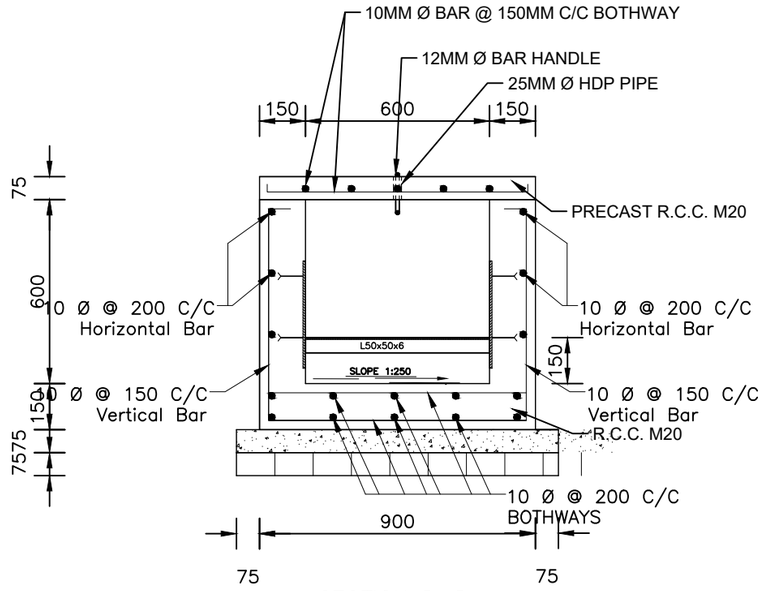
SECTION A–A
TYPE–AA



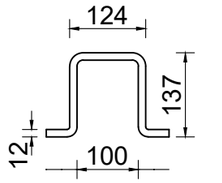
SECTION B–B
TYPE–BB



SECTION C–C
TYPE–CC



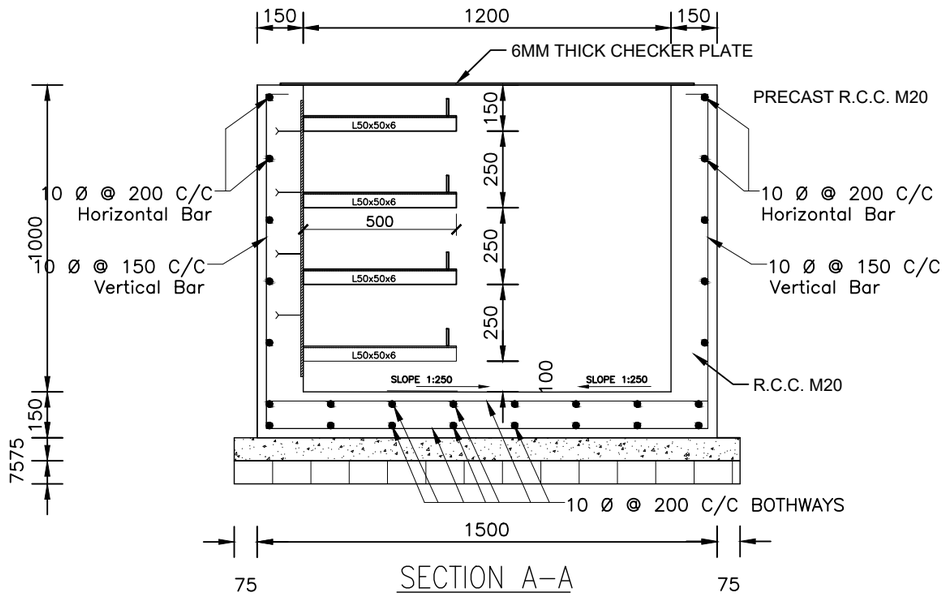
SECTION D–D
TYPE–DD



HANDLE BAR DETAIL
(12MM ø BAR)
SCALE = 1:10

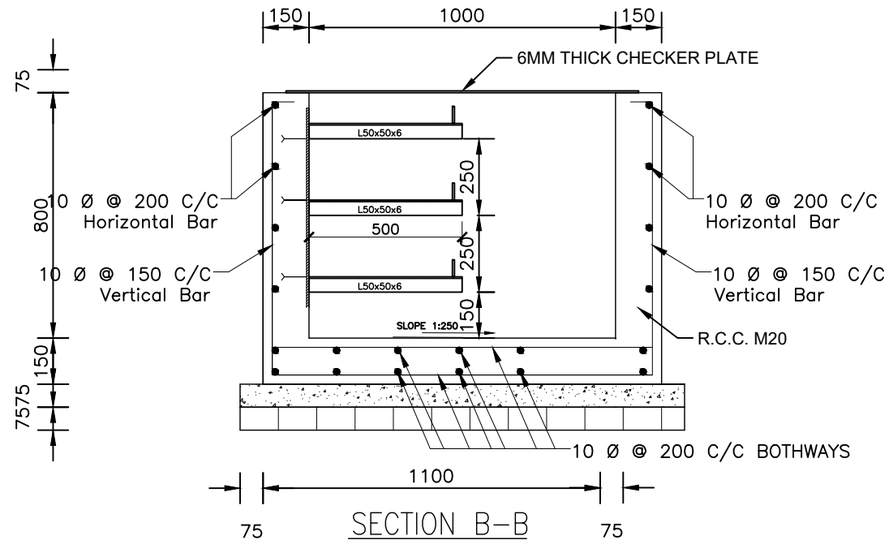
CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-SW-CAB-TRE-01	TITLE 33 kV SWITCHYARD LAYOUT FOR 33/11 kV SUBSTATION CABLE TRENCH SWITCHYARD

CABLE TRENCH SECTIONS



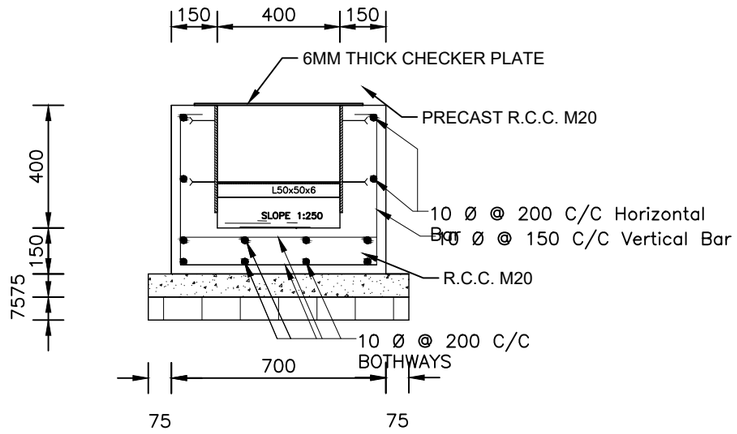
SECTION A–A

TYPE–AA



SECTION B–B

TYPE–BB



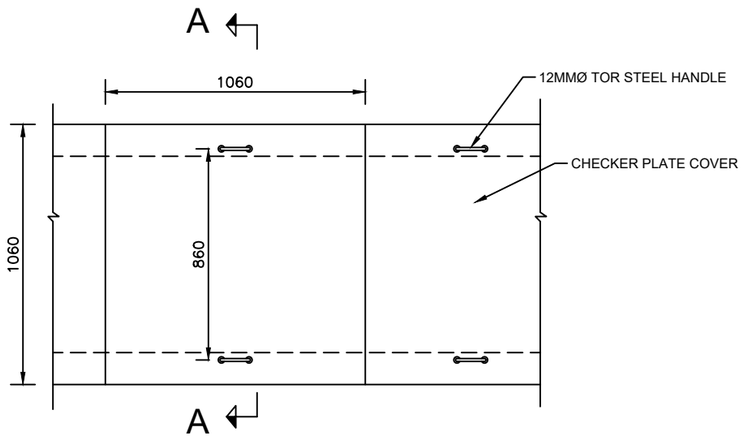
SECTION E–E

TYPE–EE

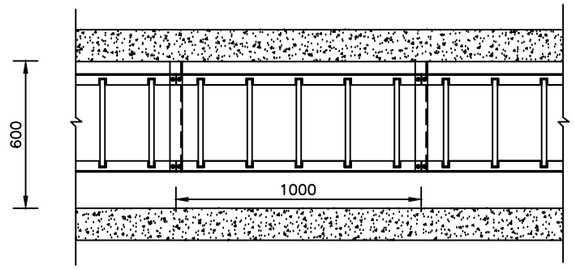
NOTE– LONGITUDINAL SLOPE 1:300 SHALL BE PROVIDED TOWARDS DRAINAGE SYSTEM

CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN	DESIGNED	TITLE 33 kV SWITCHYARD LAYOUT FOR 33/11 kV SUBSTATION CABLE TRENCH FOR CONTROL BUILDING
			DRAFTING CHECK	DESIGN CHECK	
			APPROVED	DRAWING NO. CSG-SW-CAB-TRE-03	

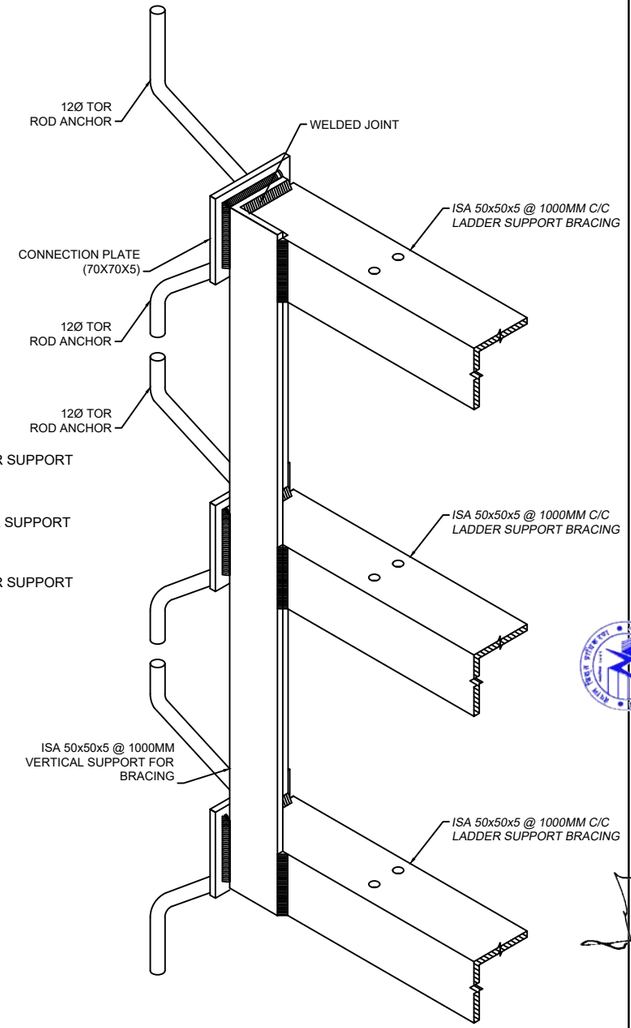
CABLE TRENCH SECTIONS

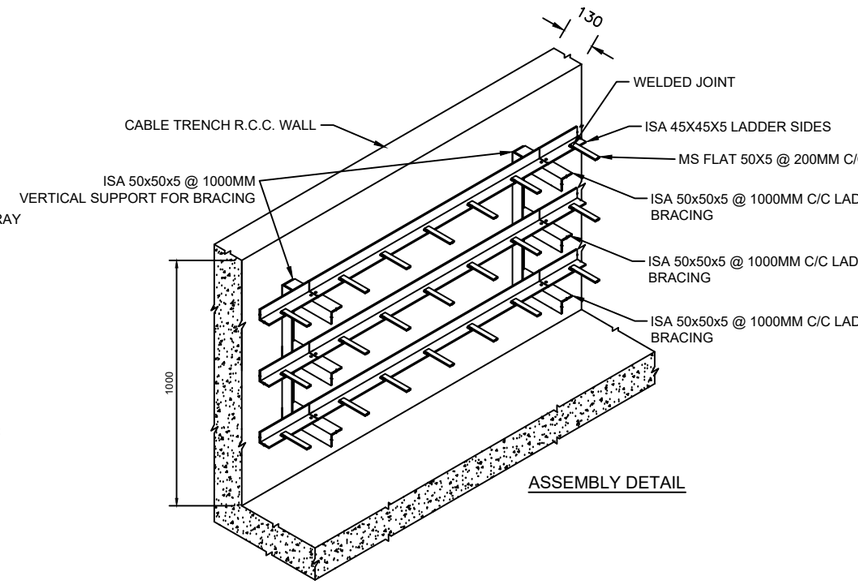


CABLE TRENCH TYPE-A
VIEW FROM FROM TOP
SCALE = 1:25

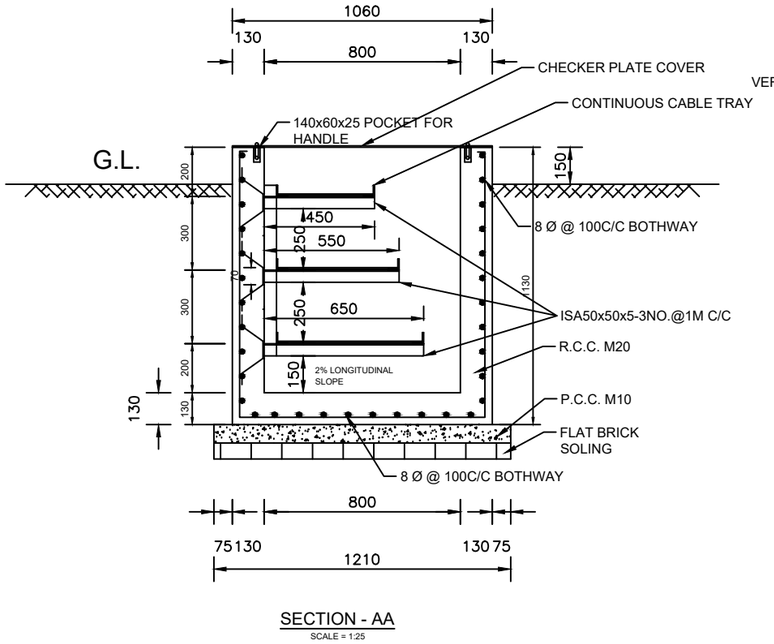


CABLE TRENCH TYPE-A
SECTIONAL PLAN
SCALE = 1:25



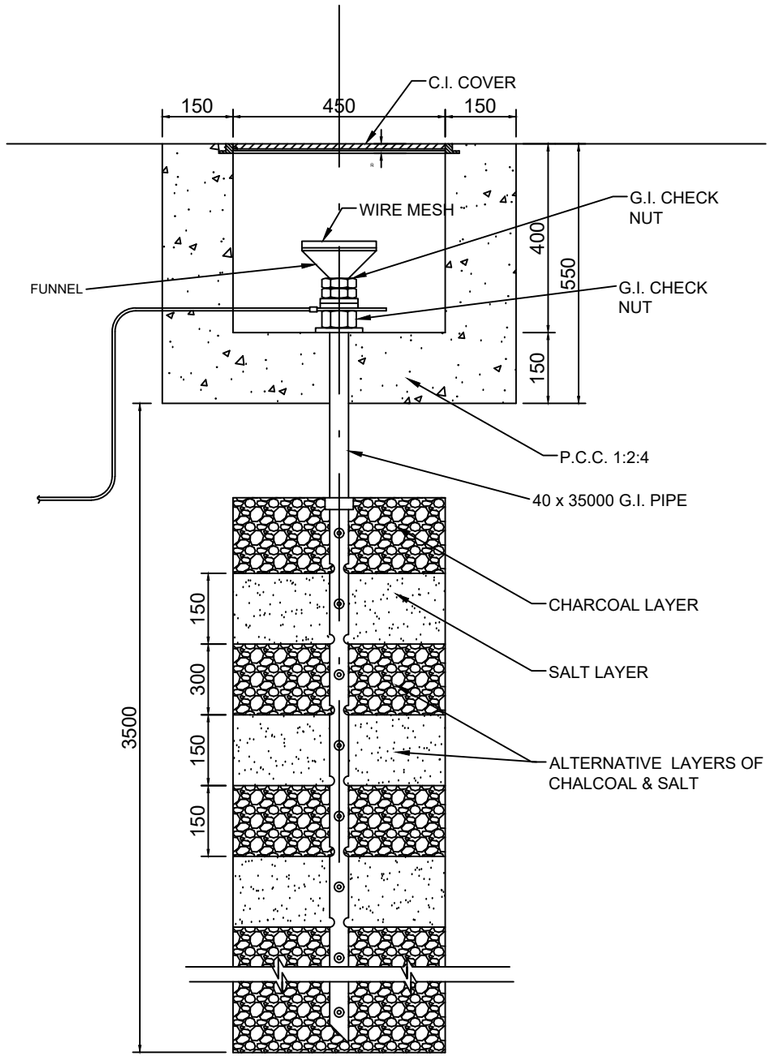


ASSEMBLY DETAIL



SECTION - AA
SCALE = 1:25

CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN	DESIGNED	TITLE 33 kV SWITCHYARD LAYOUT FOR 33/11 kV SUBSTATION CABLE TRENCH SECTIONS
			DRAFTING CHECK	DESIGN CHECK	
			APPROVED	DRAWING NO. CSG-SW-CAB-TRE-03	



EARTH STATION

SCALE = 1 : 130

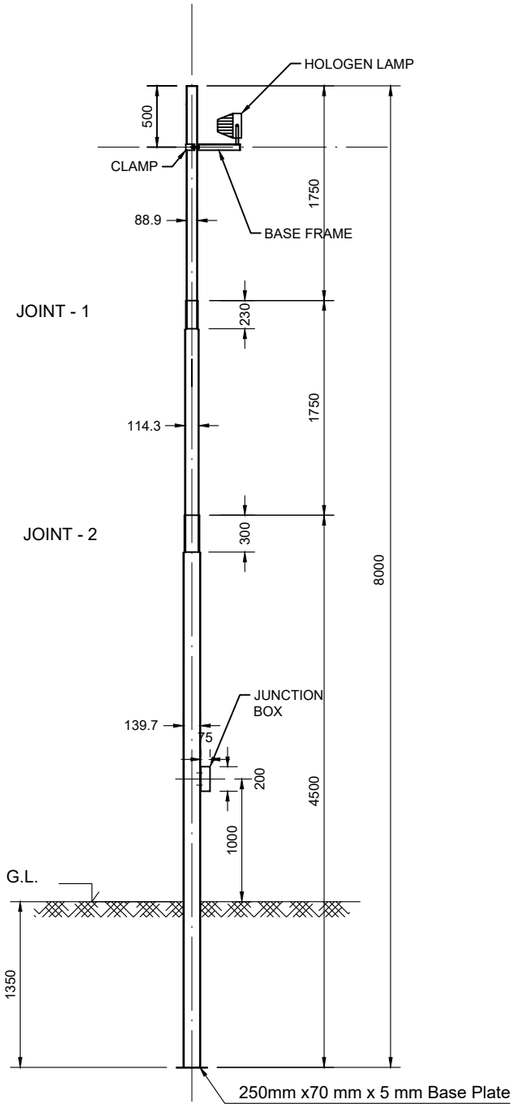
LEGENDS

--------	EARHT MAT STRIP made of 50 x 6 G.I. FLAT/EQUV CU. SEC
	EARHT STATION
	EARHT SPIKE 20 mm G.I. ROD
	RISER 50 x 6 G.I. FLAT

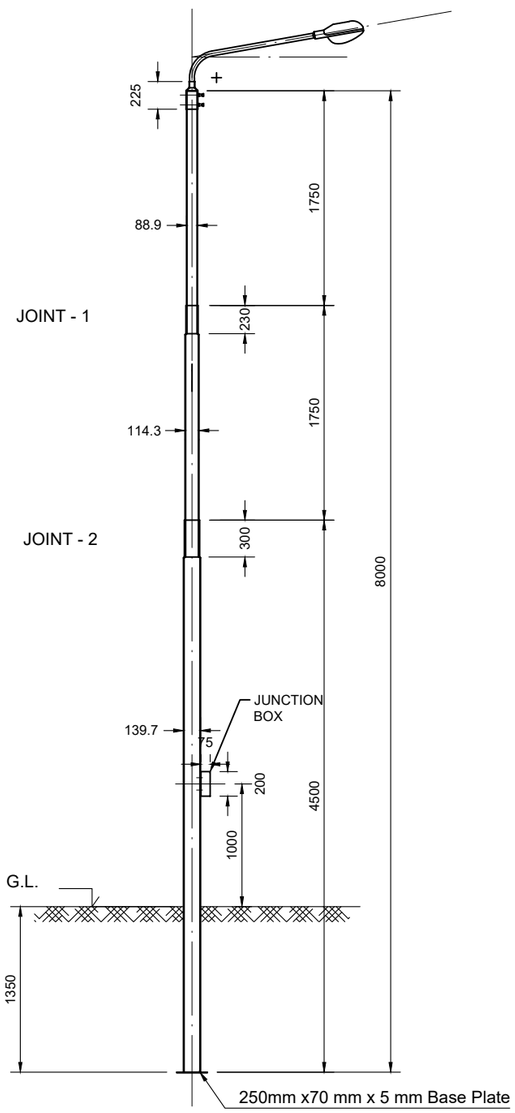
NOTES :

- Earth Station shall be installed at 1 m distance from buildings and major structures.
-They shall be placed adjacent to transformers, gantries and essential locations.

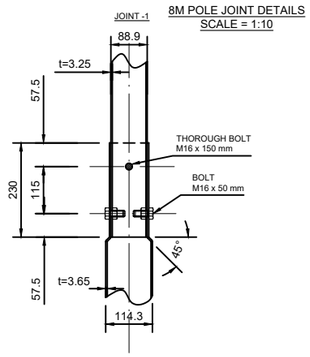
CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-SW-EARTH	TITLE 33 kV SWITCHYARD LAYOUT FOR 33/11 kV SUBSTATION TYPICAL EARTH PIT



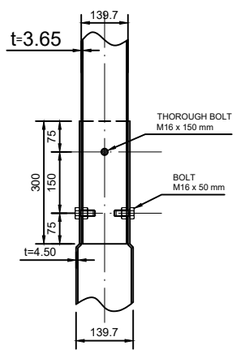
8M SWAGED TUBULAR STREET LIGHTING POLE

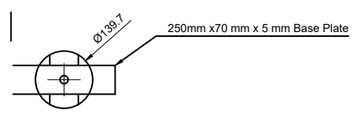


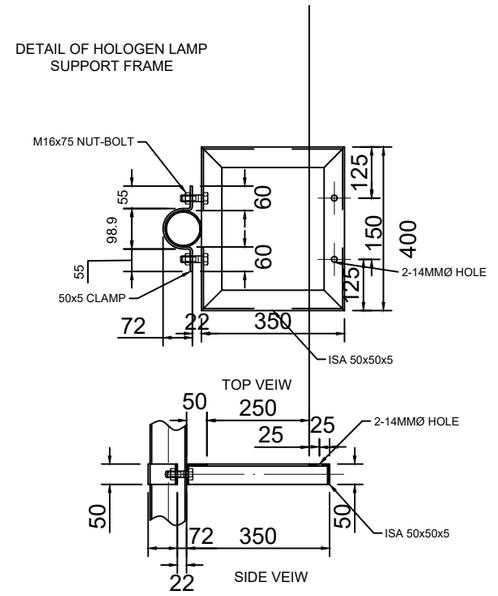
8M SWAGED TUBULAR STREET LIGHTING POLE



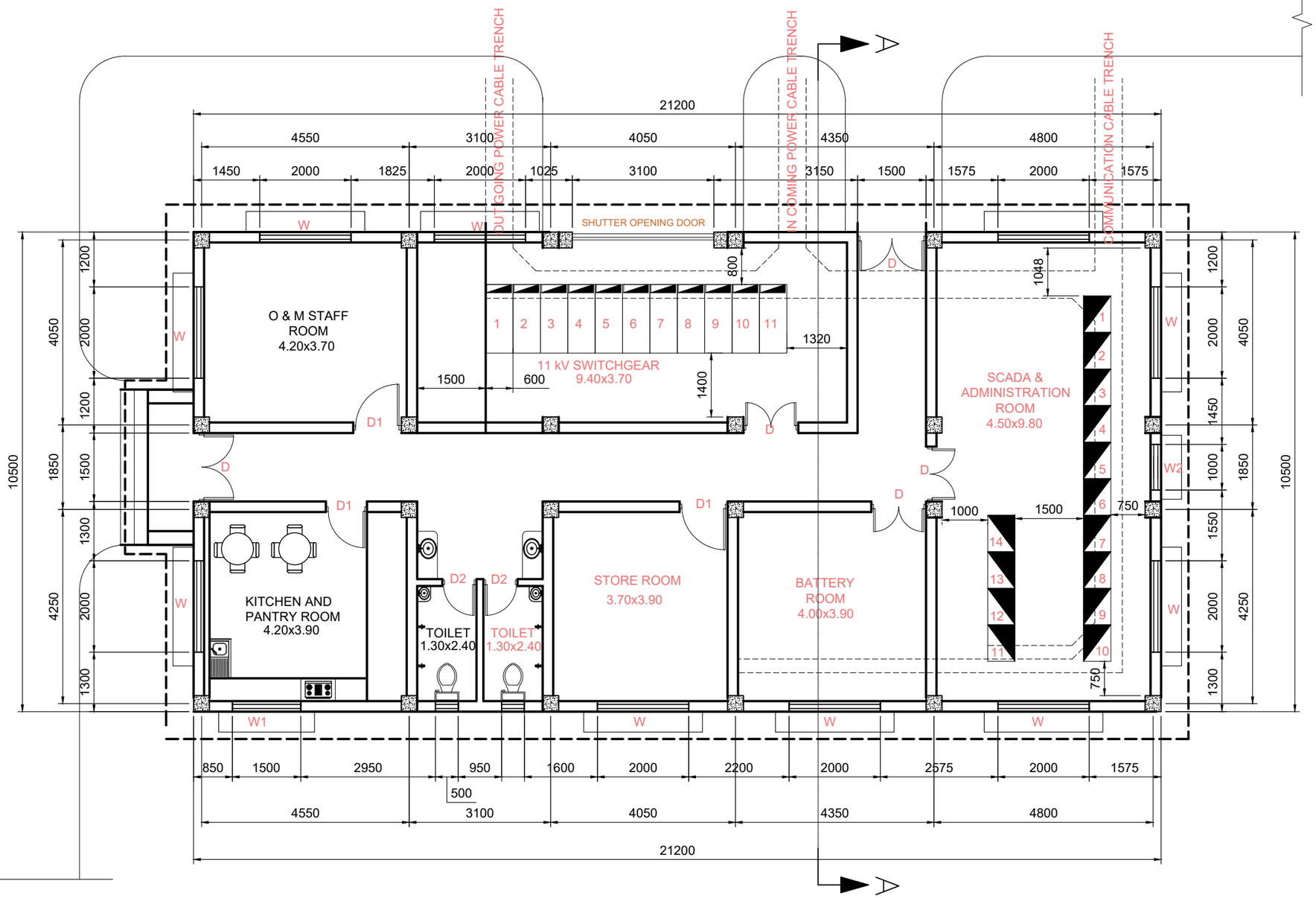
8M POLE JOINT DETAILS
SCALE = 1:10







CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-SW-LIGHT	TITLE 33 kV SWITCHYARD LAYOUT FOR 33/11 kV SUBSTATION TYPICAL STREET LIGHT

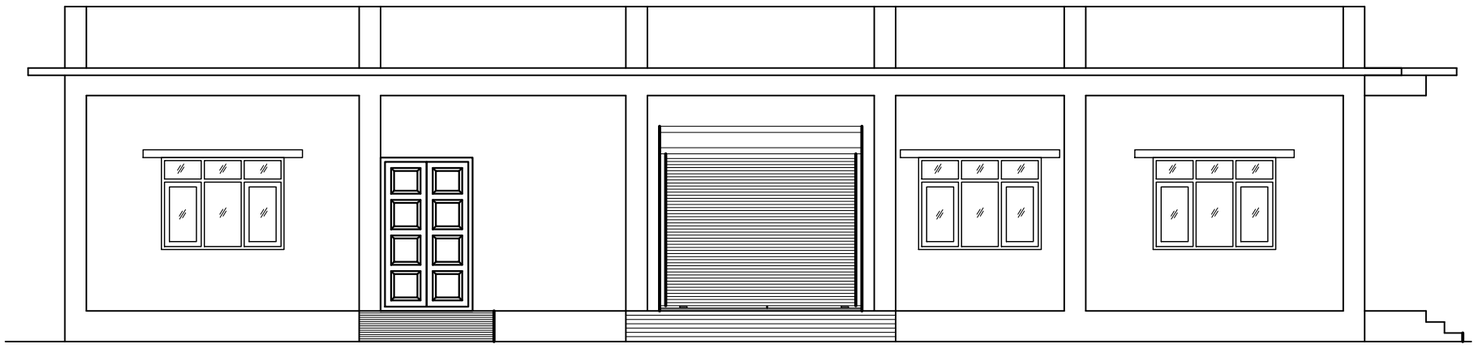


GROUND FLOOR PLAN

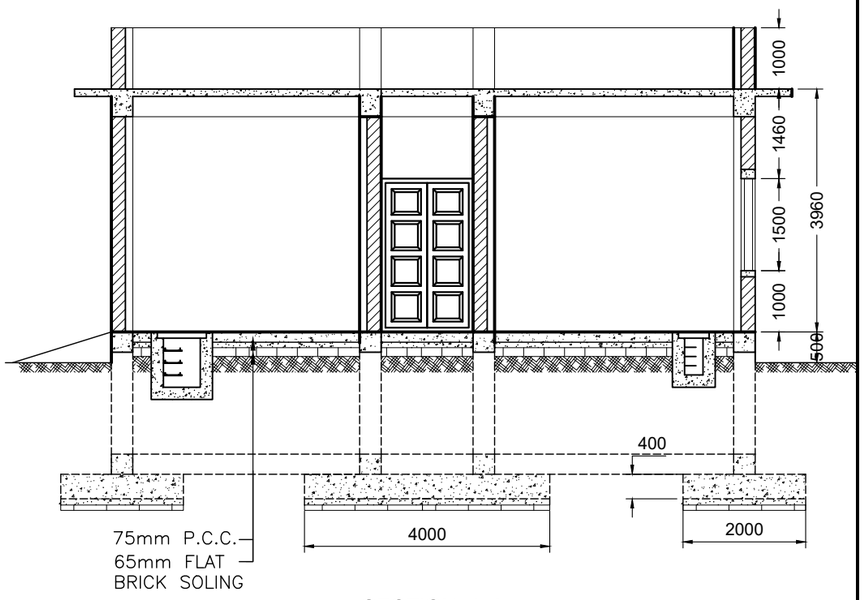
CONTROL BUILDING AREA - 222.60 Sq m.

SCALE 1:100

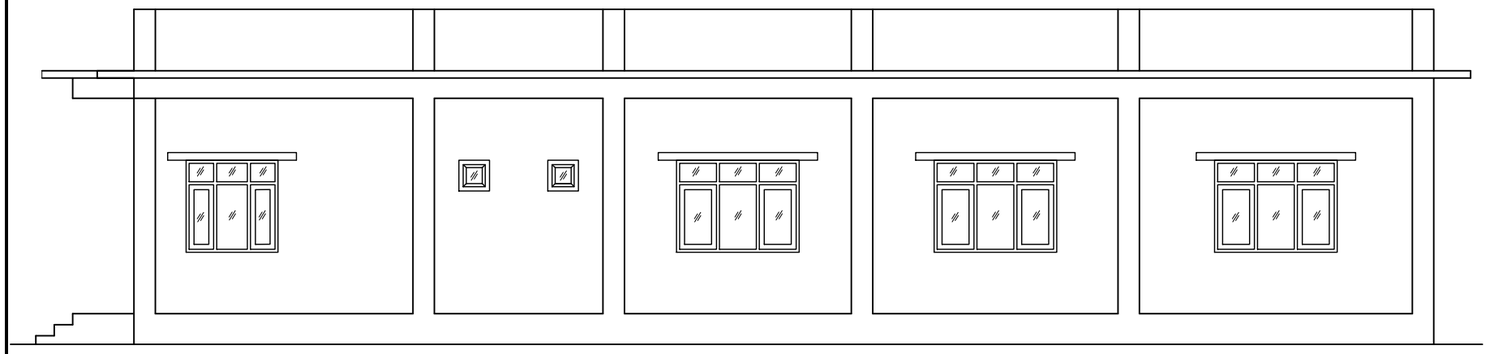
CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-BLDG-CTRL-PL	TITLE 33/11 kV SUBSTATION CONTROL BUILDING PLAN



SIDE ELEVATION



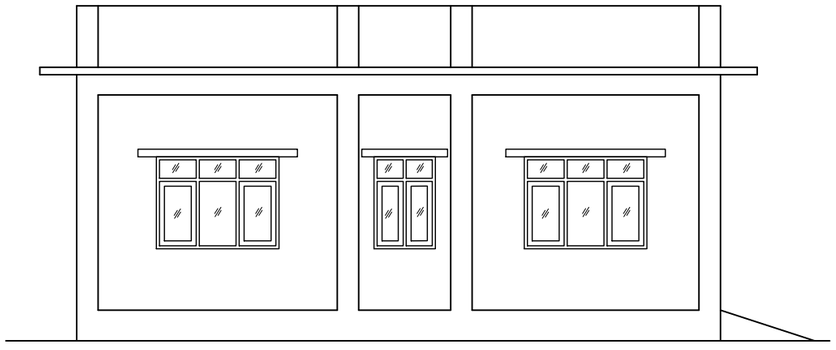
SECTION A-A



SIDE ELEVATION

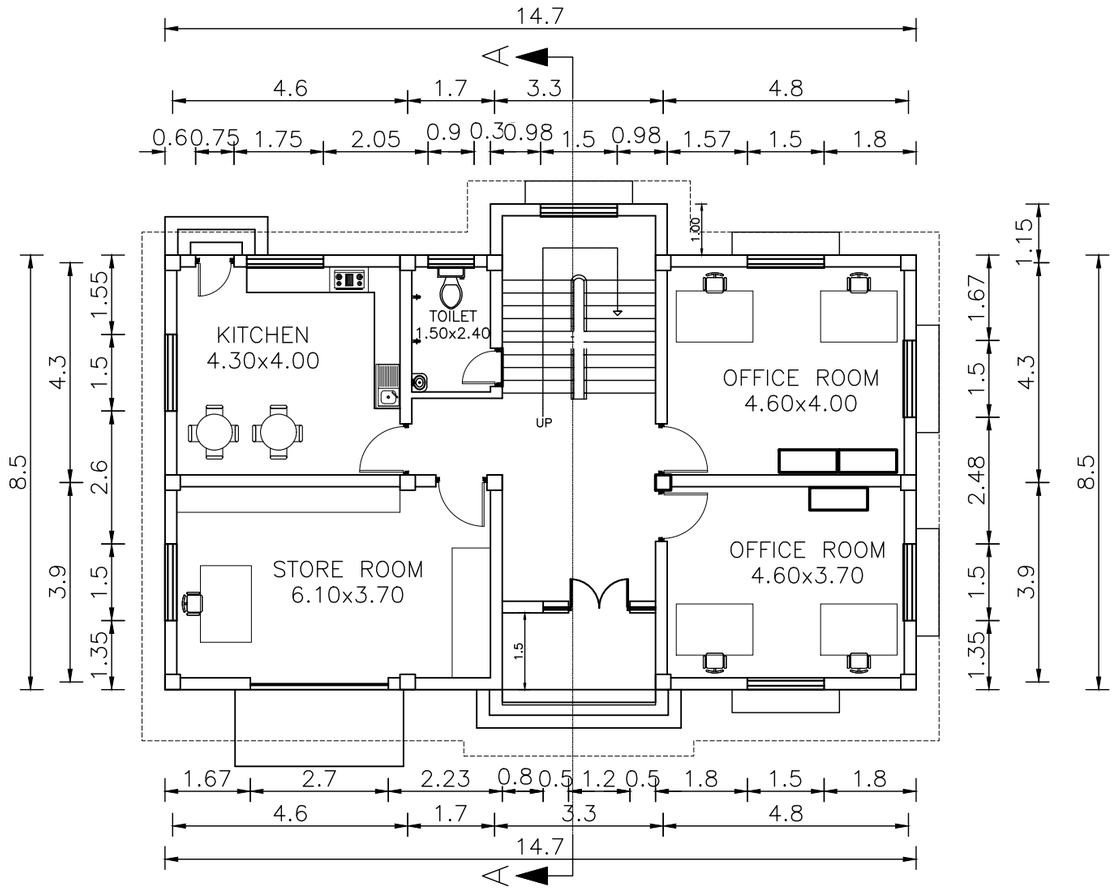


FRONT ELEVATION

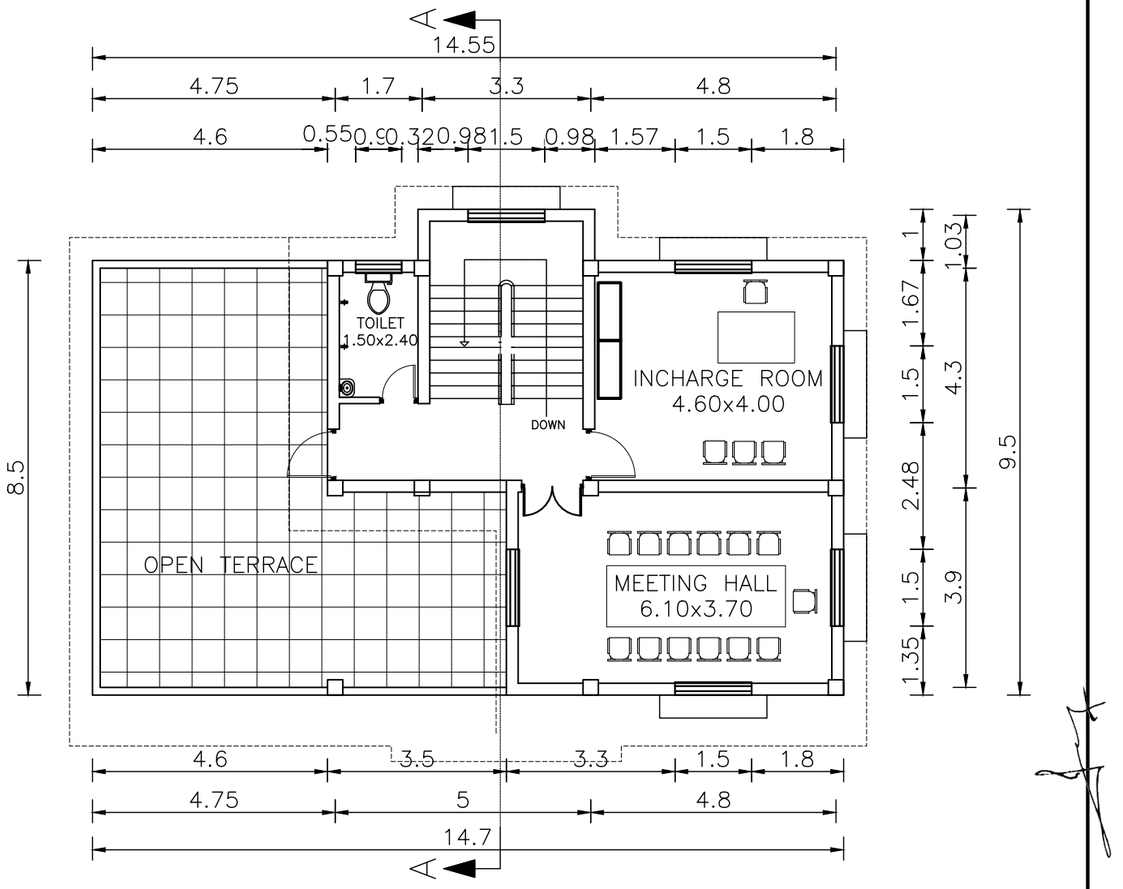


BACK ELEVATION

CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-BLDG-CTRL-ELEV-SEC	TITLE 33/11 kV SUBSTATION CONTROL BUILDING ELEVATIONS AND SECTION



GROUND FLOOR PLAN
(OFFICE BUILDING 128.41Sq.m.)
SCALE: 1:120



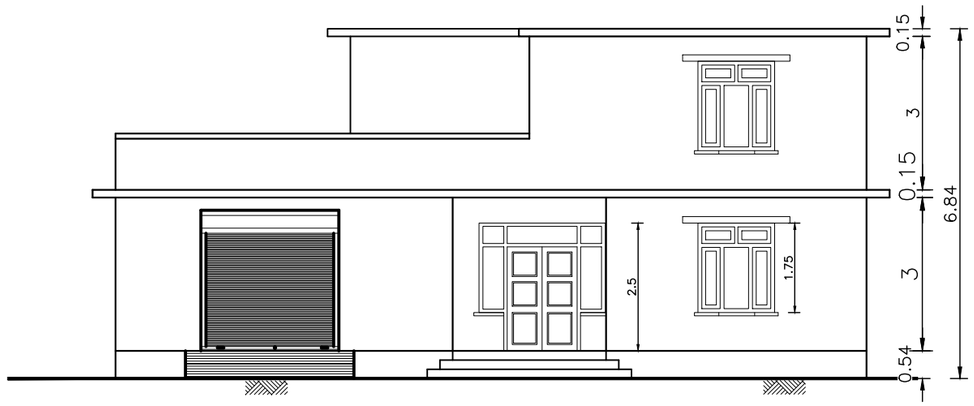
TOP FLOOR PLAN
(OFFICE BUILDING 75.66Sq.m.)
SCALE: 1:120

NOTE:

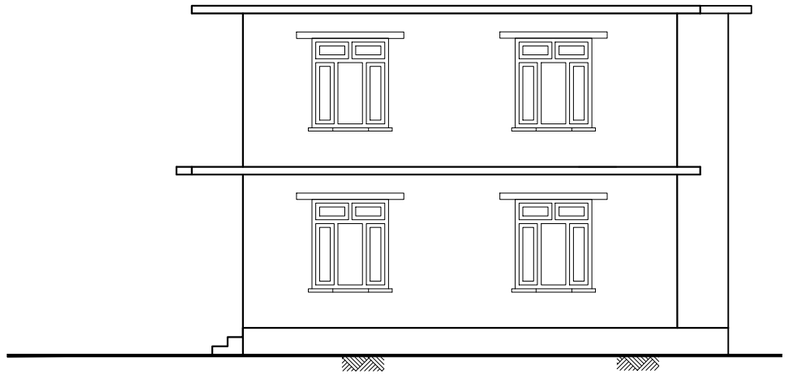
- Staff Quarter and Office Building shall be designed and built for extension up to three floors total in future.

0 0.6 1.2 2.4 3.6 4.8
SCALE 1:120

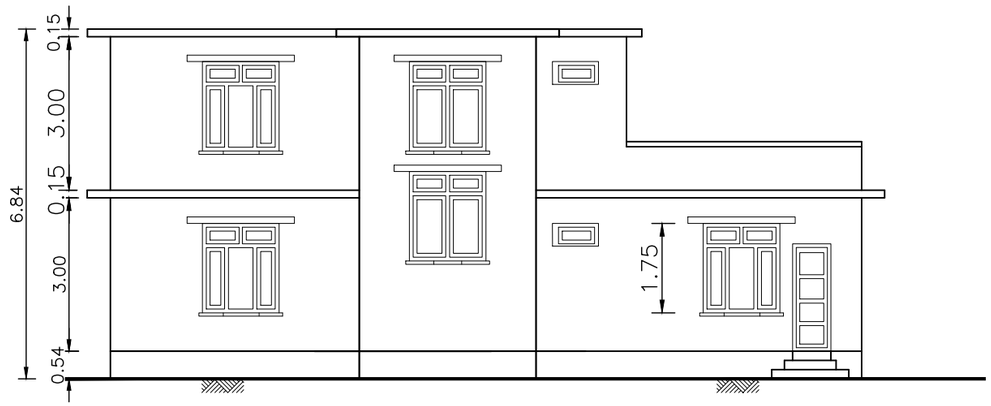
CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-BLDG-OFF-PL	TITLE 33/11 kV SUBSTATION OFFICE BUILDING PLAN



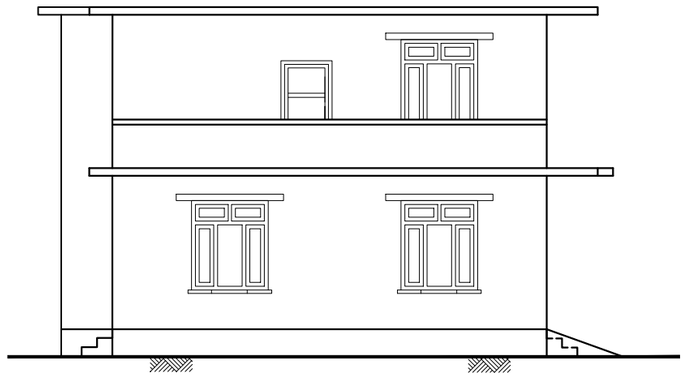
FRONT ELEVATION



SIDE ELEVATION



BACK ELEVATION

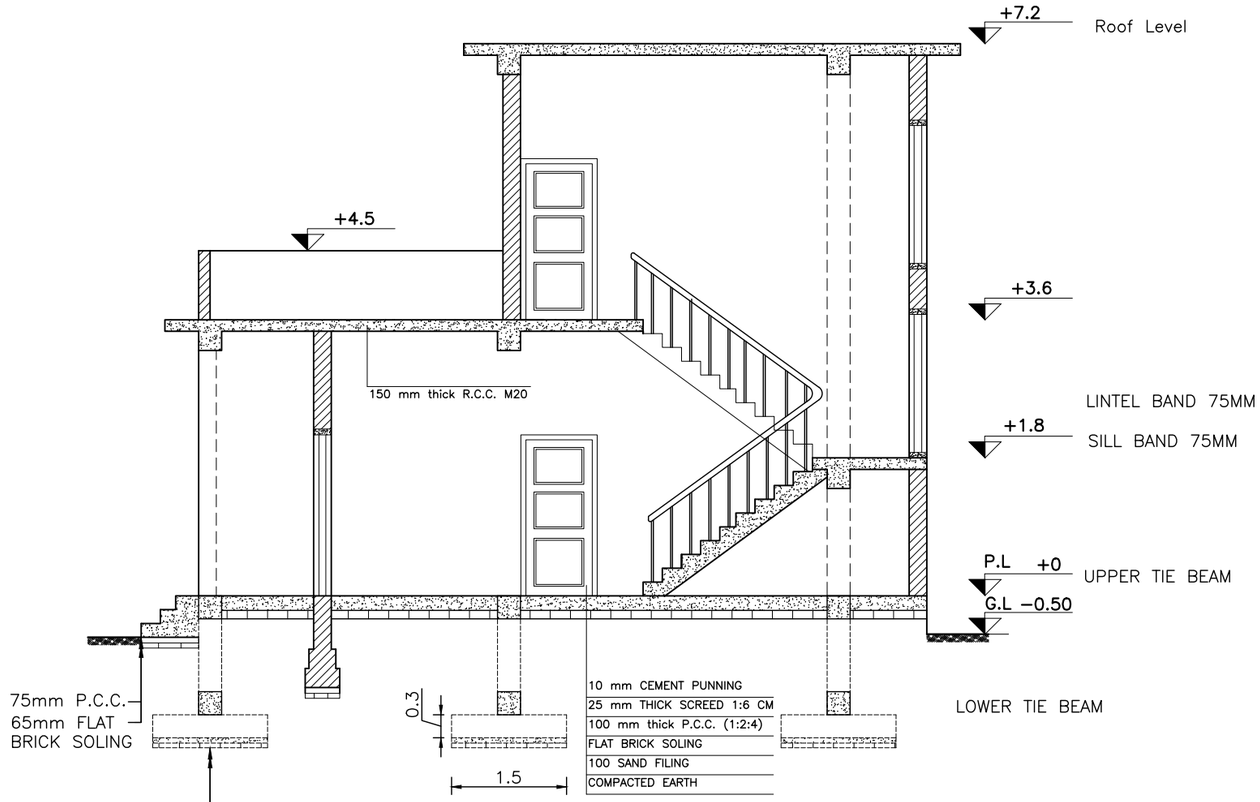


SIDE ELEVATION

0 0.6 1.2 2.4 3.6 4.8

SCALE 1:120

CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-BLDG-OFF-ELEV	TITLE 33/11 kV SUBSTATION OFFICE BUILDING ELEVATION



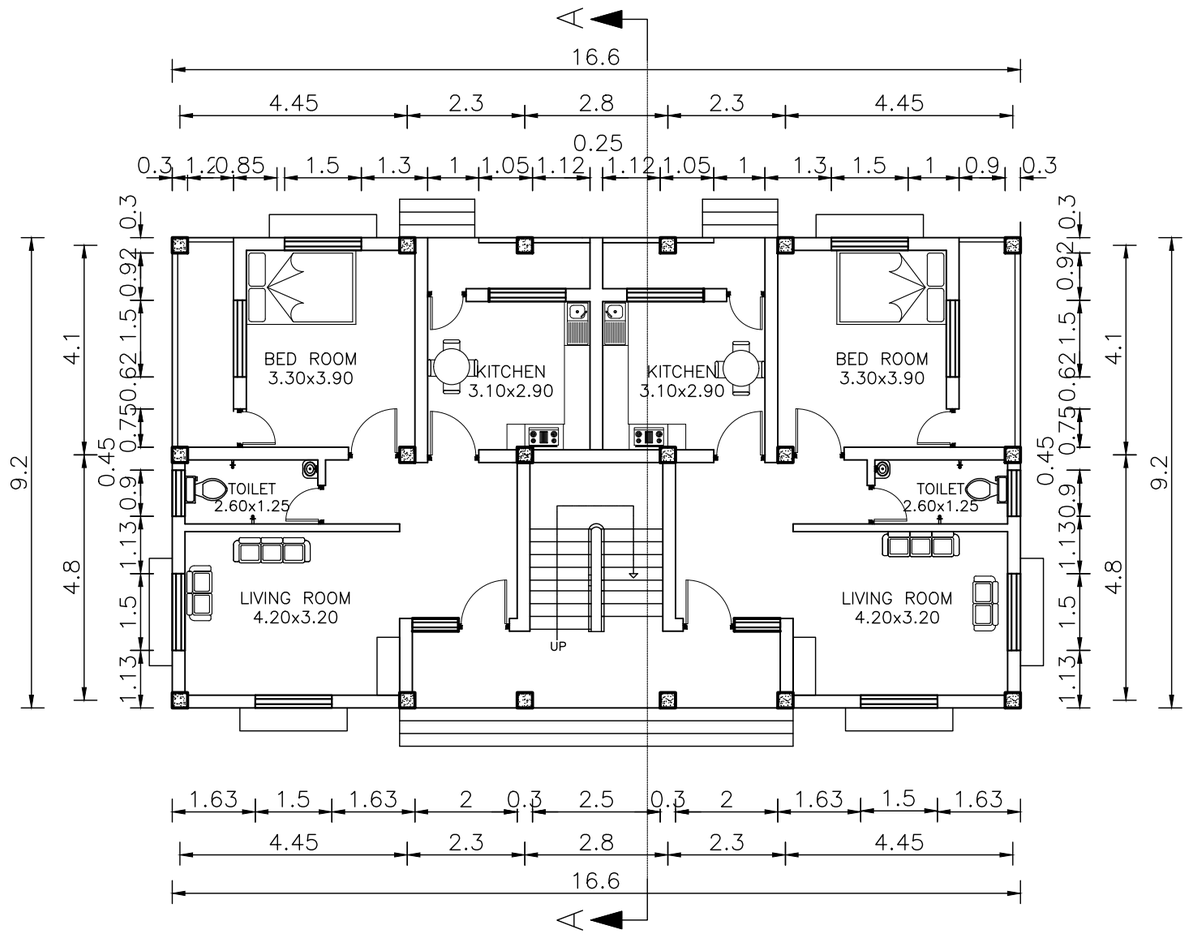
SECTION AT A-A

SCALE: 1:80

0 0.4 0.8 1.6 3.2 4.8

SCALE 1:80

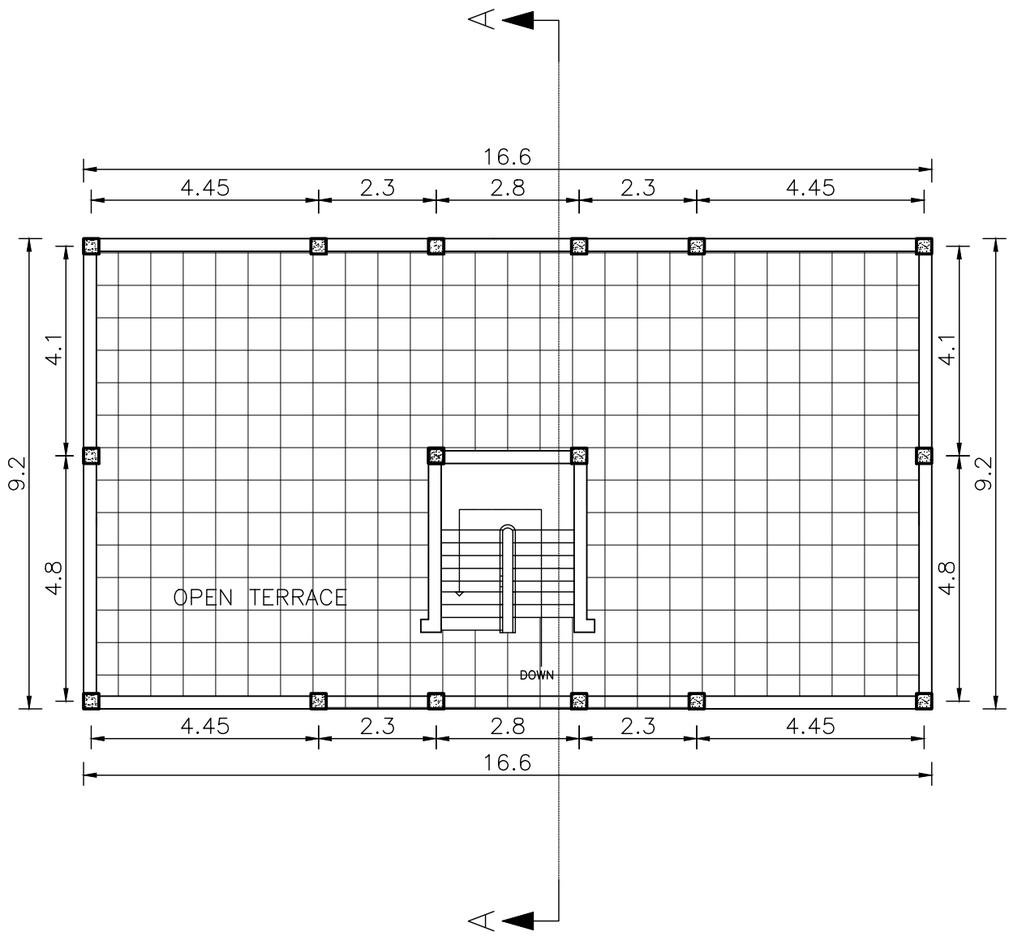
CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-BLDG-OFF-SEC	TITLE 33/11 kV SUBSTATION OFFICE BUILDING TYPE-1 SECTION ALTERNATE



GROUND FLOOR PLAN

(QUARTERS BUILDING 152.72 Sq.m.)

SCALE: 1:120



TOP FLOOR PLAN

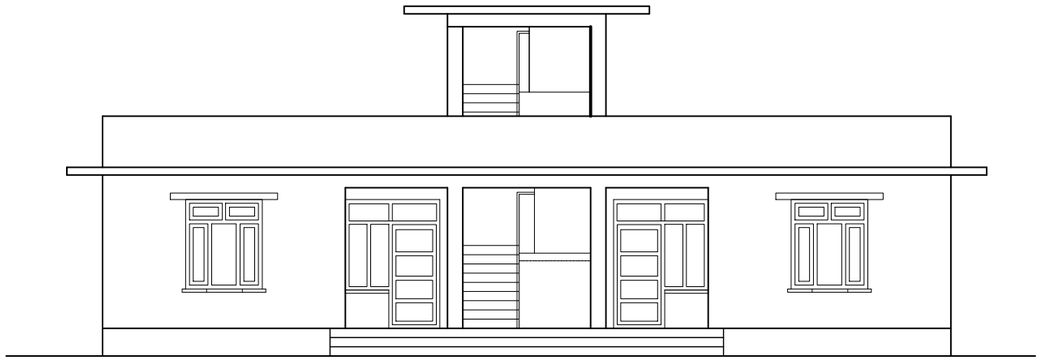
NOTE:

- Staff Quarter and Office Building shall be designed and built for extension up to three floors total in future.

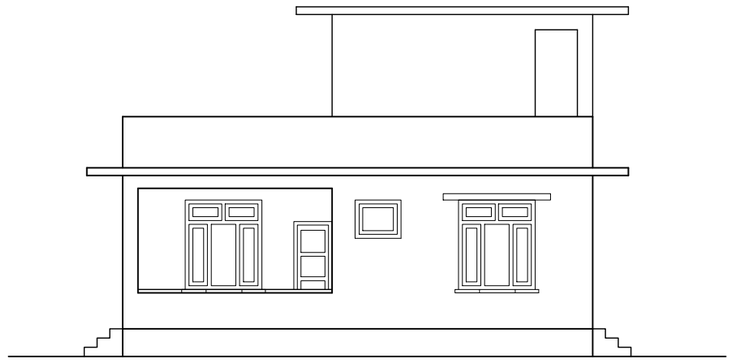
0 0.6 1.2 2.4 3.6 4.8

SCALE 1:120

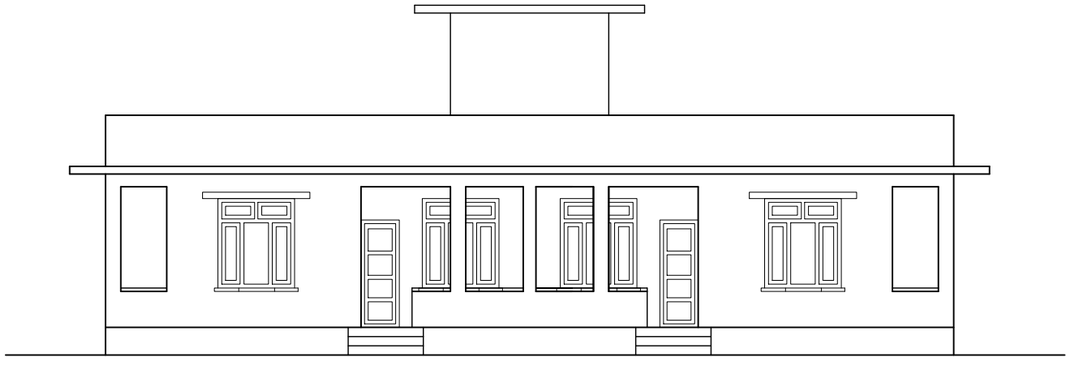
CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-BLDG-SQRT-PL	TITLE 33/11 kV SUBSTATION QUARTERS BUILDING PLAN



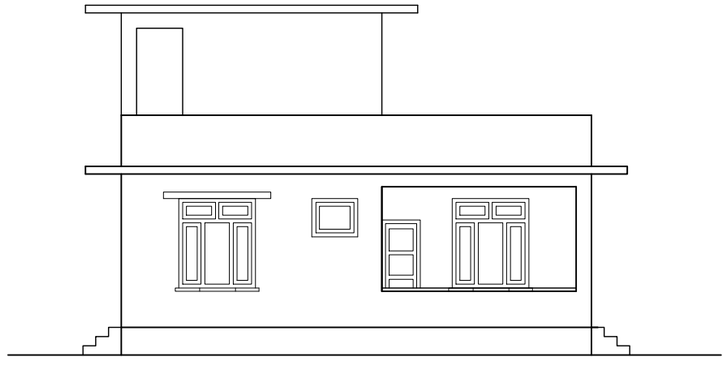
FRONT ELEVATION



SIDE ELEVATION



BACK ELEVATION

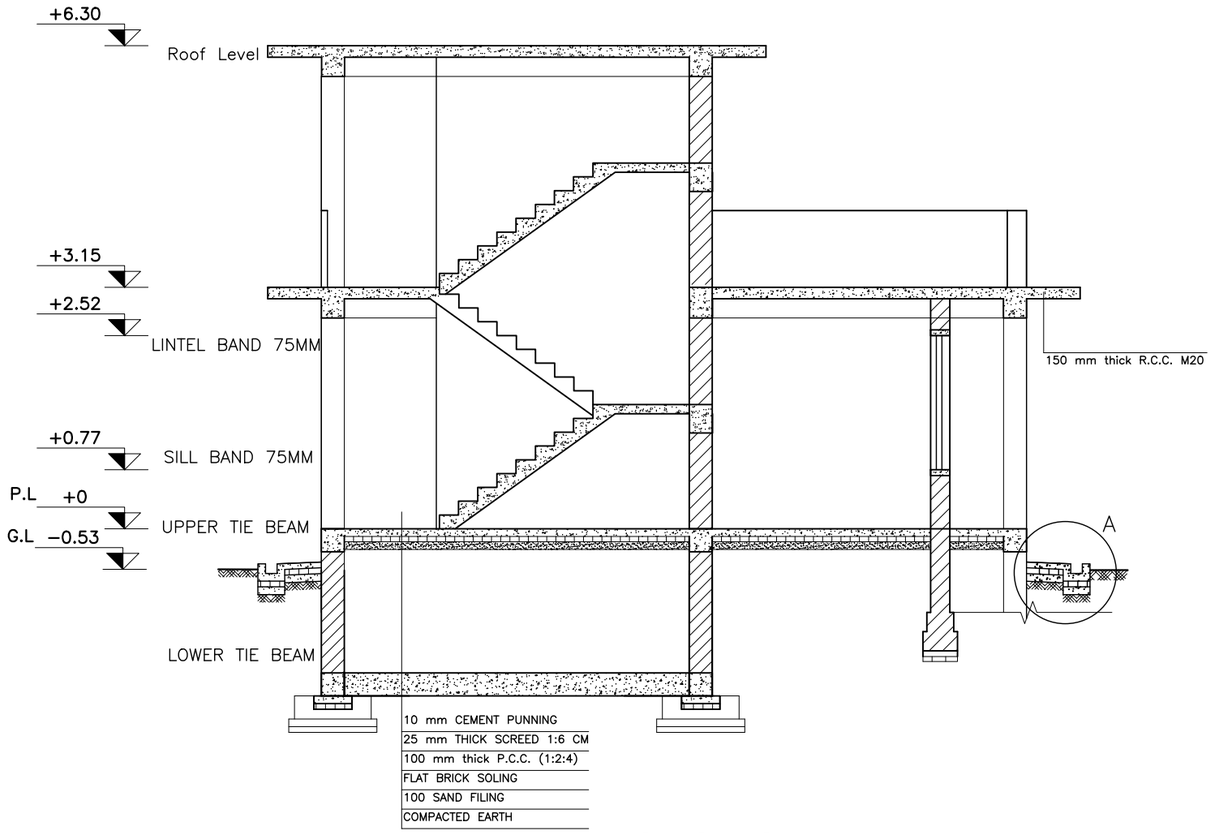


SIDE ELEVATION

0 0.6 1.2 2.4 3.6 4.8

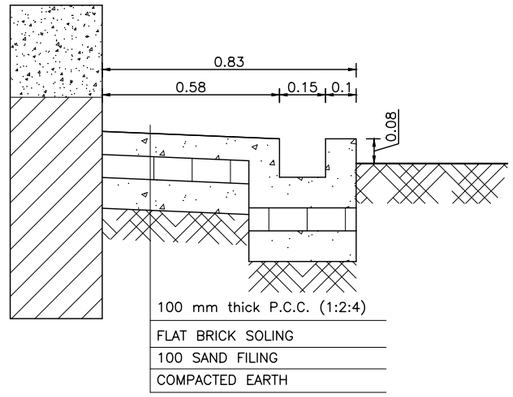
SCALE 1:120

CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-BLDG-SQRT-ELEV	TITLE 33/11 kV SUBSTATION QUARTERS BUILDING ELEVATION



SECTION A-A

SCALE: 1:80

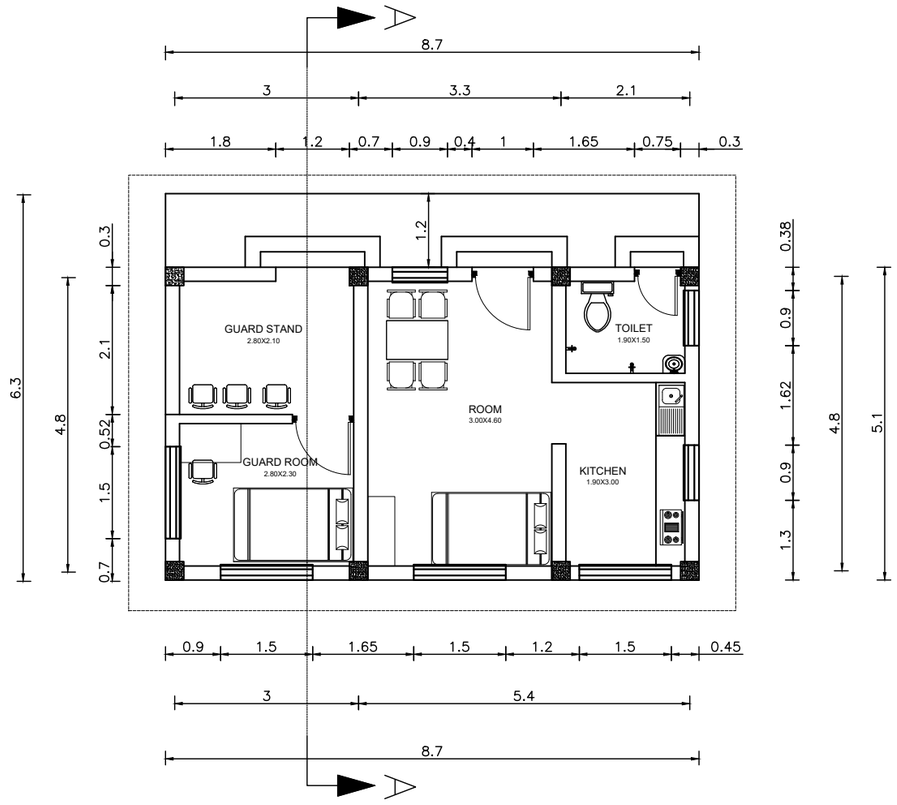


DETAIL AT A

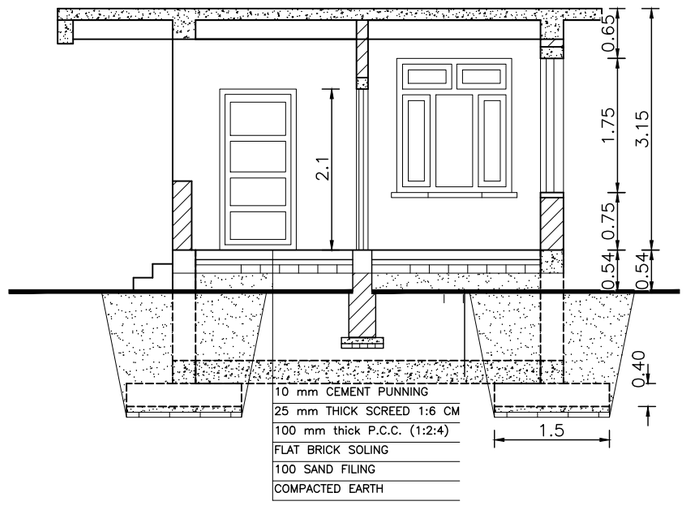
0 0.4 0.8 1.6 3.2 4.8

SCALE 1:80

CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-BLDG-SQRT-SEC	TITLE 33/11 kV SUBSTATION QUARTERS BUILDING SECTION



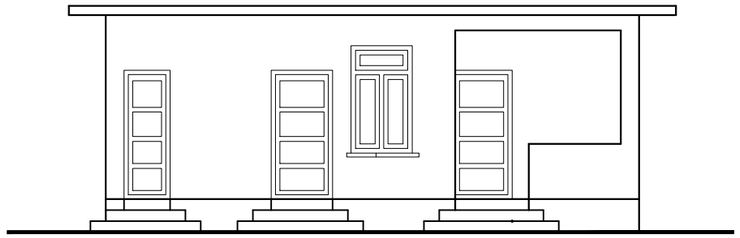
GUARD HOUSE FLOOR PLAN
AREA: 44.37 sq.m.
SCALE: 1:100



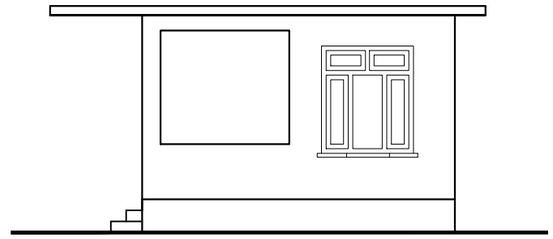
SECTION A-A
SCALE: 1:80

0 0.5 1 2 3 4m
SCALE 1:100

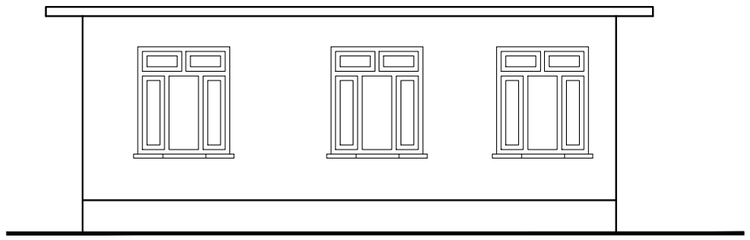
CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-BLDG-GH-PL-SEC-01	TITLE 33/11 kV SUBSTATION GUARD HOUSE PLAN AND SECTION



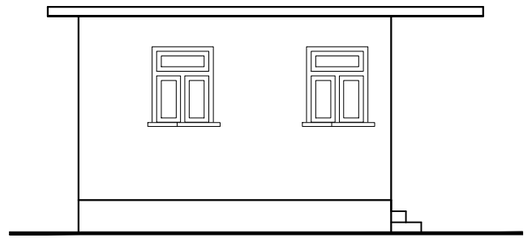
FRONT ELEVATION



SIDE ELEVATION



BACK ELEVATION

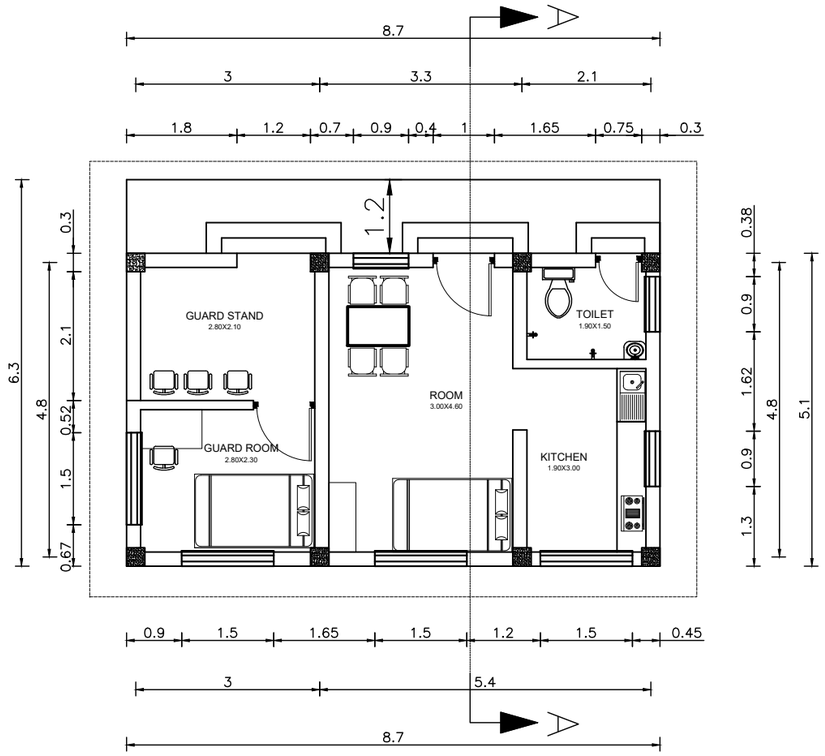


SIDE ELEVATION

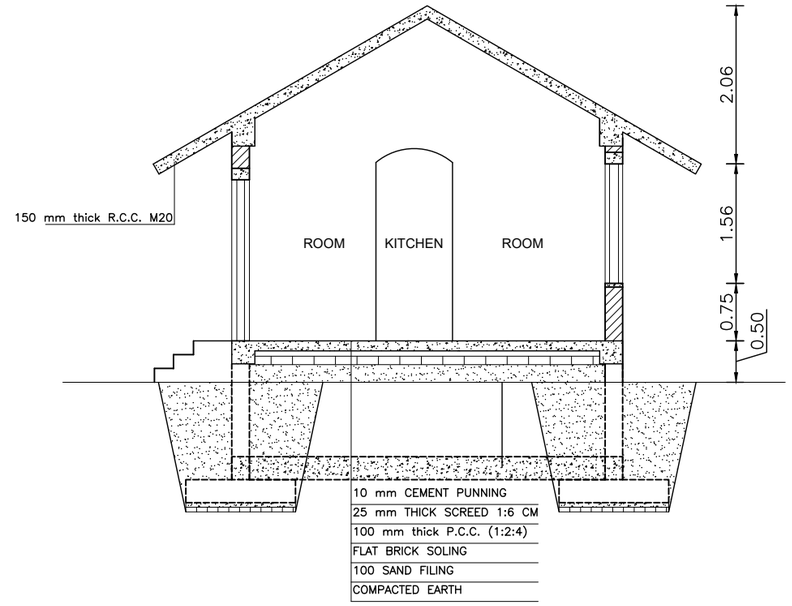
0 0.5 1 2 3 4m

SCALE 1:100

CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-BLDG-GH-ELEV-01	TITLE 33/11 kV SUBSTATION GUARD HOUSE ELEVATION



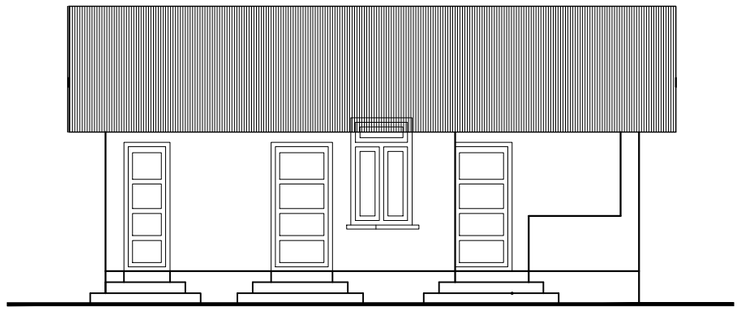
GUARD HOUSE FLOOR PLAN
AREA: 44.37 sq.m.



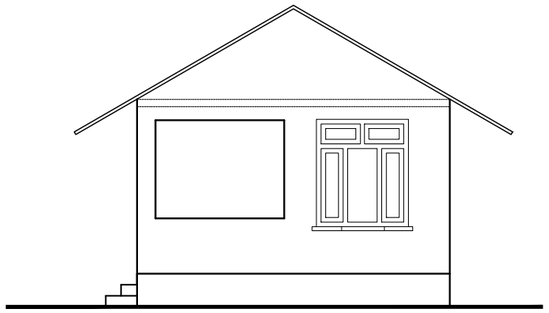
SECTION A-A
SCALE: 1:80

0 0.5 1 2 3 4m
SCALE 1:100

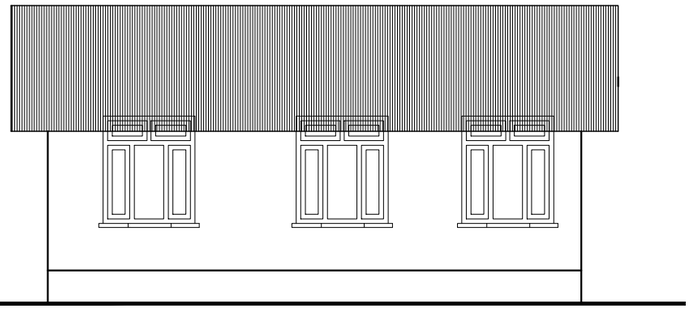
CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-BLDG-GH-PL-SEC-02	TITLE 33/11 kV SUBSTATION GUARD HOUSE TYPE-2 PLAN ELEVATION AND SECTION



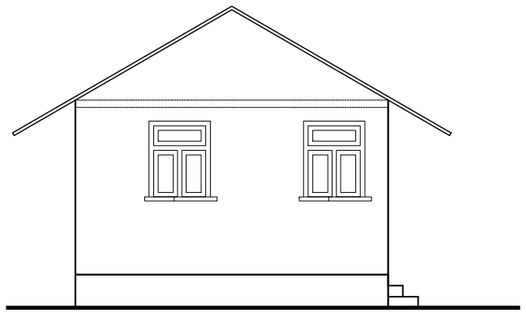
FRONT ELEVATION



SIDE ELEVATION



BACK ELEVATION



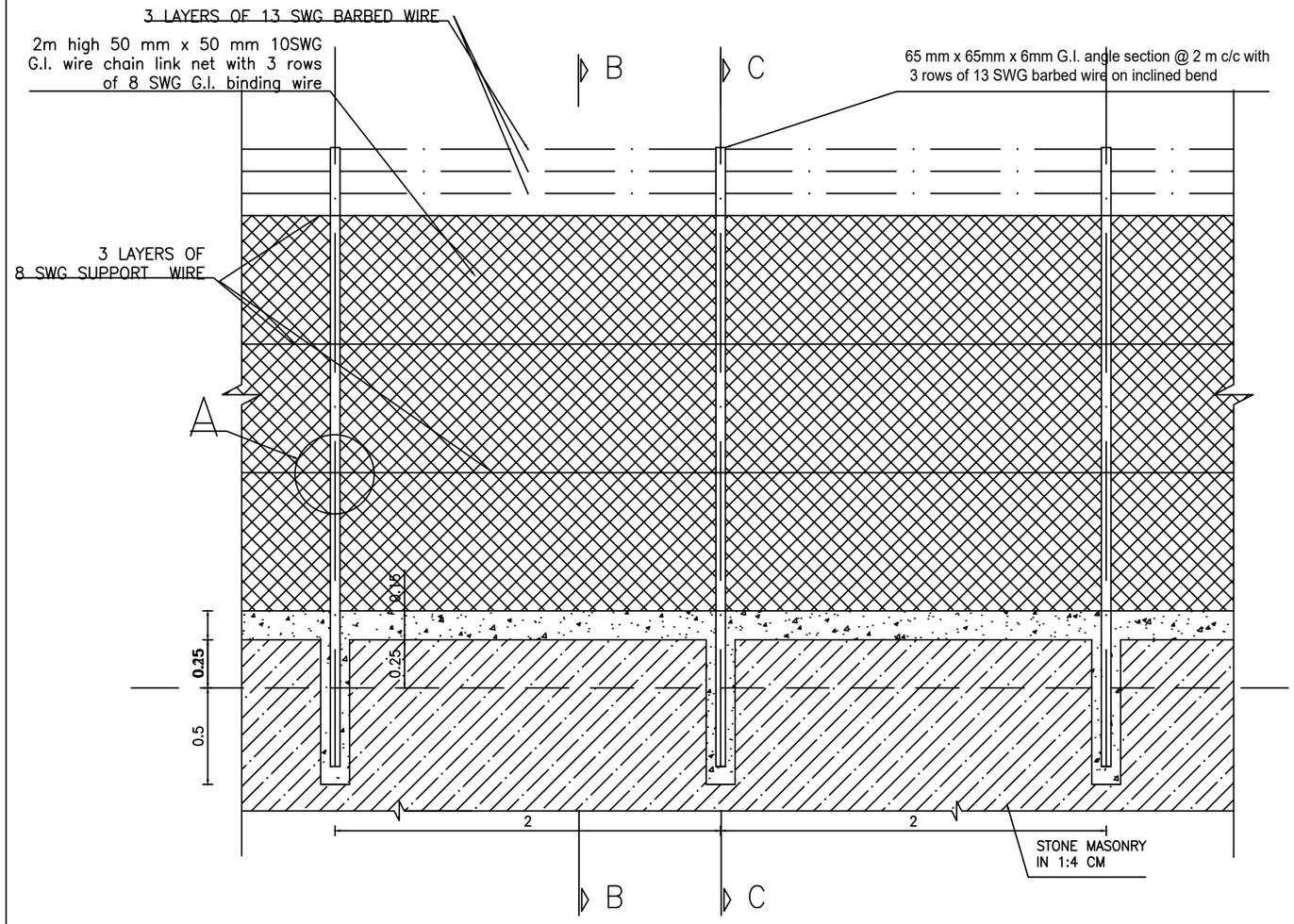
SIDE ELEVATION

0 0.5 1 2 3 4m

SCALE 1:100

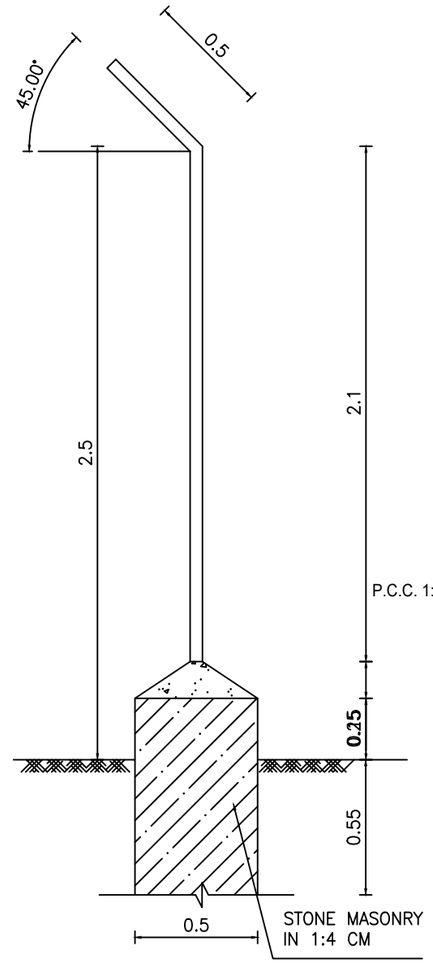
CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-BLDG-GH-ELEV-02	TITLE 33/11 kV SUBSTATION GUARD HOUSE TYPE-2 ELEVATION

DETAIL OF SWITCHYARD FENCING WALL



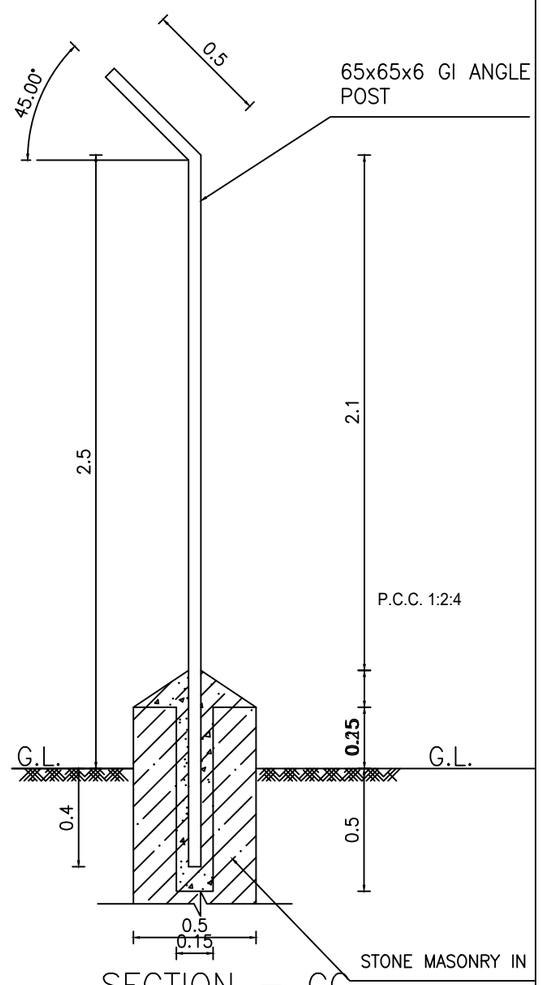
SECTIONAL ELEVATION OF FENCING WALL

SCALE = 1:30



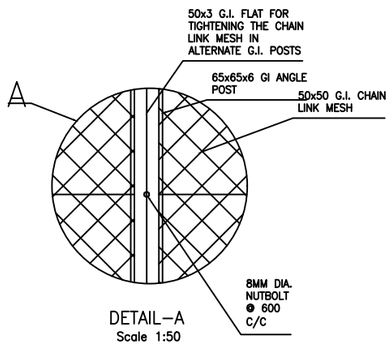
SECTION – BB

SCALE = 1:25



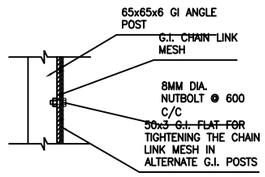
SECTION – CC

SCALE = 1:25



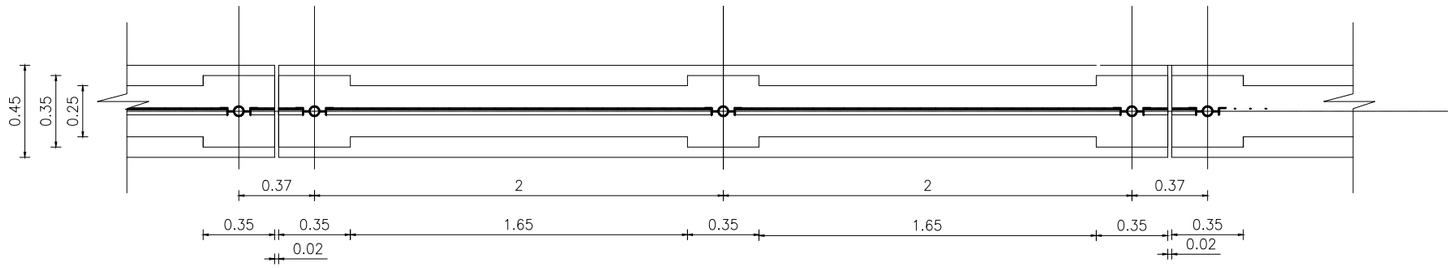
DETAIL–A

Scale 1:50

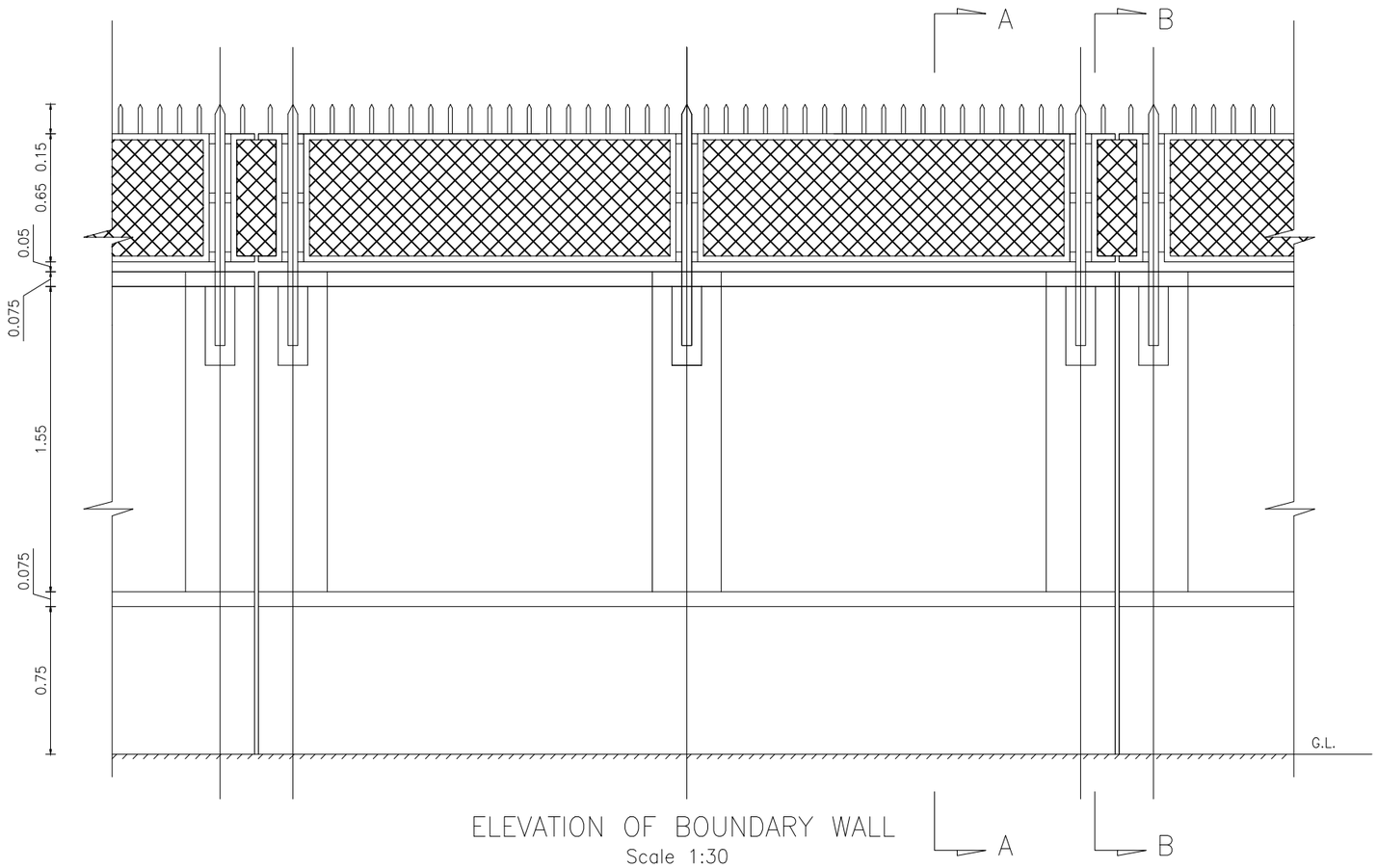


JOINT DETAIL

CLIENT: NEPAL ELECTRICITY AUTHORITY, DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE, DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT, DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT: NEA ENGINEERING COMPANY LTD., TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT: DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-FEN-SW-ELEV	TITLE: TYPICAL SECTIONAL ELEVATION OF FENCING WALL

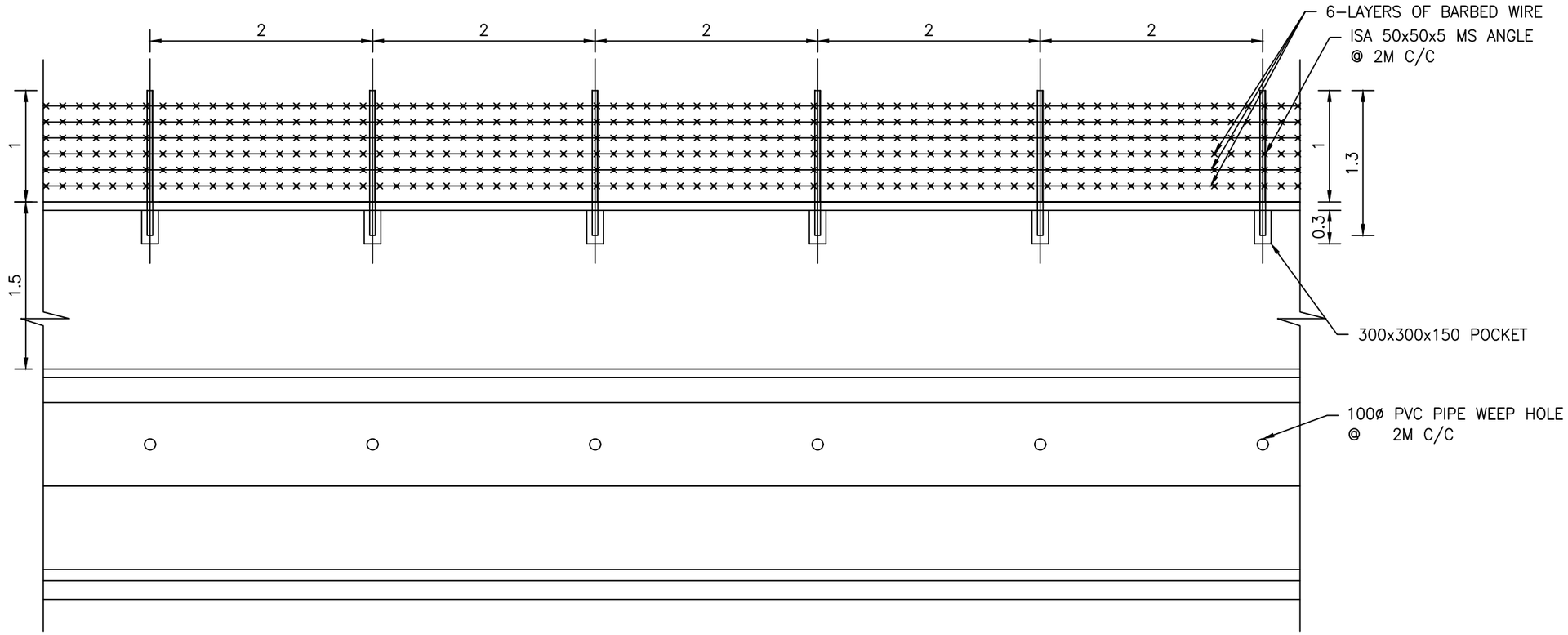


PLAN OF BOUNDARY WALL

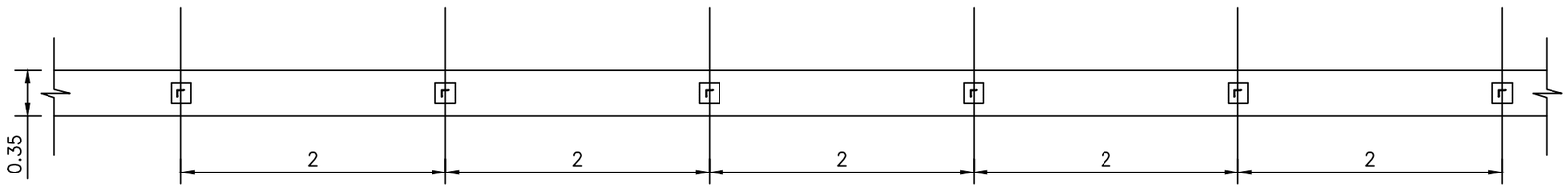


ELEVATION OF BOUNDARY WALL
Scale 1:30

CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-FEN-BWALL-ELEV-01	TITLE TYPICAL PLAN & ELEVATION OF BOUNDARY WALL

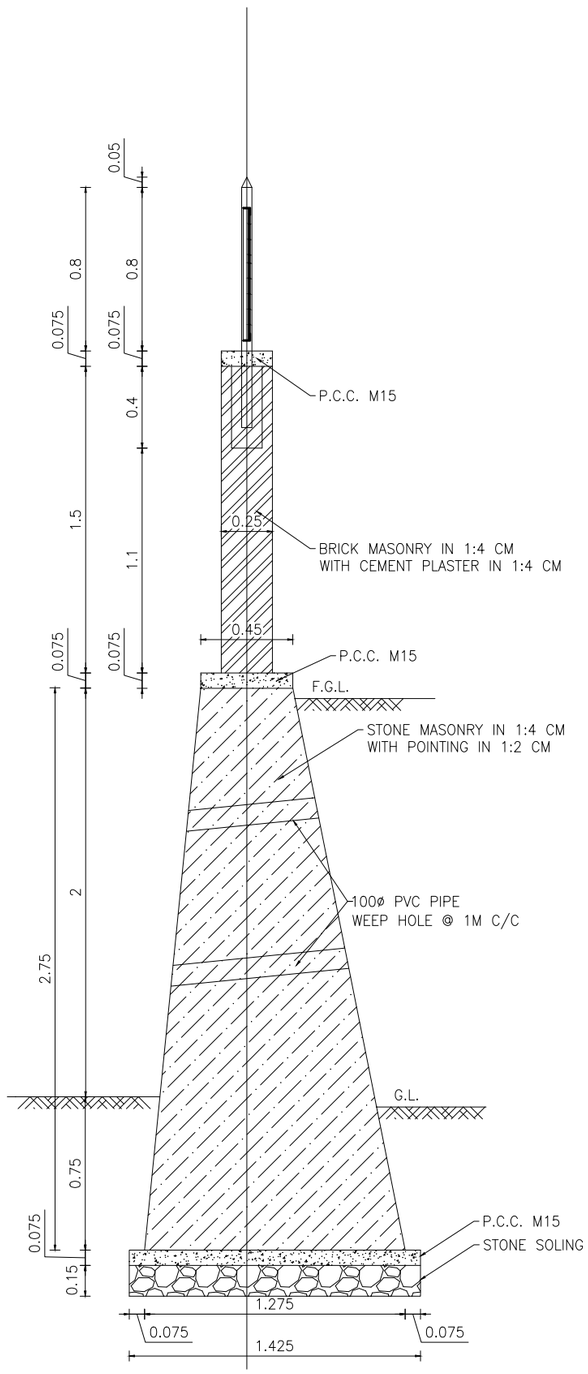


ELEVATION OF THE BOUNDARY WALL

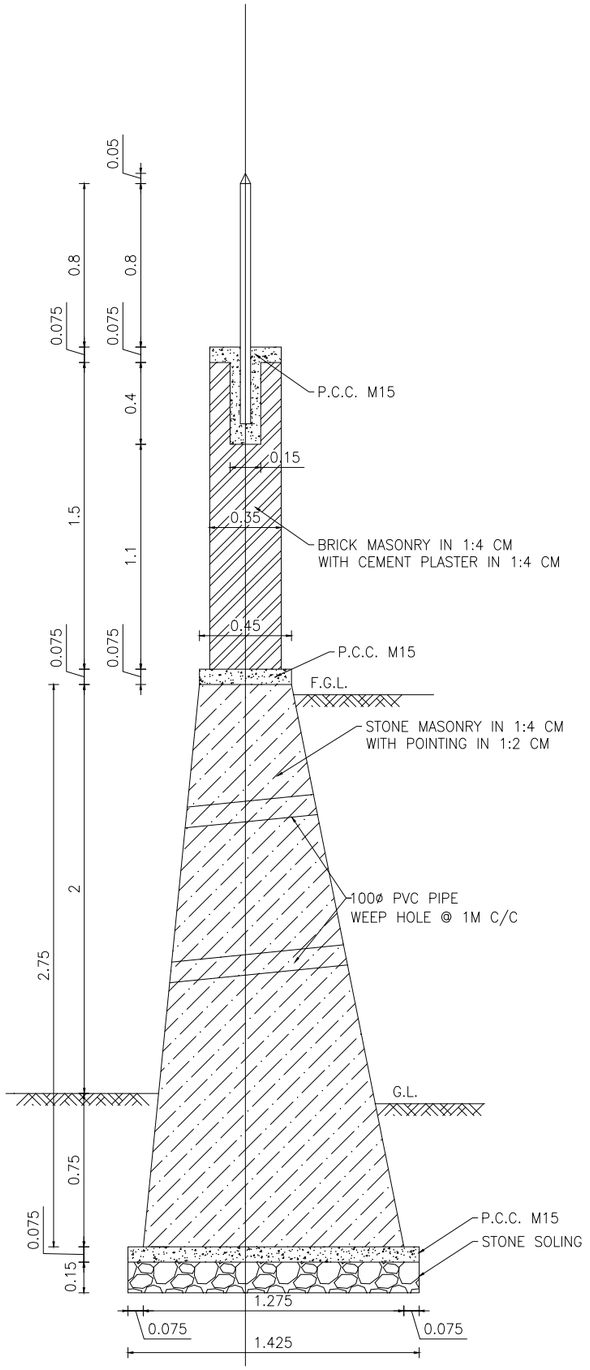


PLAN

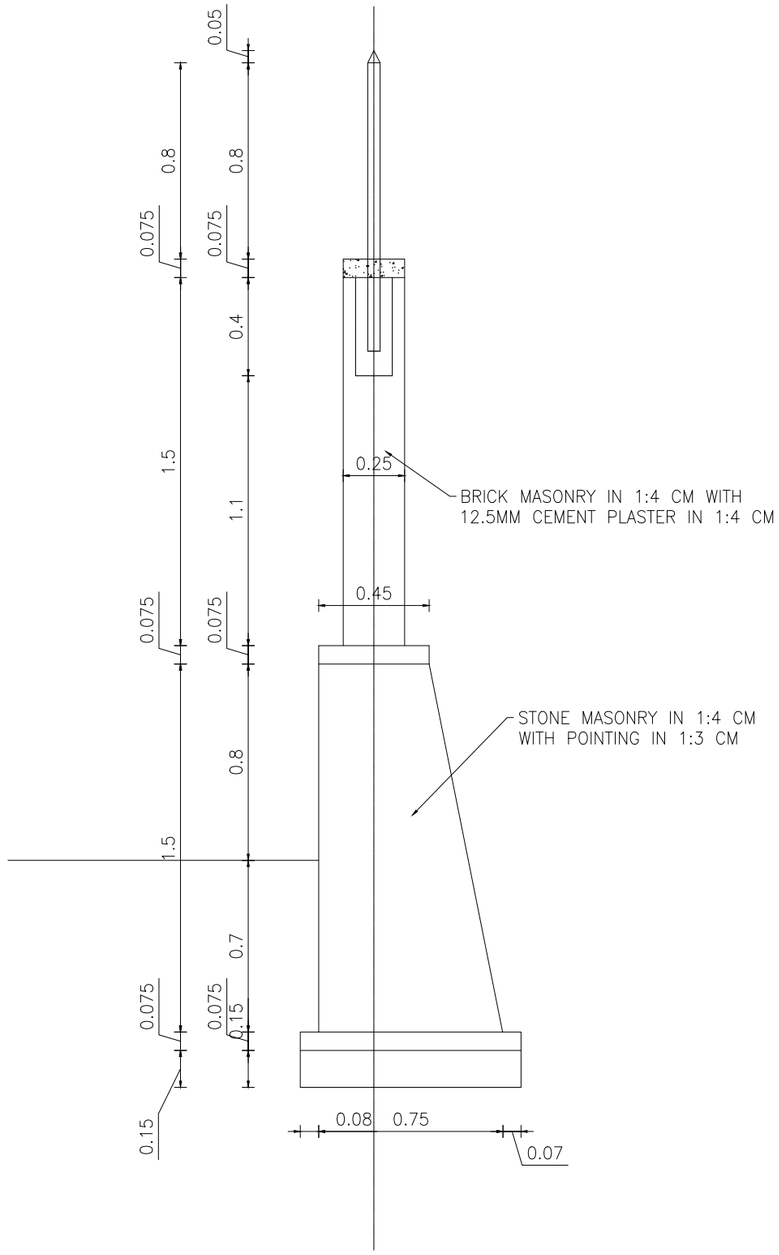
CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-FEN-BWALL-ELEV-02	TITLE TYPICAL DIAGRAMS FOR BOUNDARY WALL FOR 33/11 kV SUBSTATION



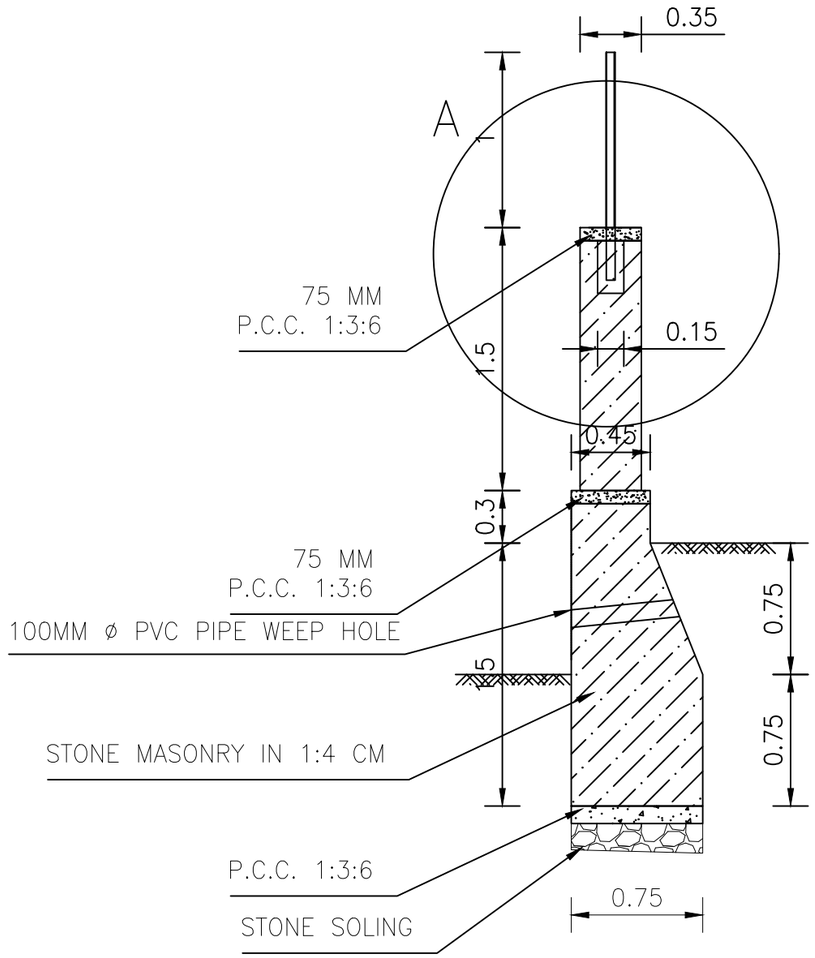
SECTION – A–A



SECTION – BB

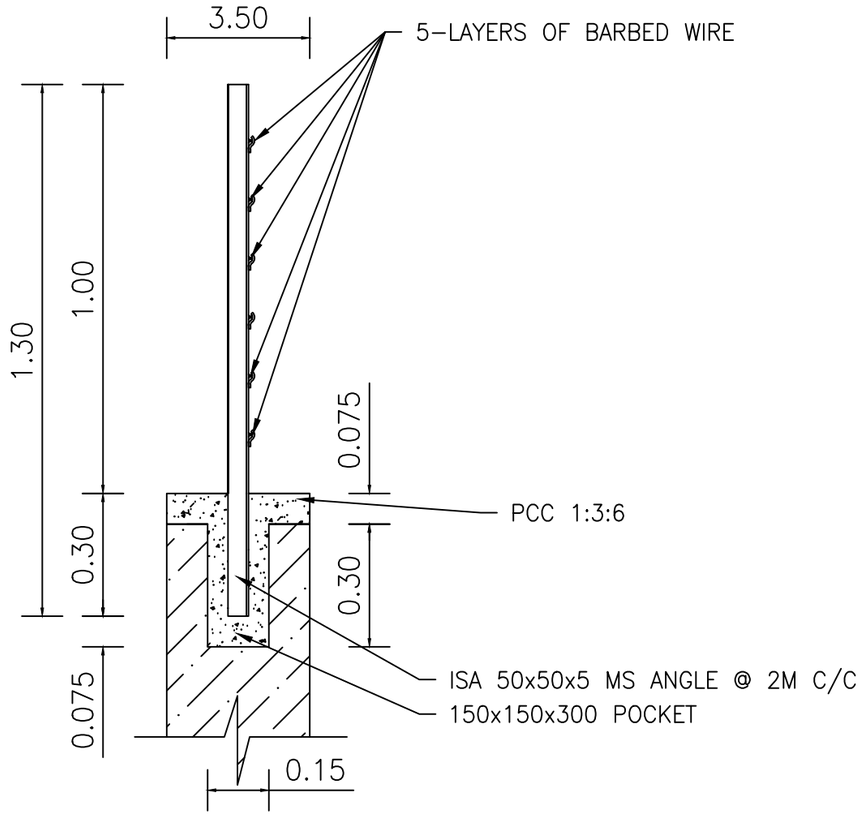


CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	**CONSULTANT** NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	**PROJECT** DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	**DRAWN**	**DESIGNED**	**TITLE** TYPICAL SECTION OF BOUNDARY WALL
			DRAFTING CHECK	**DESIGN CHECK**	
			APPROVED	**DRAWING NO.** CSG-FEN-BWALL-SEC-01	



TYPICAL SECTION OF
THE BOUNDARY WALL

SCALE 1:350



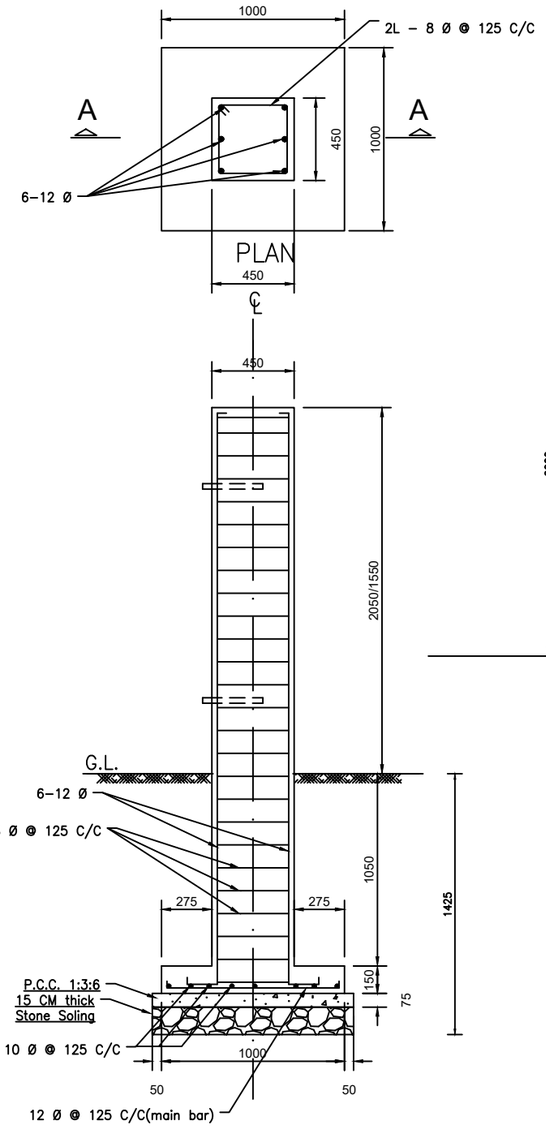
DETAIL – A

SCALE 1:150

CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN	DESIGNED	TITLE TYPICAL SECTION OF BOUNDARY WALL
			DRAFTING CHECK	DESIGN CHECK	
			APPROVED	DRAWING NO. CSG-FEN-BWALL-SEC-02	

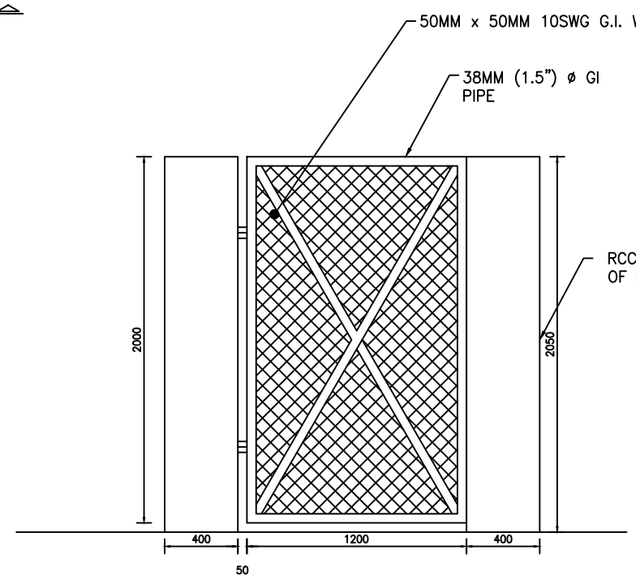
ENTRANCE GATE FOR SWITCHYARD AREA

SUPPLY AND ERECTION OF SUBSTATION ENTRANCE GATE TO THE SS AREA (1.2MX2M) AND AT POWER TRANSFORMER (1.5MX4M)WITH 1.5" GALVANIZED PIPE FRAME WITH CROSS BRACING AND 10 SWG MESH ON THE PANEL ALL COMPLETE AS DIRECTED BY SITE ENGINEER



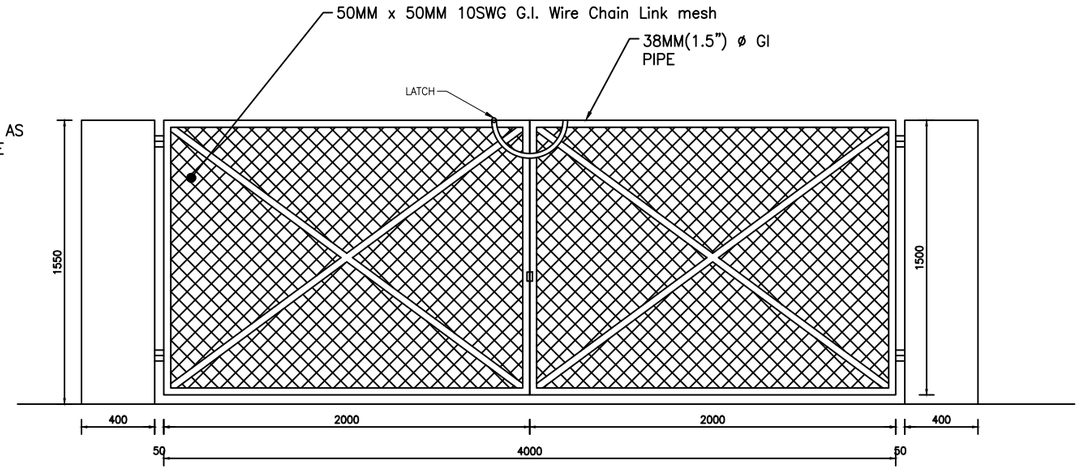
TYPICAL SECTION OF GATE COLUMN

SCALE = 1:30



SWITCHYARD FENCE GATE

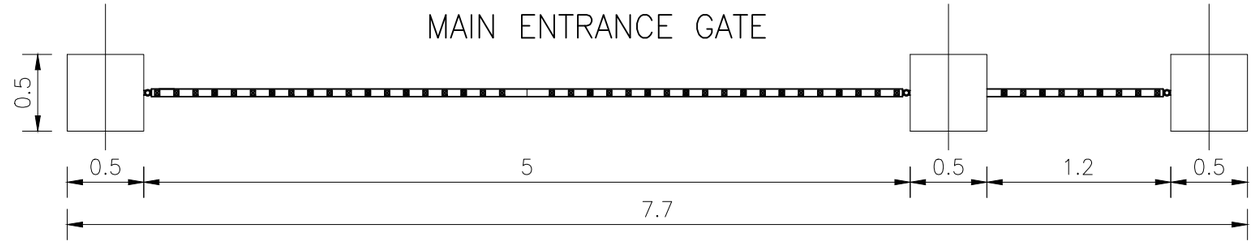
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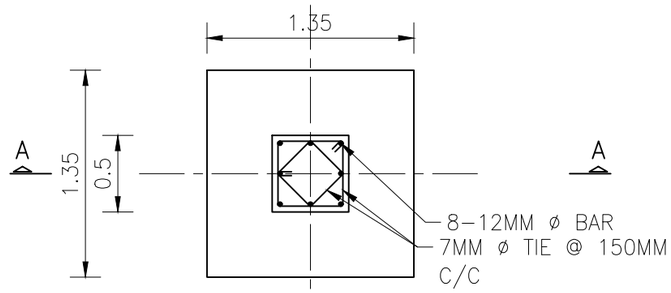
SWITCHYARD POWER TRA
FENCE GATE

SCALE = 1:30

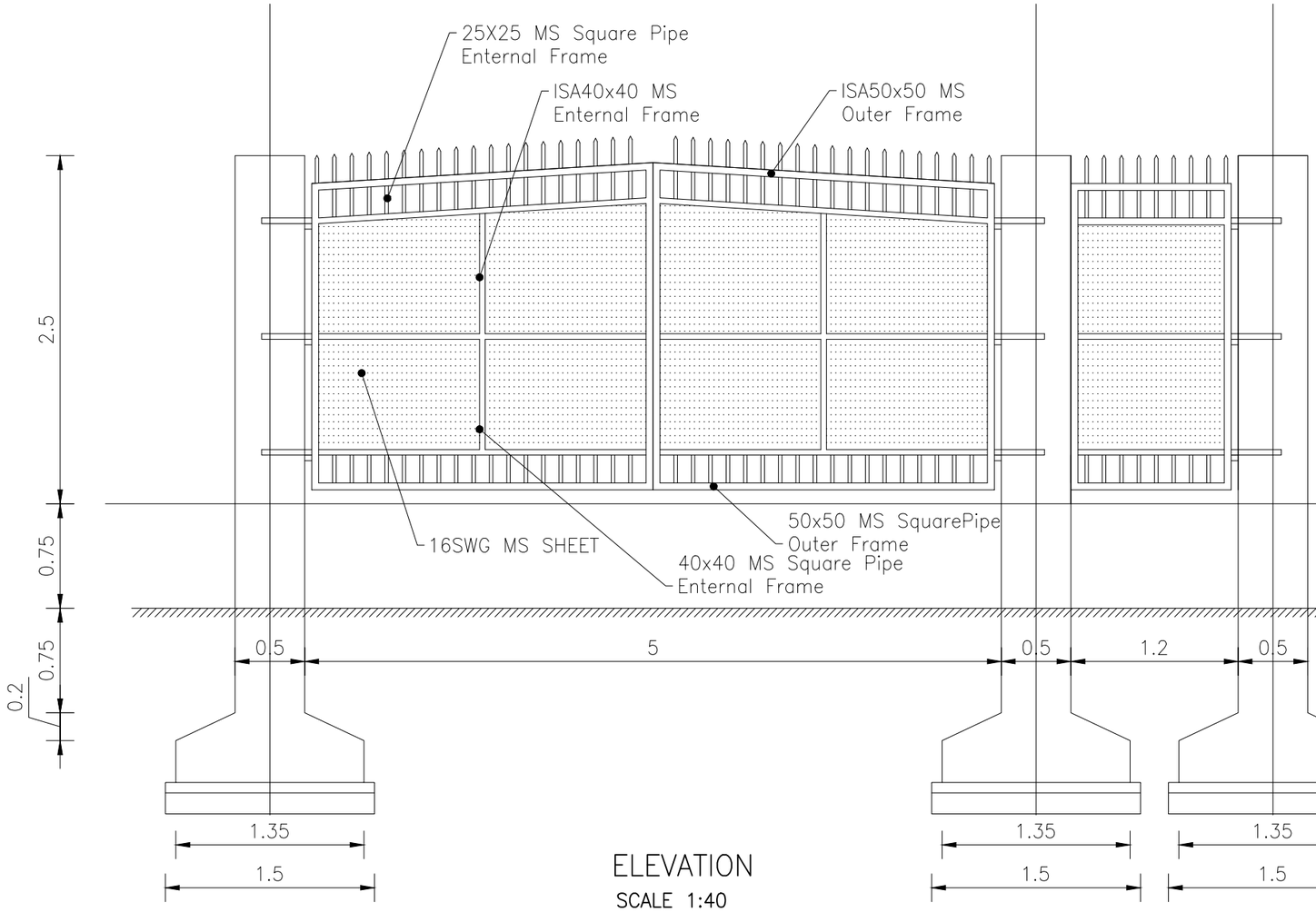
CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN	DESIGNED	TITLE TYPICAL DRAWINGS OF SWITCHYARD ENTRY GATE 33/11 kV SUBSTATION
			DRAFTING CHECK	DESIGN CHECK	
			APPROVED	DRAWING NO. CSG-FEN-SWG	



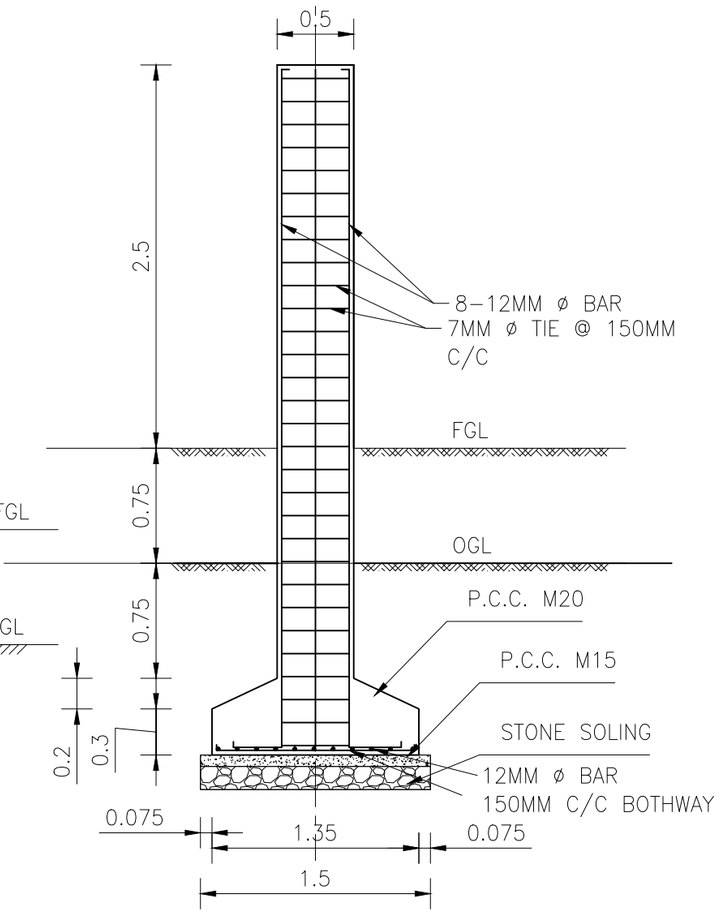
PLAN
SCALE 1:40



PLAN
SCALE 1:40

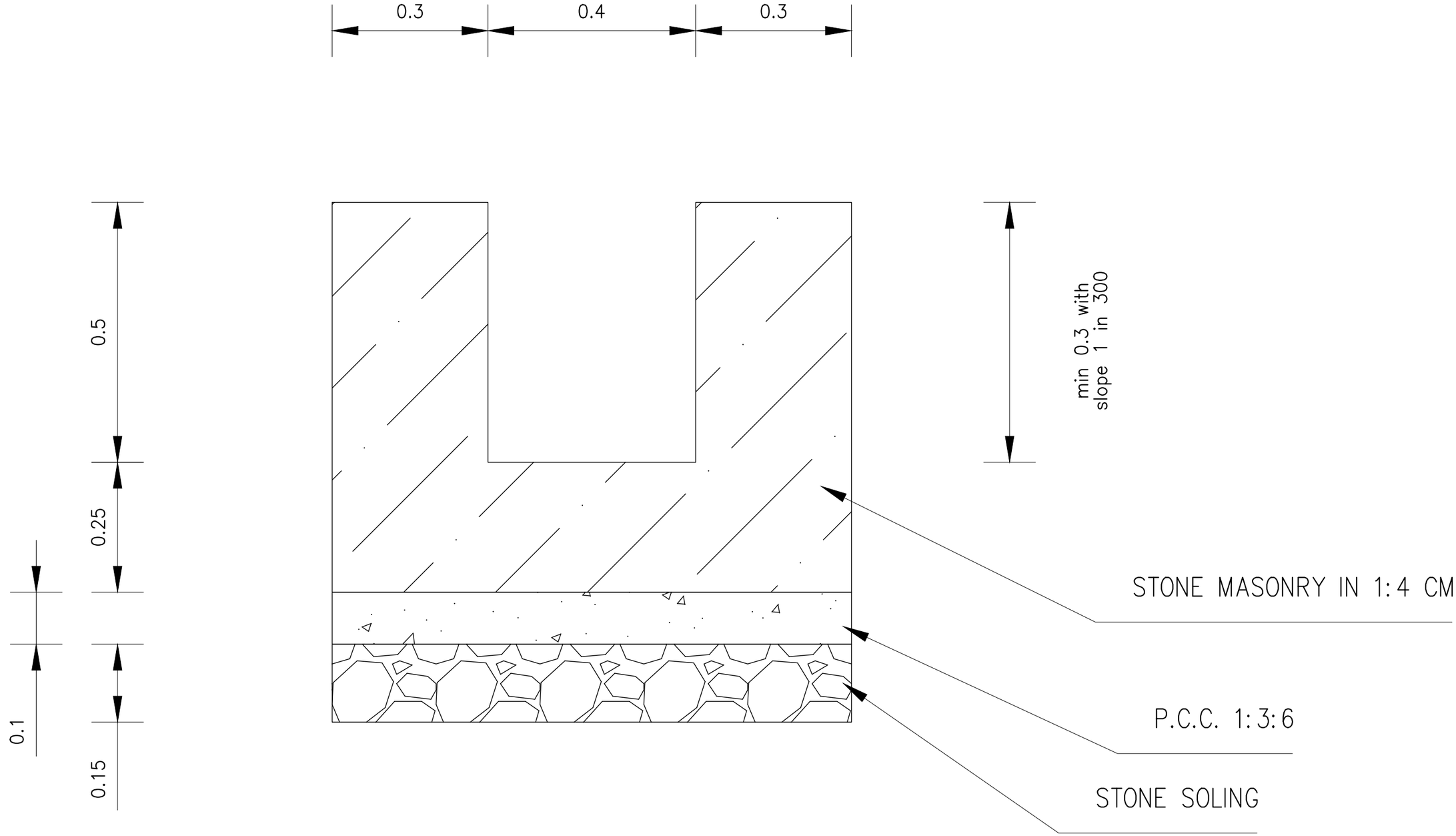


ELEVATION
SCALE 1:40

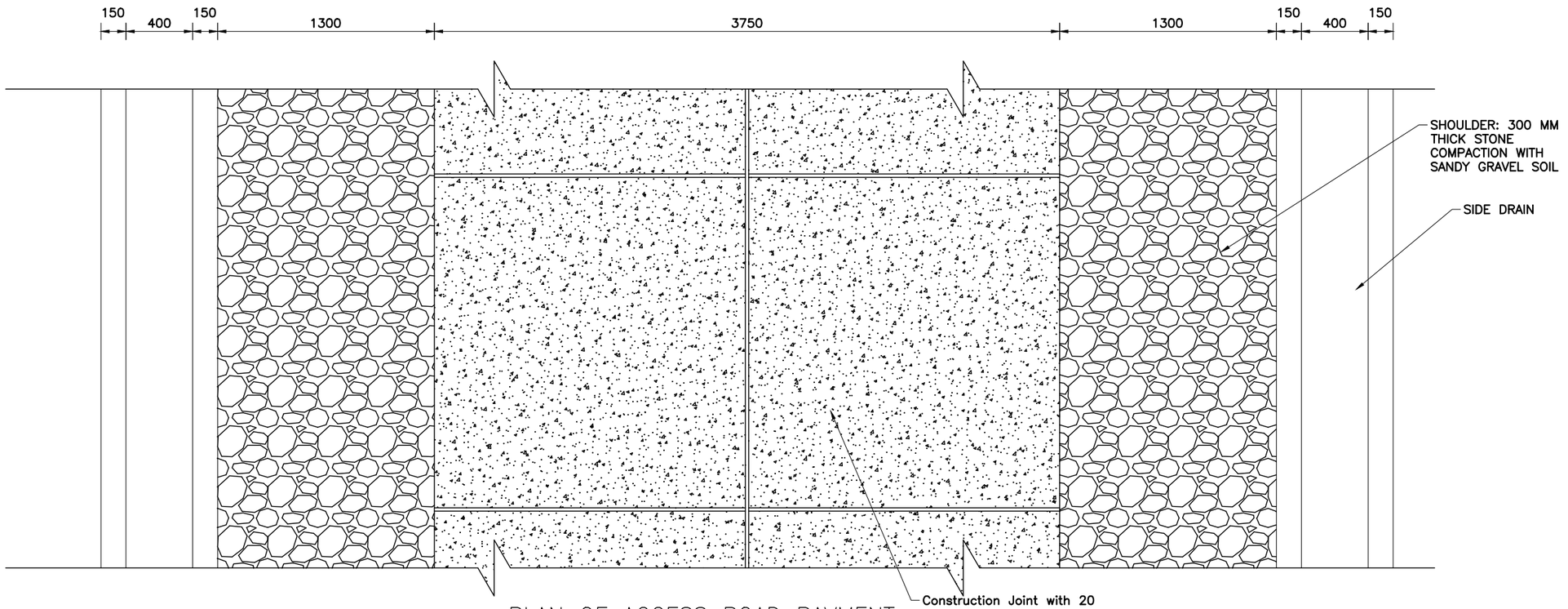


SECTION – AA
SCALE 1:40

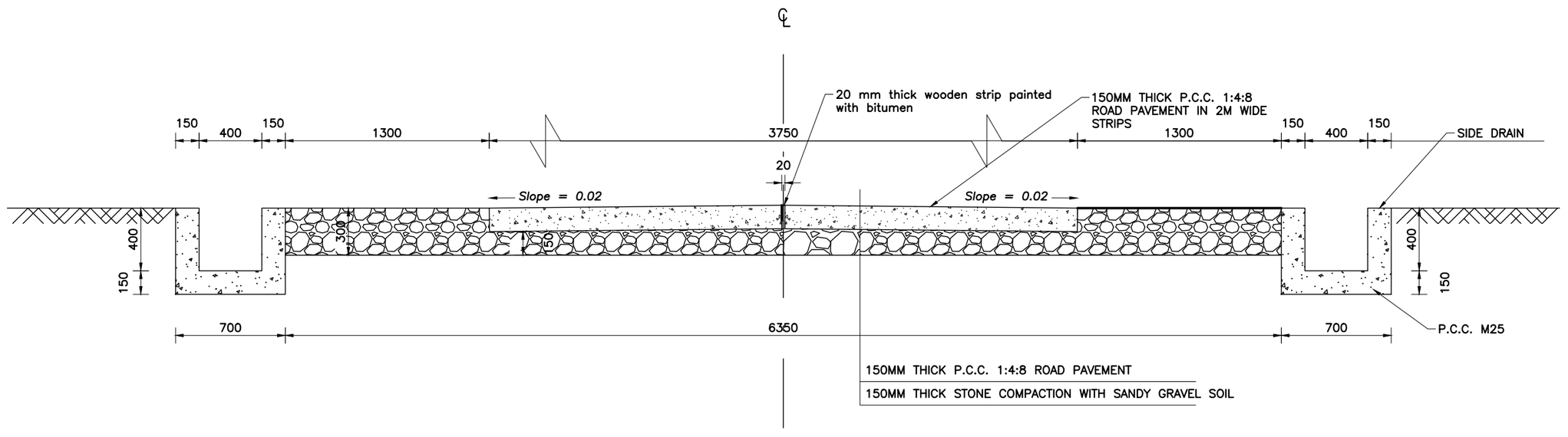
CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-FEN-MEG	TITLE TYPICAL DRAWINGS OF MAIN ENTRY GATE FOR 33/11 kV SUBSTATION



CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-ROAD-DRAIN-SEC	TITLE TYPICAL SECTION OF DIVERSION CANAL

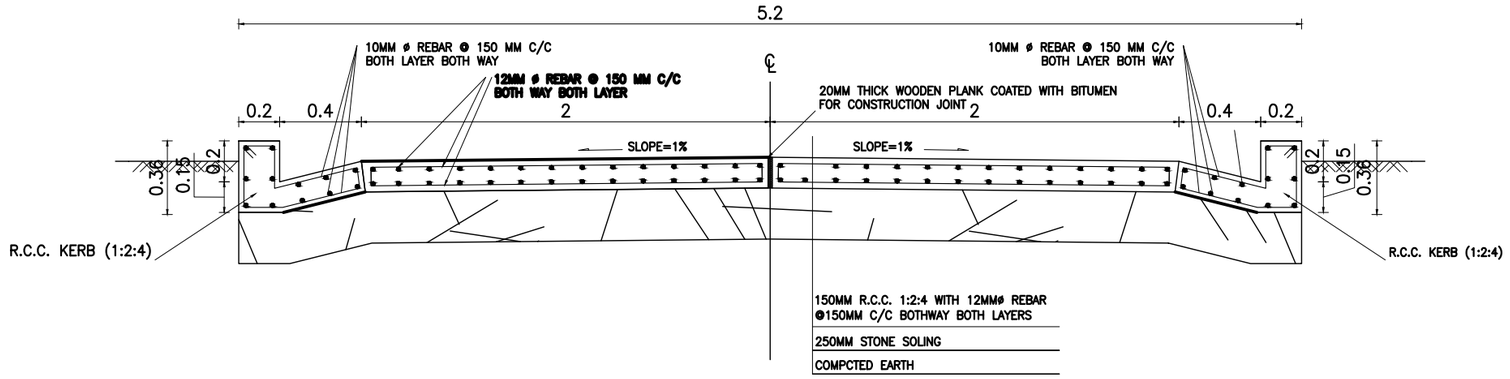


PLAN OF ACCESS ROAD PAVMENT

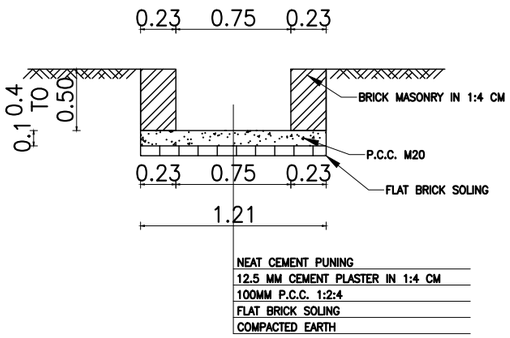


TYPICAL SECTION OF ACCESS ROAD PAVMENT

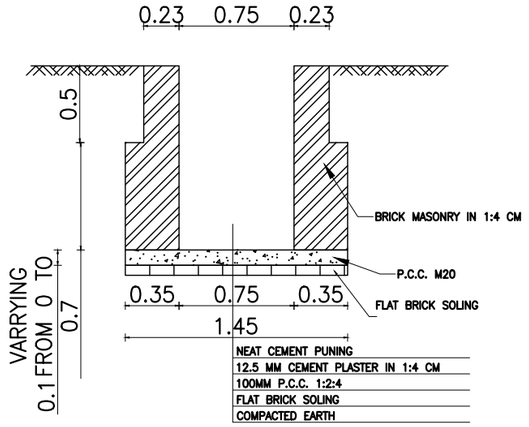
CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-ROAD-PAV-TYP	TITLE TYPICAL ROAD PAVEMENT PLAN



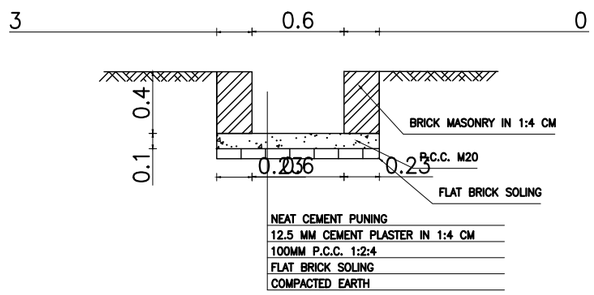
TYPICAL CROSS SECTION OF R.C.C. ROAD



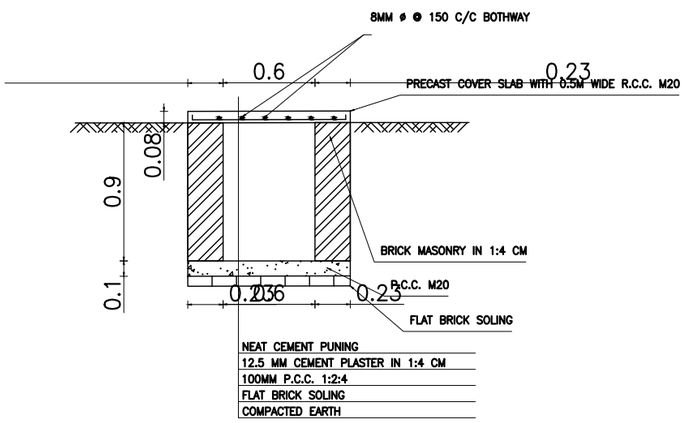
SECTION OF SIDE DRAIN TYPE–A
AT STARTING POINT
DEPTH FROM 0.4 M TO 0.5 M
@ 1:500 SLOPE



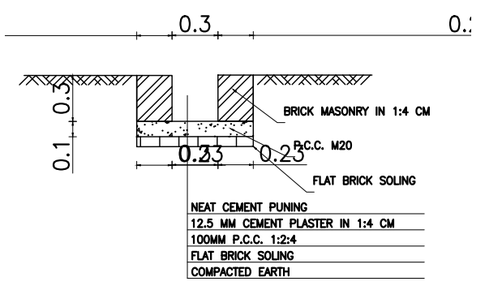
SECTION OF SIDE DRAIN TYPE–A
DEPTH FROM 0.5 M TO 1.2 M AT END POINT
@ 1:500 SLOPE



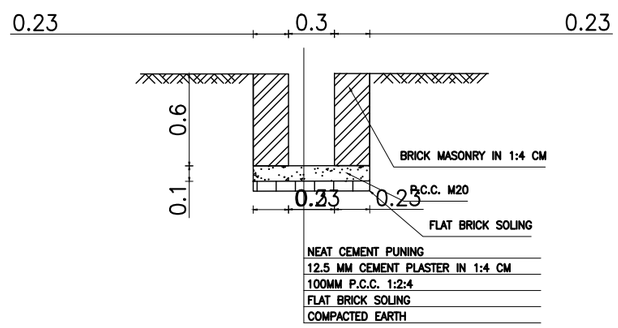
SECTION OF SIDE DRAIN TYPE–B
AT STARTING POINT
DEPTH FROM 0.4
@ 1:500 SLOPE



SECTION OF SIDE DRAIN TYPE–B
AT END POINT
DEPTH 0.9 M
@ 1:500 SLOPE

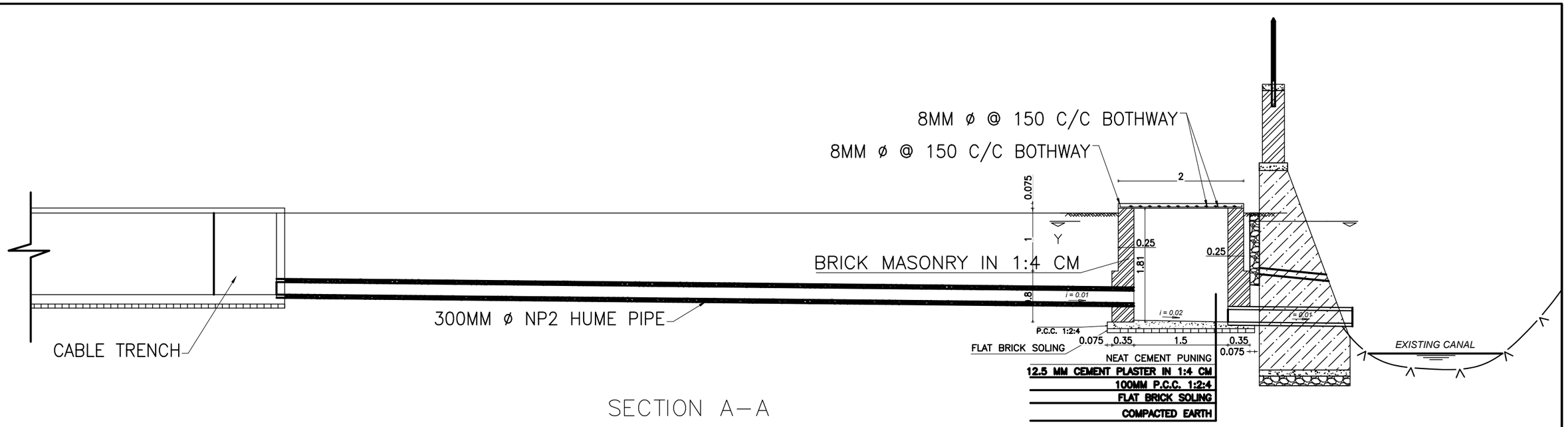


SECTION OF SIDE DRAIN TYPE–C
AT STARTING POINT
DEPTH FROM 0.3 @ 1:500 SLOPE

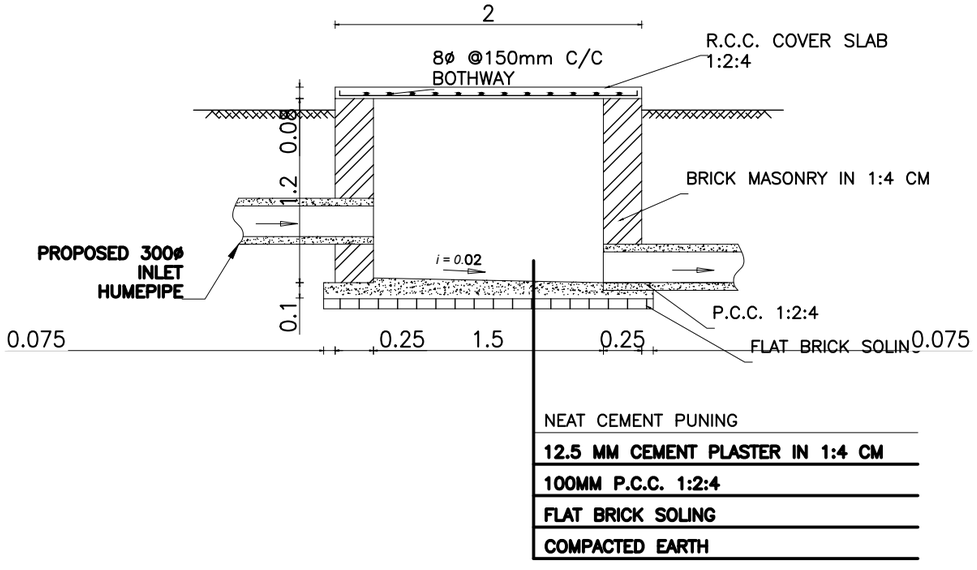


SECTION OF SIDE DRAIN TYPE–C
AT END POINT
DEPTH 0.6 M@ 1:500 SLOPE

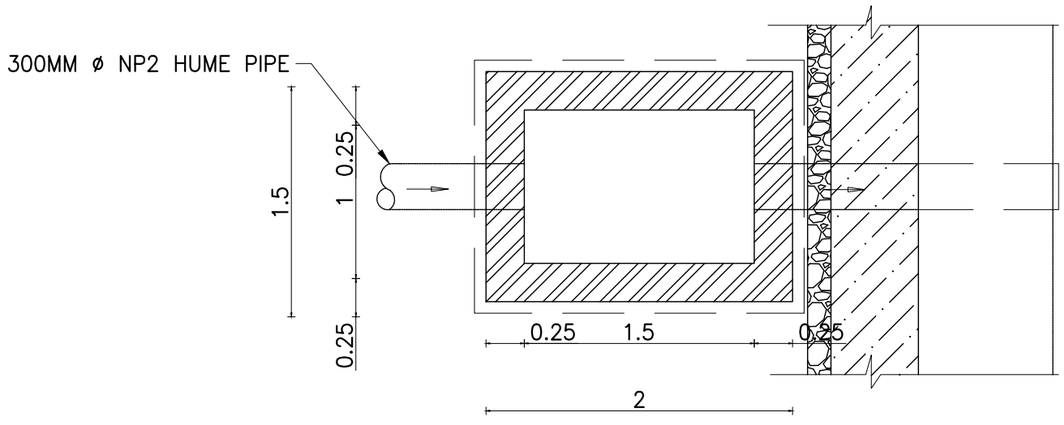
CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-ROAD-PAV-SEC-01	TITLE TYPICAL ROAD PAVEMENT PLAN & SECTION OF SIDE DRAIN



SECTION A–A

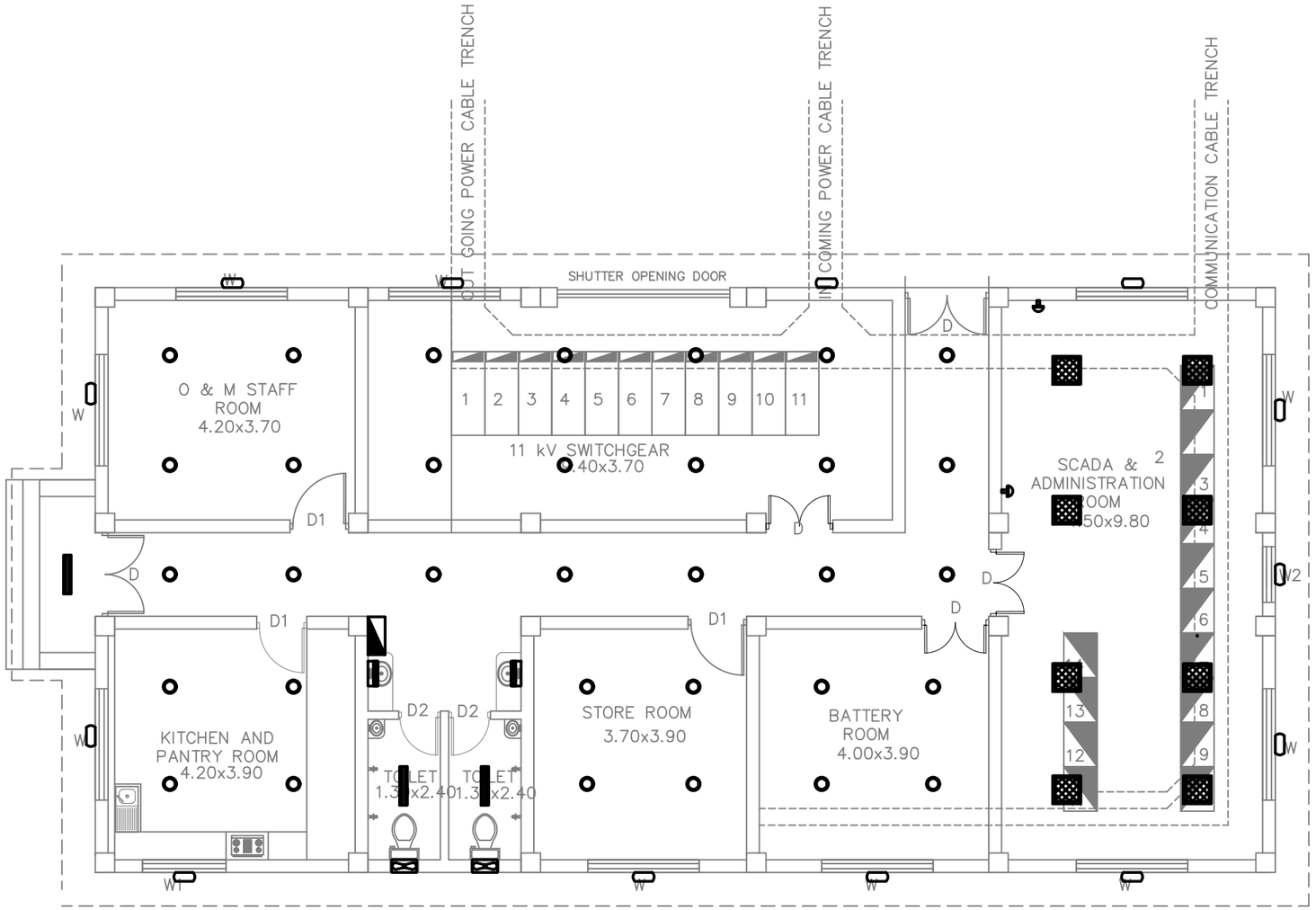


SECTION X–X



SECTION Y–Y

CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-ROAD-PAV-SEC-02	TITLE ARRANGEMENT OF CABLE, PIPE & DRAIN

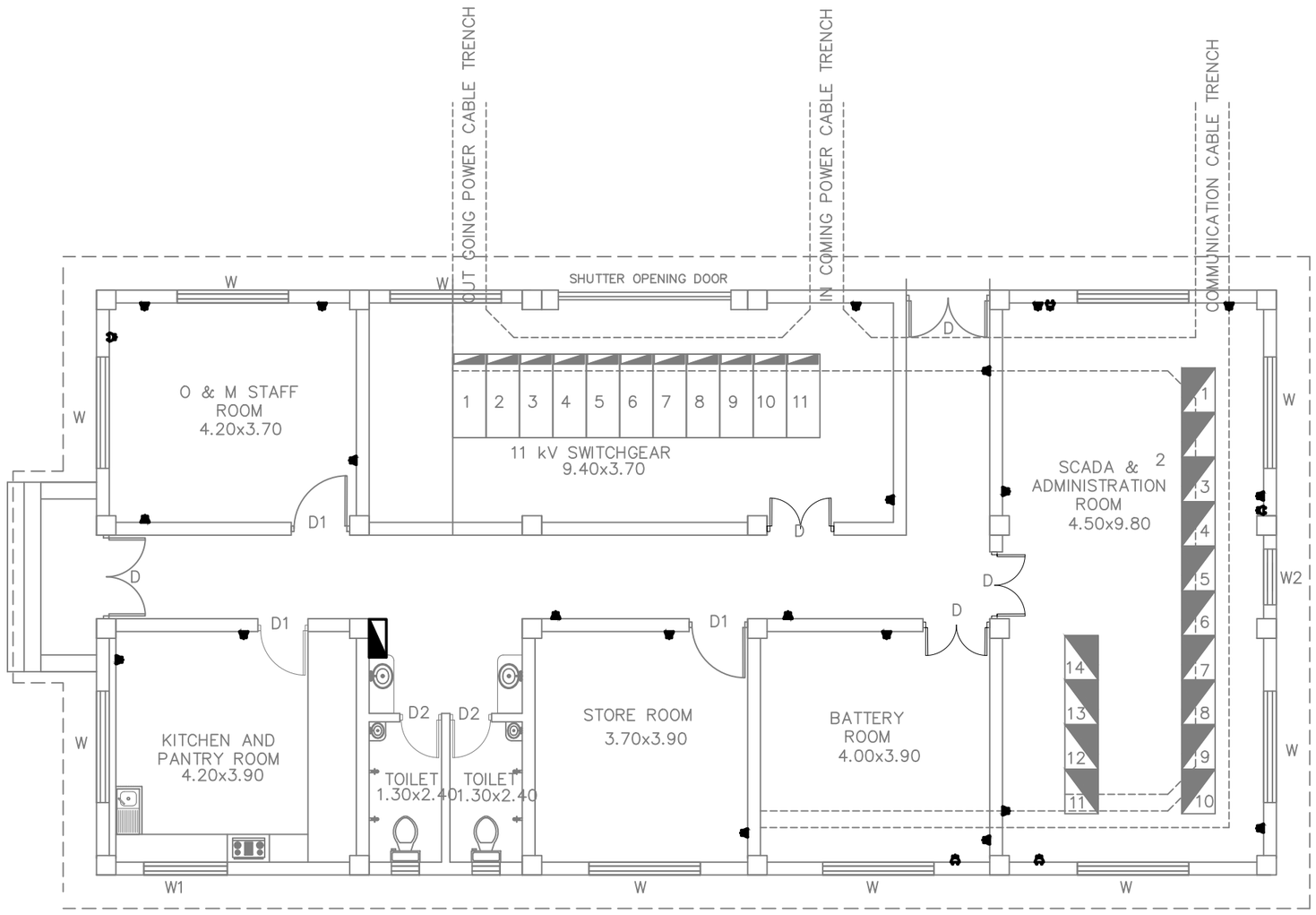


INDEX	
SYMBOL	EQUIPMENT
	36W, CEILING SURFACE MOUNTED LED
	18W, CEILING SURFACE MOUNTED LED, IP56
	12W, CEILING SURFACE MOUNTED LED
	10W, BULKHEAD, IP56
	7W WALL MOUNTED LED, IP65
	40W, EXHAUST FAN
	7W, SURFACE MOUNTED WALL LED
	7W, MIRROR LIGHT
	10W, DECORATIVE WALL LIGHT
	3 X 1.5 SQ. MM COPPER WIRE
	DISTRIBUTION BOX

GROUND FLOOR PLAN

CLIENT: NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT: NEA ENGINEERING COMPANY LTD. UPGRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT: DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-BLDG-CTRL-ELE

TITLE: 33/11 kV SUBSTATION
CONTROL BUILDING
LIGHT PLAN

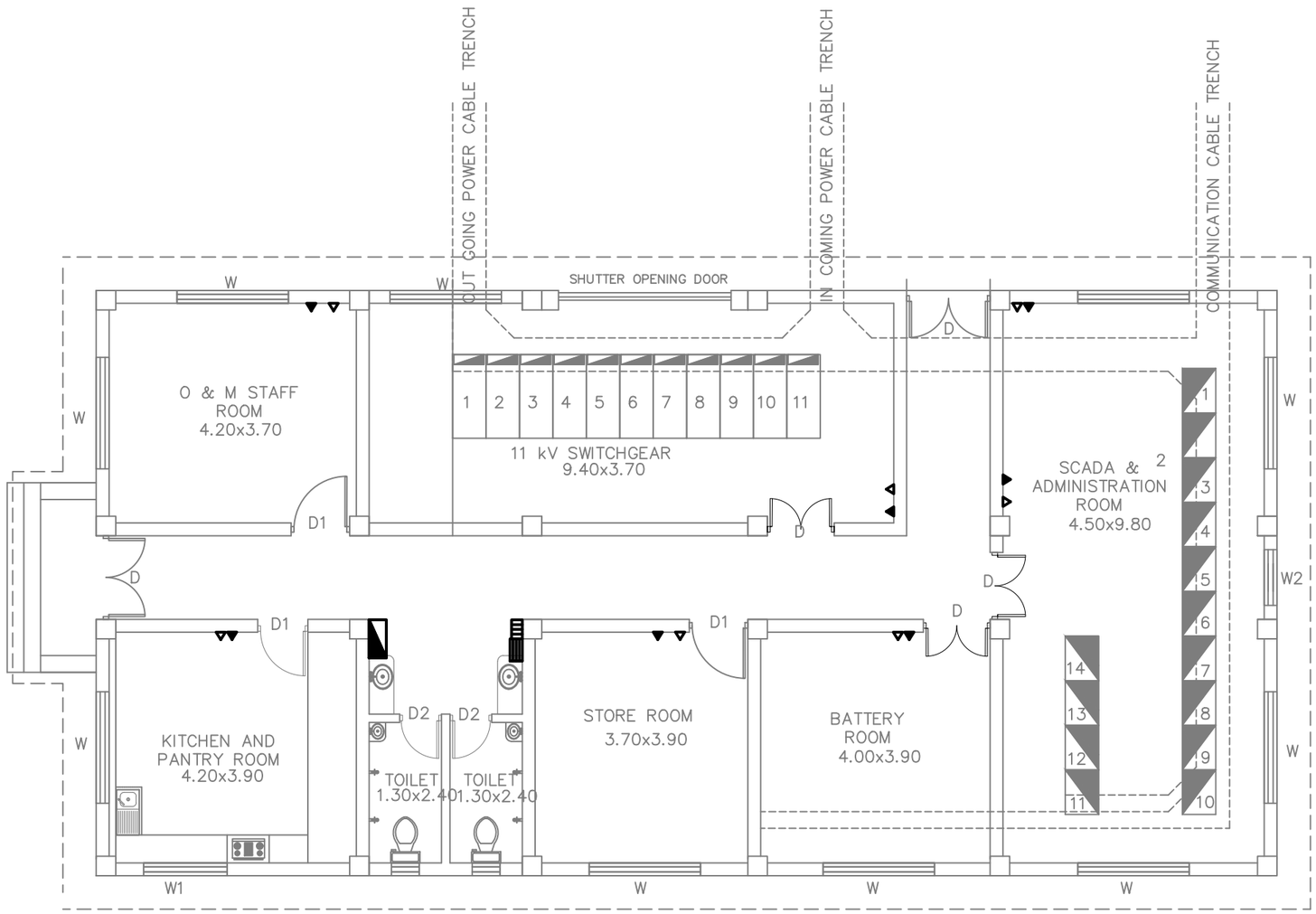


INDEX	
SYMBOL	EQUIPMENT
	6/16 AMP POWER SOCKET, TYPE D
	16 AMP POWER SOCKET FOR AIR CONDITIONER
	2X4SQ.MM+1X2.5SQ.MM COPPER CONDUCTOR
	DISTRIBUTION BOX

GROUND FLOOR PLAN

CLIENT: NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT: NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT: DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO.: CSG-BLDG-CTRL-POW

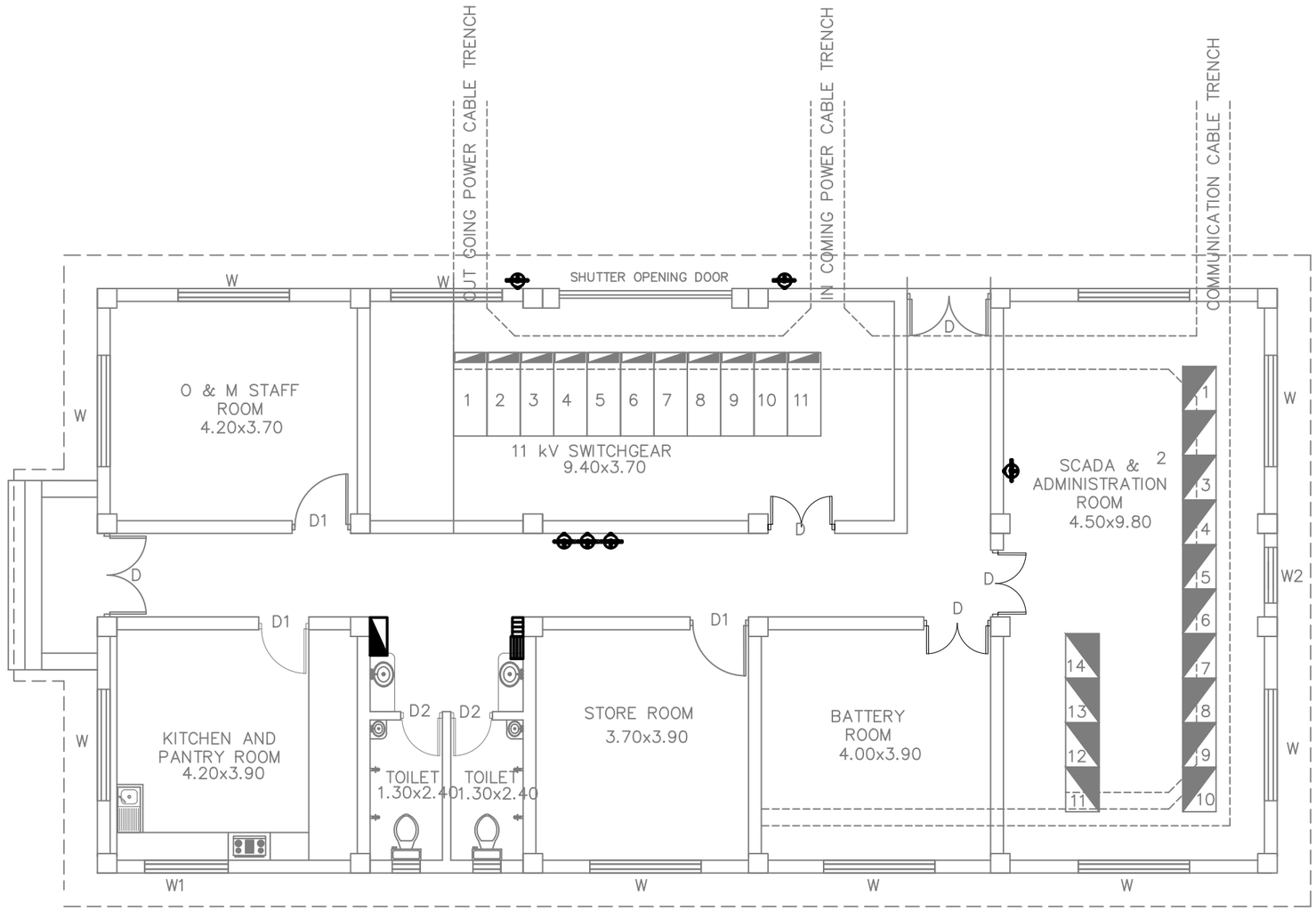
TITLE: 33/11 kV SUBSTATION
CONTROL BUILDING
POWER AND AC CIRCUIT PLAN



INDEX	
SYMBOL	EQUIPMENT
~	RJ45 CABLE FOR NETWORKING
△	SINGLE PORT TELEPHONE
▲	SINGLE PORT OUTLET FOR NETWORKING
▤	8 PORT SWITCH WITH ROUTER FOR NETWORKING
▥	8 PORT PBX FOR TELEPHONE SWITCHING
◥	DISTRIBUTION BOX

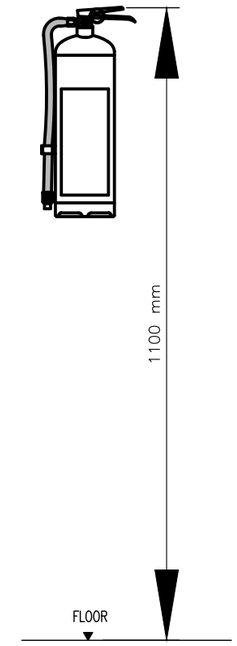
GROUND FLOOR PLAN

CLIENT: NEPAL ELECTRICITY AUTHORITY, DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE, DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT, DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT: NEA ENGINEERING COMPANY LTD., GRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT: DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-BLDG-CTRL-COMM	TITLE: 33/11 kV SUBSTATION CONTROL BUILDING COMMMUNICATION PLAN



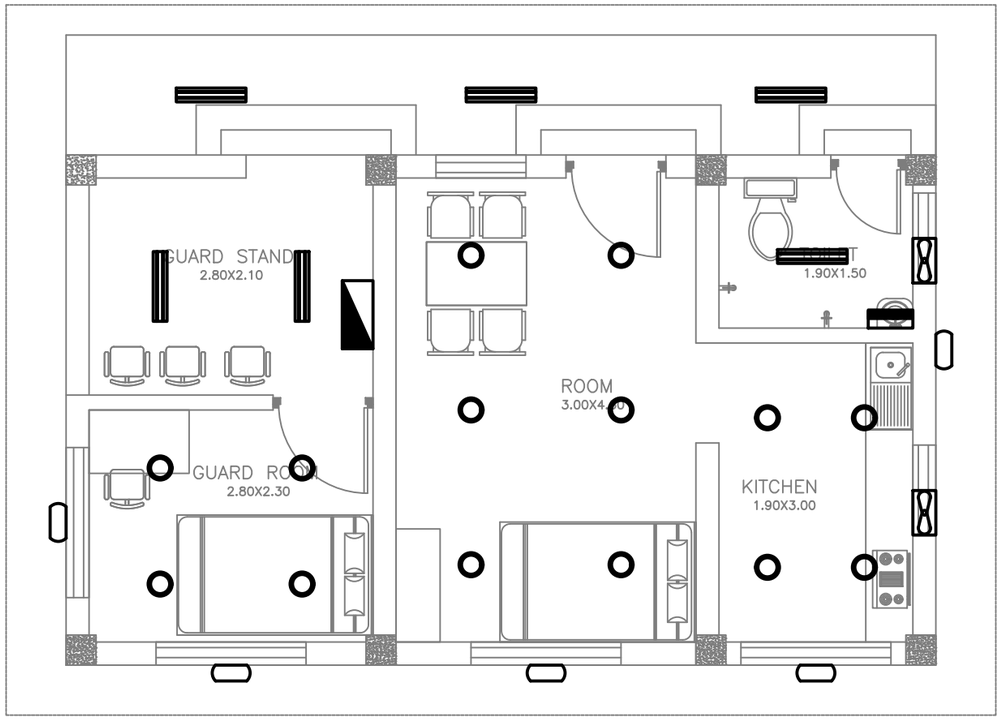
INDEX	
SYMBOL	EQUIPMENT
◆	WALL MOUNTED CO2 TYPE FIRE EXTINGUISHER

TYPICAL INSTALLATION DETAIL FOR CO2 FIRE EXTINGUISHER



GROUND FLOOR PLAN

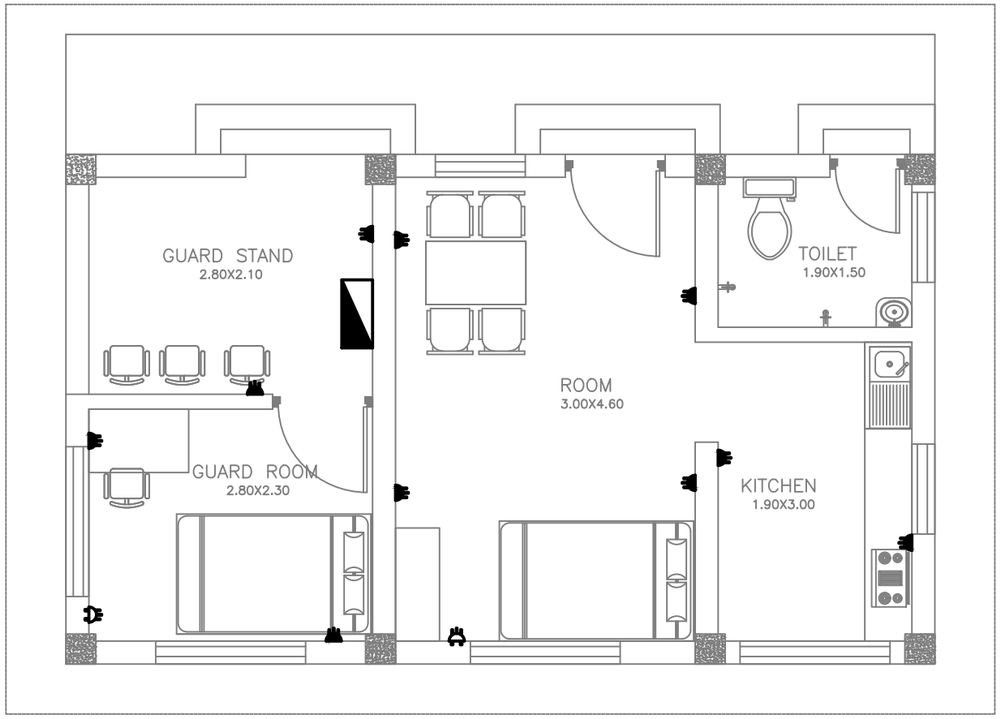
CLIENT: NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT: NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT: DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN	DESIGNED	TITLE: 33/11 kV SUBSTATION CONTROL BUILDING FIREFIGHTING
			DRAFTING CHECK	DESIGN CHECK	
			APPROVED	DRAWING NO. CSG-BLDG-CTRL-FIREF	



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SYMBOL	EQUIPMENT
	36W, CEILING SURFACE MOUNTED LED
	18W, CEILING SURFACE MOUNTED LED, IP56
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	40W, EXHAUST FAN
	7W, SURFACE MOUNTED WALL LED
	7W, MIRROR LIGHT
	10W, DECORATIVE WALL LIGHT
	3 X 1.5 SQ. MM COPPER WIRE
	DISTRIBUTION BOX

GROUND FLOOR PLAN

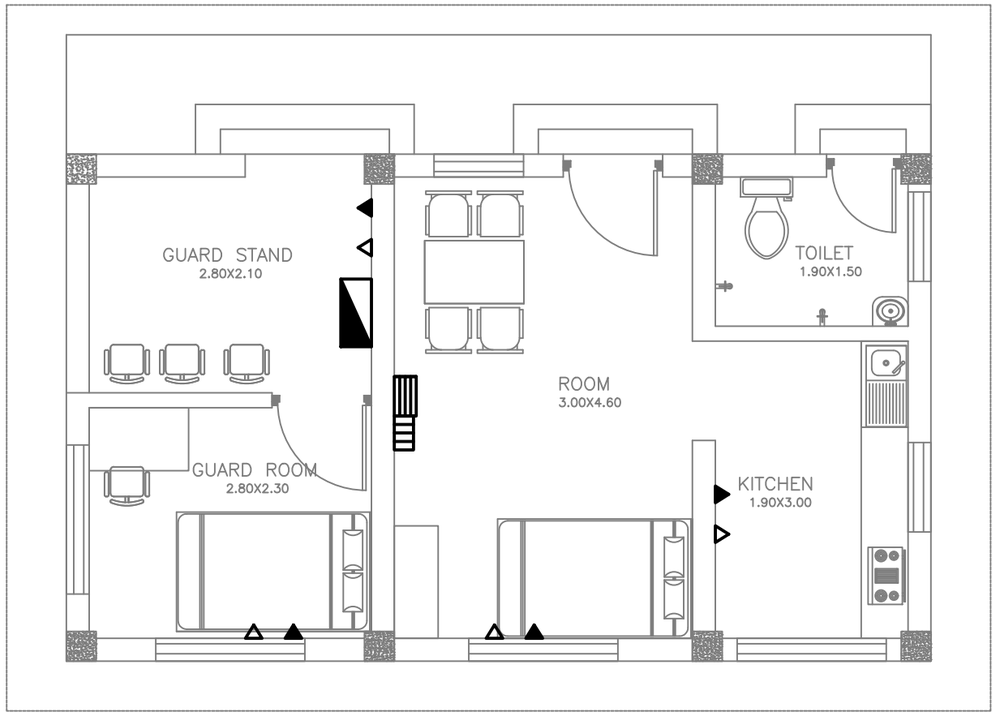
CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. GRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-BLDG-GH-ELE	TITLE 33/11 kV SUBSTATION GUARD HOUSE LIGHT PLAN



INDEX	
SYMBOL	EQUIPMENT
	6/16 AMP POWER SOCKET, TYPE D
	16 AMP POWER SOCKET FOR AIR CONDITIONER
	2X4SQ.MM+1X2.5SQ.MM COPPER CONDUCTOR
	DISTRIBUTION BOX

GROUND FLOOR PLAN

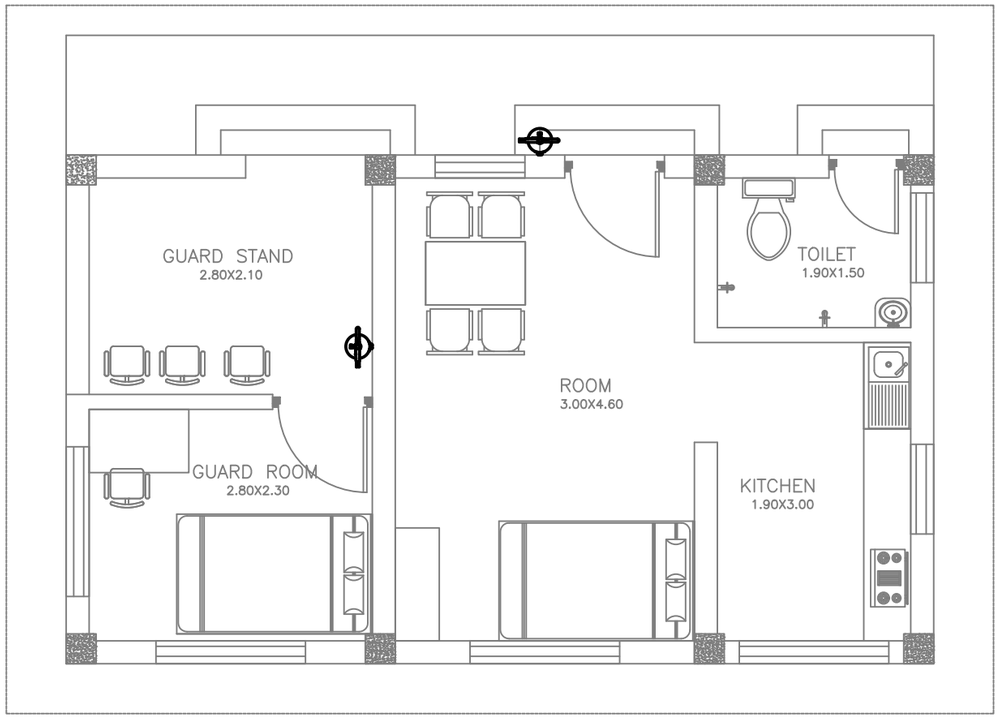
CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-BLDG-GH-POW	TITLE 33/11 kV SUBSTATION GUARD HOUSE POWER AND AC CIRCUIT PLAN



INDEX	
SYMBOL	EQUIPMENT
~	RJ45 CABLE FOR NETWORKING
△	SINGLE PORT TELEPHONE
▲	SINGLE PORT OUTLET FOR NETWORKING
▤	8 PORT SWITCH WITH ROUTER FOR NETWORKING
▥	8 PORT PBX FOR TELEPHONE SWITCHING
◥	DISTRIBUTION BOX

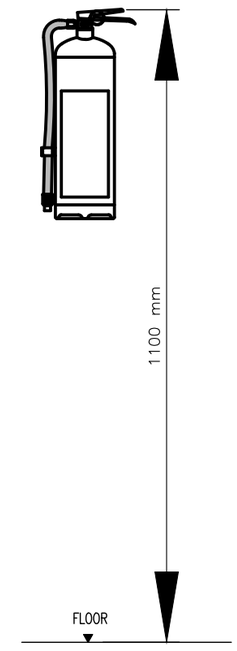
GROUND FLOOR PLAN

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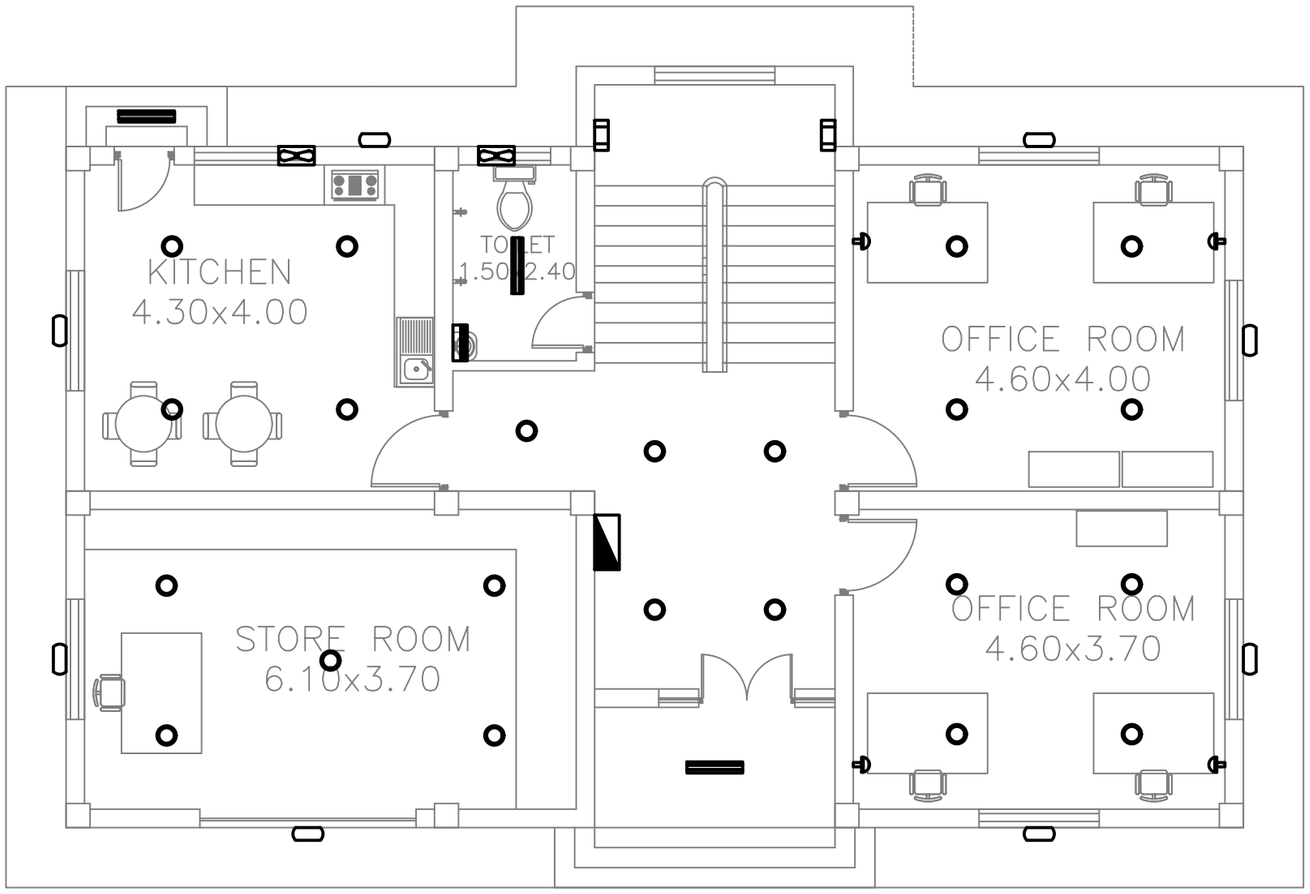
INDEX	
SYMBOL	EQUIPMENT
◆	WALL MOUNTED CO2 TYPE FIRE EXTINGUISHER

TYPICAL INSTALLATION DETAIL FOR CO2 FIRE EXTINGUISHER



GROUND FLOOR PLAN

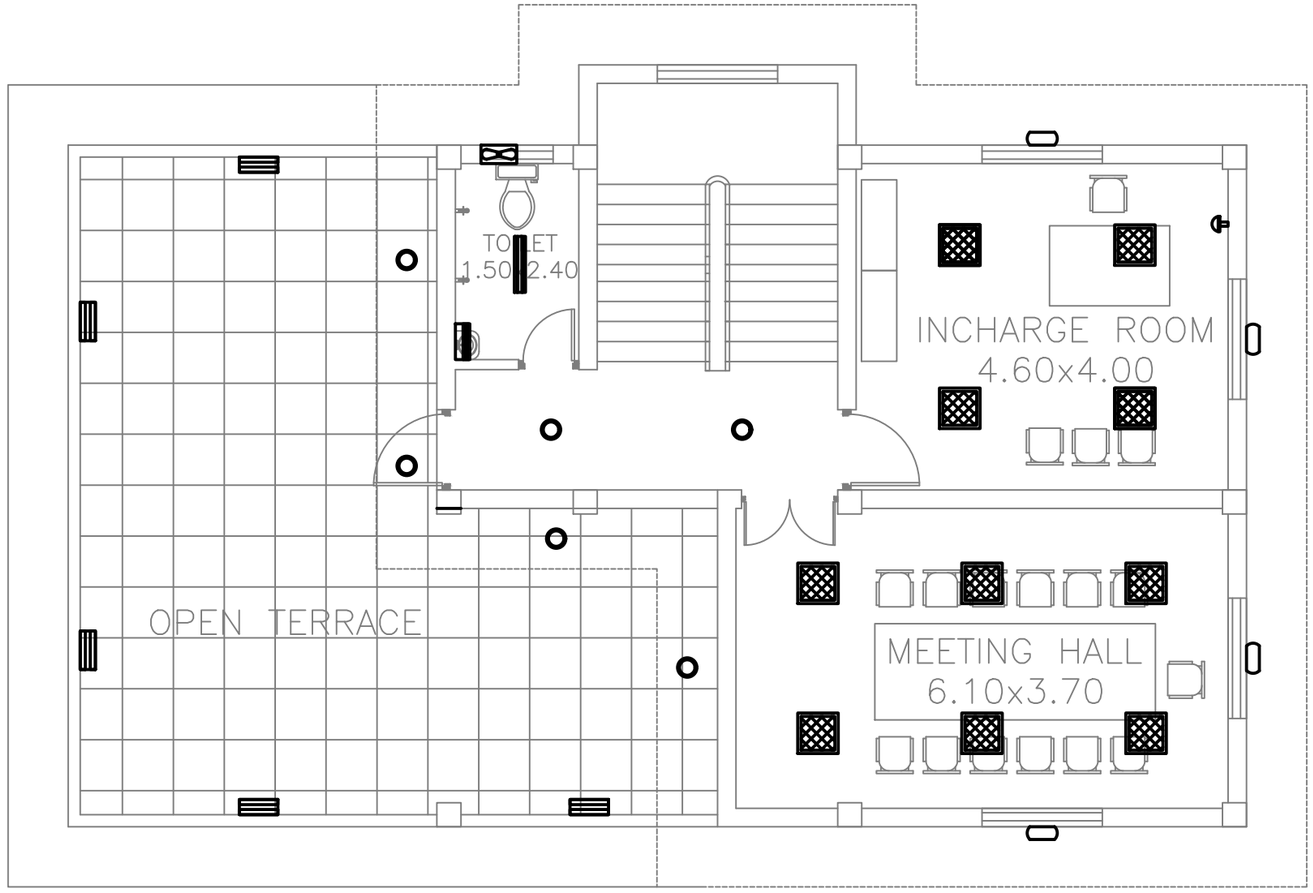
CLIENT: NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT: NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT: DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO.: CSG-BLDG-GH-FIREF	TITLE: 33/11 kV SUBSTATION GUARD HOUSE FIREFIGHTING



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SYMBOL	EQUIPMENT
	36W, CEILING SURFACE MOUNTED LED
	18W, CEILING SURFACE MOUNTED LED, IP56
	12W, CEILING SURFACE MOUNTED LED
	10W, BULKHEAD, IP56
	7W WALL MOUNTED LED, IP65
	40W, EXHAUST FAN
	7W, SURFACE MOUNTED WALL LED
	7W, MIRROR LIGHT
	10W, DECORATIVE WALL LIGHT
	3 X 1.5 SQ. MM COPPER WIRE
	DISTRIBUTION BOX

GROUND FLOOR PLAN

CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. ...RADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-BLDG-OFF-ELE-GF	TITLE 33/11 kV SUBSTATION OFFICE BUILDING LIGHT PLAN



INDEX	
SYMBOL	EQUIPMENT
	36W, CEILING SURFACE MOUNTED LED
	18W, CEILING SURFACE MOUNTED LED, IP56
	12W, CEILING SURFACE MOUNTED LED
	10W, BULKHEAD, IP56
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	40W, EXHAUST FAN
	7W, SURFACE MOUNTED WALL LED
	7W, MIRROR LIGHT
	10W, DECORATIVE WALL LIGHT
	3 X 1.5 SQ. MM COPPER WIRE
	DISTRIBUTION BOX

TOP FLOOR PLAN

CLIENT

NEPAL ELECTRICITY AUTHORITY
DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
DURBARMARGA, KATHMANDU, NEPAL

CONSULTANT

NEA ENGINEERING COMPANY LTD.
TRADE TOWER,THAPATHALI,
KATHMANDU, NEPAL

PROJECT

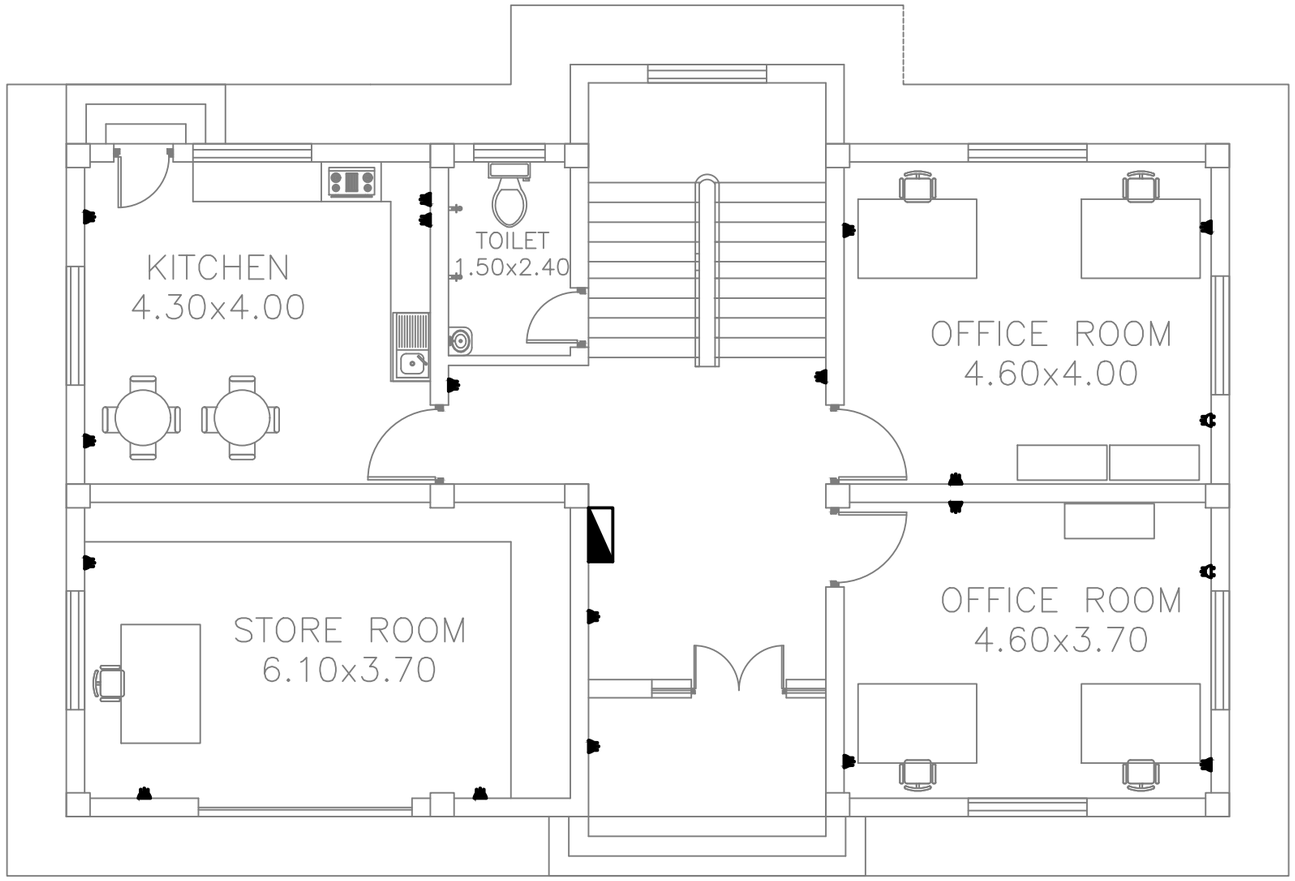
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

FOR TENDER PURPOSE ONLY

DRAWN	DESIGNED
DRAFTING CHECK	DESIGN CHECK
APPROVED	DRAWING NO. CSG-BLDG-OFF-ELE-FF

TITLE

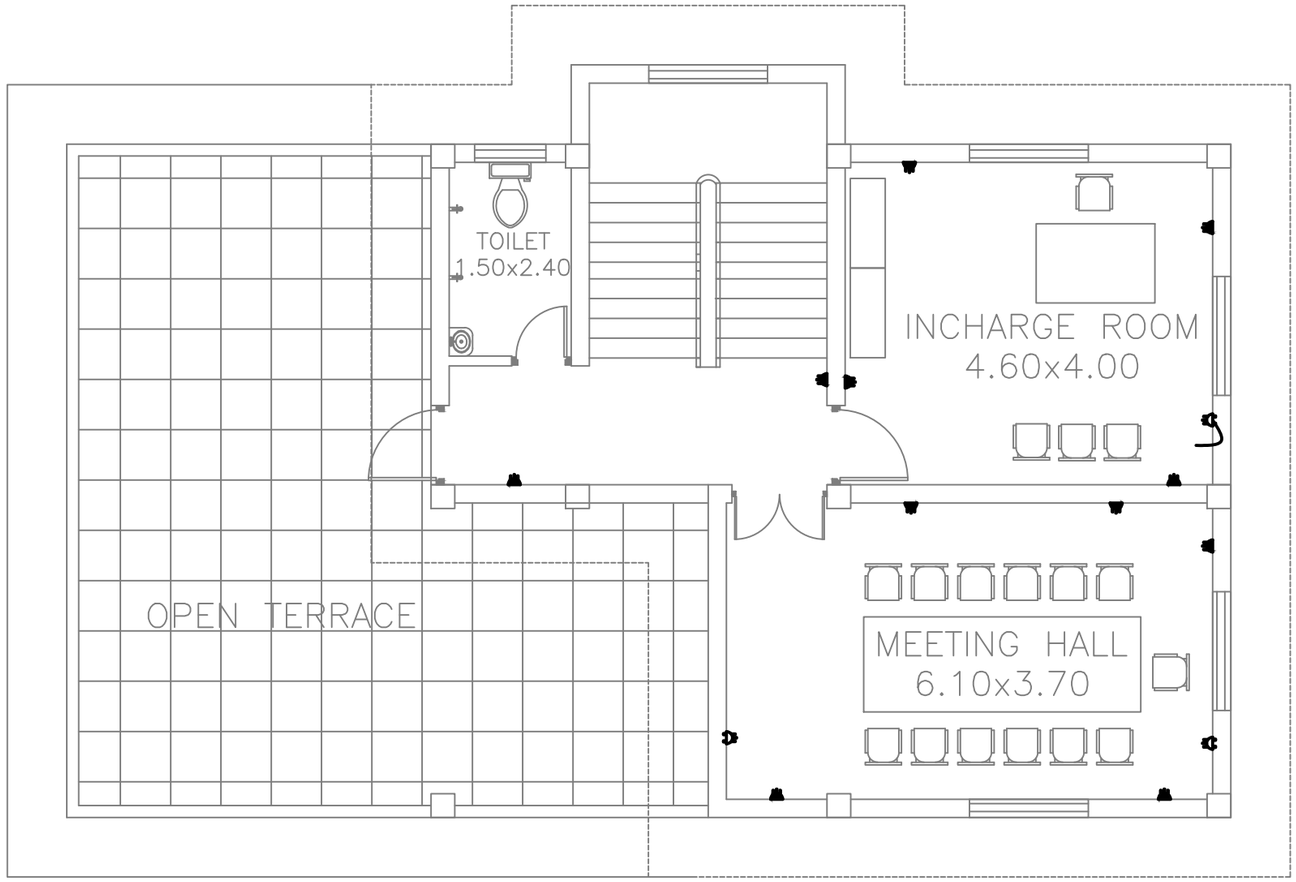
33/11 kV SUBSTATION
OFFICE BUILDING
LIGHT PLAN



INDEX	
SYMBOL	EQUIPMENT
	6/16 AMP POWER SOCKET, TYPE D
	16 AMP POWER SOCKET FOR AIR CONDITIONER
	2X4SQ.MM+1X2.5SQ.MM COPPER CONDUCTOR
	DISTRIBUTION BOX

GROUND FLOOR PLAN

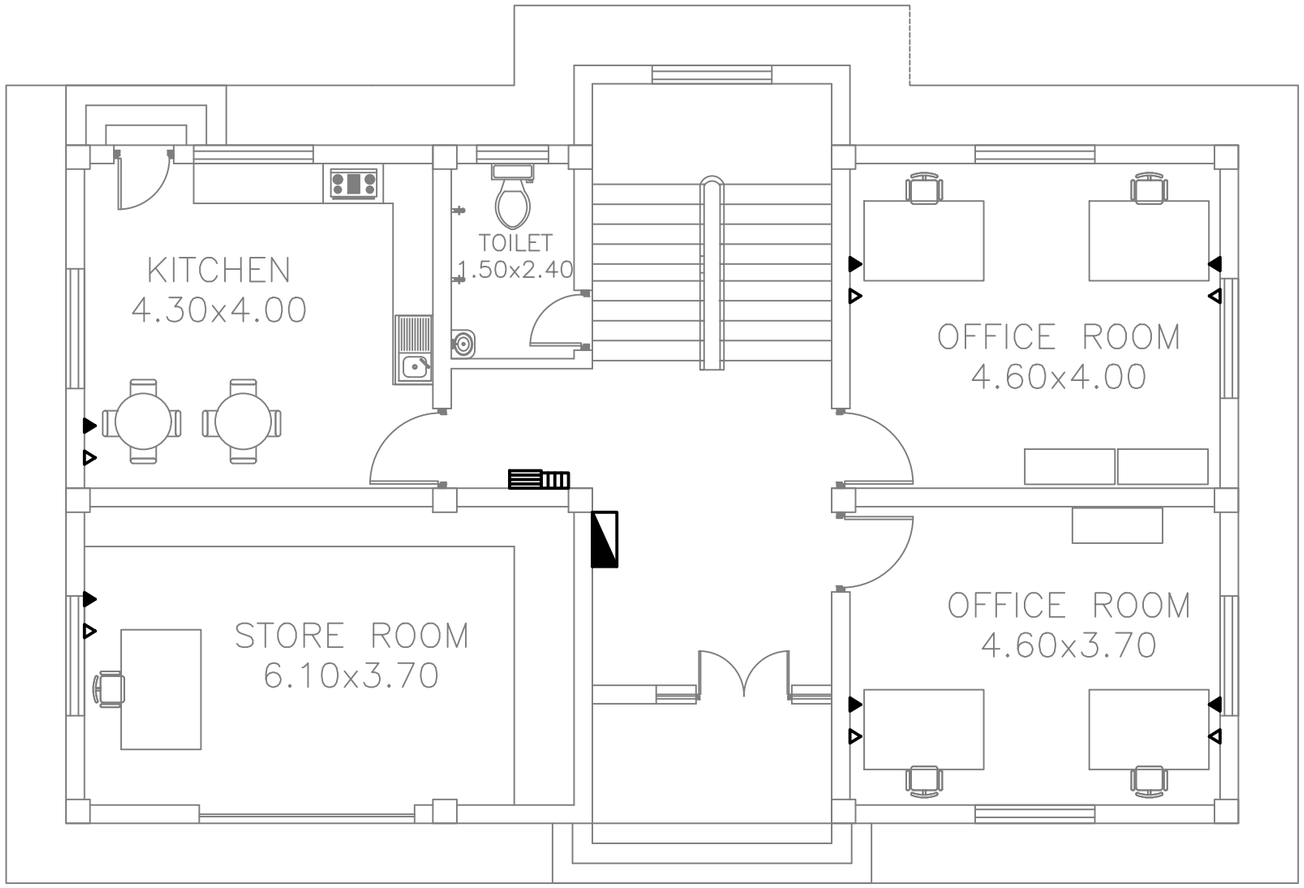
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INDEX	
SYMBOL	EQUIPMENT
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	16 AMP POWER SOCKET FOR AIR CONDITIONER
	2X4SQ.MM+1X2.5SQ.MM COPPER CONDUCTOR
	DISTRIBUTION BOX

TOP FLOOR PLAN

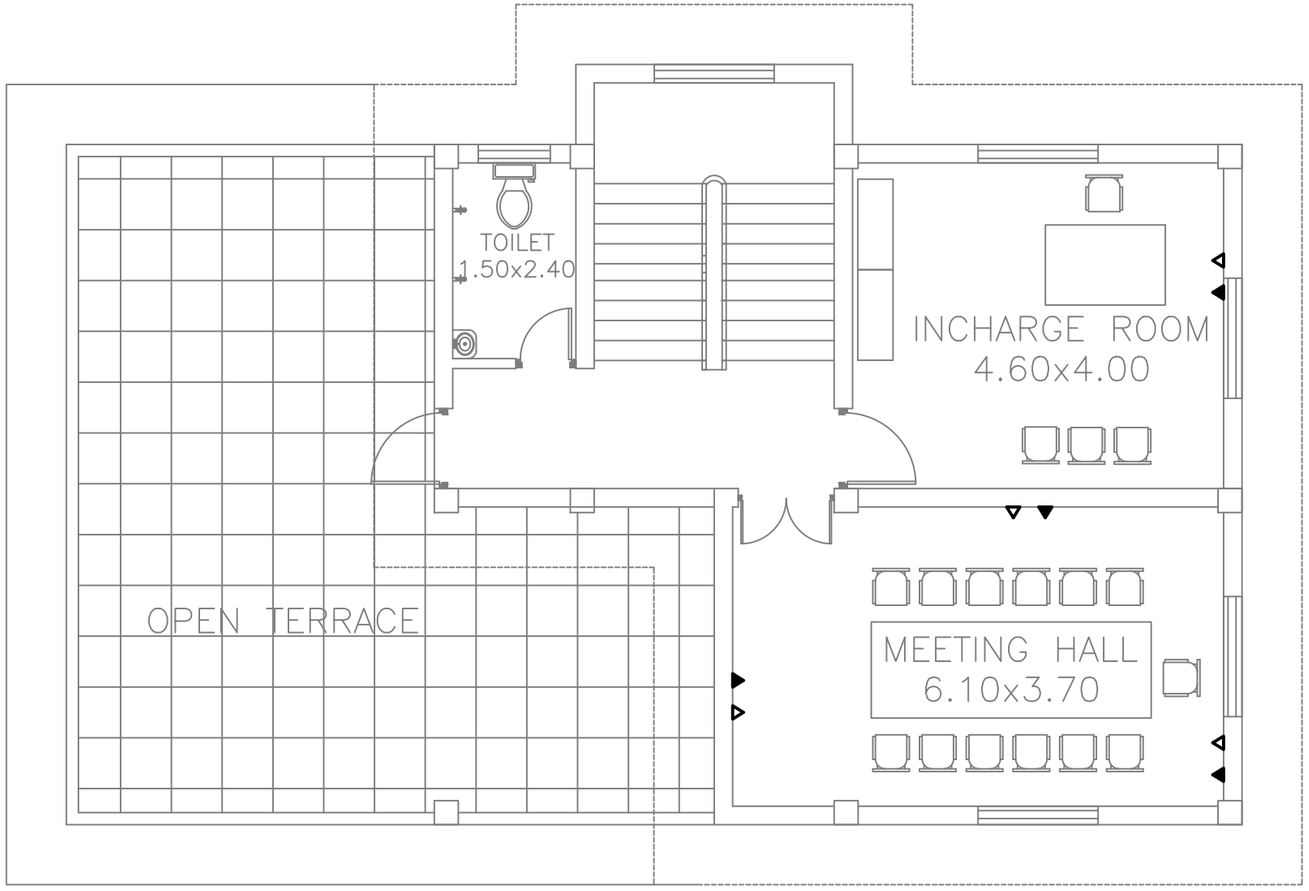
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INDEX	
SYMBOL	EQUIPMENT
~	RJ45 CABLE FOR NETWORKING
△	SINGLE PORT TELEPHONE
▲	SINGLE PORT OUTLET FOR NETWORKING
▤	8 PORT SWITCH WITH ROUTER FOR NETWORKING
▥	8 PORT PBX FOR TELEPHONE SWITCHING
◥	DISTRIBUTION BOX

GROUND FLOOR PLAN

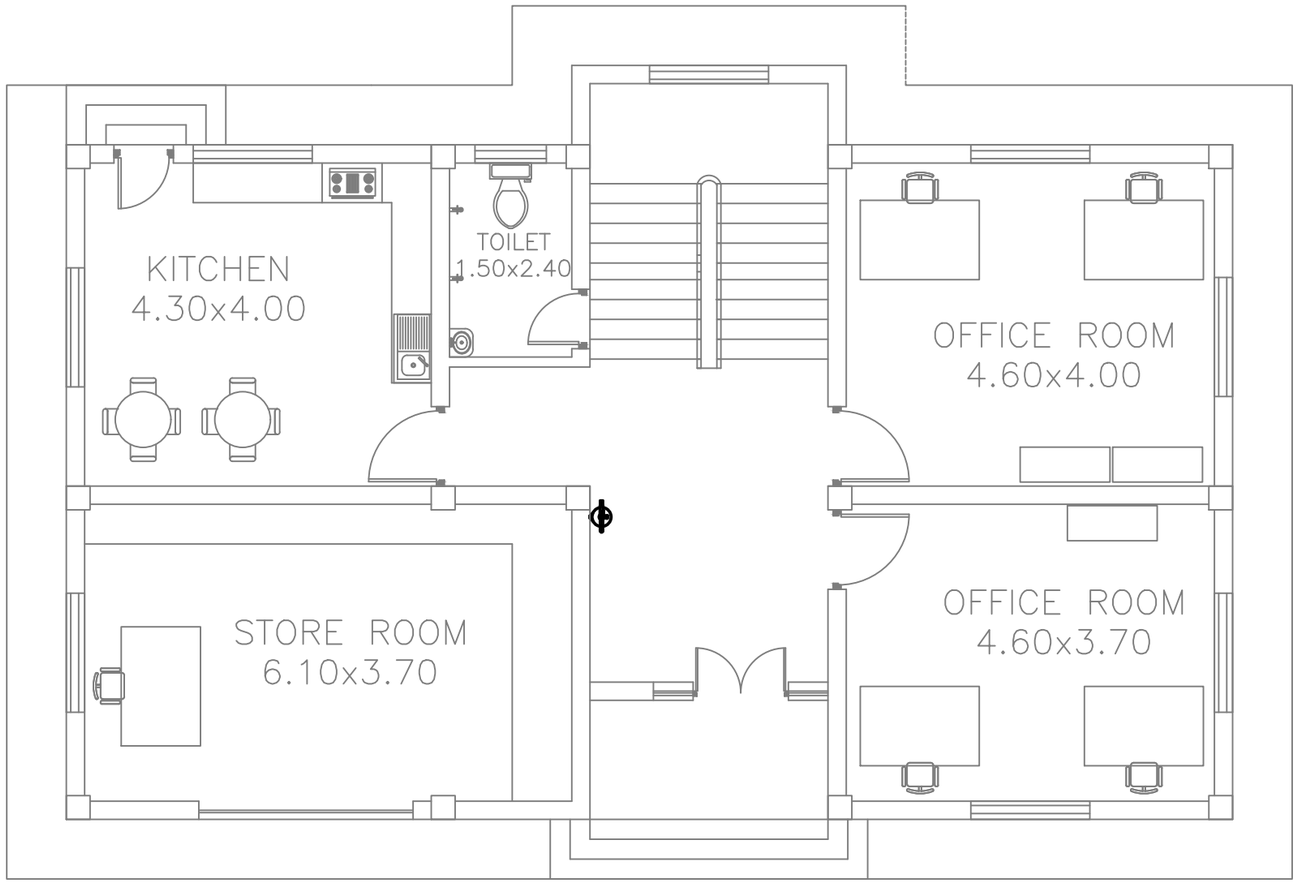
CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. UPGRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-BLDG-OFF-COMM-GF	TITLE 33/11 kV SUBSTATION OFFICE BUILDING COMMMUNICATION PLAN



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△	SINGLE PORT TELEPHONE
▲	SINGLE PORT OUTLET FOR NETWORKING
▤	8 PORT SWITCH WITH ROUTER FOR NETWORKING
▥	8 PORT PBX FOR TELEPHONE SWITCHING
◥	DISTRIBUTION BOX

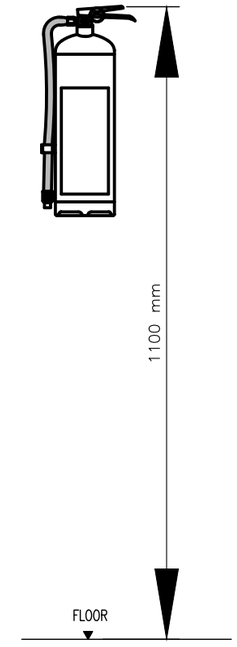
TOP FLOOR PLAN

CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-BLDG-OFF-COMM-FF	TITLE 33/11 kV SUBSTATION OFFICE BUILDING COMMMUNICATION PLAN



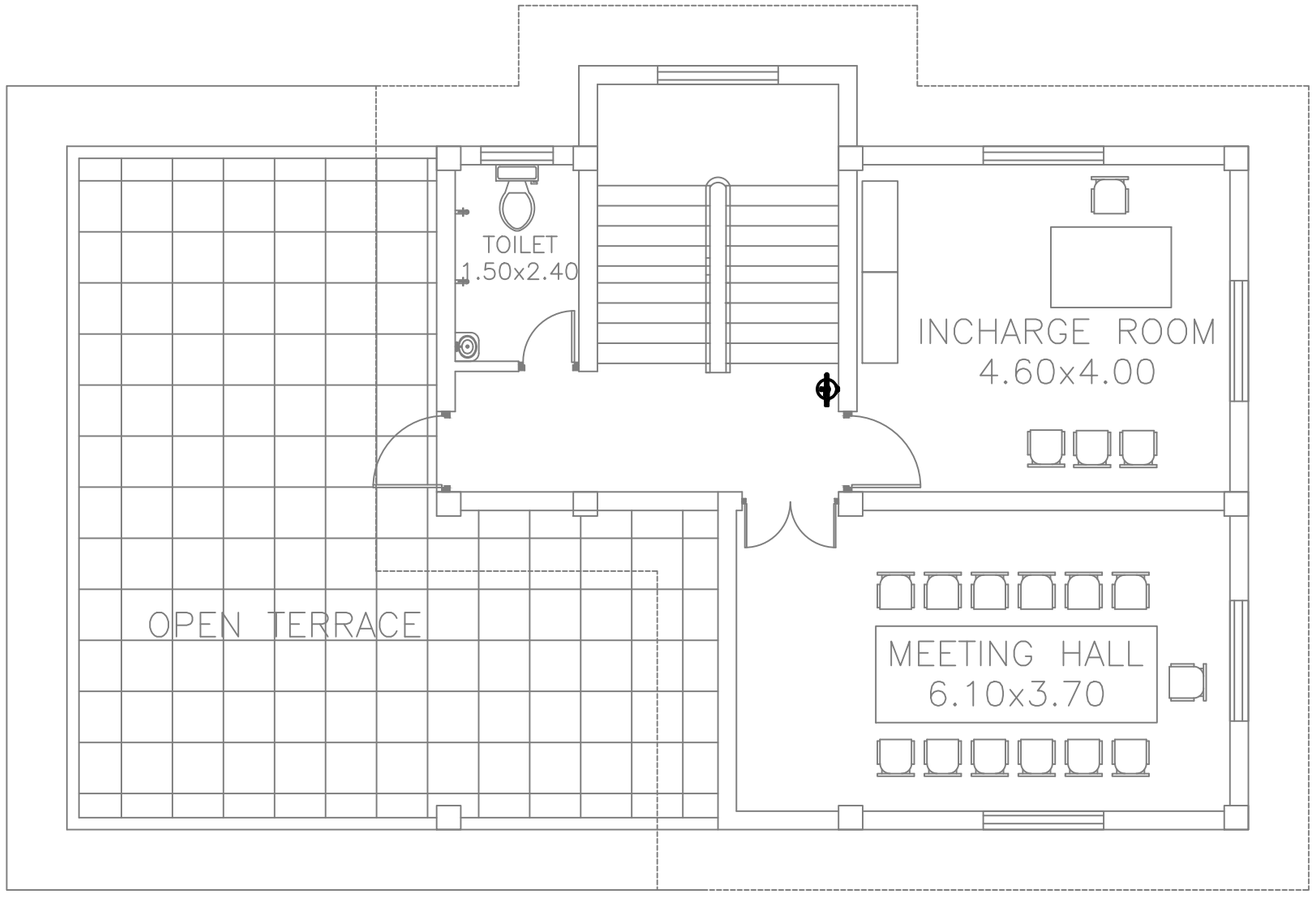
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SYMBOL	EQUIPMENT
◆	WALL MOUNTED CO2 TYPE FIRE EXTINGUISHER

TYPICAL INSTALLATION DETAIL FOR CO2 FIRE EXTINGUISHER



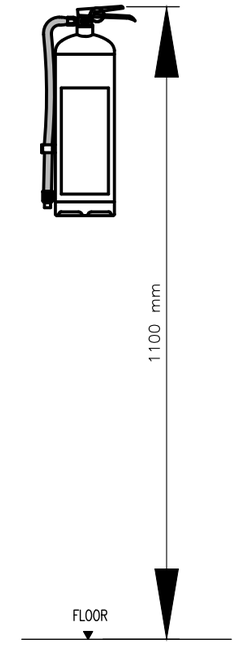
GROUND FLOOR PLAN

CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. ADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-BLDG-OFF-FIREF-FF	TITLE 33/11 kV SUBSTATION OFFICE BUILDING FIREFIGHTING



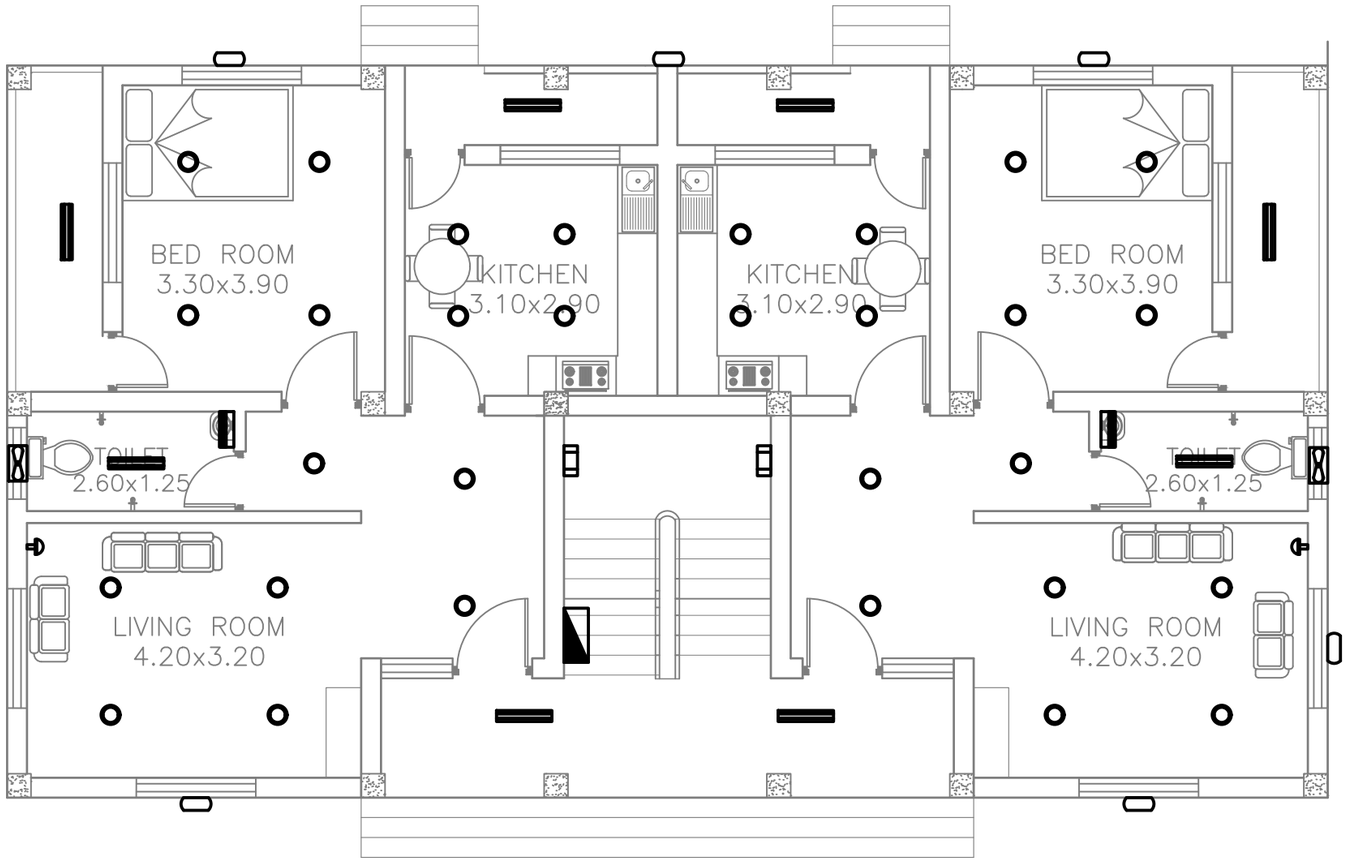
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SYMBOL	EQUIPMENT
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TYPICAL INSTALLATION DETAIL FOR CO2 FIRE EXTINGUISHER



TOP FLOOR PLAN

CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-BLDG-OFF-FIREF-FF	TITLE 33/11 kV SUBSTATION OFFICE BUILDING FIREFIGHTING



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	7W WALL MOUNTED LED, IP65
	40W, EXHAUST FAN
	7W, SURFACE MOUNTED WALL LED
	7W, MIRROR LIGHT
	10W, DECORATIVE WALL LIGHT
	3 X 1.5 SQ. MM COPPER WIRE
	DISTRIBUTION BOX

GROUND FLOOR PLAN

CLIENT

NEPAL ELECTRICITY AUTHORITY
DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
DURBARMARGA, KATHMANDU, NEPAL

CONSULTANT

NEA ENGINEERING COMPANY LTD.
GRADE TOWER,THAPATHALI,
KATHMANDU, NEPAL

PROJECT

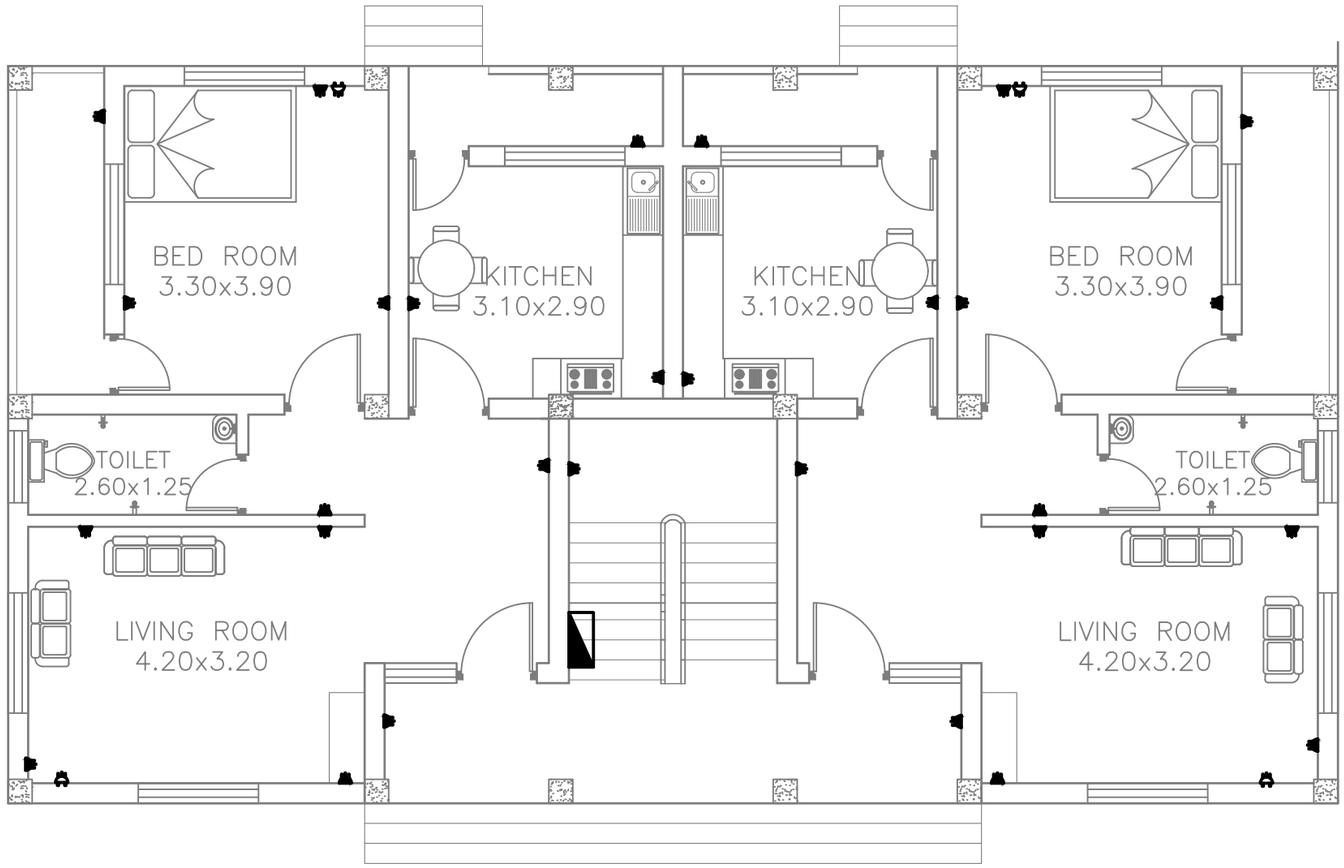
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

FOR TENDER PURPOSE ONLY

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DRAFTING CHECK	DESIGN CHECK
APPROVED	DRAWING NO. CSG-BLDG-SQRT-ELE

TITLE

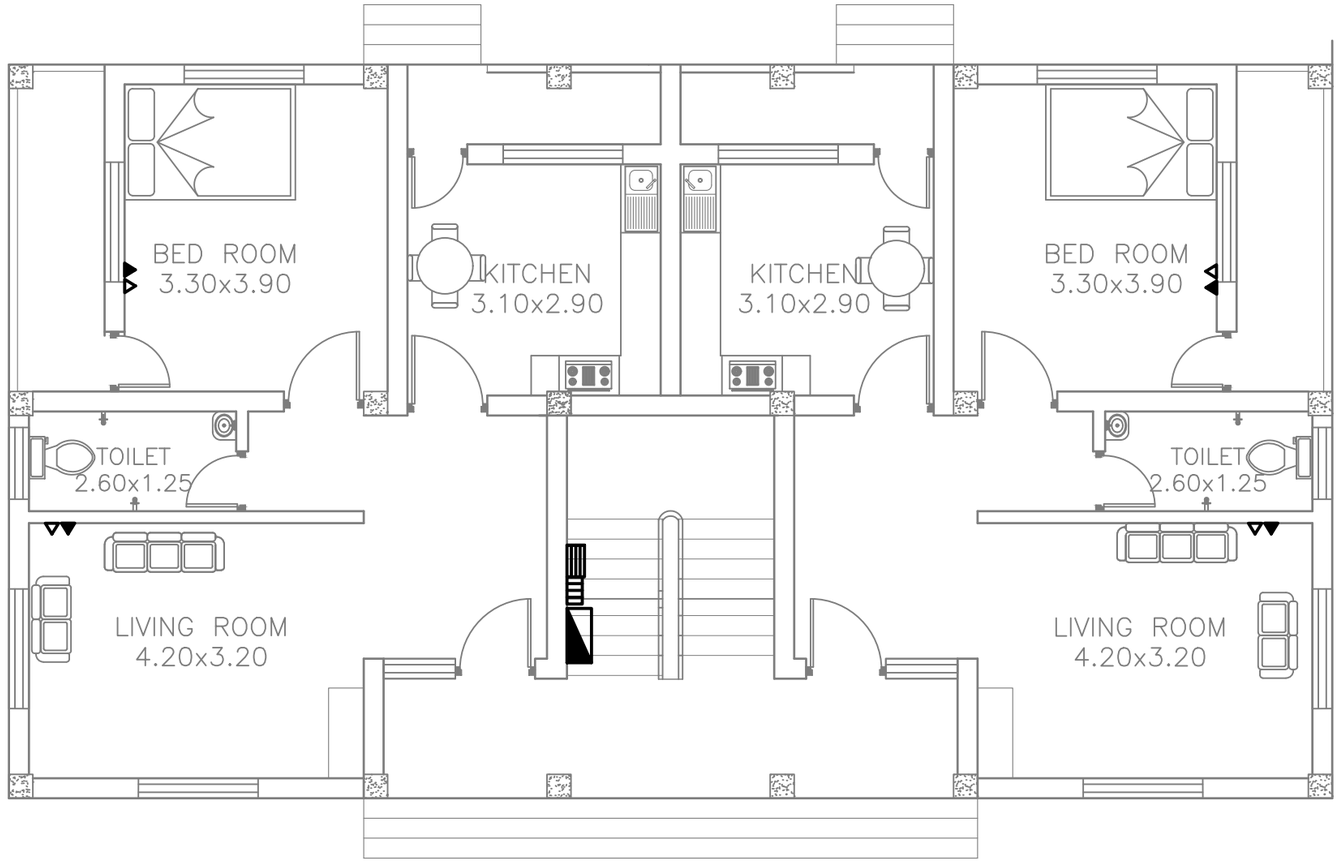
33/11 kV SUBSTATION
STAFF QUARTER
LIGHT PLAN



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SYMBOL	EQUIPMENT
	6/16 AMP POWER SOCKET, TYPE D
	16 AMP POWER SOCKET FOR AIR CONDITIONER
	2X4SQ.MM+1X2.5SQ.MM COPPER CONDUCTOR
	DISTRIBUTION BOX

GROUND FLOOR PLAN

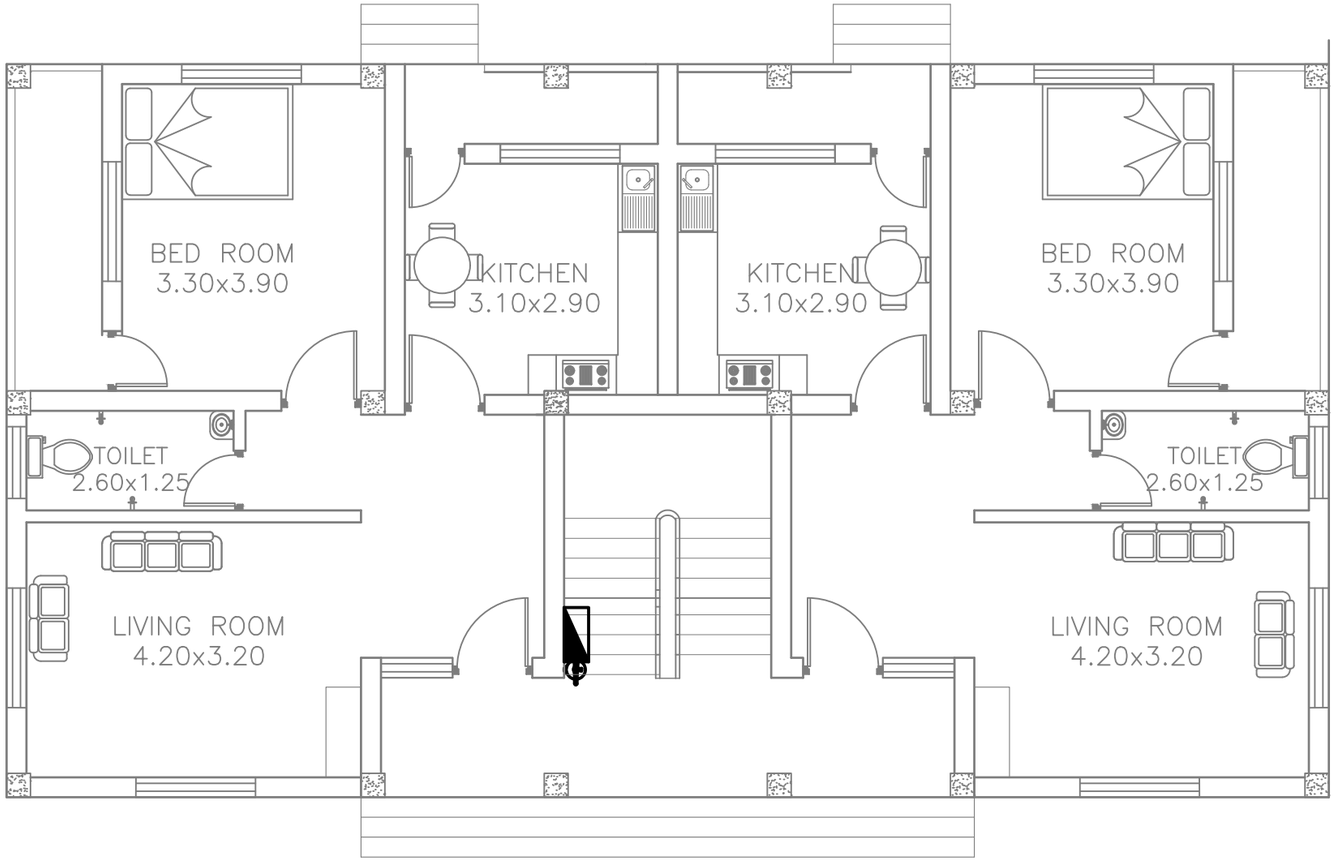
CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-BLDG-SQRT-POW	TITLE 33/11 kV SUBSTATION STAFF QUARTER POWER AND AC CIRCUIT PLAN



INDEX	
SYMBOL	EQUIPMENT
~	RJ45 CABLE FOR NETWORKING
△	SINGLE PORT TELEPHONE
▲	SINGLE PORT OUTLET FOR NETWORKING
▤	8 PORT SWITCH WITH ROUTER FOR NETWORKING
▥	8 PORT PBX FOR TELEPHONE SWITCHING
◥	DISTRIBUTION BOX

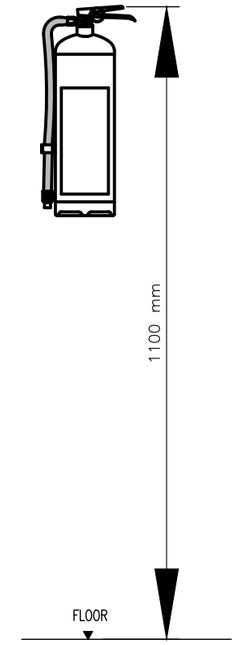
GROUND FLOOR PLAN

CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. GRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-BLDG-SQRT-COMM	TITLE 33/11 kV SUBSTATION STAFF QUARTER COMMMUNICATION PLAN



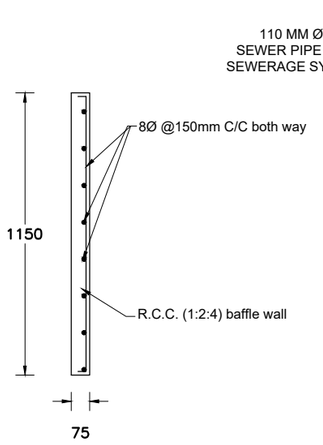
INDEX	
SYMBOL	EQUIPMENT
◆	WALL MOUNTED CO2 TYPE FIRE EXTINGUISHER

TYPICAL INSTALLATION DETAIL FOR CO2 FIRE EXTINGUISHER



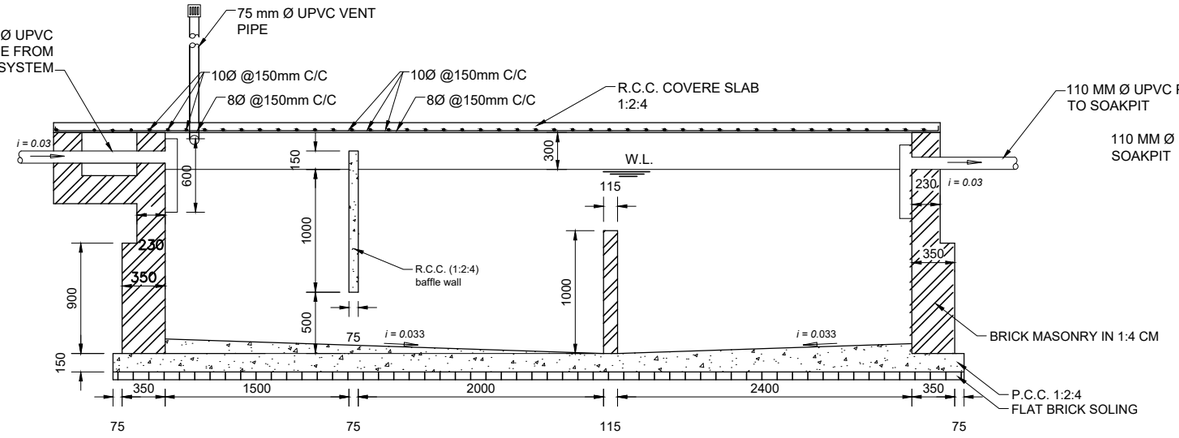
GROUND FLOOR PLAN

CLIENT: NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT: NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT: DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. CSG-BLDG-SQRT-FIREF	TITLE: 33/11 kV SUBSTATION STAFF QUARTER FIREFIGHTING

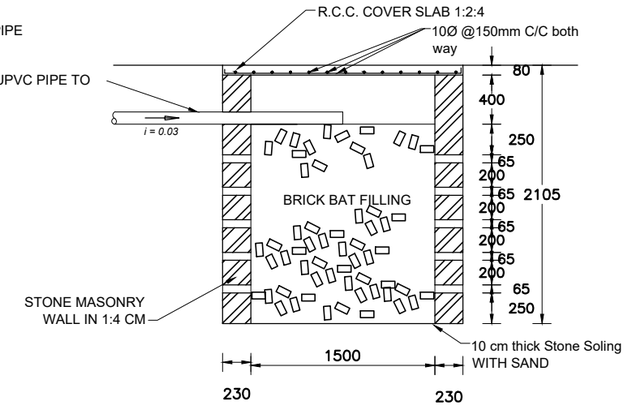


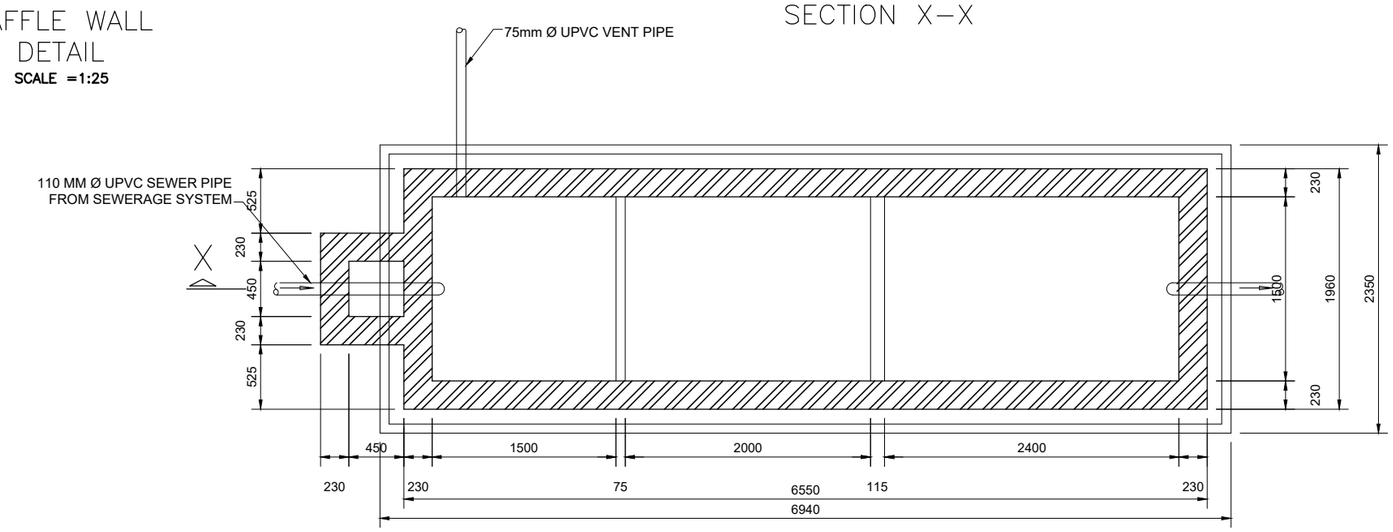
BAFFLE WALL DETAIL

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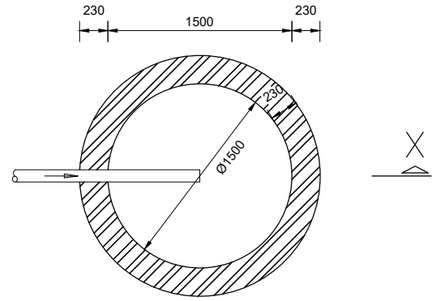


SECTION X–X

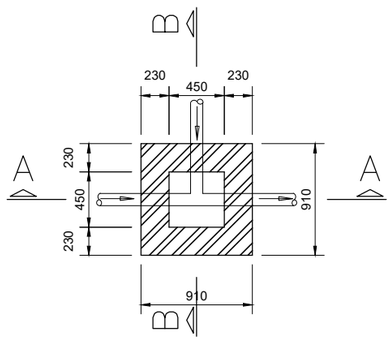




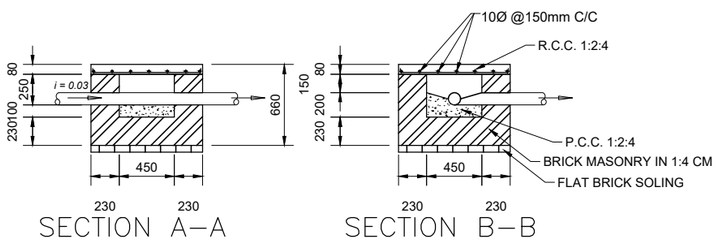
SEPTIC TANK PLAN



SOAK PIT PLAN

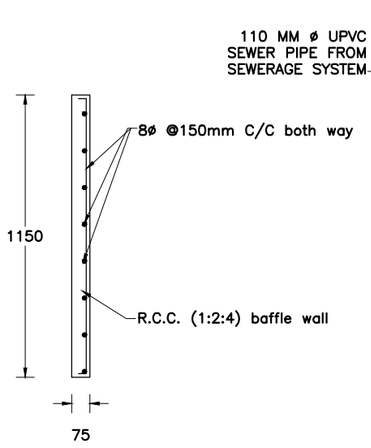


MANHOLE –A



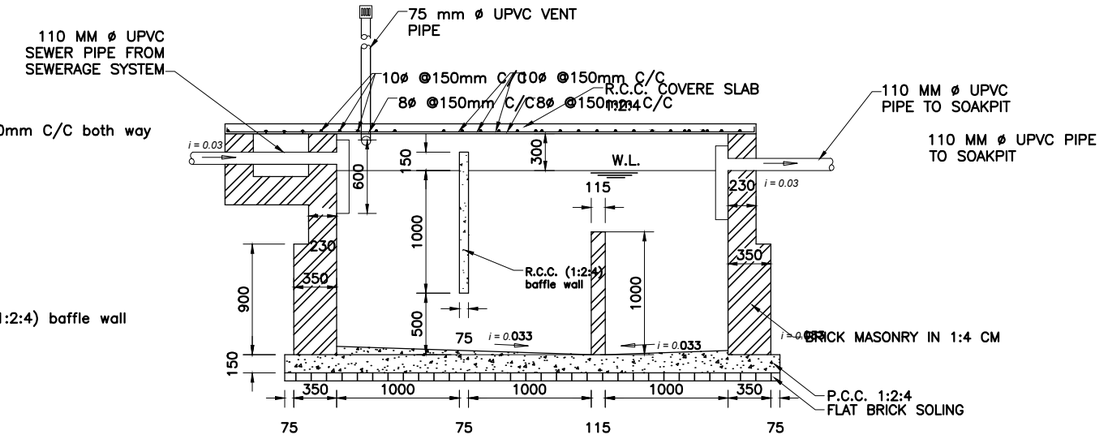
SECTION A–A SECTION B–B

CLIENT: NEPAL ELECTRICITY AUTHORITY, DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE, DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT, DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT: NEA ENGINEERING COMPANY LTD., TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT: DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT	DRAWN / DRAFTING CHECK / APPROVED	DESIGNED / DESIGN CHECK / DRAWING NO. CSG-SEP-01	TITLE: TYPICAL DRAWINGS OF SEPTIC TANK FOR STAFF QUARTER & OFFICE BUILDING

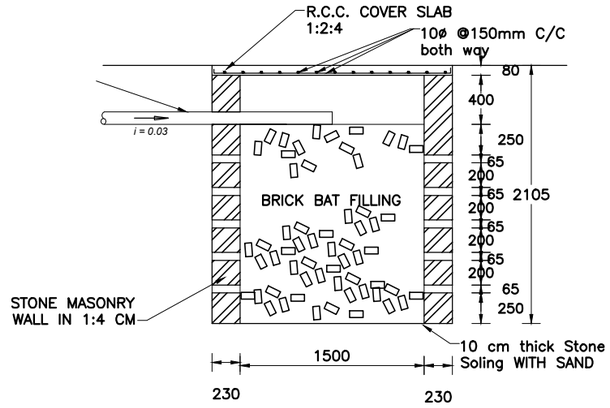


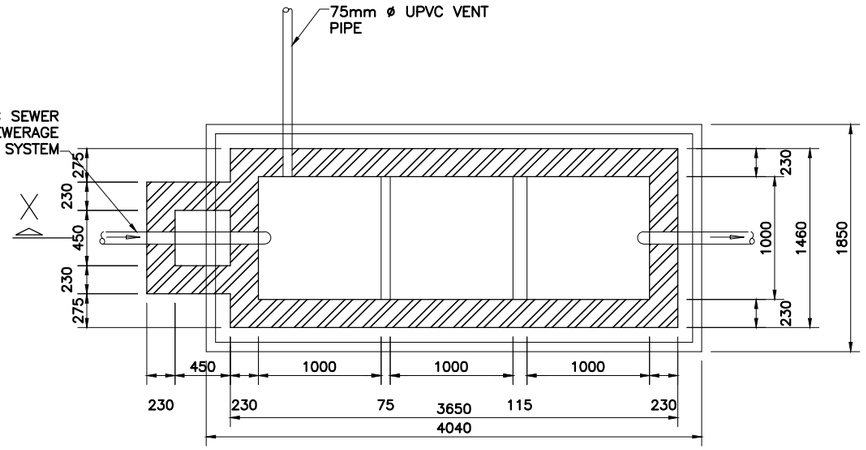
BAFFLE WALL DETAIL

SCALE =1:25

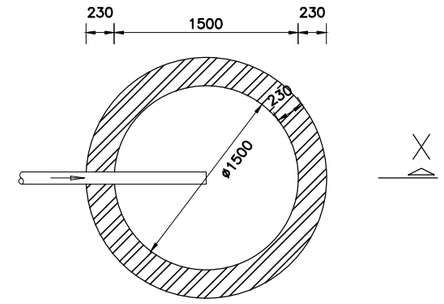


SECTION X–X

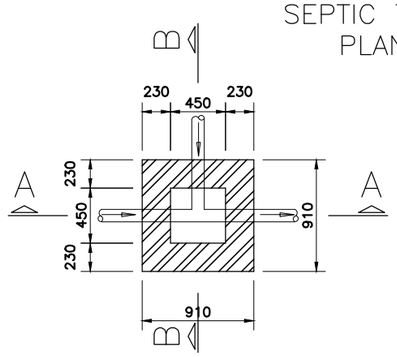




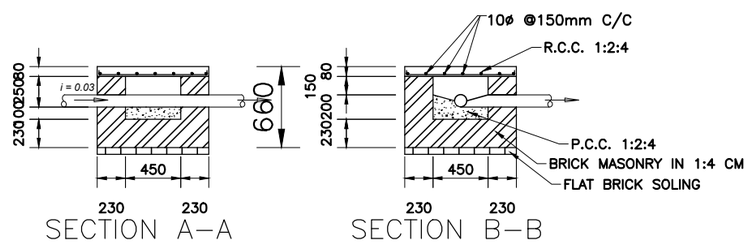
SEPTIC TANK PLAN



SOAK PIT PLAN



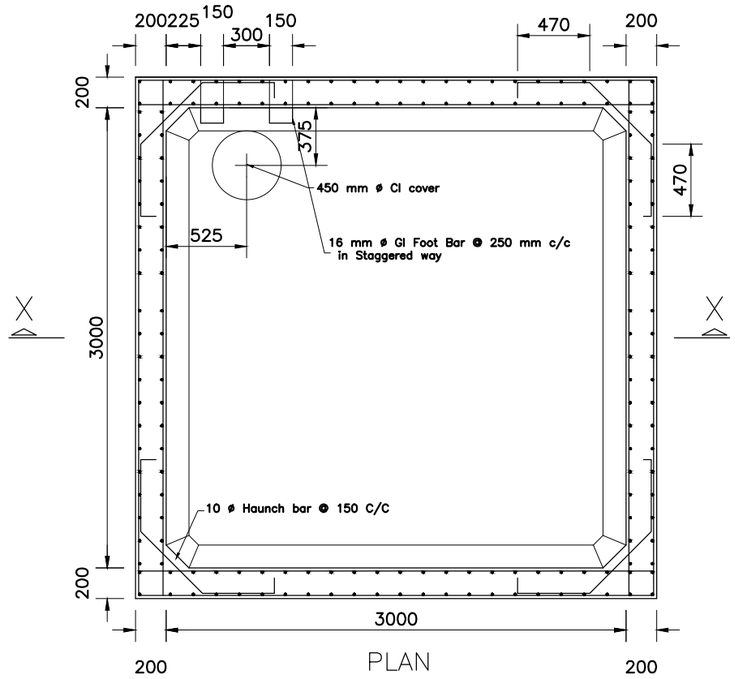
MANHOLE –A



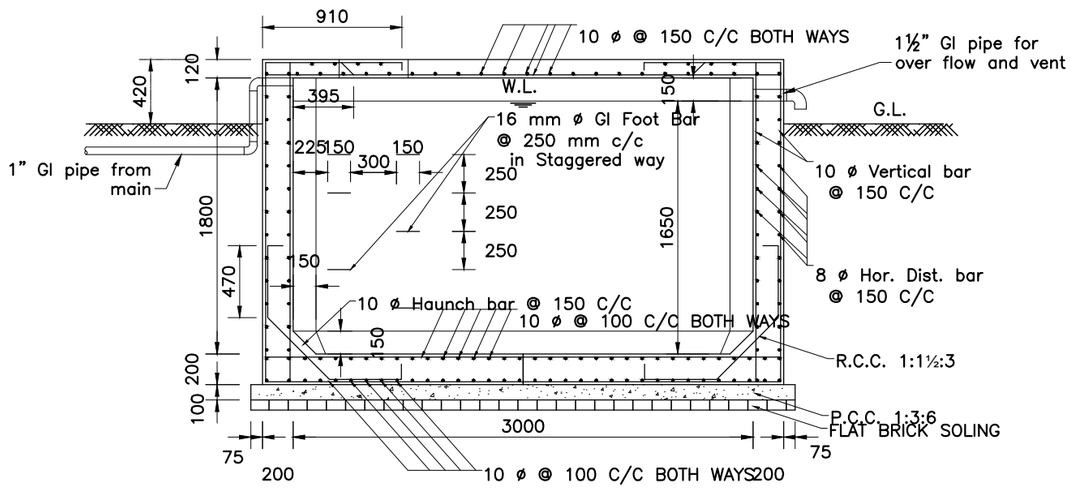
SECTION A–A SECTION B–B

CLIENT: NEPAL ELECTRICITY AUTHORITY, DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE, DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT, DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT: NEA ENGINEERING COMPANY LTD., TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT: DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT	DRAWN / DRAFTING CHECK / APPROVED	DESIGNED / DESIGN CHECK / DRAWING NO. CSG-SEP-02	TITLE: TYPICAL DRAWINGS OF SEPTIC TANK FOR CONTROL BUILDING & GUARD HOUSE

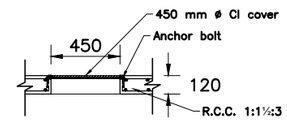
NOTES :
THE DRAWING IS INDICATIVE FOR TENDER PURPOSE ONLY. DETAIL DESIGN SHALL BE CARRIED OUT AS PER INDIAN STANDARD.



PLAN



SECTION X–X



C.I. COVER
DETAIL

UNDER GROUND WATER TANK
(14000lit)

CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT	DRAWN	DESIGNED	TITLE TYPICAL DRAWINGS OF UNDERGROUND WATER TANK
			DRAFTING CHECK	DESIGN CHECK	
			APPROVED	DRAWING NO. CSG-SEP-03	

Volume II

Section 6: Employer's Requirements

Table of Contents

A	Scope of Supply of Plant and Services
B1	Technical Specifications
B2	Technical Data Schedule
C	Drawings
D	Supplementary Information

Name of Tenderer _____

Signature of Tenderer_____

Volume II

Section 6: Employer's Requirements

Table of Contents

A	Scope of Supply of Plant and Services	
B1	Technical Specifications	
B2	Technical Data Schedule	
C	Drawings	
	C.1	Construction Standard Guidelines - 33 kV Lines
	C.2	Construction Standard Guidelines - Substation
	C.3	33 kV Line Route
	C.4	Substation Layout
D	Supplementary Information	

Name of Tenderer _____

Signature of Tenderer_____

Table of Contents

33 kV Line Route

SN	Drawing Number	Drawing Title
1	LINE-BUD-01	Babiyachaur Budhebhapar Route Sheet
2	LINE-BUD-02	Babiyachaur Budhebhapar Route Sheet
3	LINE-BUD-03	Babiyachaur Budhebhapar Route Sheet
4	LINE-BUD-04	Babiyachaur Budhebhapar Route Sheet
5	LINE-BUD-05	Babiyachaur Budhebhapar Route Sheet
6	LINE-BUD-06	Babiyachaur Budhebhapar Route Sheet
7	LINE-BUD-07	Babiyachaur Budhebhapar Route Sheet
8	LINE-BUD-08	Babiyachaur Budhebhapar Route Sheet
9	LINE-BUD-09	Babiyachaur Budhebhapar Route Sheet
10	LINE-BUD-10	Babiyachaur Budhebhapar Route Sheet
11	LINE-BUD-11	Babiyachaur Budhebhapar Route Sheet
12	LINE-BUD-12	Babiyachaur Budhebhapar Route Sheet
13	LINE-BUD-13	Babiyachaur Budhebhapar Route Sheet
14	LINE-BUD-14	Babiyachaur Budhebhapar Route Sheet
15	LINE-PIP-01	Malarani Pipledanda Route Sheet
16	LINE-PIP-02	Malarani Pipledanda Route Sheet
17	LINE-PIP-03	Malarani Pipledanda Route Sheet
18	LINE-PIP-04	Malarani Pipledanda Route Sheet
19	LINE-PIP-05	Malarani Pipledanda Route Sheet
20	LINE-PIP-06	Malarani Pipledanda Route Sheet
21	LINE-PIP-07	Malarani Pipledanda Route Sheet
22	LINE-ODA-01	Baddichaur Odaltal Route Sheet
23	LINE-MAC-01	Kohalpur Machhagadh Route Sheet
24	LINE-MAC-02	Kohalpur Machhagadh Route Sheet
25	LINE-MAC-03	Kohalpur Machhagadh Route Sheet
26	LINE-MAC-04	Kohalpur Machhagadh Route Sheet
27	LINE-MAC-05	Kohalpur Machhagadh Route Sheet
28	LINE-MAC-06	Kohalpur Machhagadh Route Sheet
29	LINE-MAC-07	Kohalpur Machhagadh Route Sheet
30	LINE-MAC-08	Kohalpur Machhagadh Route Sheet
31	LINE-MAC-09	Kohalpur Machhagadh Route Sheet
32	LINE-MAC-10	Kohalpur Machhagadh Route Sheet
33	LINE-MAC-11	Kohalpur Machhagadh Route Sheet
34	LINE-MAC-12	Kohalpur Machhagadh Route Sheet
35	LINE-MAC-13	Kohalpur Machhagadh Route Sheet
36	LINE-MAC-14	Kohalpur Machhagadh Route Sheet
37	LINE-MAC-15	Kohalpur Machhagadh Route Sheet
38	LINE-MAC-16	Kohalpur Machhagadh Route Sheet

Name of Tenderer _____

Signature of Tenderer_____

Table of Contents

33 kV Line Route

SN	Drawing Number	Drawing Title
39	LINE-MAC-17	Kohalpur Machhagadh Route Sheet

Name of Tenderer _____

Signature of Tenderer_____

Table of Contents

Substation Layout

SN	Drawing Number	Drawing Title
1	SS-LAY-BUD	Budhebhapar 33/11 kV Substation Layout
2	SS-ELE-BUD	Budhebhapar 33/11 kV Substation Layout - Outdoor Lighting
3	SS-LAY-BAD	Baddichaur 33/11 kV Substation Layout
4	SS-ELE-BAD	Baddichaur 33/11 kV Substation Layout - Outdoor Lighting
5	SS-LAY-PIP	Piple 33/11 kV Substation Layout
6	SS-ELE-PIP	Piple 33/11 kV Substation Layout - Outdoor Lighting
7	SS-LAY-MAC	Machhagadh 33/11 kV Substation Layout
8	SS-ELE-MAC	Machhagadh 33/11 kV Substation Layout - Outdoor Lighting

Name of Tenderer _____

Signature of Tenderer_____

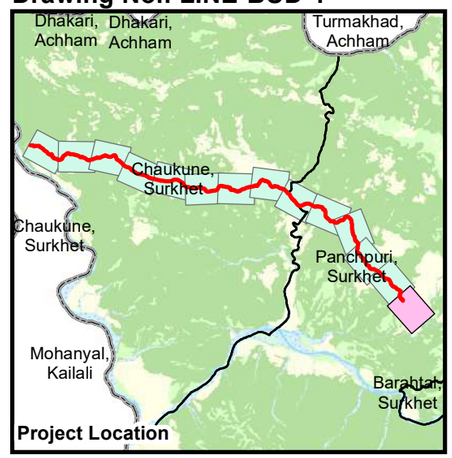
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

Panchpuri-8, Surkhet

Panchpuri-5, Surkhet

Panchpuri-4, Surkhet

Drawing No.: LINE-BUD-1



Salient Features

Project Name: Babiyachaur Budhebhapar
Starting Point: Bay Ext at Babiyachaur S/S
Ending Point: Budhebhapar S/S
Line Details: 33 kV, Single Circuit, 22 km
Substation Details: 33/11 kV, 1 MVA
Funding Agency: AIIB

Legend

Administrative
- International
- Province
- District
- Municipality
- Ward

33 kV Line Features
- Angle Points
- Terminal Points
- Overhead Line
- Underground Cable
- Substation

Landuse
- Forest
- Built Up
- Cultivation
- Vegetation
- Barren Land
- Glacier
- Swamp Area
- Water Body
- Pond/Lake
- Others

Physical Features
- Airport
- Village Name
- River

Roads
- Trunk
- Primary Road
- Secondary Road
- Tertiary Road
- Track
- Unclassified Road

Coordinate System: WGS 1984 UTM Zone 44N
Projection: Transverse Mercator
Datum: WGS 1984
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: 81.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

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Scale: 1:5,000

FOR TENDER PURPOSE ONLY

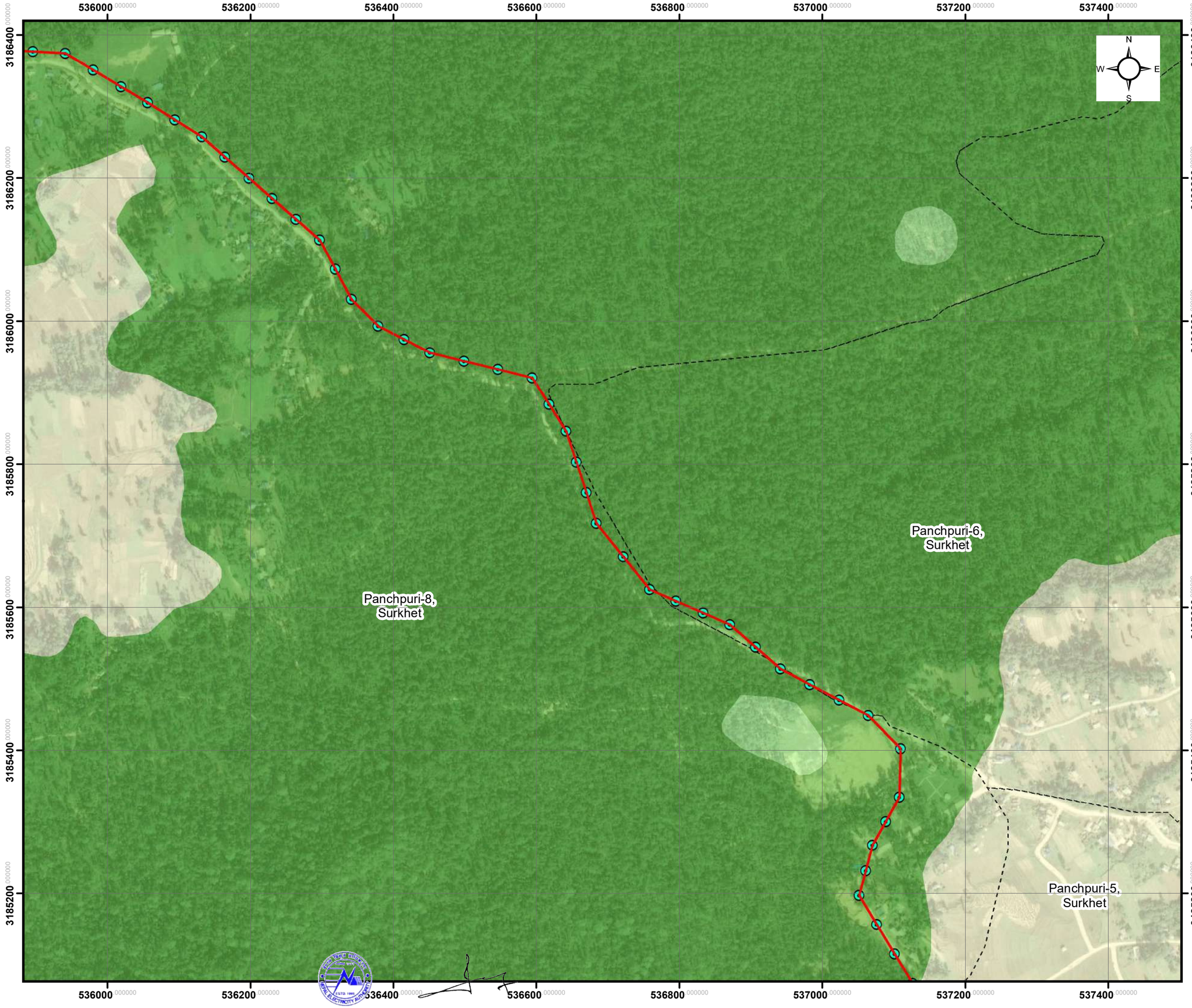
Consultant:

एनइए इन्जिनियरिङ्ग कम्पनी लि.
NEA ENGINEERING COMPANY LTD.

Client:

नेपाल विद्युत प्राधिकरण
Nepal Electricity Authority

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT



Drawing No.: LINE-BUD-2



Salient Features

Project Name: Babiyachaur Budhebhapar
Starting Point: Bay Ext at Babiyachaur S/S
Ending Point: Budhebhapar S/S
Line Details: 33 kV, Single Circuit, 22 km
Substation Details: 33/11 kV, 1 MVA
Funding Agency: AIIB

Legend

Administrative
- International
- Province
- District
- Municipality
- Ward

33 kV Line Features
- Angle Points
- Terminal Points
- Overhead Line
- Underground Cable
- Substation

Landuse
- Forest
- Built Up
- Cultivation
- Vegetation
- Barren Land
- Glacier
- Swamp Area
- Water Body
- Pond/Lake
- Others

Physical Features
- Airport
- Village Name
- River

Roads
- Trunk
- Primary Road
- Secondary Road
- Tertiary Road
- Track
- Unclassified Road

Coordinate System: WGS 1984 UTM Zone 44N
Projection: Transverse Mercator
Datum: WGS 1984
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: 81.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

0 60 120 180 240 300 Meters

Scale: 1:5,000

FOR TENDER PURPOSE ONLY

Consultant:

एनइए इन्जिनियरिङ्ग कम्पनी लि.
NEA ENGINEERING COMPANY LTD.

Client:

नेपाल विद्युत प्राधिकरण
Nepal Electricity Authority

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

Drawing No.: LINE-BUD-3



Salient Features

Project Name: Babiyachaur Budhebhapar
Starting Point: Bay Ext at Babiyachaur S/S
Ending Point: Budhebhapar S/S
Line Details: 33 kV, Single Circuit, 22 km
Substation Details: 33/11 kV, 1 MVA
Funding Agency: AIIB

Legend

Administrative
- International
- Province
- District
- Municipality
- Ward

33 kV Line Features
- Angle Points
- Terminal Points
- Overhead Line
- Underground Cable
- Substation

Landuse
- Forest
- Built Up
- Cultivation
- Vegetation
- Barren Land
- Glacier
- Swamp Area
- Water Body
- Pond/Lake
- Others

Physical Features
- Airport
- Village Name
- River

Roads
- Trunk
- Primary Road
- Secondary Road
- Tertiary Road
- Track
- Unclassified Road

Coordinate System: WGS 1984 UTM Zone 44N
Projection: Transverse Mercator
Datum: WGS 1984
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: 81.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

0 60 120 180 240 300 Meters

Scale: 1:5,000

FOR TENDER PURPOSE ONLY

Consultant:

एनइए इन्जिनियरिङ्ग कम्पनी लि.
NEA ENGINEERING COMPANY LTD.

Client:

नेपाल विद्युत प्राधिकरण
Nepal Electricity Authority

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

Drawing No.: LINE-BUD-4



Salient Features

Project Name: Babiyachaur Budhebhapar
Starting Point: Bay Ext at Babiyachaur S/S
Ending Point: Budhebhapar S/S
Line Details: 33 kV, Single Circuit, 22 km
Substation Details: 33/11 kV, 1 MVA
Funding Agency: AIIB

Legend

Administrative
- International
- Province
- District
- Municipality
- Ward

33 kV Line Features
- Angle Points
- Terminal Points
- Overhead Line
- Underground Cable
- Substation

Landuse
- Forest
- Built Up
- Cultivation
- Vegetation
- Barren Land
- Glacier
- Swamp Area
- Water Body
- Pond/Lake
- Others

Physical Features
- Airport
- Village Name
- River

Roads
- Trunk
- Primary Road
- Secondary Road
- Tertiary Road
- Track
- Unclassified Road

Coordinate System: WGS 1984 UTM Zone 44N
Projection: Transverse Mercator
Datum: WGS 1984
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: 81.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

0 60 120 180 240 300 Meters

Scale: 1:5,500

FOR TENDER PURPOSE ONLY

Consultant:

एनइए इन्जिनियरिङ्ग कम्पनी लि.
NEA ENGINEERING COMPANY LTD.

Client:

नेपाल विद्युत प्राधिकरण
Nepal Electricity Authority

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

Drawing No.: LINE-BUD-5



Salient Features

Project Name: Babiyachaur Budhebhapar
Starting Point: Bay Ext at Babiyachaur S/S
Ending Point: Budhebhapar S/S
Line Details: 33 kV, Single Circuit, 22 km
Substation Details: 33/11 kV, 1 MVA
Funding Agency: AIIB

Legend

Administrative
- International
- Province
- District
- Municipality
- Ward

33 kV Line Features
- Angle Points
- Terminal Points
- Overhead Line
- Underground Cable
- Substation

Landuse
- Forest
- Built Up
- Cultivation
- Vegetation
- Barren Land
- Glacier
- Swamp Area
- Water Body
- Pond/Lake
- Others

Physical Features
- Airport
- Village Name
- River

Roads
- Trunk
- Primary Road
- Secondary Road
- Tertiary Road
- Track
- Unclassified Road

Coordinate System: WGS 1984 UTM Zone 44N
Projection: Transverse Mercator
Datum: WGS 1984
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: 81.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

0 60 120 180 240 300 Meters

Scale: 1:5,000

FOR TENDER PURPOSE ONLY

Consultant:

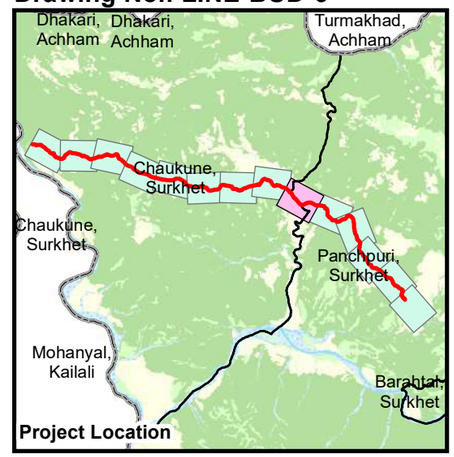
एनइए इन्जिनियरिङ्ग कम्पनी लि.
NEA ENGINEERING COMPANY LTD.

Client:

नेपाल विद्युत प्राधिकरण
Nepal Electricity Authority

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

Drawing No.: LINE-BUD-6



Salient Features

Project Name: Babiyachaur Budhebhapar
Starting Point: Bay Ext at Babiyachaur S/S
Ending Point: Budhebhapar S/S
Line Details: 33 kV, Single Circuit, 22 km
Substation Details: 33/11 kV, 1 MVA
Funding Agency: AIIB

Legend

Administrative
- International
- Province
- District
- Municipality
- Ward

33 kV Line Features
- Angle Points
- Terminal Points
- Overhead Line
- Underground Cable
- Substation

Landuse
- Forest
- Built Up
- Cultivation
- Vegetation
- Barren Land
- Glacier
- Swamp Area
- Water Body
- Pond/Lake
- Others

Physical Features
- Airport
- Village Name
- River

Roads
- Trunk
- Primary Road
- Secondary Road
- Tertiary Road
- Track
- Unclassified Road

Coordinate System: WGS 1984 UTM Zone 44N
Projection: Transverse Mercator
Datum: WGS 1984
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: 81.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

0 60 120 180 240 300 Meters

Scale: 1:5,000

FOR TENDER PURPOSE ONLY

Consultant:

एनइए इन्जिनियरिङ्ग कम्पनी लि.
NEA ENGINEERING COMPANY LTD.

Client:

नेपाल विद्युत प्राधिकरण
Nepal Electricity Authority

Panchpuri-9, Surkhet

Chaukune-8, Surkhet

531800 532000 532200 532400 532600 532800 533000 533200 533400

3190000 3189800 3189600 3189400 3189200 3189000 3188800

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

Drawing No.: LINE-BUD-7



Salient Features

Project Name: Babiyachaur Budhebhapar
Starting Point: Bay Ext at Babiyachaur S/S
Ending Point: Budhebhapar S/S
Line Details: 33 kV, Single Circuit, 22 km
Substation Details: 33/11 kV, 1 MVA
Funding Agency: AIIB

Legend

Administrative
- International
- Province
- District
- Municipality
- Ward

33 kV Line Features
- Angle Points
- Terminal Points
- Overhead Line
- Underground Cable
- Substation

Landuse
- Forest
- Built Up
- Cultivation
- Vegetation
- Barren Land
- Glacier
- Swamp Area
- Water Body
- Pond/Lake
- Others

Physical Features
- Airport
- Village Name
- River

Roads
- Trunk
- Primary Road
- Secondary Road
- Tertiary Road
- Track
- Unclassified Road

Coordinate System: WGS 1984 UTM Zone 44N
Projection: Transverse Mercator
Datum: WGS 1984
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: 81.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

0 60 120 180 240 300 Meters

Scale: 1:5,000

FOR TENDER PURPOSE ONLY

Consultant:

एनइए इन्जिनियरिङ्ग कम्पनी लि.
NEA ENGINEERING COMPANY LTD.

Client:

नेपाल विद्युत प्राधिकरण
Nepal Electricity Authority

Chaukune-8, Surkhet

Chaukune-7, Surkhet

530600 530800 531000 531200 531400 531600 531800 532000

3190600 3190400 3190200 3190000 3189800 3189600

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

Drawing No.: LINE-BUD-8



Salient Features

Project Name: Babiyachaur Budhebhapar
Starting Point: Bay Ext at Babiyachaur S/S
Ending Point: Budhebhapar S/S
Line Details: 33 kV, Single Circuit, 22 km
Substation Details: 33/11 kV, 1 MVA
Funding Agency: AIIB

Legend

Administrative
- International
- Province
- District
- Municipality
- Ward

33 kV Line Features
- Angle Points
- Terminal Points
- Overhead Line
- Underground Cable
- Substation

Landuse
- Forest
- Built Up
- Cultivation
- Vegetation
- Barren Land
- Glacier
- Swamp Area
- Water Body
- Pond/Lake
- Others

Physical Features
- Airport
- Village Name
- River

Roads
- Trunk
- Primary Road
- Secondary Road
- Tertiary Road
- Track
- Unclassified Road

Coordinate System: WGS 1984 UTM Zone 44N
Projection: Transverse Mercator
Datum: WGS 1984
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: 81.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

0 60 120 180 240 300 Meters

Scale: 1:5,000

FOR TENDER PURPOSE ONLY

Consultant:

एनइए इन्जिनियरिङ्ग कम्पनी लि.
NEA ENGINEERING COMPANY LTD.

Client:

नेपाल विद्युत प्राधिकरण
Nepal Electricity Authority

Chaukune-7, Surkhet

Chaukune-5, Surkhet

529200 529400 529600 529800 530000 530200 530400 530600

3190400 3190200 3190000 3189800 3189600 3189400

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT



Drawing No.: LINE-BUD-9



Salient Features

Project Name: Babiyachaur Budhebhapar
Starting Point: Bay Ext at Babiyachaur S/S
Ending Point: Budhebhapar S/S
Line Details: 33 kV, Single Circuit, 22 km
Substation Details: 33/11 kV, 1 MVA
Funding Agency: AIIB

Legend

Administrative
- International
- Province
- District
- Municipality
- Ward

33 kV Line Features
- Angle Points
- Terminal Points
- Overhead Line
- Underground Cable
- Substation

Landuse
- Forest
- Built Up
- Cultivation
- Vegetation
- Barren Land
- Glacier
- Swamp Area
- Water Body
- Pond/Lake
- Others

Physical Features
- Airport
- Village Name
- River

Roads
- Trunk
- Primary Road
- Secondary Road
- Tertiary Road
- Track
- Unclassified Road

Coordinate System: WGS 1984 UTM Zone 44N
Projection: Transverse Mercator
Datum: WGS 1984
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: 81.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

0 60 120 180 240 300 Meters

Scale: 1:5,000

FOR TENDER PURPOSE ONLY

Consultant:

एनइए इन्जिनियरिङ्ग कम्पनी लि.
NEA ENGINEERING COMPANY LTD.

Client:

नेपाल विद्युत प्राधिकरण
Nepal Electricity Authority

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

526400 526600 526800 527000 527200 527400 527600 527800

3190800 3190600 3190400 3190200 3190000 3189800 3189600

Chaukune-7, Surkhet

Chaukune-5, Surkhet

N W E S

Drawing No.: LINE-BUD-10



Salient Features

Project Name: Babiyachaur Budhebhapar
Starting Point: Bay Ext at Babiyachaur S/S
Ending Point: Budhebhapar S/S
Line Details: 33 kV, Single Circuit, 22 km
Substation Details: 33/11 kV, 1 MVA
Funding Agency: AIIB

Legend

Administrative
- International
- Province
- District
- Municipality
- Ward

33 kV Line Features
- Angle Points
- Terminal Points
- Overhead Line
- Underground Cable
- Substation

Landuse
- Forest
- Built Up
- Cultivation
- Vegetation
- Barren Land
- Glacier
- Swamp Area
- Water Body
- Pond/Lake
- Others

Physical Features
- Airport
- Village Name
- River

Roads
- Trunk
- Primary Road
- Secondary Road
- Tertiary Road
- Track
- Unclassified Road

Coordinate System: WGS 1984 UTM Zone 44N
Projection: Transverse Mercator
Datum: WGS 1984
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: 81.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

0 60 120 180 240 300 Meters

Scale: 1:5,000

FOR TENDER PURPOSE ONLY

Consultant:

एनइए इन्जिनियरिङ्ग कम्पनी लि.
NEA ENGINEERING COMPANY LTD.

Client:

नेपाल विद्युत प्राधिकरण
Nepal Electricity Authority

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

Drawing No.: LINE-BUD-11



Salient Features

Project Name: Babiyachaur Budhebhapar
Starting Point: Bay Ext at Babiyachaur S/S
Ending Point: Budhebhapar S/S
Line Details: 33 kV, Single Circuit, 22 km
Substation Details: 33/11 kV, 1 MVA
Funding Agency: AIIB

Legend

Administrative
- International
- Province
- District
- Municipality
- Ward

33 kV Line Features
- Angle Points
- Terminal Points
- Overhead Line
- Underground Cable
- Substation

Landuse
- Forest
- Built Up
- Cultivation
- Vegetation
- Barren Land
- Glacier
- Swamp Area
- Water Body
- Pond/Lake
- Others

Physical Features
- Airport
- Village Name
- River

Roads
- Trunk
- Primary Road
- Secondary Road
- Tertiary Road
- Track
- Unclassified Road

Coordinate System: WGS 1984 UTM Zone 44N
Projection: Transverse Mercator
Datum: WGS 1984
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: 81.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

0 60 120 180 240 300 Meters

Scale: 1:5,000

FOR TENDER PURPOSE ONLY

Consultant:

एनइए इन्जिनियरिङ्ग कम्पनी लि.
NEA ENGINEERING COMPANY LTD.

Client:

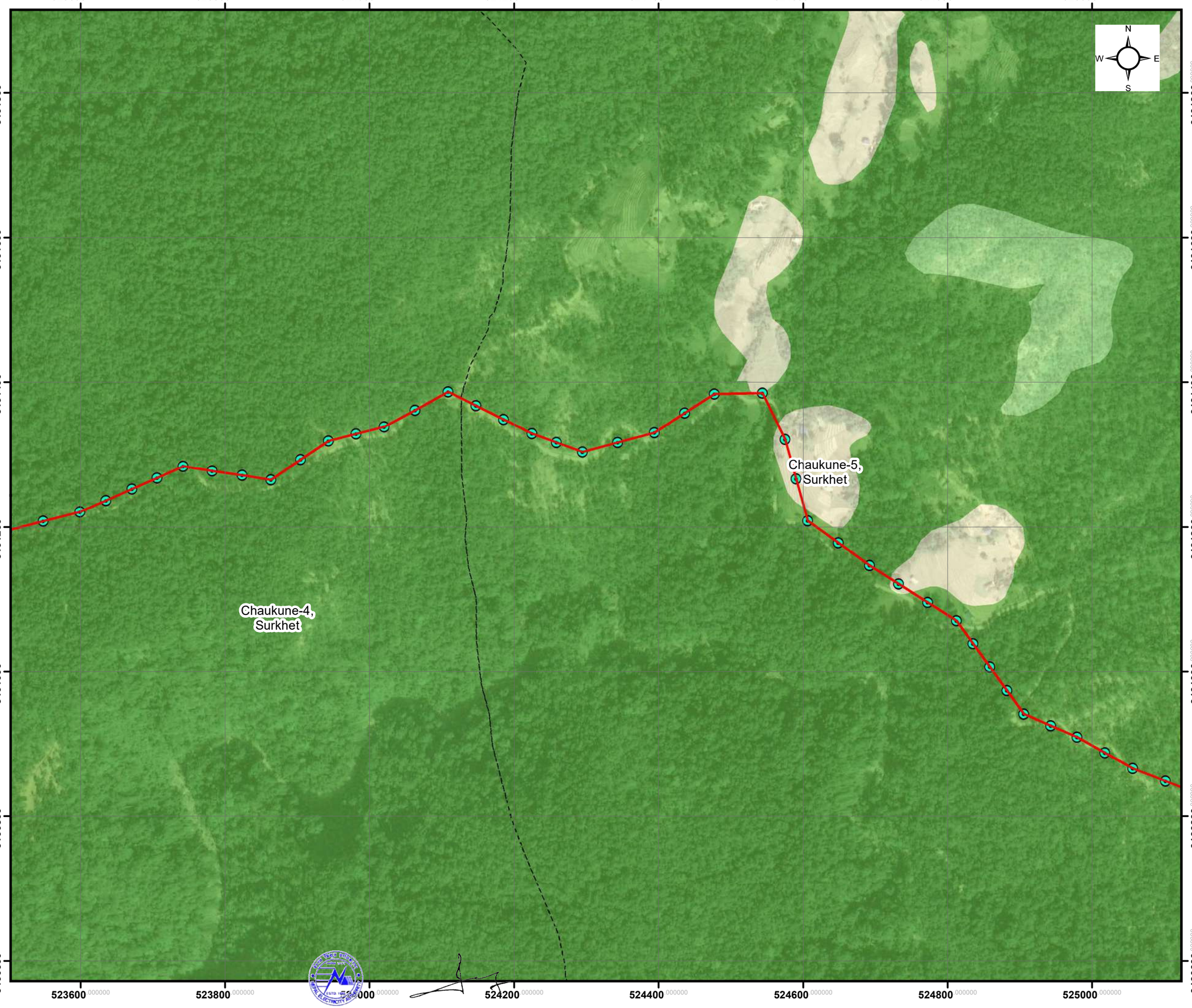
नेपाल विद्युत प्राधिकरण
Nepal Electricity Authority

Chaukune-5, Surkhet

525000 525200 525400 525600 525800 526000 526200 526400

3191200 3191000 3190800 3190600 3190400 3190200 3190000

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT



Drawing No.: LINE-BUD-12



Salient Features

Project Name: Babiyachaur Budhebhapar
Starting Point: Bay Ext at Babiyachaur S/S
Ending Point: Budhebhapar S/S
Line Details: 33 kV, Single Circuit, 22 km
Substation Details: 33/11 kV, 1 MVA
Funding Agency: AIIB

Legend

Administrative
- International
- Province
- District
- Municipality
- Ward

33 kV Line Features
- Angle Points
- Terminal Points
- Overhead Line
- Underground Cable
- Substation

Landuse
- Forest
- Built Up
- Cultivation
- Vegetation
- Barren Land
- Glacier
- Swamp Area
- Water Body
- Pond/Lake
- Others

Physical Features
- Airport
- Village Name
- River

Roads
- Trunk
- Primary Road
- Secondary Road
- Tertiary Road
- Track
- Unclassified Road

Coordinate System: WGS 1984 UTM Zone 44N
Projection: Transverse Mercator
Datum: WGS 1984
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: 81.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

0 60 120 180 240 300 Meters

Scale: 1:5,000

FOR TENDER PURPOSE ONLY

Consultant:

एनइए इन्जिनियरिङ्ग कम्पनी लि.
NEA ENGINEERING COMPANY LTD.

Client:

नेपाल विद्युत प्राधिकरण
Nepal Electricity Authority

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

Drawing No.: LINE-BUD-13



Salient Features

Project Name: Babiyachaur Budhebhapar
Starting Point: Bay Ext at Babiyachaur S/S
Ending Point: Budhebhapar S/S
Line Details: 33 kV, Single Circuit, 22 km
Substation Details: 33/11 kV, 1 MVA
Funding Agency: AIIB

Legend

Administrative
- International
- Province
- District
- Municipality
- Ward

33 kV Line Features
- Angle Points
- Terminal Points
- Overhead Line
- Underground Cable
- Substation

Landuse
- Forest
- Built Up
- Cultivation
- Vegetation
- Barren Land
- Glacier
- Swamp Area
- Water Body
- Pond/Lake
- Others

Physical Features
- Airport
- Village Name
- River

Roads
- Trunk
- Primary Road
- Secondary Road
- Tertiary Road
- Track
- Unclassified Road

Coordinate System: WGS 1984 UTM Zone 44N
Projection: Transverse Mercator
Datum: WGS 1984
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: 81.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

0 60 120 180 240 300 Meters

Scale: 1:5,000

FOR TENDER PURPOSE ONLY

Consultant:

एनइए इन्जिनियरिङ्ग कम्पनी लि.
NEA ENGINEERING COMPANY LTD.

Client:

नेपाल विद्युत प्राधिकरण
Nepal Electricity Authority

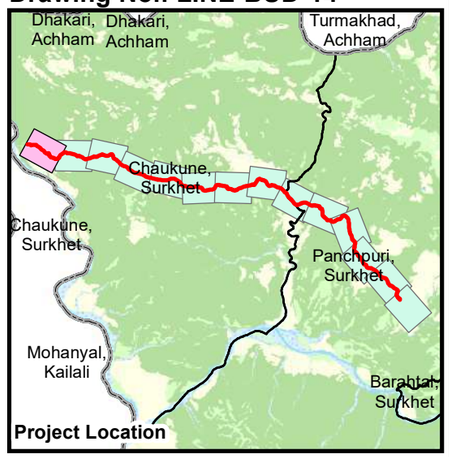
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

520600 000000 520800 000000 521000 000000 521200 000000 521400 000000 521600 000000 521800 000000 522000 000000 522200 000000 522400 000000

3192200 000000 3192000 000000 3191800 000000 3191600 000000 3191400 000000 3191200 000000 3191000 000000 3190800 000000



Drawing No.: LINE-BUD-14



Salient Features

Project Name: Babiyachaur Budhebhapar
Starting Point: Bay Ext at Babiyachaur S/S
Ending Point: Budhebhapar S/S
Line Details: 33 kV, Single Circuit, 22 km
Substation Details: 33/11 kV, 1 MVA
Funding Agency: AIIB

Legend

Administrative
- International
- Province
- District
- Municipality
- Ward

33 kV Line Features
- Angle Points
- Terminal Points
- Overhead Line
- Underground Cable
- Substation

Landuse
- Forest
- Built Up
- Cultivation
- Vegetation
- Barren Land
- Glacier
- Swamp Area
- Water Body
- Pond/Lake
- Others

Physical Features
- Airport
- Village Name
- River

Roads
- Trunk
- Primary Road
- Secondary Road
- Tertiary Road
- Track
- Unclassified Road

Coordinate System: WGS 1984 UTM Zone 44N
Projection: Transverse Mercator
Datum: WGS 1984
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: 81.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

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Scale: 1:6,000

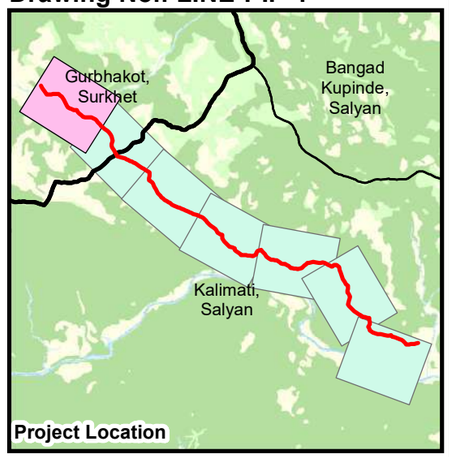
FOR TENDER PURPOSE ONLY

Consultant:
एनइए इन्जिनियरिङ्ग कम्पनी लि.
NEA ENGINEERING COMPANY LTD.

Client:
नेपाल विद्युत प्राधिकरण
Nepal Electricity Authority

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

Drawing No.: LINE-PIP-1



Salient Features

Project Name: Malarani Pipledanda
Starting Point: Tapping at Malarani
Ending Point: Pipledanda S/S
Line Details: 33 kV, Single Circuit, 11 km
Substation Details: 33/11 kV, 1 MVA
Funding Agency: AIIB

Legend

Administrative
- International
- Province
- District
- Municipality
- Ward

33 kV Line Features
- Angle Points
- Terminal Points
- Overhead Line
- Underground Cable
- Substation

Landuse
- Forest
- Built Up
- Cultivation
- Vegetation
- Barren Land
- Glacier
- Swamp Area
- Water Body
- Pond/Lake
- Others

Physical Features
- Airport
- Village Name
- River

Roads
- Trunk
- Primary Road
- Secondary Road
- Tertiary Road
- Track
- Unclassified Road

Coordinate System: WGS 1984 UTM Zone 44N
Projection: Transverse Mercator
Datum: WGS 1984
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: 81.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

0 60 120 180 240 300 Meters

Scale: 1:5,000

FOR TENDER PURPOSE ONLY

Consultant:

एनइए इन्जिनियरिङ्ग कम्पनी लि.
NEA ENGINEERING COMPANY LTD.

Client:

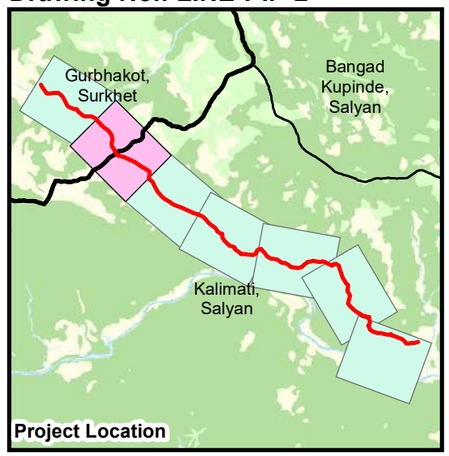
नेपाल विद्युत प्राधिकरण
Nepal Electricity Authority

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

Gurbhakot-1, Surkhet

Kalimati-5, Salyan

Drawing No.: LINE-PIP-2



Salient Features

Project Name: Malarani Pipledanda
Starting Point: Tapping at Malarani
Ending Point: Pipledanda S/S
Line Details: 33 kV, Single Circuit, 11 km
Substation Details: 33/11 kV, 1 MVA
Funding Agency: AIIB

Legend

Administrative
- International
- Province
- District
- Municipality
- Ward

33 kV Line Features
- Angle Points
- Terminal Points
- Overhead Line
- Underground Cable
- Substation

Landuse
- Forest
- Built Up
- Cultivation
- Vegetation
- Barren Land
- Glacier
- Swamp Area
- Water Body
- Pond/Lake
- Others

Physical Features
- Airport
- Village Name
- River

Roads
- Trunk
- Primary Road
- Secondary Road
- Tertiary Road
- Track
- Unclassified Road

Coordinate System: WGS 1984 UTM Zone 44N
Projection: Transverse Mercator
Datum: WGS 1984
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: 81.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

0 60 120 180 240 300 Meters

Scale: 1:5,000

FOR TENDER PURPOSE ONLY

Consultant:

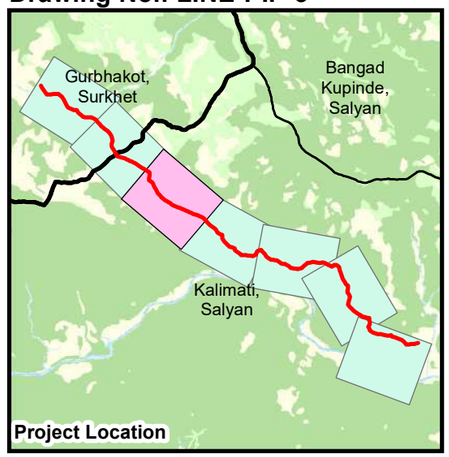
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NEA ENGINEERING COMPANY LTD.

Client:

नेपाल विद्युत प्राधिकरण
Nepal Electricity Authority

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

Drawing No.: LINE-PIP-3



Salient Features

Project Name: Malarani Pipledanda
Starting Point: Tapping at Malarani
Ending Point: Pipledanda S/S
Line Details: 33 kV, Single Circuit, 11 km
Substation Details: 33/11 kV, 1 MVA
Funding Agency: AIIB

Legend

Administrative
- International
- Province
- District
- Municipality
- Ward

33 kV Line Features
- Angle Points
- Terminal Points
- Overhead Line
- Underground Cable
- Substation

Landuse
- Forest
- Built Up
- Cultivation
- Vegetation
- Barren Land
- Glacier
- Swamp Area
- Water Body
- Pond/Lake
- Others

Physical Features
- Airport
- Village Name
- River

Roads
- Trunk
- Primary Road
- Secondary Road
- Tertiary Road
- Track
- Unclassified Road

Coordinate System: WGS 1984 UTM Zone 44N
Projection: Transverse Mercator
Datum: WGS 1984
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: 81.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

0 60 120 180 240 300 Meters

Scale: 1:5,000

FOR TENDER PURPOSE ONLY

Consultant:

एनइए इन्जिनियरिङ्ग कम्पनी लि.
NEA ENGINEERING COMPANY LTD.

Client:

नेपाल विद्युत प्राधिकरण
Nepal Electricity Authority

593800 594000 594200 594400 594600 594800 595000 595200

3135600 3135400 3135200 3135000 3134800 3134600 3134400

Kalimati-4, Salyan

Kalimati-5, Salyan

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

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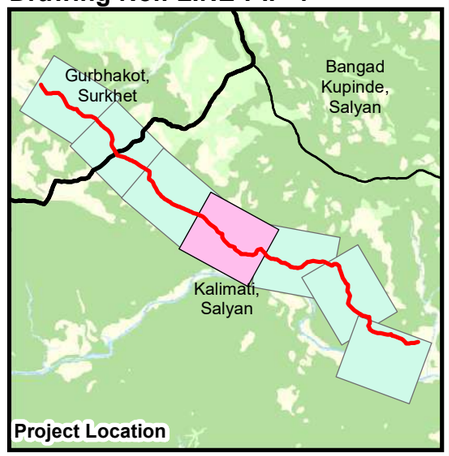
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N W E S

Kalimati-4, Salyan

Kalimati-5, Salyan

Drawing No.: LINE-PIP-4



Salient Features

Project Name: Malarani Pipledanda
Starting Point: Tapping at Malarani
Ending Point: Pipledanda S/S
Line Details: 33 kV, Single Circuit, 11 km
Substation Details: 33/11 kV, 1 MVA
Funding Agency: AIIB

Legend

Administrative
- International
- Province
- District
- Municipality
- Ward

33 kV Line Features
- Angle Points
- Terminal Points
- Overhead Line
- Underground Cable
- Substation

Landuse
- Forest
- Built Up
- Cultivation
- Vegetation
- Barren Land
- Glacier
- Swamp Area
- Water Body
- Pond/Lake
- Others

Physical Features
- Airport
- Village Name
- River

Roads
- Trunk
- Primary Road
- Secondary Road
- Tertiary Road
- Track
- Unclassified Road

Coordinate System: WGS 1984 UTM Zone 44N
Projection: Transverse Mercator
Datum: WGS 1984
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: 81.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

0 60 120 180 240 300 Meters

Scale: 1:5,000

FOR TENDER PURPOSE ONLY

Consultant:

एनइए इन्जिनियरिङ्ग कम्पनी लि.
NEA ENGINEERING COMPANY LTD.

Client:

नेपाल विद्युत प्राधिकरण
Nepal Electricity Authority

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

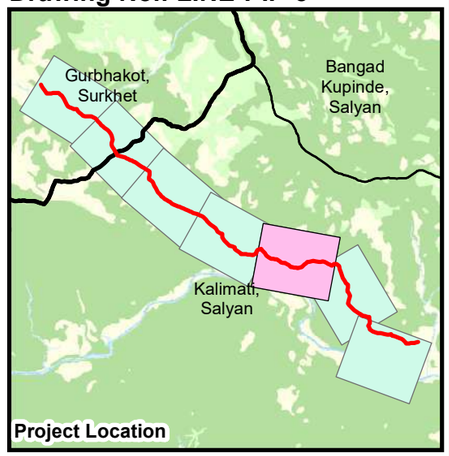
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3134200.000000 3134000.000000 3133800.000000 3133600.000000 3133400.000000 3133200.000000

N W E S

Kalimati-4, Salyan

Drawing No.: LINE-PIP-5



Salient Features

Project Name: Malarani Pipledanda
Starting Point: Tapping at Malarani
Ending Point: Pipledanda S/S
Line Details: 33 kV, Single Circuit, 11 km
Substation Details: 33/11 kV, 1 MVA
Funding Agency: AIIB

Legend

Administrative
- International
- Province
- District
- Municipality
- Ward

33 kV Line Features
- Angle Points
- Terminal Points
- Overhead Line
- Underground Cable
- Substation

Landuse
- Forest
- Built Up
- Cultivation
- Vegetation
- Barren Land
- Glacier
- Swamp Area
- Water Body
- Pond/Lake
- Others

Physical Features
- Airport
- Village Name
- River

Roads
- Trunk
- Primary Road
- Secondary Road
- Tertiary Road
- Track
- Unclassified Road

Coordinate System: WGS 1984 UTM Zone 44N
Projection: Transverse Mercator
Datum: WGS 1984
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: 81.0000
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Latitude Of Origin: 0.0000
Units: Meter

0 60 120 180 240 300 Meters

Scale: 1:5,000

FOR TENDER PURPOSE ONLY

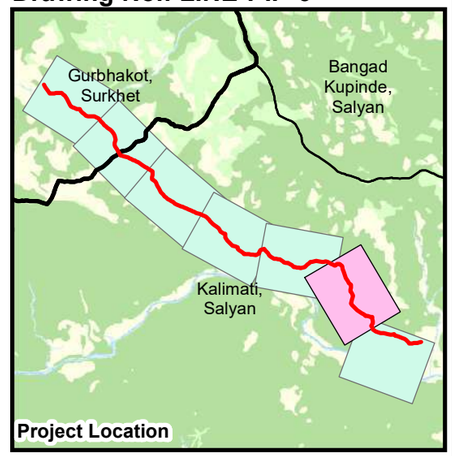
Consultant:
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NEA ENGINEERING COMPANY LTD.

Client:
नेपाल विद्युत प्राधिकरण
Nepal Electricity Authority

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

Kalimati-4, Salyan

Drawing No.: LINE-PIP-6



Salient Features

Project Name: Malarani Pipledanda
Starting Point: Tapping at Malarani
Ending Point: Pipledanda S/S
Line Details: 33 kV, Single Circuit, 11 km
Substation Details: 33/11 kV, 1 MVA
Funding Agency: AIIB

Legend

Administrative
- International
- Province
- District
- Municipality
- Ward

33 kV Line Features
- Angle Points
- Terminal Points
- Overhead Line
- Underground Cable
- Substation

Landuse
- Forest
- Built Up
- Cultivation
- Vegetation
- Barren Land
- Glacier
- Swamp Area
- Water Body
- Pond/Lake
- Others

Physical Features
- Airport
- Village Name
- River

Roads
- Trunk
- Primary Road
- Secondary Road
- Tertiary Road
- Track
- Unclassified Road

Coordinate System: WGS 1984 UTM Zone 44N
Projection: Transverse Mercator
Datum: WGS 1984
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False Northing: 0.0000
Central Meridian: 81.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

0 60 120 180 240 300 Meters

Scale: 1:5,000

FOR TENDER PURPOSE ONLY

Consultant:

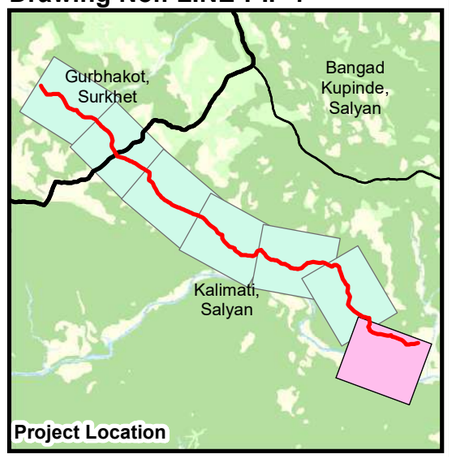
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NEA ENGINEERING COMPANY LTD.

Client:

नेपाल विद्युत प्राधिकरण
Nepal Electricity Authority

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

Drawing No.: LINE-PIP-7



Salient Features

Project Name: Malarani Pipledanda
Starting Point: Tapping at Malarani
Ending Point: Pipledanda S/S
Line Details: 33 kV, Single Circuit, 11 km
Substation Details: 33/11 kV, 1 MVA
Funding Agency: AIIB

Legend

Administrative
- International
- Province
- District
- Municipality
- Ward

33 kV Line Features
- Angle Points
- Terminal Points
- Overhead Line
- Underground Cable
- Substation

Landuse
- Forest
- Built Up
- Cultivation
- Vegetation
- Barren Land
- Glacier
- Swamp Area
- Water Body
- Pond/Lake
- Others

Physical Features
- Airport
- Village Name
- River

Roads
- Trunk
- Primary Road
- Secondary Road
- Tertiary Road
- Track
- Unclassified Road

Coordinate System: WGS 1984 UTM Zone 44N
Projection: Transverse Mercator
Datum: WGS 1984
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: 81.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

0 60 120 180 240 300 Meters

Scale: 1:5,000

FOR TENDER PURPOSE ONLY

Consultant:

एनइए इन्जिनियरिङ्ग कम्पनी लि.
NEA ENGINEERING COMPANY LTD.

Client:

नेपाल विद्युत प्राधिकरण
Nepal Electricity Authority

598200 598400 598600 598800 599000 599200 599400 599600

3132200 3132000 3131800 3131600 3131400 3131200

Kalimati-4,
Salyan

Piple
Substation

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

550400.000000 550600.000000

3168200.000000 3168000.000000

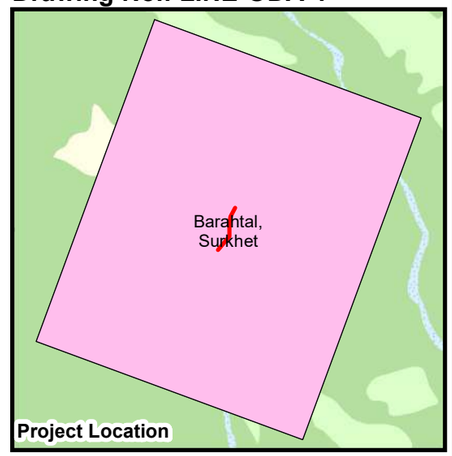
N W E S

Barahtal-8, Surkhet

Odaltal Substation

550400.000000 550600.000000

Drawing No.: LINE-ODA-1



Salient Features

Project Name: Baddichaur Odaltal
Starting Point: LILO at Odaltal
Ending Point: Odaltal S/S
Line Details: 33 kV, Double Circuit, 0.3 km
Substation Details: 33/11 kV, 1 MVA
Funding Agency: AIIB

Legend

Administrative
- International
- Province
- District
- Municipality
- Ward

33 kV Line Features
- Angle Points
- Terminal Points
- Overhead Line
- Underground Cable
- Substation

Landuse
- Forest
- Built Up
- Cultivation
- Vegetation
- Barren Land
- Glacier
- Swamp Area
- Water Body
- Pond/Lake
- Others

Physical Features
- Airport
- Village Name
- River

Roads
- Trunk
- Primary Road
- Secondary Road
- Tertiary Road
- Track
- Unclassified Road

Coordinate System: WGS 1984 UTM Zone 44N
Projection: Transverse Mercator
Datum: WGS 1984
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: 81.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

0 10 20 30 40 50 Meters

Scale: 1:1,250

FOR TENDER PURPOSE ONLY

Consultant:

एनइए इन्जिनियरिङ्ग कम्पनी लि.
NEA ENGINEERING COMPANY LTD.

Client:

नेपाल विद्युत प्राधिकरण
Nepal Electricity Authority

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

Drawing No.: LINE-MAC-1



Kohalpur-5, Banke

Kohalpur-6, Banke

Kohalpur-11, Banke

Kohal Banke

Kohalpur-10, Banke

Kohalpur-13, Banke

Salient Features

Project Name: Kohalpur Machhagadh
Starting Point: Bay Ext at Kohalpur S/S
Ending Point: Machhagadh S/S
Line Details: 33 kV, Double Circuit, 26 km
Substation Details: 33/11 kV, 16 MVA
Funding Agency: AIIB

Legend

Administrative
- International
- Province
- District
- Municipality
- Ward

33 kV Line Features
- Angle Points
- Terminal Points
- Overhead Line
- Underground Cable
- Substation

Landuse
- Forest
- Built Up
- Cultivation
- Vegetation
- Barren Land
- Glacier
- Swamp Area
- Water Body
- Pond/Lake
- Others

Physical Features
- Airport
- Village Name
- River

Roads
- Trunk
- Primary Road
- Secondary Road
- Tertiary Road
- Track
- Unclassified Road

Coordinate System: WGS 1984 UTM Zone 44N
Projection: Transverse Mercator
Datum: WGS 1984
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: 81.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

0 60 120 180 240 300 Meters

Scale: 1:5,000

FOR TENDER PURPOSE ONLY

Consultant:

एनइए इन्जिनियरिङ्ग कम्पनी लि.
NEA ENGINEERING COMPANY LTD.

Client:

नेपाल विद्युत प्राधिकरण
Nepal Electricity Authority

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

Drawing No.: LINE-MAC-2



Salient Features

Project Name: Kohalpur Machhagadh
Starting Point: Bay Ext at Kohalpur S/S
Ending Point: Machhagadh S/S
Line Details: 33 kV, Double Circuit, 26 km
Substation Details: 33/11 kV, 16 MVA
Funding Agency: AIIB

Legend

Administrative
- International
- Province
- District
- Municipality
- Ward

33 kV Line Features
- Angle Points
- Terminal Points
- Overhead Line
- Underground Cable
- Substation

Landuse
- Forest
- Built Up
- Cultivation
- Vegetation
- Barren Land
- Glacier
- Swamp Area
- Water Body
- Pond/Lake
- Others

Physical Features
- Airport
- Village Name
- River

Roads
- Trunk
- Primary Road
- Secondary Road
- Tertiary Road
- Track
- Unclassified Road

Coordinate System: WGS 1984 UTM Zone 44N
Projection: Transverse Mercator
Datum: WGS 1984
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: 81.0000
Scale Factor: 0.9996
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Units: Meter

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Scale: 1:5,000

FOR TENDER PURPOSE ONLY

Consultant:

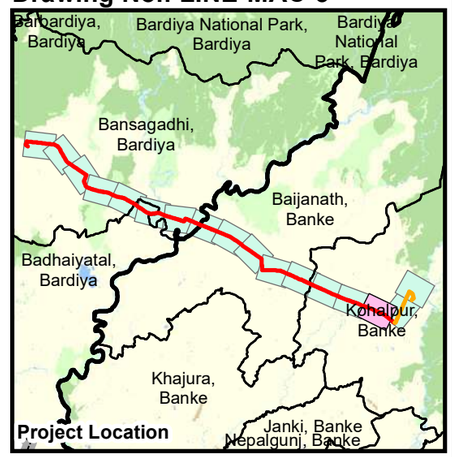
एनइए इन्जिनियरिङ्ग कम्पनी लि.
NEA ENGINEERING COMPANY LTD.

Client:

नेपाल विद्युत प्राधिकरण
Nepal Electricity Authority

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

Drawing No.: LINE-MAC-3



Salient Features

Project Name: Kohalpur Machhagadh
Starting Point: Bay Ext at Kohalpur S/S
Ending Point: Machhagadh S/S
Line Details: 33 kV, Double Circuit, 26 km
Substation Details: 33/11 kV, 16 MVA
Funding Agency: AIIB

Legend

Administrative
- International
- Province
- District
- Municipality
- Ward

33 kV Line Features
- Angle Points
- Terminal Points
- Overhead Line
- Underground Cable
- Substation

Landuse
- Forest
- Built Up
- Cultivation
- Vegetation
- Barren Land
- Glacier
- Swamp Area
- Water Body
- Pond/Lake
- Others

Physical Features
- Airport
- Village Name
- River

Roads
- Trunk
- Primary Road
- Secondary Road
- Tertiary Road
- Track
- Unclassified Road

Coordinate System: WGS 1984 UTM Zone 44N
Projection: Transverse Mercator
Datum: WGS 1984
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: 81.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

0 60 120 180 240 300 Meters

Scale: 1:5,000

FOR TENDER PURPOSE ONLY

Consultant:

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NEA ENGINEERING COMPANY LTD.

Client:

नेपाल विद्युत प्राधिकरण
Nepal Electricity Authority

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

563600 000000 | 563800 000000 | 564000 000000 | 564200 000000 | 564400 000000 | 564600 000000 | 564800 000000 | 565000 000000

3118400 000000 | 3118200 000000 | 3118000 000000 | 3117800 000000 | 3117600 000000 | 3117400 000000 | 3117200 000000

N W E S

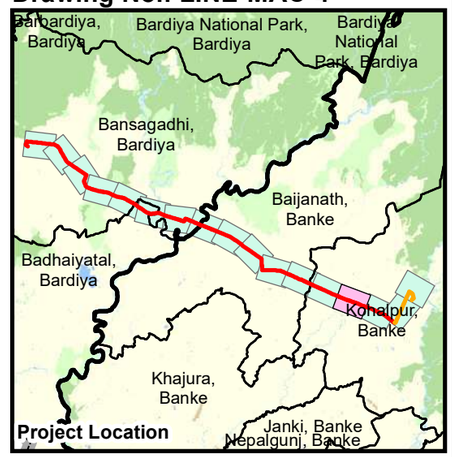
Kohalpur-3, Banke

Kohalpur-4, Banke

Kohalpur-6, Banke

Kohalpur-15, Banke

Drawing No.: LINE-MAC-4



Salient Features

Project Name: Kohalpur Machhagadh
Starting Point: Bay Ext at Kohalpur S/S
Ending Point: Machhagadh S/S
Line Details: 33 kV, Double Circuit, 26 km
Substation Details: 33/11 kV, 16 MVA
Funding Agency: AIIB

Legend

Administrative
- International
- Province
- District
- Municipality
- Ward

33 kV Line Features
- Angle Points
- Terminal Points
- Overhead Line
- Underground Cable
- Substation

Landuse
- Forest
- Built Up
- Cultivation
- Vegetation
- Barren Land
- Glacier
- Swamp Area
- Water Body
- Pond/Lake
- Others

Physical Features
- Airport
- Village Name
- River

Roads
- Trunk
- Primary Road
- Secondary Road
- Tertiary Road
- Track
- Unclassified Road

Coordinate System: WGS 1984 UTM Zone 44N
Projection: Transverse Mercator
Datum: WGS 1984
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False Northing: 0.0000
Central Meridian: 81.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

0 60 120 180 240 300 Meters

Scale: 1:5,000

FOR TENDER PURPOSE ONLY

Consultant:

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NEA ENGINEERING COMPANY LTD.

Client:

नेपाल विद्युत प्राधिकरण
Nepal Electricity Authority

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

Drawing No.: LINE-MAC-5



Salient Features

Project Name: Kohalpur Machhagadh
Starting Point: Bay Ext at Kohalpur S/S
Ending Point: Machhagadh S/S
Line Details: 33 kV, Double Circuit, 26 km
Substation Details: 33/11 kV, 16 MVA
Funding Agency: AIIB

Legend

Administrative
- International
- Province
- District
- Municipality
- Ward

33 kV Line Features
- Angle Points
- Terminal Points
- Overhead Line
- Underground Cable
- Substation

Landuse
- Forest
- Built Up
- Cultivation
- Vegetation
- Barren Land
- Glacier
- Swamp Area
- Water Body
- Pond/Lake
- Others

Physical Features
- Airport
- Village Name
- River

Roads
- Trunk
- Primary Road
- Secondary Road
- Tertiary Road
- Track
- Unclassified Road

Coordinate System: WGS 1984 UTM Zone 44N
Projection: Transverse Mercator
Datum: WGS 1984
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: 81.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

0 60 120 180 240 300 Meters

Scale: 1:5,000

FOR TENDER PURPOSE ONLY

Consultant:

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NEA ENGINEERING COMPANY LTD.

Client:

नेपाल विद्युत प्राधिकरण
Nepal Electricity Authority

562200 562400 562600 562800 563000 563200 563400 563600

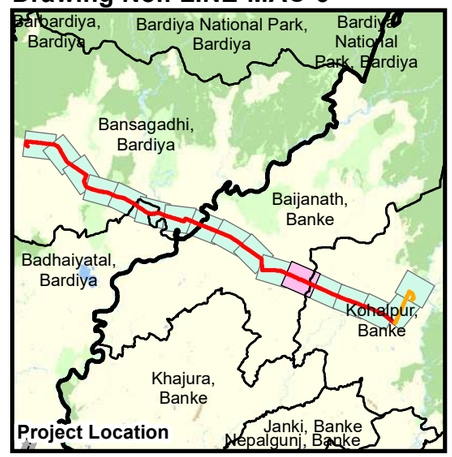
3118800 3118600 3118400 3118200 3118000 3117800

Baijanath-5, Banke
Kohalpur-3, Banke
Kohalpur-15, Banke
Kohalpur-4, Banke

N W E S

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

Drawing No.: LINE-MAC-6



Salient Features

Project Name: Kohalpur Machhagadh
Starting Point: Bay Ext at Kohalpur S/S
Ending Point: Machhagadh S/S
Line Details: 33 kV, Double Circuit, 26 km
Substation Details: 33/11 kV, 16 MVA
Funding Agency: AIIB

Legend

Administrative
- International
- Province
- District
- Municipality
- Ward

Landuse
- Forest
- Built Up
- Cultivation
- Vegetation
- Barren Land
- Glacier
- Swamp Area
- Water Body
- Pond/Lake
- Others

33 kV Line Features
- Angle Points
- Terminal Points
- Overhead Line
- Underground Cable
- Substation

Physical Features
- Airport
- Village Name
- River

Roads
- Trunk
- Primary Road
- Secondary Road
- Tertiary Road
- Track
- Unclassified Road

Coordinate System: WGS 1984 UTM Zone 44N
Projection: Transverse Mercator
Datum: WGS 1984
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: 81.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

0 60 120 180 240 300 Meters

Scale: 1:5,000

FOR TENDER PURPOSE ONLY

Consultant:

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NEA ENGINEERING COMPANY LTD.

Client:

नेपाल विद्युत प्राधिकरण
Nepal Electricity Authority

561000 561200 561400 561600 561800 562000 562200 562400

3119400 3119200 3119000 3118800 3118600 3118400

Baijanath-5, Banke
Kohalpur-3, Banke
Baijanath-7, Banke
Kohalpur-15, Banke

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

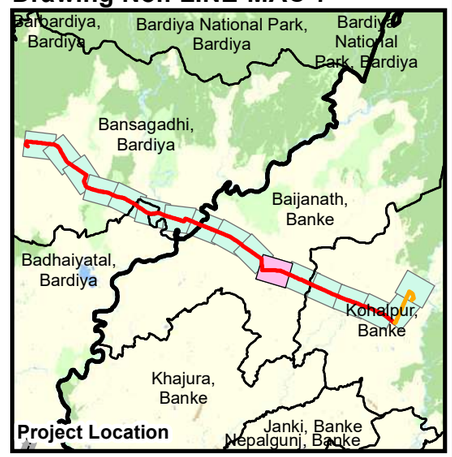
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Baijanath-5, Banke

N W E S

Drawing No.: LINE-MAC-7



Salient Features

Project Name: Kohalpur Machhagadh
Starting Point: Bay Ext at Kohalpur S/S
Ending Point: Machhagadh S/S
Line Details: 33 kV, Double Circuit, 26 km
Substation Details: 33/11 kV, 16 MVA
Funding Agency: AIIB

Legend

Administrative
- International
- Province
- District
- Municipality
- Ward

33 kV Line Features
- Angle Points
- Terminal Points
- Overhead Line
- Underground Cable
- Substation

Landuse
- Forest
- Built Up
- Cultivation
- Vegetation
- Barren Land
- Glacier
- Swamp Area
- Water Body
- Pond/Lake
- Others

Physical Features
- Airport
- Village Name
- River

Roads
- Trunk
- Primary Road
- Secondary Road
- Tertiary Road
- Track
- Unclassified Road

Coordinate System: WGS 1984 UTM Zone 44N
Projection: Transverse Mercator
Datum: WGS 1984
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False Northing: 0.0000
Central Meridian: 81.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

0 60 120 180 240 300 Meters

Scale: 1:5,000

FOR TENDER PURPOSE ONLY

Consultant:

एनइए इन्जिनियरिङ्ग कम्पनी लि.
NEA ENGINEERING COMPANY LTD.

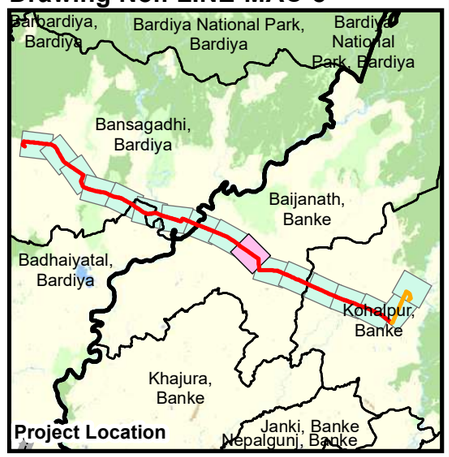
Client:

नेपाल विद्युत प्राधिकरण
Nepal Electricity Authority

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT



Drawing No.: LINE-MAC-8



Salient Features

Project Name: Kohalpur Machhagadh
Starting Point: Bay Ext at Kohalpur S/S
Ending Point: Machhagadh S/S
Line Details: 33 kV, Double Circuit, 26 km
Substation Details: 33/11 kV, 16 MVA
Funding Agency: AIIB

Legend

Administrative
- International
- Province
- District
- Municipality
- Ward

33 kV Line Features
- Angle Points
- Terminal Points
- Overhead Line
- Underground Cable
- Substation

Landuse
- Forest
- Built Up
- Cultivation
- Vegetation
- Barren Land
- Glacier
- Swamp Area
- Water Body
- Pond/Lake
- Others

Physical Features
- Airport
- Village Name
- River

Roads
- Trunk
- Primary Road
- Secondary Road
- Tertiary Road
- Track
- Unclassified Road

Coordinate System: WGS 1984 UTM Zone 44N
Projection: Transverse Mercator
Datum: WGS 1984
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False Northing: 0.0000
Central Meridian: 81.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

0 60 120 180 240 300 Meters

Scale: 1:5,000

FOR TENDER PURPOSE ONLY

Consultant:

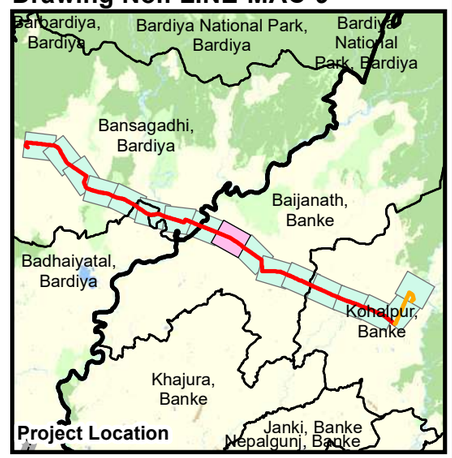
एनइए इन्जिनियरिङ्ग कम्पनी लि.
NEA ENGINEERING COMPANY LTD.

Client:

नेपाल विद्युत प्राधिकरण
Nepal Electricity Authority

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

Drawing No.: LINE-MAC-9



Salient Features

Project Name: Kohalpur Machhagadh
Starting Point: Bay Ext at Kohalpur S/S
Ending Point: Machhagadh S/S
Line Details: 33 kV, Double Circuit, 26 km
Substation Details: 33/11 kV, 16 MVA
Funding Agency: AIIB

Legend

Administrative
- International
- Province
- District
- Municipality
- Ward

33 kV Line Features
- Angle Points
- Terminal Points
- Overhead Line
- Underground Cable
- Substation

Landuse
- Forest
- Built Up
- Cultivation
- Vegetation
- Barren Land
- Glacier
- Swamp Area
- Water Body
- Pond/Lake
- Others

Physical Features
- Airport
- Village Name
- River

Roads
- Trunk
- Primary Road
- Secondary Road
- Tertiary Road
- Track
- Unclassified Road

Coordinate System: WGS 1984 UTM Zone 44N
Projection: Transverse Mercator
Datum: WGS 1984
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: 81.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

0 60 120 180 240 300 Meters

Scale: 1:5,000

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Consultant:

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NEA ENGINEERING COMPANY LTD.

Client:

नेपाल विद्युत प्राधिकरण
Nepal Electricity Authority

Baijanath-6, Banke
Baijanath-8, Banke
Baijanath-5, Banke

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

Bansagadhi-3, Bardiya

Baijanath-6, Banke

Baijanath-8, Banke

Drawing No.: LINE-MAC-10



Salient Features

Project Name: Kohalpur Machhagadh
Starting Point: Bay Ext at Kohalpur S/S
Ending Point: Machhagadh S/S
Line Details: 33 kV, Double Circuit, 26 km
Substation Details: 33/11 kV, 16 MVA
Funding Agency: AIIB

Legend

Administrative
- International
- Province
- District
- Municipality
- Ward

33 kV Line Features
- Angle Points
- Terminal Points
- Overhead Line
- Underground Cable
- Substation

Landuse
- Forest
- Built Up
- Cultivation
- Vegetation
- Barren Land
- Glacier
- Swamp Area
- Water Body
- Pond/Lake
- Others

Physical Features
- Airport
- Village Name
- River

Roads
- Trunk
- Primary Road
- Secondary Road
- Tertiary Road
- Track
- Unclassified Road

Coordinate System: WGS 1984 UTM Zone 44N
Projection: Transverse Mercator
Datum: WGS 1984
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: 81.0000
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Units: Meter

0 60 120 180 240 300 Meters

Scale: 1:5,000

FOR TENDER PURPOSE ONLY

Consultant:

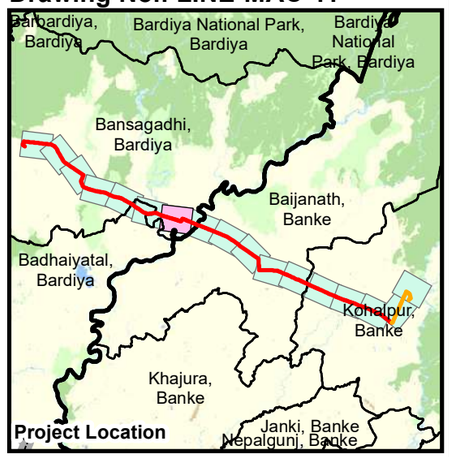
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NEA ENGINEERING COMPANY LTD.

Client:

नेपाल विद्युत प्राधिकरण
Nepal Electricity Authority

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

Drawing No.: LINE-MAC-11



Salient Features

Project Name: Kohalpur Machhagadh
Starting Point: Bay Ext at Kohalpur S/S
Ending Point: Machhagadh S/S
Line Details: 33 kV, Double Circuit, 26 km
Substation Details: 33/11 kV, 16 MVA
Funding Agency: AIIB

Legend

Administrative
- International
- Province
- District
- Municipality
- Ward

33 kV Line Features
- Angle Points
- Terminal Points
- Overhead Line
- Underground Cable
- Substation

Landuse
- Forest
- Built Up
- Cultivation
- Vegetation
- Barren Land
- Glacier
- Swamp Area
- Water Body
- Pond/Lake
- Others

Physical Features
- Airport
- Village Name
- River

Roads
- Trunk
- Primary Road
- Secondary Road
- Tertiary Road
- Track
- Unclassified Road

Coordinate System: WGS 1984 UTM Zone 44N
Projection: Transverse Mercator
Datum: WGS 1984
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False Northing: 0.0000
Central Meridian: 81.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

0 60 120 180 240 300 Meters

Scale: 1:5,000

FOR TENDER PURPOSE ONLY

Consultant:

एनइए इन्जिनियरिङ्ग कम्पनी लि.
NEA ENGINEERING COMPANY LTD.

Client:

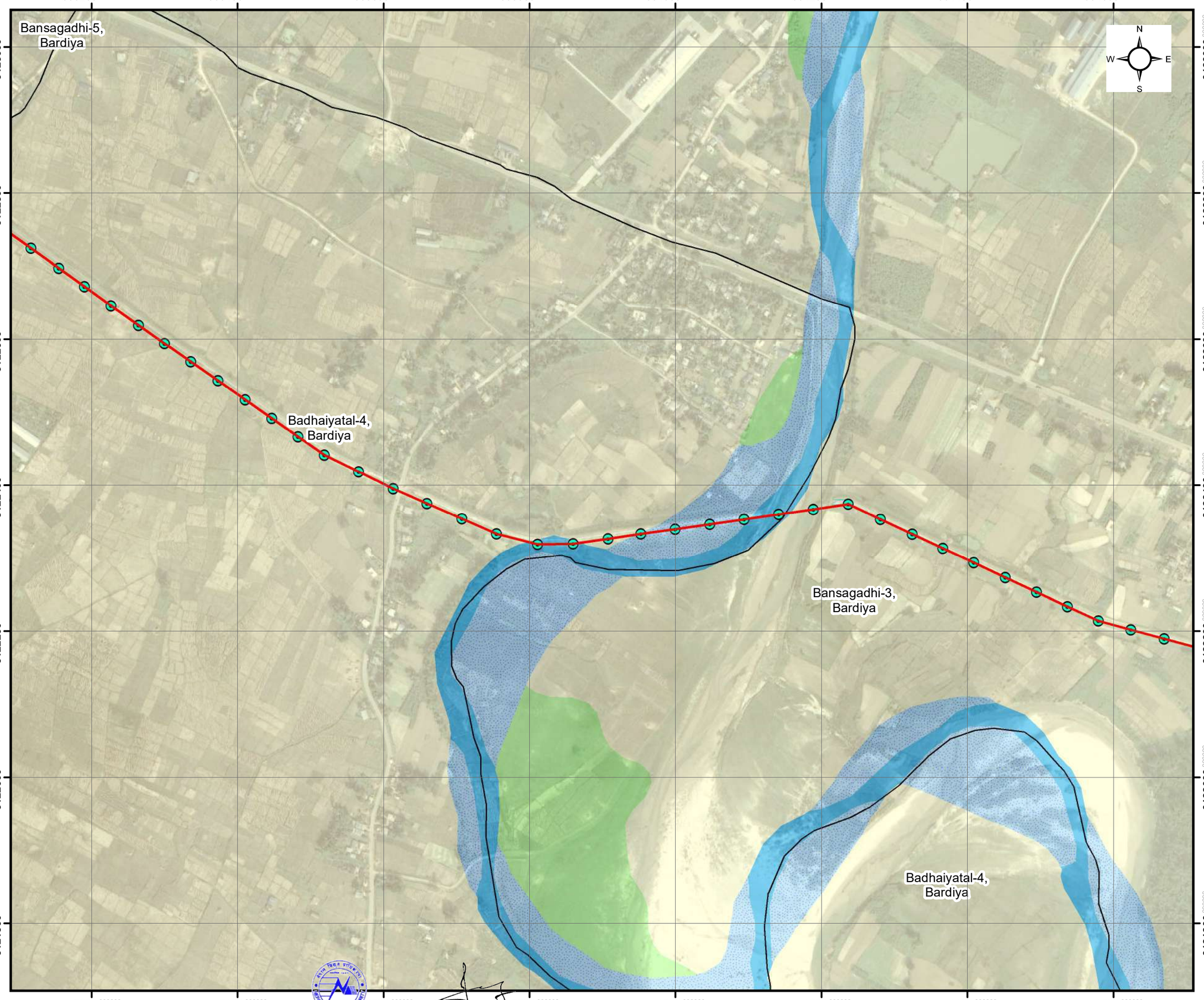
नेपाल विद्युत प्राधिकरण
Nepal Electricity Authority

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3122600 3122400 3122200 3122000 3121800 3121600 3121400

Bansagadhi-3, Bardiya
Badhaiyatal-4, Bardiya
Baijanath-8, Banke
Baijanath-8, Banke

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT



Drawing No.: LINE-MAC-12



Salient Features

Project Name: Kohalpur Machhagadh
Starting Point: Bay Ext at Kohalpur S/S
Ending Point: Machhagadh S/S
Line Details: 33 kV, Double Circuit, 26 km
Substation Details: 33/11 kV, 16 MVA
Funding Agency: AIIB

Legend

Administrative
- International
- Province
- District
- Municipality
- Ward

33 kV Line Features
- Angle Points
- Terminal Points
- Overhead Line
- Underground Cable
- Substation

Landuse
- Forest
- Built Up
- Cultivation
- Vegetation
- Barren Land
- Glacier
- Swamp Area
- Water Body
- Pond/Lake
- Others

Physical Features
- Airport
- Village Name
- River

Roads
- Trunk
- Primary Road
- Secondary Road
- Tertiary Road
- Track
- Unclassified Road

Coordinate System: WGS 1984 UTM Zone 44N
Projection: Transverse Mercator
Datum: WGS 1984
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: 81.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

0 60 120 180 240 300 Meters

Scale: 1:5,000

FOR TENDER PURPOSE ONLY

Consultant:

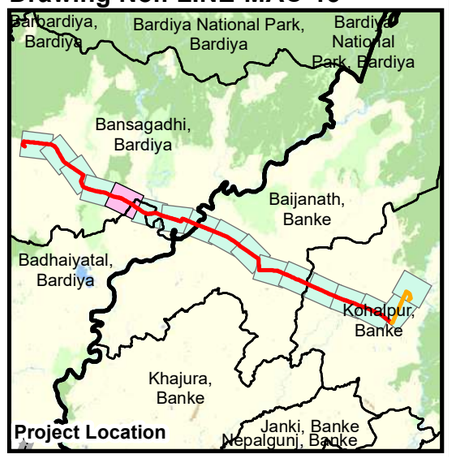
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NEA ENGINEERING COMPANY LTD.

Client:

नेपाल विद्युत प्राधिकरण
Nepal Electricity Authority

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

Drawing No.: LINE-MAC-13



Salient Features

Project Name: Kohalpur Machhagadh
Starting Point: Bay Ext at Kohalpur S/S
Ending Point: Machhagadh S/S
Line Details: 33 kV, Double Circuit, 26 km
Substation Details: 33/11 kV, 16 MVA
Funding Agency: AIIB

Legend

Administrative
- International
- Province
- District
- Municipality
- Ward

33 kV Line Features
- Angle Points
- Terminal Points
- Overhead Line
- Underground Cable
- Substation

Landuse
- Forest
- Built Up
- Cultivation
- Vegetation
- Barren Land
- Glacier
- Swamp Area
- Water Body
- Pond/Lake
- Others

Physical Features
- Airport
- Village Name
- River

Roads
- Trunk
- Primary Road
- Secondary Road
- Tertiary Road
- Track
- Unclassified Road

Coordinate System: WGS 1984 UTM Zone 44N
Projection: Transverse Mercator
Datum: WGS 1984
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: 81.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

0 60 120 180 240 300 Meters

Scale: 1:5,000

FOR TENDER PURPOSE ONLY

Consultant:

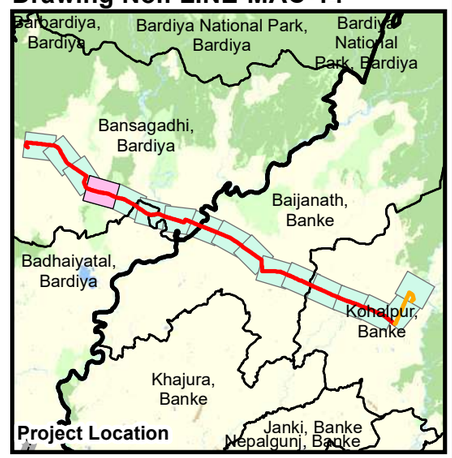
एनइए इन्जिनियरिङ्ग कम्पनी लि.
NEA ENGINEERING COMPANY LTD.

Client:

नेपाल विद्युत प्राधिकरण
Nepal Electricity Authority

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

Drawing No.: LINE-MAC-14



Salient Features

Project Name: Kohalpur Machhagadh
Starting Point: Bay Ext at Kohalpur S/S
Ending Point: Machhagadh S/S
Line Details: 33 kV, Double Circuit, 26 km
Substation Details: 33/11 kV, 16 MVA
Funding Agency: AIIB

Legend

Administrative
- International
- Province
- District
- Municipality
- Ward

33 kV Line Features
- Angle Points
- Terminal Points
- Overhead Line
- Underground Cable
- Substation

Landuse
- Forest
- Built Up
- Cultivation
- Vegetation
- Barren Land
- Glacier
- Swamp Area
- Water Body
- Pond/Lake
- Others

Physical Features
- Airport
- Village Name
- River

Roads
- Trunk
- Primary Road
- Secondary Road
- Tertiary Road
- Track
- Unclassified Road

Coordinate System: WGS 1984 UTM Zone 44N
Projection: Transverse Mercator
Datum: WGS 1984
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: 81.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

0 60 120 180 240 300 Meters

Scale: 1:5,000

FOR TENDER PURPOSE ONLY

Consultant:

एनइए इन्जिनियरिङ्ग कम्पनी लि.
NEA ENGINEERING COMPANY LTD.

Client:

नेपाल विद्युत प्राधिकरण
Nepal Electricity Authority

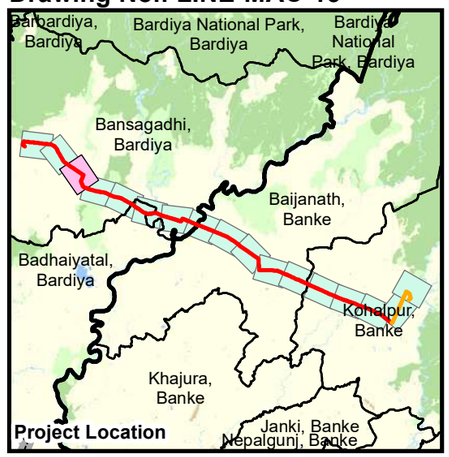
Bansagadhi-5,
Bardiya

550600 550800 551000 551200 551400 551600 551800 552000

3124000 3123800 3123600 3123400 3123200 3123000

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

Drawing No.: LINE-MAC-15



Salient Features

Project Name: Kohalpur Machhagadh
Starting Point: Bay Ext at Kohalpur S/S
Ending Point: Machhagadh S/S
Line Details: 33 kV, Double Circuit, 26 km
Substation Details: 33/11 kV, 16 MVA
Funding Agency: AIIB

Legend

Administrative
- International
- Province
- District
- Municipality
- Ward

33 kV Line Features
- Angle Points
- Terminal Points
- Overhead Line
- Underground Cable
- Substation

Landuse
- Forest
- Built Up
- Cultivation
- Vegetation
- Barren Land
- Glacier
- Swamp Area
- Water Body
- Pond/Lake
- Others

Physical Features
- Airport
- Village Name
- River

Roads
- Trunk
- Primary Road
- Secondary Road
- Tertiary Road
- Track
- Unclassified Road

Coordinate System: WGS 1984 UTM Zone 44N
Projection: Transverse Mercator
Datum: WGS 1984
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: 81.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

0 60 120 180 240 300 Meters

Scale: 1:5,000

FOR TENDER PURPOSE ONLY

Consultant:

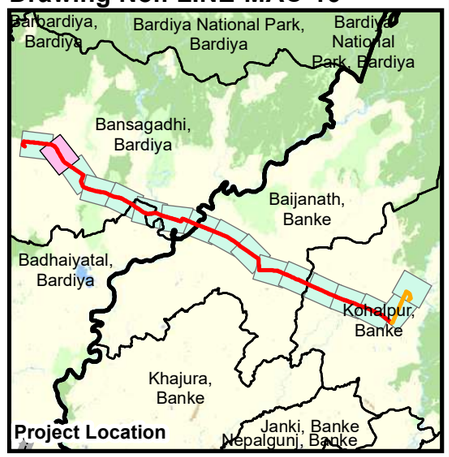
एनइए इन्जिनियरिङ्ग कम्पनी लि.
NEA ENGINEERING COMPANY LTD.

Client:

नेपाल विद्युत प्राधिकरण
Nepal Electricity Authority

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

Drawing No.: LINE-MAC-16



Salient Features

Project Name: Kohalpur Machhagadh
Starting Point: Bay Ext at Kohalpur S/S
Ending Point: Machhagadh S/S
Line Details: 33 kV, Double Circuit, 26 km
Substation Details: 33/11 kV, 16 MVA
Funding Agency: AIIB

Legend

Administrative
- International
- Province
- District
- Municipality
- Ward

33 kV Line Features
- Angle Points
- Terminal Points
- Overhead Line
- Underground Cable
- Substation

Landuse
- Forest
- Built Up
- Cultivation
- Vegetation
- Barren Land
- Glacier
- Swamp Area
- Water Body
- Pond/Lake
- Others

Physical Features
- Airport
- Village Name
- River

Roads
- Trunk
- Primary Road
- Secondary Road
- Tertiary Road
- Track
- Unclassified Road

Coordinate System: WGS 1984 UTM Zone 44N
Projection: Transverse Mercator
Datum: WGS 1984
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: 81.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

0 60 120 180 240 300 Meters

Scale: 1:5,000

FOR TENDER PURPOSE ONLY

Consultant:

एनइए इन्जिनियरिङ्ग कम्पनी लि.
NEA ENGINEERING COMPANY LTD.

Client:

नेपाल विद्युत प्राधिकरण
Nepal Electricity Authority

Bansagadhi-8, Bardiya
Bansagadhi-4, Bardiya
Bansagadhi-6, Bardiya

DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

Drawing No.: LINE-MAC-17



Salient Features

Project Name: Kohalpur Machhagadh
Starting Point: Bay Ext at Kohalpur S/S
Ending Point: Machhagadh S/S
Line Details: 33 kV, Double Circuit, 26 km
Substation Details: 33/11 kV, 16 MVA
Funding Agency: AIIB

Legend

Administrative
- International
- Province
- District
- Municipality
- Ward

33 kV Line Features
- Angle Points
- Terminal Points
- Overhead Line
- Underground Cable
- Substation

Landuse
- Forest
- Built Up
- Cultivation
- Vegetation
- Barren Land
- Glacier
- Swamp Area
- Water Body
- Pond/Lake
- Others

Physical Features
- Airport
- Village Name
- River

Roads
- Trunk
- Primary Road
- Secondary Road
- Tertiary Road
- Track
- Unclassified Road

Coordinate System: WGS 1984 UTM Zone 44N
Projection: Transverse Mercator
Datum: WGS 1984
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: 81.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

0 60 120 180 240 300 Meters

Scale: 1:5,000

FOR TENDER PURPOSE ONLY

Consultant:

एनइए इन्जिनियरिङ्ग कम्पनी लि.
NEA ENGINEERING COMPANY LTD.

Client:

नेपाल विद्युत प्राधिकरण
Nepal Electricity Authority

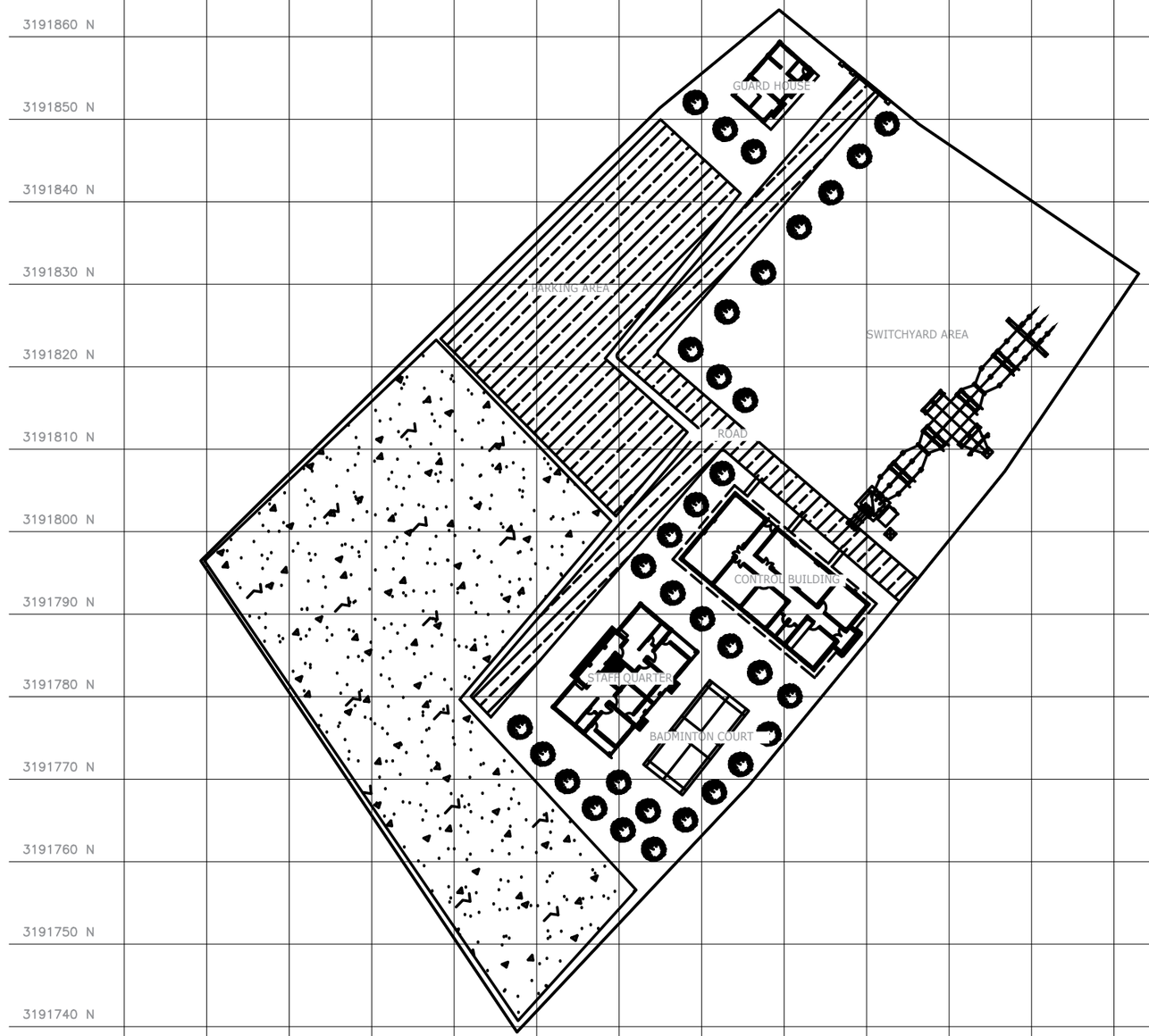
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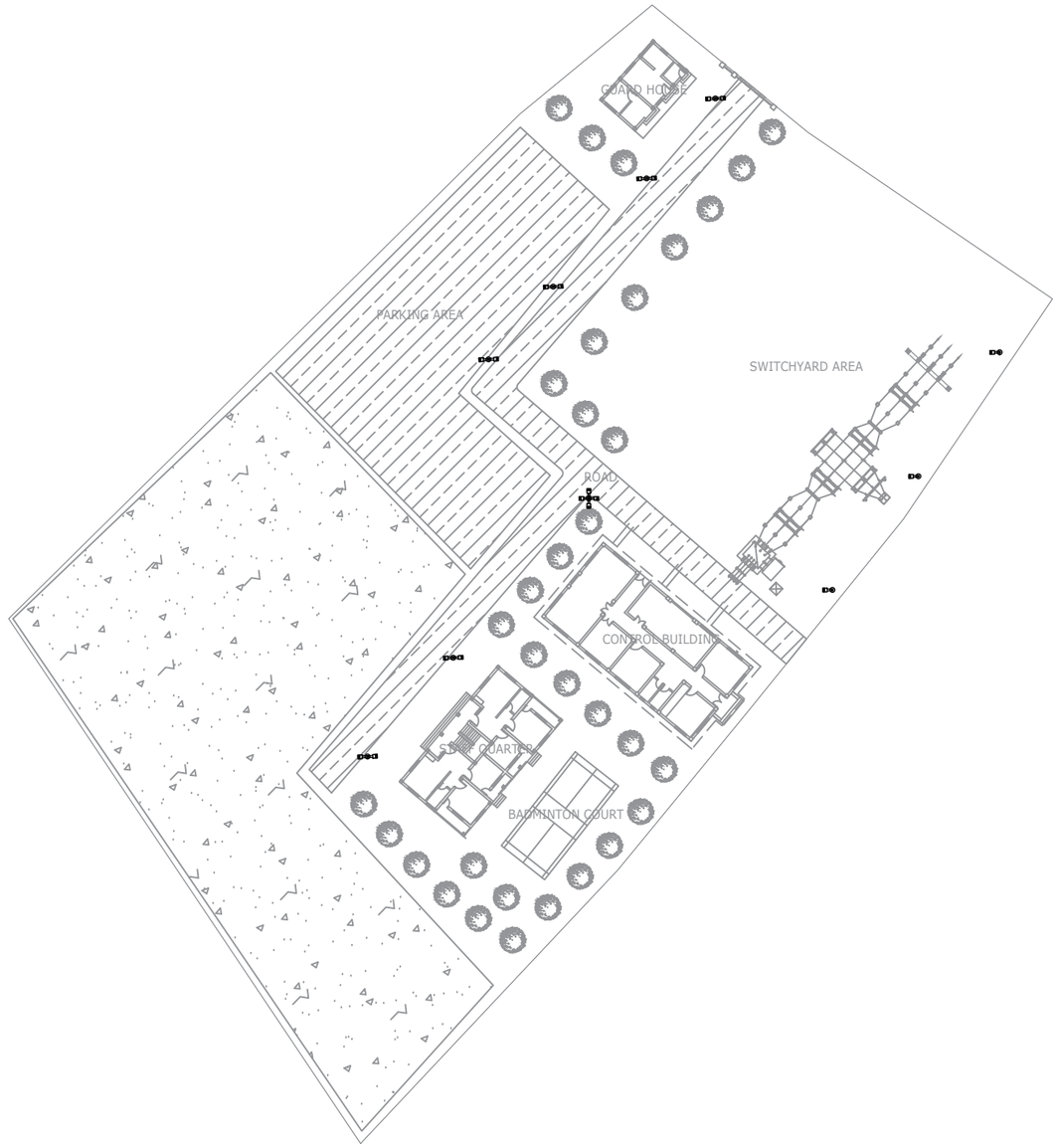
Bansagadhi-8,
Bardiya

Machhagadh
Substation

N
W E
S



CLIENT	CONSULTANT	PROJECT	DRAWN	DESIGNED	TITLE
NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY NOT IN SCALE	DRAFTING CHECK APPROVED	DESIGN CHECK DRAWING NO. SS-LAY-BUD	33/11 kV SUBSTATION LAYOUT FOR BUDHEBAPAR SUBSTATION

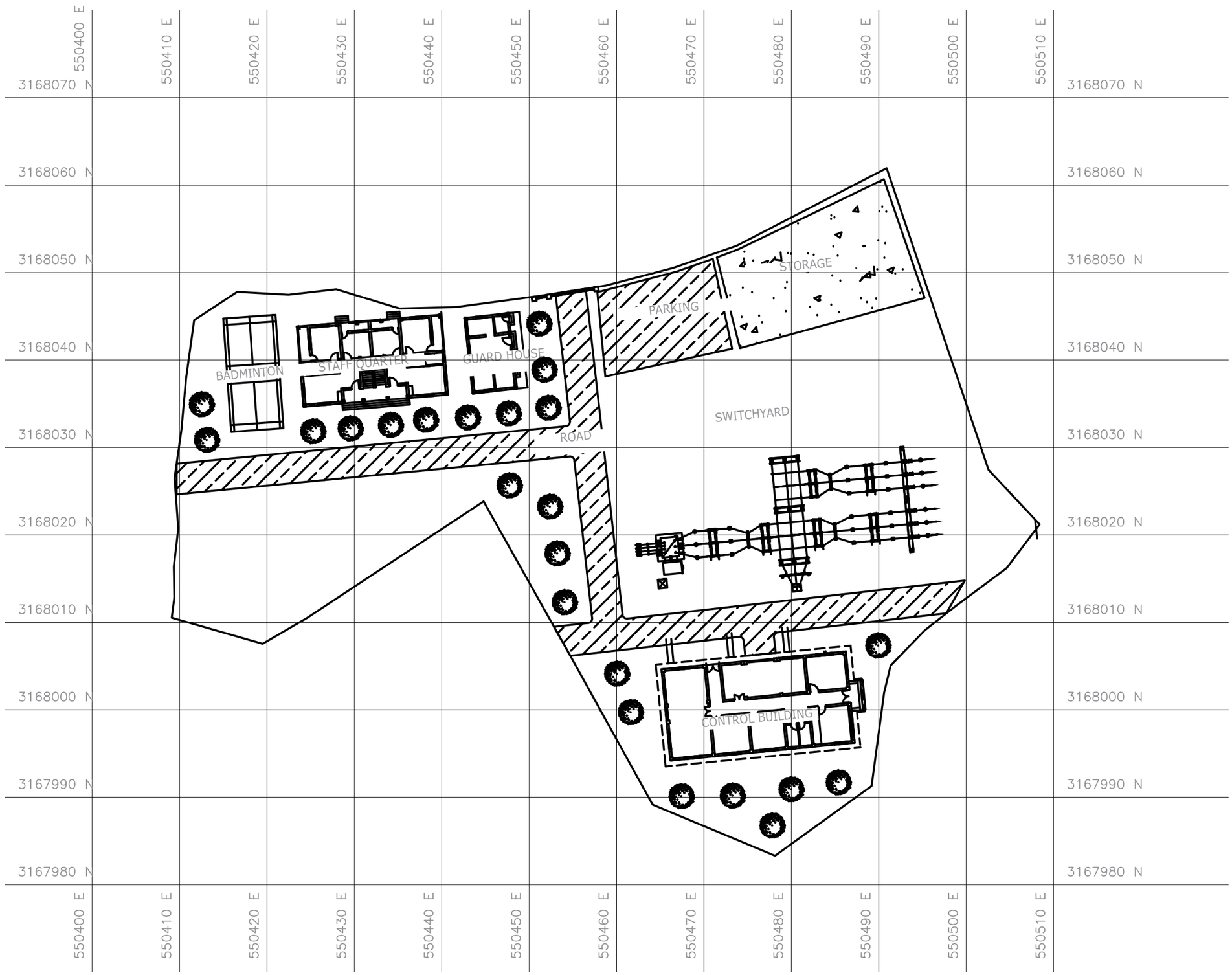


LEGEND

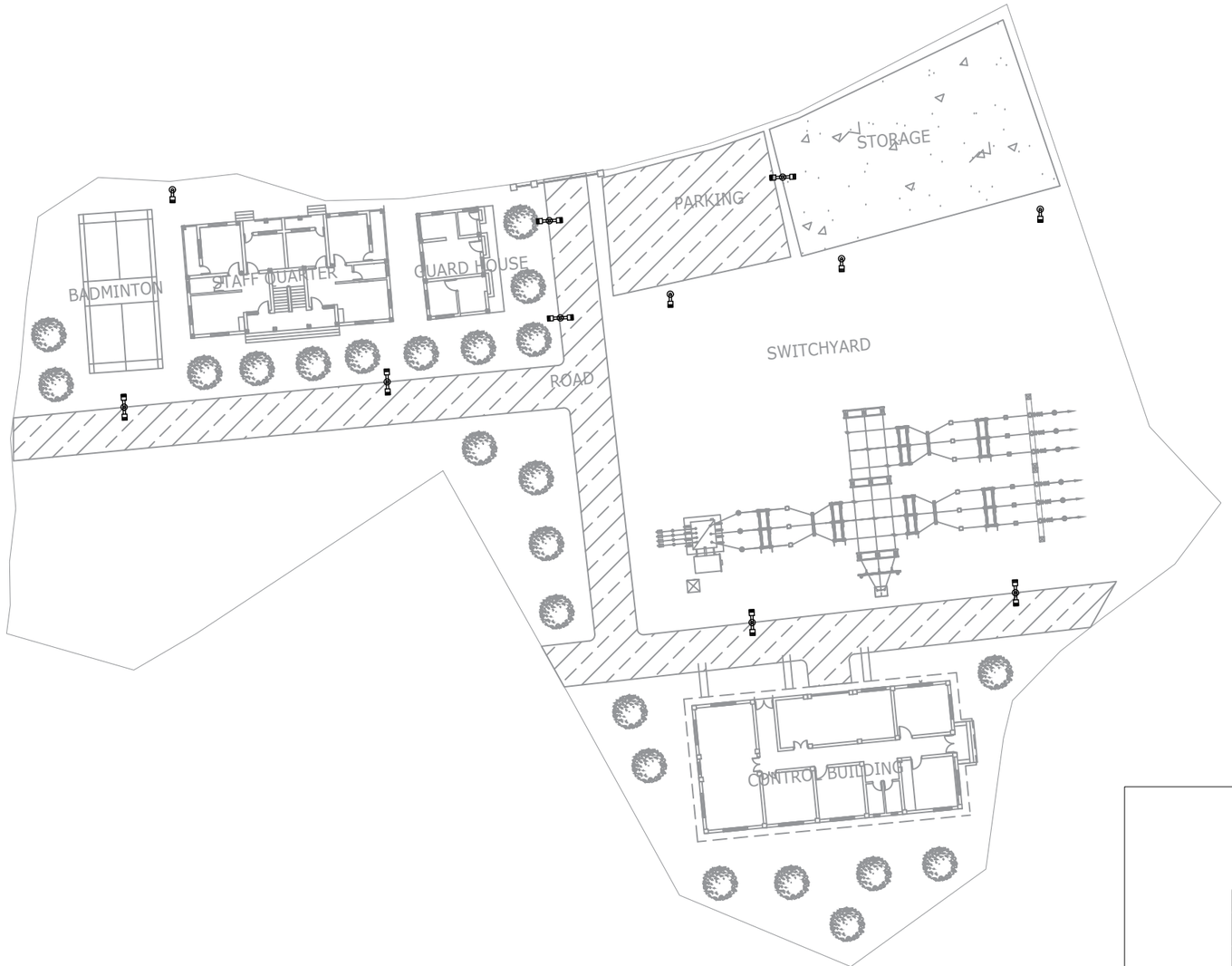
SYMBOL	DESCRIPTION
	100W, 230V LED STREET LIGHT LUMINAIRE
	100W, 230V TWO WAY LED STREET LIGHT LUMINAIRE
	100W, 230V FOUR WAY LED STREET LIGHT LUMINAIRE

NOTES:
ADDITIONAL BEAUTIFICATION LIGHTS HAS TO PROVIDED FOR GATE TOPS, BOUNDARY WALLS AND SWITCHYARD FENCING

CLIENT: NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT: NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT: DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY NOT IN SCALE	DRAWN DRAFTING CHECK APPROVED DESIGNED DESIGN CHECK DRAWING NO. SS-ELE-BUD	TITLE: 33/11 kV SUBSTATION LAYOUT (OUTDOOR LIGHTING) FOR BUDHEBHAPAR SUBSTATION



CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY NOT IN SCALE	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. SS-LAY-BAD	TITLE 33/11 kV SUBSTATION LAYOUT FOR BADDICHAUR SUBSTATION



LEGEND

SYMBOL	DESCRIPTION
	100W, 230V LED STREET LIGHT LUMINAIRE
	100W, 230V TWO WAY LED STREET LIGHT LUMINAIRE
	100W, 230V FOUR WAY LED STREET LIGHT LUMINAIRE

NOTES:
ADDITIONAL BEAUTIFICATION LIGHTS HAS TO PROVIDED FOR GATE TOPS, BOUNDARY WALLS AND SWITCHYARD FENCING

CLIENT
NEPAL ELECTRICITY AUTHORITY
DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
DURBARMARGA, KATHMANDU, NEPAL

CONSULTANT
NEA ENGINEERING COMPANY LTD.
TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL

PROJECT
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

FOR TENDER PURPOSE ONLY

NOT IN SCALE

DRAWN

DESIGNED

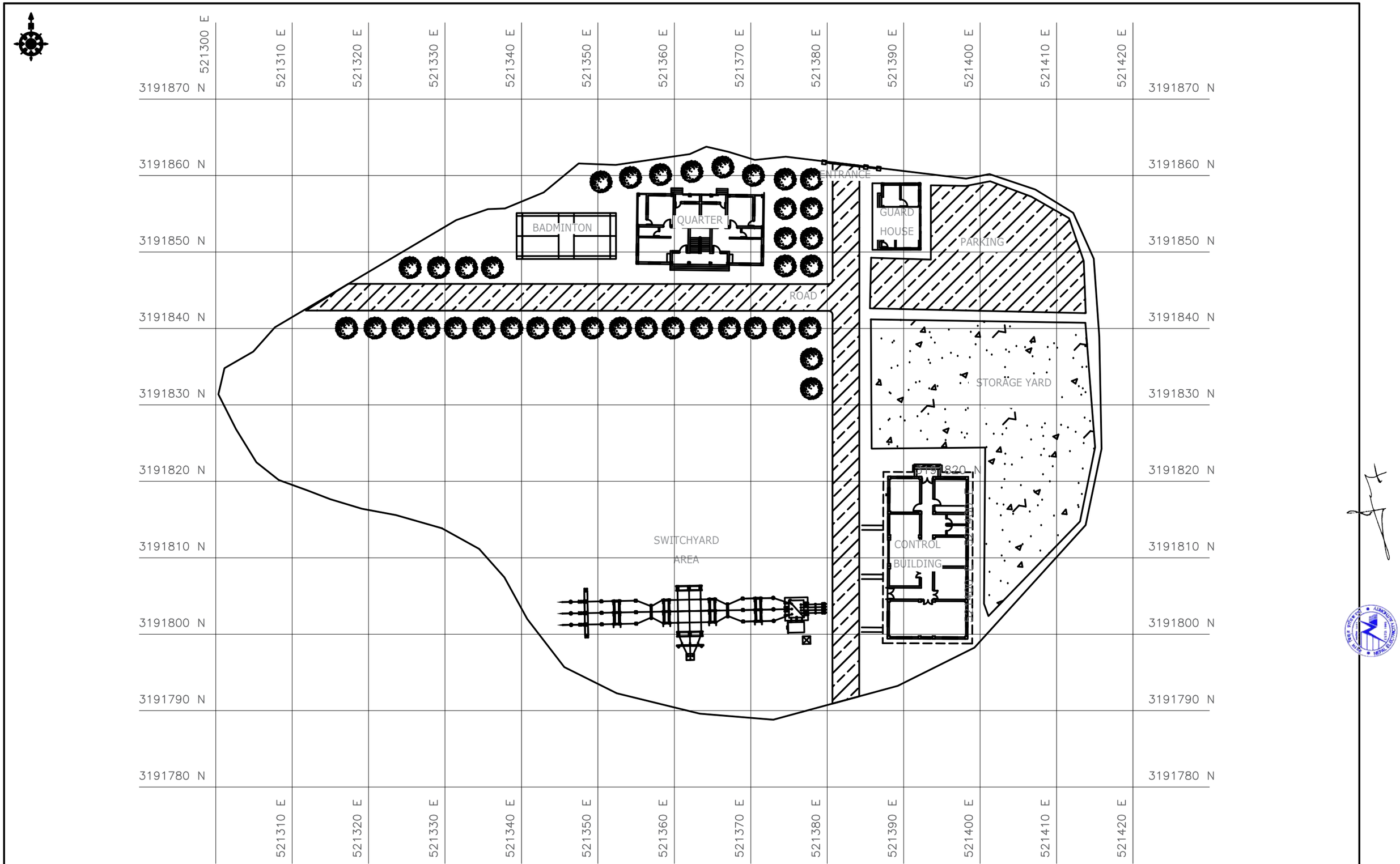
DRAFTING CHECK

DESIGN CHECK

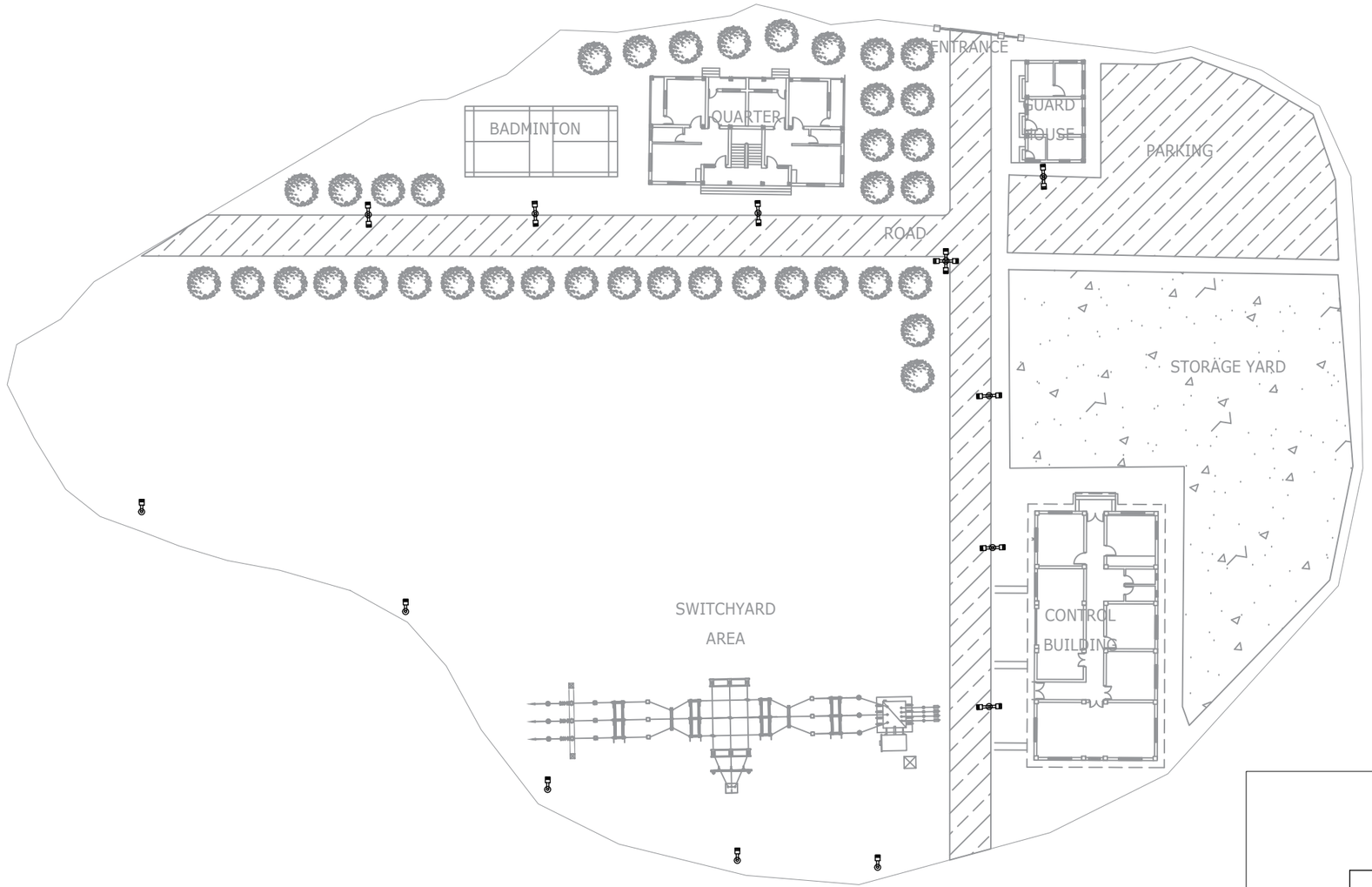
APPROVED

DRAWING NO.
SS-ELE-BAD

TITLE
33/11 kV SUBSTATION LAYOUT (OUTDOOR LIGHTING) FOR
BADDICHAUR SUBSTATION



CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY NOT IN SCALE	DRAWN	DESIGNED	TITLE 33/11 kV SUBSTATION LAYOUT FOR PIPLE SUBSTATION
			DRAFTING CHECK	DESIGN CHECK	
			APPROVED	DRAWING NO. SS-LAY-PIP	



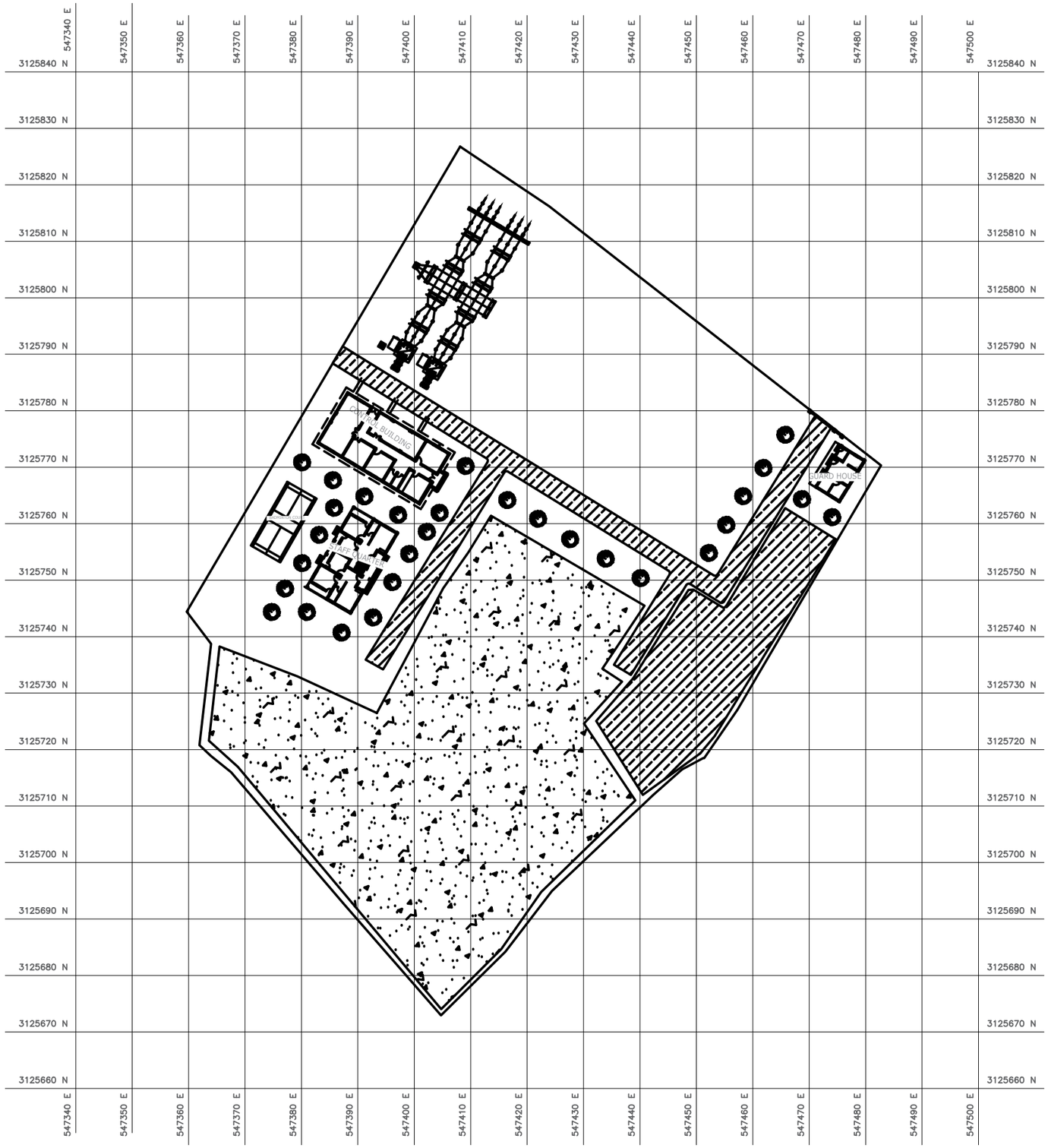
LEGEND

SYMBOL	DESCRIPTION
	100W, 230V LED STREET LIGHT LUMINAIRE
	100W, 230V TWO WAY LED STREET LIGHT LUMINAIRE
	100W, 230V FOUR WAY LED STREET LIGHT LUMINAIRE

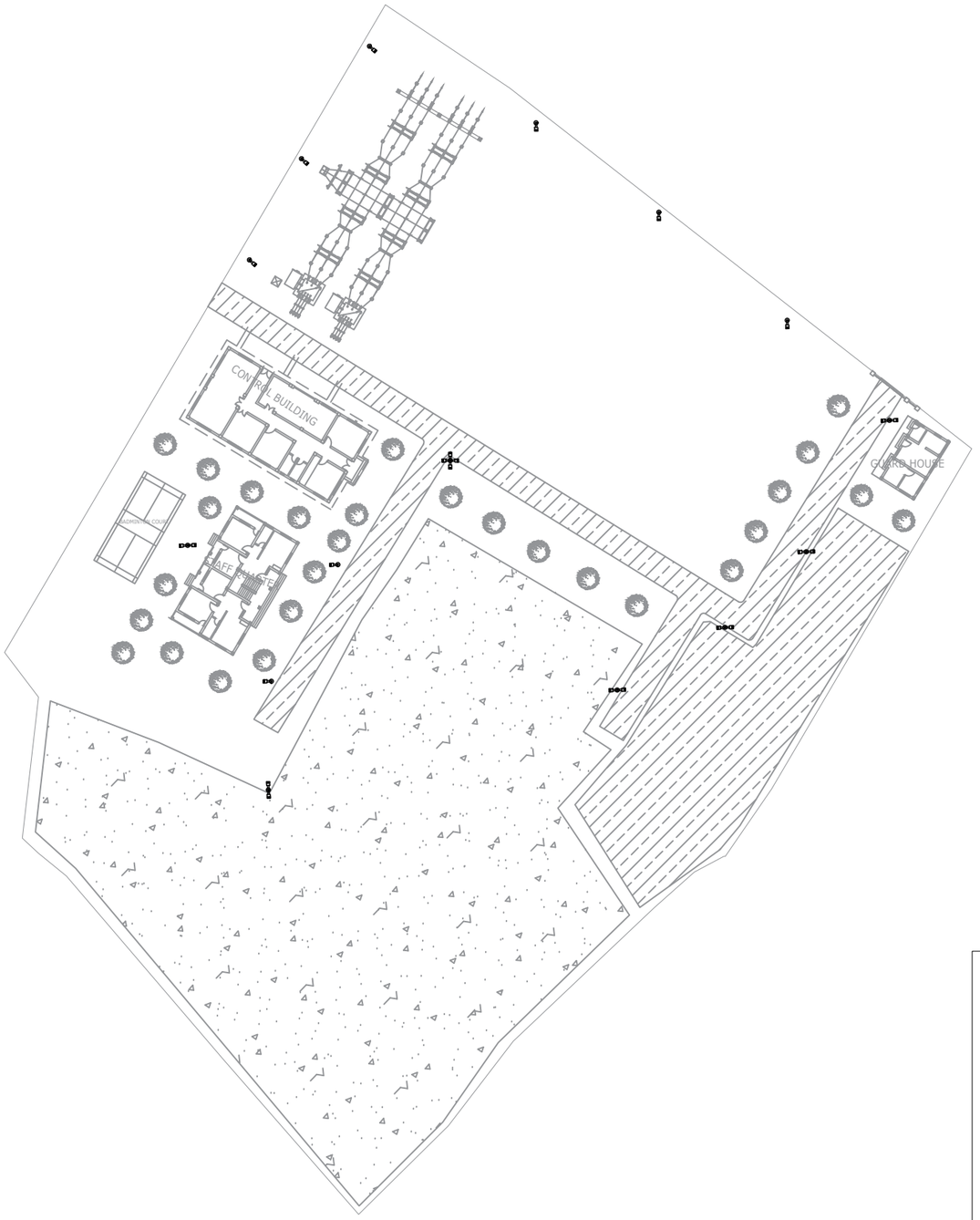
NOTES:
ADDITIONAL BEAUTIFICATION LIGHTS HAS TO PROVIDED FOR GATE TOPS, BOUNDARY WALLS AND SWITCHYARD FENCING

CLIENT: NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT: NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT: DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY NOT IN SCALE	DRAWN / DESIGNED DRAFTING CHECK / DESIGN CHECK APPROVED / DRAWING NO. SS-ELE-PIP

TITLE: 33/11 kV SUBSTATION LAYOUT (OUTDOOR LIGHTING) FOR PIPLE SUBSTATION



CLIENT NEPAL ELECTRICITY AUTHORITY DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT DURBARMARGA, KATHMANDU, NEPAL	CONSULTANT NEA ENGINEERING COMPANY LTD. TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL	PROJECT DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT FOR TENDER PURPOSE ONLY NOT IN SCALE	DRAWN DRAFTING CHECK APPROVED	DESIGNED DESIGN CHECK DRAWING NO. SS-LAY-MAC	TITLE 33/11 kV SUBSTATION LAYOUT FOR MACHHAGADH SUBSTATION



LEGEND

SYMBOL	DESCRIPTION
	100W, 230V LED STREET LIGHT LUMINAIRE
	100W, 230V TWO WAY LED STREET LIGHT LUMINAIRE
	100W, 230V FOUR WAY LED STREET LIGHT LUMINAIRE

NOTES:
ADDITIONAL BEAUTIFICATION LIGHTS HAS TO PROVIDED FOR GATE TOPS, BOUNDARY WALLS AND SWITCHYARD FENCING

CLIENT
NEPAL ELECTRICITY AUTHORITY
DISTRIBUTION AND CONSUMER SERVICES DIRECTORATE
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT
DURBARMARGA, KATHMANDU, NEPAL

CONSULTANT
NEA ENGINEERING COMPANY LTD.
TRADE TOWER,THAPATHALI, KATHMANDU, NEPAL

PROJECT
DISTRIBUTION SYSTEM UPGRADE AND EXPANSION PROJECT

FOR TENDER PURPOSE ONLY

NOT IN SCALE

DRAWN	DESIGNED
DRAFTING CHECK	DESIGN CHECK
APPROVED	DRAWING NO. SS-ELE-RAS

TITLE
33/11 kV SUBSTATION LAYOUT (OUTDOOR LIGHTING) FOR
MACHHAGADH SUBSTATION

Volume II

Section 6: Employer's Requirements

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A	Scope of Supply of Plant and Services
B1	Technical Specifications
B2	Technical Data Schedule
C	Drawings
D	Supplementary Information

Name of Tenderer _____

Signature of Tenderer_____

Volume II

Section 6: Employer's Requirements

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A	Scope of Supply of Plant and Services	
B1	Technical Specifications	
B2	Technical Data Schedule	
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	D.1	Environmental and Social Information of Projects
	D.2	Malarani Pipledanda 33 kV line of Substation Location and Angle Points
	D.3	Kohalpur Machhagadh 33 kV line of Substation Location and Angle Points
	D.4	Babiyachaur Budhebhapar 33 kV line of Substation Location and Angle Points
	D.5	Baddichaur Odaltal 33 kV line of Substation Location and Angle Points

Name of Tenderer _____

Signature of Tenderer_____

Nepal Electricity Authority
Distribution and Consumer Services Directorate
Distribution System Upgrade and Expansion Project
Environmental and Social Information of Projects

Refer to respective ESMP Reports

SN	Title	Remarks
1	ESMP Report of Malarani Pipledanda 33 kV line	
2	ESMP Report of Kohalpur Machhagadh 33 kV line	
3	ESMP Report of Babiyachaur Budhebhapar 33 kV line	
4	ESMP Report of Baddichaur Odaltal 33 kV line	

Name of Tenderer _____

Signature of Tenderer_____

Nepal Electricity Authority
Distribution and Consumer Services Directorate
Distribution System Upgrade and Expansion Project
Malarani Pipledanda 33 kV line
Substation Location and Angle Points

WGS 1984 UTM Zone 44N

Pole Code	Easting	Northing	Elevation, m	Ahead Span, m	Deviation Angle, Degree	Pole Height, m	Physical Region	Conductor	Cumulative Span, m	Selected Pole Type
P1	591781.583	3137395.645	802.8	40.864	0	11	Hilly	DOG	40.864	DDPDA
P2	591803.348	3137361.061	795.758	43.273	0	11	Hilly	DOG	84.137	SPSA
P3	591826.397	3137324.437	788.3	58.807	-2.2306	11	Hilly	DOG	142.944	SPDDE
P4	591859.634	3137275.923	781.7	36.145	-6.6305	11	Hilly	DOG	179.089	SPDDE
P5	591883.369	3137248.663	782.992	36.614	0	11	Hilly	DOG	215.703	SPSA
P6	591907.412	3137221.049	784.3	44.648	-43.2682	11	Hilly	DOG	260.351	DDPDA
P7	591951.84	3137216.625	784.009	47.457	0	11	Hilly	DOG	307.808	SPSA
P8	591999.064	3137211.923	783.7	36.925	-21.738	11	Hilly	DOG	344.733	SPDDE
P9	592034.549	3137222.133	784.199	37.074	0	11	Hilly	DOG	381.807	SPSA
P10	592070.178	3137232.384	784.7	38.774	19.8712	11	Hilly	DOG	420.581	SPDDE
P11	592108.866	3137229.801	786.356	40.847	0	11	Hilly	DOG	461.428	SPSA
P12	592149.623	3137227.08	788.1	43.621	37.4539	11	Hilly	DOG	505.049	DDPDA
P13	592182.407	3137198.305	786.974	41.59	0	11	Hilly	DOG	546.639	SPSA
P14	592213.665	3137170.87	785.9	37.453	17.5093	11	Hilly	DOG	584.092	SPDDE
P15	592233.076	3137138.839	790.917	38.694	0	11	Hilly	DOG	622.786	SPSA
P16	592253.131	3137105.748	796.1	48.396	0.0399	11	Hilly	DOG	671.182	SPDDE
P17	592278.185	3137064.342	800.403	48.334	0	11	Hilly	DOG	719.516	SPSA
P18	592303.207	3137022.989	804.7	43.549	2.4515	11	Hilly	DOG	763.065	SPDDE
P19	592324.137	3136984.799	807.714	41.708	0	11	Hilly	DOG	804.773	SPSA
P20	592344.183	3136948.224	810.6	43.343	-36.7762	11	Hilly	DOG	848.116	DDPDA
P21	592383.624	3136930.252	811.031	43.008	0	11	Hilly	DOG	891.124	SPSA
P22	592422.76	3136912.418	811.458	44.479	0	11	Hilly	DOG	935.603	SPSA
P23	592463.235	3136893.974	811.9	62.19	-20.5443	11	Hilly	DOG	997.793	SPDDE

Name of Tenderer _____

Signature of Tenderer_____

Nepal Electricity Authority
Distribution and Consumer Services Directorate
Distribution System Upgrade and Expansion Project
Malarani Pipledanda 33 kV line
Substation Location and Angle Points

WGS 1984 UTM Zone 44N

Pole Code	Easting	Northing	Elevation, m	Ahead Span, m	Deviation Angle, Degree	Pole Height, m	Physical Region	Conductor	Cumulative Span, m	Selected Pole Type
P24	592525.277	3136889.686	819.4	46.828	48.6204	11	Hilly	DOG	1044.621	DDPDA
P25	592553.736	3136852.498	820.896	47.082	0	11	Hilly	DOG	1091.703	SPSA
P26	592582.349	3136815.109	822.4	49.28	-11.2807	11	Hilly	DOG	1140.983	SPDDE
P27	592619.376	3136782.588	824.012	48.577	0	11	Hilly	DOG	1189.56	SPSA
P28	592655.873	3136750.532	825.6	46.464	-34.2793	11	Hilly	DOG	1236.024	DDPDA
P29	592701.99	3136744.858	824.382	48.916	0	11	Hilly	DOG	1284.94	SPSA
P30	592750.54	3136738.885	823.1	37.709	-10.319	11	Hilly	DOG	1322.649	SPDDE
P31	592788.186	3136741.059	824.477	41.682	0	11	Hilly	DOG	1364.331	SPSA
P32	592829.799	3136743.462	826	45.822	28.6008	11	Hilly	DOG	1410.153	SPDDE
P33	592871.227	3136723.883	826.566	51.257	0	11	Hilly	DOG	1461.41	SPSA
P34	592917.569	3136701.981	827.2	36.118	26.2142	11	Hilly	DOG	1497.528	SPDDE
P35	592940.048	3136673.71	834.477	35.879	0	11	Hilly	DOG	1533.407	DPA
P36	592962.378	3136645.628	841.705	38.209	0	11	Hilly	DOG	1571.616	SPSA
P37	592986.159	3136615.72	849.404	33.732	0	11	Hilly	DOG	1605.348	SPSA
P38	593007.153	3136589.318	856.2	41.198	0	11	Hilly	DOG	1646.546	SPSA
P39	593032.794	3136557.071	864.5	39.016	-14.6605	11	Hilly	DOG	1685.562	SPDDE
P40	593064.015	3136533.672	874.797	38.179	0	11	Hilly	DOG	1723.741	SPSA
P41	593094.566	3136510.776	884.872	43.238	0	11	Hilly	DOG	1766.979	SPSA
P42	593129.166	3136484.845	896.283	43.238	0	11	Hilly	DOG	1810.217	SPSA
P43	593163.766	3136458.914	907.694	45.492	0	11	Hilly	DOG	1855.709	SPSA
P44	593200.169	3136431.632	919.7	46.928	24.3966	11	Hilly	DOG	1902.637	SPDDE
P45	593222.744	3136390.491	931.912	49.144	0	11	Hilly	DOG	1951.781	SPSA
P46	593246.385	3136347.406	944.7	43.536	14.5277	11	Hilly	DOG	1995.317	SPDDE

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P47	593257.084	3136305.205	955.028	45.408	0	11	Hilly	DOG	2040.725	DPA
P48	593268.243	3136261.189	965.8	31.983	26.4097	11	Hilly	DOG	2072.708	SPDDE
P49	593261.493	3136229.927	979.126	38.69	0	11	Hilly	DOG	2111.398	SPSA
P50	593253.328	3136192.108	995.247	38.765	0	11	Hilly	DOG	2150.163	SPSA
P51	593245.146	3136154.216	1011.4	38.512	-39.8309	11	Hilly	DOG	2188.675	DDPDA
P52	593263.017	3136120.101	1022.879	38.332	0	11	Hilly	DOG	2227.007	SPSA
P53	593280.804	3136086.146	1034.305	40.577	0	11	Hilly	DOG	2267.584	SPSA
P54	593299.633	3136050.202	1046.4	44.326	-1.9821	11	Hilly	DOG	2311.91	SPDDE
P55	593321.547	3136011.672	1052.258	43.545	0	11	Hilly	DOG	2355.455	SPSA
P56	593343.075	3135973.821	1058.014	43.78	0	11	Hilly	DOG	2399.235	SPSA
P57	593364.719	3135935.766	1063.8	41.344	-47.1831	11	Hilly	DOG	2440.579	DDPDA
P58	593404.972	3135926.334	1065.72	40.172	0	11	Hilly	DOG	2480.751	SPSA
P59	593444.085	3135917.169	1067.585	45.538	0	11	Hilly	DOG	2526.289	DPA
P60	593488.422	3135906.78	1069.7	39.387	11.9106	11	Hilly	DOG	2565.676	SPDDE
P61	593524.09	3135890.073	1060.512	40.679	0	11	Hilly	DOG	2606.355	SPSA
P62	593560.928	3135872.819	1051.023	39.134	0	11	Hilly	DOG	2645.489	SPSA
P63	593596.367	3135856.219	1041.895	37.589	0	11	Hilly	DOG	2683.078	SPSA
P64	593630.408	3135840.275	1033.126	39.649	0	11	Hilly	DOG	2722.727	SPSA
P65	593666.313	3135823.457	1023.877	38.104	0	11	Hilly	DOG	2760.831	SPSA
P66	593700.82	3135807.294	1014.989	34.677	0	11	Hilly	DOG	2795.508	SPSA
P67	593732.223	3135792.585	1006.9	40.934	8.4937	11	Hilly	DOG	2836.442	SPDDE
P68	593766.321	3135769.937	1001.54	45.202	0	11	Hilly	DOG	2881.644	SPSA
P69	593803.974	3135744.928	995.622	47.521	0	11	Hilly	DOG	2929.165	SPSA

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P70	593843.559	3135718.636	989.4	38.343	-1.7081	11	Hilly	DOG	2967.508	SPDDE
P71	593876.117	3135698.383	978.918	41.923	0	11	Hilly	DOG	3009.431	DPA
P72	593911.715	3135676.24	967.458	41.005	0	11	Hilly	DOG	3050.436	SPSA
P73	593946.533	3135654.581	956.249	37.333	0	11	Hilly	DOG	3087.769	SPSA
P74	593978.234	3135634.862	946.043	31.519	0	11	Hilly	DOG	3119.288	SPSA
P75	594004.997	3135618.213	937.427	35.949	0	11	Hilly	DOG	3155.237	SPSA
P76	594035.522	3135599.225	927.6	38.676	61.1482	11	Hilly	DOG	3193.913	DDPDA
P77	594033.477	3135560.603	930.313	39.781	0	11	Hilly	DOG	3233.694	SPSA
P78	594031.373	3135520.877	933.103	39.292	0	11	Hilly	DOG	3272.986	SPSA
P79	594029.294	3135481.641	935.859	40.499	0	11	Hilly	DOG	3313.485	SPSA
P80	594027.152	3135441.198	938.7	37.432	-59.035	11	Hilly	DOG	3350.917	DDPDA
P81	594058.186	3135420.268	930.019	39.753	0	11	Hilly	DOG	3390.67	SPSA
P82	594091.144	3135398.04	920.8	38.605	32.6926	11	Hilly	DOG	3429.275	DDPDA
P83	594106.421	3135362.586	915.508	39.63	0	11	Hilly	DOG	3468.905	SPSA
P84	594122.103	3135326.191	910.076	39.219	0	11	Hilly	DOG	3508.124	DPA
P85	594137.623	3135290.173	904.7	45.097	-7.5631	11	Hilly	DOG	3553.221	SPDDE
P86	594160.764	3135251.466	888.889	48.196	0	11	Hilly	DOG	3601.417	SPSA
P87	594185.496	3135210.099	871.991	41.334	0	11	Hilly	DOG	3642.751	SPSA
P88	594206.706	3135174.622	857.5	38.611	-11.9031	11	Hilly	DOG	3681.362	SPDDE
P89	594232.928	3135146.282	844.228	39.659	0	11	Hilly	DOG	3721.021	SPSA
P90	594259.862	3135117.172	830.595	39.659	0	11	Hilly	DOG	3760.68	SPSA
P91	594286.796	3135088.062	816.962	40.327	0	11	Hilly	DOG	3801.007	SPSA
P92	594314.184	3135058.462	803.1	44.682	-14.0919	11	Hilly	DOG	3845.689	SPDDE

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P93	594351.602	3135034.04	802.559	43.79	0	11	Hilly	DOG	3889.479	SPSA
P94	594388.272	3135010.107	802.03	41.587	0	11	Hilly	DOG	3931.066	SPSA
P95	594423.098	3134987.377	801.526	45.993	0	11	Hilly	DOG	3977.059	SPSA
P96	594461.613	3134962.239	800.97	48.472	0	11	Hilly	DOG	4025.531	DPA
P97	594502.204	3134935.746	800.383	48.214	0	11	Hilly	DOG	4073.745	SPSA
P98	594542.58	3134909.394	799.8	51.804	-11.7737	11	Hilly	DOG	4125.549	SPDDE
P99	594590.826	3134890.528	793.427	33.021	0	11	Hilly	DOG	4158.57	SPSA
P100	594621.58	3134878.502	789.365	41.311	0	11	Hilly	DOG	4199.881	SPSA
P101	594660.054	3134863.457	784.284	42.964	0	11	Hilly	DOG	4242.845	SPSA
P102	594700.067	3134847.81	778.999	42.688	0	11	Hilly	DOG	4285.533	SPSA
P103	594739.824	3134832.263	773.747	41.587	0	11	Hilly	DOG	4327.12	SPSA
P104	594778.554	3134817.118	768.632	54.723	0	11	Hilly	DOG	4381.843	SPSA
P105	594829.519	3134797.188	761.9	48.368	5.4121	11	Hilly	DOG	4430.211	SPDDE
P106	594872.703	3134775.403	765.78	44.194	0	11	Hilly	DOG	4474.405	SPSA
P107	594912.16	3134755.498	769.324	34.603	0	11	Hilly	DOG	4509.008	DPA
P108	594943.054	3134739.912	772.1	42.886	-11.2202	11	Hilly	DOG	4551.894	SPDDE
P109	594984.371	3134728.415	774.637	42.983	0	11	Hilly	DOG	4594.877	SPSA
P110	595025.78	3134716.893	777.18	27.373	0	11	Hilly	DOG	4622.25	SPSA
P111	595052.151	3134709.555	778.8	42.852	11.4487	11	Hilly	DOG	4665.102	SPDDE
P112	595090.334	3134690.102	774.092	38.745	0	11	Hilly	DOG	4703.847	SPSA
P113	595124.856	3134672.513	769.835	33.991	0	11	Hilly	DOG	4737.838	SPSA
P114	595155.143	3134657.082	766.1	35.19	21.7305	11	Hilly	DOG	4773.028	SPDDE
P115	595178.355	3134630.633	766.244	39.552	0	11	Hilly	DOG	4812.58	SPSA

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P116	595204.444	3134600.906	766.405	42.781	0	11	Hilly	DOG	4855.361	SPSA
P117	595232.664	3134568.752	766.579	41.974	0	11	Hilly	DOG	4897.335	SPSA
P118	595260.351	3134537.205	766.751	36.58	0	11	Hilly	DOG	4933.915	SPSA
P119	595284.48	3134509.711	766.9	48.637	-14.9471	11	Hilly	DOG	4982.552	SPDDE
P120	595324.905	3134482.668	766.528	47.22	0	11	Hilly	DOG	5029.772	DPA
P121	595364.153	3134456.412	766.167	48.071	0	11	Hilly	DOG	5077.843	SPSA
P122	595404.107	3134429.683	765.8	40.316	30.8527	11	Hilly	DOG	5118.159	DDPDA
P123	595421.378	3134393.254	762.85	48.507	0	11	Hilly	DOG	5166.666	SPSA
P124	595442.159	3134349.423	759.3	28.552	-41.462	11	Hilly	DOG	5195.218	DDPDA
P125	595468.407	3134338.188	756.376	37.937	0	11	Hilly	DOG	5233.155	SPSA
P126	595503.283	3134323.26	752.49	37.984	0	11	Hilly	DOG	5271.139	SPSA
P127	595538.203	3134308.313	748.6	34.652	62.7933	11	Hilly	DOG	5305.791	DDPDA
P128	595540.641	3134273.747	742.397	41.321	0	11	Hilly	DOG	5347.112	SPSA
P129	595543.549	3134232.529	735	79.904	-30.3021	11	Hilly	DOG	5427.016	DDPDA
P130	595588.619	3134166.549	718.5	52.769	-11.4376	11	Hilly	DOG	5479.785	SPDDE
P131	595626.432	3134129.743	710.066	51.267	0	11	Hilly	DOG	5531.052	DPA
P132	595663.17	3134093.985	701.873	43.63	0	11	Hilly	DOG	5574.682	SPSA
P133	595694.435	3134063.554	694.9	51.31	-31.8399	11	Hilly	DOG	5625.992	DDPDA
P134	595744.551	3134052.548	689.3	58.914	6.8039	11	Hilly	DOG	5684.906	SPDDE
P135	595800.191	3134033.183	697.9	37.032	65.2032	11	Hilly	DOG	5721.938	DDPDA
P136	595803.809	3133996.328	694.2	26.767	-34.5389	11	Hilly	DOG	5748.705	DDPDA
P137	595821.067	3133975.867	692.8	43.361	-21.0667	11	Hilly	DOG	5792.066	SPDDE
P138	595859.069	3133954.986	684.1	36.375	11.7641	11	Hilly	DOG	5828.441	SPDDE

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P139	595886.708	3133931.337	671.907	40.762	0	11	Hilly	DOG	5869.203	SPSA
P140	595917.679	3133904.836	658.243	19.221	0	11	Hilly	DOG	5888.424	SPSA
P141	595932.284	3133892.34	651.8	63.557	-35.8574	11	Hilly	DOG	5951.981	DDPDA
P142	595995.628	3133887.139	664.525	37.526	0	11	Hilly	DOG	5989.507	SPSA
P143	596033.028	3133884.068	672.038	40.552	0	11	Hilly	DOG	6030.059	DPA
P144	596073.444	3133880.749	680.157	40.175	0	11	Hilly	DOG	6070.234	SPSA
P145	596113.485	3133877.461	688.2	63.732	8.0083	11	Hilly	DOG	6133.966	SPDDE
P146	596175.657	3133863.447	690.5	34.103	-43.1202	11	Hilly	DOG	6168.069	DDPDA
P147	596205.066	3133880.713	691.592	40.819	0	11	Hilly	DOG	6208.888	SPSA
P148	596240.266	3133901.38	692.9	39.202	-35.6662	11	Hilly	DOG	6248.09	DDPDA
P149	596256.159	3133937.216	701.3	35.003	0	11	Hilly	DOG	6283.093	SPSA
P150	596270.349	3133969.214	708.8	41.719	44.5068	11	Hilly	DOG	6324.812	DDPDA
P151	596309.144	3133984.556	715.156	43.616	0	11	Hilly	DOG	6368.428	SPSA
P152	596349.704	3134000.596	721.8	40.141	73.8199	11	Hilly	DOG	6408.569	DDPDA
P153	596374.283	3133968.86	730.511	39.415	0	11	Hilly	DOG	6447.984	SPSA
P154	596398.417	3133937.698	739.064	39.797	0	11	Hilly	DOG	6487.781	SPSA
P155	596422.785	3133906.234	747.7	66.603	2.2643	11	Hilly	DOG	6554.384	DDPDA
P156	596461.455	3133852.007	758.9	52.16	-18.5569	11	Hilly	DOG	6606.544	SPDDE
P157	596503.679	3133821.385	764.1	56.901	-9.6033	11	Hilly	DOG	6663.445	SPDDE
P158	596554.67	3133796.132	769	43.257	-18.2282	11	Hilly	DOG	6706.702	SPDDE
P159	596597.493	3133790.023	776.258	43.482	0	11	Hilly	DOG	6750.184	SPSA
P160	596640.539	3133783.882	783.555	37.22	0	11	Hilly	DOG	6787.404	SPSA
P161	596677.385	3133778.626	789.8	35.094	28.2971	11	Hilly	DOG	6822.498	SPDDE

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P162	596705.627	3133757.792	785.022	38.852	0	11	Hilly	DOG	6861.35	SPSA
P163	596736.892	3133734.728	779.733	31.09	0	11	Hilly	DOG	6892.44	SPSA
P164	596761.911	3133716.272	775.5	40.454	-25.7645	11	Hilly	DOG	6932.894	SPDDE
P165	596801.668	3133708.795	775.257	42.621	0	11	Hilly	DOG	6975.515	SPSA
P166	596843.555	3133700.917	775	44.64	17.726	11	Hilly	DOG	7020.155	DDPDA
P167	596882.831	3133679.701	769.47	46.585	0	11	Hilly	DOG	7066.74	SPSA
P168	596923.818	3133657.56	763.7	52.644	12.5206	11	Hilly	DOG	7119.384	SPDDE
P169	596963.611	3133623.093	756.5	33.467	-32.2455	11	Hilly	DOG	7152.851	DDPDA
P170	596996.697	3133618.058	754.868	35.473	0	11	Hilly	DOG	7188.324	SPSA
P171	597031.767	3133612.722	753.139	37.444	0	11	Hilly	DOG	7225.768	SPSA
P172	597068.785	3133607.089	751.313	39.229	0	11	Hilly	DOG	7264.997	SPSA
P173	597107.567	3133601.187	749.4	43.598	-23.5567	11	Hilly	DOG	7308.595	SPDDE
P174	597149.698	3133612.401	749.808	41.933	0	11	Hilly	DOG	7350.528	SPSA
P175	597190.22	3133623.186	750.2	37.741	-25.9199	11	Hilly	DOG	7388.269	SPDDE
P176	597218.78	3133647.859	752.381	38.289	0	11	Hilly	DOG	7426.558	SPSA
P177	597247.754	3133672.89	754.594	32.94	0	11	Hilly	DOG	7459.498	SPSA
P178	597272.68	3133694.424	756.498	43.286	0	11	Hilly	DOG	7502.784	DPA
P179	597305.435	3133722.722	759	40.434	30.7984	11	Hilly	DOG	7543.218	DDPDA
P180	597345.252	3133729.761	768.054	40.752	0	11	Hilly	DOG	7583.97	SPSA
P181	597385.382	3133736.856	777.179	37.608	0	11	Hilly	DOG	7621.578	SPSA
P182	597422.415	3133743.403	785.6	61.027	14.6528	11	Hilly	DOG	7682.605	SPDDE
P183	597483.243	3133738.48	796.3	66.781	3.0074	11	Hilly	DOG	7749.386	SPDDE
P184	597549.432	3133729.608	797.5	35.756	-11.0877	11	Hilly	DOG	7785.142	SPDDE

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P185	597585.123	3133731.762	798.918	39.866	0	11	Hilly	DOG	7825.008	SPSA
P186	597624.916	3133734.163	800.5	42.205	9.1399	11	Hilly	DOG	7867.213	SPDDE
P187	597666.914	3133729.981	805	43.046	25.231	11	Hilly	DOG	7910.259	SPDDE
P188	597703.843	3133707.864	801.99	41.323	0	11	Hilly	DOG	7951.582	SPSA
P189	597739.294	3133686.632	799.1	39.258	-2.2388	11	Hilly	DOG	7990.84	SPDDE
P190	597773.736	3133667.792	790.912	37.935	0	11	Hilly	DOG	8028.775	DPA
P191	597807.018	3133649.587	783	20.82	-22.389	11	Hilly	DOG	8049.595	SPDDE
P192	597827.712	3133647.306	779.4	45.395	-54.6586	11	Hilly	DOG	8094.99	DDPDA
P193	597857.87	3133681.236	789.2	58.192	43.415	11	Hilly	DOG	8153.182	DDPDA
P194	597915.845	3133686.261	789.2	66.05	44.5392	11	Hilly	DOG	8219.232	DDPDA
P195	597966.748	3133644.172	795.4	63.826	45.4803	11	Hilly	DOG	8283.058	DDPDA
P196	597972.238	3133580.583	792.7	60.144	-18.0664	11	Hilly	DOG	8343.202	SPDDE
P197	597995.739	3133525.22	800.8	35.615	6.2824	11	Hilly	DOG	8378.817	SPDDE
P198	598005.984	3133491.11	801.677	39.539	0	11	Hilly	DOG	8418.356	SPSA
P199	598017.358	3133453.242	802.651	34.481	0	11	Hilly	DOG	8452.837	SPSA
P200	598027.277	3133420.219	803.5	35.518	-9.7524	11	Hilly	DOG	8488.355	SPDDE
P201	598043.109	3133388.424	798.889	35.35	0	11	Hilly	DOG	8523.705	DPA
P202	598058.866	3133356.78	794.3	40.962	-8.7565	11	Hilly	DOG	8564.667	SPDDE
P203	598082.494	3133323.319	797.073	40.288	0	11	Hilly	DOG	8604.955	SPSA
P204	598105.733	3133290.409	799.8	53.191	-15.1229	11	Hilly	DOG	8658.146	SPDDE
P205	598146.687	3133256.468	801.5	34.428	44.6545	11	Hilly	DOG	8692.574	DDPDA
P206	598150.104	3133222.21	784.608	32.421	0	11	Hilly	DOG	8724.995	SPSA
P207	598153.322	3133189.949	768.7	38.358	32.4823	11	Hilly	DOG	8763.353	DDPDA

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Pole Code	Easting	Northing	Elevation, m	Ahead Span, m	Deviation Angle, Degree	Pole Height, m	Physical Region	Conductor	Cumulative Span, m	Selected Pole Type
P208	598136.035	3133155.707	750.8	38.442	-34.8982	11	Hilly	DOG	8801.795	DDPDA
P209	598141.459	3133117.65	742.7	28.404	-22.2211	11	Hilly	DOG	8830.199	SPDDE
P210	598155.803	3133093.134	757.681	27.583	0	11	Hilly	DOG	8857.782	SPSA
P211	598169.733	3133069.327	772.229	26.561	0	11	Hilly	DOG	8884.343	SPSA
P212	598183.147	3133046.401	786.238	26.283	0	11	Hilly	DOG	8910.626	SPSA
P213	598196.421	3133023.716	800.1	38.19	46.0711	11	Hilly	DOG	8948.816	DDPDA
P214	598186.062	3132986.958	800.882	38.991	0	11	Hilly	DOG	8987.807	SPSA
P215	598175.485	3132949.429	801.681	41.204	0	11	Hilly	DOG	9029.011	DPA
P216	598164.309	3132909.77	802.525	42.688	0	11	Hilly	DOG	9071.699	SPSA
P217	598152.73	3132868.682	803.4	36.425	-46.5627	11	Hilly	DOG	9108.124	DDPDA
P218	598171.394	3132837.402	805	36.442	0	11	Hilly	DOG	9144.566	SPSA
P219	598190.067	3132806.108	806.6	42.525	-17.3753	11	Hilly	DOG	9187.091	SPDDE
P220	598221.768	3132777.763	808.444	45.716	0	11	Hilly	DOG	9232.807	SPSA
P221	598255.848	3132747.292	810.426	34.479	0	11	Hilly	DOG	9267.286	SPSA
P222	598281.551	3132724.31	811.921	36.416	0	11	Hilly	DOG	9303.702	SPSA
P223	598308.698	3132700.037	813.5	40.787	-10.0961	11	Hilly	DOG	9344.489	SPDDE
P224	598343.398	3132678.602	810.395	42.652	0	11	Hilly	DOG	9387.141	SPSA
P225	598379.685	3132656.187	807.148	42.396	0	11	Hilly	DOG	9429.537	SPSA
P226	598415.754	3132633.906	803.921	44.933	0	11	Hilly	DOG	9474.47	SPSA
P227	598453.981	3132610.292	800.5	38.134	-18.3678	11	Hilly	DOG	9512.604	DDPDA
P228	598491.087	3132601.496	803.26	36.478	0	11	Hilly	DOG	9549.082	SPSA
P229	598526.581	3132593.081	805.9	36.228	-2.5667	11	Hilly	DOG	9585.31	SPDDE
P230	598562.171	3132586.311	809.858	34.244	0	11	Hilly	DOG	9619.554	SPSA

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Pole Code	Easting	Northing	Elevation, m	Ahead Span, m	Deviation Angle, Degree	Pole Height, m	Physical Region	Conductor	Cumulative Span, m	Selected Pole Type
P231	598595.812	3132579.912	813.6	42.814	78.837	11	Hilly	DOG	9662.368	DDPDA
P232	598596.105	3132537.099	822.288	42.907	0	11	Hilly	DOG	9705.275	SPSA
P233	598596.4	3132494.193	830.994	42.905	0	11	Hilly	DOG	9748.18	SPSA
P234	598596.694	3132451.289	839.7	52.346	26.8995	11	Hilly	DOG	9800.526	SPDDE
P235	598573.332	3132404.445	833.4	38.964	-49.7083	11	Hilly	DOG	9839.49	DDPDA
P236	598588.682	3132368.632	829.571	43.462	0	11	Hilly	DOG	9882.952	SPSA
P237	598605.805	3132328.685	825.3	33.88	-30.6593	11	Hilly	DOG	9916.832	DDPDA
P238	598633.167	3132308.704	821.991	36.764	0	11	Hilly	DOG	9953.596	SPSA
P239	598662.857	3132287.023	818.4	34.429	-13.6749	11	Hilly	DOG	9988.025	SPDDE
P240	598694.673	3132273.868	813.416	37.383	0	11	Hilly	DOG	10025.408	DPA
P241	598729.219	3132259.584	808.005	34.573	0	11	Hilly	DOG	10059.981	SPSA
P242	598761.169	3132246.373	803	63.65	-26.9578	11	Hilly	DOG	10123.631	SPDDE
P243	598824.623	3132251.36	800.7	44.969	19.2654	11	Hilly	DOG	10168.6	SPDDE
P244	598868.106	3132239.894	798.948	47.42	0	11	Hilly	DOG	10216.02	SPSA
P245	598913.958	3132227.804	797.1	53.793	-2.6085	11	Hilly	DOG	10269.813	SPDDE
P246	598966.544	3132216.47	785.5	36.776	-19.767	11	Hilly	DOG	10306.589	SPDDE
P247	599002.996	3132221.336	785.402	38.192	0	11	Hilly	DOG	10344.781	SPSA
P248	599040.853	3132226.39	785.3	34.851	63.8197	11	Hilly	DOG	10379.632	DDPDA
P249	599060.232	3132197.424	775.3	57.393	-41.8282	11	Hilly	DOG	10437.025	DDPDA
P250	599115.825	3132183.163	774.451	57.484	0	11	Hilly	DOG	10494.509	SPSA
P251	599171.507	3132168.879	773.6	58.199	6.4737	11	Hilly	DOG	10552.708	DDPDA
P252	599225.89	3132148.154	773.4	34.077	8.0356	11	Hilly	DOG	10586.785	SPDDE
P253	599255.724	3132131.687	766.386	35.882	0	11	Hilly	DOG	10622.667	SPSA

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Pole Code	Easting	Northing	Elevation, m	Ahead Span, m	Deviation Angle, Degree	Pole Height, m	Physical Region	Conductor	Cumulative Span, m	Selected Pole Type
P254	599287.139	3132114.347	759	63.473	17.9733	11	Hilly	DOG	10686.14	SPDDE
P255	599330.532	3132068.024	746.7	39.13	3.341	11	Hilly	DOG	10725.27	SPDDE
P256	599355.574	3132037.956	743	59.211	-47.2809	11	Hilly	DOG	10784.481	DDPDA
P257	599414.708	3132034.929	734.3	43.477	-17.2033	11	Hilly	DOG	10827.958	SPDDE
P258	599456.843	3132045.648	710.5	33.797	11.6892	11	Hilly	DOG	10861.755	SPDDE
P259	599490.605	3132047.172	707.194	35.724	0	11	Hilly	DOG	10897.479	SPSA
P260	599526.293	3132048.782	703.7	39.326	-8.8736	11	Hilly	DOG	10936.805	SPDDE
P261	599564.835	3132056.594	701.785	42.802	0	11	Hilly	DOG	10979.607	SPSA
P262	599606.785	3132065.096	699.7	0	0	11	Hilly	DOG	10979.607	DDPDA

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Pole Code	Easting	Northing	Elevation, m	Ahead Span, m	Deviation Angle, Degree	Pole Height, m	Physical Region	Conductor	Cumulative Span, m	Selected Pole Type
P1	547408.977	3125826.506	162	52.296		13	Terai	WOLF	52.296	DDPDA
P2	547366.013	3125856.321	162	52.297		13	Terai	WOLF	104.593	SPSA
P3	547323.048	3125886.137	162	52.543		13	Terai	WOLF	157.136	SPSA
P4	547279.881	3125916.093	162	25.646	70.2609	13	Terai	WOLF	182.782	DDPDA
P5	547286.527	3125940.863	161.7	30.73	14.2104	13	Terai	WOLF	213.512	SPDDE
P6	547301.533	3125967.68	161.4	44.083	0.9088	13	Terai	WOLF	257.595	SPDDE
P7	547323.667	3126005.804	161.249	43.61		13	Terai	WOLF	301.205	SPSA
P8	547345.564	3126043.518	161.1	51.342	-18.2545	13	Terai	WOLF	352.547	SPDDE
P9	547356.137	3126093.759	161.9	48.35	84.3335	13	Terai	WOLF	400.897	DDPDA
P10	547404.203	3126088.522	161.9	49.705		13	Terai	WOLF	450.602	SPSA
P11	547453.616	3126083.138	161.9	47.35		13	Terai	WOLF	497.952	SPSA
P12	547500.687	3126078.01	161.9	47.255		13	Terai	WOLF	545.207	DPA
P13	547547.664	3126072.892	161.9	47.821		13	Terai	WOLF	593.028	SPSA
P14	547595.203	3126067.712	161.9	47.962		13	Terai	WOLF	640.99	SPSA
P15	547642.883	3126062.517	161.9	47.821		13	Terai	WOLF	688.811	SPSA
P16	547690.423	3126057.337	161.9	47.255		13	Terai	WOLF	736.066	SPSA
P17	547737.4	3126052.219	161.9	46.643		13	Terai	WOLF	782.709	SPSA
P18	547783.768	3126047.167	161.9	47.056		13	Terai	WOLF	829.765	SPSA
P19	547830.548	3126042.07	161.9	47.703		13	Terai	WOLF	877.468	SPSA
P20	547877.97	3126036.904	161.9	47.506		13	Terai	WOLF	924.974	SPSA
P21	547925.197	3126031.758	161.9	47.984	-0.5302	13	Terai	WOLF	972.958	SPDDE
P22	547972.944	3126027.002	162.482	49.47		13	Terai	WOLF	1022.428	DPA
P23	548022.17	3126022.099	163.081	47.394		13	Terai	WOLF	1069.822	SPSA

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Pole Code	Easting	Northing	Elevation, m	Ahead Span, m	Deviation Angle, Degree	Pole Height, m	Physical Region	Conductor	Cumulative Span, m	Selected Pole Type
P24	548069.331	3126017.402	163.656	44.873		13	Terai	WOLF	1114.695	SPSA
P25	548113.983	3126012.955	164.2	53.881	5.8553	13	Terai	WOLF	1168.576	SPDDE
P26	548166.775	3126002.173	164.2	42.967	-4.6386	13	Terai	WOLF	1211.543	SPDDE
P27	548209.43	3125997.008	163.952	42.638		13	Terai	WOLF	1254.181	SPSA
P28	548251.759	3125991.882	163.706	44.994		13	Terai	WOLF	1299.175	SPSA
P29	548296.427	3125986.473	163.446	42.648		13	Terai	WOLF	1341.823	SPSA
P30	548338.765	3125981.346	163.2	44.073	-1.3891	13	Terai	WOLF	1385.896	SPDDE
P31	548382.634	3125977.11	163.282	45.583		13	Terai	WOLF	1431.479	SPSA
P32	548428.006	3125972.729	163.367	45.936		13	Terai	WOLF	1477.415	SPSA
P33	548473.729	3125968.314	163.452	45.229		13	Terai	WOLF	1522.644	DPA
P34	548518.749	3125963.967	163.536	48.056		13	Terai	WOLF	1570.7	SPSA
P35	548566.583	3125959.348	163.626	46.289		13	Terai	WOLF	1616.989	SPSA
P36	548612.658	3125954.899	163.712	47.358		13	Terai	WOLF	1664.347	SPSA
P37	548659.797	3125950.347	163.8	62.528	4.2409	13	Terai	WOLF	1726.875	SPDDE
P38	548721.421	3125939.751	163.183	59.101		13	Terai	WOLF	1785.976	SPSA
P39	548779.667	3125929.736	162.6	44.611	17.4329	13	Terai	WOLF	1830.587	SPDDE
P40	548819.348	3125909.352	162.536	48.763		13	Terai	WOLF	1879.35	SPSA
P41	548862.723	3125887.071	162.467	47.098		13	Terai	WOLF	1926.448	SPSA
P42	548904.617	3125865.55	162.4	34.598	10.0428	13	Terai	WOLF	1961.046	SPDDE
P43	548932.163	3125844.617	162.305	38.219		13	Terai	WOLF	1999.265	SPSA
P44	548962.593	3125821.493	162.2	67.212	10.441	13	Terai	WOLF	2066.477	DDPDA
P45	549007.851	3125771.802	162.8	72.045	6.3546	13	Terai	WOLF	2138.522	SPDDE
P46	549050.169	3125713.496	161.8	48.288	7.1393	13	Terai	WOLF	2186.81	SPDDE

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Pole Code	Easting	Northing	Elevation, m	Ahead Span, m	Deviation Angle, Degree	Pole Height, m	Physical Region	Conductor	Cumulative Span, m	Selected Pole Type
P47	549073.457	3125671.194	161.915	46.643		13	Terai	WOLF	2233.453	SPSA
P48	549095.951	3125630.334	162.026	47.35		13	Terai	WOLF	2280.803	SPSA
P49	549118.785	3125588.854	162.139	47.35		13	Terai	WOLF	2328.153	SPSA
P50	549141.62	3125547.375	162.252	47.35		13	Terai	WOLF	2375.503	SPSA
P51	549164.455	3125505.895	162.365	48.056		13	Terai	WOLF	2423.559	SPSA
P52	549187.631	3125463.796	162.48	46.289		13	Terai	WOLF	2469.848	SPSA
P53	549209.954	3125423.246	162.59	46.006		13	Terai	WOLF	2515.854	DPA
P54	549232.141	3125382.943	162.7	41.444	-0.5487	13	Terai	WOLF	2557.298	SPDDE
P55	549252.475	3125346.83	161.645	47.349		13	Terai	WOLF	2604.647	SPSA
P56	549275.705	3125305.571	160.439	48.665		13	Terai	WOLF	2653.312	SPSA
P57	549299.582	3125263.166	159.2	41.879	-0.1189	13	Terai	WOLF	2695.191	SPDDE
P58	549320.204	3125226.717	159.525	42.429		13	Terai	WOLF	2737.62	SPSA
P59	549341.098	3125189.788	159.853	42.14		13	Terai	WOLF	2779.76	SPSA
P60	549361.849	3125153.112	160.18	41.303		13	Terai	WOLF	2821.063	SPSA
P61	549382.188	3125117.164	160.5	47.611	-5.1596	13	Terai	WOLF	2868.674	SPDDE
P62	549409.265	3125078.002	160.301	48.24		13	Terai	WOLF	2916.914	SPSA
P63	549436.699	3125038.323	160.1	50.056	-14.5701	13	Terai	WOLF	2966.97	SPDDE
P64	549474.609	3125005.636	160.497	50.701		13	Terai	WOLF	3017.671	DPA
P65	549513.007	3124972.527	160.9	38.345	-8.9043	13	Terai	WOLF	3056.016	SPDDE
P66	549545.573	3124952.284	161.357	37.174		13	Terai	WOLF	3093.19	SPSA
P67	549577.144	3124932.659	161.8	44.757	1.8816	13	Terai	WOLF	3137.947	SPDDE
P68	549614.36	3124907.795	161.925	46.407		13	Terai	WOLF	3184.354	SPSA
P69	549652.947	3124882.015	162.054	47.821		13	Terai	WOLF	3232.175	SPSA

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P70	549692.71	3124855.449	162.187	45.606		13	Terai	WOLF	3277.781	SPSA
P71	549730.632	3124830.114	162.315	45.936		13	Terai	WOLF	3323.717	SPSA
P72	549768.828	3124804.595	162.443	46.407		13	Terai	WOLF	3370.124	SPSA
P73	549807.416	3124778.815	162.572	45.908		13	Terai	WOLF	3416.032	SPSA
P74	549845.588	3124753.312	162.7	58.333	-0.629	13	Terai	WOLF	3474.365	SPDDE
P75	549894.445	3124721.441	162.6	47.299	0.1626	13	Terai	WOLF	3521.664	DDPDA
P76	549933.987	3124695.486	162.534	46.815		13	Terai	WOLF	3568.479	SPSA
P77	549973.124	3124669.797	162.468	48.509		13	Terai	WOLF	3616.988	SPSA
P78	550013.677	3124643.179	162.4	48.327	0.2849	13	Terai	WOLF	3665.315	SPDDE
P79	550053.946	3124616.459	162.313	47.821		13	Terai	WOLF	3713.136	SPSA
P80	550093.793	3124590.02	162.228	48.527		13	Terai	WOLF	3761.663	SPSA
P81	550134.228	3124563.19	162.141	48.763		13	Terai	WOLF	3810.426	SPSA
P82	550174.861	3124536.23	162.053	48.056		13	Terai	WOLF	3858.482	SPSA
P83	550214.904	3124509.66	161.967	50.883		13	Terai	WOLF	3909.365	SPSA
P84	550257.302	3124481.527	161.876	48.999		13	Terai	WOLF	3958.364	SPSA
P85	550298.131	3124454.437	161.788	49.272		13	Terai	WOLF	4007.636	DPA
P86	550339.187	3124427.195	161.7	44.202	0.2906	13	Terai	WOLF	4051.838	SPDDE
P87	550375.894	3124402.57	162.16	45.465		13	Terai	WOLF	4097.303	SPSA
P88	550413.65	3124377.241	162.632	44.981		13	Terai	WOLF	4142.284	SPSA
P89	550451.004	3124352.182	163.1	24.838	29.5317	13	Terai	WOLF	4167.122	SPDDE
P90	550462.131	3124329.975	163.2	52.617	51.396	13	Terai	WOLF	4219.739	DDPDA
P91	550440.074	3124282.204	163.353	50.048		13	Terai	WOLF	4269.787	SPSA
P92	550419.094	3124236.765	163.499	52.425		13	Terai	WOLF	4322.212	SPSA

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Pole Code	Easting	Northing	Elevation, m	Ahead Span, m	Deviation Angle, Degree	Pole Height, m	Physical Region	Conductor	Cumulative Span, m	Selected Pole Type
P93	550397.118	3124189.169	163.651	51.59		13	Terai	WOLF	4373.802	SPSA
P94	550375.492	3124142.331	163.801	52.404		13	Terai	WOLF	4426.206	SPSA
P95	550353.525	3124094.753	163.954	50.321		13	Terai	WOLF	4476.527	SPSA
P96	550332.431	3124049.067	164.1	48.235	-20.7016	13	Terai	WOLF	4524.762	DDPDA
P97	550328.998	3124000.954	164.3	46.319	-25.0609	13	Terai	WOLF	4571.081	SPDDE
P98	550345.581	3123957.705	164.1	44.758		13	Terai	WOLF	4615.839	SPSA
P99	550361.606	3123915.914	163.907	45.936		13	Terai	WOLF	4661.775	SPSA
P100	550378.052	3123873.023	163.708	47.114		13	Terai	WOLF	4708.889	SPSA
P101	550394.92	3123829.032	163.505	47.429		13	Terai	WOLF	4756.318	SPSA
P102	550411.901	3123784.747	163.3	52.93	-13.5378	13	Terai	WOLF	4809.248	SPDDE
P103	550441.893	3123741.135	163.3	44.477	-12.5804	13	Terai	WOLF	4853.725	SPDDE
P104	550474.473	3123710.857	162.6	61.201	-16.0651	13	Terai	WOLF	4914.926	SPDDE
P105	550529.082	3123683.227	162.3	44.469	-5.8257	13	Terai	WOLF	4959.395	SPDDE
P106	550570.594	3123667.282	161.968	44.792		13	Terai	WOLF	5004.187	DPA
P107	550612.407	3123651.221	161.634	44.83		13	Terai	WOLF	5049.017	SPSA
P108	550654.256	3123635.147	161.3	48.187	-1.7504	13	Terai	WOLF	5097.204	SPDDE
P109	550699.745	3123619.251	161.107	50.883		13	Terai	WOLF	5148.087	SPSA
P110	550747.78	3123602.466	160.904	51.032		13	Terai	WOLF	5199.119	SPSA
P111	550795.956	3123585.631	160.7	54.22	-5.7396	13	Terai	WOLF	5253.339	SPDDE
P112	550848.673	3123572.953	160.503	56.301		13	Terai	WOLF	5309.64	SPSA
P113	550903.414	3123559.789	160.299	54.978		13	Terai	WOLF	5364.618	SPSA
P114	550956.868	3123546.934	160.1	44.008	0.1652	13	Terai	WOLF	5408.626	SPDDE
P115	550999.626	3123536.521	159.906	44.994		13	Terai	WOLF	5453.62	SPSA

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Pole Code	Easting	Northing	Elevation, m	Ahead Span, m	Deviation Angle, Degree	Pole Height, m	Physical Region	Conductor	Cumulative Span, m	Selected Pole Type
P116	551043.343	3123525.874	159.708	47.821		13	Terai	WOLF	5501.441	DPA
P117	551089.805	3123514.559	159.498	45.008		13	Terai	WOLF	5546.449	SPSA
P118	551133.535	3123503.909	159.3	49.126	1.0862	13	Terai	WOLF	5595.575	SPDDE
P119	551181.037	3123491.382	158.843	47.616		13	Terai	WOLF	5643.191	SPSA
P120	551227.079	3123479.24	158.4	45.01	-5.8754	13	Terai	WOLF	5688.201	SPDDE
P121	551271.547	3123472.278	158.696	45.936		13	Terai	WOLF	5734.137	SPSA
P122	551316.93	3123465.173	158.997	46.172		13	Terai	WOLF	5780.309	SPSA
P123	551362.547	3123458.031	159.301	44.758		13	Terai	WOLF	5825.067	SPSA
P124	551406.766	3123451.108	159.595	45.465		13	Terai	WOLF	5870.532	SPSA
P125	551451.684	3123444.076	159.893	46.697		13	Terai	WOLF	5917.229	SPSA
P126	551497.819	3123436.853	160.2	54.161	4.1337	13	Terai	WOLF	5971.39	SPDDE
P127	551550.585	3123424.64	162.142	52.65		13	Terai	WOLF	6024.04	DPA
P128	551601.879	3123412.768	164.029	52.176		13	Terai	WOLF	6076.216	SPSA
P129	551652.711	3123401.003	165.9	60.403	14.9168	13	Terai	WOLF	6136.619	SPDDE
P130	551706.069	3123372.694	165.751	61.152		13	Terai	WOLF	6197.771	SPSA
P131	551760.088	3123344.033	165.6	44.359	-2.4436	13	Terai	WOLF	6242.13	SPDDE
P132	551800.125	3123324.932	164.551	42.911		13	Terai	WOLF	6285.041	SPSA
P133	551838.855	3123306.455	163.537	43.58		13	Terai	WOLF	6328.621	SPSA
P134	551878.188	3123287.69	162.507	44.994		13	Terai	WOLF	6373.615	SPSA
P135	551918.797	3123268.316	161.443	45.701		13	Terai	WOLF	6419.316	SPSA
P136	551960.044	3123248.638	160.363	44.982		13	Terai	WOLF	6464.298	SPSA
P137	552000.642	3123229.269	159.3	52.747	-3.4936	13	Terai	WOLF	6517.045	DDPDA
P138	552049.544	3123209.5	160.8	48.183	-11.0776	13	Terai	WOLF	6565.228	SPDDE

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P139	552096.853	3123200.361	160.745	47.821		13	Terai	WOLF	6613.049	SPSA
P140	552143.806	3123191.291	160.69	49.705		13	Terai	WOLF	6662.754	SPSA
P141	552192.609	3123181.863	160.633	50.883		13	Terai	WOLF	6713.637	SPSA
P142	552242.568	3123172.212	160.575	50.883		13	Terai	WOLF	6764.52	SPSA
P143	552292.527	3123162.56	160.516	51.354		13	Terai	WOLF	6815.874	SPSA
P144	552342.95	3123152.82	160.458	50.238		13	Terai	WOLF	6866.112	SPSA
P145	552392.275	3123143.291	160.4	27.971	10.585	13	Terai	WOLF	6894.083	SPDDE
P146	552418.297	3123133.031	160.7	43.204	7.0868	13	Terai	WOLF	6937.287	SPDDE
P147	552456.227	3123112.346	160.636	47.585		13	Terai	WOLF	6984.872	SPSA
P148	552498.004	3123089.564	160.565	44.664		13	Terai	WOLF	7029.536	DPA
P149	552537.216	3123068.18	160.499	47.35		13	Terai	WOLF	7076.886	SPSA
P150	552578.786	3123045.51	160.428	43.957		13	Terai	WOLF	7120.843	SPSA
P151	552617.378	3123024.464	160.363	44.287		13	Terai	WOLF	7165.13	SPSA
P152	552656.259	3123003.26	160.297	43.816		13	Terai	WOLF	7208.946	SPSA
P153	552694.727	3122982.282	160.232	44.287		13	Terai	WOLF	7253.233	SPSA
P154	552733.608	3122961.079	160.167	44.052		13	Terai	WOLF	7297.285	SPSA
P155	552772.283	3122939.988	160.101	45.936		13	Terai	WOLF	7343.221	SPSA
P156	552812.612	3122917.995	160.033	43.816		13	Terai	WOLF	7387.037	SPSA
P157	552851.08	3122897.017	159.968	45.668		13	Terai	WOLF	7432.705	SPSA
P158	552891.173	3122875.152	159.9	53.429	4.0922	13	Terai	WOLF	7486.134	SPDDE
P159	552936.136	3122846.289	160.37	49.293		13	Terai	WOLF	7535.427	DPA
P160	552977.617	3122819.661	160.804	36.573		13	Terai	WOLF	7572	SPSA
P161	553008.395	3122799.904	161.126	31.087		13	Terai	WOLF	7603.087	SPSA

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Pole Code	Easting	Northing	Elevation, m	Ahead Span, m	Deviation Angle, Degree	Pole Height, m	Physical Region	Conductor	Cumulative Span, m	Selected Pole Type
P162	553034.556	3122783.11	161.4	47.145	2.862	13	Terai	WOLF	7650.232	SPDDE
P163	553072.908	3122755.693	160.949	54.064		13	Terai	WOLF	7704.296	SPSA
P164	553116.89	3122724.252	160.432	47.173		13	Terai	WOLF	7751.469	SPSA
P165	553155.266	3122696.819	159.981	42.932		13	Terai	WOLF	7794.401	SPSA
P166	553190.191	3122671.851	159.571	45.053		13	Terai	WOLF	7839.454	SPSA
P167	553226.842	3122645.651	159.14	45.992		13	Terai	WOLF	7885.446	SPSA
P168	553264.257	3122618.904	158.7	43.347	-0.6112	13	Terai	WOLF	7928.793	SPDDE
P169	553299.787	3122594.073	158.658	43.816		13	Terai	WOLF	7972.609	SPSA
P170	553335.702	3122568.974	158.616	45.583		13	Terai	WOLF	8018.192	DPA
P171	553373.065	3122542.862	158.572	45.583		13	Terai	WOLF	8063.775	SPSA
P172	553410.427	3122516.751	158.528	44.169		13	Terai	WOLF	8107.944	SPSA
P173	553446.632	3122491.449	158.485	44.169		13	Terai	WOLF	8152.113	SPSA
P174	553482.836	3122466.147	158.442	43.886		13	Terai	WOLF	8195.999	SPSA
P175	553518.808	3122441.007	158.4	52.439	-8.906	13	Terai	WOLF	8248.438	SPDDE
P176	553565.922	3122417.984	158.101	52.725		13	Terai	WOLF	8301.163	SPSA
P177	553613.294	3122394.836	157.8	50.313	-2.482	13	Terai	WOLF	8351.476	SPDDE
P178	553659.413	3122374.725	157.343	51.943		13	Terai	WOLF	8403.419	SPSA
P179	553707.026	3122353.963	156.871	51.923		13	Terai	WOLF	8455.342	SPSA
P180	553754.621	3122333.208	156.4	58.162	-9.1283	13	Terai	WOLF	8513.504	DDPDA
P181	553810.948	3122318.712	155.8	48.519	-15.4111	13	Terai	WOLF	8562.023	SPDDE
P182	553859.46	3122319.541	155.9	48.391	-7.1736	13	Terai	WOLF	8610.414	SPDDE
P183	553907.361	3122326.403	156.014	45.583		13	Terai	WOLF	8655.997	SPSA
P184	553952.484	3122332.867	156.122	47.35		13	Terai	WOLF	8703.347	SPSA

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P185	553999.355	3122339.582	156.234	47.763		13	Terai	WOLF	8751.11	SPSA
P186	554046.635	3122346.355	156.347	47.643		13	Terai	WOLF	8798.753	SPSA
P187	554093.796	3122353.112	156.459	47.703		13	Terai	WOLF	8846.456	SPSA
P188	554141.017	3122359.876	156.572	48.056		13	Terai	WOLF	8894.512	SPSA
P189	554188.588	3122366.691	156.685	48.577		13	Terai	WOLF	8943.089	SPSA
P190	554236.673	3122373.58	156.8	48.525	33.1475	13	Terai	WOLF	8991.614	DDPDA
P191	554280.654	3122353.076	157.044	48.056		13	Terai	WOLF	9039.67	DPA
P192	554324.21	3122332.771	157.286	46.289		13	Terai	WOLF	9085.959	SPSA
P193	554366.164	3122313.212	157.518	46.643		13	Terai	WOLF	9132.602	SPSA
P194	554408.439	3122293.503	157.753	47.703		13	Terai	WOLF	9180.305	SPSA
P195	554451.674	3122273.347	157.993	46.996		13	Terai	WOLF	9227.301	SPSA
P196	554494.269	3122253.49	158.229	46.996		13	Terai	WOLF	9274.297	SPSA
P197	554536.864	3122233.632	158.465	46.661		13	Terai	WOLF	9320.958	SPSA
P198	554579.154	3122213.916	158.7	45.847	-9.8769	13	Terai	WOLF	9366.805	SPDDE
P199	554623.415	3122201.959	158.452	47.35		13	Terai	WOLF	9414.155	SPSA
P200	554669.126	3122189.61	158.195	47.703		13	Terai	WOLF	9461.858	SPSA
P201	554715.178	3122177.168	157.936	47.35		13	Terai	WOLF	9509.208	DPA
P202	554760.889	3122164.819	157.68	47.35		13	Terai	WOLF	9556.558	SPSA
P203	554806.6	3122152.47	157.423	48.763		13	Terai	WOLF	9605.321	SPSA
P204	554853.675	3122139.753	157.159	47.785		13	Terai	WOLF	9653.106	SPSA
P205	554899.806	3122127.29	156.9	48.257	1.4711	13	Terai	WOLF	9701.363	SPDDE
P206	554946.055	3122113.512	156.9	51.236		13	Terai	WOLF	9752.599	SPSA
P207	554995.158	3122098.884	156.9	48.056		13	Terai	WOLF	9800.655	SPSA

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Pole Code	Easting	Northing	Elevation, m	Ahead Span, m	Deviation Angle, Degree	Pole Height, m	Physical Region	Conductor	Cumulative Span, m	Selected Pole Type
P208	555041.214	3122085.164	156.9	45.936		13	Terai	WOLF	9846.591	SPSA
P209	555085.239	3122072.049	156.9	48.056		13	Terai	WOLF	9894.647	SPSA
P210	555131.295	3122058.329	156.9	49.116		13	Terai	WOLF	9943.763	SPSA
P211	555178.367	3122044.306	156.9	48.009		13	Terai	WOLF	9991.772	SPSA
P212	555224.378	3122030.599	156.9	40.319	1.4086	13	Terai	WOLF	10032.091	DDPDA
P213	555262.724	3122018.141	156.749	42.402		13	Terai	WOLF	10074.493	SPSA
P214	555303.051	3122005.04	156.59	44.605		13	Terai	WOLF	10119.098	SPSA
P215	555345.473	3121991.258	156.422	42.851		13	Terai	WOLF	10161.949	SPSA
P216	555386.228	3121978.018	156.261	44.523		13	Terai	WOLF	10206.472	SPSA
P217	555428.572	3121964.262	156.094	42.307		13	Terai	WOLF	10248.779	SPSA
P218	555468.809	3121951.19	155.936	44.523		13	Terai	WOLF	10293.302	SPSA
P219	555511.153	3121937.433	155.768	44.884		13	Terai	WOLF	10338.186	SPSA
P220	555553.841	3121923.565	155.6	18.626	-61.6826	13	Terai	WOLF	10356.812	DDPDA
P221	555567.311	3121936.43	155.8	44.257	-27.2543	13	Terai	WOLF	10401.069	SPDDE
P222	555581.764	3121978.261	156	45.016	8.2373	13	Terai	WOLF	10446.085	SPDDE
P223	555602.409	3122018.264	156.8	55.063	-17.6651	13	Terai	WOLF	10501.148	DDPDA
P224	555611.623	3122072.551	157.9	18.124	93.8281	13	Terai	WOLF	10519.272	DDPDA
P225	555629.249	3122068.332	157.6	49.221	10.1563	13	Terai	WOLF	10568.493	SPDDE
P226	555674.348	3122048.613	157.477	49.47		13	Terai	WOLF	10617.963	SPSA
P227	555719.674	3122028.794	157.354	47.703		13	Terai	WOLF	10665.666	SPSA
P228	555763.381	3122009.683	157.235	46.996		13	Terai	WOLF	10712.662	SPSA
P229	555806.441	3121990.855	157.118	47.551		13	Terai	WOLF	10760.213	SPSA
P230	555850.009	3121971.805	157	50.611	-1.8059	13	Terai	WOLF	10810.824	SPDDE

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P231	555896.997	3121953	157.02	49.116		13	Terai	WOLF	10859.94	SPSA
P232	555942.597	3121934.751	157.04	50.176		13	Terai	WOLF	10910.116	SPSA
P233	555989.182	3121916.108	157.06	50.176		13	Terai	WOLF	10960.292	SPSA
P234	556035.766	3121897.465	157.08	50.176		13	Terai	WOLF	11010.468	DPA
P235	556082.35	3121878.822	157.1	50.53		13	Terai	WOLF	11060.998	SPSA
P236	556129.263	3121860.047	157.12	50.176		13	Terai	WOLF	11111.174	SPSA
P237	556175.847	3121841.404	157.141	50.883		13	Terai	WOLF	11162.057	SPSA
P238	556223.088	3121822.498	157.161	48.41		13	Terai	WOLF	11210.467	SPSA
P239	556268.032	3121804.511	157.18	49.079		13	Terai	WOLF	11259.546	SPSA
P240	556313.597	3121786.276	157.2	38.162	20.6054	13	Terai	WOLF	11297.708	SPDDE
P241	556341.771	3121760.535	155.8	105.71	-14.5886	13	Terai	WOLF	11403.418	SPDDE
P243	556435.254	3121711.188	157.1	72.063	-25.3706	13	Terai	WOLF	11475.481	SPDDE
P244	556507.251	3121708.098	158	47.707	19.2194	13	Terai	WOLF	11523.188	DDPDA
P245	556551.584	3121690.476	157.978	46.289		13	Terai	WOLF	11569.477	SPSA
P246	556594.6	3121673.378	157.957	48.41		13	Terai	WOLF	11617.887	SPSA
P247	556639.586	3121655.497	157.935	48.41		13	Terai	WOLF	11666.297	SPSA
P248	556684.572	3121637.616	157.912	48.056		13	Terai	WOLF	11714.353	SPSA
P249	556729.23	3121619.865	157.89	48.41		13	Terai	WOLF	11762.763	SPSA
P250	556774.216	3121601.984	157.868	49.116		13	Terai	WOLF	11811.879	SPSA
P251	556819.859	3121583.842	157.845	48.41		13	Terai	WOLF	11860.289	SPSA
P252	556864.845	3121565.961	157.823	50.528		13	Terai	WOLF	11910.817	SPSA
P253	556911.799	3121547.297	157.8	41.981	0.3062	13	Terai	WOLF	11952.798	SPDDE
P254	556950.728	3121531.582	158.073	42.215		13	Terai	WOLF	11995.013	SPSA

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P255	556989.874	3121515.78	158.348	42.943		13	Terai	WOLF	12037.956	DPA
P256	557029.695	3121499.705	158.628	41.775		13	Terai	WOLF	12079.731	SPSA
P257	557068.432	3121484.067	158.9	48.755	0.2731	13	Terai	WOLF	12128.486	SPDDE
P258	557113.555	3121465.601	158.786	48.056		13	Terai	WOLF	12176.542	SPSA
P259	557158.031	3121447.4	158.674	48.056		13	Terai	WOLF	12224.598	SPSA
P260	557202.507	3121429.199	158.562	47.703		13	Terai	WOLF	12272.301	SPSA
P261	557246.656	3121411.131	158.451	47.35		13	Terai	WOLF	12319.651	SPSA
P262	557290.478	3121393.198	158.34	47.35		13	Terai	WOLF	12367.001	SPSA
P263	557334.3	3121375.264	158.229	46.643		13	Terai	WOLF	12413.644	SPSA
P264	557377.468	3121357.598	158.121	46.526		13	Terai	WOLF	12460.17	SPSA
P265	557420.528	3121339.976	158.012	48.001		13	Terai	WOLF	12508.171	DPA
P266	557464.953	3121321.796	157.9	50.631	-0.0306	13	Terai	WOLF	12558.802	SPDDE
P267	557511.822	3121302.645	158.012	51.236		13	Terai	WOLF	12610.038	SPSA
P268	557559.252	3121283.264	158.126	50.059		13	Terai	WOLF	12660.097	SPSA
P269	557605.592	3121264.329	158.237	52.414		13	Terai	WOLF	12712.511	SPSA
P270	557654.111	3121244.503	158.353	50.883		13	Terai	WOLF	12763.394	SPSA
P271	557701.214	3121225.257	158.465	49.116		13	Terai	WOLF	12812.51	SPSA
P272	557746.681	3121206.678	158.574	50.883		13	Terai	WOLF	12863.393	SPSA
P273	557793.783	3121187.431	158.687	51.08		13	Terai	WOLF	12914.473	SPSA
P274	557841.069	3121168.11	158.8	45.456	3.4429	13	Terai	WOLF	12959.929	SPDDE
P275	557882.039	3121148.42	158.826	45.855		13	Terai	WOLF	13005.784	DPA
P276	557923.369	3121128.557	158.851	44.25		13	Terai	WOLF	13050.034	SPSA
P277	557963.252	3121109.39	158.876	42.567		13	Terai	WOLF	13092.601	SPSA

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Pole Code	Easting	Northing	Elevation, m	Ahead Span, m	Deviation Angle, Degree	Pole Height, m	Physical Region	Conductor	Cumulative Span, m	Selected Pole Type
P278	558001.619	3121090.951	158.9	51.759	4.9181	13	Terai	WOLF	13144.36	SPDDE
P279	558046.176	3121064.614	159.633	54.133		13	Terai	WOLF	13198.493	SPSA
P280	558092.777	3121037.069	160.4	42.776	4.2598	13	Terai	WOLF	13241.269	SPDDE
P281	558127.883	3121012.628	160.42	41.343		13	Terai	WOLF	13282.612	SPSA
P282	558161.813	3120989.005	160.44	40.989		13	Terai	WOLF	13323.601	SPSA
P283	558195.452	3120965.585	160.46	42.049		13	Terai	WOLF	13365.65	SPSA
P284	558229.961	3120941.559	160.48	42.594		13	Terai	WOLF	13408.244	SPSA
P285	558264.917	3120917.222	160.5	47.794	1.3237	13	Terai	WOLF	13456.038	SPDDE
P286	558303.5	3120889.015	160.362	47.472		13	Terai	WOLF	13503.51	DPA
P287	558341.823	3120860.997	160.225	46.643		13	Terai	WOLF	13550.153	SPSA
P288	558379.476	3120833.47	160.091	45.107		13	Terai	WOLF	13595.26	SPSA
P289	558415.89	3120806.848	159.961	47.35		13	Terai	WOLF	13642.61	SPSA
P290	558454.114	3120778.903	159.824	46.996		13	Terai	WOLF	13689.606	SPSA
P291	558492.052	3120751.167	159.689	47.35		13	Terai	WOLF	13736.956	SPSA
P292	558530.276	3120723.222	159.552	47.703		13	Terai	WOLF	13784.659	SPSA
P293	558568.785	3120695.068	159.414	46.996		13	Terai	WOLF	13831.655	SPSA
P294	558606.724	3120667.332	159.279	48.763		13	Terai	WOLF	13880.418	SPSA
P295	558646.089	3120638.553	159.138	47.946		13	Terai	WOLF	13928.364	SPSA
P296	558684.794	3120610.256	159	49.015	-0.5552	13	Terai	WOLF	13977.379	SPDDE
P297	558724.64	3120581.713	159.297	49.47		13	Terai	WOLF	14026.849	DPA
P298	558764.857	3120552.905	159.596	49.823		13	Terai	WOLF	14076.672	SPSA
P299	558805.36	3120523.892	159.898	50.176		13	Terai	WOLF	14126.848	SPSA
P300	558846.151	3120494.672	160.202	50.883		13	Terai	WOLF	14177.731	SPSA

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P301	558887.517	3120465.041	160.51	49.47		13	Terai	WOLF	14227.201	SPSA
P302	558927.733	3120436.233	160.809	50.176		13	Terai	WOLF	14277.377	SPSA
P303	558968.524	3120407.014	161.113	49.116		13	Terai	WOLF	14326.493	SPSA
P304	559008.453	3120378.412	161.41	49.116		13	Terai	WOLF	14375.609	SPSA
P305	559048.382	3120349.81	161.708	48.257		13	Terai	WOLF	14423.866	SPSA
P306	559087.613	3120321.708	162	45.08	-0.7543	13	Terai	WOLF	14468.946	SPDDE
P307	559124.603	3120295.941	161.784	44.05		13	Terai	WOLF	14512.996	DPA
P308	559160.748	3120270.763	161.574	45.701		13	Terai	WOLF	14558.697	SPSA
P309	559198.248	3120244.641	161.355	45.465		13	Terai	WOLF	14604.162	SPSA
P310	559235.554	3120218.654	161.137	44.523		13	Terai	WOLF	14648.685	SPSA
P311	559272.087	3120193.206	160.924	44.758		13	Terai	WOLF	14693.443	SPSA
P312	559308.813	3120167.623	160.71	43.948		13	Terai	WOLF	14737.391	SPSA
P313	559344.874	3120142.503	160.5	53.295	0.9497	13	Terai	WOLF	14790.686	SPDDE
P314	559388.094	3120111.32	160.601	52.061		13	Terai	WOLF	14842.747	SPSA
P315	559430.314	3120080.859	160.699	53.493		13	Terai	WOLF	14896.24	SPSA
P316	559473.695	3120049.56	160.8	47.378	-4.1654	13	Terai	WOLF	14943.618	SPDDE
P317	559514.028	3120024.703	161.51	46.172		13	Terai	WOLF	14989.79	SPSA
P318	559553.335	3120000.479	162.201	46.648		13	Terai	WOLF	15036.438	DPA
P319	559593.048	3119976.005	162.9	49.134	53.5529	13	Terai	WOLF	15085.572	DDPDA
P320	559597.161	3119927.043	163.066	50.176		13	Terai	WOLF	15135.748	SPSA
P321	559601.362	3119877.043	163.236	48.52		13	Terai	WOLF	15184.268	SPSA
P322	559605.424	3119828.693	163.4	18.318	28.3252	13	Terai	WOLF	15202.586	SPDDE
P323	559598.113	3119811.897	163.5	46.518	-28.3791	13	Terai	WOLF	15249.104	SPDDE

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P324	559602.051	3119765.546	162.518	49.234		13	Terai	WOLF	15298.338	SPSA
P325	559606.218	3119716.489	161.479	49.705		13	Terai	WOLF	15348.043	SPSA
P326	559610.426	3119666.962	160.43	48.793		13	Terai	WOLF	15396.836	SPSA
P327	559614.557	3119618.344	159.4	41.713	0.3151	13	Terai	WOLF	15438.549	SPDDE
P328	559617.859	3119576.762	159.724	41.46		13	Terai	WOLF	15480.009	SPSA
P329	559621.142	3119535.432	160.046	40.754		13	Terai	WOLF	15520.763	DPA
P330	559624.369	3119494.806	160.362	40.282		13	Terai	WOLF	15561.045	SPSA
P331	559627.558	3119454.65	160.675	41.861		13	Terai	WOLF	15602.906	SPSA
P332	559630.872	3119412.921	161	23.245	-18.2192	13	Terai	WOLF	15626.151	SPDDE
P333	559639.865	3119391.486	160.8	43.445	-65.0475	13	Terai	WOLF	15669.596	DDPDA
P334	559683.278	3119389.824	160.524	44.758		13	Terai	WOLF	15714.354	SPSA
P335	559728.004	3119388.112	160.239	42.403		13	Terai	WOLF	15756.757	SPSA
P336	559770.376	3119386.49	159.97	44.758		13	Terai	WOLF	15801.515	SPSA
P337	559815.101	3119384.778	159.685	44.888		13	Terai	WOLF	15846.403	SPSA
P338	559859.957	3119383.061	159.4	46.324	-0.6583	13	Terai	WOLF	15892.727	SPDDE
P339	559906.264	3119381.821	160.163	45.936		13	Terai	WOLF	15938.663	SPSA
P340	559952.184	3119380.591	160.92	46.407		13	Terai	WOLF	15985.07	SPSA
P341	559998.575	3119379.349	161.685	46.878		13	Terai	WOLF	16031.948	DPA
P342	560045.436	3119378.094	162.457	45.071		13	Terai	WOLF	16077.019	SPSA
P343	560090.491	3119376.888	163.2	56.366	-1.012	13	Terai	WOLF	16133.385	SPDDE
P344	560146.854	3119376.375	163.249	57.614		13	Terai	WOLF	16190.999	SPSA
P345	560204.466	3119375.85	163.3	45.048	2.6729	13	Terai	WOLF	16236.047	SPDDE
P346	560249.443	3119373.34	162.188	45.229		13	Terai	WOLF	16281.276	SPSA

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P347	560294.602	3119370.819	161.071	47.407		13	Terai	WOLF	16328.683	SPSA
P348	560341.935	3119368.177	159.9	50.167	-0.0811	13	Terai	WOLF	16378.85	SPDDE
P349	560392.028	3119365.452	160.199	50.412		13	Terai	WOLF	16429.262	SPSA
P350	560442.365	3119362.714	160.5	50.176		13	Terai	WOLF	16479.438	SPSA
P351	560492.468	3119359.989	160.799	50.365		13	Terai	WOLF	16529.803	DPA
P352	560542.758	3119357.253	161.1	58.603	5.498	13	Terai	WOLF	16588.406	SPDDE
P353	560600.701	3119348.478	160.3	47.639	15.4051	13	Terai	WOLF	16636.045	SPDDE
P354	560644.215	3119329.089	160.633	48.527		13	Terai	WOLF	16684.572	SPSA
P355	560688.541	3119309.338	160.973	47.35		13	Terai	WOLF	16731.922	SPSA
P356	560731.792	3119290.067	161.304	50.412		13	Terai	WOLF	16782.334	SPSA
P357	560777.839	3119269.549	161.657	49.028		13	Terai	WOLF	16831.362	SPSA
P358	560822.623	3119249.594	162	47.746	0.9183	13	Terai	WOLF	16879.108	SPDDE
P359	560865.918	3119229.465	161.229	51.357		13	Terai	WOLF	16930.465	SPSA
P360	560912.488	3119207.813	160.4	42.774	-2.1726	13	Terai	WOLF	16973.239	SPDDE
P361	560951.932	3119191.263	160.651	43.345		13	Terai	WOLF	17016.584	DPA
P362	560991.901	3119174.492	160.905	41.696		13	Terai	WOLF	17058.28	SPSA
P363	561030.349	3119158.36	161.15	42.581		13	Terai	WOLF	17100.861	SPSA
P364	561069.613	3119141.885	161.4	44.863	1.2573	13	Terai	WOLF	17145.724	SPDDE
P365	561110.591	3119123.623	161.846	44.052		13	Terai	WOLF	17189.776	SPSA
P366	561150.828	3119105.692	162.283	44.287		13	Terai	WOLF	17234.063	SPSA
P367	561191.28	3119087.665	162.723	44.287		13	Terai	WOLF	17278.35	SPSA
P368	561231.733	3119069.638	163.163	44.031		13	Terai	WOLF	17322.381	SPSA
P369	561271.95	3119051.715	163.6	49.302	1.2424	13	Terai	WOLF	17371.683	SPDDE

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P370	561316.537	3119030.675	163.208	51.825		13	Terai	WOLF	17423.508	SPSA
P371	561363.407	3119008.558	162.797	49.971		13	Terai	WOLF	17473.479	SPSA
P372	561408.599	3118987.232	162.4	47.131	-0.6733	13	Terai	WOLF	17520.61	DDPDA
P373	561451.455	3118967.621	162.105	48.763		13	Terai	WOLF	17569.373	SPSA
P374	561495.796	3118947.33	161.8	47.856		13	Terai	WOLF	17617.229	SPSA
P375	561539.313	3118927.417	161.5	61.721	1.8428	13	Terai	WOLF	17678.95	SPDDE
P376	561594.582	3118899.943	160.8	40.999	-11.5059	13	Terai	WOLF	17719.949	SPDDE
P377	561634.198	3118889.383	160.285	43.345		13	Terai	WOLF	17763.294	SPSA
P378	561676.08	3118878.219	159.74	42.958		13	Terai	WOLF	17806.252	SPSA
P379	561717.589	3118867.154	159.2	44.794	13.4352	13	Terai	WOLF	17851.046	SPDDE
P380	561757.006	3118845.876	159.925	50.529		13	Terai	WOLF	17901.575	SPSA
P381	561801.47	3118821.873	160.744	48.41		13	Terai	WOLF	17949.985	SPSA
P382	561844.069	3118798.877	161.528	47.703		13	Terai	WOLF	17997.688	SPSA
P383	561886.047	3118776.217	162.3	40.139	-4.0745	13	Terai	WOLF	18037.827	DDPDA
P384	561922.634	3118759.708	161.892	40.754		13	Terai	WOLF	18078.581	SPSA
P385	561959.781	3118742.946	161.477	43.559		13	Terai	WOLF	18122.14	SPSA
P386	561999.485	3118725.03	161.035	42.743		13	Terai	WOLF	18164.883	SPSA
P387	562038.445	3118707.45	160.6	45.759	0.4661	13	Terai	WOLF	18210.642	SPDDE
P388	562080	3118688.291	160.4	45.984		13	Terai	WOLF	18256.626	SPSA
P389	562121.759	3118669.037	160.2	61.838	-1.5289	13	Terai	WOLF	18318.464	SPDDE
P390	562178.586	3118644.653	160.975	57.797		13	Terai	WOLF	18376.261	SPSA
P391	562231.701	3118621.862	161.7	43.755	1.4172	13	Terai	WOLF	18420.016	SPDDE
P392	562271.471	3118603.619	161.7	43.109		13	Terai	WOLF	18463.125	SPSA

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P393	562310.655	3118585.646	161.7	44.052		13	Terai	WOLF	18507.177	DPA
P394	562350.695	3118567.279	161.7	43.816		13	Terai	WOLF	18550.993	SPSA
P395	562390.521	3118549.011	161.7	43.109		13	Terai	WOLF	18594.102	SPSA
P396	562429.705	3118531.038	161.7	43.807		13	Terai	WOLF	18637.909	SPSA
P397	562469.523	3118512.773	161.7	43.306	-1.8417	13	Terai	WOLF	18681.215	SPDDE
P398	562509.446	3118495.992	161.964	43.109		13	Terai	WOLF	18724.324	SPSA
P399	562549.187	3118479.287	162.227	44.781		13	Terai	WOLF	18769.105	SPSA
P400	562590.469	3118461.934	162.5	49.117	2.3342	13	Terai	WOLF	18818.222	SPDDE
P401	562634.936	3118441.073	161.764	48.999		13	Terai	WOLF	18867.221	SPSA
P402	562679.295	3118420.261	161.03	48.705		13	Terai	WOLF	18915.926	SPSA
P403	562723.389	3118399.575	160.3	49.81	-0.9344	13	Terai	WOLF	18965.736	SPDDE
P404	562768.822	3118379.158	160.519	50.176		13	Terai	WOLF	19015.912	DPA
P405	562814.59	3118358.59	160.739	51.825		13	Terai	WOLF	19067.737	SPSA
P406	562861.861	3118337.346	160.967	48.527		13	Terai	WOLF	19116.264	SPSA
P407	562906.124	3118317.454	161.18	50.042		13	Terai	WOLF	19166.306	SPSA
P408	562951.769	3118296.942	161.4	61.842	-0.5304	13	Terai	WOLF	19228.148	SPDDE
P409	563008.408	3118272.116	161.6	71.571	0.7399	13	Terai	WOLF	19299.719	SPDDE
P410	563073.583	3118242.54	160.2	48.205	0.2164	13	Terai	WOLF	19347.924	SPDDE
P411	563117.404	3118222.454	160.82	48.999		13	Terai	WOLF	19396.923	SPSA
P412	563161.946	3118202.038	161.451	45.229		13	Terai	WOLF	19442.152	SPSA
P413	563203.062	3118183.192	162.033	44.287		13	Terai	WOLF	19486.439	SPSA
P414	563243.322	3118164.738	162.603	46.378		13	Terai	WOLF	19532.817	DPA
P415	563285.481	3118145.414	163.2	43.186	-2.6935	13	Terai	WOLF	19576.003	SPDDE

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P416	563325.542	3118129.284	163.099	42.874		13	Terai	WOLF	19618.877	SPSA
P417	563365.313	3118113.271	163	42.739		13	Terai	WOLF	19661.616	SPSA
P418	563404.96	3118097.308	162.9	47.721	1.0492	13	Terai	WOLF	19709.337	SPDDE
P419	563448.893	3118078.677	162.109	48.573		13	Terai	WOLF	19757.91	SPSA
P420	563493.611	3118059.713	161.304	48.292		13	Terai	WOLF	19806.202	SPSA
P421	563538.071	3118040.859	160.503	48.438		13	Terai	WOLF	19854.64	SPSA
P422	563582.664	3118021.948	159.7	43.152	0.5502	13	Terai	WOLF	19897.792	SPDDE
P423	563622.228	3118004.72	159.895	43.345		13	Terai	WOLF	19941.137	SPSA
P424	563661.968	3117987.415	160.09	43.109		13	Terai	WOLF	19984.246	SPSA
P425	563701.493	3117970.204	160.284	43.109		13	Terai	WOLF	20027.355	DPA
P426	563741.018	3117952.993	160.479	46.643		13	Terai	WOLF	20073.998	SPSA
P427	563783.782	3117934.371	160.689	46.779		13	Terai	WOLF	20120.777	SPSA
P428	563826.671	3117915.695	160.9	51.879	-3.1762	13	Terai	WOLF	20172.656	SPDDE
P429	563875.311	3117897.65	161.917	49.47		13	Terai	WOLF	20222.126	SPSA
P430	563921.692	3117880.443	162.888	51.614		13	Terai	WOLF	20273.74	SPSA
P431	563970.083	3117862.49	163.9	48.878	-0.7341	13	Terai	WOLF	20322.618	SPDDE
P432	564016.123	3117846.077	163.549	48.763		13	Terai	WOLF	20371.381	SPSA
P433	564062.055	3117829.703	163.199	49.234		13	Terai	WOLF	20420.615	SPSA
P434	564108.43	3117813.171	162.845	48.081		13	Terai	WOLF	20468.696	SPSA
P435	564153.72	3117797.026	162.5	44.309	0.36	13	Terai	WOLF	20513.005	DDPDA
P436	564195.362	3117781.886	161.952	44.523		13	Terai	WOLF	20557.528	SPSA
P437	564237.205	3117766.672	161.401	44.287		13	Terai	WOLF	20601.815	SPSA
P438	564278.827	3117751.539	160.854	44.757		13	Terai	WOLF	20646.572	SPSA

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Nepal Electricity Authority
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Kohalpur Machhagadh 33 kV line
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Pole Code	Easting	Northing	Elevation, m	Ahead Span, m	Deviation Angle, Degree	Pole Height, m	Physical Region	Conductor	Cumulative Span, m	Selected Pole Type
P439	564320.889	3117736.246	160.3	49.049	-0.0048	13	Terai	WOLF	20695.621	SPDDE
P440	564366.988	3117719.49	160.73	37.102		13	Terai	WOLF	20732.723	SPSA
P441	564401.858	3117706.815	161.055	43.816		13	Terai	WOLF	20776.539	SPSA
P442	564443.038	3117691.846	161.44	52.513		13	Terai	WOLF	20829.052	SPSA
P443	564492.391	3117673.907	161.9	47.698	-0.432	13	Terai	WOLF	20876.75	SPDDE
P444	564537.341	3117657.951	161.806	53.003		13	Terai	WOLF	20929.753	SPSA
P445	564587.291	3117640.22	161.702	28.269		13	Terai	WOLF	20958.022	SPSA
P446	564613.931	3117630.763	161.647	74.592		13	Terai	WOLF	21032.614	DPA
P447	564684.226	3117605.81	161.5	56.361	5.9971	13	Terai	WOLF	21088.975	SPDDE
P448	564735.079	3117581.51	160.751	56.55		13	Terai	WOLF	21145.525	SPSA
P449	564786.103	3117557.128	160	54.47	0.071	13	Terai	WOLF	21199.995	SPDDE
P450	564835.221	3117533.582	161	53.007	-8.9258	13	Terai	WOLF	21253.002	SPDDE
P451	564885.996	3117518.362	161.154	50.153		13	Terai	WOLF	21303.155	SPSA
P452	564934.038	3117503.962	161.3	42.426	5.0237	13	Terai	WOLF	21345.581	SPDDE
P453	564973.454	3117488.268	161.35	42.593		13	Terai	WOLF	21388.174	SPSA
P454	565013.027	3117472.513	161.4	47.724	-4.0027	13	Terai	WOLF	21435.898	SPDDE
P455	565058.489	3117457.998	162.721	45.583		13	Terai	WOLF	21481.481	SPSA
P456	565101.913	3117444.134	163.984	51.155		13	Terai	WOLF	21532.636	DPA
P457	565150.645	3117428.575	165.4	45.522	2.1322	13	Terai	WOLF	21578.158	SPDDE
P458	565193.465	3117413.125	165.848	49.469		13	Terai	WOLF	21627.627	SPSA
P459	565239.998	3117396.337	166.334	47.361		13	Terai	WOLF	21674.988	SPSA
P460	565284.549	3117380.263	166.8	49.269	4.5698	13	Terai	WOLF	21724.257	SPDDE
P461	565329.413	3117359.903	166.8	48.292		13	Terai	WOLF	21772.549	SPSA

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Pole Code	Easting	Northing	Elevation, m	Ahead Span, m	Deviation Angle, Degree	Pole Height, m	Physical Region	Conductor	Cumulative Span, m	Selected Pole Type
P462	565373.389	3117339.946	166.8	50.908		13	Terai	WOLF	21823.457	SPSA
P463	565419.747	3117318.909	166.8	48.04		13	Terai	WOLF	21871.497	SPSA
P464	565463.493	3117299.056	166.8	48.471	-0.2425	13	Terai	WOLF	21919.968	SPDDE
P465	565507.716	3117279.212	166.167	48.763		13	Terai	WOLF	21968.731	SPSA
P466	565552.206	3117259.249	165.53	48.292		13	Terai	WOLF	22017.023	DPA
P467	565596.265	3117239.479	164.899	51.379		13	Terai	WOLF	22068.402	SPSA
P468	565643.141	3117218.445	164.227	51.944		13	Terai	WOLF	22120.346	SPSA
P469	565690.533	3117197.18	163.549	49.641		13	Terai	WOLF	22169.987	SPSA
P470	565735.824	3117176.857	162.9	45.81	1.0425	13	Terai	WOLF	22215.797	SPDDE
P471	565777.27	3117157.346	162.514	47.35		13	Terai	WOLF	22263.147	SPSA
P472	565820.11	3117137.179	162.116	47.821		13	Terai	WOLF	22310.968	SPSA
P473	565863.377	3117116.811	161.713	49.079		13	Terai	WOLF	22360.047	SPSA
P474	565907.781	3117095.907	161.3	49.437	-3.573	13	Terai	WOLF	22409.484	SPDDE
P475	565953.735	3117077.679	161.689	51.825		13	Terai	WOLF	22461.309	SPSA
P476	566001.909	3117058.571	162.096	51.424		13	Terai	WOLF	22512.733	DPA
P477	566049.71	3117039.61	162.5	49.541	21.5318	13	Terai	WOLF	22562.274	SPDDE
P478	566085.843	3117005.717	163.157	48.432		13	Terai	WOLF	22610.706	SPSA
P479	566121.167	3116972.583	163.8	46.669	-0.1047	13	Terai	WOLF	22657.375	SPDDE
P480	566155.263	3116940.717	164.194	48.045		13	Terai	WOLF	22705.42	SPSA
P481	566190.365	3116907.912	164.6	29.286	-19.2532	13	Terai	WOLF	22734.706	SPDDE
P482	566217.158	3116896.089	164.7	52.019	16.3261	13	Terai	WOLF	22786.725	SPDDE
P483	566256.928	3116862.557	164.232	52.532		13	Terai	WOLF	22839.257	SPSA
P484	566297.089	3116828.695	163.759	50.944		13	Terai	WOLF	22890.201	SPSA

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P485	566336.037	3116795.856	163.3	45.216	-1.2953	13	Terai	WOLF	22935.417	SPDDE
P486	566371.255	3116767.499	163.717	47.585		13	Terai	WOLF	22983.002	SPSA
P487	566408.319	3116737.655	164.156	46.878		13	Terai	WOLF	23029.88	DPA
P488	566444.832	3116708.255	164.589	44.551		13	Terai	WOLF	23074.431	SPSA
P489	566479.532	3116680.315	165	51.447	0.3985	13	Terai	WOLF	23125.878	SPDDE
P490	566519.378	3116647.772	164.5	36.043	-29.0354	13	Terai	WOLF	23161.921	SPDDE
P491	566554.851	3116641.387	164.4	35.231	-24.7655	13	Terai	WOLF	23197.152	DDPDA

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Pole Code	Easting	Northing	Elevation, m	Ahead Span, m	Deviation Angle, Degree	Pole Height, m	Physical Region	Conductor	Cumulative Span, m	Selected Pole Type
P1	520811.05	3191807.276	322.7	66.472		11	Hilly	DOG	66.472	DDPDA
P2	520874.004	3191828.616	324	49.598	45.2407	11	Hilly	DOG	116.07	DDPDA
P3	520918.385	3191806.474	318.717	56.481		11	Hilly	DOG	172.551	SPSA
P4	520968.925	3191781.259	312.7	54.551	-29.4685	11	Hilly	DOG	227.102	SPDDE
P5	521023.404	3191784.07	313.736	56.053		11	Hilly	DOG	283.155	SPSA
P6	521079.382	3191786.958	314.8	53.649	-2.468	11	Hilly	DOG	336.804	SPDDE
P7	521132.791	3191792.027	314.649	52.73		11	Hilly	DOG	389.534	SPSA
P8	521185.285	3191797.009	314.5	54.744	49.3805	11	Hilly	DOG	444.278	DDPDA
P9	521224.692	3191759.009	310.888	55.892		11	Hilly	DOG	500.17	DPA
P10	521264.925	3191720.212	307.2	41.817	-9.5876	11	Hilly	DOG	541.987	SPDDE
P11	521299.44	3191696.604	306.102	42.321		11	Hilly	DOG	584.308	SPSA
P12	521334.372	3191672.712	304.99	41.497		11	Hilly	DOG	625.805	SPSA
P13	521368.624	3191649.284	303.9	42.403	21.9075	11	Hilly	DOG	668.208	SPDDE
P14	521392.164	3191614.015	304.762	41.241		11	Hilly	DOG	709.449	SPSA
P15	521415.059	3191579.713	305.6	49.341	-37.4493	11	Hilly	DOG	758.79	DDPDA
P16	521461.759	3191563.788	307.552	46.705		11	Hilly	DOG	805.495	SPSA
P17	521505.964	3191548.714	309.4	40.017	34.8805	11	Hilly	DOG	845.512	DDPDA
P18	521529.649	3191516.459	307.047	39.915		11	Hilly	DOG	885.427	SPSA
P19	521553.274	3191484.286	304.7	41.238	-21.1225	11	Hilly	DOG	926.665	SPDDE
P20	521588.02	3191462.076	305.682	41.208		11	Hilly	DOG	967.873	SPSA
P21	521622.741	3191439.882	306.664	43.498		11	Hilly	DOG	1011.371	DPA
P22	521659.391	3191416.454	307.7	45.97	-38.9637	11	Hilly	DOG	1057.341	DDPDA
P23	521705.077	3191421.559	312.313	43.715		11	Hilly	DOG	1101.056	SPSA

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Pole Code	Easting	Northing	Elevation, m	Ahead Span, m	Deviation Angle, Degree	Pole Height, m	Physical Region	Conductor	Cumulative Span, m	Selected Pole Type
P24	521748.521	3191426.414	316.7	50.432	86.0231	11	Hilly	DOG	1151.488	DDPDA
P25	521757.584	3191376.803	314.579	51.797		11	Hilly	DOG	1203.285	SPSA
P26	521766.893	3191325.85	312.4	50.517	-35.3691	11	Hilly	DOG	1253.802	DDPDA
P27	521803.061	3191290.583	314.236	48.557		11	Hilly	DOG	1302.359	SPSA
P28	521837.826	3191256.683	316	51.415	-22.5339	11	Hilly	DOG	1353.774	SPDDE
P29	521885.582	3191237.636	320.6	46.891	-15.2051	11	Hilly	DOG	1400.665	SPDDE
P30	521932.168	3191232.296	324.003	44.059		11	Hilly	DOG	1444.724	SPSA
P31	521975.941	3191227.279	327.2	36.5	43.3369	11	Hilly	DOG	1481.224	DDPDA
P32	521999.463	3191199.369	324.185	37.355		11	Hilly	DOG	1518.579	DPA
P33	522023.536	3191170.806	321.1	48.401	-52.5238	11	Hilly	DOG	1566.98	DDPDA
P34	522071.886	3191173.042	319.16	48.887		11	Hilly	DOG	1615.867	SPSA
P35	522120.721	3191175.301	317.2	44.74	-28.9502	11	Hilly	DOG	1660.607	SPDDE
P36	522158.828	3191198.743	321.477	44.171		11	Hilly	DOG	1704.778	SPSA
P37	522196.45	3191221.887	325.7	41.214	-34.6434	11	Hilly	DOG	1745.992	DDPDA
P38	522213.054	3191259.608	327.425	41.208		11	Hilly	DOG	1787.2	SPSA
P39	522229.656	3191297.324	329.15	41.82		11	Hilly	DOG	1829.02	SPSA
P40	522246.505	3191335.6	330.9	39.987	34.5654	11	Hilly	DOG	1869.007	DDPDA
P41	522280.535	3191356.598	337.564	38.857		11	Hilly	DOG	1907.864	SPSA
P42	522313.603	3191377.002	344.04	38.82		11	Hilly	DOG	1946.684	SPSA
P43	522346.64	3191397.388	350.509	38.946		11	Hilly	DOG	1985.63	SPSA
P44	522379.784	3191417.839	357	36.477	-14.1582	11	Hilly	DOG	2022.107	DDPDA
P45	522405.199	3191444.005	362.492	35.26		11	Hilly	DOG	2057.367	SPSA
P46	522429.766	3191469.298	367.8	49.441	51.598	11	Hilly	DOG	2106.808	DDPDA

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Pole Code	Easting	Northing	Elevation, m	Ahead Span, m	Deviation Angle, Degree	Pole Height, m	Physical Region	Conductor	Cumulative Span, m	Selected Pole Type
P47	522478.956	3191464.333	367.9	39.095	15.9924	11	Hilly	DOG	2145.903	SPDDE
P48	522515.267	3191449.842	364.397	40.151		11	Hilly	DOG	2186.054	SPSA
P49	522552.558	3191434.96	360.8	37.067	-11.0886	11	Hilly	DOG	2223.121	SPDDE
P50	522588.985	3191428.099	357.521	36.42		11	Hilly	DOG	2259.541	SPSA
P51	522624.776	3191421.357	354.3	60.466	-12.2159	11	Hilly	DOG	2320.007	SPDDE
P52	522685.22	3191422.991	351.5	47.204	15.1525	11	Hilly	DOG	2367.211	SPDDE
P53	522731.099	3191411.888	351.865	47.519		11	Hilly	DOG	2414.73	SPSA
P54	522777.284	3191400.711	352.233	47.393		11	Hilly	DOG	2462.123	SPSA
P55	522823.348	3191389.564	352.6	48.189	5.9882	11	Hilly	DOG	2510.312	DDPDA
P56	522868.747	3191373.405	354.713	49.251		11	Hilly	DOG	2559.563	SPSA
P57	522915.146	3191356.89	356.873	48.518		11	Hilly	DOG	2608.081	SPSA
P58	522960.855	3191340.621	359	67.795	24.7683	11	Hilly	DOG	2675.876	SPDDE
P59	523009.325	3191293.221	369.4	39.223	-62.0915	11	Hilly	DOG	2715.099	DDPDA
P60	523046.685	3191305.166	376.623	40.597		11	Hilly	DOG	2755.696	SPSA
P61	523085.353	3191317.53	384.1	41.469	44.9243	11	Hilly	DOG	2797.165	DDPDA
P62	523122.239	3191298.579	394.532	41.764		11	Hilly	DOG	2838.929	SPSA
P63	523159.387	3191279.493	405.039	40.651		11	Hilly	DOG	2879.58	SPSA
P64	523195.545	3191260.915	415.266	41.476		11	Hilly	DOG	2921.056	SPSA
P65	523232.437	3191241.961	425.7	25.819	27.5558	11	Hilly	DOG	2946.875	SPDDE
P66	523247.339	3191220.876	432.7	46.081	-26.7661	11	Hilly	DOG	2992.956	SPDDE
P67	523288.032	3191199.254	440.904	46.776		11	Hilly	DOG	3039.732	DPA
P68	523329.34	3191177.307	449.232	45.879		11	Hilly	DOG	3085.611	SPSA
P69	523369.855	3191155.78	457.4	42.105	-46.5684	11	Hilly	DOG	3127.716	DDPDA

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P70	523409.764	3191169.2	459.324	41.044		11	Hilly	DOG	3168.76	SPSA
P71	523448.667	3191182.281	461.2	51.067	4.3729	11	Hilly	DOG	3219.827	SPDDE
P72	523498.17	3191194.819	463.272	51.973		11	Hilly	DOG	3271.8	SPSA
P73	523548.553	3191207.579	465.381	52.235		11	Hilly	DOG	3324.035	SPSA
P74	523599.189	3191220.404	467.5	39.239	-9.6296	11	Hilly	DOG	3363.274	SPDDE
P75	523635.08	3191236.265	466.291	39.351		11	Hilly	DOG	3402.625	SPSA
P76	523671.073	3191252.172	465.079	37.866		11	Hilly	DOG	3440.491	SPSA
P77	523705.708	3191267.478	463.912	39.36		11	Hilly	DOG	3479.851	SPSA
P78	523741.709	3191283.388	462.7	40.877	32.3739	11	Hilly	DOG	3520.728	DDPDA
P79	523782.134	3191277.324	462.501	42.074		11	Hilly	DOG	3562.802	SPSA
P80	523823.742	3191271.082	462.296	40.279		11	Hilly	DOG	3603.081	SPSA
P81	523863.575	3191265.106	462.1	49.562	-42.6399	11	Hilly	DOG	3652.643	DDPDA
P82	523904.611	3191292.898	462.824	46.259		11	Hilly	DOG	3698.902	SPSA
P83	523942.912	3191318.838	463.5	39.423	20.1713	11	Hilly	DOG	3738.325	SPDDE
P84	523981.175	3191328.333	461.966	40.244		11	Hilly	DOG	3778.569	SPSA
P85	524020.234	3191338.026	460.4	48.359	-14.7357	11	Hilly	DOG	3826.928	SPDDE
P86	524062.662	3191361.229	458.48	52.407		11	Hilly	DOG	3879.335	SPSA
P87	524108.643	3191386.374	456.4	43.026	54.9982	11	Hilly	DOG	3922.361	DDPDA
P88	524147.207	3191367.293	452.41	42.569		11	Hilly	DOG	3964.93	SPSA
P89	524185.361	3191348.415	448.463	43.811		11	Hilly	DOG	4008.741	DPA
P90	524224.629	3191328.986	444.4	36.03	-6.1608	11	Hilly	DOG	4044.771	SPDDE
P91	524258.45	3191316.566	442.077	38.433		11	Hilly	DOG	4083.204	SPSA
P92	524294.527	3191303.317	439.6	50.219	-35.2871	11	Hilly	DOG	4133.423	DDPDA

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P93	524343.008	3191316.418	438.04	52.774		11	Hilly	DOG	4186.197	SPSA
P94	524393.954	3191330.186	436.4	49.688	-17.7065	11	Hilly	DOG	4235.885	SPDDE
P95	524435.707	3191357.123	437.156	48.899		11	Hilly	DOG	4284.784	SPSA
P96	524476.796	3191383.633	437.9	66.74	31.832	11	Hilly	DOG	4351.524	DDPDA
P97	524543.526	3191384.794	433.8	70.988	64.9399	11	Hilly	DOG	4422.512	DDPDA
P98	524574.709	3191321.021	433.4	57.104	10.5367	11	Hilly	DOG	4479.616	SPDDE
P99	524589.988	3191266	432.765	59.889		11	Hilly	DOG	4539.505	DPA
P100	524606.014	3191208.294	432.1	52.275	-38.6831	11	Hilly	DOG	4591.78	DDPDA
P101	524648.413	3191177.718	433.286	53.471		11	Hilly	DOG	4645.251	SPSA
P102	524691.784	3191146.442	434.5	47.407	-3.4076	11	Hilly	DOG	4692.658	SPDDE
P103	524731.816	3191121.047	433.833	47.866		11	Hilly	DOG	4740.524	SPSA
P104	524772.235	3191095.407	433.159	46.825		11	Hilly	DOG	4787.349	SPSA
P105	524811.775	3191070.325	432.5	39.352	21.7504	11	Hilly	DOG	4826.701	SPDDE
P106	524834.828	3191038.432	436.054	39.599		11	Hilly	DOG	4866.3	SPSA
P107	524858.025	3191006.339	439.63	40.589		11	Hilly	DOG	4906.889	SPSA
P108	524881.803	3190973.444	443.295	39.915		11	Hilly	DOG	4946.804	SPSA
P109	524905.186	3190941.095	446.9	40.421	-30.6395	11	Hilly	DOG	4987.225	DDPDA
P110	524942.254	3190924.977	450.224	39.83		11	Hilly	DOG	5027.055	DPA
P111	524978.78	3190909.095	453.5	43.872	5.768	11	Hilly	DOG	5070.927	SPDDE
P112	525017.052	3190887.646	454.696	44.187		11	Hilly	DOG	5115.114	SPSA
P113	525055.598	3190866.043	455.9	48.87	-8.4208	11	Hilly	DOG	5163.984	SPDDE
P114	525101.269	3190848.651	454.118	49.251		11	Hilly	DOG	5213.235	SPSA
P115	525147.296	3190831.124	452.322	49.985		11	Hilly	DOG	5263.22	SPSA

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P116	525194.009	3190813.335	450.5	40.894	27.3696	11	Hilly	DOG	5304.114	SPDDE
P117	525221.257	3190782.841	452.532	40.589		11	Hilly	DOG	5344.703	SPSA
P118	525248.302	3190752.575	454.549	41.268		11	Hilly	DOG	5385.971	SPSA
P119	525275.799	3190721.803	456.6	43.523	-23.2928	11	Hilly	DOG	5429.494	SPDDE
P120	525315.269	3190703.461	462.689	43.68		11	Hilly	DOG	5473.174	SPSA
P121	525354.881	3190685.054	468.8	42.992	14.7317	11	Hilly	DOG	5516.166	DDPDA
P122	525387.98	3190657.617	469.937	42.321		11	Hilly	DOG	5558.487	SPSA
P123	525420.563	3190630.609	471.056	42.816		11	Hilly	DOG	5601.303	SPSA
P124	525453.527	3190603.285	472.188	42.079		11	Hilly	DOG	5643.382	SPSA
P125	525485.923	3190576.431	473.3	69.134	-22.5118	11	Hilly	DOG	5712.516	SPDDE
P126	525551.985	3190556.052	473.7	42.134	-13.2175	11	Hilly	DOG	5754.65	SPDDE
P127	525594.02	3190553.167	473.651	42.899		11	Hilly	DOG	5797.549	SPSA
P128	525636.818	3190550.229	473.6	42.883		11	Hilly	DOG	5840.432	SPSA
P129	525679.6	3190547.293	473.55	42.781		11	Hilly	DOG	5883.213	SPSA
P130	525722.281	3190544.363	473.5	50.854	18.3444	11	Hilly	DOG	5934.067	SPDDE
P131	525769.341	3190525.09	473.105	50.324		11	Hilly	DOG	5984.391	SPSA
P132	525815.91	3190506.018	472.715	51.974		11	Hilly	DOG	6036.365	DPA
P133	525864.007	3190486.321	472.311	52.966		11	Hilly	DOG	6089.331	SPSA
P134	525913.022	3190466.247	471.9	31.885	-13.5145	11	Hilly	DOG	6121.216	SPDDE
P135	525944.535	3190461.393	472.8	55.249	32.7116	11	Hilly	DOG	6176.465	DDPDA
P136	525985.935	3190424.807	472.9	43.837	-16.5089	11	Hilly	DOG	6220.302	SPDDE
P137	526025.678	3190406.309	474.091	46.528		11	Hilly	DOG	6266.83	SPSA
P138	526067.861	3190386.675	475.356	42.115		11	Hilly	DOG	6308.945	SPSA

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P139	526106.043	3190368.904	476.5	56.768	-12.7337	11	Hilly	DOG	6365.713	SPDDE
P140	526161.523	3190356.883	477.643	57.438		11	Hilly	DOG	6423.151	SPSA
P141	526217.658	3190344.72	478.8	68.706	0.5056	11	Hilly	DOG	6491.857	SPDDE
P142	526284.675	3190329.579	478	53.569	4.3719	11	Hilly	DOG	6545.426	DDPDA
P143	526335.875	3190313.825	476.422	55.051		11	Hilly	DOG	6600.477	SPSA
P144	526388.492	3190297.635	474.8	65.812	-9.5099	11	Hilly	DOG	6666.289	SPDDE
P145	526453.727	3190288.939	474	43.77	8.0338	11	Hilly	DOG	6710.059	SPDDE
P146	526495.879	3190277.149	474.359	41.563		11	Hilly	DOG	6751.622	SPSA
P147	526535.905	3190265.953	474.7	44.004	-10.6253	11	Hilly	DOG	6795.626	SPDDE
P148	526579.742	3190262.117	475.109	42.026		11	Hilly	DOG	6837.652	SPSA
P149	526621.607	3190258.453	475.5	50.24	1.5619	11	Hilly	DOG	6887.892	SPDDE
P150	526671.518	3190252.711	475.931	54.739		11	Hilly	DOG	6942.631	SPSA
P151	526725.898	3190246.454	476.4	52.706	-4.8393	11	Hilly	DOG	6995.337	SPDDE
P152	526778.58	3190244.868	478.784	49.012		11	Hilly	DOG	7044.349	DPA
P153	526827.57	3190243.394	481	65.992	6.9357	11	Hilly	DOG	7110.341	SPDDE
P154	526892.81	3190233.458	483.1	27.211	-23.6908	11	Hilly	DOG	7137.552	SPDDE
P155	526919.09	3190240.515	484.4	40.522	15.2235	11	Hilly	DOG	7178.074	SPDDE
P156	526959.612	3190240.379	488.341	39.675		11	Hilly	DOG	7217.749	SPSA
P157	526999.287	3190240.246	492.2	44.404	-26.4628	11	Hilly	DOG	7262.153	SPDDE
P158	527039.105	3190259.9	504.442	46.034		11	Hilly	DOG	7308.187	SPSA
P159	527080.384	3190280.275	517.133	44.178		11	Hilly	DOG	7352.365	SPSA
P160	527119.998	3190299.828	529.313	44.205		11	Hilly	DOG	7396.57	SPSA
P161	527159.637	3190319.394	541.5	41.445	26.3231	11	Hilly	DOG	7438.015	SPDDE

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P162	527201.082	3190319.356	550.59	41.764		11	Hilly	DOG	7479.779	SPSA
P163	527242.847	3190319.318	559.751	41.259		11	Hilly	DOG	7521.038	DPA
P164	527284.106	3190319.28	568.8	41.753	43.2624	11	Hilly	DOG	7562.791	DDPDA
P165	527314.485	3190290.637	566.094	41.579		11	Hilly	DOG	7604.37	SPSA
P166	527344.737	3190262.114	563.4	46.727	-17.7823	11	Hilly	DOG	7651.097	SPDDE
P167	527386.9	3190241.974	556.151	47.519		11	Hilly	DOG	7698.616	SPSA
P168	527429.778	3190221.492	548.779	46.529		11	Hilly	DOG	7745.145	SPSA
P169	527471.763	3190201.437	541.561	46.16		11	Hilly	DOG	7791.305	SPSA
P170	527513.415	3190181.541	534.4	40.512	37.3408	11	Hilly	DOG	7831.817	DDPDA
P171	527531.887	3190145.485	529.674	41.084		11	Hilly	DOG	7872.901	SPSA
P172	527550.619	3190108.92	524.881	41.826		11	Hilly	DOG	7914.727	SPSA
P173	527569.69	3190071.695	520.002	41.159		11	Hilly	DOG	7955.886	SPSA
P174	527588.457	3190035.063	515.2	44.226	-27.923	11	Hilly	DOG	8000.112	DDPDA
P175	527624.707	3190009.727	513.368	45.072		11	Hilly	DOG	8045.184	SPSA
P176	527661.651	3189983.907	511.5	45.906	-31.5746	11	Hilly	DOG	8091.09	DDPDA
P177	527707.477	3189981.204	507.894	45.747		11	Hilly	DOG	8136.837	SPSA
P178	527753.145	3189978.51	504.3	50.428	15.4318	11	Hilly	DOG	8187.265	SPDDE
P179	527800.881	3189962.252	502.772	51.854		11	Hilly	DOG	8239.119	SPSA
P180	527849.966	3189945.535	501.2	49.024	-17.3992	11	Hilly	DOG	8288.143	SPDDE
P181	527898.976	3189944.33	495.805	50.94		11	Hilly	DOG	8339.083	SPSA
P182	527949.9	3189943.078	490.2	56.557	3.3046	11	Hilly	DOG	8395.64	SPDDE
P183	528006.267	3189938.431	482.3	46.029	17.0204	11	Hilly	DOG	8441.669	SPDDE
P184	528049.024	3189921.387	478	45.408	-28.3012	11	Hilly	DOG	8487.077	SPDDE

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P185	528094.134	3189926.581	470.341	47.668		11	Hilly	DOG	8534.745	DPA
P186	528141.489	3189932.033	462.3	49.305	-37.3289	11	Hilly	DOG	8584.05	DDPDA
P187	528177.018	3189966.219	457.8	62.368	45.5386	11	Hilly	DOG	8646.418	DDPDA
P188	528239.36	3189964.432	454.6	39.298	17.6456	11	Hilly	DOG	8685.716	SPDDE
P189	528276.452	3189951.452	453.541	38.621		11	Hilly	DOG	8724.337	SPSA
P190	528312.905	3189938.695	452.5	43.3	-7.6246	11	Hilly	DOG	8767.637	SPDDE
P191	528355.311	3189929.942	452.551	42.051		11	Hilly	DOG	8809.688	SPSA
P192	528396.494	3189921.441	452.6	43.977	1.8947	11	Hilly	DOG	8853.665	SPDDE
P193	528439.245	3189911.132	451.312	44.808		11	Hilly	DOG	8898.473	SPSA
P194	528482.804	3189900.628	450	54.982	44.1957	11	Hilly	DOG	8953.455	DDPDA
P195	528512.141	3189854.126	447.849	57.504		11	Hilly	DOG	9010.959	DPA
P196	528542.823	3189805.492	445.6	69.453	-41.5882	11	Hilly	DOG	9080.412	DDPDA
P197	528609.529	3189786.156	445.9	37.676	-19.6721	11	Hilly	DOG	9118.088	SPDDE
P198	528647.135	3189788.461	444.491	34.516		11	Hilly	DOG	9152.604	SPSA
P199	528681.586	3189790.572	443.2	49.384	-9.8754	11	Hilly	DOG	9201.988	SPDDE
P200	528729.629	3189802.002	442.456	56.748		11	Hilly	DOG	9258.736	SPSA
P201	528784.836	3189815.136	441.6	58.386	2.2017	11	Hilly	DOG	9317.122	SPDDE
P202	528842.114	3189826.457	439.349	58.326		11	Hilly	DOG	9375.448	SPSA
P203	528899.333	3189837.767	437.1	47.094	18.7003	11	Hilly	DOG	9422.542	SPDDE
P204	528946.023	3189831.604	435.1	58.371	-32.1462	11	Hilly	DOG	9480.913	DDPDA
P205	528999.084	3189855.927	434.793	55.816		11	Hilly	DOG	9536.729	DPA
P206	529049.823	3189879.186	434.5	50.51	-45.357	11	Hilly	DOG	9587.239	DDPDA
P207	529067.112	3189926.645	435.74	51.351		11	Hilly	DOG	9638.59	SPSA

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P208	529084.689	3189974.894	437	46.657	25.9823	11	Hilly	DOG	9685.247	SPDDE
P209	529118.251	3190007.305	437.401	46.513		11	Hilly	DOG	9731.76	SPSA
P210	529151.709	3190039.617	437.8	42.104	54.1273	11	Hilly	DOG	9773.864	DDPDA
P211	529193.157	3190032.215	436.048	42.693		11	Hilly	DOG	9816.557	SPSA
P212	529235.184	3190024.709	434.271	42.693		11	Hilly	DOG	9859.25	SPSA
P213	529277.212	3190017.203	432.494	42.693		11	Hilly	DOG	9901.943	SPSA
P214	529319.239	3190009.697	430.717	42.321		11	Hilly	DOG	9944.264	SPSA
P215	529360.902	3190002.256	428.956	41.208		11	Hilly	DOG	9985.472	SPSA
P216	529401.467	3189995.012	427.241	41.82		11	Hilly	DOG	10027.292	DPA
P217	529442.636	3189987.659	425.5	46.047	1.8997	11	Hilly	DOG	10073.339	SPDDE
P218	529487.673	3189978.065	424.943	47.519		11	Hilly	DOG	10120.858	SPSA
P219	529534.148	3189968.165	424.368	46.949		11	Hilly	DOG	10167.807	SPSA
P220	529580.067	3189958.383	423.8	48.881	60.2533	11	Hilly	DOG	10216.688	DDPDA
P221	529594.945	3189911.822	424.458	47.69		11	Hilly	DOG	10264.378	SPSA
P222	529609.461	3189866.395	425.1	46.73	-52.4181	11	Hilly	DOG	10311.108	DDPDA
P223	529653.412	3189850.519	426.8	33.368	-45.2803	11	Hilly	DOG	10344.476	DDPDA
P224	529683.55	3189864.842	426.7	66.119	28.9347	11	Hilly	DOG	10410.595	SPDDE
P225	529749.544	3189860.788	426.5	55.718	13.2234	11	Hilly	DOG	10466.313	SPDDE
P226	529802.9	3189844.741	422.6	63.028	26.2468	11	Hilly	DOG	10529.341	DDPDA
P227	529849.007	3189801.768	419.4	38.244	-33.9866	11	Hilly	DOG	10567.585	DDPDA
P228	529886.781	3189795.786	417.863	41.385		11	Hilly	DOG	10608.97	SPSA
P229	529927.656	3189789.313	416.2	49.742	-19.5775	11	Hilly	DOG	10658.712	SPDDE
P230	529976.553	3189798.445	414.519	47.906		11	Hilly	DOG	10706.618	SPSA

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P231	530023.644	3189807.24	412.9	33.519	-28.3985	11	Hilly	DOG	10740.137	SPDDE
P232	530049.702	3189828.324	412.609	35.505		11	Hilly	DOG	10775.642	SPSA
P233	530077.304	3189850.657	412.3	46.811	4.6713	11	Hilly	DOG	10822.453	SPDDE
P234	530115.971	3189877.04	411.58	44.177		11	Hilly	DOG	10866.63	SPSA
P235	530152.463	3189901.939	410.9	55.422	46.7038	11	Hilly	DOG	10922.052	DDPDA
P236	530206.593	3189890.04	411.7	51.521	-35.9062	11	Hilly	DOG	10973.573	DDPDA
P237	530253.838	3189910.591	410.34	54.548		11	Hilly	DOG	11028.121	DPA
P238	530303.858	3189932.349	408.9	51.676	-1.0682	11	Hilly	DOG	11079.797	SPDDE
P239	530350.852	3189953.841	408.667	51.726		11	Hilly	DOG	11131.523	SPSA
P240	530397.892	3189975.355	408.434	52.06		11	Hilly	DOG	11183.583	SPSA
P241	530445.236	3189997.007	408.2	65.948	29.2088	11	Hilly	DOG	11249.531	SPDDE
P242	530510.969	3189991.681	405.8	53.802	-17.8424	11	Hilly	DOG	11303.333	SPDDE
P243	530563.347	3190003.976	402.829	58.458		11	Hilly	DOG	11361.791	SPSA
P244	530620.258	3190017.335	399.6	45.39	-9.7471	11	Hilly	DOG	11407.181	SPDDE
P245	530662.053	3190035.039	400.008	43.538		11	Hilly	DOG	11450.719	SPSA
P246	530702.143	3190052.021	400.4	42.738	38.7729	11	Hilly	DOG	11493.457	DDPDA
P247	530743.263	3190040.373	398.806	45.751		11	Hilly	DOG	11539.208	DPA
P248	530787.282	3190027.904	397.1	28.076	-50.1413	11	Hilly	DOG	11567.284	DDPDA
P249	530810.468	3190043.736	397.1	35.128	-34.0987	11	Hilly	DOG	11602.412	DDPDA
P250	530823.386	3190076.403	398.8	40.184	18.2573	11	Hilly	DOG	11642.596	SPDDE
P251	530849.126	3190107.261	399.375	43.625		11	Hilly	DOG	11686.221	SPSA
P252	530877.07	3190140.761	400	44.532	-17.0017	11	Hilly	DOG	11730.753	SPDDE
P253	530894.349	3190181.804	400.934	43.559		11	Hilly	DOG	11774.312	SPSA

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P254	530911.251	3190221.95	401.848	45.39		11	Hilly	DOG	11819.702	SPSA
P255	530928.863	3190263.784	402.8	49.301	41.0268	11	Hilly	DOG	11869.003	DDPDA
P256	530973.121	3190285.506	400.485	50.77		11	Hilly	DOG	11919.773	SPSA
P257	531018.697	3190307.875	398.1	43.673	49.1959	11	Hilly	DOG	11963.446	DDPDA
P258	531058.882	3190290.773	396.418	44.591		11	Hilly	DOG	12008.037	DPA
P259	531099.912	3190273.311	394.7	38.221	-3.2841	11	Hilly	DOG	12046.258	SPDDE
P260	531135.88	3190260.383	395.188	40.125		11	Hilly	DOG	12086.383	SPSA
P261	531173.64	3190246.811	395.7	42.686	-3.3128	11	Hilly	DOG	12129.069	SPDDE
P262	531214.577	3190234.718	396.529	44.866		11	Hilly	DOG	12173.935	SPSA
P263	531257.605	3190222.008	397.4	50.728	27.8289	11	Hilly	DOG	12224.663	SPDDE
P264	531293.92	3190186.588	397.5	52.704	16.8659	11	Hilly	DOG	12277.367	SPDDE
P265	531319.349	3190140.424	398.875	54.608		11	Hilly	DOG	12331.975	SPSA
P266	531345.697	3190092.593	400.3	44.538	-11.0811	11	Hilly	DOG	12376.513	SPDDE
P267	531374.283	3190058.44	400.3	45.043		11	Hilly	DOG	12421.556	SPSA
P268	531403.194	3190023.899	400.3	44.658		11	Hilly	DOG	12466.214	SPSA
P269	531431.857	3189989.654	400.3	47.291	-49.9725	11	Hilly	DOG	12513.505	DDPDA
P270	531479.148	3189989.573	400.9	47.934	-25.4028	11	Hilly	DOG	12561.439	SPDDE
P271	531522.483	3190010.061	402.541	48.442		11	Hilly	DOG	12609.881	SPSA
P272	531566.277	3190030.767	404.2	49.112	39.6845	11	Hilly	DOG	12658.993	DDPDA
P273	531613.85	3190018.57	403.2	48.368	5.9464	11	Hilly	DOG	12707.361	SPDDE
P274	531659.207	3190001.769	399.686	49.356		11	Hilly	DOG	12756.717	SPSA
P275	531705.489	3189984.624	396.1	47.81	5.9608	11	Hilly	DOG	12804.527	SPDDE
P276	531748.355	3189963.451	392.459	48.043		11	Hilly	DOG	12852.57	SPSA

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P277	531791.429	3189942.174	388.8	42.402	-8.9174	11	Hilly	DOG	12894.972	SPDDE
P278	531831.897	3189929.516	386.623	43.806		11	Hilly	DOG	12938.778	SPSA
P279	531873.706	3189916.438	384.374	42.321		11	Hilly	DOG	12981.099	SPSA
P280	531914.097	3189903.803	382.202	42.816		11	Hilly	DOG	13023.915	DPA
P281	531954.961	3189891.021	380.004	42.924		11	Hilly	DOG	13066.839	SPSA
P282	531995.927	3189878.207	377.8	54.282	31.5822	11	Hilly	DOG	13121.121	DDPDA
P283	532031.574	3189837.27	375.8	66.383	-2.1594	11	Hilly	DOG	13187.504	SPDDE
P284	532077.022	3189788.885	368.5	46.211	14.0686	11	Hilly	DOG	13233.715	SPDDE
P285	532099.524	3189748.522	367.242	49.268		11	Hilly	DOG	13282.983	SPSA
P286	532123.514	3189705.489	365.9	50.119	-37.6883	11	Hilly	DOG	13333.102	DDPDA
P287	532169.59	3189685.767	358.8	52.845	0.8401	11	Hilly	DOG	13385.947	SPDDE
P288	532217.861	3189664.262	354	57.443	45.8161	11	Hilly	DOG	13443.39	DDPDA
P289	532237.669	3189610.342	355.575	55.626		11	Hilly	DOG	13499.016	SPSA
P290	532256.851	3189558.127	357.1	42.43	-20.6611	11	Hilly	DOG	13541.446	DDPDA
P291	532284.594	3189526.023	357.931	43.064		11	Hilly	DOG	13584.51	SPSA
P292	532312.751	3189493.44	358.774	42.188		11	Hilly	DOG	13626.698	SPSA
P293	532340.335	3189461.519	359.6	46.563	-5.3077	11	Hilly	DOG	13673.261	SPDDE
P294	532373.909	3189429.256	357.999	47.024		11	Hilly	DOG	13720.285	SPSA
P295	532407.814	3189396.673	356.382	46.005		11	Hilly	DOG	13766.29	SPSA
P296	532440.986	3189364.796	354.8	39.925	8.0698	11	Hilly	DOG	13806.215	SPDDE
P297	532465.604	3189333.365	352.729	39.846		11	Hilly	DOG	13846.061	SPSA
P298	532490.174	3189301.996	350.662	37.831		11	Hilly	DOG	13883.892	SPSA
P299	532513.502	3189272.213	348.7	55.721	1.0748	11	Hilly	DOG	13939.613	SPDDE

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P300	532547.032	3189227.709	347.181	54.325		11	Hilly	DOG	13993.938	SPSA
P301	532579.722	3189184.321	345.7	50.415	-30.2457	11	Hilly	DOG	14044.353	DDPDA
P302	532626.211	3189164.818	343.661	50.941		11	Hilly	DOG	14095.294	SPSA
P303	532673.186	3189145.111	341.6	40.285	-41.2048	11	Hilly	DOG	14135.579	DDPDA
P304	532711.401	3189157.857	341.963	41.826		11	Hilly	DOG	14177.405	SPSA
P305	532751.079	3189171.092	342.339	40.079		11	Hilly	DOG	14217.484	SPSA
P306	532789.099	3189183.773	342.7	43.969	-12.799	11	Hilly	DOG	14261.453	SPDDE
P307	532826.691	3189206.58	342.008	44.981		11	Hilly	DOG	14306.434	SPSA
P308	532865.148	3189229.911	341.3	40.058	11.0236	11	Hilly	DOG	14346.492	SPDDE
P309	532902.737	3189243.757	341.106	42.749		11	Hilly	DOG	14389.241	SPSA
P310	532942.851	3189258.533	340.9	40.557	15.9774	11	Hilly	DOG	14429.798	SPDDE
P311	532983.297	3189261.534	339.697	40.375		11	Hilly	DOG	14470.173	SPSA
P312	533023.561	3189264.522	338.5	45.653	26.062	11	Hilly	DOG	14515.826	DDPDA
P313	533065.944	3189247.554	340.484	46.411		11	Hilly	DOG	14562.237	SPSA
P314	533109.031	3189230.305	342.5	46.3	1.2511	11	Hilly	DOG	14608.537	SPDDE
P315	533151.628	3189212.163	344.106	46.034		11	Hilly	DOG	14654.571	SPSA
P316	533193.981	3189194.125	345.702	46.076		11	Hilly	DOG	14700.647	SPSA
P317	533236.372	3189176.07	347.3	49.506	17.4783	11	Hilly	DOG	14750.153	SPDDE
P318	533273.99	3189143.887	350.229	50.214		11	Hilly	DOG	14800.367	SPSA
P319	533312.146	3189111.244	353.2	37.894	-55.6851	11	Hilly	DOG	14838.261	DDPDA
P320	533348.725	3189121.14	353.725	34.302		11	Hilly	DOG	14872.563	SPSA
P321	533381.837	3189130.097	354.2	34.649	12.9012	11	Hilly	DOG	14907.212	SPDDE
P322	533416.459	3189131.449	355.449	34.7		11	Hilly	DOG	14941.912	SPSA

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P323	533451.133	3189132.803	356.7	32.767	11.5545	11	Hilly	DOG	14974.679	SPDDE
P324	533483.468	3189127.497	356.801	32.327		11	Hilly	DOG	15007.006	DPA
P325	533515.368	3189122.263	356.9	48.256	0.7899	11	Hilly	DOG	15055.262	SPDDE
P326	533562.876	3189113.794	357.972	48.509		11	Hilly	DOG	15103.771	SPSA
P327	533610.631	3189105.28	359.05	47.28		11	Hilly	DOG	15151.051	SPSA
P328	533657.178	3189096.982	360.1	51.618	59.1614	11	Hilly	DOG	15202.669	DDPDA
P329	533675.449	3189048.706	368.241	51.73		11	Hilly	DOG	15254.399	SPSA
P330	533693.76	3189000.325	376.4	36.774	-52.4469	11	Hilly	DOG	15291.173	DDPDA
P331	533728.96	3188989.682	376.15	36.645		11	Hilly	DOG	15327.818	SPSA
P332	533764.036	3188979.077	375.9	49.136	48.3411	11	Hilly	DOG	15376.954	DDPDA
P333	533784.675	3188934.485	380.494	49.262		11	Hilly	DOG	15426.216	SPSA
P334	533805.366	3188889.779	385.1	36.766	28.023	11	Hilly	DOG	15462.982	SPDDE
P335	533803.322	3188853.07	387.309	36.481		11	Hilly	DOG	15499.463	SPSA
P336	533801.294	3188816.645	389.5	37.173	3.6802	11	Hilly	DOG	15536.636	DDPDA
P337	533796.85	3188779.738	389.997	37.619		11	Hilly	DOG	15574.255	SPSA
P338	533792.352	3188742.389	390.5	39.104	-25.6548	11	Hilly	DOG	15613.359	SPDDE
P339	533804.946	3188705.369	390.746	40.497		11	Hilly	DOG	15653.856	SPSA
P340	533817.988	3188667.03	391	60.157	-33.9307	11	Hilly	DOG	15714.013	DDPDA
P341	533865.853	3188630.591	389.2	41.952	4.6729	11	Hilly	DOG	15755.965	SPDDE
P342	533897.051	3188602.545	388.263	43.14		11	Hilly	DOG	15799.105	SPSA
P343	533929.134	3188573.704	387.3	38.533	6.7198	11	Hilly	DOG	15837.638	SPDDE
P344	533954.578	3188544.767	388.464	37.63		11	Hilly	DOG	15875.268	SPSA
P345	533979.427	3188516.508	389.6	40.259	-7.3742	11	Hilly	DOG	15915.527	SPDDE

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P346	534009.672	3188489.937	391.1	56.742	-34.2859	11	Hilly	DOG	15972.269	DDPDA
P347	534065.99	3188483.008	394.1	49.207	-5.3344	11	Hilly	DOG	16021.476	DDPDA
P348	534115.175	3188481.566	397.95	46.655		11	Hilly	DOG	16068.131	SPSA
P349	534161.811	3188480.198	401.6	27.479	32.8468	11	Hilly	DOG	16095.61	DDPDA
P350	534184.45	3188464.623	403.2	42.076	46.597	11	Hilly	DOG	16137.686	DDPDA
P351	534190.942	3188423.051	404.7	43.818	-70.7236	11	Hilly	DOG	16181.504	DDPDA
P352	534234.041	3188415.141	409.103	43.769		11	Hilly	DOG	16225.273	SPSA
P353	534277.091	3188407.24	413.5	39.043	-37.8676	11	Hilly	DOG	16264.316	DDPDA
P354	534311.732	3188425.248	416.117	38.549		11	Hilly	DOG	16302.865	SPSA
P355	534345.935	3188443.029	418.7	54.132	-17.155	11	Hilly	DOG	16356.997	SPDDE
P356	534384.464	3188481.053	421.9	46.955	21.2459	11	Hilly	DOG	16403.952	SPDDE
P357	534427.564	3188499.684	422.995	43.056		11	Hilly	DOG	16447.008	SPSA
P358	534467.086	3188516.767	424	50.051	15.2315	11	Hilly	DOG	16497.059	SPDDE
P359	534516.632	3188523.858	423.69	46.842		11	Hilly	DOG	16543.901	DPA
P360	534563.002	3188530.495	423.4	36.563	-36.4807	11	Hilly	DOG	16580.464	DDPDA
P361	534589.024	3188556.179	423.651	36.355		11	Hilly	DOG	16616.819	SPSA
P362	534614.898	3188581.718	423.9	44.08	-16.6607	11	Hilly	DOG	16660.899	SPDDE
P363	534636.076	3188620.377	424.557	43.176		11	Hilly	DOG	16704.075	SPSA
P364	534656.819	3188658.244	425.2	43.645	46.2665	11	Hilly	DOG	16747.72	DDPDA
P365	534698.973	3188669.555	421.504	44.549		11	Hilly	DOG	16792.269	SPSA
P366	534741.999	3188681.1	417.732	44.067		11	Hilly	DOG	16836.336	SPSA
P367	534784.56	3188692.52	414	49.634	62.2037	11	Hilly	DOG	16885.97	DDPDA
P368	534818.294	3188656.111	410.446	49.994		11	Hilly	DOG	16935.964	SPSA

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P369	534852.273	3188619.439	406.867	48.422		11	Hilly	DOG	16984.386	SPSA
P370	534885.182	3188583.92	403.4	54.189	14.0902	11	Hilly	DOG	17038.575	DDPDA
P371	534911.227	3188536.4	400.349	52.372		11	Hilly	DOG	17090.947	SPSA
P372	534936.398	3188490.474	397.4	46.808	12.8069	11	Hilly	DOG	17137.755	SPDDE
P373	534949.236	3188445.461	393.5	41.198	13.175	11	Hilly	DOG	17178.953	SPDDE
P374	534951.209	3188404.31	391.56	41.331		11	Hilly	DOG	17220.284	SPSA
P375	534953.188	3188363.026	389.615	40.341		11	Hilly	DOG	17260.625	SPSA
P376	534955.119	3188322.731	387.715	42.81		11	Hilly	DOG	17303.435	SPSA
P377	534957.169	3188279.97	385.7	47.274	-2.811	11	Hilly	DOG	17350.709	SPDDE
P378	534961.745	3188232.918	383.847	47.519		11	Hilly	DOG	17398.228	SPSA
P379	534966.345	3188185.622	381.984	47.024		11	Hilly	DOG	17445.252	SPSA
P380	534970.897	3188138.819	380.14	47.024		11	Hilly	DOG	17492.276	SPSA
P381	534975.449	3188092.016	378.296	47.123		11	Hilly	DOG	17539.399	DPA
P382	534980.011	3188045.115	376.449	47.156		11	Hilly	DOG	17586.555	SPSA
P383	534984.576	3187998.18	374.6	44.822	-15.4138	11	Hilly	DOG	17631.377	SPDDE
P384	535000.616	3187956.326	374.101	44.985		11	Hilly	DOG	17676.362	SPSA
P385	535016.715	3187914.32	373.6	47.94	-5.1255	11	Hilly	DOG	17724.302	SPDDE
P386	535037.801	3187871.266	373.8	47.849		11	Hilly	DOG	17772.151	SPSA
P387	535058.848	3187828.295	374	47.931		11	Hilly	DOG	17820.082	SPSA
P388	535079.93	3187785.249	374.2	47.799	17.119	11	Hilly	DOG	17867.881	SPDDE
P389	535087.387	3187738.035	372.531	47.849		11	Hilly	DOG	17915.73	SPSA
P390	535094.852	3187690.772	370.86	47.542		11	Hilly	DOG	17963.272	SPSA
P391	535102.269	3187643.813	369.2	49.738	-38.4448	11	Hilly	DOG	18013.01	DDPDA

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P392	535138.893	3187610.159	367.042	51.666		11	Hilly	DOG	18064.676	SPSA
P393	535176.937	3187575.201	364.8	50.202	12.0555	11	Hilly	DOG	18114.878	SPDDE
P394	535205.993	3187534.262	362.614	53.142		11	Hilly	DOG	18168.02	SPSA
P395	535236.75	3187490.926	360.3	40.46	42.8949	11	Hilly	DOG	18208.48	DDPDA
P396	535231.448	3187450.815	356.924	41.579		11	Hilly	DOG	18250.059	SPSA
P397	535225.999	3187409.594	353.455	41.41		11	Hilly	DOG	18291.469	SPSA
P398	535220.573	3187368.542	350	38.501	4.716	11	Hilly	DOG	18329.97	SPDDE
P399	535212.406	3187330.917	345.114	38.98		11	Hilly	DOG	18368.95	SPSA
P400	535204.138	3187292.824	340.168	38.361		11	Hilly	DOG	18407.311	SPSA
P401	535196.001	3187255.336	335.3	53.929	-10.3506	11	Hilly	DOG	18461.24	SPDDE
P402	535194.217	3187201.436	331.401	52.576		11	Hilly	DOG	18513.816	DPA
P403	535192.478	3187148.889	327.6	45.947	-3.5789	11	Hilly	DOG	18559.763	SPDDE
P404	535193.828	3187102.962	325.4	38.687	-75.5021	11	Hilly	DOG	18598.45	DDPDA
P405	535231.552	3187094.381	323.826	37.5		11	Hilly	DOG	18635.95	SPSA
P406	535268.117	3187086.064	322.3	54.419	36.5977	11	Hilly	DOG	18690.369	DDPDA
P407	535303.523	3187044.737	321.452	54.668		11	Hilly	DOG	18745.037	SPSA
P408	535339.091	3187003.222	320.6	55.655	32.9231	11	Hilly	DOG	18800.692	DDPDA
P409	535346.514	3186948.064	321.8	64.899	-28.2666	11	Hilly	DOG	18865.591	SPDDE
P410	535384.597	3186895.514	325.2	39.206	-20.0432	11	Hilly	DOG	18904.797	SPDDE
P411	535417.091	3186873.576	327.37	38.609		11	Hilly	DOG	18943.406	SPSA
P412	535449.09	3186851.972	329.508	39.596		11	Hilly	DOG	18983.002	SPSA
P413	535481.907	3186829.815	331.7	39.701	27.7537	11	Hilly	DOG	19022.703	DDPDA
P414	535500.68	3186794.834	334.105	39.351		11	Hilly	DOG	19062.054	SPSA

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P415	535519.288	3186760.16	336.489	39.793		11	Hilly	DOG	19101.847	SPSA
P416	535538.105	3186725.097	338.9	59.699	10.7437	11	Hilly	DOG	19161.546	SPDDE
P417	535556.034	3186668.154	337.29	58.931		11	Hilly	DOG	19220.477	SPSA
P418	535573.733	3186611.943	335.7	40.19	-13.3497	11	Hilly	DOG	19260.667	SPDDE
P419	535594.328	3186577.431	334.575	41.962		11	Hilly	DOG	19302.629	SPSA
P420	535615.831	3186541.397	333.4	49.957	-38.3765	11	Hilly	DOG	19352.586	DDPDA
P421	535662.533	3186523.66	334.584	51.318		11	Hilly	DOG	19403.904	SPSA
P422	535710.508	3186505.439	335.8	76.861	51.9409	11	Hilly	DOG	19480.765	DDPDA
P423	535733.316	3186432.04	337.9	44.521	-37.707	11	Hilly	DOG	19525.286	DDPDA
P424	535769.772	3186406.484	340.381	43.416		11	Hilly	DOG	19568.702	SPSA
P425	535805.323	3186381.563	342.8	45.701	-31.9233	11	Hilly	DOG	19614.403	DDPDA
P426	535850.956	3186379.086	344.111	44.549		11	Hilly	DOG	19658.952	SPSA
P427	535895.44	3186376.671	345.388	45.749		11	Hilly	DOG	19704.701	SPSA
P428	535941.122	3186374.191	346.7	45.229	27.7801	11	Hilly	DOG	19749.93	SPDDE
P429	535979.936	3186350.972	346.363	45.539		11	Hilly	DOG	19795.469	SPSA
P430	536019.017	3186327.595	346.023	43.263		11	Hilly	DOG	19838.732	SPSA
P431	536056.144	3186305.386	345.7	45.241	1.3863	11	Hilly	DOG	19883.973	SPDDE
P432	536094.395	3186281.229	346.76	44.361		11	Hilly	DOG	19928.334	SPSA
P433	536131.902	3186257.542	347.8	43.054	8.9375	11	Hilly	DOG	19971.388	SPDDE
P434	536164.291	3186229.176	348.351	44.549		11	Hilly	DOG	20015.937	DPA
P435	536197.805	3186199.826	348.92	43.064		11	Hilly	DOG	20059.001	SPSA
P436	536230.201	3186171.454	349.471	44.301		11	Hilly	DOG	20103.302	SPSA
P437	536263.528	3186142.267	350.038	43.96		11	Hilly	DOG	20147.262	SPSA

Name of Tenderer _____

Signature of Tenderer_____

Nepal Electricity Authority
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Distribution System Upgrade and Expansion Project
Babiyachaur Budhebhapar 33 kV line
Substation Location and Angle Points

WGS 1984 UTM Zone 44N

Pole Code	Easting	Northing	Elevation, m	Ahead Span, m	Deviation Angle, Degree	Pole Height, m	Physical Region	Conductor	Cumulative Span, m	Selected Pole Type
P438	536296.599	3186113.304	350.6	46.177	20.471	11	Hilly	DOG	20193.439	SPDDE
P439	536318.503	3186072.653	350.403	47.406		11	Hilly	DOG	20240.845	SPSA
P440	536340.991	3186030.92	350.2	53.395	-16.3059	11	Hilly	DOG	20294.24	SPDDE
P441	536378.498	3185992.917	352.7	40.666	-18.1924	11	Hilly	DOG	20334.906	SPDDE
P442	536414.672	3185974.339	355.008	40.376		11	Hilly	DOG	20375.282	SPSA
P443	536450.589	3185955.893	357.3	49.365	-13.3994	11	Hilly	DOG	20424.647	SPDDE
P444	536498.532	3185944.131	358.64	49.004		11	Hilly	DOG	20473.651	SPSA
P445	536546.124	3185932.455	359.971	48.955		11	Hilly	DOG	20522.606	DPA
P446	536593.669	3185920.79	361.3	44.003	43.5868	11	Hilly	DOG	20566.609	DDPDA
P447	536617.395	3185883.731	361.549	44.482		11	Hilly	DOG	20611.091	SPSA
P448	536641.38	3185846.269	361.8	45.407	14.4891	11	Hilly	DOG	20656.498	SPDDE
P449	536655.517	3185803.118	361.267	45.044		11	Hilly	DOG	20701.542	SPSA
P450	536669.54	3185760.313	360.738	45.805		11	Hilly	DOG	20747.347	SPSA
P451	536683.801	3185716.785	360.2	59.529	-20.8777	11	Hilly	DOG	20806.876	SPDDE
P452	536721.277	3185670.534	359.747	58.86		11	Hilly	DOG	20865.736	SPSA
P453	536758.333	3185624.802	359.3	40.186	-27.3228	11	Hilly	DOG	20905.922	SPDDE
P454	536795.141	3185608.675	358.479	41.331		11	Hilly	DOG	20947.253	SPSA
P455	536832.999	3185592.088	357.635	40.862		11	Hilly	DOG	20988.115	SPSA
P456	536870.426	3185575.69	356.8	47.74	17.5608	11	Hilly	DOG	21035.855	DDPDA
P457	536906.335	3185544.231	357.818	46.033		11	Hilly	DOG	21081.888	SPSA
P458	536940.961	3185513.897	358.8	46.826	-13.1846	11	Hilly	DOG	21128.714	SPDDE
P459	536982.292	3185491.887	360.851	46.281		11	Hilly	DOG	21174.995	SPSA
P460	537023.142	3185470.134	362.878	46.178		11	Hilly	DOG	21221.173	SPSA

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Pole Code	Easting	Northing	Elevation, m	Ahead Span, m	Deviation Angle, Degree	Pole Height, m	Physical Region	Conductor	Cumulative Span, m	Selected Pole Type
P461	537063.901	3185448.429	364.9	64.626	17.6067	11	Hilly	DOG	21285.799	SPDDE
P462	537109.083	3185402.222	368.9	67.438	45.6754	11	Hilly	DOG	21353.237	DDPDA
P463	537107.532	3185334.802	369.8	39.354	27.8974	11	Hilly	DOG	21392.591	SPDDE
P464	537088.323	3185300.454	368.072	38.101		11	Hilly	DOG	21430.692	SPSA
P465	537069.726	3185267.2	366.4	36.79	-14.371	11	Hilly	DOG	21467.482	SPDDE
P466	537060.3	3185231.638	367.412	35.904		11	Hilly	DOG	21503.386	DPA
P467	537051.102	3185196.932	368.4	47.304	-46.132	11	Hilly	DOG	21550.69	DDPDA
P468	537075.668	3185156.507	369.319	48.013		11	Hilly	DOG	21598.703	SPSA
P469	537100.603	3185115.476	370.252	48.783		11	Hilly	DOG	21647.486	SPSA
P470	537125.938	3185073.788	371.2	30.482	-6.0791	11	Hilly	DOG	21677.968	SPDDE
P471	537144.437	3185049.562	368.9	59.328	-17.9571	11	Hilly	DOG	21737.296	SPDDE
P472	537193.227	3185015.808	362.6	41.157	29.6946	11	Hilly	DOG	21778.453	SPDDE
P473	537211.029	3184978.7	360.7			11	Hilly	DOG	21778.453	DDPDA

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Distribution and Consumer Services Directorate
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Baddichaur Odaltal 33 kV line
Substation Location and Angle Points

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Pole Code	Easting	Northing	Elevation, m	Ahead Span, m	Deviation Angle, Degree	Pole Height, m	Physical Region	Conductor	Cumulative Span, m	Selected Pole Type
P1	550580.21	3168224.47	784	47		13	Hilly	DOG	47	DDPDA
P2	550558.47	3168182.8	796	32.81	-18.4857	13	Hilly	DOG	79.81	SPDDE
P3	550553.3	3168150.4	798	60.861	-8.8025	13	Hilly	DOG	140.671	SPDDE
P4	550553.02	3168089.54	807	41.603	38.8004	13	Hilly	DOG	182.274	DDPDA
P5	550526.802	3168057.237	806.504	42.292		13	Hilly	DOG	224.566	SPSA
P6	550500.15	3168024.4	806			13	Hilly	DOG	224.566	DDPDA

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