

# NEPAL ELECTRICITY AUTHORITY

(An Undertaking of Government of Nepal)  
Project Management Directorate



*SASEC Power Transmission and Distribution System Strengthening Project*

## BIDDING DOCUMENT FOR

Procurement of Plant  
for  
**Supply, Delivery, Installation, Testing, Commissioning, Operation and  
Maintenance of Electric Vehicle Charging Stations**

Single-Stage, Two-Envelope  
Bidding Procedure

Issued on:	.....
Invitation for Bids No.:	PMD/PTDSSP/EVCS/2076/77-01
OCB No.:	PMD/PTDSSP/EVCS /2076/77-01
Employer:	Nepal Electricity Authority
Country:	Nepal

VOLUME –II OF III

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# Employer's Requirements

This volume contains the specification, drawings, and supplementary information that describe the works to be procured.



## 1. Scope of Work

The main works of Electric Vehicle (EV) charging station (referred interchangeably as “plant and services” or “facilities” throughout) installation project shall include but not limited to the following:

- a. Design, supply, delivery to the project site, installation/erection, testing, pre-commissioning, commissioning and operation of EV charging station with required HT Line extension and transformer installation as per the terms of the bidding document.
- b. Civil works associated with the erection of charger and transformer along with required HT line extension are within the scope of the bidder. Civil works for erection of charger would also include the following:
  - Construction of hood structure on the top of the EV Charger with LED Panel lights for illumination during evening hours. An auto day-light sensor enabled or remotely through ON/OFF using GPRS enabled communication technology
  - Bollards around each EV charging station to protect chargers from vehicle impacts
- c. The charging equipment must come with a comprehensive extended on-site warranty and AMC package of 5 years from the date of installation and commissioning of the charging equipment and design life of 15 years.
- d. Construction of 11 kV line from nearest available existing supply line up to the site location and making necessary electrical connection to the EV charger including earthing as required.
- e. Electric connection from transformer to meter and from meter to charger
- f. Training/refresher course to the project/operation team, contractor staff for carrying out operations, and addressing common issues related to operation of charging stations

### 1.1 Design, Supply, Delivery, Installation, Testing, Commissioning and Warranty of EV Fast Charging Stations



- i) Bidder has to perform planning, designing, engineering, manufacturing, testing, inspection, packing, supply, transportation & insurance (till delivery at site), delivery to project site, unloading, handling and storage and erection, testing, commissioning and operation, along with 5-year comprehensive on-site warranty and AMC for 5 years of EV-Fast Charger (CCS 2.0, CHAdeMo, GB/T and AC Type 2). The technical specifications of the fast charger shall comply with the requirements given under Chapter "Technical Specifications".
- ii) The bidder shall supply the entire lot of charging stations and part components of the charging station including other related items/software to the project site.
- iii) Insurance: The goods supplied under the contract shall be fully insured against loss or damage incidental to manufacture or acquisition, transportation, storage, delivery. For delivery of goods at site, the insurance shall be obtained by the bidder, for an amount not less than the Contract Price of the goods from "warehouse to warehouse" (final destinations) on "All Risks" basis including War risks and strikes. This shall include insurance during the entire contract period against natural calamities and theft.
- iv) Transportation, storage, Demurrage/Wharfage, etc:  

Bidder is required under the contract to transport the Goods to place of destination defined as Site and make necessary arrangements for storage of the material till the same are installed at various locations. Transport to such place of destination including insurance shall be arranged by the successful bidder, and the related cost shall be included in the Contract Price.
- v) All the Tools and Plants, including Special T&P, testing and measuring instruments required for the implementation of the project is to be arranged by the bidder and quoted price shall be inclusive of the same.



- vi) Storage for supplies, servicing warranty redemptions is in the scope of work of the bidder.

## **1.2 Warranty of EV Fast Charging Stations during operation, Repair & Maintenance phase for the 5-year AMC period**

- i) Bidder shall make proper arrangements for stocking up sufficient materials at their store during the contract period for ensuring that any downtime (excluding the period of non-availability of power supply) shall be rectified within a period not exceeding 48 hours and also keeping minimum an uptime of 95% at any point of time throughout the contract period in close coordination with the employer. Bidder shall ensure that material supplied by them should not be a constraint in fulfilling these conditions, failing which the bidder shall be liable to be penalized by the employer.
- ii) For Repair & Maintenance of chargers, the bidder has to set-up service centers at appropriate location(s).
- iii) There shall be the provision for buffer stock of spare parts to be maintained for its replenishment, opening of a representative office during warranty period and mechanism to ensure warranty clause during the entire period of contract.
- iv) If above conditions are not met by the bidder, employer reserves the right to make appropriate deductions from payments.

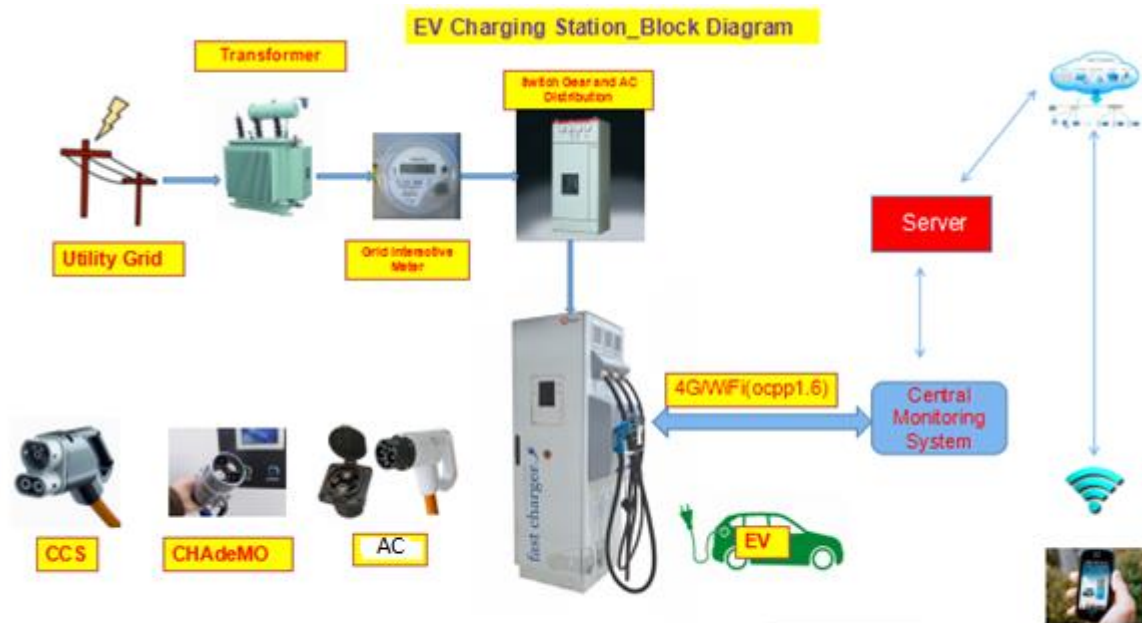


## Section – A: TECHNICAL SPECIFICATIONS



### 1. Overview

Nepal Electricity Authority (NEA) intends to select a contractor for the design and engineering (as per site conditions), manufacturing, supply, erection, testing & commissioning of 142 kW EV fast charging station, which also includes the infrastructure to supply power followed by operation and a comprehensive on-site maintenance of the entire system for five (5) years from the date of handing over in all designated locations, and then handing over the project to NEA.



**Fig 1: Overview of EV Charging Station**

## 2. EV Charging stations

EV charging station of 142 kW capacity each compatible to charge EV battery (Lithium ion integrated technology) with voltage range 200 V to 750 V as described in specification with compatibility of combination of charging protocols, such as CCS 2.0, CHAdeMO, GB/T and AC Type 2 with CAN/PLC communication between Electric Vehicle Service Equipment (EVSE) and Electric Vehicle (EV). It should also be compatible for communication between EVSE and Central Monitoring System (CMS) with Open Charge Point Protocol (OCPP) 1.6 or latest version.

### Following requirements must be fulfilled at the minimum:

- Bidders must submit basic design details, including details of the chargers, transformers, cables, scheme to effectively power the EV chargers, system protection schemes, integration and power evacuation details with existing power system, with appropriate diagram and drawings;
- The drawings must be submitted along with detailed structure design and material selected as per the relevant standards;
- DC charging integrated machine must include but not limited to charging module, power supply interface, charging interface, protection module, earthing system, control module, metering module, man-machine interface and cabinet;
- With charging management function, the color touch screen display and input for human-machine interaction interface, which can display the current charging mode, charging current, charging voltage and charging time;
- The charger should be able to dynamically adjust the constant current and constant voltage modes according to the Battery Management System (BMS) charging voltage and current limit. When the requested charging current is greater than the constant power output range of the charger, its output must be adjusted according to the maximum allowable current value of the charger;
- Automatically detect whether the charging connector and charging cable are properly connected. When the charger is properly connected to the EV, the charger may start the charging process and when the charger detects that the connection with the electric vehicle is not normal, the charging must be automatically stopped immediately;
- If an individual module is damaged, it must be possible to remove only that module from the working system without affecting the normal operation of the charger with the remaining modules;
- All guaranteed technical particulars, details of each item, make, model number and specification conforming to relevant standards, entire drawings, detailed test reports, list of Operation & Maintenance spares for major materials, detailed Bill of materials and Priced Bill of Quantities in respect of materials/equipment and works for the entire Project shall be submitted within 15 days of receipt of the LoA.
- Details of all materials and equipment required for successful completion and commissioning of the project must be included. The design details and other





accessories should adhere to and match with the technical specifications and standards provided in tender document.

- The contractor shall submit all the appropriate diagram and drawings to the employer for approval. Also, specifications of major items such as EVSE, transformers, distribution panel board etc. shall be submitted to the employer for approval.
- The design of distribution panel board must be such as to facilitate the supply connection to an additional charging module incorporating CCS, CHAdeMO or GB/T protocol whenever required.
- The bidders are required to submit the overall technical details of the charging station meeting all the requirements of the bid document.
- The bidders are required to submit the operation modality for 5 years along with the details of personnel to be engaged in the 5 years operation/maintenance of the charging stations.
- During the process of bid evaluation, NEA will arrange a program where the bidders are required to present their proposed methodology, technical details, 5-year operation/maintenance plan and resource planning.

## 2.1. Safety aspects

1. Unsafe charging mode such as manual charging should not be performed;
2. The system must have following protections at the minimum: AC input over/under voltage protection, DC output over/under voltage protection, setting DC output voltage limiting/current limiting value, overvoltage and overcurrent protection, short circuit protection, AC lightning protection, overheat protection, battery reverse connection, limit Protection functions such as pressure limiting current protection, accidental extraction of guns, lightning protection, insulation monitoring, bleeder circuit, power supply loop contactor adhesion monitoring, and charging gun temperature protection;
3. The charger should have an emergency stop device which is visible and easily accessible and measures to prevent maloperation, which is used to cut off the connection between the power supply equipment and the electric vehicle to prevent electric shock, fire or explosion;
4. The charging gun should have a temperature detection function;
5. The charger should have a bleed function. After fault detection, the charging output voltage shall be vented to avoid voltage shock to the battery load during the charging phase.
6. The charger should have an insulation monitoring function. When the charging gun interface is connected, the charger should be responsible for the insulation monitoring inside the charger (including the charging cable) before charging starts. An alarm should be created and charging stopped when the insulation resistance crosses standard limit;



7. There should be a proper protection scheme provided with the system for an immediate system shutdown in case of fatal errors (such as load polarity reverse, input and output short circuit);
8. The charger should have the function of monitoring and alarming the power circuit contactor.
9. **Locking of coupler:** A vehicle connector used for DC charging shall be locked on a vehicle inlet if the voltage is higher than 60 V DC. The vehicle connector shall not be unlocked (if the locking mechanism is engaged) when hazardous voltage is detected through charging process including after the end of charging. In case of charging system malfunction, a means for safe disconnection may be provided
10. **Disconnection of EV:** One second after having disconnected the EV from the supply (mains), the voltage between accessible conductive parts or any accessible conductive part and earth shall be less than or equal to 42.4 V peak (30 V rms) , or 60 V D.C., and the stored energy available shall be less than 20 J (as per IEC 60950). If the voltage is greater than 42.4 V peak (30 V rms) or 60 V D.C., or the energy is 20 J or more, a warning label shall be attached in an appropriate position on the charging stations.
11. **Protection against overvoltage at the battery:** The D.C. EV charging point shall disconnect supply of electricity to prevent overvoltage at the battery, if output voltage exceeds maximum voltage limit sent by the vehicle.
12. **Verification of Vehicle Connector Voltage:** The EV Charging station shall not energize the charging cable when the vehicle connector is unlocked. The voltage at which the vehicle connector unlocks shall be lower than 60 V.
13. **Earth protection system for charging stations**
  - All Residual Current Device (RCDs) for the protection of supplies for EVs shall have a residual operating current of not greater than 30 mA and shall operate to interrupt all live conductors, including the neutral.
  - All RCDs used for the protection of supplies to EVs shall be permanently marked to identify their function and the location of the charging station or socket outlet they protect.
  - Each EV charging station shall be supplied individually by a dedicated final sub-circuit protected by an overcurrent protective device complying with IEC 60947-2, IEC 60947-6-2 or the IEC 60269 series. The overcurrent protective device shall be part of a switchboard.
  - Co-ordination of various protective devices shall be required.
  - Where required for service reasons, discrimination (selectivity) shall be maintained between the RCD protecting a connecting point and an RCD installed upstream.
  - All EV charging stations shall be supplied from a sub-circuit protected by a voltage independent RCD and also providing personal protection that is compatible with a charging supply for an electric vehicle.



- All EV charging stations shall be provided with an earth continuity monitoring system that disconnects the supply in the event that the earthing connection to the vehicle becomes ineffective.
- Earthing of all EV charging stations shall be TN system as per IS 732 and/or other recognized national/ international standards.
- The cable may be fitted with an earth-connected metal shielding. The cable insulation shall be wear resistant and maintain flexibility over the full temperature range.
- **Detection of the electrical continuity by the protective conductor:** A protective earth conductor shall be provided to establish an equipotential connection between the earth terminal of the supply and the conductive parts of the vehicle. The protective conductor shall be of sufficient rating to satisfy the requirements of IEC 60364-5-54

#### 14. Maintenance of Records

- To be tested/inspected by owner/ electrical Inspector/ CESE and keep records that the EV charging station has been designed, constructed and labelled to be compatible with a supply of standard voltage at a nominal frequency of 50 Hertz;
- Keep records of the relevant test certificate as indicated as per IEC 61851 standard.

#### 2.2. Drawings and documents

Bidder shall include the required documents and drawings for the following:

1. EV DC Charger
2. LT Distribution Board
3. Surveillance camera location
4. Earthing and pit calculations
5. Lightning protection details and specifications

The drawings along with detailed structure design and material selected and their standards shall be submitted to NEA and statutory authorities for approval before starting the execution work. The work will be carried out as per the approved design. Contractor shall furnish the following drawings to NEA for approval.

1. General arrangement and dimensional layout of the entire system
2. Schematic drawing showing the EV charger, AC and DC Distribution Boards, meters etc.
  - a. Cable layout (indicating details of cable route for power & communication cables)
  - b. Itemized bill of material for complete grid powered EV charging infrastructure covering all the components and associated accessories.
  - c. Sizes and specification of cables for interconnections, etc. shall be furnished.



### 2.3. Quality Assurance

The Contractor shall establish a Quality Assurance system for the Work as per tender requirements. The Quality Assurance system as per tender requirement shall be subject to the approval of the Engineer-in-Charge / concern authority appointed by NEA.

1. Contractor must ensure strict compliance with the approved, proven & established quality assurance systems and procedures during the different stages of the project starting from sizing, selection of make, storage (at site), and during erection, testing and commissioning of the whole system.
2. The material supplied for the project should be tested as per the technical specification of the tender. All acceptance and routine tests of equipment as per the specification and relevant standards shall be carried out by the contractor in presence NEA's representatives.
3. NEA may undertake to perform the quality checks during the manufacturing stages also.
4. All works shall be undertaken with the highest levels of quality and workmanship. Work shall be carried out in conformity with quality and safety norms.
5. Any materials or work found to be defective or which does not meet the requirements of the specification will be rejected and shall be replaced at contractor's cost.
6. The contractor shall furnish a detailed Quality Assurance Plan (QAP) for the project. The test and inspection shall be done in accordance with the relevant standards and the manufacturer's standard before the delivery to site as well as after the erection and commission at site.
7. The contractor shall give the list of necessary tests they will carry out at site to show the performance of the system.
8. The staff / workers employed by the contractor should preferably be trained under Skill Development Program centers proposed/identified by NEA for proper module erection and allied electrical works.

### 2.4. General Quality Requirements

The bidder shall use power electronics of adequate capacity as per standard test conditions, etc. to ensure attainment of design estimates.

1. The bidders must submit an offer integrated upon their own design with requirement mentioned in this bid document. The bidders are advised to visit the site before designing the system and offer their bid.
2. The equipment and materials for each location of EV charging infrastructure with associated system shall include but not limited to the design, supply, erection, testing, commissioning, operation and maintenance of charging stations as specified.
3. Busbars and circuit breakers LT Power Interfacing Panel are suitable for EV charging station as specified in the bid document, common AC power evacuation panel.
4. Metering and protection along with associated battery system.
5. LT power and control cables including end terminations and other required accessories for both AC & DC power communication interface, and any other equipment necessary for safe and efficient operation of the EV charging system shall be provided.
6. Testing, maintenance and condition monitoring of equipment.



7. Spares for 5 years.
8. Receipt, unloading, storage, erection, testing and commissioning of all supplied material.
9. Suitable termination and isolation from grid for safety of maintenance with lock and key as applicable.
10. Transformer installation and LT/HT evacuation from the system at the interconnection point of NEA Grid shall be under the Bidder's scope of work.
11. Contractor shall be responsible for obtaining all statutory clearances including sanction from Electrical Inspectorate regarding operation of the system. NEA shall facilitate to ensure that the same is obtained successfully.



### 3. Electric Vehicle Supply Equipment (EVSE)

This section prescribes the definition, requirements and specifications for EVSE in Nepal, herein also referred to as "DC charger", for conductive connection to the vehicle, with an AC input voltage of 3-phase, 400 V, 50Hz system. It also specifies the requirements for digital communication between DC EV charging station and electric vehicle for control of DC charging.

#### 3.1. General Requirements

The requirement for EVSE is as follows:

Charger	Charger Connectors	Rated Voltage (V)	No. of Charging Guns (CG)	Quantity
Category 1	CCS 2.0 (Min 60 kW)	200-750	2	approx. 50% of total quantity
	Type-2 AC (Min 22 kW)	380-480	1	
Category 2	CCS 2.0 (Min 60 kW)	200-750	1	approx. 10% of total quantity
	CHAdeMO (Min 60 kW)	200-500	1	
	Type-2 AC (Min 22 kW)	380-480	1	
Category 3	GB/T (Min 60 kW)	200-750	2	approx. 40% of total quantity
	GB/T AC (Min 22 kW)	380-480	1	

Note: The power rating of the EVSE should be 142 kW (Min 60 kW CCS, Min 60 kW CHAdeMO, Min 60kW GB/T DC, Min 22 kW AC Type-2 or GB/T AC). In case of parallel operation, the wattage should not go lower than the minimum power defined for each output, but maximum power output of the charger should not cross 142 kW in any case. The exact number of chargers to be procured in each category would be finalized during the contract signing.

An EV is to use an off-board charger for delivering direct current at minimum 60 kW with CCS, CHAdeMO or GB/T along with on-board AC charger at minimum 22 kW. The EV shall be connected to the EVSE so that in normal conditions of use, the conductive energy transfer function operates safely.

- a) Energy transfer mode: Conductive
- b) EVSE type: Combination of CCS 2.0, CHAdeMO, GB/T and Type 2 AC
- c) No. of outputs: 3
- d) Charging mode:
  - i. CHAdeMO mode-4
  - ii. CCS 2.0 mode-4
  - iii. GB/T mode-3 and mode-4
  - iv. Type-2 mode-3
- e) Charger shall be Compact Pillar Charger



### 3.2. System Structure

The System requirement parameters are derived from Table D1 of Annex DD of IEC 61851-23.

- a) **Regulation:** Regulated DC EV Charging station with combination of the modes: controlled voltage charging (CVC) and controlled current charging (CCC)
- b) **Isolation:** Isolated DC EV charging station, according to the type of insulation between input and output: a) Basic insulation (b) Reinforced insulation (c) Double insulation
- c) Each DC output should be isolated from each other [Section 7.5.101 of IEC 61851-23]
- d) **Environmental conditions:** Outdoor use. EVSEs classified for outdoor use can be used for indoor use, provided ventilation requirements are satisfied.
- e) **Power supply:** AC mains to EVSE charging station
- f) **DC output voltage rating:** 200 - 750V for CCS and GB/T and 200-500 V for CHAdeMO
- g) **AC output voltage rating:** 380 - 480V
- h) **Charge control communication:** Communicate by digital and analog signals
- i) **Output Current:** 200 A
- j) **Interface inter-operability:** Interoperable with any EV supporting CCS, CHAdeMO, GB/T protocols, or AC Type-2 (for each gun respectively)
- k) Bollards or Wheel stops and Mounting of EV charger needs to be included in charger according to the project site.

### 3.3. Input Requirements

- a) Rating of the AC supply voltage
  - a. The AC supply system would be 3-Phase, 5 Wire AC system (3Ph+N+E) Nominal Input Voltage is 400V as per IS 12360 or equivalent.
  - b. The rated value of the frequency is 50 Hz  $\pm$  3Hz.
- b) Battery back-up: The Input supply system to have a battery backup for minimum 1 hour for control and billing unit. The data logs should be synced with CMS during back-up time, in case battery drains out.

### 3.4. Output Requirements

The chargers should allow parallel charging of EV with minimum 60 kW of DC output from both the gun simultaneously and AC output of 22 kW as per the output configuration types given below.



- a) DC output voltage: 200-750 V for CCS and GB/T and 200-500 V for CHAdeMO
- b) AC output voltage: 380-480 V
- c) Output current: 200 A
- d) Converter efficiency: > 95% at nominal output power
- e) Power Factor: > 0.96 (Full Load)

The service life of coupler and breaking capacity of the coupler as defined in Section 9 of IEC 61851-23.

### 3.5. Charger configuration Requirement

EV DC fast charger shall be compatible to configure either one of CCS 2.0, CHAdeMO, GB/T and AC type-2 charging modes depending on the connected EV type. Therefore, all these modes of charging protocol must be available at every EVSE location as per the following:

CCS 2.0 (2 guns) and AC Type 2 (1 gun)	-	25
CCS 2.0 (1 gun), CHAdeMO (1 gun) and AC Type 2 (1 gun)	-	5
GB/T DC (2 guns) and AC Type 2 (1 gun)	-	20

The exact number of chargers to be procured in each category would be finalized during the contract signing.

### 3.6. Cable Requirements

Charging Cable Assembly: As per IEC 62196-1-2010, with the functional characteristics defined as below

- a. Functional characteristics: The minimum cord length shall be 5.0meter, straight cable.
- b. Cable Connection Type: supply cable shall be with EVSE as per Case C defined in section 12.11 of IEC61851-1.
- c. Cord Extension Set: No extension cord to be used.
- d. Adaptors: No adaptors to be used.
- e. Storage means of the cable assembly and vehicle connector: EVSE should have the provision for storage of cable and connector when not in use, at a height between 0.4m to 1.5m above ground level, as per IEC 61851-23 Section 101.1.3.

### 3.7. Environmental Requirements

- a. Ambient Temperature Range: -5°C to 55°C
- b. Ambient Humidity: 5% to 95%
- c. Ambient Pressure: 86 kpa to 106 kpa
- d. Storage Temperature: 0°C to 60°C

### 3.8. Mechanical Requirements

- a. Ingress Protection: The minimum IP degrees for ingress of objects shall be IP 55
- b. Mechanical Impact: As per IEC 61851-1 Section 11.11.2
- c. Mechanical Stability: As per IEC 61851-1 or equivalent





- d. Cooling: Forced cooling for protection and safety of equipment from any fire hazards
- e. Noise levels: Less than 65 dBA decibel levels

### 3.9. Protection Requirements

- a. Protection against Electric Shock: As per IEC 61140 and IEC 61851 or equivalent.
- b. Effective earth continuity between the enclosure and the external protective circuit, as per IEC 61851-1 or equivalent.

### 3.10. Specific Requirements

EVSE shall have provision of emergency switching, protection against uncontrolled reverse power flow from vehicle, output current regulation in CCC, Output voltage regulation in CVC, Controlled delay of charging current in CCC, limited periodic and random deviation (current ripple) and limited periodic and random deviation (voltage ripple in CVC), as per Section 102.2 of IEC 61851-23.

The specific requirements defined in Section 102.2 of IEC 61851-23 except for the functions provided with descriptions:

1. Rated outputs and maximum output power: The clause from Section 101.2.1.1 of IEC 61851- 23 is applicable except for the ambient temperature range to be -5°C to 55°C for climatic conditions in Nepal.
2. Descending rate of charging current: In case of normal condition, DCFC should be able to reduce the descending current at a rate of 100A per second or more as per Section 101.2.1.4 IEC 61851-23.
3. Load dump: In any case of load dump, voltage overshoot shall not exceed 110% of the maximum voltage limit of the battery systems, as per Annex BB 3.8.3 of IEC61851-23.
4. EMI/EMC as per IEC 61000 or equivalent.

### 3.11. Functional Requirements

The functional requirements should be as per Section 6 of IEC 61851-1 and Section 19.4.3 of IEC 61851- 23.

- a) **Measuring current and voltage:** The accuracy of output measurement of system shall be within the following values:
  1. Voltage measurement:  $\pm 0.5\%$
  2. Current measurement:
    - a.  $\pm 1\%$  if the actual current is less than or equal to ( $\leq$ ) 50 A
    - b.  $\pm 2\%$  if the actual current is above ( $>$ ) 50A
- b) **Protection against overvoltage at the battery:** The DC EV charging station shall reduce the DC output current to less than 5A within 2s, to prevent overvoltage at the battery, if the output voltage exceeds the maximum voltage limit of the battery system for 1s.



### 3.12. Communication requirements

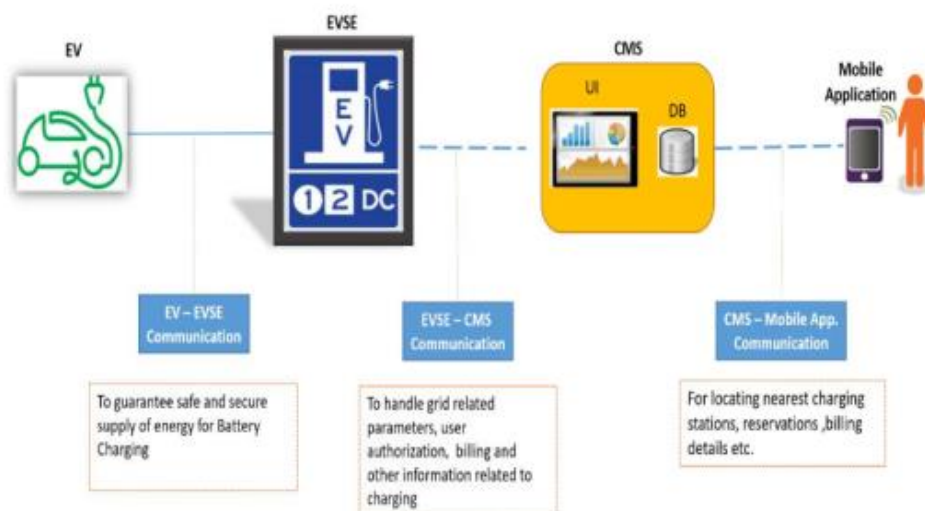


Figure 1: Architecture for EV and Charging Infrastructure

### EV charging station Architecture

#### 3.12.1. EV – EVSE Communication

The EV – EVSE communication would be as follows:

1. PLC Communication (CCS)
2. CAN Communication (CHAdeMO and GB/T)
3. PWM Control (AC Type-2)

#### 3.12.2. EVSE – CMS Communication

The EVSE should be able to communicate with CMS using Open Charge Point Protocol (OCPP) 1.6 or higher versions compatible to OCPP1.6.

1. **Communication interface:** Reliable Internet connectivity
2. Should enable handshaking between EVSE and CMS for its discovery, firmware version, vendor version, vendor etc. It should authorize the operation, before electric vehicle can start or stop charging. EVSE should respond to CMS for the queried parameters. Reservation, cancellation addition and deletion of EVSE should be possible from CMS.
3. **Metering:** Grid responsive metering as per unit consumption
4. Should be upgradable to next version of OCPP whenever it is released.

### 3.12.3. Specifications of Server for CMS Setup:

The server setup shall have the following components/features at minimum. Bidder may suggest changes in the specifications for the server to meet the requirements mentioned in section 3.15.

#### 3.12.3.1. Server Specification

Server Type	Rack Server
Number of Processors	1
Processor Model	Intel Xeon E5-2620 v4(2.1GHz/8-core/20MB/85W) Processor (with heatsink)
Memory	DDR4 RDIMM Memory, 16 GB
Local Storage	HDD, 1TB, SAS 12Gb/s, 10K rpm, 128MB or above
RAID	Supports RAID a. Uses a supercapacitor to protect RAID cache data from power failures b. Supports RAID state migration, configuration memory, self-diagnosis, and web-based remote configuration
Network Ports	Must Support two or four GE ports or two 10GE ports or two 56G FDR IB ports
Fan	Hot-swappable fan modules in N+1 redundancy
Power Supply	2 hot-swappable power supplies in 1+1 redundancy
Server Accessories and Connectors	KVM, KVM 4 in 1 Control Module, 1U, 17" LED, 8 KVM ports, With Power Cable, 8 USB Straight signal cables/With mounting Accessories, English doc, 110V-240V AC
Management	Require on-board iBMC module supports Intelligent Platform Management Interface (IPMI), SOL, KVM over IP, and virtual media, and provides a 1 Gbit/s RJ45 management network port supporting NC-SI.
Server License	To be provided by bidder if license required
Operating temperature	-5°C to 55°C

#### 3.12.3.2. Router/Switch Specification

WAN speed	400 Mbps
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Fixed LAN ports	8xGE (can be configured as WAN interfaces), 2xGE Combo
Console port	1
Memory	Minimum 512 MB
Ambient temperature	-5°C - 55°C

NEA will provide only the space for server installation in its server room. The successful contractor shall be responsible for ensuring the smooth running of server and software setup for proper coordination with EVSE and payment gateway. Any maintenance works, error handling, software upgradation or other server/software related issues shall be dealt with by the contractor for the whole contract warranty period of 5 years.

### 3.13. Billing and Payment Requirements

The bidder is expected to provide an all-inclusive software solution for billing and payment, with CMS and 'User App'

1. Billing: Based on grid responsive metering
2. Payment: Smart Card, QR/OTP/APP Server based Online Payment
3. Billing and metering system shall be separate for each of CCS, CHAdeMO, GB/T and AC Type-2 systems.

#### Notes:

- 1) Payment from EV charging consumers must be deposited in real time to the designated NEA Bank Account following a digital payment gateway approved by Nepal Rashtra Bank.
- 2) The contractor will be responsible for arrangement of data communication facilities using 3G/4G, Wifi or other methods. In case SIM cards are to be used for data communication, NEA would bear the upfront and operational cost related to SIM cards only.

### 3.14. User Interface and Display Requirements

1. **ON- OFF (Start-Stop) Switches** - Must be provided
2. **Emergency stop switch:** Mushroom headed Push button type in Red Color, visible and easily accessible
3. **Visual Indicators:** Error indication, Presence of input supply indication, State of charge process indication and other relevant indications/notifications.
4. **Display:**
  - a. Minimum 10 inches with 720 x 480 pixels TFT LCD screen, user interface with touch screen or keypad
  - b. Separate displays, 1 for each of CCS, CHAdeMO, GB/T and AC Type-2
  - c. Toughened unbreakable glass to be used for display screen
5. **Support Language:** English, with provision for additional regional languages including Nepali.
6. **Display Messages:** EVSE should display appropriate messages for user during the various charging states like: Suggestive sequence of charger operation, Vehicle plugged in / Vehicle plugged out, Duration since start of charge, User authorization status, Idle / Charging in progress: SOC, Fault conditions, Metering Information: Consumption Units, time of charge.
7. **User Authentication:** User authentication is essential; Charging to start only after user authentication is successful.



8. **End of Charging:** Once the charging stops, the connector shall be released only after successful payment receipt / acknowledgement is received.
9. **Voice notifications** to indicate the charging has started or stopped or any other notification as directed by NEA in English / Nepali

### **3.15. Key features of CMS**

For following sections, operator refer to charge point operator who is operating and maintaining the chargers. Under this procurement process, the contractor would be operator for first five years. For the first five years, contractor must provide dedicated personnel(s) for central monitoring of the chargers and handling any complaint as raised by consumers at NEA office. At the end of five years, the CMS would be handed over to NEA. Following sub-sections provide key features that contractor must provide in the CMS.

#### **3.15.1. Web Interface**

1. Operator can monitor Charging units through CMS Web interface, receive automatically diagnostics for each charging unit to be analyzed with the aid of integrated alarm systems
2. Operator will also be able to analyze data about charging sessions thus realizing reporting
3. The key features of the web portal are provided in section 3.16.

#### **3.15.2. Charging unit provisioning, management & real-time geo-localization**

1. The system allows configuration of charging units and real-time status of charging unit and its visualization on geo-referenced maps (geo-localization) with all the info related to their technical characteristics and the availability of charge.
2. The system supports different kinds of charging units in terms of mechanical and functional characteristics as well as communication protocols. This "openness" of the system is basic to let operator to manage different models/brands of charging units according to its need and on the basis of new products, without requiring a specific system customization.

#### **3.15.3. Communication between Charging Unit and CMS using Open Charge Point Protocol (OCPP)**

1. The communication between the charging units and the CMS is based on OCPP protocol that enables real-time response to requests from the charging units, such as authorizations to recharge, requests for available services and energy delivery and charging unit meter readings at configurable intervals.
2. Data communication is encrypted according to the most modern public and private key systems with certificate issue/revocation for each charging unit.
3. Charging units are always connected to the system and can send and receive data in real time; if the communication channel is under temporary fail, the charging unit can operate also in standalone mode until communication is



back. During this black-out period, all the functionalities necessary to allow recharging, such as white list management or authorization process are in place and the charging unit automatically aligns with the CMS as soon as the connection is on again.

#### **3.15.4. Firmware Upgrade**

1. The system supports automatic and bulk charging station firmware upgrade.
2. Firmware update can be scheduled based on operator preferences or as per NEA's preferences and contractor would be responsible for firmware upgradation (at no extra cost) while operating the chargers.

#### **3.15.5. Alarm Management**

1. The alarm management is essential to operate the charging infrastructure as it allows the operator to be aware in real time if some issues are occurring in the charging unit, like faults in some components, misuse of the charging equipment, problems on the communication between the charging unit and the CMS solution.
2. The alarm management follows an industry standard process for notification (via visual, sound alerts, and alerts to specific persons as notified by NEA from time-to-time), acquisition, operation and automatic closing of alarms if the problem is fixed.

#### **3.15.6. Ticket Management**

1. An integrated ticketing feature allows the Operator to issue maintenance tickets for faults occurring in the charging network.
2. The ticket management module allows tracking the ticket and the related actions performed by the system operators and technicians

#### **3.15.7. User Management**

1. This module is provided to manage and create new user ID to access the CMS.
2. Every user can only be created by an administrator.
3. Different profiles can be associated to every user in order to limit the visibility of data on the system based on privileges (access list) and stakeholder associated to these users. In this way each user can access only the data where user is authorized for, and can perform only the activities for which user is authorized as well (visualization, command management, alarm management etc.)

#### **3.15.8. Reporting**

1. The CMS already has a predefined set of reports concerning network status, charging sessions data etc.



2. Reports can be defined according to different parameters available to the operator and mainly based on different aggregation criteria based on location and time range. Some of these available reports
  - **Charger Overview report:** It includes the following data: Number of charging sessions and amount of energy consumed per charger, Number of charging sessions and amount of energy consumed per charging unit type and plug type, overall utilization of the chargers and utilization of individual chargers.
  - **Periodic Monitoring report:** It includes monitoring report which would be released periodically (daily, weekly, monthly, quarterly, half-yearly, and yearly). The monitoring report should list all issues faced during the period, uptime of the chargers, average time taken to resolve any issue / compliant, Number of charging sessions and amount of energy consumed per charger, Number of charging sessions and amount of energy consumed per charging unit type and plug type, overall utilization of the chargers and utilization of individual chargers.

### 3.15.9. Web services for integration with external system

1. The system can also export data to external systems/applications (web portal, smartphone Apps etc.) via standard web services based on SOAP standard.
2. The web services allow the export data (charging unit status, customer data, contract)
3. Through the web services, CMS can exchange data with different external systems billing systems

### 3.15.10. Summary

Requirements	Remark
<b>Multi-tenancy support – Multi tenant management</b>	
Single system managing multiple companies and different charging infrastructures	
<b>User Interface</b>	
Web based UI for Administrator/Operator	
Browser compatibility with Internet Explorer, Firefox, Chrome	
<b>Login window (Operator login) registration</b>	
Secure program login by username and password	
Password reset	
<b>Overview of charging units</b>	
Dashboard with total energy, total recharge, CO2 saved	
Dashboard with quick selection of charging unit status Status of Charging unit with color coding as follows <ol style="list-style-type: none"> <li>a. Available</li> <li>b. Occupied Charging units</li> <li>c. Partially occupied charging units</li> <li>d. Not Operative</li> <li>e. No communication with remote backend system</li> <li>f. Switched off</li> <li>g. Standalone (Charging unit not connected with backend system)</li> </ol>	
Overview (map and list) of charging units	
Overview (map and list) of charging units with filter by status	



Requirements	Remark
Overview (map and list) of charging units with filter by location	
Overview (list) of active charging session and alarms with filter by location	
Overview of aggregated number of charging units per status and per location	
Search for charging units	
Filter for charging units by specific status and reservation status	
Filter for charging units by characteristics (plug, brand/make, model)	
Filter for charging units by codes (Serial number, system code, etc.)	
Find charging units by geographical location	
List (table or map) of charging units according to search criteria	
Multi selection of charging units in list view	
<b>Detail view of charging units</b>	
Overview of overall status of single charging unit	
Overview of working parameters of charging units	
Overview of map	
Write and read notes to charging unit	
Overview of log and audit trail info of charging units	
Overview of charging unit characteristics	
Overview of charging unit location	
Overview of IP address in detail dialog	
Quick link to related recharges, alarms, events	
<b>Controlling</b>	
Command – reboot	
Command - set maintenance mode	
Command – reservation	
Command - remote start of charging session	
Command - stop charging	
Command - pause/resume charging	
Command - unlock plug	
Command - remote software update	
Command - remote software update for multiple charging units	
Command - monitor of multiple software update process status	
Command - meter data requests	
Set parameters for single charging unit	
<b>Configuration of charging unit</b>	
Charging unit definition: operating voltage and current, meters and plugs	
Charging unit definition: configurable parameters (either on charging station or system only)	
Charging unit definition: diagnostic information with description and priority	
Create/modify charging units	
Configure charging unit address	
Configure charging unit coordinates	
Set position parameters (longitude, latitude) by dragging & dropping the charging unit into the map	
Manage charging unit life cycle: creation, commissioning, dismiss	
<b>Remote firmware update</b>	
Management of different firmware version for the same brand/model	
Scheduling of firmware updates	
Multiple charging station firmware update	
Full report of ongoing and historical request of firmware update	





Requirements	Remark
<b>Events analysis</b>	
Full event list	
Complete description of each event	
Manage of buffered events from charging units	
<b>Alarms handling</b>	
overview of alarms, acknowledged alarms and closed alarms	
sort, search and filter for alarms	
Acknowledge alarms	
Management of alarms	
<b>Recharge session management</b>	
Authorization list	
Management of incoming or outgoing authorization	
Authorization through different IDTag (RFID, Contract/account, generic code)	
Acquisition of meter data in real time	
<b>Reservation (Charging unit should support this feature)</b>	
Reservations list	
Detailed reservation starting from now	
<b>White list of cards (if supported by Charging unit)</b>	
Automatic RFID white-list download to charging infrastructure management	
<b>CU issues management (Trouble ticketing)</b>	
Ticket definition	
<b>Report and dashboard</b>	
Technical Charging unit indicator	
Charger overview report	
Charger periodic monitoring report	
Tickets report	
<b>User Management (Admin/Operator)</b>	
Management of role-based permissions for functions	
Add, delete and edit users of systems	
Assign roles to users for system	
Add, edit and disable users for own tenant	
Assign roles to users for own tenant	
Add and delete roles	
<b>Charging unit communication protocols</b>	
OCPP V1.6/2.0 support for connection and communication of charging units and should be upgradable to next version of OCPP whenever it is released	

### 3.16. Key features of Web Portal /Mobile Application

#### 3.16.1. Web Portal

1. A web portal is available to provide all the needed info related to charging network status and availability are displayed on a map; available tariff to customers and provide the charging details and payment options.
2. The customer can also book the charging units or change some profile parameters such as the e-mail and SMS notification (for example for the Charge session start or stop).

#### 3.16.2. Smartphone Apps (available for Android and iOS)



1. Smartphone Apps are available to provide the final user with all the info about charging network status and availability are displayed on a map.
2. The driver can get also indication about the easiest way to reach the closest available charging station and the geo-location info about the place where the vehicle is parked.
3. The customer can also book the charging units or start/stop the recharge session from remote and provide payment options.
4. Through the App, the driver can also get the info about the ongoing recharging session and in case the session has been started from remote through the App, the driver can get the SMS notification when the defined charging level (in State of Charge of battery) is reached
5. The app must be available free of cost to EV users.
6. No charges other than EV charging service rate as specified by NEA should be charged from the EV users
7. To generate any other form of revenue, contractor must take approval from NEA

### 3.16.3. Summary

<b>EV Driver interface (Web Portal and Mobile application)</b>	
<b>EV Driver/User Management</b>	
Self-user registration	
<b>Customer web-portal for EV driver</b>	
Registration of new driver	
Change password	
Association with contracts/accounts	
Registration of a new contract/account	
Association with digital payment options for EV driver	
Charging point information & status detail	
Charging point search	
Charge session list	
Nearest charging station locator with an option to locate nearest idle charging station	
Reservation list	
Payment by payment options (integrated with existing NEA's payment gateway providers)	
History of charging sessions indicating: <ul style="list-style-type: none"> <li>a) Location of charger used</li> <li>b) Mode of payment used</li> <li>c) Date and time of charger used</li> <li>d) Amount of energy consumed</li> <li>e) Time taken to charge the vehicle</li> <li>f) Amount paid</li> <li>g) Vehicle Identification Number / Vehicle registration number</li> <li>h) Start State of Charge (SoC) and end SoC</li> </ul>	
Invoice generation for EV Users/drivers	
<b>Mobile app for EV driver</b>	
Registration of new driver	
Change password	
Association with contracts/accounts	
Association with digital payment options for EV driver	



<b>EV Driver interface (Web Portal and Mobile application)</b>	
Charging point information & status detail	
Charging point search	
Charge session list	
Nearest charging station locator with an option to locate nearest idle charging station	
Reservation list	
Remote Start and stop commands	
Payment by payment options (integrated with existing NEA's payment gateway providers)	
History of charging sessions indicating: <ul style="list-style-type: none"> <li>a) Location of charger used</li> <li>b) Mode of payment used</li> <li>c) Date and time of charger used</li> <li>d) Amount of energy consumed</li> <li>e) Time taken to charge the vehicle</li> <li>f) Amount paid</li> <li>g) Vehicle Identification Number / Vehicle registration number</li> <li>h) Start State of Charge (SoC) and end SoC</li> </ul>	
Invoice generation for EV Users/drivers	

### 3.17. Type Testing

<b>S. N.</b>	<b>Criteria</b>	<b>Parameter</b>	<b>IEC Standard</b>
1	Safety functions Verification	Earth Presence Detection (Socket - EVSE)	IEC 61851 – 1
		Earth Continuity Check (EVSE-EV)	
		Over Current and Short-Circuit Protection	
		Leakage Current (RCD)	
		Dielectric withstand voltage	
2	Mechanical Stability	Mechanical Impact	IP55
		IP testing	
3	Climatic environmental tests	Ambient air temperature	IEC 60068 and relevant standards
		Ambient humidity	
4	EMC Verification	General Compliance	IEC 61000 and relevant clauses for EV DC fast charger
		Immunity to electrostatic discharge	
		Electric Fast transient bursts	
		Surge immunity tests	
		Limitation of voltage changes, voltage	



S. N.	Criteria	Parameter	IEC Standard
		fluctuations, and flicker in public low voltage supply system. Limitation for harmonic currents produced by equipment connected to public low voltage charging systems	

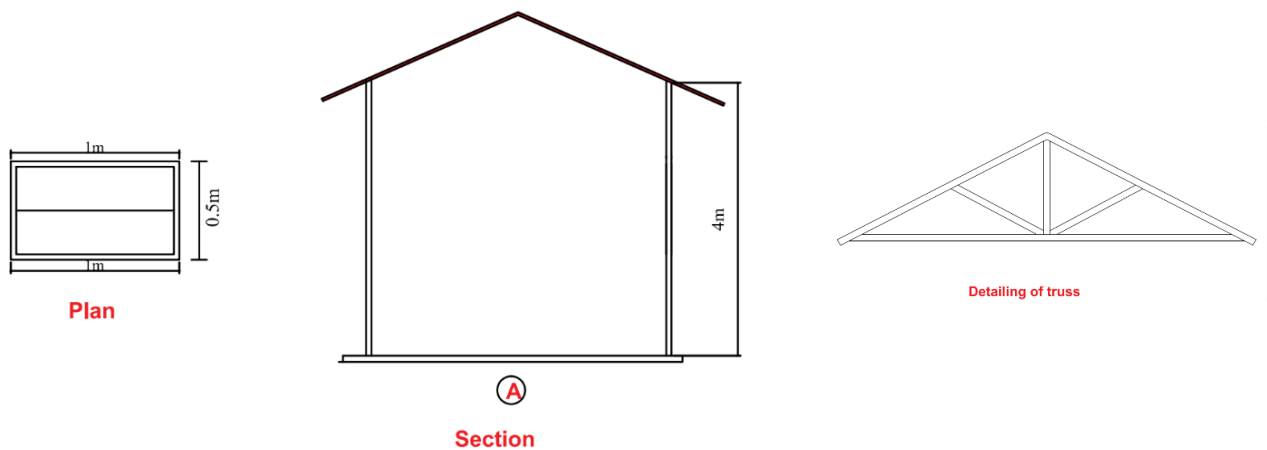
**3.18. Requirement to prevent fire for EVs Charging Stations**

Adequate firefighting equipment and extinguishing agents of sufficient capacity and quantity must always be available at site and kept ready for immediate use.

One liquefied carbon dioxide fire extinguisher upright type of capacity 10 kg having IS: 2171 -7, IS: 10658 or equivalent IEC marked per installation of DC EV Charger shall be supplied by the Contractor and shall also be responsible for periodic renewal during the maintenance period. The fire extinguisher shall be suitable for fighting fire of oils, solvents, gases, paints, varnishes, electrical wiring, live machinery fires and all flammable liquid & gas.

**3.19. EV Charger Installation**

The EV Charger shall be installed over the civil foundation structure designed as per the drawing provided below. The EV charger shall be secured over the foundation structure by means of Anchor Bolts (fixed over the civil foundation) and Nuts of proper sizes at the appropriate locations of the EV Charger. Figure below is just for reference purpose. The bidder can propose any other better design for shading structure.



The design of civil foundation must include at least the following:

1. Brick wall with 1:3 mortar
2. Plain cement concrete (1:2:4)
3. 12.5 mm thick 1:4 plaster
4. 50 x 30 x 3 mm rectangular black iron pipe posts for roof support



5. 48.3 x 3.2 m circular black iron pipes for truss construction
6. 0.5 mm thick color G.I. sheet roof

### **3.20. Drawings, Data and Documents**

The Contractor shall furnish following documents/ information along with the offer.

1. General description of equipment offered specifying the important features, make, technical parameters, materials of construction, etc. to enable the employer to have proper understanding of the equipment offered and its operation.
2. Technical literature, catalogue and publications.
3. Layout of Complete Plant Installation showing location of all major sub-systems.
4. Single line diagram.
5. Typical general arrangement and foundation details.
6. Technical particulars as listed in this specification.
7. Type test certificates of all major equipment like EV Chargers, transformers, applicable modules etc.

### **3.21. Erection, Testing and Commissioning**

1. The contractor shall provide necessary drawings and documents required by employer and obtain approval before taking up erection.
2. Any modification in the equipment or installation that may be demanded by the inspecting authorities shall be carried out by the contractor at no additional cost to the employer.
3. In accordance with the specific installation instruction as per the manufacturers drawings or as directed by the employer, the successful Bidder shall unload, assemble, erect, install, test, commission and hand over all the equipment included in this contract.
4. Erection materials including all consumables, tools, testing instruments or any other equipment required for successful commissioning shall be arranged by the successful Bidder in a timely manner.
5. All equipment and instruments, indoor and outdoor, shall be marked with relevant information as instructed by the employer and provided with danger boards before commissioning.
6. All Power equipment shall be handled and erected as per the relevant codes of practice and manufacturer's drawings and instruction manuals.
7. The Contractor shall obtain the temporary Electrical connection for construction purposes and the same has to be dismantled off the premises after completion of erection of plant.
8. After the Inspection and Approval of the Electrical Inspectorate, date of Energisation to the Grid will be considered as the official Date of Commissioning (CoD) of the project.

### **3.22. Operation and maintenance**

The operation and maintenance period shall be 5 (five) years after the commissioning, starting from the date of issuance of operational acceptance certificate from the employer.



Employer will arrange its employees for regular monitoring of charging stations from the control center. However, the contractor shall be responsible for comprehensive operation, repair and maintenance of the EV charging station for the 5 years after commissioning. The operation and maintenance services to be performed for the 5-year period mentioned above shall include but not limited to the following:

- a. Operating the EV charging station
- b. Performing all duties for safe and efficient operation & maintenance as per the standards
- c. Performing regular routine and non-routine maintenance on the EV charging station
- d. Providing all materials and services necessary for smooth operation of EV charging station
- e. Take care of every faulty operation of charging stations or any related components upon receiving the notification from employer's representatives and take corrective actions as immediately as possible and ensure smooth operation.

Successful contractor shall ensure the operation and maintenance of EVSE as per the following:

- a. The faulty components of charging equipment should be repaired and/or replaced within 48 hours of the complaint.
- b. Contractor must ensure that the charging equipment must be online for at least 95% of the time. (Power failure related downtime is excluded)
- c. Contractor must ensure that the Payment Gateway Software and Charger Management Software must be online for at least 95% of the time. (Power failure related downtime is excluded).

Frequent and extended delays in repair/replacement of the faulty components may lead to the forfeiture of AMC security and performance security.

### **3.23. Complying with all regulatory obligations**

1. Contractor shall supply manual for Operation and Maintenance of all the system in English
2. Contractor shall perform the Work and supply all required spare parts in a prudent and efficient manner and in accordance with
  - a. Manufacturers and systems designers' specifications, the Annual Operating Plan for the Plant and all operation and maintenance manuals,
  - b. All applicable laws of the GoN including environmental protection, pollution, sanitary, employment and safety laws, ("Government Rules").
  - c. Prudent Utility Practice to maximize plant capacity utilization and to minimize plant downtime
  - d. Optimize useful life of all the components of the installed system. Contractor shall be responsible for all the required activities for the successful running, optimum energy consumption & maintenance of the entire EV charging station
  - e. Monitoring, controlling, troubleshooting and maintaining of records/registers.
  - f. Supply of all spares, consumables and fixing/application, LT Distribution Box, other associated EV charging infrastructure for a period of 5 (five) years from commissioning. Cost of these items (including Cost of spares) and operation/maintenance cost shall be included in the price quoted.



- g. Supply & use of consumables throughout the maintenance period as per recommendations of the equipment manufacturers.
- h. Conducting periodical checking, testing, over hauling and preventive action.
- i. Submission of Monthly reports to NEA on performance of EV charging infrastructure by 2<sup>nd</sup> day of every month to the Engineer in Charge and copy of consolidated report of all locations to the Chief Engineer by 5<sup>th</sup> of every month.
- j. Replacement of EV charger, damaged modules if any, during the contract warranty period.
- k. Insurance covering all risks (Fire & allied perils, earth quake, terrorists, and burglary).
- l. Periodic Testing/calibration of all measuring devices as per respective manufacturer's instruction/ guideline.

### **3.24. Training**

1. Contractor shall impart required training of seven days period regarding manufacturing technology and operation of EV charging station to the 2 nos of relevant engineers of the employer at the manufacturer's premises. The costs involved in organizing and conducting such trainings including the travel fare of the participants shall be borne by the contractor.
2. Contractor shall also impart required training regarding the operation of EV charging stations to the 3 nos of relevant technical personnel of the employer from each of the provincial offices. The costs involved in organizing and conducting such trainings shall be borne by the employer.



**TECHNICAL DATA SHEET**

(To be completed by Bidder)

S.No.	Parameter	Description	Bidder's Offer
<b>General Requirements</b>			
1	EVSE Type	Category 1: CCS 2.0 (60 kW) + CCS 2.0 (60 kW) + Type-2 AC (22 kW) Category 2: CCS 2.0 (60 kW) + CHAdeMO (60 kW) + Type-2 AC (22 kW) Category 3: GB/T (60 kW) + GB/T (60 kW) + GB/T AC (22 kW)	
2	Energy Transfer Mode	Conductive	
3	Charging Mode	CHAdeMO - mode 4 - DC Fast Charging CCS 2.0 – mode 4 – DC fast charging GB/T – mode 3 (AC) and mode 4 (DC fast charging) Type-2 AC – mode 3	
4	Reliability and Serviceability	Modularity, self-diagnostic features, fault codes and easy serviceability in the field	
<b>System Structure</b>			
5	Regulation Method	Regulated DC EV Charging Station with combination of CVC or CCC but not simultaneously	
6	Isolation	Each output isolated from each other with proper insulation	
7	Environmental Conditions	Outdoor use	
8	Power Supply	DC EV charging station connected to AC mains	
9	DC output voltage rating	200-750 V (for CCS and GB/T) and 200-500 V (for CHAdeMO)	





S.No.	Parameter	Description	Bidder's Offer
10	AC output voltage rating	380-480 V	
11	Charge control communication	Communicate by digital and analog signals	
12	Interface inter-operability	Inter-operable with any EV supporting CCS or CHAdeMO or GB/T or AC Type-2 (for each gun respectively)	
13	Operator	Operated by a trained person or EV owner	
<b>Input Requirements</b>			
14	AC Supply System	3-Phase, 5 Wire AC System (3Ph+N+E)	
15	Nominal Input Voltage	3-Phase 400V	
16	Input Frequency	50 Hz, +/- 3 Hz	
17	Input Supply Failure Backup	Battery backup for minimum 1 hour for control system and billing unit, to enable activities such as billing, to be provided	
<b>Output Requirements</b>			
18	No. of Outputs	3	
19	Output Connectors	3 output connectors	
20	Output Connector Compatibility	CCS: IEC 61851-23/24, IEC 62196-3, DIN 70121 CHAdeMO: IEC 61851-23/24, JEVS G 105, Rev. 1.2 compliant GB/T: GB/T 20234, IEC 62196-3 (for DC) and IEC 62196-2 (for AC) AC: IEC 61851-22, IEC 62196-2 Mode 3, Type 2	
21	Converter Efficiency	> 95% at nominal output power	
22	Power Factor	≥ 0.96 (Full Load)	



S.No.	Parameter	Description	Bidder's Offer
<b>Cable Requirements</b>			
23	Charging Cable Length	5-meter straight cable	
24	Cable Type	Charging cable and connector permanently attached to EVSE (liquid cooled)	
<b>Environmental Requirements</b>			
25	Ambient Temperature Range	-5°C to 55°C	
26	Ambient Humidity	5 to 95%	
27	Ambient Pressure	86 kpa to 106 kpa	
28	Storage Temperature	0 to 60°C	
<b>Mechanical Requirements</b>			
29	Ingress Protection	IP55	
30	Mechanical Stability	Shall not be damaged by mechanical impact as defined in IEC 61851-1	
31	Cooling	Forced Cooling	
32	Mechanical Impact	Shall not be damaged by mechanical impact as defined in IEC 61851-1	
33	Dimension (W*H*D) / Weight	To be proposed by the bidder	
<b>User Interface and Display Requirements</b>			
34	ON-OFF (Start-Stop) Switches	Mandatory	
35	Emergency Stop Switch	Mushroom headed type	



S.No.	Parameter	Description	Bidder's Offer
36	Visual Indicators and voice notifications	<p><b>Visual Indicators:</b> Error indication, Presence of input supply indication, State of Charge process indication</p> <p><b>Voice Notifications:</b> Related to start and stop of charging session in English / Nepali</p>	
37	Display	<p>Minimum 10 inches with 720 x 480 pixels TFT LCD Screen, user interface with touch screen or keypad. Toughened unbreakable glass to be used for display screen</p>	
38	Support Language	English, with provision for additional regional languages including Nepali.	
39	Display Messages	<p>EVSE should display appropriate messages for user during the various charging states like:</p> <ul style="list-style-type: none"> <li>- Vehicle plugged in / Vehicle plugged out</li> <li>- Duration since start of charge and kWh consumed</li> <li>- User authorization status</li> <li>- Idle / Charging in progress: SOC</li> <li>- Fault Conditions</li> <li>- Metering Information: Consumption Units</li> </ul>	
40	Authentication	As per OCPP 1.6 or higher (through mobile application)	
<b>Performance Requirements</b>			
41	DC Output Voltage and Current Tolerance	<p>DC Output current regulation in Constant Current Charging (CCC); <math>\pm 2.5</math> A for the requirement below 50 A, and <math>\pm 5\%</math> of the required value for 50 A or more DC Output voltage regulation in constant voltage charging (CVC); Max. 2% for the max rated voltage for the EVSE</p>	



S.No.	Parameter	Description	Bidder's Offer
42	Control delay of charging current in CCC	DC output current demand response time<1 s Ramp up rate: 20 A/s or more Ramp Down rate: 100 A/s or more	
43	Descending rate of charging current	EVSE should be able to reduce DC current with the descending rate of 100 A/s or more	
44	Periodic and random deviation (current ripple)	DC Output current ripple limit of EVSE: 1.5 A below 10 Hz, 6 A below 5 kHz, 9A below 150 kHz	
45	Periodic and random deviation (voltage ripple)	Max. Ripple voltage $\pm 5$ V. Max slew rate $\pm 20$ V/ms	
<b>Communication Requirements</b>			
46	Communication between EVSE and Vehicle	As specified by CCS, GB/T and CHAdeMo Protocols	
47	Communication interface between charger and central management system	All of: Ethernet, Wi-Fi and 2G/3G/4G	
48	Communication between EVSE and Central Server	Open Charge Point Protocol (OCPP) 1.6 or higher version compatible with OCPP 1.6. Metering: Grid Responsive Metering	
<b>Billing Requirements</b>			
49	Software Solution	CMS and USER APP	
50	Billing	Grid Responsive metering (Billing and Metering System shall be separate	



S.No.	Parameter	Description	Bidder's Offer
		for each of CCS, CHAdeMO, GB/T and AC type-2 systems)	
51	Payment	Mobile application payment	
<b>Protection and Safety Requirements</b>			
52	Safety Parameters	Over Current, Under Current, Over Voltage, Residual Current, Surge Protection, Short Circuit, Earth Fault at input and output, Input Phase reversal, Emergency Shut-down with alarm, over temperature, Protection against electric shock.	
<b>Marking of EVSE</b>			
53	Marking Requirements	The EVSE shall bear the markings in a clear manner. Logo, Marking and paint of EVSE to be approved by NEA.	



## 4. Distribution Transformer

### 4.1. Scope

These specifications cover the requirements of oil-immersed, naturally cooled three-phase station transformers suitable for outdoors installation on 11 kV, 50 Hz distribution systems.

### 4.2. Service Condition

The transformers shall be designed and constructed for outdoor installation and operation under the following conditions:

Ambient temperature: -5°C to 55°C

Relative humidity: up to 95%

Altitude: up to 2000 m above the mean sea level

### 4.3. Standards and Quality Certification

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

IEC 60076	Power transformers
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 uninhibited mineral insulating oils for transformers and switchgear
IEC 60076-10	Determination of transformer and reactor sound levels
IEC 60616	Terminal and tapping materials for power transformer
IEC 60076-4	Guide to lightning and switching impulse testing of power transformers and reactors
IEC 60733	Determination of water in insulating oils
BS 5493	Protective coating of iron and steel structures against corrosion



2. The manufacturer of the offered transformers must have been accredited with valid ISO 9000 quality certification with design in its scope of registration.

#### **4.4. Description**

Technical details are given in Table 1. The quantity of the transformers to be supplied shall be as given in the Price Schedule.

##### **4.4.1. Tank**

The tank shall be of welded construction and fabricated from mild steel of adequate thickness. All seams shall be properly welded to withstand requisite impact during short circuit without distortion. All welding shall be stress relieved. The tank cover shall be bolted on to the tank with weatherproof, hot-oil resistant, resilient gasket in between for complete oil tightness. Pressed-steel radiators shall be mounted on transformer-tanks. The radiator shall be of pressed-steel of corrugated type design.

Heat dissipation calculation in respect of the number, size and length of the radiators are to be satisfied by design calculation. Each transformer shall be provided with a case of rigid construction, which shall be oil-tight and gas-tight. The thickness of all tank sides except the tank-bottom and cover shall not be less than 3.2 mm. The thickness of tank-bottom and cover shall not be less than 4.0 mm. The tank shall be capable of withstanding, without leakage or permanent deformation, a pressure 25% greater than the maximum operating pressure. The tank cover shall be bolted on to the main-tank. Each transformer shall be provided with earthing terminal with clamp type connector.

##### **4.4.2. Painting**

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

The tank body shall be sand/shot blasted to remove the welding scales. Oil, grease, dirt shall be thoroughly removed by emulsion cleaning. Rust and scale shall be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly alkaline hot water and drying. After phosphating, thorough rinsing shall be carried out with clean water, followed by final rinsing with dilute dichromate solution and even drying. The phosphate coating shall be sealed by the application of two coats of stoving type zinc chromate primer. The first coat may be "flash dried" while the second coat shall be stoved. After application of the primer, two coats of finishing synthetic enamel paint shall be applied, each coat followed by stoving. Touch up shall be applied after completion of tests. The color for the finishing paint shall be light gray or as approved by Employer. The final finished thickness of paint film on steel shall not be less than 60 microns. Finished painted surface shall present aesthetically pleasing appearance free from runs and drips. A small quantity of finishing paint shall be supplied for minor touching up required at site.



#### 4.4.3. Core

The transformer shall be of core type. The cores shall be constructed with prime core-material of interleaved grade non-aging, low loss, high permeability, grain oriented and cold rolled silicon steel laminations, properly treated after being sheared to remove any burrs and shall be re-annealed to remove any residual stresses. The steel shall be thin in lamination.

The yoke laminations shall be in single piece instead of pieces to reduce chances of introducing more air gaps in the core construction.

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

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

The core shall be rigidly clamped with positive locking device to ensure adequate mechanical strength. Core and coil assembly shall be capable of withstanding the vibrations and shock during transportation, installation, service and adequate provision shall be made to prevent movement of core and coil assembly relative to the tank during these conditions.

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

#### Permissible Flux Density and Over Fluxing

Flux density at rated voltage and frequency shall not exceed 1.6 T. The no-load current at rated voltage and at 112.5% voltage shall not exceed the values given below with tolerance as indicated.

At 100% rated voltage:	2% of rated full load current + 30% as tolerance.
At 112.5% rated voltage:	max 4% of rated full load current

The bidder shall submit the design calculation in support of flux density and no-load current at 100% and 112.5% voltage along with drawings of core-steps, limb-diameter, window-height, limb-center, etc.

#### 4.4.4. Winding

The design, construction and treatment of winding shall give proper consideration to all service factors. The winding shall be so designed that all coil assemblies are of identical voltage ratio and shall be interchangeable. All delta leads should be clamped tightly on to the special frame/bracket making pie ( $\pi$ ) frame. The leads leading to the bushing terminals should be clamped to the horizontal support base of the pie frame so that vibration during short circuit is not passed on to the windings. The completed assembly of core and coils shall be dried in a vacuum sufficient to ensure elimination of air and





moisture within the insulating structure. After the drying process, the assembly shall be immediately impregnated with dry oil to develop full electrical strength in the windings. The windings of the transformer shall be fabricated from high conductivity E.C. Grade (A) copper materials.

### **Current Density**

Current density for any part of the winding shall not exceed the following values:

Copper winding transformers	$\leq 2.8 \text{ amp/mm}^2$
Aluminum winding transformers	$\leq 1.5 \text{ amp/mm}^2$

#### **4.4.5. Oil Preservation System**

The transformers shall be oil filled type and provided with conservator. The conservator vessel shall have a capacity between highest and the lowest levels of not less than 7.5% of the total cold oil volume of the transformer. Each conservator vessel shall be fitted with a sufficient-size breather in which silica-gel shall be used as the drying agent. Windows in the silica-gel breathers shall be sufficiently large enough to allow crystal color change to be easily observed from a distance of 6 m. The position of the silica gel breather shall be such that maintenance can be carried out without the need to de-energize the transformer.

#### **4.4.6. Tap Changer**

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

#### **4.4.7. Insulating Oil**

All transformers shall be filled to the required level with a new, unused, clean, standard mineral oil in compliance with IEC 60296.

#### **4.4.8. Bushings**

The bushings shall be made of homogeneous and well vitrified porcelain. The color of the insulator shall be brown and the surface shall have polished glaze.

The high voltage bushings shall have clamp-type terminal lugs suitable for terminating 30-120 mm<sup>2</sup> stranded conductor.



The low voltage bushings shall have clamp-type bi-metallic terminal lugs suitable for terminating aluminum conductor compatible to the kVA rating (with 100% factor of safety) of the transformer.

The low voltage neutral bushings shall include a clamp-type bi-metallic terminal lug for terminating together an earth-wire and an aluminium conductor of neutral circuit of the LV system.

#### 4.4.9. Temperature rise

Maximum oil-temperature rise and maximum winding-temperature rise above ambient-temperature of 55°C when carrying maximum continuous rated current shall not exceed the following;

- a. In oil by thermometer: 50°C
- b. In winding by resistance : 55°C

The temperature rise of the insulating oil shall be measured near the top of the main tank.

#### 4.4.10. Gaskets

All sealing washers / Gaskets shall be made of oil and heat resistance nitrile / neoprene/ synthetic rubber bonded with cork gasket. Gasket made with natural rubber and cork shall not be acceptable. The thickness of the tank cover gasket shall not be less than 6 mm before compression.

#### 4.4.11. Clearances

Minimum electrical clearances between the phases and phase to earth shall not be less than the values given below:

Voltage	Medium	Phase to phase, mm	Phase to earth, mm
11 kV	Air	255	205
400 V	Air	75	55

The clearances shall be maintained by fixing the bimetallic connectors in position.

#### 4.4.12. Accessories

The following accessories shall be provided with each transformer.

- a. Lower oil filter and drain valve
- b. Liquid level gauge
- c. Lifting Lug
- d. Name plate



- e. Tank grounding terminal connector suitable for grounding cable
- f. Pressure relief device of explosion-vent type for 25 kVA and higher ratings

#### **4.4.13. Rating and Terminal Marking Plate**

Each transformer shall be provided with a non-detachable rating and terminal marking plate of weather proof material, preferably of brass fitted in a visible position mentioning the following information:

- a. Guaranteed No Load Loss and Load loss
- b. Details of rating (rated output, voltage, phases, frequency etc.)
- c. Cooling
- d. Connection and vector diagram
- e. Weights (Total, weight of core, weight of winding and weight of oil)
- f. Name of manufacturer and year of manufacture
- g. Standards of manufacture
- h. Physical dimension of the transformer
- i. Any other relevant information

#### **4.5. Tests**

Tests shall be performed in accordance with these specifications in line with relevant IEC standards.

##### **4.5.1. Type Tests**

The Bidder shall submit, along with the Bid, type test reports (detail) on the following tests performed on identical units.

- a. Temperature rise tests
- b. Dielectric Type test
  - i) Impulse voltage tests
  - ii) Separate source AC withstand voltage test
  - iii) Short Circuit Test

The type test certificates shall be furnished for transformer offered which, in addition to other required data, shall show the actual no-load and full-load losses of the transformer at rated load. For the purpose of evaluation, the higher values of no-load and load losses shall be considered from the values guaranteed by the Bidder and the values given in the type test reports. The test of the transformer shall have been conducted by an internationally accredited independent laboratory.



If at any stage it is established that the type test report submitted by the bidder is not satisfactory, discrepant or ambiguous, then NEA reserves the right to ask the bidder/supplier to conduct the type test on the rating/s of transformers chosen by the NEA in the presence of their representative at reputed national/international testing laboratory prior to its mass production *and/or* dispatch. The costs involved in organizing and conducting such tests shall be borne by the bidder/supplier.

#### **4.5.2. Routine Tests**

The following tests (latest revision of IEC 60076) shall be performed on each unit of transformer by the manufacturer before dispatch and submit the test-reports to the Employer.

- a. Applied voltage test
- b. Induced voltage test
- c. No load loss and excitation current test
- d. Impedance voltage and load loss tests
- e. Winding resistance measurement
- f. Ratio tests
- g. Polarity and phase relation tests
- h. Tank leakage tests
- i. Insulation resistance tests
- j. Separate source power frequency voltage withstand test
- k. Dielectric breakdown strength of oil

The bidders are required to furnish the details of testing facilities available at the manufacturer's premises for conducting the tests listed above.

#### **4.5.3. Tests to be witnessed by the Employer**

Pre dispatch inspection shall be carried out at finished stage i.e. transformers are fully assembled and are ready for dispatch. As and when the transformers are ready for dispatch, an offer intimating about the readiness of transformers, for pre dispatch inspection for carrying out routine tests (specified in Clause 4.5.2) on minimum 2% quantity of offered lot shall be sent by the supplier along with Routine Test Certificates as specified in Clause 4.5.2. In addition to above the Purchaser's representative(s) shall also witness the (a) temperature-rise test, (b) dielectric type-test for each type (and rating) of transformer on at least 2 (two) % of each type (and rating) of transformer to be procured. The sample shall be selected by the Employer's representative(s) from the complete-lot ready for dispatch. The above mentioned tests shall be carried out in the premises of the Manufacturer.

#### **4.5.4. Testing after Delivery of Goods**



The Contractor shall carry-out [which the Purchaser's representative(s) shall witness the following tests in a laboratory owned or nominated by the Employer after delivery in Nepal.

- a) Temperature rise test on at least one transformer of each rating.
- b) No Load Loss and Load Loss test on 100 (hundred) % of transformer

Cost for such tests (per unit and respective ratings of distribution transformer) shall be quoted in the Price Schedule and shall be paid by the Contractor. The cost for testing shall be as per prevailing practice of NEA.

#### 4.5.5. Dispute on quality of Goods:

The purchaser has all the rights to conduct the test including type tests, at his own cost by an independent agency whenever there is dispute regarding the quality of supply or interpretation of test results. In the event of failure of transformers in such tests, the expenses incurred in testing shall be to the supplier's account as already mentioned above in case of Testing after Delivery of Goods.

#### 4.6. Losses Value

1. The transformer no-load and load losses shall not exceed the following prescribed values. If the guaranteed no load and load losses exceed the prescribed values below, the offer shall be rejected.

For 11/0.4/0.23 kV

<b>S.N. Rating</b>	<b>No Load Loss (watts)</b>	<b>Load Loss (watts)</b>
1. 200 kVA, 3-ph	365	2100

2. Transformer shall be evaluated for the loss values (no load losses and load losses) during bid evaluation based on the following loss capitalization formula:

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

Where,

$P_E$  = Evaluated Price

$P_b$  = Bid Price

$K_L$  = Value of Load Loss

$L_L$  = Guaranteed load losses at rated current

$K_{NL}$  = Value of no load Loss

$L_{NL}$  = Guaranteed no load losses

The transformer losses shall be capitalized as follows:



**$K_{NL}$  = Value of No Load Loss = US\$ 4,684 per KW**

**$K_L$  = Value of Load Loss = US\$ 618 per KW**

3. Penalty for Excessive losses: During testing, if it is found that the actual measured losses are more than the values guaranteed by the bidder (provided that they are within the limit specified above), a penalty shall be recovered from the bidder at double the loss capitalization rates arrived as above. For fraction of a kW, proportionate penalty will be recovered. Any transformer shall be rejected if losses exceed the guaranteed value by an amount in excess of the following (as prescribed in IEC 60076, Power Transformers):

Total losses: 10%

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

#### **4.7. Bid Documentation**

The bidder shall furnish with the Bid, the following documentation:

- a) One (1) clear copy of the IEC standards governing fabrication and testing of the transformers.
- b) Two (2) clear certified copies of type tests carried out as required by the governing IEC standard and the specifications.
- c) Two (2) copies of certified outline drawings showing dimensions, arrangements, and locations of all parts.
- d) A clause-by-clause commentary on the specification, specifying compliance or deviations, if any.



## TECHNICAL PARTICULARS OF 11/0.4 kV DISTRIBUTION TRANSFORMER

**TABLE 1**

Type	Three-phase, 11/0.4 kV
Rated power	As specified in the Price Schedule
Rated voltage - Primary	11kV
- Secondary	400/230V
Max system voltage - Primary	12 kV
- Secondary	440V
Rated Frequency	50Hz
Connection - Primary	Delta
- Secondary	Grd.Wye
Cooling System	ONAN
Vector group	Dyn 11
Rated impedance voltage	3.5 - 4.5%
BIL for windings and bushings for primary side	75kV
Withstand voltage, 50 Hz, 60 Sec.	
- Primary	28 kV
- Secondary	3 kV
No load tap changer	+/- 2.5%, +/- 5% on HV side
Mounting	Platform
Insulation levels (IEC) 76	LI 75 AC 28/AC 3
Insulation temperature class (IEC 76)	A
Maximum allowable noise level at 3 metre hemispherical radius	<44 dB
Applicable standard	These Specifications and IEC



**TECHNICAL DATA SHEET**

(To be completed by Bidder)

**Item Description**

1. Manufacturer
2. Copies of IEC standards attached? Yes/No
3. Copies of type test for each rating attached? Yes/No
4. Copies of outline drawings  
for each size attached? Yes/No
5. Winding material: \_\_\_\_\_
6. Primary Winding BIL \_\_\_\_\_ kV
7. Primary Bushing BIL \_\_\_\_\_ kV
8. Accessories listed below furnished?
  - a) Lower oil filter valve Yes/No
  - b) Liquid level guage Yes/No
  - c) Lifting lugs Yes/No
  - d) Hand hole Yes/No
  - e) Tank earthing terminal Yes/No
  - f) Overload protection Yes/No
  - If yes, details attached? Yes/No

## 9. Testing facilities available at Manufacturer's Plant

<u>Description</u>	<u>Name of the test equipment/facility</u>
Applied voltage test	
Induced voltage test	
No load loss and excitation current test	
Impedance voltage and load loss tests	
Resistance measurement	
Ratio tests	
Polarity and phase relation tests	
Leakage tests	
Insulation resistance tests	
Temperature rise test	





Dielectric Type test

Tank pressure test

#### 10. Design information

Rated kVA (IEC rating), kVA.....

Number of phases .....

Frequency, Hz .....

Voltage ratio at no-load , kV.....

Winding connections.....

Type of core sheet.....

Magnetising current at normal ratio:

hv, Amp .....

lv, Amp .....

Maximum flux density in core iron at normal

voltage and frequency based on the net section of iron:

Cores, T .....

Yokes, T .....

Type of winding:

hv ..

lv .....

Maximum current density in winding at rated power:

hv, Amp/mm<sup>2</sup> .....

lv, Amp/mm<sup>2</sup> .....

Type of insulation used for:

hv winding .....

lv winding .....

No-load loss at normal voltage ratio and 75°C, Watt .....

Load loss at rated current and at 75°C, Watt .....

Regulation at 75°C and rated power as a percentage of normal voltage:

at 1 p.f, % .....



- at 0.8 p.f, % .....
- Impedance voltage at 75°C and rated power:
- at normal tapping,% .....
- at -5% tapping % .....
- at +5% tapping % .....
- Efficiency at 1 p.f and 125% load, % .....
- Efficiency at 1 p.f and 100% load, % .....
- Efficiency at 1 p.f and 75% load, % .....
- Efficiency at 1 p.f and 50% load, % .....
- Efficiency at 1 p.f and 25% load, % .....
- Load at which maximum efficiency will occur, % .....
- Maximum efficiency, % .....
- Temperature rise at rated kVA by  
thermometer in oil .....
- Temperature rise at rated kVA by  
resistance of windings .....
- Permissible overload .....
- Transformer insulating oil specification .....
- Total volume of insulating oil at 20°C, litre .....
- Effective expansion capacity of conservator, litre .....
- 11 Approximate weight and dimensions
- Weight of core, kg.....
- Weight of winding, kg, .....
- Weight of tank and fittings, kg.....
- Weight of oil , kg.....
- Total weight, kg.....
- 12 Radiator details
- No of radiators per transformer, no .....
- No. of fins per radiator, no .....



- Width of each fin, mm .....
- Thickness of radiator, mm.....
- 13 Tank dimensions
  - Length, mm .....
  - Breadth, mm .....
  - Height, mm .....
  - Tank sheet thickness (sides x bottom x top), mm .....
- 14 Approximate dimensions including fittings:
  - Overall length, mm.....
  - Overall width, mm.....
  - Overall height, mm.....
- 15. Winding resistance values
  - Per phase resistance of HV winding AB ..... BC ..... CA .....
  - Per phase resistance of HV winding an ..... bn ..... cn .....



## 5. Prestressed Concrete Pole

### 5.1. Scope

These specifications apply to design, manufacture, and testing of rectangular pre-stressed concrete poles for use in electrical distribution.

### 5.2. Description

The pre-stressed concrete pole shall be designed and fabricated in full compliance with IS: 1678-1978, or latest revision 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.

### 5.3. Load

The working loads of various pole categories are given in Table 1. The design ultimate strength shall be calculated using a safety factor of 2.5. Pole Attributes are listed in Table 2.

### 5.4. Design

1. The poles shall be as per following design parameters and the dimensions shall be as shown in drawing CS11-PSCP-01, CS11-PSCP-02 and CS11-PSCP-03

*Design Parameters:*

Concrete mix:	M400
Minimum diameter of pre-stressing wire:	7.9 mm (7/2.6mm)
No. of pre-stressing wire:	8
Working Load:	Refer Table 1
Depth of Plantation:	Refer Table 2
Point of Application of Load:	Refer Table 2

Further design details are given in Drawings.

2. The minimum strength of concrete in the pole shall meet the requirements laid down in IS:1343-1960 and IS:456-1964 or in any other equivalent national or international standards.
3. The strands shall be made from cold-drawn non-alloy steel (high carbon content) wires. The seven-wire strand consists of a group of wires arranged in stranded formation and shall have the following properties. The seven-wire strands shall confirm to IS:6006-1983, or latest revision thereof or any other equivalent national or international standards.



*Geometrical Properties for the 11m pole*

Type of material:	Seven-wire strand
Minimum diameter of strand:	7.9 mm (7/2.6mm)
Minimum cross-sectional area of strands:	37.4 mm <sup>2</sup>

*Mechanical Properties:*

Nominal mass of strand:	294 g/m
Minimum breaking load:	64.50 kN
0.2% proof load	54.70 kN

*Long Term Behaviour:*

Maximum relaxation after 1000 h of operation at initial load equivalent to 60%, 70% and 80% of breaking load shall not be higher than 1.0%, 2.5% and 4.5% respectively.

4. The pre-stressing strands shall be accurately positioned and satisfactorily protected against the formation of rust or other corrosion prior to the placement of the concrete. All pre-stressing strands shall be free from loose rust, dirt, grease, oil and other lubricants or substance that might impair their bond with the concrete.
5. The cement employed shall be the Ordinary Portland Cement (OPC), which shall conform to the chemical and physical requirements as set forth in BS: 12, or any other equivalent national or international standards.
6. The amount of concrete cover on the outside of the pre-stressed reinforcement shall be not less than 20mm.
7. The pole shall include cast-in holes. Typical hole patterns are shown in the drawings. Hole patterns must be confirmed with the NEA prior to manufacture.
8. All poles shall be unpolished but free of roughness, chips, excess cements, and other surface irregularities. All poles shall present a straight and symmetrical appearance after erection. The corners of all the poles shall be rounded so that they do not present a dangerously sharp edge, which could cause tearing or excessive wearing of safety belts.
9. All poles shall be provided with lifting hooks at two points for loading and unloading of poles.
10. For construction works (pole installation and conductor stringing), bidders may refer to CS11-PSCP-04, CS11-PSCP-05, CS11-PSCP-06, CS11-PSCP-07, CS11-PSCP-08, CS11-PSCP-09 and CS11-PSCP-10

**Table 1: Working Load**

<u>S.No.</u>	<u>Pole Length (m)</u>	<u>Design Load (kgf)</u>
--------------	------------------------	--------------------------



1

11

350

## 5.5. Tests

*Definition of various types of loads:*

1. **Working load** = Expected Load
2. **Design Working Load** = Expected Load x Factor of Safety (FOS)
3. **Ultimate Transverse Load (UTL)** = Load when applied at specified point of the pole, the failure occurs.
4. **Minimum Ultimate Transverse Load (MUTL)** = Load when applied at specified point of the pole, the first crack appears.
5. **Design Transverse Load (DTL)** = Design Working Load
6. **Design Ultimate Transverse Load (DUTL)** = Design load at the transverse direction at which the first crack expected to appear (given by the Designer after calculation)
7. The **Design Ultimate Transverse Load (DUTL)** is less or equal to Ultimate Transverse Load

### 5.5.1. Transverse Strength Test

The pole shall be rigidly supported at the butt end for a distance equal to the specified planting depth. The load shall be applied at a point specified in Table 2 from the top of the pole and shall be steadily and gradually increased to the design transverse load until the occurrence of the first crack. The deflection is then measured. Prior to the application of the design transverse load there shall be no crack.

The load shall then be reduced to zero and increased gradually to a load equal to the first crack load plus 10% of the minimum ultimate transverse load, and held for 2 minutes. This procedure shall be repeated until the load reaches the value of 80% of the minimum ultimate transverse load and thereafter increased by 5% of the minimum ultimate transverse load until failure. Each time the load is applied, it shall be held for 2 minutes. The ultimate transverse load shall not be less than the design ultimate transverse load.

### 5.5.2. Measurement of Cover

The cover shall be measured at 3 points, one within 1.8m from the butt end of the pole, second within 0.6m from the top and the third at the intermediate point. The mean value of the measured cover should not differ by more than +/-1mm from the specified value, and the individual value should not differ by more than +/-3mm from the specified value.



### 5.5.3. Number of poles selected for testing

The number of poles selected for testing and their conformity criteria shall be as follows:

Table 3: Number of poles selected for testing

<i>Lot Size</i>	<i>Sample Size</i>	<i>Permissible No. of Defective Samples</i>	<i>No. of Poles for Transverse Strength Test</i>
Up to 100	10	1	2
101 to 200	15	1	3
201 to 300	20	2	4
301 to 500	30	3	5

All the poles selected shall be tested for overall length, cross-section and up-rightness. The tolerance shall be +/-15mm on overall length, +/-3mm on cross-sectional dimensions, and 0.5% on uprightness.

The number of poles which do not satisfy the requirements of overall strength, cross-section and uprightness shall not exceed the number given in table 3. If the number of such poles exceeds the corresponding number, all poles in the lot shall be tested for requirements, and those not satisfying the requirements shall be rejected.

All the poles tested for transverse strength test shall satisfy the requirements of the test. If one or more poles fail, twice the number of poles originally tested shall be selected from those already selected and subjected to test. If there is no failure among these poles, the lot shall be considered to have satisfied the requirements of the test.

### 5.6.6. Marking

The poles shall be cleanly and indelibly marked with the following:

- a) Month and year of manufacture, at approximately 3m from the butt end;
- b) Specified working load in kg, at approximately 3m from the butt end; and
- c) The design lifting point.

### 5.7. Bid Documentation

1. The Bidder shall furnish following documents together with Bid;
  - a) Two (2) clear certified copies of all tests performed on similar poles of same sizes and similar working loads.
  - b) Clause-by-clause commentary on specification, specifying compliance and deviations, if any.
2. The Bidder shall provide the following details:
  - a) Pole dimensions in cross-section and pole taper;



- b) Location and size of pre-stressing strands;
- c) Hole locations;
- d) Design ground line;
- e) Marking of the lifting point;
- f) Minimum ultimate transverse load;
- g) Transverse load at first crack
- h) Concrete design mix and cement specification
- i) Specifications of the pre-stressing strands, their tensile strength and sizes

**Table: 2**

## Pole Attributes

Overall length	11 m
Point of Application of Load from Pole Top	0.6 m
Minimum Depth of Planting (shall be based on site condition)	1.8 m





**TECHNICAL DATA SHEETS**

(To be completed by Bidder)

**Item: Pre-stressed Concrete Pole**

- 1. Manufacturer: \_\_\_\_\_
- 2. Reference Standard: \_\_\_\_\_
- 3. Overall Length: \_\_\_\_\_ meters
- 4. Dimensions:
  - Top Width \_\_\_\_\_ mm
  - Bottom Width \_\_\_\_\_ mm
  - Pole thickness \_\_\_\_\_ mm
- 5. Weight of the pole: \_\_\_\_\_ kg
- Guaranteed minimum Transverse Failure Load: \_\_\_\_\_ kgf

Signed \_\_\_\_\_

On behalf of \_\_\_\_\_

Address \_\_\_\_\_

Date \_\_\_\_\_



## 6. ACSR Conductor

### 6.1. Scope

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

### 6.2. Description

1. The manufacturer of the ACSR conductor must have been accredited with ISO 9001:2000 (design included) quality certifications.
2. The ACSR conductor shall be a concentrically stranded right-hand lay conductor.
3. The ACSR conductor shall be fabricated in accordance with BS: 215 (Part 2) latest revision or any other national or international standards that ensures a substantially equal quality to the standard mentioned above, will also be acceptable.
4. The following type of conductors shall be supplied:

Code Name	Nominal Area (Sq. mm)	Stranding (Al/Steel)	Breaking Strength (KN)	Mass (kg/km)	Max. d.c. Resistance at 20° Ohm/km	Diameter	
						Aluminum (mm)	Steel (mm)
DOG	100	6/7	32.7	394	0.2722	4.72	1.57

### 6.3. Packaging

1. 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 confirming to IS: 1778-1980.
2. Each reel of the conductors furnished shall contain only one (1) length of conductor.
3. All reels shall be legibly marked in paint with the following information:
  - a) Manufacturer's name or trade mark:
  - b) Contract/specification number:
  - c) Size and type of conductor:



- d) Net mass of the conductor:
- e) Net mass of drum:
- f) Gross mass of the drum and conductor:
- g) Lengths of the conductor in meter:
- h) Direction of rolling:
- i) Drum and lot number:
- j) Name and address of the consignee: NEA, PTSD
- k) Supplier's Name:

3.4 The standard length of the completed conductor in each reel shall be as per the mentioned below:

Conductor Size (sq. mm): 100

Normal Length of the Conductor (m): 1000

#### 6.4. Tests

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

##### Aluminum wire

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

##### Steel wire

- a) Determination of stress at 1% elongation
- b) Tensile test
- c) Torsion test or elongation test as appropriate
- d) Wrapping test
- e) Galvanization test

#### 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 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 test normally carried out on raw materials;
- vii. List of manufacturing facilities available;
- viii. List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections;
- ix. List of testing equipment available with the manufacturer for final testing of equipment specified and the test plant limitation, if any, vis-à-vis the type, special, acceptance and routine tests specified in the relevant standards.

#### **6.6. Bid Documentation**

1. The Bidder shall provided with the Bid two (2) clear copies of the governing standards for fabrication and testing of the ACSR conductor and two (2) clear copies of all other relevant standards referenced therein.
2. The Bidder shall provide certified type test results of all types of ACSR conductor as required by governing standards.
3. The Bidder shall also furnish the Certificate of Compliance, as specified in Paragraph 4.4 of BS 215, Part 2:1970, at the time of the shipment of each lot of conductor, or as required by the appropriate section of the equivalent national standard.
4. A clause-by-clause commentary on specification, specifying compliance and deviations, if any.
5. All data, drawings, catalogues and other technical documents shall be bound separately from the Bid documents.





## Porcelain Insulators

### 6.7. Scope

This specification covers the fabrication and supply of pin insulators, disc insulators and stay insulators, as herein specified for use on overhead power line construction.

### 6.8. General

1. Insulators shall be fabricated and tested in accordance with the standards referenced for each type of insulator or equivalent standards.
2. 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.
3. The design of insulators shall be such that stresses due to expansion and contraction in any part of the insulator shall not lead to deterioration. The porcelain shall not engage directly with hard metal.
4. The cement used in construction of insulators shall not give rise to chemical reaction with metal fittings and its thickness shall be as uniform as possible.
5. The insulators should be manufactured in automatic temperature-controlled kilns to obtain uniform baking and better electrical and mechanical properties.
6. The manufacturer of the Insulators must have been accredited with ISO 9001 (including design in the scope of registration) quality certification.

### 6.9. Pin Insulator

The pin insulator shall be manufactured and tested in accordance with IS: 731-1971 and IS:3188 or the latest version thereof or any other national or international standards that ensures at least equal or better quality to the standard mentioned above, will also be acceptable. The lead thread shall be compatible with the insulator pin specified in these documents.

*The pin insulator shall have following ratings and features:*

- |  |        |
|--|--------|
| • Highest system voltage                 | 12 kV  |
| • Rated voltage                          | 11 kV  |
| • Creepage distance (min)                | 265 mm |
| • 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
- Cantilever strength 5 kN
- G I pin head Small

IS Ref.165P Thimble type IS 2486 Part-II

The pin insulator shall conform to the shape and dimension shown in the drawing number CS11-LM-01.

### 6.10. Disc Insulator

The disc insulator shall be manufactured and tested in accordance with 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 have the following ratings and features:

- Highest system Voltage 12 kV
- Rated Voltage 11 kV
- Porcelain Diameter (min) 255 mm
- Spacing 145 mm
- Creepage Distance (min) 280 mm
- Power Frequency Puncture withstand voltage: 1.3x Actual dry flashover voltage
- Wet Power Frequency Withstand Voltage 35 kV
- Impulse Withstand Voltage 75 kV
- Puncture Power Frequency Voltage (min): 105 kV
- Visible Discharge Voltage 9 kV
- Mechanical Strength 45 kN
- Ball and Socket Size: 16 mm B
- Applicable Standard for Special Characteristics: IS: 3188-1980

### 6.11. Stay Insulator

The stay insulator shall be manufactured and tested in accordance with IS: 5300-1969 or latest version thereof or any other national or international standards that ensures at



least equal or better quality to the standard mentioned above, will also be acceptable. The stay insulator shall have the following ratings and features:

- Highest system Voltage 12 kV
- Rated Voltage 11 kV
- Creepage Distance (min) 41 mm
- Minimum failing load > 40 kN
- Power Frequency Withstand Voltage
  - Dry 18 kV
  - Wet 8 kV
- IS designation A

### 6.12. Marking

Each insulator shall be legibly and indelibly marked to show the following:

- a) Name or trademark of manufacturer.
- b) Year of manufacture.
- c) Minimum failing load in Newton
- d) Name of Employer "NEA-EELRD"

Markings on porcelain shall be printed and shall be applied before firing.

### 6.13. Tests

The insulators shall comply with the following tests as per IS: 731-1971.

#### 6.13.1. Type Test

- a. Visual examination,,
- b. Verification of dimensions,
- c. Visible discharge test,
- d. Impulse voltage withstand test,
- e. Wet power frequency voltage withstand test
- f. Temperature cycle test,
- g. Mechanical failing load test
- h. 24-hour mechanical strength test for strain insulators





- i. Puncture test
- j. Porosity test and
- k. Galvanizing test

**6.13.2. Routine Test**

The following tests shall be performed on the pin insulators before delivery.

- a. Visual examination
- b. Mechanical routine test
- c. Electrical routine test



## 7. Insulator Pins

### 7.1. Scope

This specification covers the fabrication and supply of bolt type cross arm insulator pins.

### 7.2. Description

The insulator pin to be supplied shall conform to the nominated standards or to internationally accepted standards and to the shape and dimensions shown in the drawings contained in this specification. The insulator pin shall be furnished with a spring steel split lock washer and nut assembled on the insulator pin. The ratings and features of the insulator pins shall be as follows:

#### For 11 kV

Head type	Small S165P
Total length	315 mm
Stalk length	165 mm
Shank length	150 mm
Minimum failing load	5 kN
Applicable standard	IS: 2486 (Part I & II) or equivalent national or international standard.

The insulator pins shall be compatible with the insulators specified above and shall conform to the shape and dimension shown in the drawing number CS11-LM-04.

### 7.3. Material

The insulator pins specified herein shall be fabricated from hot rolled steel. The pin shall be a single piece obtained preferably by the process of forging. It shall not be made by jointing, welding, shrink fitting or any other processes from more than one piece of material. It shall be of good finish free from flaws and other defects. The finish of the collar shall be such that a sharp angle between the collar and the shank is avoided.

### 7.4. Galvanizing

All ferrous pins, nuts and washers except those made of stainless steel shall be hot dip galvanized. The threads of nuts shall be cut after galvanizing and shall be well oiled and greased. The galvanizing shall conform to IS 2629-1985 or equivalent national or international standard.



### **7.5. Finish**

All insulator pins shall be reasonably smooth on all surfaces and free of sharp projections.

### **7.6. Tests**

Insulator pins shall comply with the following tests as per IS: 2486.

#### **7.6.1. Type Tests**

- Visual examination test,
- Checking of threads on head,
- Galvanizing test,
- Mechanical test.

#### **7.6.2. Acceptance Tests**

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

#### **7.6.3. Routine Test**

- Visual examination.

### **7.7. BID DOCUMENTATION**

- 7.1 The Bidder shall provide with the Bid two (2) clear copies of the governing standards for fabrication and testing of pin insulator and insulator pin and two (2) clear copies of all other relevant standards referenced therein.
- 7.2 The Bidder shall provide certified type test results of pin insulator and insulators pin as required by governing standards.
- 7.3 The Bidder shall provide standard catalogue and certified dimensional drawings of pin insulator and insulator pins.



- 7.4 A clause-by-clause commentary on specification, specifying compliance and deviations, if any.
- 7.5 All data, drawings, catalogues and other technical documents shall be bound separately from the Bid documents.



**TECHNICAL DATA SHEETS**

(To be completed by Bidder)

**Item: Insulator Pins**

<b>Description</b>	<b>Unit</b>
1. Manufacturer	_____
2. Type of Steel Used	_____
3. Dimensional drawings attached?	Yes/No
4. Governing Standard	_____
5. Copies of Standards attached?	Yes/No
6. Copies of type test attached?	Yes/No
7. Ratings and Features:	
Head Type	_____
Total Length (mm)	_____
Stalk Length (mm)	_____
Shank Length (mm)	_____
Minimum Failing Load (kN)	_____
Applicable Standard	_____
Catalogue Number	_____
IS reference	

Signed \_\_\_\_\_

On behalf of \_\_\_\_\_

Address \_\_\_\_\_

Date \_\_\_\_\_



## Disc Insulator Fittings

### 7.8. Scope

This Specification covers the fabrication and supply of tension type disc insulator fittings, for use on overhead power line construction.

### 7.9. Description

The disc insulator fittings shall be supplied with ball and socket couplings and twisted straps. The insulator fittings shall conform to the shape and dimension shown in the drawings CS11-LM-02, CS11-LM-05, and CS11-LM-06.

### 7.10. Material

Disc insulator fittings like Ball and socket, nuts, bolts shall be made of hot rolled steel and the twisted cross arm strap shall be made of MS sheet metal. Cotter bolts and U-bolts shall be of galvanized steel. Cotter pins shall be of stainless steel.

All forgings and castings shall be of good finish and free from flaws and other defects. The edges on the outside of fittings, such as the ball socket and holes, shall be rounded. The nominal dimensions of the ball and socket, ball eye and twisted cross arm straps, are given in Drawings. The ultimate strength of the fittings shall not be less than 41 kN.

### 7.11. Galvanizing

All ferrous fittings and the parts other than those of stainless steel, shall be hot dip galvanized as per IS: 2629-1985 or equal internationally recognized standards.

### 7.12. Tests

The disc insulator fittings shall comply with the following tests as per IS: 2486 or equivalent national or international standard.

#### 7.12.1. Type Test

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



### **7.12.2. Acceptance Tests**

- Verification of dimensions,
- Galvanizing,
- Mechanical Tests.

### **7.12.3. Routine Tests**

- Visual Examination Test
- Routine Mechanical Test

## **7.13. Bid Documentation**

1. The Bidder shall provide with the Bid two (2) clear copies of the governing standards for fabrication and testing of disc insulator and disc insulator fittings and two (2) clear copies of all other relevant standards referenced therein.
2. The Bidder shall provide certified type test results of disc insulator and disc insulator fittings as required by governing standards.
3. The Bidder shall provide standard catalogue and certified dimensional drawings of disc insulator and disc insulator fittings.
4. A clause-by-clause commentary on specification, specifying compliance and deviations, if any.
5. All data, drawings, catalogues and other technical documents shall be bound separately from the Bid documents.



**TECHNICAL DATA SHEET**

(To be completed by Bidder)

**Item: Disc Insulator Fittings**

<b>Description</b>	<b>Unit</b>
1. Manufacturer/Catalogue No.	_____
2. Dimensional drawings attached?	Yes/No
3. Governing Standard	_____
4. Copies of Standards Attached:	Yes/No
5. Copies of type test attached?	Yes/No
6. Steel Classification	_____
7. Ferrous parts are galvanized As per IS 2629 – 1985?	Yes/No
8. Cotter Pins are Stainless Steel?	Yes/No
9. Ultimate Strength of Fittings	_____ kN

Signed \_\_\_\_\_

On behalf of \_\_\_\_\_

Address \_\_\_\_\_

Date \_\_\_\_\_





## 8. Surge Arresters

### 8.1. Scope

This specification covers the manufacture, testing and supply of distribution type polymer-housed surge arresters commonly installed on overhead power lines.

### 8.2. Descriptions

1. The surge arresters shall be suitable for use on a three-phase, wye-connected, uni-grounded (solid grounding), 11 kV, 50 Hz distribution circuits at an altitude up to 2000 meters, and ambient temperatures ranging from -5°C to 55°C .
2. The surge arrester housing shall be of polymer type, manufactured using industry recognized polymeric material having superior insulating properties necessary for outdoor installations. The housing shall display in an indelible manner: Arrester type, voltage rating, and year of manufacture.
3. The surge arresters shall be of gapless metal-oxide type.
4. The surge arresters shall have line terminals and ground lead terminals accommodating copper or aluminium conductor sizes from 13.3 mm sq. through 53.49 mm sq. Each arrester shall be provided with nut and wire clamp as the line terminal and ground terminal accessory hardware.
5. The surge arresters shall be furnished with necessary mounting bracket and accessories necessary for steel channel (100x50x50x6mm) cross-arm mounting.
6. The surge arresters must be manufactured by a company approved to quality standard ISO9001. The ISO 9001 certification number, the name of the authorized approving authority with the contact address and telephone and fax numbers shall also be stated. The Bidder shall enclose a verified copy of the ISO 9001 certificate with the bid.
7. The surge arresters shall have the following characteristics:
 

a. Voltage rating (Ur), Vrms	9
b. Nominal system voltage, kVrms	11
c. Maximum system voltage, kVrms	12
d. System frequency, Hz	50
e. Nominal discharge current, kA	10
f. Creepage distance (terminal to base), mm	390
g. Minimum power-frequency withstand Wet, kVrms	50



	Dry, kVrms	70
h.	Impulse withstand (1.2/50 $\mu$ sec), kVcrest	95
i.	Maximum discharge (residual) voltage at 10kA lighting impulse current, kVcrest	29
j.	Steep current residual voltage, kVcrest	32
k.	Pressure relief class B	
	High current	for 0.2s 20 kA
	Low current	for 0.5s 0.8 kA

2. The surge arresters shall be manufactured and tested in accordance with IEC 60099-4 (latest revision).
3. Bidder can take the reference of drawing number CS11-LM-12 for surge arresters.

### 8.3. Quantity

The quantity of the arresters to be under this Bid shall be as given in price schedule.

### 8.4. Bid Documentation

1. The Bidder shall provide with the Bid two (2) clear copies of the governing test specification and a full description and list of electrical and protective characteristics of the surge arresters offered.
2. The Bidder shall have to provide two (2) clear copies of certified type-set results of the surge arresters offered.



**TECHNICAL DATA SHEET****(To be filled by the Bidder/Manufacturer)**

The Bidders/manufacturers are required to furnish the following information in the Data Sheet. Separate sheets can be used if additional space is required. The information furnished shall be supported by the catalogue and test reports. The information not supported by the catalogues, test reports etc. shall be deemed to have been "Not provided". The bidders/manufacturers are also required to underline the information asked for in the catalogue and /or test reports. Any deviation from NEA's requirements shall be clearly mentioned giving the reasons thereof.

<b>S. No.</b>	<b>Description</b>	<b>NEA's requirement</b>	<b>Offered specifications</b>
1.	Catalogue No. Model offered		
2	Applicable standard Certification: Name of the authorized approving authority Certification number Date of certification Address, telephone and fax numbers of the approving authority	IEC 600 99 ISO 9001 (including design)	
3	Copy of certified type test attached	To be provided	
4	Surge arrester type	Gapless metal oxide with polymer housing	
5	Ground lead disconnecter provided?	Yes	
6	Ratings: a. System Voltage, kV b. Max. system voltage, kVrms c. Voltage rating (Ur), kVrms	11 12 9 50	



	d. System frequency, Hz	10	
	e. Nominal discharge current, kA	390	
	f. Creepage distance, mm		
	g. Min. power frequency withstand Wet, kVrms	50	
	Dry, kVrms	70	
	h. Impulse withstand (1.2/50 $\mu$ sec), kVcrest	95	
	i. Maximum discharge (residual) voltage at 10 kA lightning impulse current, kV crest	29	
	j. Steep current residual voltage, kV crest	32	
	k. Pressure relief class	B	
8	Governing standards and type test reports submitted	Yes	

Signed \_\_\_\_\_

On behalf of \_\_\_\_\_

Address \_\_\_\_\_

Date \_\_\_\_\_



## 9. Drop Out Fuses

### 9.1. SCOPE

This Specification covers the manufacture, testing and supply of drop out fuse commonly used on the primary side of 11 kV distribution transformers as protective device.

### 9.2. DESCRIPTION

1. The drop out fuse shall be suitable for use on three-phase, wye-connected, ungrounded, 50 Hz distribution circuits at an altitude up to 2000 meters.
2. The drop out fuse shall be tested in full compliance with ANSI C 37.41-1981, ANSI C 37.42 or IEC 60282-2.
3. The drop out fuse shall incorporate wet-process glazed porcelain insulators. The insulator shall display in an indelible manner: manufacture, type and voltage rating.
4. The fuse holder shall accommodate a non-expendable cap or an expendable cap determined by interrupting rating.
5. The drop out fuse shall be furnished with a galvanized steel-mounting bracket that may be adapted for steel channel (100x50x50x6mm) cross arm mounting.
6. The drop out fuse shall have clamp type terminals to accept copper or aluminium conductors ranging from 25 mm<sup>2</sup> to 150 mm<sup>2</sup>.
7. The drop out fuse must be manufactured by a company approved to quality standard ISO 9001 (including design in the scope of registration). The ISO 9001 certification number, the name of the authorized approving authority with the contact address and telephone and fax numbers shall also be stated. The Bidder shall enclose a verified copy of the ISO 9001 certificate with the bid.

### 9.3. RATINGS

The drop out fuse shall have the following electrical characteristics:

a) System voltage	kVrms	11
b) Design rating	kVrms	15
c) Minimum power frequency withstand:		
Dry kVrms		35
Wet kVrms		30
d) Impulse withstand, kVcrest		95



e) Interrupting capacity, kA	10
f) Creepage distance, mm	220
(Leakage to ground)	
g) Temperature Rise Limit (In air)	
i. Copper contacts silver faced	65°C
ii. Terminals	50°C
	Metal parts acting as spring
	The temp. shall not reach such a value that elasticity of the metal is changed

The drop out fuse shall have fuse holder from 100 Ampere to 300 Ampere capacities.

#### 9.4. GENERAL REQUIREMENTS/CONSTRUCTIONAL DETAILS

1. The typical constructional details of the drop out fuse are as follows:

- a. Copper current path;
- b. Copper arc shortening rod;
- c. Bird-proofed one-piece solid porcelain insulator;
- d. Tinned plated bronze terminals for use with copper or aluminium conductor;
- e. Two-place locking to prevent side movement of hood, contacts or hooks;
- f. One piece stainless steel channel;
- g. Stainless steel backup spring to maintain contact pressure;
- h. Silver to silver contacts;
- i. Galvanized steel hooks for load break tool;
- j. Cast bronze top tube casting and pull ring;
- k. High strength fibre glass fuse tube coated with ultra violet inhibitor;
- l. Hot stick hole in trunnion casting for hot stick work;
- m. Cast bronze lower tube casting;
- n. Stainless steel fuse link ejector and spring insures proper toggle action;
- o. Fuse holder toggle latch limits tension of fuse link;
- p. Cast bronze hinge for corrosion resistance;
- q. Large nut to fasten fuse link without breaking strands;

2. The design of drop out fuse shall be such that the fuse holder can be interchanged with those of other manufacturer.

#### 9.5. TESTS

Tests shall be performed in accordance with the relevant latest IEC standards supplemented by the specific requirements indicated below. In the absence of IEC recommendations the tests must be equivalent at least to the conditions, provisions and definitions of the above-mentioned standards.



### 9.5.1. Type Tests

The Bidder shall submit, along with the Bid, detail type test reports performed on similar or higher rating of drop out fuse. The test shall have been conducted by recognised national or international testing lab in accordance with the latest version of IEC or ANSI C 37.41-1981, ANSI C 37.42 and it must include following tests :

- a. Dielectric tests (rated impulse withstand and rated one minute power frequency withstand test voltages)
- b. Temperature rise test
- c. Pull out test for embedded components of the fuse base (Mechanical test)
- d. Beam strength of porcelain base

### 9.5.2. Routine Test

The drop out fuse shall be subjected to the routine tests at the manufacturer's premises as per applicable standards.

## 9.6. BID DOCUMENTATION

1. The Bidder shall provide with the Bid literature/catalogue giving a full description of the drop out fuse and the fuse holders, including their operational details.
2. The Bidder shall provide a clear copy of certified type test results of the drop out fuse offered.
3. The Bidder shall provide with the Bid two (2) clear copies of the governing test specification and a full description and list of electrical and protective characteristics of the drop out fuse offered.

## DATA SHEET

(To be filled in by the Bidder/ Manufacturer)

The Bidders/manufacturers are required to furnish the following information in the Data Sheet. Separate sheets can be used if additional space is required. The information furnished shall be supported by the catalogue and test reports. The information not supported by the catalogues, test reports etc. shall be deemed to have been "Not Provided". The bidders/manufacturers are also required to underline the information asked for in the catalogue and /or test reports. Any deviation from NEA's requirements shall be clearly mentioned giving the reasons thereof.

S. No.	Description	NEA's requirement	Offered specifications
1.	Manufacturer: Catalogue No.: Model offered:		



2.	Applicable standard  Certification:  Name of the authorized approving authority  Certification number  Date of certification  Address, telephone and fax numbers of the approving authority	ANSI C 37.41, C 37.42 or IEC 60282-2  ISO 9001 (Including design)	
3.	Copy of certified type test attached	To be provided	
4.	Steel mounting bracket provided	To be provided	
5.	Clamp type terminals for copper/aluminium cable 25-150 mm <sup>2</sup> size	Yes	
6.	Ratings:		
	a. System Voltage, kVrms	11	
	b. Design rating, kVrms	15	
	c. System frequency, Hz	50	
	d. Min. power frequency withstand Wet, kVrms	30	
	Dry, kVrms	35	
	e. Impulse withstand, kVrms	95	
	f. Creepage distance (leakage to ground), mm	220	
	g. Interrupting capacity , kA	10	
7.	All the features mentioned in the specifications	Yes/No	

Signed \_\_\_\_\_

On behalf of \_\_\_\_\_

Address \_\_\_\_\_

Date \_\_\_\_\_





## 10. Fuse Link

### 10.1. Scope

This Specification covers the supply of button head fuse links commonly used in the protection of distribution transformers.

### 10.2. Description

1. The button-head fuse link shall be fabricated in full compliance with American National Standard specification ANSI C 37.42-1981, or latest revision thereof or any other national or international standards that ensures at least a substantially equal quality to the standard mentioned above, will also be acceptable.
2. The fuse link shall have fast characteristics and shall be suitable for protection of distribution transformers.
3. The fuse link shall be supplied in accordance with the type and ratings shown in the bid package.

### 10.3. Bid Documentation

1. The Bidder shall furnish two (2) clear copies of governing standards for fabrication and testing of fuse links
2. The Bidder shall furnish two (2) clear certified copies of catalogue of fuse links.
3. The Bidder shall furnish a clause-by-clause commentary on specification, specifying compliance and deviations, if any.
4. The Bidder shall also furnish with the Bid two (2) copies of the following data with respect to the fuse links furnished:
  - a) Time-Current (TC) characteristic curves at 30°C, including minimum melting time and total clearing time.
  - b) Preloading adjustment factors or curves.
  - c) Ambient temperature adjustment factors or curve
5. All data, drawings, catalogues and other technical documents shall be bound separately from the Bid documents



**DATA SHEET**

(To be filled in by the Bidder/ Manufacturer)

<b>Description</b>	<b>Queries</b>
1. Manufacturer	_____
2. Catalog Numbers	_____
3. Governing Standard	_____
4. Copies of Standard attached?	_____
5. Time Curves attached	
Minimum melting time	Yes/No
Total clearing time	Yes/No
6. Preload adjustment data attached?	Yes/No
7. Ambient temperature adjustment data attached?	Yes/No

Signed \_\_\_\_\_

On behalf of \_\_\_\_\_

Address \_\_\_\_\_

Date \_\_\_\_\_



## 11. MOULDED CASE CIRCUIT BREAKERS

### 11.1. Scope

This Specification covers the manufacture, testing and supply of moulded-case circuit breakers (MCCB).

### 11.2. Description

1. The MCCB shall be fabricated and tested in accordance with IEC-60947-2 or latest revision, or any other national or international standards that ensures at least a substantially equal quality to the standard mentioned above, will also be acceptable.
2. The manufacturer of MCCBs must have been accredited with ISO 9001 including design quality certification.
3. The MCCB shall be suitable for connection to 400/230 volt, 3 -phase, 4 wire, uni-grounded circuits.
4. The MCCB shall be rated in accordance with the parameters shown in Table 1.
5. The MCCB shall be completely enclosed in a moulded case and shall be factory sealed. The MCCB shall have a quick make, quick break, over current switching mechanism that is mechanically trip-free for simultaneous tripping of all poles. Tripping due to overload or short circuit shall be clearly indicated by the position of the handle. The ON and OFF positions shall be clearly marked on the breaker case.
6. The MCCB shall have line load reversibility features.
7. Marking shall be in accordance with IEC-60947-2.
8. The MCCB shall be of inverse time and instantaneous trip type. The trip device shall be of thermal-magnetic, or static release type.
9. The MCCB shall be provided with terminal connection of the screw-type or bus-bar type as specified in Table 1 with required hardware.
10. The circuit breakers shall be suitable for mounting in outdoor distribution panels and each breaker shall be furnished complete with one (1) set of bolt fastenings, complete with nuts and lock washers of the correct diameter for the mounting hole and of a length equal to the depth of the MCCB body plus approximately two (2) centimetres.

### 11.3. Tests

Tests shall be carried out as per the requirements laid down in the relevant governing standards, which should at least include following tests:



**11.3.1. Type Tests**

- a) Temperature rise test
- b) Tripping limits and characteristics
- c) Dielectric properties
- d) Operational performance capability
- e) Overload performance
- f) Short-circuit breaking capacities
- g) Shot-time withstand current

**11.3.2. Routine or Sample Test**

- a) Mechanical operation test
- b) Calibration of releases
- c) Dielectric withstand

**11.4. Bid Documentation**

- a. The Bidder shall furnish two (2) clear copies of the IEC Standards/governing standards for fabrication and testing of the MCCB and two (2) clear copies of all other relevant standards referenced therein.
- b. The Bidder shall furnish two (2) clear certified copies of all type tests of MCCB as required by the governing standard.
- c. The Bidder shall furnish two (2) clear certified copies of catalogue and outline drawings for each MCCB rating showing dimensions, arrangements and name and location of all parts.
- d. The Bidder shall furnish two (2) copies of time - current characteristic trip curves for each breaker rating.
- e. The Bidder shall furnish a clause-by-clause commentary on specification, specifying compliance and deviations, if any.
- f. All data, drawings, catalogues and other technical documents shall be bound separately from the Bid documents.



TABLE 1

**RATING AND FEATURES**

Rated Voltage	600 Volt
Rated Impulse Withstand Voltage	8 kV
Number of Poles	3
Ampere Ratings	As per Price Schedules
Ambient Temperature	-5°C to 55°C
Interrupting Capability	(IEC category P2)
Service Breaking Capacity:	
a) 50-100 Amps.	25 kA
b) Above 100 Amps.	36 kA

The MCCB rated 50 Amperes through 200 Amperes shall be furnished with thermal-magnetic or static trip.

The MCCB rated above 200 Amperes shall be furnished with Thermal-adjustable magnetic or static trip.

The MCCB's are intended to be used in the Distribution Panel Boards of the distribution transformers and shall include busbar terminals as specified in table 2.



## TECHNICAL DATA SHEET

(To be filled in by the Bidder/ Manufacturer)

The Bidders/manufacturers are required to furnish the following information in the Data Sheet. Separate sheets can be used if additional space is required. The information furnished shall be supported by the catalogue and test reports. The information not supported by the catalogues, test reports etc. shall be deemed to have been "Not Provided". The bidders/manufacturers are also required to underline the information asked for in the catalogue and /or test reports. Any deviation from NEA's requirements shall be clearly mentioned giving the reasons thereof.

S. No.	Description	NEA's requirement	Offered specifications
1.	Manufacturer Catalogue No. Model offered		
2	Applicable standard Certification:	IEC 60947-2 ISO 9001 including Design	
3	Ratings and type: Rated Voltage, V  Nominal current rating, A	600	
4	Service Breaking Capacity, A	25 kA up to 100 A 36 kA above 100 A	
5	Impulse withstand voltage, kV	8	
6	Interrupting Capability	(IEC category P2)	
7	Trip device	Thermal magnetic or static for breaker rated up to 200 A Thermal adjustable magnetic or static for rating greater than 200A	
8	Line load reversibility	Yes	
9	All Bid documents furnished	As per Clause 4 of Specs	
10	Ancillary fittings provided	As per Table 2	
11	Copies of standards attached?  Copies of certified type tests attached?  Copies of outline drawings attached?  Copies of time - current characteristic trip curves for each breaker rating	Yes  Yes  Yes  Yes	



	attached?		
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Signed \_\_\_\_\_

On behalf of \_\_\_\_\_

Address \_\_\_\_\_

Date \_\_\_\_\_



## DISTRIBUTION PANEL BOARD

### 11.5. Scope

This Specification covers the fabrication, testing and supply of Distribution Panel Boards.

### 11.6. Description

1. The Distribution Panel Boards shall be fabricated and tested in accordance with IEC-61439 or latest revision, or any other national or international standards that ensures at least a substantially equal quality to the standard mentioned above, will also be acceptable.
2. The panel board shall be pole-mounted and used in conjunction with pole-mounted distribution transformers to house moulded case circuit breaker (MCCB) feeding 400/230 Volt circuits.
3. The manufacturer of panel boards must have been accredited with ISO 9001 quality certification.
4. The panel board shall be rectangular in shape with an entrance door in the front of the panel board. The panel board shall be equipped with interior standoffs suitable for mounting MCCB and for supporting cables. The panel board will be fixed to the pole by exterior mounting brackets attached to the back of the panel board. Details of these components shall be as specified in the following text.
5. The panel board shall be fabricated to prevent ingress of moisture due to rainfall and dripping. The panel board shall be provided with means for natural ventilation.

### Material

6. The panel board case and door shall be fabricated out of steel sheet of minimum 2 mm. in thickness and pole mounting brackets shall be fabricated out of mild steel flat of 6 mm. in thickness.
7. The interior standoffs shall be fabricated of steel sheet of sufficient thickness to support installed circuit breaker and cables without lateral movements.

### Construction

8. The panel board case and all interior and exterior attachment shall be spot-welded. All welding shall be of the highest quality. The panel boards shall be formed and welded square and all attachments to the interior and exterior surfaces shall be welded square and perpendicular to the panel attached.
9. The panel board shall be so constructed as to be water tight from blowing of free-falling rain. There shall be no apertures in the panel board case other than those provided for the entrance door, cable fittings, or ventilation. The top extension and





bottom shall be so formed to provide a drip edge and prevent water from flowing on the respective under-surfaces.

10. All individual pieces of metal shall be edge finished prior to assembly to provide surfaces and edges which are free from sharp points and edges. After welding in place, all welds shall be finished to smooth condition.

### **Panel board Front**

11. The front panel shall be fabricated as a separate piece containing the panel board door and doorframe. The front shall be attached to the panel board housing by suitable bolting arrangements to provide a watertight and dust tight seal at the perimeter.
12. The door shall be equipped with a gasketed removable door, door-handle lock, and suitable hinges.
13. The door and panel frame shall be so fabricated to provide an integrated structure which is warp-resistant and which will maintain dust-tight and watertight seal.
14. Gasketing material shall be heat-resistant and shall retain its resilience over time to precluded degradation of dust-tight and watertight properties.
15. The insertable (and removable) door handle shall provide a door a locking function. The handle shall be insulated.
16. The door hinge may be continuous type or separate hinge units. However, the type of hinge furnished must accommodate, and not degrade, the dust-tight and watertight characteristics and must provide adequate door alignment and support over time.

### **MCCB Standoffs**

17. The standoffs shall be shaped and dimensioned to accommodate the MCCBs as required by Bid Packages.
18. The standoffs shall be precisely located.

### **Cable Standoffs**

19. The cable standoffs shall be properly shaped and dimensioned.
20. The standoff shall have the metal edges contoured and smoothed to prevent abrasion of applied cable serving.
21. The standoff shall be located within the panel board to make allowance for cable bending radii and the location of other components.

### **Bus bars**



22. The neutral and phase bus bars shall consist of copper bus bar insulated from the panel board by 600 V porcelain insulators. The copper bus bar shall be of proper size (ampere capacity) and properly dimensioned.
23. The bus bars shall be located within the panel board to provide adequate clearance for the installation and correct functioning of all items.
24. If it is required to drill or penetrate the panel board back to install 600 V insulators, the outside of the panel board shall be permanently sealed over the attachment to retain water-tightness.

#### Cable Entrance Fittings and Knockouts

25. Knockouts for cable entrance fittings (bushings) shall be provided in the bottom of the panel board.
26. All necessary cable entrance fittings shall be supplied for proper connection of all circuits to fulfil the requirement of the Bid Package. The fittings shall be designed to be suitable for exposed cables entering the panel board from below and shall secure the cable with inserts to prevent lateral and longitudinal movement of the cables.
27. The fittings shall be threaded multi-piece construction which when installed securely locks the fittings to the panel board. The fittings may be of metal or polymer material. Metal fittings shall be galvanized or plated as appropriate. The fitting inserts may be single or multi pieces and shall be of material sufficiently elastic and resilient to securely grip the PVC cable sheath without damage. The fitting components shall enable capturing of the inserts to preclude insert creep and fallout due to clamping pressure.

#### **Ventilation**

28. The panel board shall be provided with apertures for natural draft ventilation in the panel board bottom and in the top overhang.
29. The ventilation apertures shall be covered with bronze screen materials of a mesh sufficiently to preclude passage of small insects. The edges of the bronze screening shall be surely fastened to the panel board by means of soldering or epoxy adhesive. The mesh shall be protected during panel board fittings to preclude clogging of mesh openings by finished materials.

#### Pole Mounting Bracket

30. The panel board shall be provided with two (2) pole mounting brackets. The size of poles will be confirmed by the Project before manufacturing.

#### **Grounding Stud**

31. The panel board shall be provided with a brass grounding stud located in an approved location.



32. The grounding stud shall be fitted to the panel board to insure low resistivity and water tightness of the installation.
33. The grounding stud shall be complete with pressure washer, lock washer, and nuts.

### **Finish**

34. After fabrication, the panel board shall be thoroughly cleaned of all dirt, grease, mill scale, and weld slag on all interior and exterior surfaces and all surfaces of all component. After thorough cleaning of panel board one (1) coat of red oxide metal priming paint and two (2) finish coats of paint color shall be thoroughly applied. The paint color shall be of light grey. The finish coats shall be of oil based or epoxy paint. Alternatively, powder coating of panel board may also be acceptable.
35. The bronzed screen ventilation holes, working surfaces of door hinge and door lock, and outside face of grounding stud shall be free from all finishing materials.

### **11.7. Bid Documentation**

- a. The Bidder shall furnish two (2) copies of certified fabrication drawings showing all views, section, and dimensions of individual components and assembled panel board.
- b. The Bidder shall furnish complete description of all materials to be used, including cable entrance fittings and finishing materials.
- c. The Bidder shall furnish a clause-by-clause commentary on specification, specifying compliance and deviations, if any.
- d. All data, drawings, catalogues and other technical documents shall be bound separately from the Bid documents.





## Drawings

***The bidder is required to furnish the certified fabrication drawings showing all views, section, and dimensions of individual components and assembled panel board and shall take approval of drawings from the project prior to manufacture.***



## 12. STAY SET

### 12.1. Scope

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

### 12.2. Material

1. The stay set shall consist of mild steel, galvanized stay rod, stay tightener (turn buckle) or adjustable head, eyebolt for pre-stressed concrete pole or two-way clamp and twisted double-eye for steel tubular pole, thimbles complete with stay plate as shown in the conceptual drawings.
2. The manufacturer of the Stay Set must have been accredited with ISO 9001 or ISO 9002 quality certification.
3. The stay rod and stay tightener shall be made of mild steel of minimum ultimate tensile strength of 4200-kg/sq. cm.
4. The stay plate shall be square type mild steel plate.
5. The thimbles shall be made of 1.219mm (18 SWG) GI sheet.

### 12.3. Description

1. Conceptual drawings of stay set and its associate hardware are given in drawing CSG 12 and technical features and dimensions in Table 1.
2. The stay rod is either thimble-eye type or twin-eye type. The stay rod and suitable nut shall be fabricated to the shape and dimensions shown in CSG 12. The thimble-eye or twin-eye of the stay rod shall be made by drop-forged processing. 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 1 without creep or stripping over the full life of the rod material at specified diameter.
3. The stay tightener shall be fabricated in accordance with the conceptual drawing shown in CSG 12.
4. The eyebolt shall be oval-eye type. The eyebolt shall be made by drop-forged processing. The eyebolt shall be supplied with suitable nut and washer.
5. The two-way clamp required for mounting stay set (stay tightener) in steel tubular pole shall be made of hot-rolled steel flat. The clamp shall be two halve type and



shall be provided with two numbers of nuts and bolts, diameter not less than 19 mm. The both ways of the clamp shall be suitable for accommodating two numbers of twisted double-eye fittings described in Clause 3.6 below. The two-way clamp shall be following types:

- a) Type A: Suitable for pole diameter ranging from 180-230 mm.
  - b) Type B: Suitable for pole diameter ranging from 140-180 mm.
6. The twisted double eye shall be made by drop-forged processing. The twisted double-eye shall be twisted in 90°. The diameter of the steel shall not be less than 16 mm, and eye of the twisted-eye shall be suitable for accommodating stay tightener.
  7. The Stay plate shall be square and the plate shall have a matching hole at the center to fit the end of the stay rod.
  8. The thimble shall be suitable for terminating steel stay wire with a preformed grip.
  9. 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.

#### **12.4. Galvanizing**

All ferrous parts of the stay set shall be galvanized after fabrication in accordance with IS: 2629-1985 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.

#### **12.5. Tests**

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

- a) Visual Inspection.
- b) Verification of Dimensions.
- c) Tensile test: The stay set assemblies shall withstand a minimum tensile loads specified in Table 1.
- d) 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 22.5 deg Celsius.

Routine tests shall be performed on each batch of the stay sets as per the relevant governing standards.



## 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 ISO9000;
- vi. Statement giving list of important raw materials, names of manufacturer for the raw materials, list of standards according to which the raw materials are tested, list of test normally carried out on raw materials;
- vii. List of manufacturing facilities available;
- viii. List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections;
- ix. List of testing equipment available with the manufacturer for final testing of equipment specified and the test plant limitation, if any, vis-à-vis the type, special, acceptance and routine tests specified in the relevant standards.

## 12.7. Bid Documentation

- a. The Bidder shall provide a complete description, catalogue and two (2) clear copies of certified dimensional drawings of all the components of the stay set.
- b. A clause-by-clause commentary on specification, specifying compliance and deviations, if any.
- c. All data, drawings, catalogues and other technical documents shall be bound separately from the Bid documents.





**TABLE 1**  
RATINGS AND FEATURES

	<b>HT Stay</b>
Length of stay rod, m.	2.44
Diameter of stay rod, mm.	19
Ultimate tensile strength of stay rod and tightner (min.), kg/sq. mm.	4200
Minimum breaking load, kg.	10,454
Length of threaded portion, mm.	300
Thimble shape	Suitable for preformed for 7/8 SWG stay wire
Thimble section Min.), SWG	18
Stay plate section, mm.	600x600x6
Eyebolt length, mm./1	300
Galvanization	<b>IS: 2629-1985</b>



## TECHNICAL DATA SHEETS

(To be completed by Bidder)

<b>Item:</b>	<b>Stay Set</b>	
<u>Description</u>	<u>Unit</u>	<u>Stay Set (19 mm.)</u>
1. Manufacturer		
2. Catalog Numbers		
3. Steel Classification		
4. Governing Standard for galvanization		
5. Load rating, kg.		
6. Type tests-tensile load data attached?		Yes/No
7. Type test-bend test data attached?		Yes/No
8. Dimensional drawing attached?		Yes/No

Signed \_\_\_\_\_

On behalf of \_\_\_\_\_

Address \_\_\_\_\_

Date \_\_\_\_\_



## 13. STRANDED STAY WIRE

### 13.1. 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.

### 13.2. Description

1. The steel strand shall be fabricated in accordance with B.S. 183 1972/(1983) 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<sup>2</sup>. The wires shall be 45-ton quality.
2. The steel wire strand shall have a left-hand lay. The steel wires shall have no joint throughout the whole length. Strands shall be uniform and shall have no defects such as cracks, dust encapsulation or crevices. Further details are given in Table 1 herein.
3. The manufacturer of the Stranded Stay Wire must have been accredited with ISO 9001 or ISO 9002 quality certification.

### 13.3. Galvanizing

The stranded stay wire 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 equal or better quality to the standard mentioned above will also be acceptable.

### 13.4. Tests

The stranded stay wire shall undergo type and routine tests in accordance with the governing standard.

### 13.5. Packaging

The stranded stay wire shall be furnished in reels holding approximately 300m. Each reel shall have a weather-resistant tag securely attached showing the length, nominal diameter, number of individual wires, and grade of the strand.

### 13.6. 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.

- i. The structure of the organization;
- ii. The duties and responsibilities assigned to staff ensuring quality of works;



- iii. The system for purchasing, taking delivery and verification of materials;
- iv. The system for ensuring quality of workmanship;
- v. The quality assurance arrangement shall conform to relevant requirements of ISO9000;
- vi. Statement giving list of important raw materials, names of manufacturer for the raw materials, list of standards according to which the raw materials are tested, list of test normally carried out on raw materials;
- vii. List of manufacturing facilities available;
- viii. List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections;
- ix. List of testing equipment available with the manufacturer for final testing of equipment specified and the test plant limitation, if any, vis-à-vis the type, special, acceptance and routine tests specified in the relevant standards.

### 13.7. Bid Documentation

1. The Bidder shall provide with the Bid two (2) clear copies of the governing standards for fabrication and testing of stranded stay wire and two (2) clear copies of all other relevant standards referenced therein.
2. The Bidder shall provide a complete description, and catalogue of stranded stay wire.
3. The Bidder shall provide certified type test results of insulator pins as required by governing standards.
4. A clause-by-clause commentary on specification, specifying compliance and deviations, if any.
5. All data, drawings, catalogues and other technical documents shall be bound separately from the Bid documents.

**TABLE 1**  
**RATING AND FEATURES**

Steel Wire Size (No. of wire/SWG)	7/12
Grade	700
Steel quality	45 ton
Diameter of Wires, mm.	2.64
Minimum Weight, kg/km	300



Applicable Standard	B.S. 183 1972/(1983)
Galvanization	<b>IS: 2629-1985</b>



**TECHNICAL DATA SHEET**

(To be completed by Bidder)

**Item: Steel Wire Strand**

	<i>Description</i>	<i>Unit</i>	<i>7/8 SWG</i>
1.	Manufacturer		
2.	Strand diameter (overall)	mm	
3.	No. of Strands		
4.	Minimum Breaking load	kg	
5.	Nominal diameter of coated wire in strand	mm	
6.	Left hand lay	Yes/No	
7.	Governing Standard for manufacturing and testing	Yes/No	
8.	Governing Standard for galvanization		
9.	Standards attached?	Yes/No	

Signed \_\_\_\_\_

On behalf of \_\_\_\_\_

Address \_\_\_\_\_

Date \_\_\_\_\_



## GALVANISED STEEL BOLTS, NUTS AND MISCELLANEOUS FASTENING COMPONENTS

### 13.8. Scope

This Specification covers the fabrication and supply of galvanized steel bolts and nuts, as specified herein, for use in overhead electric line construction.

### 13.9. 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.

### 13.10. General

1. Bolts and nuts shall be furnished in the types, diameters and lengths specified in the Price Schedule. **However, the dimensions and length of threading of bolt must be confirmed with the Project prior to manufacture.**
2. Thread forms shall be consistent with all material/items listed herein and shall not strip or slip under sustained tensile loading equal to the design tensile strength of the threaded material item.
3. The manufacturer must have been accredited with ISO 9001:2000 with design and manufacturing quality certification.

### 13.11. Machine Bolt and Nut

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

### 13.12. Double-Arming Bolt and Nut

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

### 13.13. Galvanizing

The nut-bolts and ferrous materials in all other fastening components shall be galvanized after fabrication in accordance with IS: 2629-1985 or any revision thereof or other equivalent national or international standard provided that ensure at least equal or better quality to the standard mentioned above will also be acceptable.



**13.14. Tests**

The bolt and nut shall undergo type and routine tests in accordance with the relevant governing standard.

**13.15. Quality Assurance Program**

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

- i. The structure of the organization;
- ii. The duties and responsibilities assigned to staff ensuring quality of works;
- iii. The system for purchasing, taking delivery and verification of materials;
- iv. The system for ensuring quality of workmanship;
- v. The quality assurance arrangement shall conform to relevant requirements of ISO9000;
- vi. Statement giving list of important raw materials, names of manufacturer for the raw materials, list of standards according to which the raw materials are tested, list of test normally carried out on raw materials;
- vii. List of manufacturing facilities available;
- viii. List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections;
- ix. List of testing equipment available with the manufacturer for final testing of equipment specified and the test plant limitation, if any, vis-à-vis the type, special, acceptance and routine tests specified in the relevant standards.

**13.16. Bid Documentation**

1. Bidder shall provide with the Bid two (2) clear copies of the governing standards for fabrication and testing of bolt and nut and two (2) clear copies of all other relevant standards referenced therein.
2. The Bidder shall provide certified type test results of bolt and nut as required by governing standards.
3. The Bidder shall provide catalogue and certified dimensional drawings of all types of bolt and nut.
4. A clause-by-clause commentary on specification, specifying compliance and deviations, if any.





5. All data, drawings, catalogues and other technical documents shall be bound separately from the Bid documents.



**TECHNICAL DATA SHEET**

(To be completed by Bidder)

**Item : Galvanized Steel Nuts and Bolts**

<b>Description</b>	<b>Unit</b>
1. Manufacturer	
2. Material Description furnished?	Yes/No
3. Governing Standard for manufacturing and testing	
4. Governing Standard for galvanization	
5. Standards attached?	Yes/No
6. Catalog numbers attached for all items?	Yes/No

Signed \_\_\_\_\_

On behalf of \_\_\_\_\_

Address \_\_\_\_\_

Date \_\_\_\_\_



## 14. GROUND RODS AND CLAMPS

### 14.1. Scope

This specification covers the fabrication and supply of galvanized steel ground rods and clamps for use in overhead power line construction.

### 14.2. Description

#### Ground Rod

1. The ground rod shall be made of high carbon, open-hearth steel so as to achieve maximum strength. It shall be hot dip galvanized.
2. The ground rod shall be 19mm in diameter and 4,000 mm in overall length.
3. The driven end of the ground rod shall have a truncated cone point. The cone point shall be approximately 13mm long, measured along the axis of the ground rod. The driving head of the ground rod shall have an approximate 3 mm, 45 degrees chamfer.
4. The manufacturing process shall assure that ground rod does not bend when driven into hard soils.

#### Ground Rod Clamp

5. The ground rod clamp shall be heavy duty forged steel clamp provided with a hex head cup point set screw of high strength steel with machine-cut threads. It shall be so manufactured that it gives low resistance connection. The ground rod clamp shall be galvanized.
6. The clamp shall suitably accommodate and clamp a 19 mm. ground rod and a stranded grounding conductor of suitable size.

### 14.3. Galvanizing

The galvanization of ground rod and clamp shall be in accordance with IS: 2629-1985 or any revision thereof or other equivalent national or international standard provided that ensure at least equal or better quality to the standard mentioned above will also be acceptable.

### 14.4. Tests

Grounds rods and clamps shall undergo type and routine tests in accordance with the relevant governing standard.



#### **14.5. Quality Assurance Program**

1. The manufacturer must have been accredited with ISO 9001:2000 with design and manufacturing quality certification.
2. Along with the Bid the Bidder shall furnish quality assurance program of the manufacturer which includes the Quality System and the Quality Plans, which shall include, among others, information to meet the following requirement, failing which the Bid shall be liable for rejection.
  - i. The structure of the organization;
  - ii. The duties and responsibilities assigned to staff ensuring quality of works;
  - iii. The system for purchasing, taking delivery and verification of materials;
  - iv. The system for ensuring quality of workmanship;
  - v. The quality assurance arrangement shall conform to relevant requirements of ISO9000;
  - vi. Statement giving list of important raw materials, names of manufacturer for the raw materials, list of standards according to which the raw materials are tested, list of test normally carried out on raw materials;
  - vii. List of manufacturing facilities available;
  - viii. List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections;
  - ix. List of testing equipment available with the manufacturer for final testing of equipment specified and the test plant limitation, if any, vis-à-vis the type, special, acceptance and routine tests specified in the relevant standards.

#### **14.6. Bid Documentation**

- a. The Bidder shall provide with the Bid two (2) clear copies of the governing standards for fabrication and testing of grounding rod and clamp and two (2) clear copies of all other relevant standards referenced therein.
- b. The Bidder shall provide certified type test results of ground rods and clamps as required by governing standards.
- c. The Bidder shall provide catalogue and certified dimensional drawings of all types of ground rods and clamps.
- d. A clause-by-clause commentary on specification, specifying compliance and deviations, if any.
- e. All data, drawings, catalogues and other technical documents shall be bound separately from the Bid documents.



**TECHNICAL DATA SHEET**

(To be completed by Bidder)

<b>Item:</b>	<b>Ground ( Rods and Clamps)</b>	<b>Unit</b>
<i>Description</i>		<i>Unit</i>
1. Manufacturer		
2. Material Description furnished?		Yes/No
3. Governing Standard for manufacturing and testing		
4. Governing Standard for galvanization		
5. Standards attached?		Yes/No
6. Catalogue/ dimensional drawings attached for all items?		Yes/No
7. Dimensions (Ground Rod):		
Length		mm.
Diameter		mm.
8. Catalogue number		
Rod		
Clamp		
9. Copies of type test results attached?		Yes/No

Signed \_\_\_\_\_

On behalf of \_\_\_\_\_

Address \_\_\_\_\_

Date \_\_\_\_\_



## 15. GROUNDING CONDUCTOR

### 15.1. Scope

This specification covers the fabrication and supply of galvanized stranded steel grounding conductor for use in the neutral grounding of distribution transformers and body grounding of electrical equipment.

### 15.2. Description

1. The conductor shall be 7-wire stranded conductor and shall conform to the characteristics as specified in Table 1 contained herein. Stranded conductor shall be galvanized.
2. The manufacturer of ground Conductor must have been accredited with ISO 9001:2000 with design and manufacturing quality certification.

### 15.3. Galvanizing

The grounding conductor 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 equal or better quality to the standard mentioned above will also be acceptable.

### 15.4. Tests

The grounding conductor shall undergo type and routine tests in accordance with the relevant governing standard.

### 15.5. Quality Assurance Program

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

- i. The structure of the organization;
- ii. The duties and responsibilities assigned to staff ensuring quality of works;
- iii. The system for purchasing, taking delivery and verification of materials;
- iv. The system for ensuring quality of workmanship;
- v. The quality assurance arrangement shall conform to relevant requirements of ISO9000;
- vi. Statement giving list of important raw materials, names of manufacturer for the raw materials, list of standards according to which the raw materials are tested, list of test normally carried out on raw materials;
- vii. List of manufacturing facilities available;



- viii. List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections;
- ix. List of testing equipment available with the manufacturer for final testing of equipment specified and the test plant limitation, if any, vis-à-vis the type, special, acceptance and routine tests specified in the relevant standards.

#### 15.6. Bid Documentation

- a. The Bidder shall provide with the Bid two (2) clear copies of the governing standards for fabrication and testing of grounding conductor and two (2) clear copies of all other relevant standards referenced therein.
- b. The Bidder shall provide a complete description, and catalogue of grounding conductor.
- c. The Bidder shall provide certified type test results of grounding conductor as required by governing standards.
- d. A clause-by-clause commentary on specification, specifying compliance and deviations, if any.
- e. All data, drawings, catalogues and other technical documents shall be bound separately from the Bid documents.

#### **TABLE 1**

#### GROUNDING CONDUCTOR MINIMUM REQUIREMENTS

7-No. 12 SWG

Diameter of single strand	2.67 mm
Weight	299 kg/km
Short time fusing current	12 kA
Resistivity	15 Micro-Ohm-cm



**TECHNICAL DATA SHEETS**

(To be completed by Bidder)

**Item: Grounding Conductor**

<i>Description</i>	<i>Unit</i>
1. Manufacturer	
2. Governing Standard for manufacturing and testing	
3. Governing Standard for galvanization	
4. Standards attached?	Yes/No
5. Diameter	mm
6. Cross Section	sq. mm
7. Short time fusing 30 cycles	Amps
8. Weight (Approx.)	kg/km
9. Resistance 20 degree C (Approx.)	ohms/km

Signed \_\_\_\_\_

On behalf of \_\_\_\_\_

Address \_\_\_\_\_

Date \_\_\_\_\_





## CROSSARMS AND BRACING ANGLES

### 15.7. Scope

This Specification covers the fabrication and supply of galvanized steel cross-arms and bracing members commonly used in overhead power line construction.

### 15.8. Material

1. The steel cross-arms shall be fabricated from hot-rolled channels and angles.
2. The steel channels and angles shall be fabricated and tested in accordance with Indian Standards IS: 226-1975 and IS-808-1964 or any revision thereof or other equivalent national or international standard provided that ensure at least equal or better quality to the standard mentioned above will also be acceptable. The minimum tensile strength of the steel shall be 4200 kg/cm<sup>2</sup>.

### 15.9. Description

1. The steel cross-arms and bracing angles shall be of sizes shown in the Table 1: Cross-arms and bracing angles, contained herein.
2. Conceptual hole pattern and size of holes on cross-arm channels are shown in appropriate drawings herein, however, the Supplier must confirm with the Project the locations and sizes of holes prior to the manufacture.
3. 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.
4. The steel cross-arm and bracing angles shall be furnished reasonably smooth on all surfaces and free of burrs or sharp projections.

### 15.10. Galvanizing

The steel cross-arms and bracing angles shall be galvanized after fabrication in accordance with IS: 2629-1985 or any revision thereof or other equivalent national or international standard provided that ensure at least equal or better quality to the standard mentioned above will also be acceptable.

### 15.11. Tests

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

- Visual Inspection;
- Verification of Dimensions;



**15.12. 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 ISO9000;
- vi. Statement giving list of important raw materials, names of manufacturer for the raw materials, list of standards according to which the raw materials are tested, list of test normally carried out on raw materials;
- vii. List of manufacturing facilities available;
- viii. List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections;
- ix. List of testing equipment available with the manufacturer for final testing of equipment specified and the test plant limitation, if any, vis-à-vis the type, special, acceptance and routine tests specified in the relevant standards.

**15.13. Bid Documentation**

- a. The Bidder shall provide with the Bid two (2) clear copies of the governing standards for fabrication and testing of channels and angles and two (2) clear copies of all other relevant standards referenced therein.
- b. The Bidder shall provide a complete description, catalogue and certified dimensional drawings of all channels and angles.
- c. A clause-by-clause commentary on specification, specifying compliance and deviations, if any.
- d. All data, drawings, catalogues and other technical documents shall be bound separately from the Bid documents.



TABLE 1: STEEL CROSSARM CHANNELS AND ANGLE BRACES

SN	Description	Type	Dimension in mm.
1.	11 kV, Single Pole, Triangular:	Channel	100x50x6.4x5x300
	1.1 Pole Top	Channel	100x50x6.4x5x1200
	1.2 Standard		
2.	Transformer Platform Complete set	Channel	100x50x6.4x5x2500
		Channel	100x50x6.4x5x1200
3.	Lightning Arrester and Cut-out Support  (at Transformer Platform):	Channel	100x50x6.4x5x2348
3.1 Support			



**TECHNICAL DATA SHEETS**

(To be completed by Bidder)

**Item: Cross-arm and angle**

<b><i>Description</i></b>	<b><i>Unit</i></b>
1. Manufacturer	
2. Steel Classification	
3. Minimum tensile strength of steel	
4. Is the cross arm and angles fabricated from hot-rolled steel sections?	Yes/No
5. Governing Standard	
6. Standard attached?	Yes/No
6. Governing Standard for galvanizing	
7. Drawings of cross arm and bracing?	Yes/No

Signed \_\_\_\_\_

On behalf of \_\_\_\_\_

Address \_\_\_\_\_

Date \_\_\_\_\_



## 16. FLAT CROSSARM BRACE

### 16.1. Scope

This Specification covers the fabrication, testing and supply of flat, galvanized steel cross-arm braces.

### 16.2. Material

- 2.1 The flat cross-arms brace shall be fabricated out of hot rolled steel flat.
- 2.2 The steel flat for cross-arms brace shall be fabricated and tested in accordance with Indian Standards IS: 226-1975, and IS-1731-1971 or any revision thereof or other equivalent national or international standard provided that ensure at least equal or better quality to the standard mentioned above will also be acceptable. The minimum tensile strength of the steel shall be 4200 kg/cm<sup>2</sup>.

### 16.3. Description

- 3.1 The brace shall be furnished reasonably smooth on all surfaces and free of burrs or sharp projections.
- 3.2 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.
- 3.3 The brace shall have a minimum tensile strength of 3182 kg at the bolt-hole and bolt slot.
- 3.4 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.
- 3.5 The brace shall have holes at appropriate locations

### 16.4. Galvanizing

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

### 16.5. Tests

Apart from the tests indicated herein in the referenced standards, the flat cross arm brace shall undergo following tests:

- Visual Inspection;
- Verification of Dimensions;



### **16.6. 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 ISO9000;
- vi. Statement giving list of important raw materials, names of manufacturer for the raw materials, list of standards according to which the raw materials are tested, list of test normally carried out on raw materials;
- vii. List of manufacturing facilities available;
- viii. List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections;
- ix. List of testing equipment available with the manufacturer for final testing of equipment specified and the test plant limitation, if any, vis-à-vis the type, special, acceptance and routine tests specified in the relevant standards.

### **16.7. Bid Documentation**

The Bidder shall provide with the Bid two (2) clear copies of the governing standards for fabrication and testing of flat cross arm brace and two (2) clear copies of all other relevant standards referenced therein.

The Bidder shall provide a complete description, catalogue and certified dimensional drawings of flat cross arm brace.

A clause-by-clause commentary on specification, specifying compliance and deviations, if any.

All data, drawings, catalogues and other technical documents shall be bound separately from the Bid documents.



**TECHNICAL DATA SHEETS**

(To be completed by Bidder)

**Item: Flat cross-arm brace**

<b>Description</b>	<b>Unit</b>
1. Manufacturer	
2. Steel Classification	
3. Minimum tensile strength of steel	
4. Is the flat cross arm brace fabricated from hot-rolled steel sections?	Yes/No
5. Governing Standard for manufacturing and testing	
6. Governing Standard for galvanizing	
7. Standards attached?	Yes/No
8. Drawings of flat cross arm brace?	Yes/No

Signed \_\_\_\_\_

On behalf of \_\_\_\_\_

Address \_\_\_\_\_

Date \_\_\_\_\_



## 17. TRANSFORMER PLATFORMS

### 17.1. Scope

This specification covers the fabrication and supply of transformer platforms used in overhead power line construction.

### 17.2. Material

The transformer platform shall be fabricated from hot-rolled channels, angles and steel members. The steel channels and angles for transformer platform shall be fabricated in accordance with Indian Standards IS: 226-1975 and IS-808-1964 or any revision thereof or other equivalent national or international standard provided that ensure at least equal or better quality to the standard mentioned above will also be acceptable. The minimum tensile strength of the steel shall be 4200 kg/cm<sup>2</sup>.

### 17.3. Description

1. The platform shall be fabricated out of galvanized steel members, field assembled by bolting.
2. The platform will support the transformer above the ground and will be supported by two-pole structures of tubular steel or pre-stressed concrete (PSC) poles. Transformers will be bolted to the platform at four (4) points. Provision should be made for the mounting of transformers of different physical dimensions and ratings up to 300 kVA.
3. The platform shall be designed by the supplier and fabricated, in general, in accordance with the conceptual configuration shown in Dwg. CS11-TRN-05 contained herein. The design shall provide support for a transformer of a minimum of 1500 kg in weight with a minimum safety factor of 2.0. The Platform shall be stiff and shall be capable of withstanding horizontal forces and an overturning moment due to seismic effects on a transformer with centre of gravity 0.5 meter above its base and seismic horizontal acceleration of 0.4g. The platform shall be stiff and shall not visibly deflect under static loading.
4. The platform shall be supplied disassembled, complete with all required members and fastenings. Packing may be made by banding structural members. Fastenings shall be separately packed. Structural members shall be clearly identified for ease of assembly in accordance with the assembly drawing furnished by the supplier.
5. The platform shall be suitable for fixing to support tubular poles of 150 to 250 mm diameter, and o PSC poles of rectangular section with 250 to 350 mm in width and 140 to 180 mm depth.





#### **17.4. Galvanizing**

All ferrous parts of transformer platform shall be galvanized after fabrication in accordance with IS: 2629-1985 or any revision thereof or other equivalent national or international standard provided that ensure at least equal or better quality to the standard mentioned above will also be acceptable.

#### **17.5. Tests**

Apart from the tests indicated herein in the referenced standards, the transformer platform shall undergo following tests:

- Visual Inspection;
- Verification of Dimensions;

#### **17.6. 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 ISO9000;
- vi. Statement giving list of important raw materials, names of manufacturer for the raw materials, list of standards according to which the raw materials are tested, list of 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.

#### **17.7. Bid Documentation**

1. A preliminary design of the platform shall be submitted with the Bid. Data to be supplied with the preliminary design shall be:
  - a) Steel classification proposed to be used and the characteristics thereof;
  - b) Two copies of Preliminary detail drawings of the proposed platform;
  - c) Data regarding:
    - i) Vertical and horizontal loading on poles,
    - ii) Resultant safety factor,
    - iii) Resultant deflection,



- iv) Resultant percent of allowable tension, compression, and shear limits for the steel selected and associated fastening, Moments on pole due to seismic effects on the platform and transformers.
2. A clause-by-clause commentary on specification, specifying compliance and deviations, if any.
3. All data, drawings, catalogues and other technical documents shall be bound separately from the Bid documents.



**TECHNICAL DATA SHEET**

(To be completed by the Bidder)

**Item: Transformer Platform**

	<b><i>Description</i></b>	<b><i>Unit</i></b>
1.	Manufacturer	
2.	Preliminary details dwg. furnished?	Yes/No
3.	Steel Classification/ Characteristics furnished?	Yes/No
4.	Governing Standard for galvanization	
5.	Vertical Load on pole	
6.	Resultant Safety Factor	
7.	Resultant Deflection at design load	mm
8.	% of allowable tension	
9.	% of allowable compression	
10.	% of allowable shear limits	

Signed \_\_\_\_\_

On behalf of \_\_\_\_\_

Address \_\_\_\_\_

Date \_\_\_\_\_



## POLE CLAMPS

### 17.8. Scope

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

### 17.9. Material

1. The pole clamp shall be fabricated out of hot-rolled steel flat.
2. The steel flat for pole clamp shall be fabricated and tested in accordance with Indian Standards IS: 226-1975, and IS-1731-1971 or any revision thereof or other equivalent national or international standard provided that ensure at least equal or better quality to the standard mentioned above will also be acceptable. The minimum tensile strength of the steel shall be 4200 kg/cm<sup>2</sup>.

### 17.10. Description

1. Dimensions may be changed to comply with the final pole sizes selected. Therefore, the dimensions must be confirmed with the Project prior to manufacture.
2. 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.
3. The fittings shall be free of burrs, splinters, splits, sharp points and edges, which may damage conductors or show evidence of poor workmanship.
4. 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.
5. The pole clamps shall have a minimum tensile strength of 3182 kg at the bolt-hole and bolt slot.

### 17.11. 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 other equivalent national or international standard provided that ensure at least equal or better quality to the standard mentioned above will also be acceptable.



**17.12. Tests**

Apart from the tests indicated herein in the referenced standards, the pole clamps shall undergo following tests:

- Visual Inspection;
- Verification of Dimensions;

**17.13. Quality Assurance Program**

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

- i. The structure of the organization;
- ii. The duties and responsibilities assigned to staff ensuring quality of works;
- iii. The system for purchasing, taking delivery and verification of materials;
- iv. The system for ensuring quality of workmanship;
- v. The quality assurance arrangement shall conform to relevant requirements of ISO9000;
- vi. Statement giving list of important raw materials, names of manufacturer for the raw materials, list of standards according to which the raw materials are tested, list of test normally carried out on raw materials;
- vii. List of manufacturing facilities available;
- viii. List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections;
- ix. List of testing equipment available with the manufacturer for final testing of equipment specified and the test plant limitation, if any, vis-à-vis the type, special, acceptance and routine tests specified in the relevant standards.

**17.14. Bid Documentation**

The Bidder shall provide a complete description, catalogue and two (2) copies of certified dimensional drawings of pole clamps.

A clause-by-clause commentary on specification, specifying compliance and deviations, if any.

All data, drawings, catalogues and other technical documents shall be bound separately from the Bid documents.



### TECHNICAL DATA SHEETS

(To be completed by Bidder)

Item: Pole Clamps

<u>Description</u>	<u>Unit</u>
1. Manufacturer	
2. Steel Classification	
3. Governing Standard for galvanization	
4. Drawings of Pole Clamp furnished?	Yes/No

Signed \_\_\_\_\_

On behalf of \_\_\_\_\_

Address \_\_\_\_\_

Date \_\_\_\_\_



## DRAWINGS

***(The data and the drawings related to the Installation of EV Charging Station, Transformer and 11 kV line extensions (Civil & Electrical works) provided here are only conceptual. After agreement, Contractor shall carry out detail Design & Drawing and submit for approval to the concerned office. Only after approval of the submitted design & drawings the contractor shall manufacture the electrical & Civil items and perform construction and installation works.)***



Distribution cut out

### **17.15. Scope**

This specification covers the general requirements of the design, manufacture, testing, supply and delivery of 12 kV complete with fuse carriers and mounting brackets.

### **17.16. SYSTEM PARAMETERS**

- a) Nominal Voltage: 11kV
- b) System highest Voltage: 12kV
- c) System frequency: 50 Hz.
- d) Number of phases: 03
- e) System faults level 20 kA rms

### **17.17. SERVICE CONDITIONS**

- a) Annual average ambient temperature: 25 °C
- b) Ambient temperature: -5°C - 55°C
- c) Maximum relative humidity: 99%
- d) Environmental conditions: Humid tropical climate with heavily polluted atmosphere.
- e) Operational altitude: Up to 2000 meters above MSL

### **17.18. APPLICABLE STANDARDS**

The equipment and the components supplied shall be in accordance with the latest editions of the Standards specified below and amendments thereof. However the NEA Specification shall supersede these Standards in the event there is a discrepancy

- a) IEC 60282-2 (1995) H.V. Fuses - Expulsion and similar fuses
- b) IEC 60071-1 (2006) Insulation co-ordination.- Part I Definitions, principles and rules
- c) IEC 60071-2 (1996) Insulation co-ordination - Part 2 - Application guide
- d) IEC 60273 (1990) Characteristic of indoor & outdoor post insulators for systems with nominal voltages greater than 1000V.
- e) IEC 60694 (2002) Common Specifications for high-voltage switchgear & controlgear standards
- f) IEC 60060-2 (1994) High-voltage test techniques -Part 2 Measuring systems





- g) BSEN1461 (1999) Hot dip galvanized coatings on iron and steel articles.

### **17.19. MINIMUM TECHNICAL REQUIREMENTS**

- a) Rated Voltage, kV: 12
- b) Rated Frequency, Hz: 50
- c) Rated continuous current, A :100
- d) Insulation level
- a. Dry Impulse withstand (1.2kV/50<sup>μ</sup>s) voltage (positive & negative polarity) (peak)
- i. Across the isolating distance of the fuse base, kV: 85
- ii. To earth and between poles, kV: 75
- b. Wet 1 min. Power frequency withstand voltage (rms.)
- i. Across the isolating distance of the fuse base, kV: 32
- ii. To earth and between poles, kV: 28
- e) Total creepage distance(min), mm: 240
- f) Mounting angle (to vertical plane), deg: 15 ~20
- g) Interrupting rating
- a. Symmetrical interrupting rating (minimum) rms., kA : 8.0
- b. Asymmetrical interrupting rating (minimum) rms., kA : 9.6
- h) X/R Ratio: 4.0

**NOTE :** The minimum values of wet power frequency 50 Hz withstand voltages for 01 minute (one) duration should be as stipulated in Table 4 of IEC 60282-2.

### **17.20. BASIC FEATURES**

#### **17.20.1. General**

The Dropout Fuse Cutouts shall be of Class A as per IEC 60282-2. It shall be suitable for use in outdoor circuits under tropical conditions stipulated in Clause 3.0 above. The Dropout fuse cutout shall be complying with the minimum technical requirements stipulated in Clause 5.0 above.

#### **17.20.2. Design**



- a) The Dropout Fuse cutout shall be designed with a solid core, bird proof, one piece Porcelain Insulator and, it should be robust enough to withstand shocks due to frequent operations. The fuse carrier shall drop-out immediately following the blowing of the fuse.
- b) Dropout Fuse cutout within the same voltage class shall be so designed that fuse carrier together with mounting assembly shall be dimensionally compatible to facilitate the interchange of fuse carriers of the cutouts of corresponding rating.
- c) The Dropout fuse cutouts shall be able to mount on a single channel iron cross arm (100mm x 50mm x 6mm) at an angle of 15 to 20 degrees to the vertical. The whole unit shall be complete with long mounting bracket, bolts, nuts & washers.
- d) Fuse carrier shall be made of high strength fiberglass filament wound tube or suitable insulating material and it shall be protected from weather and environment by a ultraviolet resistant coating. Inside liner of the fuse tube shall be constructed of a synthetic arc quenching material.
- e) Copper Arc Shortening rod shall be attached to the cap of the fuse tube to obtain higher interrupting rating. A removable button head type fuse link having M6x1 thread shall be able to fix to the arc shortening tube.
- f) The installation and removal of the fuse carrier shall be facilitated by inserting the operating rod into a lifting eye at the hinge end (lower) of the fuse carrier when it is in the dropped out position. An operating lever eye shall be provided at the top of the carrier to facilitate a downward pull by the operating rod to release the latch incorporated in the stationary upper contact
- g) All castings such as upper and lower moving and fixed contacts, clamp type terminals, toggle mechanism shall be of phosphor bronze, silicon bronze, aluminum bronze or Silver-plated brass.

### **17.20.3. Stationary and Movable Contacts**

- a) The Stationary and Movable Contact surfaces shall be silver plated to minimize the contact resistance.
- b) The upper stationary contact assembly shall be provided with a safety latch to prevent the fuse carrier from dropping due to vibration and The upper contacts shall be protected from any airborne contaminants
- c) A back up spring made out of stainless steel or phosphor bronze shall be provided to ensure constant pressure between the upper stationary contact and the upper movable contact of the fuse carrier.
- d) The lower stationary contact support and the fuse carrier shall be machined at the swiveling or axle point to enable the fuse carrier with the fuse link to be correctly guided into the latching position by an operating rod. The hinge at the stationary



contact shall be so designed to prevent the dropping off of the fuse carrier in the drop-out position, due to shock and vibration.

- e) A suitable guiding arrangement shall be provided in the upper contact to ensure easy engagement of the fuse carrier.
- f) The Asymmetrical breaking current ratings shall be permanently marked on the upper metal part.

#### **17.20.4. Terminals**

- a) The upper and lower terminals shall be of Bi-metallic type, suitable to accommodate Copper/Aluminum Conductors of Sizes from 5mm to 14mm diameter.
- b) The upper terminal shall be positioned to receive the conductor from either side or upward direction while the lower terminal shall be able to receive the conductor from either side or downward direction.
- c) The maximum temperature rise for contacts (movable and stationary) shall not be more than 40°C and, for terminals the temperature rise shall not be more than 30° C.

#### **17.20.5. Galvanizing**

All iron and steel parts such as mounting and support brackets, bolts and nuts, washers etc. shall be galvanized after processes such as sawing, shearing, drilling, punching, filling, bending and machining are completed.



### 18. Contract Execution Schedule

The works shall be completed in 12 months in the following manner.

Description of Works	1	2	3	4	5	6	7	8	9	10	11	12
Contract Agreement	█											
Work Team Mobilization	█	█										
Pre-construction survey		█										
Construction works			█									
Preparation of as built drawings and SDS											█	
Testing, Commissioning and Handover									█			



## 19. EV Charging Station Installation Sites

The site locations for installation of EV Charging Stations in all seven provinces of Nepal shall be identified by the employer and the contractor will be notified of the exact site locations during contract agreement.



## Section-B: CONSTRUCTION STANDARDS



## 1. GENERAL INSTRUCTIONS

### A. General

The general instructions included in this section shall be applied to all 11 kV and 400/230 volt overhead line construction under this Project. Additional general instructions are included in each section as they are applied specifically to the subject covered in that section.

These construction standards provide basic requirements for new facilities.

Deviations from these standards may become necessary due to unique or special conditions. In such cases, the directions of the Employer shall be followed.

The safety rules of the NEA shall be strictly observed at all times by the Contractors' and NEA's work forces.

### B. Pole numbering

Poles and structures shall be numbered in accordance with a numbering system provided by NEA. Each pole or structure shall be paint stencilled with the assigned number.



## 2. POLES, CROSSARMS, AND STAYS

### A. Poles

Poles shall be installed by length and class at locations in accordance with the construction plan.

### B. 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 shoveler 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 centimetres 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 river beds shall be protected by gabions as designated by the Employer. Gabions should be approximately 2 metres x 1 metre x metre. Four such gabions are required for each pole.

Set pole and pour 860 mm diameter foundation and level areas around pole and set gabions in pattern shown in CSG-06. It is important to lace adjacent gabions together along the perimeter of all contact surfaces. Fill gabions with hard, durable, clean stone, 100 mm to 200 mm in size in three layers. Install two connecting wires at each layer. Lace gabion lids securely and make certain that all edges are closed. Fill void between pole and gabion with hard, durable, clean rock 200 mm minimum size.

### C. 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 centimetres beyond the nut shall be cut off to a length of 2 centimetres beyond the nut. Each bolt, when installed, shall have its full complement of nuts.

#### E. Stays

Stay leads specified in construction documents are defined as the horizontal distance from the centre line of the pole at ground line to the point where the anchor rod should enter the ground assuming the ground to be level.

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.

#### G. Stay insulators

Stay insulators shall be installed on all stays in accordance with the construction drawings.



#### H. Field modifications

During the erection work at the field there may be necessity to modify galvanised 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.



## CONDUCTOR

### A. Materials

Aluminum conductor of the size mentioned in the Bill of Quantities shall be used for the construction of HT line to feed power to the distribution transformer.

### B. 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 emphasised. 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.

### C. 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 centre scale representing the length of span to be sagged. The straight edge will then indicate the proper stringing sag on the right-hand 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.

#### D. Stringing

The dynamometers and similar apparatus shall be used for tensioning of conductor to obtain appropriate sagging of conductors.

For stringing of XLPE Covered (AAAC) 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 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 specially important when 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.

#### E. 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.

#### F. Sag Error

Sag error shall not exceed  $\pm 40$  mm from the sag defined by the sag chart.



### G. 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.

### H. 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 centred 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 pre-filled 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 are of same metal and size.

### I. Connectors

1. Cleaned and polished contact surfaces are necessary to make electrical connections that will be free from trouble.
2. 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.



3. 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
4. Connectors shall be installed on non-tensioned portion of the conductor such as loops in preference to the conductor in the span.
5. Connectors installed on conductor shall be located in a span adjacent to the crossing rather than the crossing span when practicable.
6. 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.
7. Aluminium compression connectors shall be used for connecting aluminium to aluminium conductors.



## LINE CONSTRUCTION

### A. Arrangement of Conductor

The standard position of 11 kV phase conductors on the cross-arm in the normal triangular configuration looking from the normal source of power supply shall be seen as:

Red (R) on top of the pole, Yellow (Y) on right hand end of the cross-arm and Blue (B) on left hand end of the cross arm.

### B. Attachments To Poles

Bolt holes are provided on poles for cross-arms, cross-arm braces and stay bolts.

### C. 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.

### D. 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.

### E. 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 centimetres clearance from other conductors. Any connection carried from one side of the pole to the other side shall be supported on pin insulators.



### 3. INSTALLATION OF STAYS

1. Where stays are installed on a line angle structure, line of stay shall bisect the outside line angle.
2. The span of stay extending between poles shall not be greater than 50 meter.
3. 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 centimetres above the ground after the anchor is set.
4. If gravel back fill is required to set anchor in soft or unstable soil, gravel back fill shall be designated as "Local Material".
5. 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".
6. 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.



## TRANSFORMER STRUCTURES

1. Distribution panel-board material and equipment ratings shall be determined by the kVA rating of the transformer and number of 400/230 volt out going distribution circuits. Please see Drawing No.CS11-TRN-01 to CS11-TRN-05 and associated material list for associated equipment ratings and quantities.
2. Where outgoing distribution circuits are installed, pole moment loading must be balanced by another outgoing distribution circuits in the opposite direction or by installation of stays.
3. Two separate rods shall be used to earth the transformer structure.
  - a. One for surge arresters and equipment
  - b. Another for the neutral of transformer low voltage winding

Each earth rod shall be driven at a minimum distance of 2 metres from the adjacent pole resulting in a minimum distance of 6 meters between the two ground rods.

4. Ground conductor lead shall be stranded steel wire.
6. 1/2" banding material shall be used to strap grounding conductors to pole(s) at one (1) meter intervals.
7. Compression connectors and PG clamp shall be used to make all electrical connections.
9. Conductor shall be terminated on main breaker and neutral bus with cable socket of proper size. If a sufficient number of connectors are not provided with the main breaker, the Contractor shall provide the remaining number required as local material.
10. Distribution Panel Board installation includes MCCB fitting and necessary connections with transformers and outgoing feeders



## 4. INSTALLATION CRITERIA

### GENERAL INSTRUCTION

1. The line alignment should be as straight as possible to minimize requirements for stays.
2. The basic span shall be maintained within the following limits:- 50 m to 70 m
3. The entire construction works shall be performed as per the construction units specified. Whenever the construction unit does not cover any specific activity, the Contractor and the Project shall mutually settle the cost as per the man-hour involvement for the same and according to the labour rate quoted by the Contractor in his Bid.
4. Detailed schedules of material to be used are provided in each structure drawing of the construction standards. It shall be the responsibility of the Contractor to judge the appropriateness of the listed material according to the site conditions. If there is any need for addition/reduction or deviation from the listed material size/quantity, the Contractor shall ask the Project for the approval of the same.
5. All types of line clearances shall be maintained as per the construction standards provided to the Contractor. Deviations from the standards may be allowed only for unique or special conditions.
6. Safety rules of the NEA shall be strictly observed at all times by the Project, Contractor and their personnel. Special care shall be taken to maintain the optimum conductor sag to provide adequate safety to the construction and the property or people.
7. All fastenings (e.g. preformed ties, nut bolts, stays etc.) shall be so installed that the constructed line components shall not fail to remain within the safety margin while maximum working load is applied.



8. If the Contractor requires clarification of any construction standard or unit or he feels any doubt in his interpretation of construction activities he should clarify the points with the Project in writing and the decision thus made shall be valid for further work.
  
9. HV Insulators: The Contractor shall use HV pin insulators in the alignment of the line where the break angle does not exceed 7 degrees. In the case where the break angle exceeds this value, the Contractor shall make dead-end at the angle structure and use disc insulator fittings.
  
10. Stays:- The Contractor, in general case, shall install at least one stay for the supports in the following cases:
  1. Dead end structure
  2. Tee-off (Tap) structure
  
11. Transformer mounting:- Each transformer (except single phase pole mounted) shall be so mounted on the plate-form that the centre of the transformer is in the middle of the plate-form. Deviations are not permitted from this rule.



**4.1. Contract Execution Schedule**

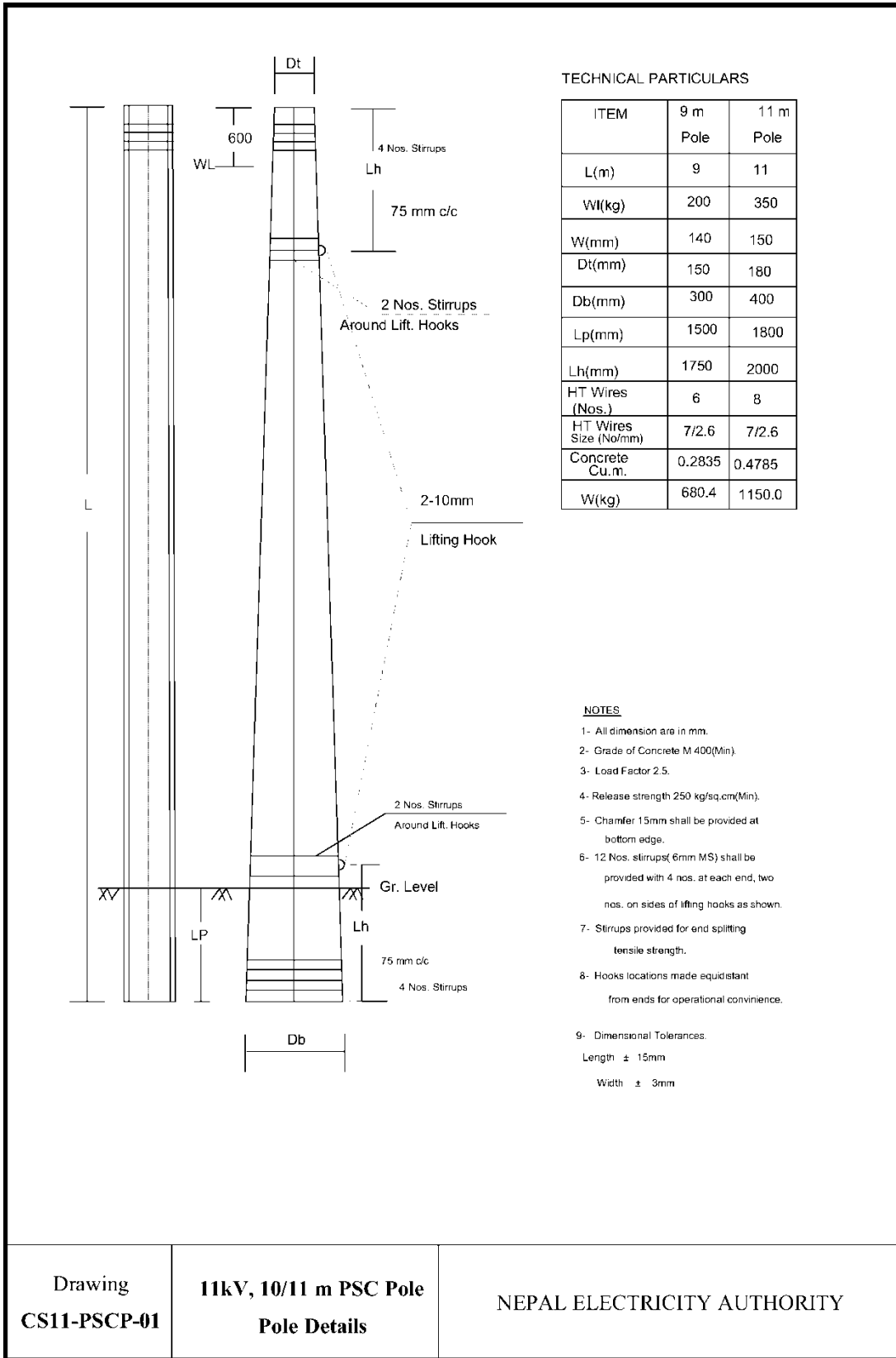
The works shall be completed in 365 days in the following manner.

Description of Works	1	2	3	4	5	6	7	8	9	10	11	12
Contract Agreement	■											
Work Team Mobilization		■										
Pre-construction survey		■										
Construction works			■	■	■	■	■	■	■	■	■	■
Preparation of as built drawings and SDS											■	■
Testing, Commissioning and Handover										■	■	■



**Section-C: CONSTRUCTION STRANDARD DRAWINGS AND  
MATERIAL LISTS**

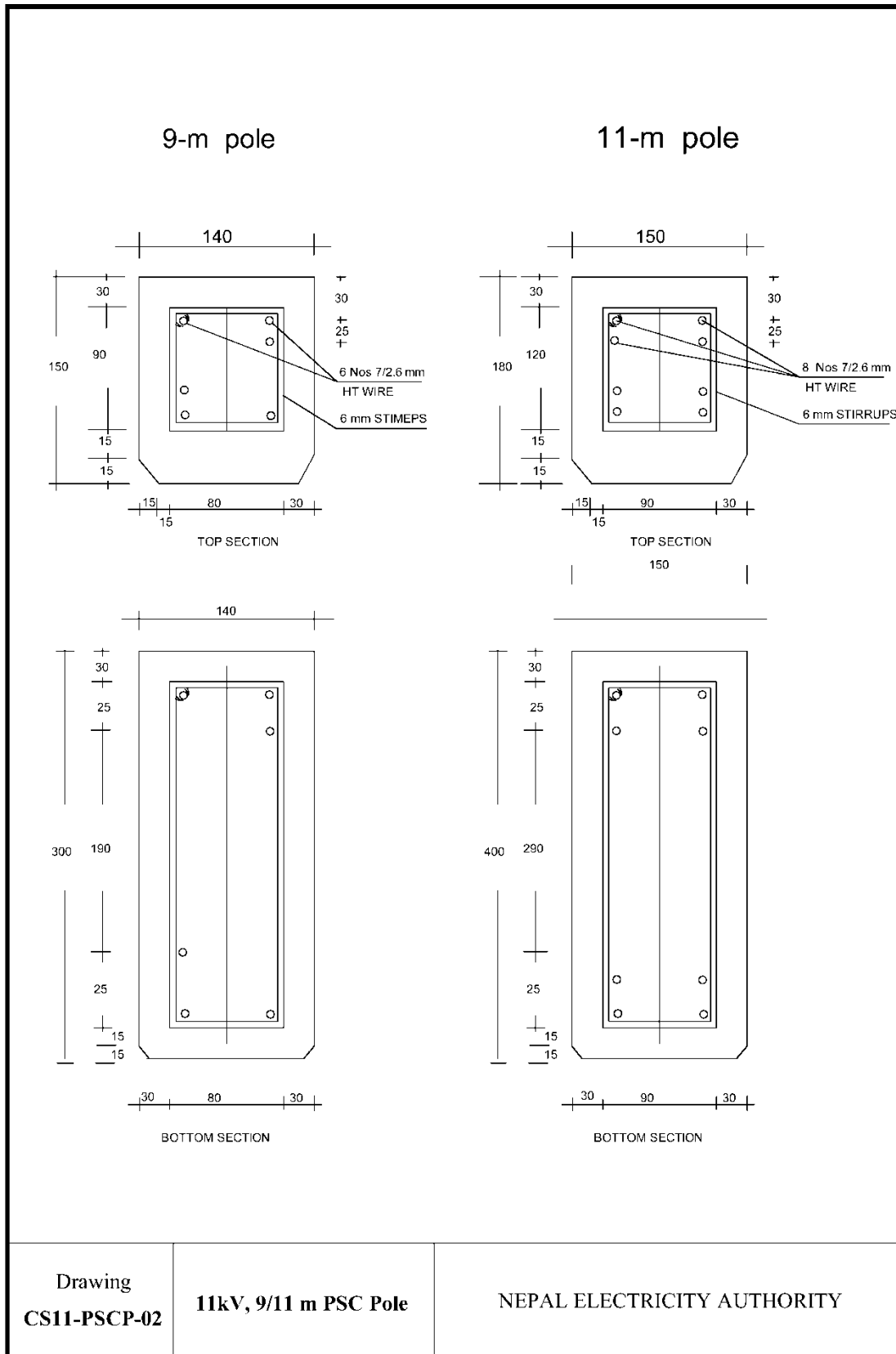


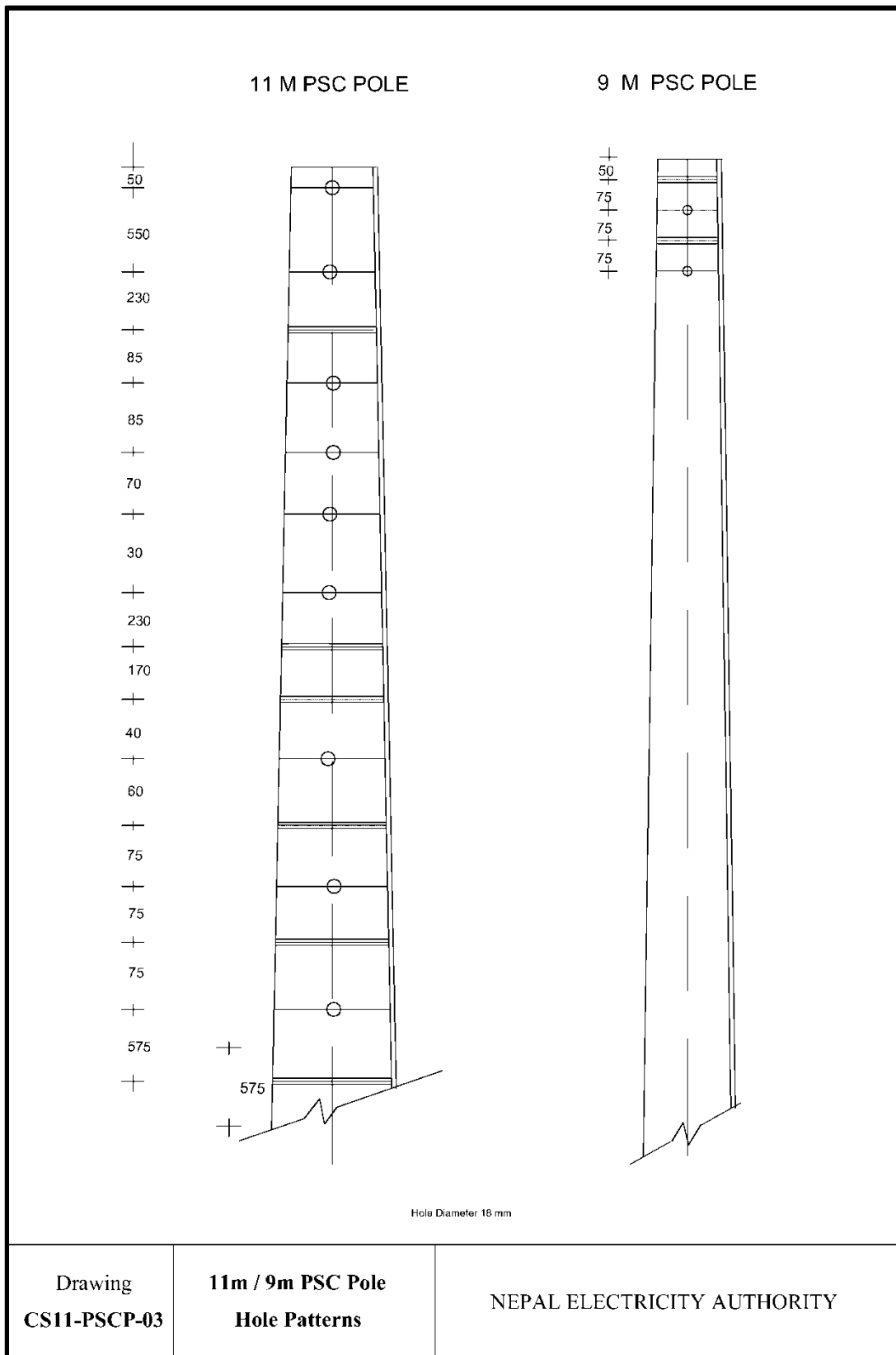


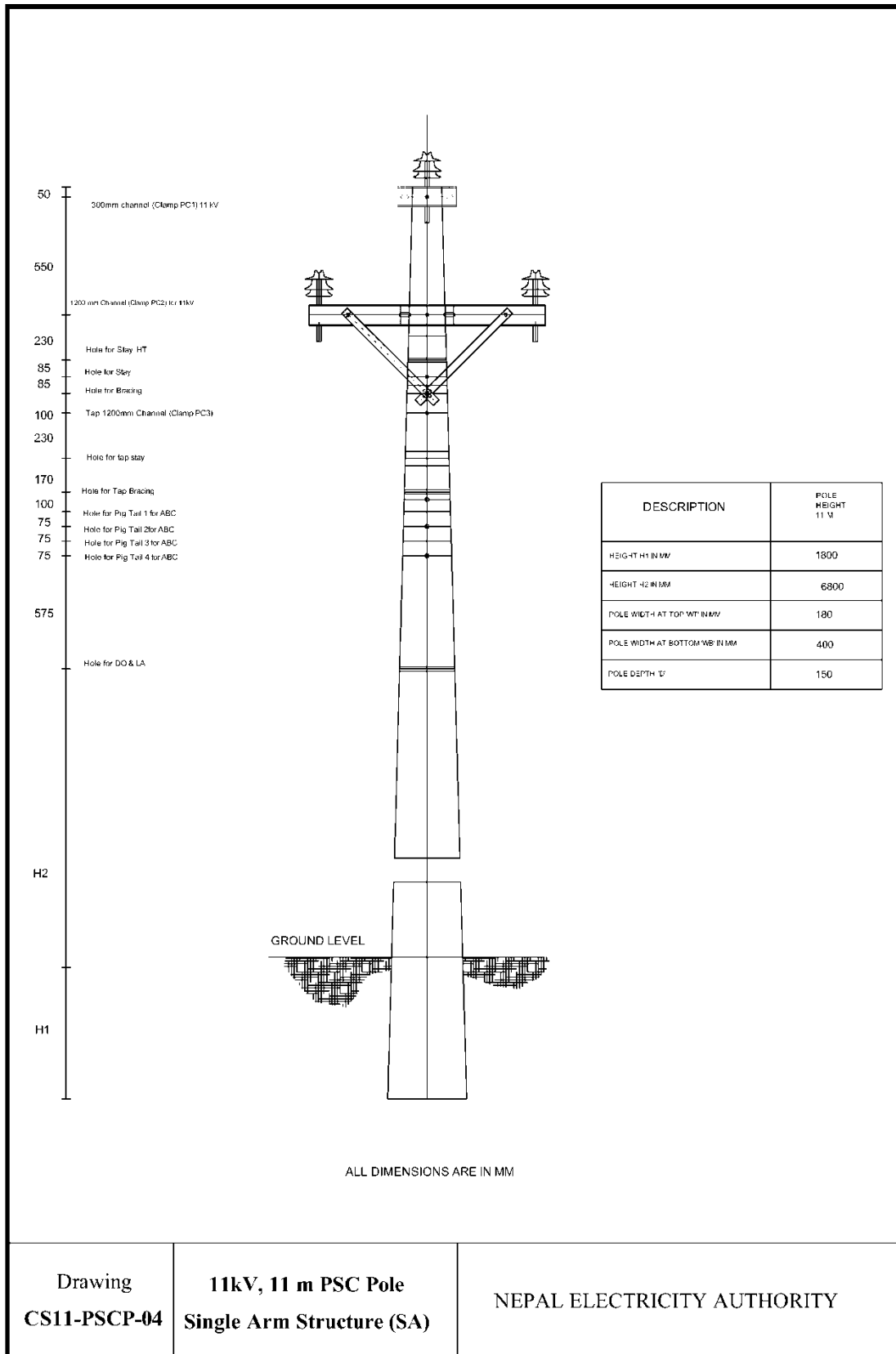
Drawing <b>CS11-PSCP-01</b>	<b>11kV, 10/11 m PSC Pole</b> <b>Pole Details</b>	NEPAL ELECTRICITY AUTHORITY
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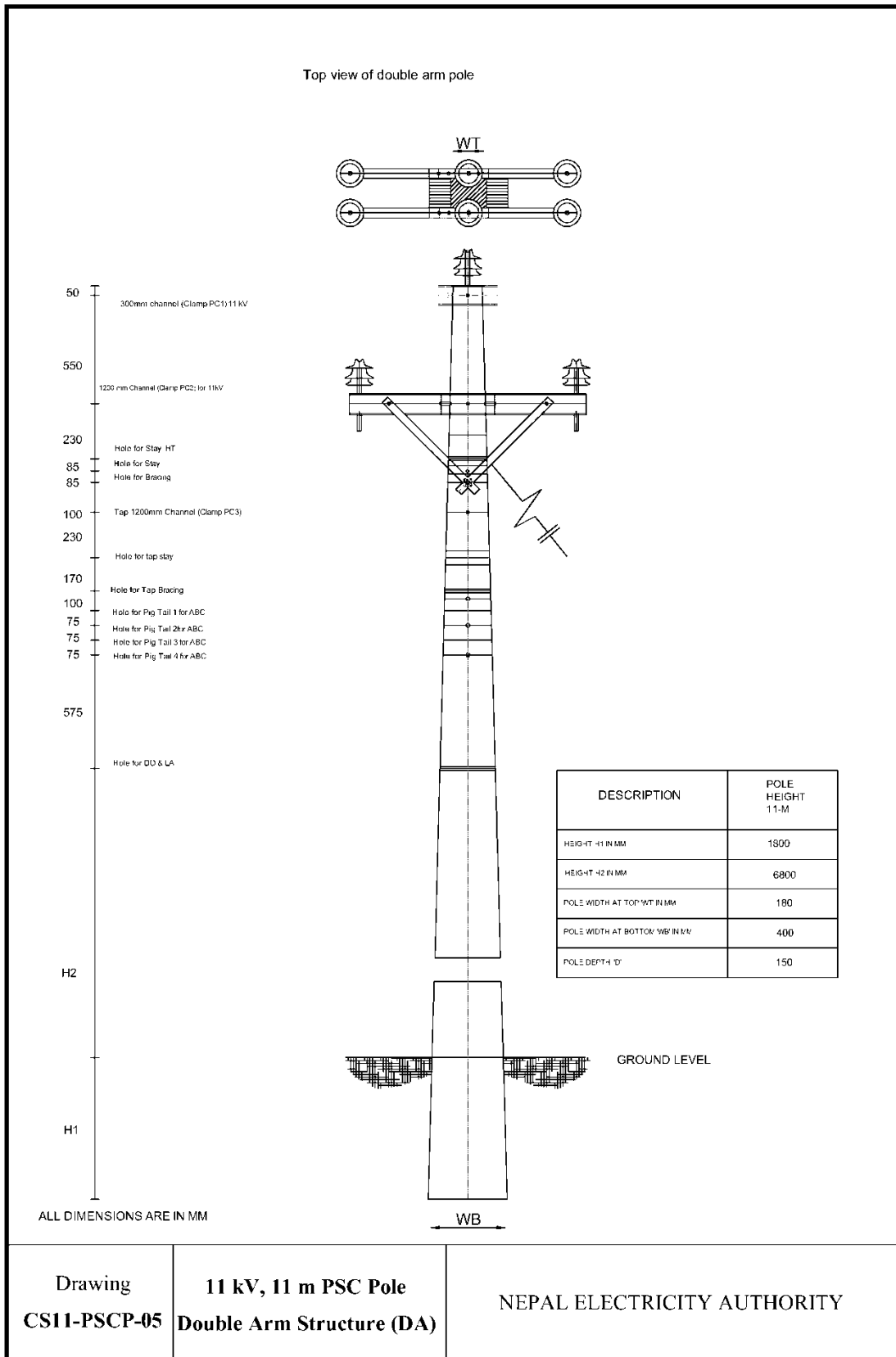


S.No.	QTY.	UNIT	MATERIAL
1	3	NOS	PIN INSULATOR WITH PIN AND NUTS/WASHER
2	1	NOS	STEEL CROSSARM CHANNEL ( 50x100x300 ) mm.
3	1	NOS	POLE CLAMP WITH NUTS, BOLTS AND WASHERS (PC1)
4	1	NOS	STEEL CROSSARM CHANNEL ( 50x100x1200 ) mm.
5	1	NOS	POLE CLAMP WITH NUTS, BOLTS AND WASHERS (PC2)
6	2	NOS	FLAT CROSSARM BRACE (40 X 6 X 660) mm
7	1	LOT	BOLTS WITH SUITABLE NUTS AND WASHERS
8	3	NOS	PREFORMED WIRE (TOP TIE)
9	1	NOS	PSC POLE 11 M

<b>CONSTRUCTION STANDARDS</b>  <b>11 KV SINGLE ARM STRUCTURE (SA)</b>  <b>PSC POLE</b>	<b>NEPAL ELECTRICITY AUTHORITY</b>
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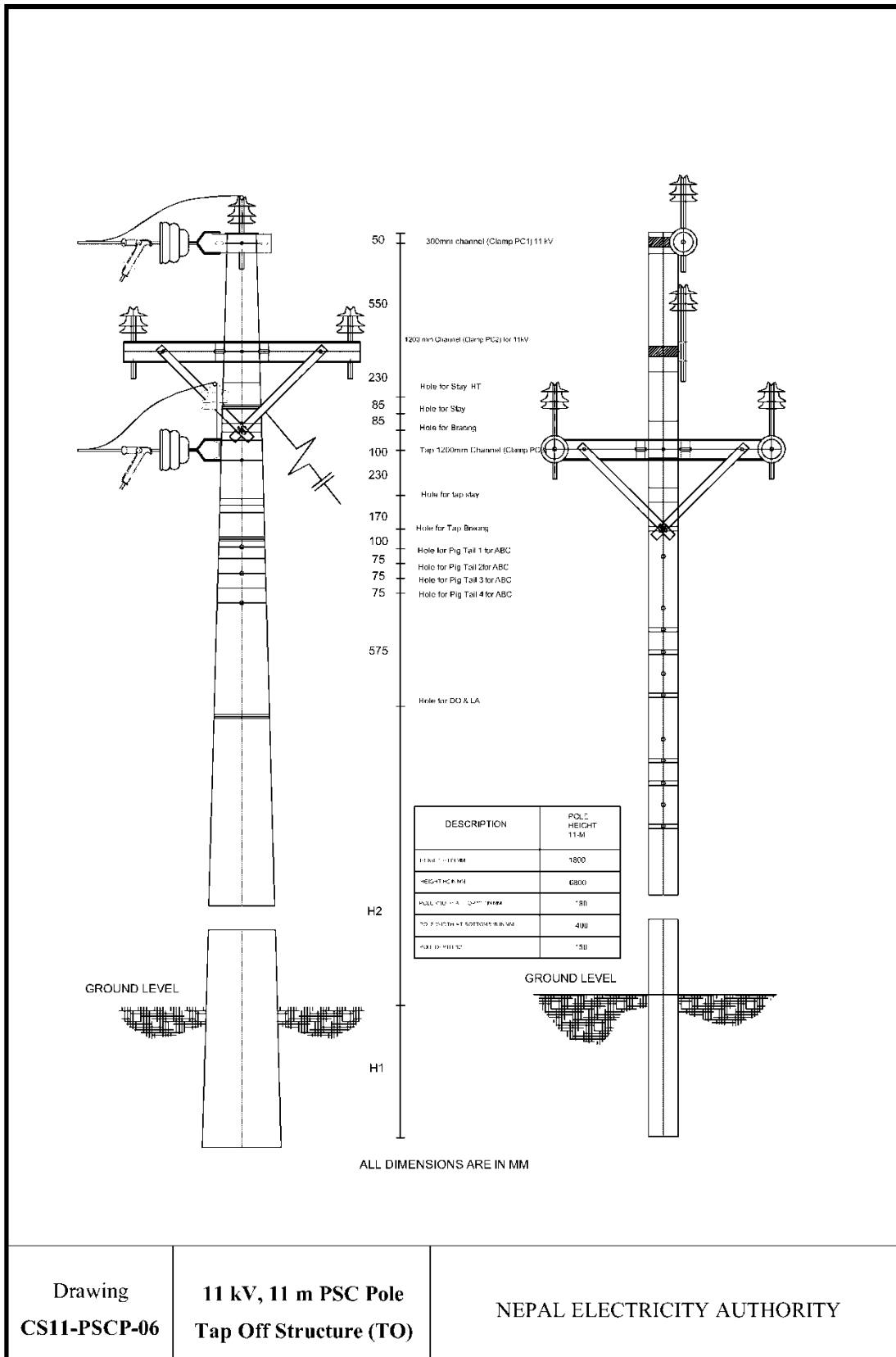


S.No.	QTY.	UNIT	MATERIAL
1	6	NOS	PIN INSULATOR WITH PIN AND NUTS/WASHER
2	2	NOS	STEEL CROSSARM CHANNEL ( 50x100x300 ) mm.
3	2	NOS	STEEL CROSSARM CHANNEL ( 50x100x1200 ) mm.
4	4	NOS	FLAT CROSSARM BRACE (40 X 6 X 660) mm
5	1	LOT	BOLTS WITH SUITABLE NUTS AND WASHERS
6	6	NOS	PREFORMED WIRE (DOUBLE SIDE TIES)
7	1	NOS	PSC POLE - 11 M

<b>CONSTRUCTION STANDARDS</b> <b>11 kV DOUBLE ARM STRUCTURE (DA)</b> <b>PSC POLE</b>	<b>NEPAL ELECTRICITY AUTHORITY</b>
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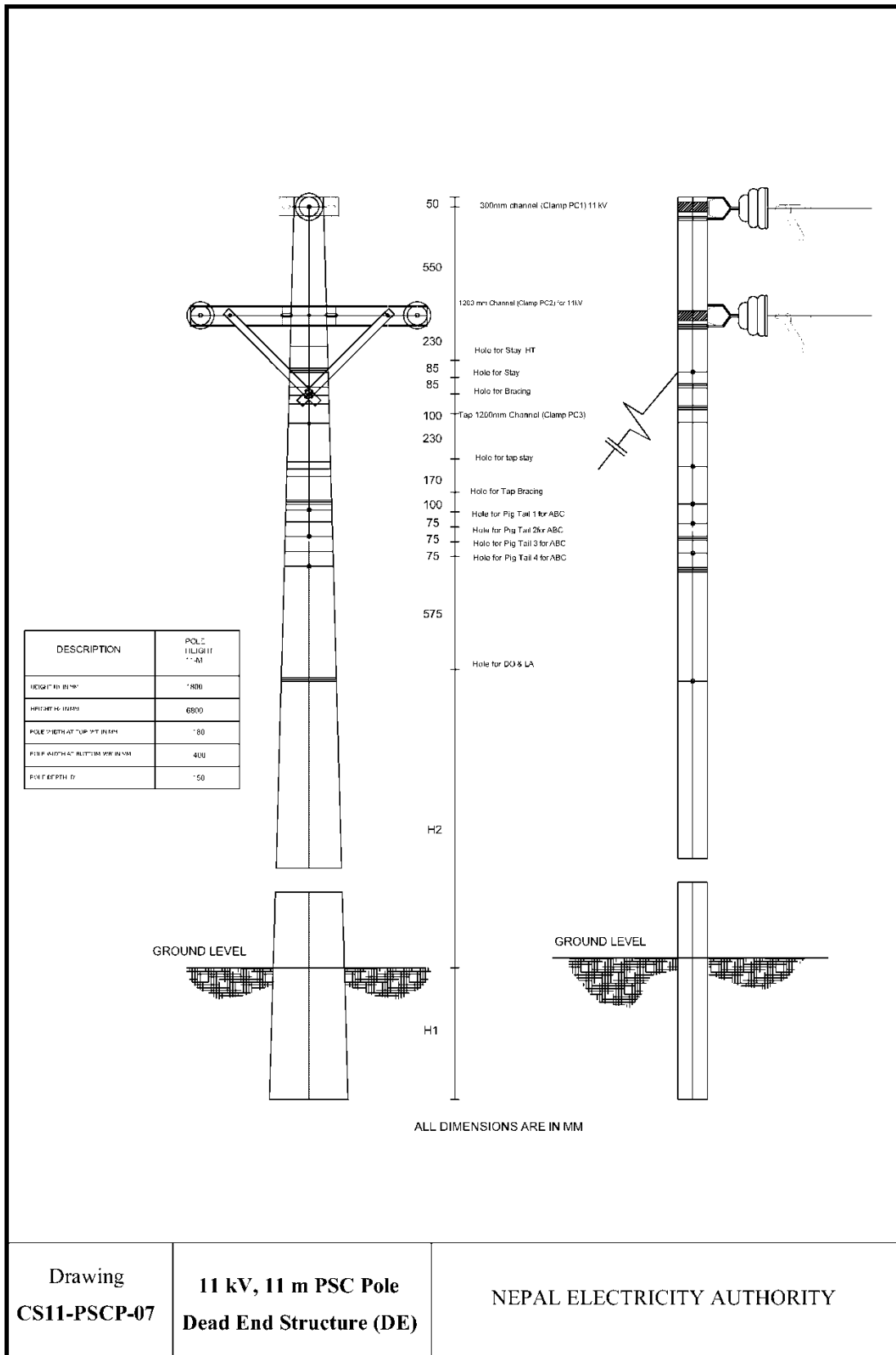
S.No.	QTY.	UNIT	MATERIAL
1	5	NOS	PIN INSULATOR WITH PIN AND NUTS/WASHER
2	3	SET	DISC INSULATOR WITH HARDWARE
3	3	NOS	DEAD END CLAMPS
4	1	NOS	STEEL CROSSARM CHANNEL ( 50x100x300 ) mm.
5	1	NOS	POLE CLAMP WITH NUTS, BOLTS AND WASHERS (PC1)
6	2	NOS	STEEL CROSSARM CHANNEL ( 50x100x1200 ) mm.
7	1	NOS	POLE CLAMP WITH NUTS, BOLTS AND WASHERS (PC3)
8	4	NOS	FLAT CROSSARM BRACE (40 X 6 X 660) mm
9	1	LOT	BOLTS WITH SUITABLE NUTS AND WASHERS
10	5	NOS	PREFORMED WIRE (TOP TIE)
11	3	NOS	INSULATED PIERCING CONNECTORS
12	1	SET	HT STAY (TYPE AS REQUIRED)
13	1	NOS	PSC POLE - 11 M

<b>CONSTRUCTION STANDARDS</b> <b>11 kV TAP OFF STRUCTURE (TO)</b> <b>PSC POLE</b>	<b>NEPAL ELECTRICITY AUTHORITY</b>
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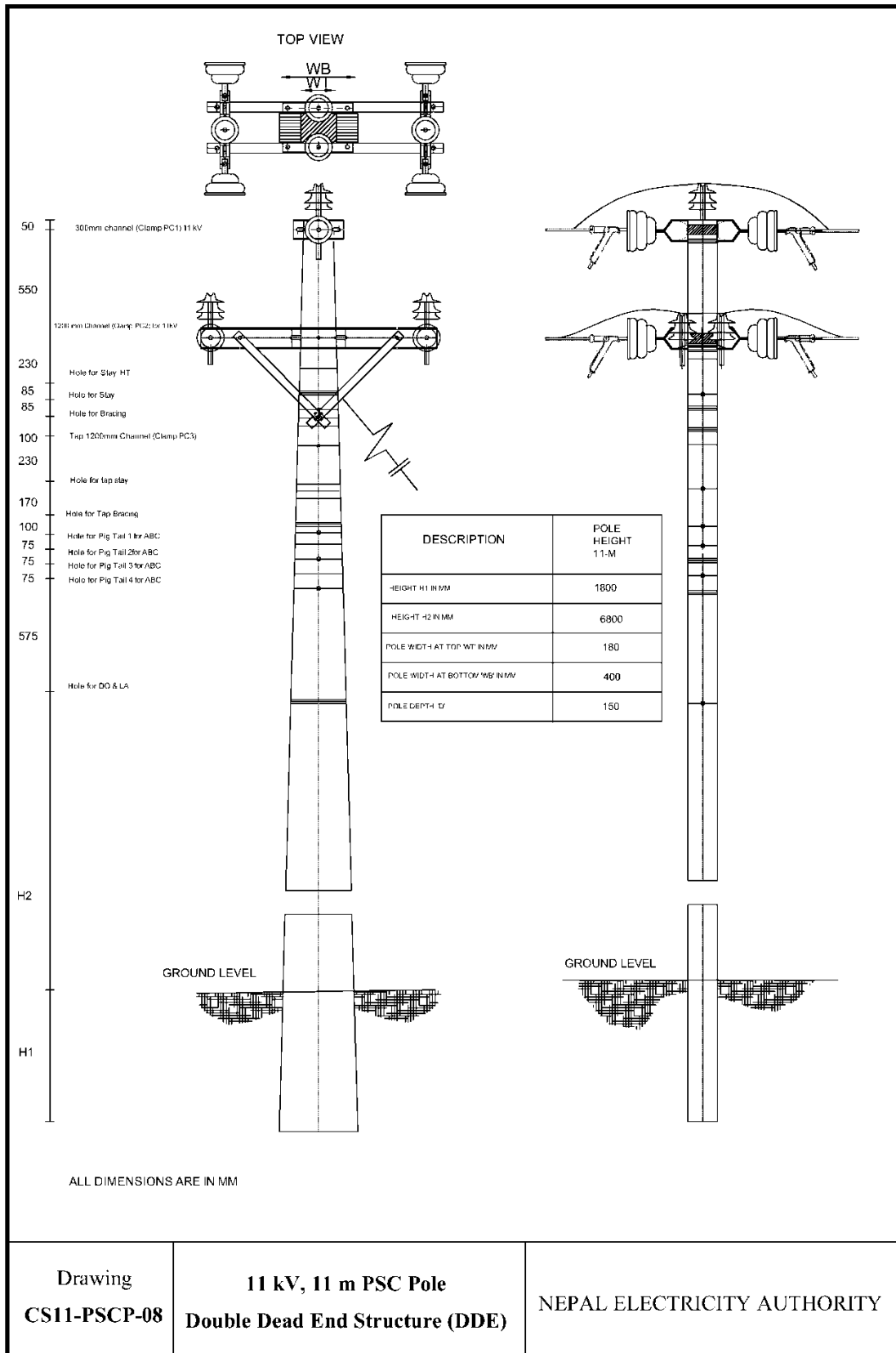


S.No.	QTY.	UNIT	MATERIAL
1	3	NOS	DISC INSULATOR WITH HARDWARE
2	3	NOS	DEAD END CLAMPS
3	1	NOS	STEEL CROSSARM CHANNEL ( 50x100x300 ) mm.
4	1	NOS	POLE CLAMP WITH NUTS, BOLTS AND WASHERS (PC1)
5	1	NOS	STEEL CROSSARM CHANNEL ( 50x100x1200 ) mm.
6	1	NOS	POLE CLAMP WITH NUTS, BOLTS AND WASHERS (PC2)
7	2	NOS	FLAT CROSSARM BRACE (40 X 6 X 660) mm
8	1	LOT	BOLTS WITH SUITABLE NUTS AND WASHERS
9	1	SET	HT STAY (TYPE AS REQUIRED)
10	1	NOS	PSC POLE – 11m

<b>CONSTRUCTION STANDARDS</b> <b>11 kV DEAD END STRUCTURE (DE)</b> <b>PSC POLE</b>	<b>NEPAL ELECTRICITY AUTHORITY</b>
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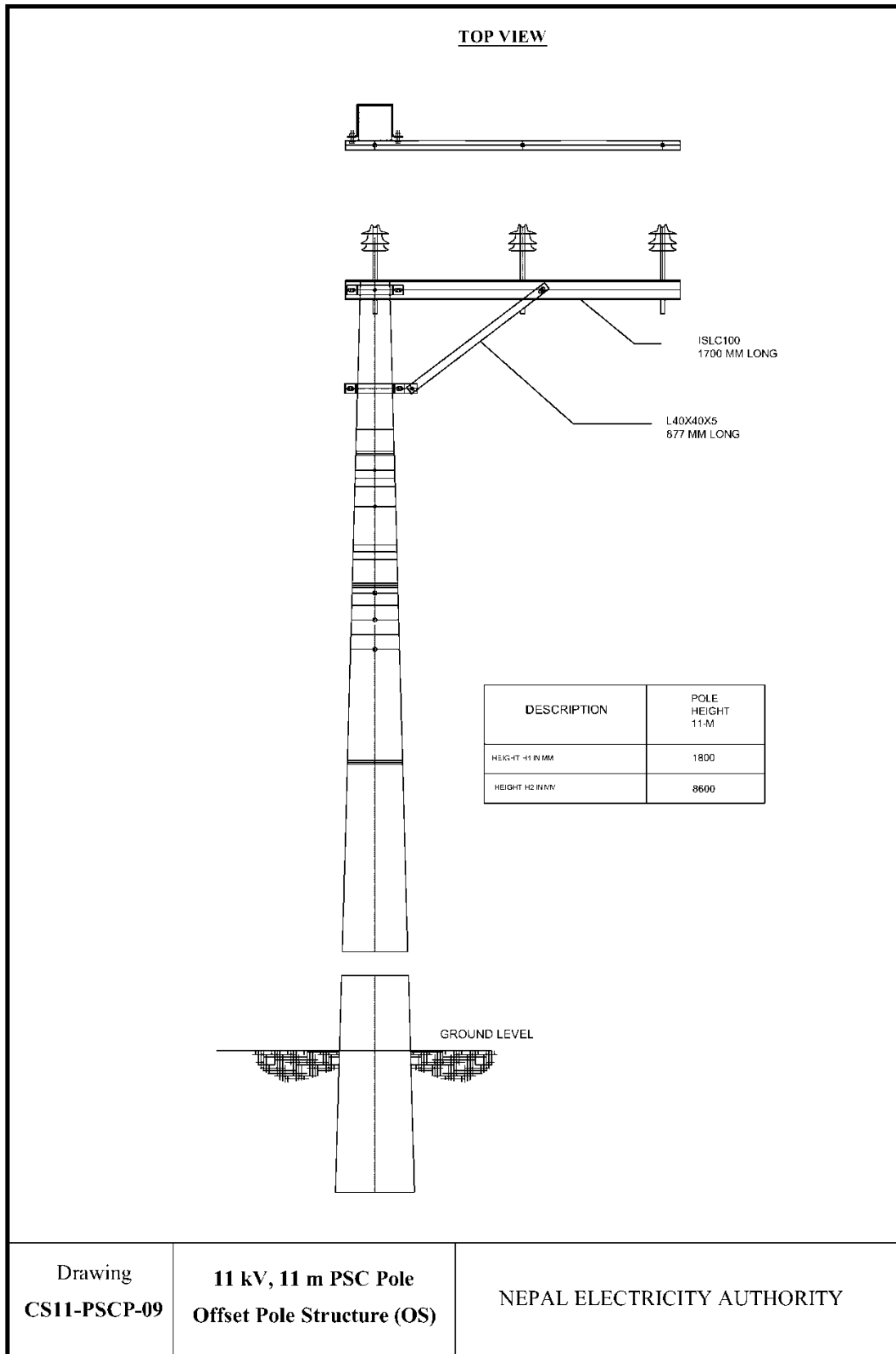


S.No.	QTY.	UNIT	MATERIAL
1	3	NOS	PIN INSULATOR WITH PIN AND NUTS/WASHER
2	6	SET	DISC INSULATOR WITH HARDWARE
3	6	NOS	DEAD END CLAMPS
4	2	NOS	STEEL CROSSARM CHANNEL ( 50x100x300 ) mm.
5	2	NOS	STEEL CROSSARM CHANNEL ( 50x100x1200 ) mm.
6	4	NOS	FLAT CROSSARM BRACE (40 X 6 X 660) mm
7	1	LOT	BOLTS WITH SUITABLE NUTS AND WASHERS
8	3	NOS	PREFORMED WIRE (TOP TIE)
9	3	NOS	INSULATED PIERCING CONNECTOR
10	1	NOS	PSC POLE - 11 M

<b>CONSTRUCTION STANDARDS</b> <b>11 kV DOUBLE DEAD END STRUCTURE (DDE)</b> <b>PSC POLE</b>	<b>NEPAL ELECTRICITY AUTHORITY</b>
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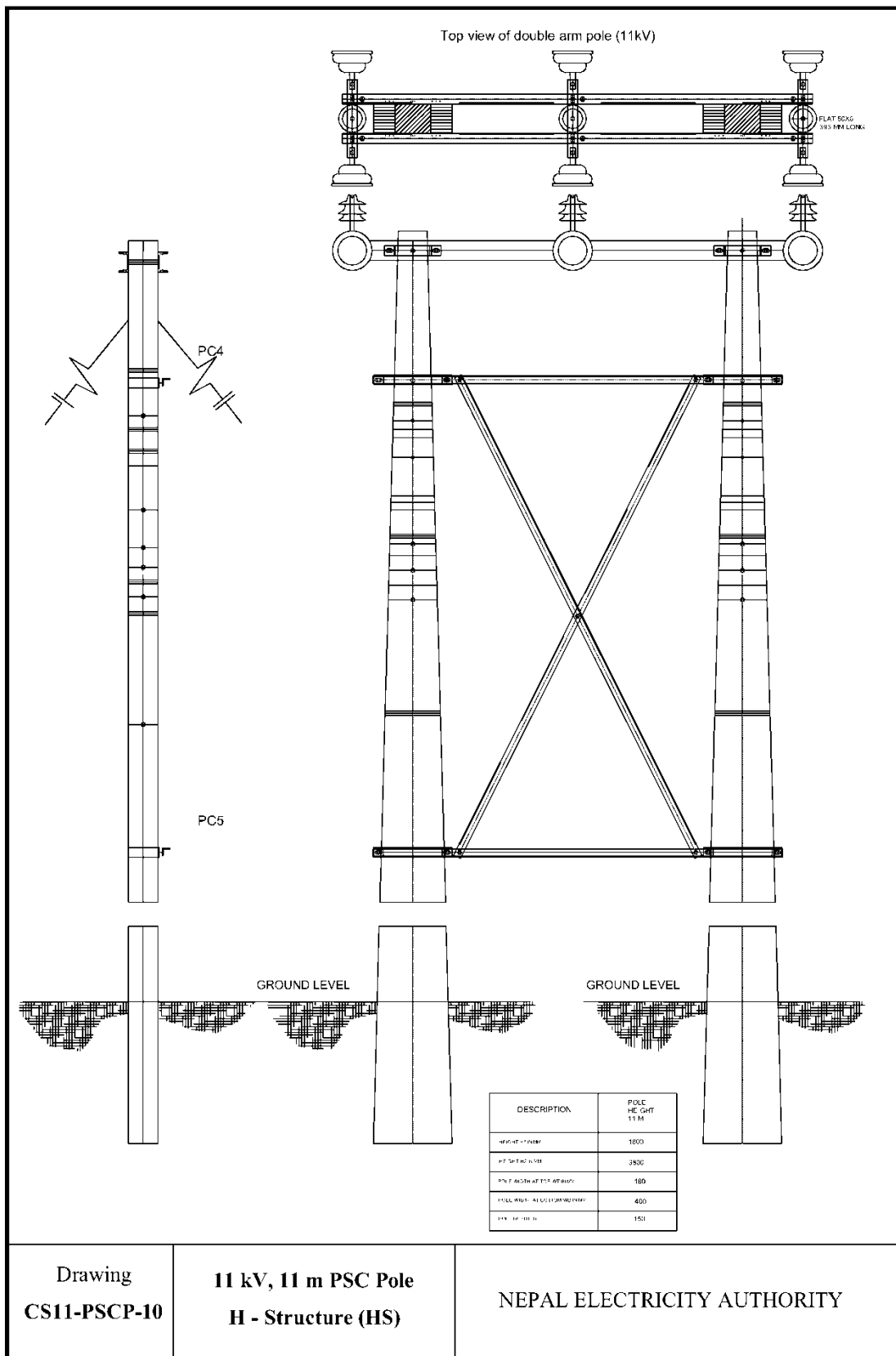


S.No.	QTY.	UNIT	MATERIAL
1	3	NOS	PIN INSULATOR WITH PIN AND NUTS/WASHER
2	1	NOS	STEEL CROSSARM CHANNEL ( 50x100x1700 ) mm.
3	1	NOS	POLE CLAMP WITH NUTS, BOLTS AND WASHERS (PC1)
4	1	NOS	BRACING ANGLE FOR OFFSET STRUCTURE (827 X 40 X 5) mm
5	1	NOS	POLE CLAMP WITH NUTS, BOLTS AND WASHERS (PC2)
6	4	NOS	FLAT BRACE FOR OFFSET STRUCTURE (40 X 6 X 374) mm
7	1	LOT	BOLTS WITH SUITABLE NUTS AND WASHERS
8	3	NOS	PREFORMED WIRE (TOP TIE)
9	1	NOS	PSC POLE - 11 M

**CONSTRUCTION STANDARDS**  
**11 kV OFF SET STRUCTURE (OS)**  
**PSC POLE**

**NEPAL ELECTRICITY AUTHORITY**



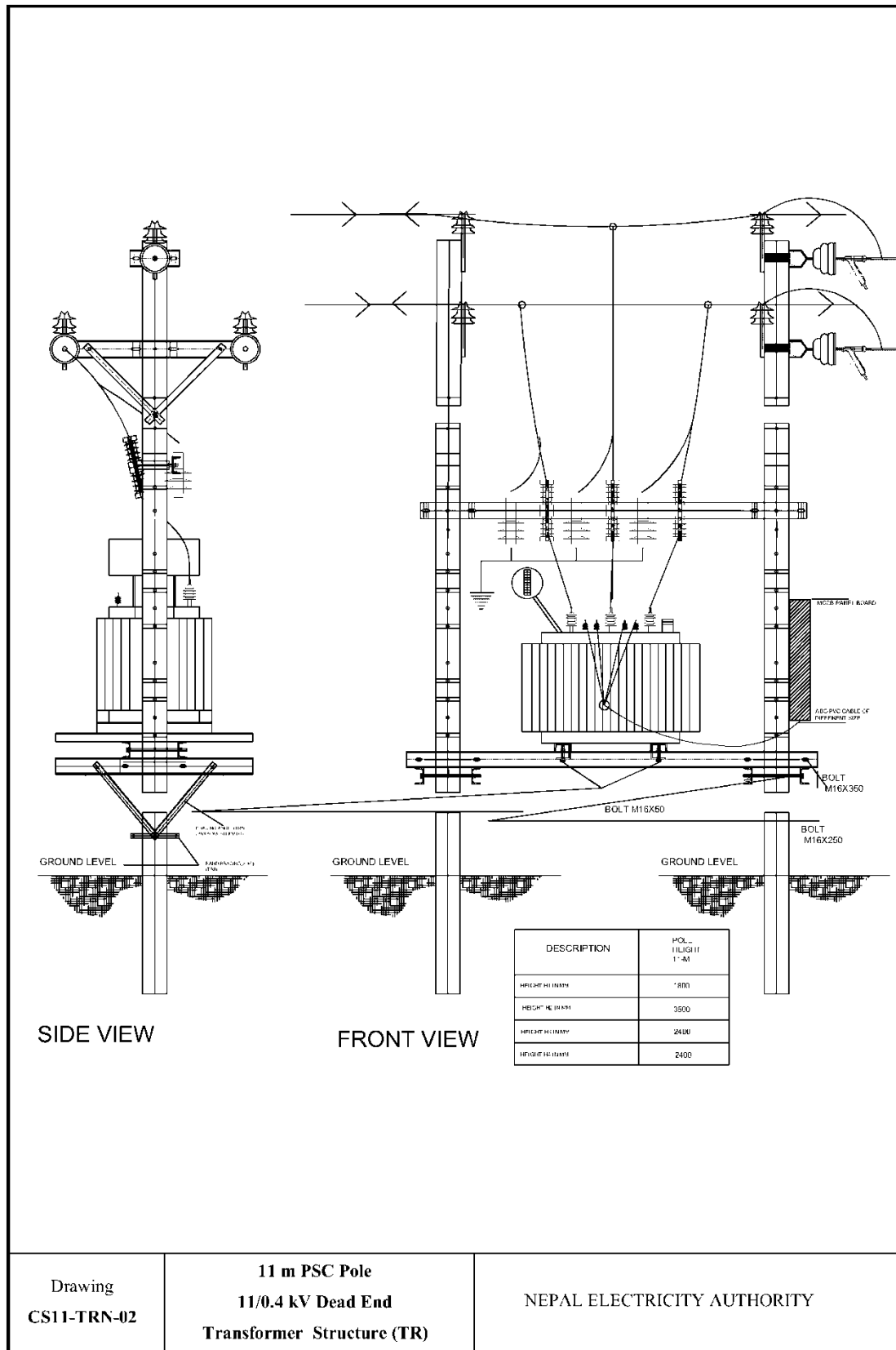


S.No.	QTY.	UNIT	MATERIAL
1	3	NOS	PIN INSULATOR WITH PIN AND NUTS/WASHER
2	6	SET	DISC INSULATOR WITH HARDWARE
3	6	NOS	DEAD END CLAMPS
4	1	NOS	STEEL CROSSARM CHANNEL ( 50x100x6.4 x2390 ) mm.
5	2	NOS	POLE CLAMP WITH NUTS, BOLTS AND WASHERS (PC1)
6	2	NOS	BRACING ANGLE ( 40 x 40 x 5 x 2071 ) mm.
7	2	NOS	POLE CLAMP WITH NUTS, BOLTS AND WASHERS (PC4)
8	2	NOS	POLE CLAMP WITH NUTS, BOLTS AND WASHERS (PC5)
9	2	NOS	BRACING ANGLE ( 40 x 40 x 5 x 2723 ) mm.
10	1	LOT	BOLTS WITH SUITABLE NUTS AND WASHERS
11	3	NOS	PREFORMED TIE (TOP TIE)
12	3	NOS	INSULATED PIERCING CONNECTORS
13	1	SET	HT STAY SET (TYPE AS REQUIRED)
14	2	NOS	PSC POLE - 11 M

<b>CONSTRUCTION STANDARDS</b> <b>11 kV H - STRUCTURE (HS)</b> <b>PSC POLE</b>	<b>NEPAL ELECTRICITY AUTHORITY</b>
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Drawing  
CS11-TRN-02

**11 m PSC Pole**  
**11/0.4 kV Dead End**  
**Transformer Structure (TR)**

NEPAL ELECTRICITY AUTHORITY



Refer Drawing No: CS11 - TRN - 01 - 04

S.No.	QTY.	UNIT	MATERIAL
1	6	NOS	PIN INSULATOR WITH PIN AND NUTSWASHER
2	2	NOS	STEEL CROSSARM CHANNEL ( 50x100x6.4 x300 ) mm.
3	2	NOS	POLE CLAMP WITH NUTS, BOLTS AND WASHERS (PC1)
4	2	NOS	STEEL CROSSARM CHANNEL (500x100x 6.4 x 1200 ) mm
5	2	NOS	POLE CLAMP WITH NUTS, BOLTS AND WASHERS (PC2)
6	4	NOS	FLAT CROSS ARM
7	3	NOS	9 kV SURGE ARRESTOR
8	3	NOS	DISTRIBUTION CUTOOUT WITH FUSE HOLDERS
9	1	NOS	CHANNEL FOR LA & DO ISLC 100 2348 MM
10	2	NOS	PLATFORM CHANNEL (TR1) ISMC 100 2500 MM
11	2	NOS	PLATFORM CHANNEL (TR3) ISMC 100 2500 MM
12	4	NOS	PLATFORM CHANNEL (TR2) ISMC 100 1200 MM
13	2	NOS	PLATFORM CHANNEL (TR4) ISMC 100 1200 MM
14	8	NOS	BRACING ANGLE (TR5) 50 X 50 X 5 841 MM
15	2	SET	BRACING BAND (TR6 OR TR6P) WITH 2-M16 BOLT, 2-M16 X 50 BOLT, 8-M16 NUT, 8-M16 WASHER
16	16	NOS	M16 X 50 BOLT WITH 2-M16 NUT, 2-M16 WASHER
17	12	NOS	M16 X 250 BOLT WITH 2-M16 NUT, 2-M16 WASHER

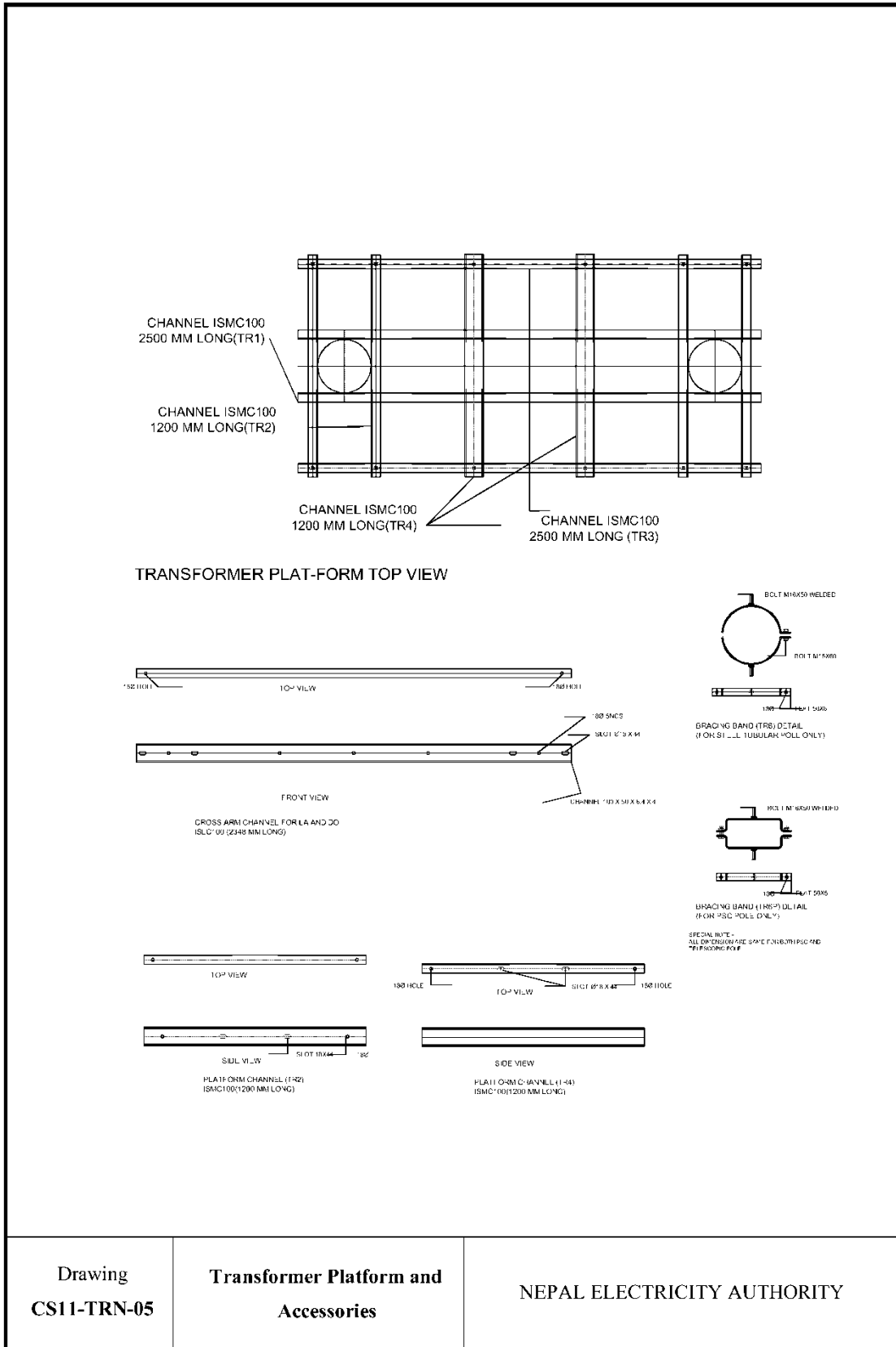


18	12	NOS	M16 X 350 BOLT WITH 2-M16 NUT, 2-M16 WASHER
19	1	NOS	TRANSFORMER
20	3	NOS	TRANSFORMER EARTHING
21	AS REQ.	M	GROUNDING CONDUCTOR (COPPER)
22	6	NOS	PREFORM TIES
23	2	NOS	STEEL TUBULAR POLE/ PSC POLE

**CONSTRUCTION STANDARDS**

11/0.4 kV TRANSFORMER  
STRUCTURE  
PSC POLE

**NEPAL ELECTRICITY AUTHORITY**

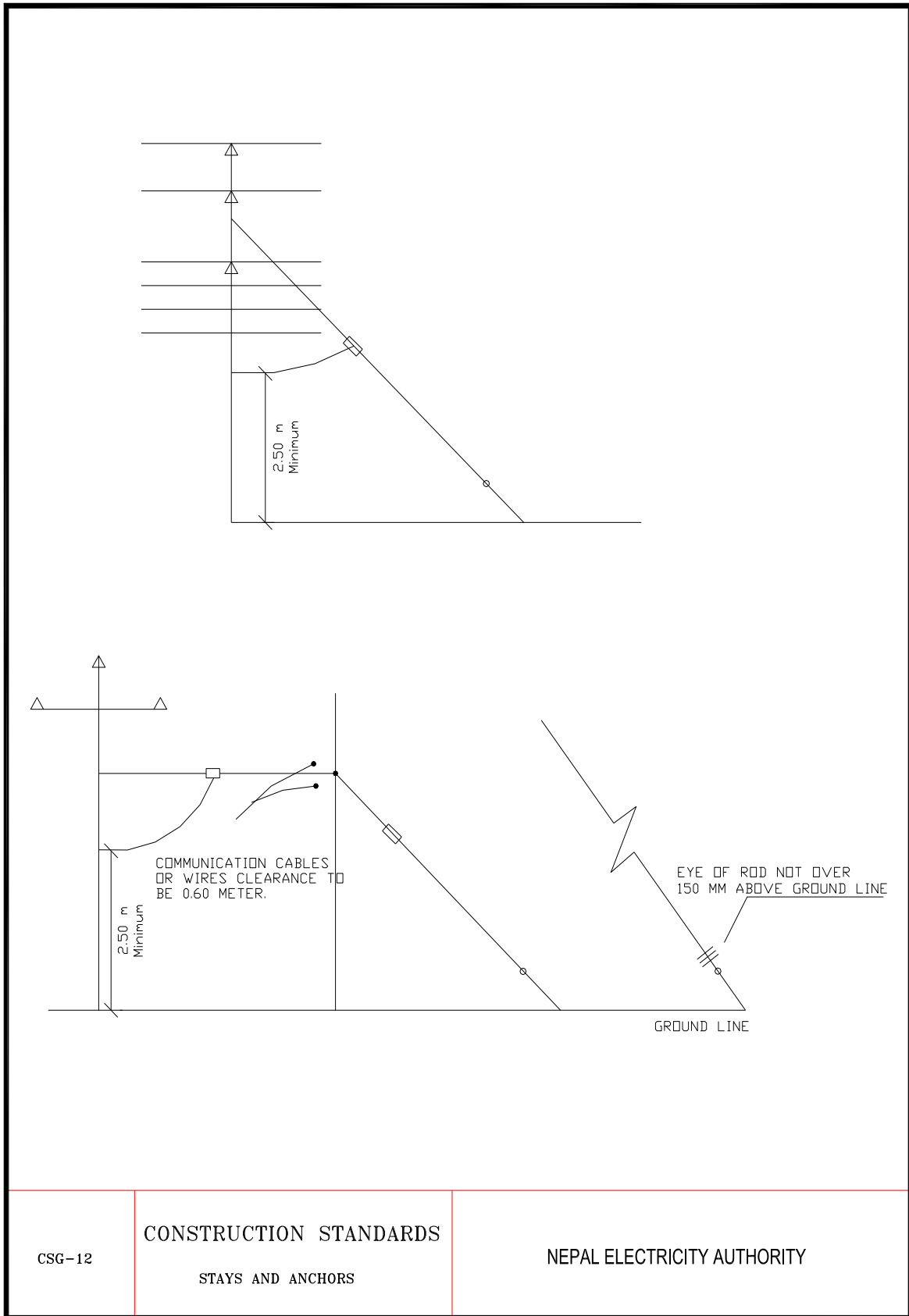


<b>S.No.</b>	<b>MATERIAL (HT-STAY)</b>	<b>QTY.</b>	<b>UNIT</b>		
1	HT STAY SET (600 x 600 MM PLATE AND ROD)	1	NOS		
2	HT TURN BUCKLE	1	NOS		
3	HT THIMBLES	1	NOS		
4	POLE CLAMP(TC6)	1	NOS		
5	HT STAY INSULATOR	1	NOS		
6	PREFORM TIE FOR STAY WIRE 7/8 SWG	4	NOS		
7	7/8" SWG STAY WIRE	12	M		
8	HT EYE BOLT	0	NOS		

<b>CONSTRUCTION STANDARDS</b> <b>HT - SINGLE STAY</b>	<b>NEPAL ELECTRICITY AUTHORITY</b>
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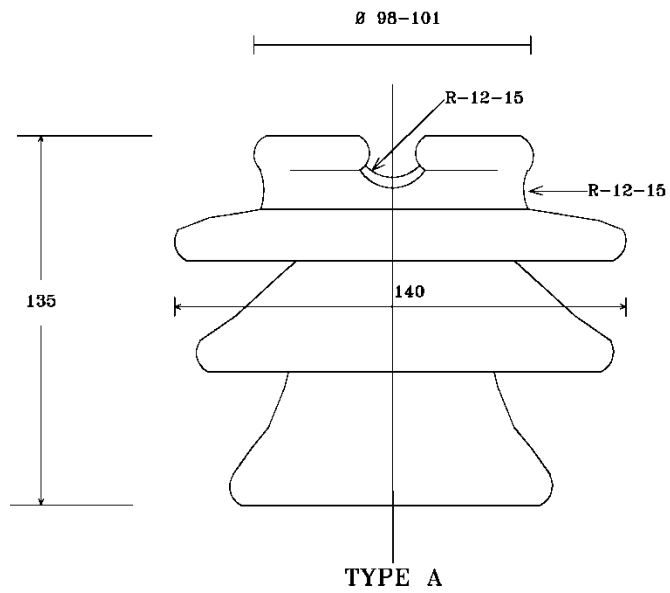
CSG-12

CONSTRUCTION STANDARDS

STAYS AND ANCHORS

NEPAL ELECTRICITY AUTHORITY

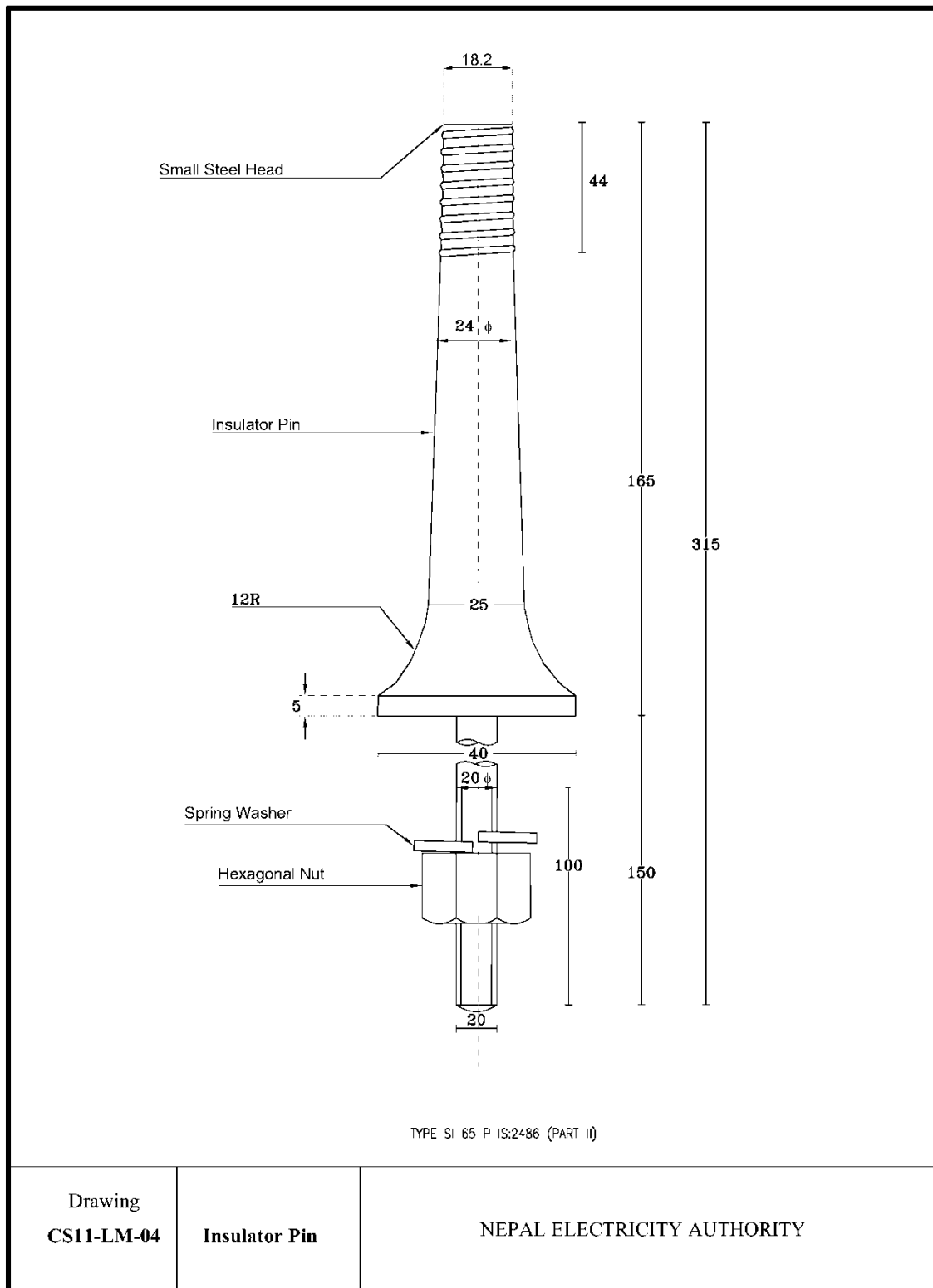




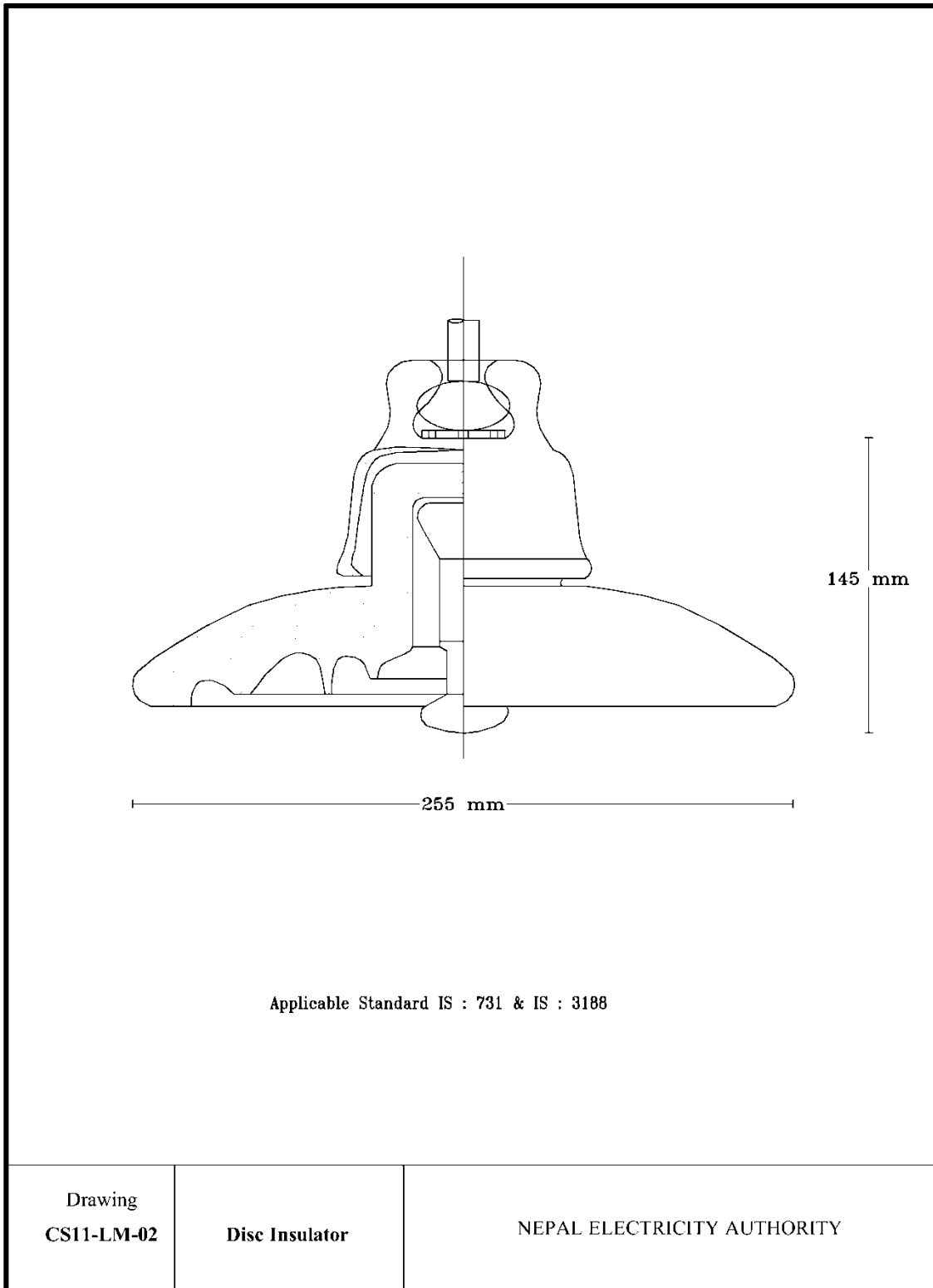
Applicable Standard IS : 731

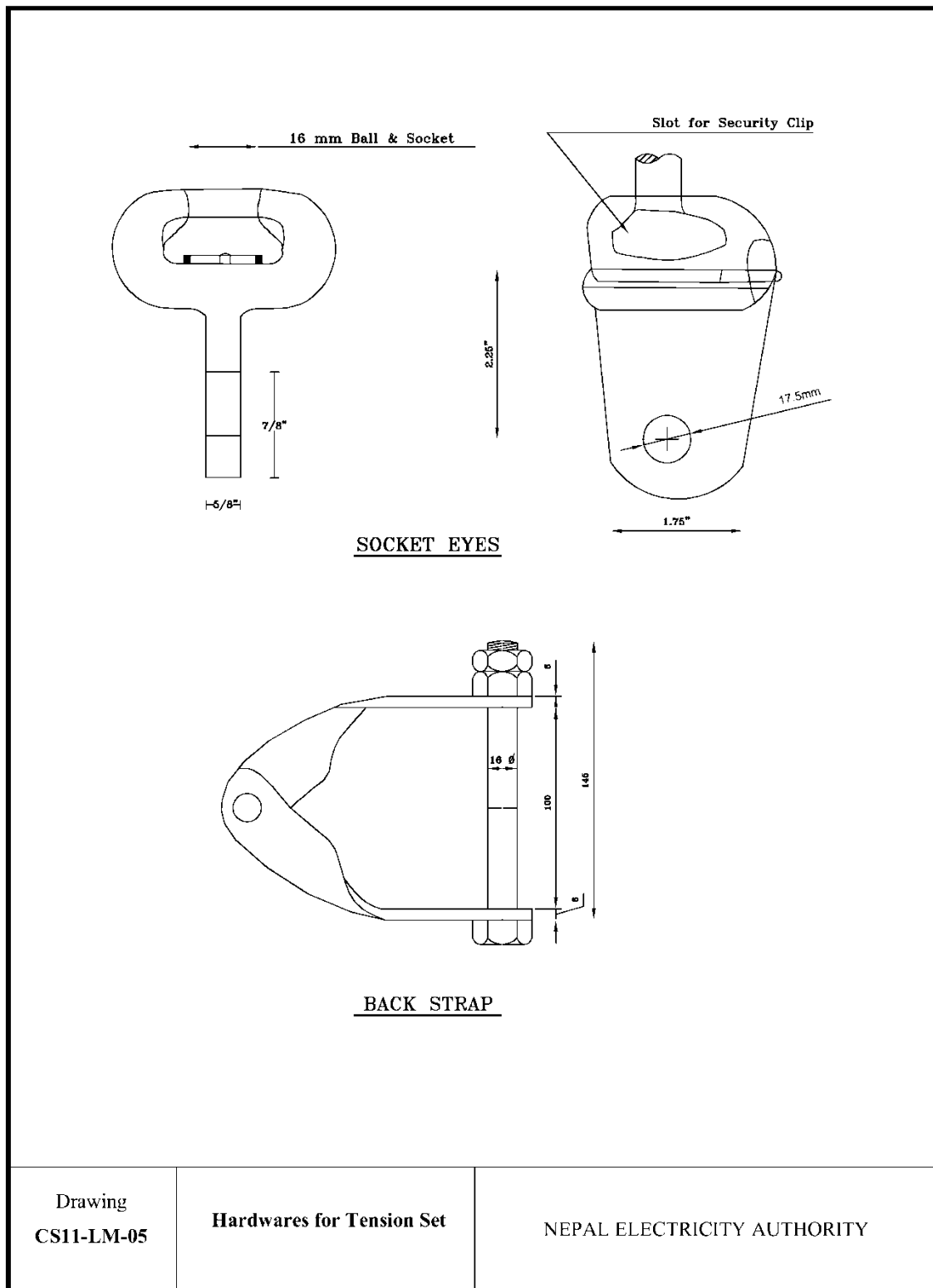
<p>Drawing CS11-LM-01</p>	<p>11 kV Pin Insulator</p>	<p>NEPAL ELECTRICITY AUTHORITY</p>
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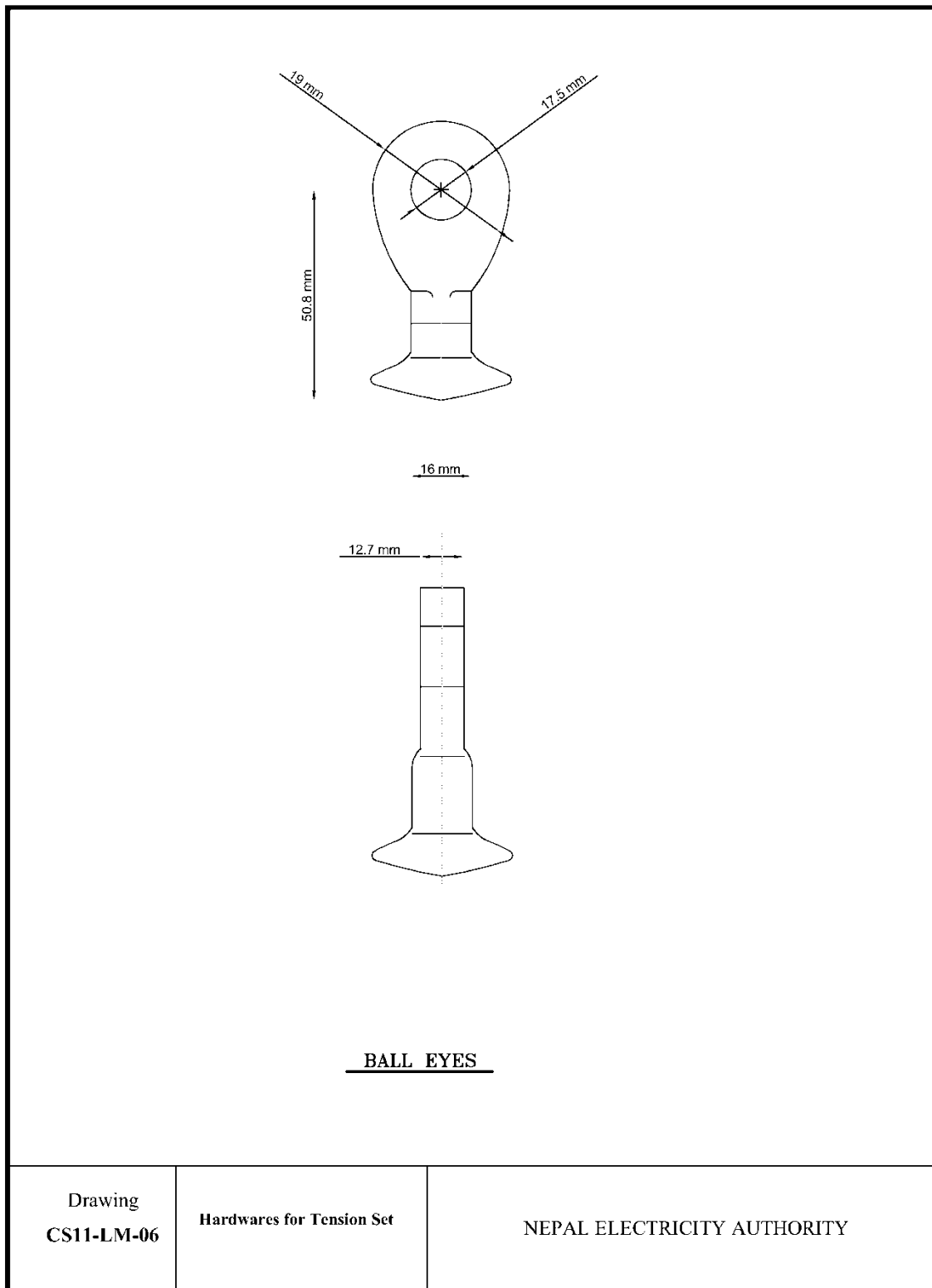


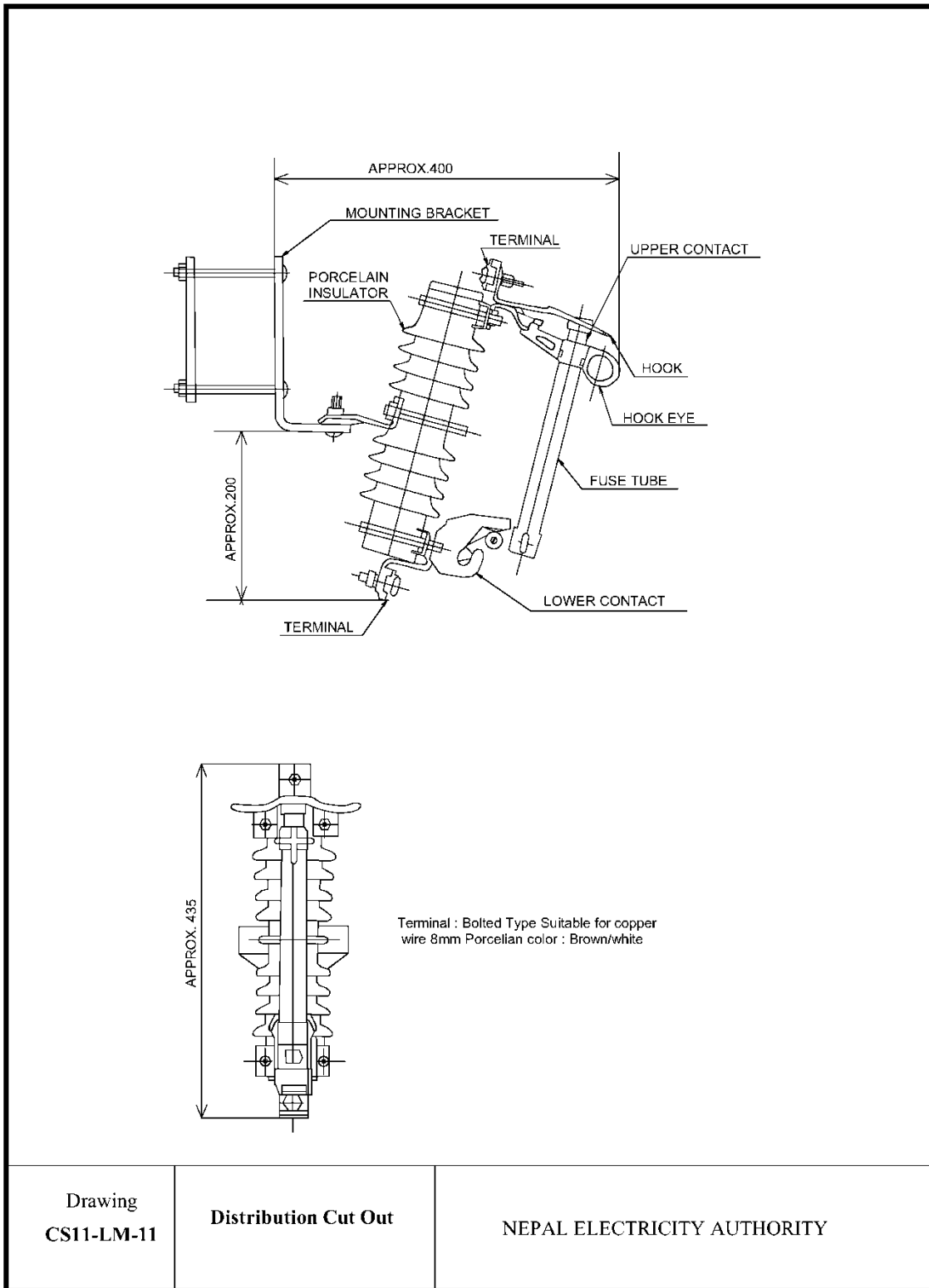


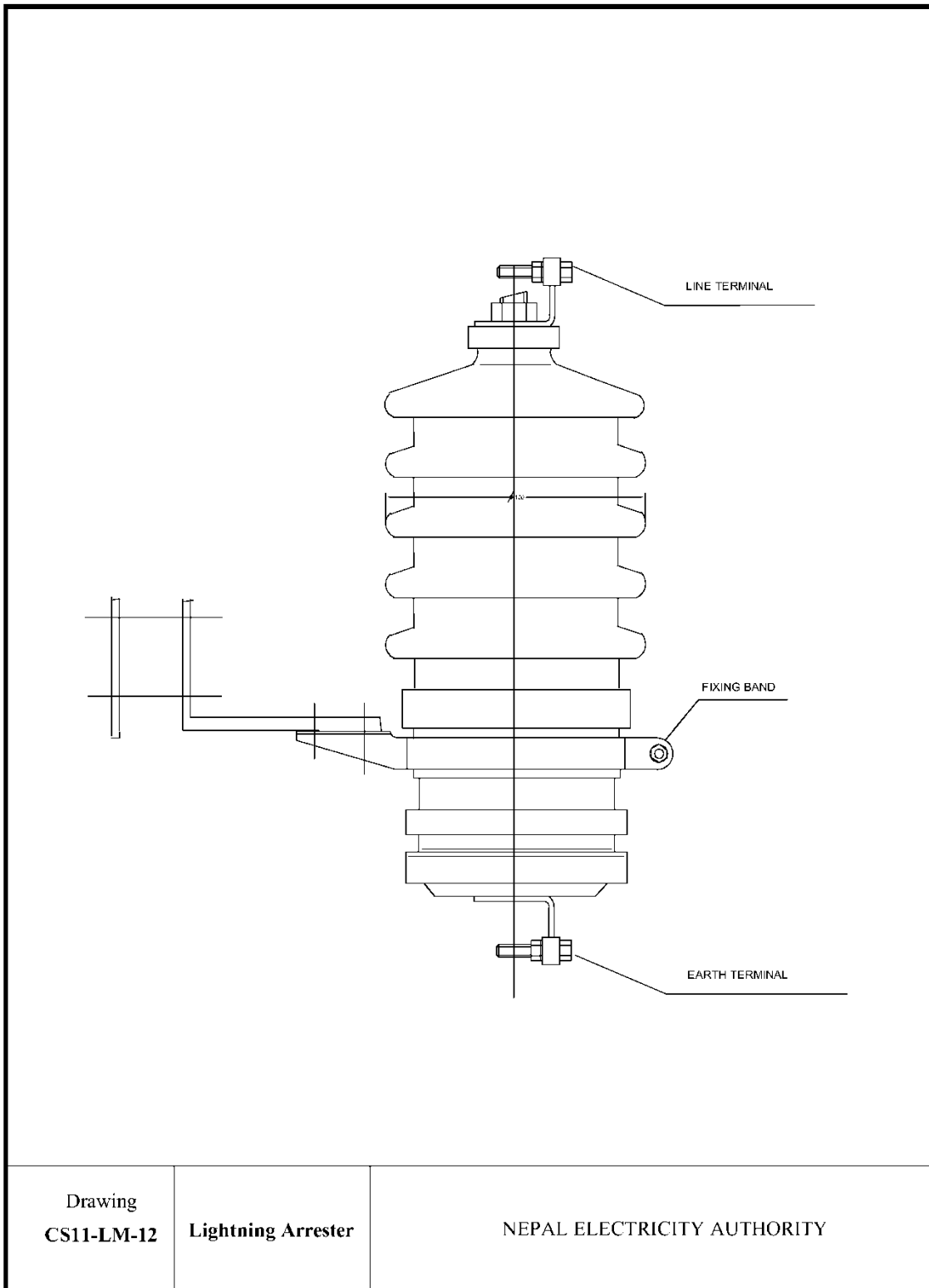












Drawing CS11-LM-12	Lightning Arrester	NEPAL ELECTRICITY AUTHORITY
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