NEPAL ELECTRICITY AUTHORITY

(An Undertaking of Government of Nepal)
Project Management Directorate

KATHMANDU VALLEY EAST AND SOUTH DISTRIBUTION SYSTEM ENHANCEMENT PROJECT

(A Component of
Power Transmission and Distribution Efficiency Enhancement Project)

BIDDING DOCUMENT
FOR

Enhancement of Distribution Networks in Central Region of Kathmandu Valley (Design, Supply, Installation and Commissioning of Underground Distribution Network under Ratnapark Distribution Center including Reinforcement and Automation)

Single-Stage, Two-Envelope
Bidding Procedure

Issued on:	**27th October 2018**
Invitation for Bids No.:	**PMD/PTDEEP/KVESDSEP–074/75 – 01 (RE)**
ICB No.:	**PMD/PTDEEP/KVESDSEP–074/75 – 01 (RE)**
Employer:	**Nepal Electricity Authority**
Country:	**Nepal**

VOLUME –II OF III

Kathmandu Valley East and South Distribution System Enhancement Project
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CHAPTER 1 – PROJECT SPECIFIC REQUIREMENT (PSR)

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CHAPTER 1-Project Specification Requirement

1. General

1.1 The project is funded by the GoN and ADB to meet the growing energy demand of Kathmandu valley and to increase the capacity and reliability of distribution networks by undergrounding and automation of the distribution networks, necessary reinforcement, use of insulated cables for overhead lines, use of distribution SCADA system, use of smart meters etc.

Nepal Electricity Authority intend to carry out the following services in Turn key mode of Contract:

Engineering and Design of the Distribution Network involving Underground distribution Network, overhead distribution network with insulated conductor necessary reinforcement of existing system and distribution system automation, **Supply and erection** of materials, **conversion** of existing 11 kV and LT overhead distribution system into underground systems (as far as possible the 11 kV will be in Ring Main Configuration), Reinforce existing overhead ABC cable, underground system for 11kV and LT distribution system, **Supply , delivery and installation of SCADA enabled** Ring Main Units with inbuilt FRTU and FPI, optical fibre cables, LT feeder panels including the associated civil works. **Integration with existing systems, testing and commissioning**, along with the support services including operation and maintenance of the installed system for a period of 3 years after the commissioning of project.

1.1.1 **Area Coverage**: The area under Ratnapark distribution Centre is under current scope of work. Refer Annexure III for tentative areas where underground work is to be done.

1.1.3 Scope Activities:

The following shall be in the scope of the Contractor:

1. Detail DGPS survey and complete network designing (Underground, overhead, automation) and reinforcement of the distribution system including the design of civil works.
2. Undergrounding and laying of HT and LT Power cables and Optical fiber using Trenchless boring methodology. Where trenchless boring (Horizontal drilling) is not possible, with Employers approval open cut trenching shall be used for undergrounding the HT and LT Power cables and Optical fiber.
3. Installation and laying of Optical Fibre Cables to establish communication network for SCADA communication.
4. Installation of HT and LT ABC cables
5. Erection of 11/ 0.4 kV DT substations and LT feeder panel.

6. Erection of SCADA enabler equipment RMUs, Gang Operating Switches, FRTU, FPIs etc. to be compatible with proposed distribution control centre equipment (where applicable).
7. Associated civil works.
8. Dismantling of Existing 11 kV system including DTs, LT overhead system and the street lights etc. (required if any) and existing 11kV and LT underground system for reinforcement of the system (required if any). Cost for such works shall be included in the installation of the respective items.
9. Restoration (when and as required)
10. Integration with Existing NEA Network
11. Support services (operational support and maintenance) for 3 years after issuance of operational acceptance certificate.
12. Optical fibre connection to the equipment and to the distribution automation control centre to achieve proper communication for control and status of the equipment from / to the distribution automation control centre. However, if Distribution automation control centre is not available during the execution, the Contractor is required to test the installed communication facilities and guarantee its operation.

Note:

a) Contractor may have to relocate the existing distribution transformers to the new transformer structures; install the new distribution transformers in new transformer structures and location.

b) The material requiring dismantling shall be dismantled by the contractor by dismantling the material Section wise i.e. from dead end pole to next dead end pole with proper accounting in the presence of representatives of Project and concerned Distribution Centre of NEA and the dismantled materials shall be returned to designated NEA stores at the expense of the contractor.

c) Any minor electrical/ communication equipment/items which are not mentioned in the biding documents but are required for the successful completion of the project shall be in the scope of contractor for which no extra payment will be made.

d) Charges if any be paid to the Road, Sewage or any other Government bodies as per the requirement of the works under the scope of the Contractor will be borne by the NEA on actual cost basis. Initially the requisite charges are to be deposited by the Contractor with the concerned department. The same shall be reimbursed to the Contractor on production receipt of such deposited amount after completing the work for which the amount is paid. However, any damages to the existing facilities of NEA and other utilities incurred by the Contractor during the construction process shall be borne by the contractor.

e) Contractor shall work during day and night as instructed by the Employer. Contractor shall

not leave any trenches or pits open for more than 24 hours from the time of excavation. For critical working site, employer may instruct to the contractor to complete particular section of the work within 6 hours so that there will not be any hindrances for vehicle and pedestrians. The trench or pits are to be covered with rubber mat such that dust pollution is minimal. The cost of rubber mat (on returnable basis) shall be borne by contractor.

f) The Contractor shall not start the work of excavation/drilling/boring without having consultation with the Employer. Each and Every excavation/drilling/boring work shall be restored to its original state (along with the black top wherever required) within 10 (ten) days of excavation.

g) Any property belongs to public or government (eg, water pipe, tele communication cable, power cable, sewerage pipe etc:) damaged during the excavation/drilling/boring or during construction shall immediately be restored by the Contractor without any cost to Employer.

2.0 Detailed Scope

2.1 **Detail survey and network designing of the system:**

2.1.1 The existing network sketches provided are for reference only. The Contractor shall conduct a detail survey of the existing facilities and perform network analysis and load flow studies of the proposed network. The network analysis and load flow studies shall be carried out by the Contractor by using internationally recognized/reputable software tools and any modifications required on account of the same shall be incorporated after obtaining due approval of the project. Based on the data, the Contractor shall propose or design the new distribution networks based on ring main design for highly reliable system.

2.1.2 In the proposed network design, the Contractor shall clearly mark all the details but not limited to the locations of the proposed Distribution Transformers, the RMUs, FRTUs, LT feeder panel, the proposed route to be taken for laying of the under-ground cable along with Optical Fibre Cable and submit to the Employer for approval.

2.1.3 The mapped details of the underground utilities such as water, sewerage, telecom etc. may also be provided to the Contractor for reference (wherever possible), however the contractor shall have to prepare afresh/update the same by carrying out the mapping of the existing underground utilities by GPS and GPR (Ground Penetrating Radar) equipment to avoid the damage to any utility at the time of execution.

2.1.4 The contractor shall carry out the detail survey within 90 (ninety) days of Contract signing under the supervision of the Project and shall submit four sets drawings/maps of existing and proposed system.

2.1.5 The Contractor shall submit the detail design including revised Bill of Quantity, Work schedule, Work methodology –all complete in every respect - for approval. The details regarding the cables type and size, the DTs capacity, detail quantity of underground 11kV and 400 V network, detail quantity of OH line reinforcement etc. shall be provided in the drawings.

2.2 **Laying of 11 kV and LT underground cables**

2.2.1 As per the approved drawing, the cable shall be laid underground by the Contractor in the approved area.

2.2.2 The laying of the cable shall be carried out as per the specification and the relevant international standard.

2.2.3 Wherever required with the point of view of reliability and future growth, multiple 11 kV cables, optical fibre cables and the LT cables on the same route shall be laid together in different combinations with adequate clearances as per relevant standards of safety.

2.2.4 The laying of cables shall normally be done direct in ground through trenchless boring using HDPE pipes (if not possible then by manual digging). Cable laying at road crossings shall preferably be made by trenchless (Horizontal drilling technology) method. However in exceptional circumstances the cables may have to be laid in covered trenches or in racks fixed to the walls or supported from the ceilings.

2.2.5 The contractor will lay the underground power cable in such a fashion that no straight through joints are required and only end terminations joints are required. However in exceptional circumstances straight through joints may be allowed.

2.2.6 The General information for laying and terminations of XLPE Cable is given in Chapter 3. However, the methodology of laying shall be documented in details and shall be submitted along with inception report for approval.

2.2.7 Any property or services damaged by the Contractor in the built up areas shall be immediately repaired or replaced, the cost of which shall be borne by the Contractor.

2.3 **Installation of overhead ABC Cable for 11 kV and LT system:**

2.3.1 As per the approved drawing, the existing overhead conductor shall be suitably replaced with ABC cable (if required).

2.3.2 The installations, underground or overhead shall be carried out as per specification and the relevant international standard.

2.3.3 Wherever possible multiple 11 kV cable and the LT cables on the same route shall be laid together with adequate clearances as per relevant standards of safety.

2.3.4 The cable route markers, at a maximum distance of 50 meters, and danger boards shall be provided for the information of all concerned and for their safety. Any additional requirement in terms of safety perspective shall be provided by the contractor without any extra cost. The cable route marker shall also be visible during night.

2.3.5 It is the responsibility of the contractor to maintain the required statutory clearances from other utility services. Any damage caused to any utility services/ human life / public property etc. shall be the sole responsibility of the contractor.

2.3.6 The methodology of laying shall be documented in details and shall be submitted along with inception report for approval.

2.4 **Laying of Optical Fibre Cables to establish communication network for SCADA communication:**

2.4.1 The Optical Fibre Cable is to be laid adjacent to the 11 kV cables and to be laid in the same manner. The fibre optic cable is intended for the SCADA communication between the equipment and the future Distribution SCADA control room. Provision shall be kept for laying of additional OFC in future.

2.4.2 The installation of the OFC shall be done as per relevant international standard.

2.5 **Connection of existing 11/ 0.4 kV DT substations and new distribution transformer (DT) and LT feeder panel:**

2.5.1 The contractor shall provide necessary provision for connection of existing Distribution Transformers strictly in accordance with the finalized and approved locations.

2.5.2 For new DT (Completely Self Protected and SCADA enabled), the contractor shall provide necessary provision for connection such that it is ready for connection with Distribution control centre.

2.5.3 In case any change is required due to Right of Way problems, alternate feasible nearby location shall be sought.

2.5.4 The RMUs with inbuilt FRTU and FPIs, LT feeder panel etc. shall be installed at the tee points and selected DT locations. Requisite clearances shall be maintained by the contractor as per the relevant standard, Electricity Rules and Electricity Act of Nepal.

2.5.5 The installation of the DTs, RMUs, LT panels etc. may be over the ground, on the plinths or underground or in double-decker arrangement, as required by the site condition.

2.5.6 The complete fencing of the entire area wherever required by the Employer shall be carried out by the contractor. The Danger signs/ plates shall be provided by the contractor for the safety of people.

2.6 **Erection of SCADA enabled equipment FRTU, RMUs:**

2.6.1 The design, supply and erection of the SCADA enabled equipment such as RMU's with inbuilt FRTU's and FPI's, Optical Fibre Cable connectivity/ jointing shall be carried out by the Contractor.

2.6.2 In case of interconnection of feeders originated from different substations, RMUs shall include the facilities for inclusion of CT's, PT's and all metering arrangements. Location of this special provision shall be decided by the Employer.

2.7 **Associated Civil works:**

2.7.1 The RCC plinths for mounting the DTs, RMU's, LT feeder panels, trenches, double-decker arrangement, service pit, installation of DTs, RMU's etc. and other related civil work and their design shall be carried out by the Contractor. For underground system, the plinths shall include the provision for cable entry and exit from beneath in case of RMU's and LT feeder panels. In case of DTs the cable entry/ exit shall be alongside the plinth on the tray.

2.7.2 The Contractor shall submit detail design and drawings for approval.

2.8. Dismantling of Existing 11 kV, LT overhead system and the street lights:

2.8.1 Dismantling of the selected existing 11 kV system, LT overhead system and the selected street lights shall be carried out by the Contractor as instructed by the Employer.

2.8.2 Dismantling of the selected existing 11 kV system, LT underground system shall be carried out by the Contractor as instructed by the Employer.

2.9 Restoration of Road:

2.9.1 The laying of the power and optical cables and other works may require digging alongside/ across the roads/streets/pavements/or any other public/private area. The contractor has to restore the dugout area by back filling and suitable compacting. The top layer has to be restored in the same fashion and condition to give it the original look as per the norms and standards of Department of Road, GoN (http://dor.gov.np/home/publication/standard-specification-of-roads-and-bridges/standard-specifications-for-road-and-bridge-works-2-73) and in the earliest possible time.

2.9.2 No payment towards any additional material, other than that provided in the Price Schedules incurred on labour / erection/ services etc. required for the restoration shall be

allowed to the contractor in this regard, however, the proper restoration shall be considered as a part of the laying of cables.

2.9.3 Any permission charges/fee, if applicable, shall be refunded to the contractor on actual basis on submission of receipt, after the successful completion of the work for which charges are deposited.

2.10 GIS Mapping:

2.10.1 As under this project, the existing overhead infrastructure is to be replaced with new network consisting of underground infrastructure, overhead conductor and ABC cables complete to ensure highest level of reliability at each level, the Contractor shall carry out the DGPS GIS survey of the newly erected infrastructure on the approved format.

2.10.2 The Contractor shall provide the as built GIS mapping of the electrical network under the scope of this project. In as built GIS mapping, all the underground utilities (water pipe, sewerage, telecomm etc:) shall be mapped.

2.11 Integration with New Distribution Control Centre

2.11.1 The Distribution Control Centre is supposed to be implemented in the project area for supervision and control of the new network. So, the Contractor under the present scope of work shall design and provide SCADA compatible equipment and connectivity in such a fashion that the same can be integrated smoothly with SCADA deployment included hardware/ software for the entire system on open platform so as to ensure successful SCADA operation.

2.11.2 The RF Communication is planned to be used for Smart metering Communication. RMU and DTs under this project is supposed to use the Optical fibre Communication. Some of the equipment related with the Smart meter are planned to be installed at DTs and RMU which may require optical Fibre Communication to transmit/receive the data to Control centre. The Communication equipment under this project shall also be compatible for RF Communication or necessary conversion provision (RF signal to Optical Fibre Communication) shall be provided.

2.12 Miscellaneous:

2.12.1 Care has been taken to make provision of all the items / materials / equipment required for the execution within the scope of the project. The contractor shall examine the same if any item which is required for the execution within the scope of the project but has been left out then the contractor shall be responsible for supply/erection/ provide services of the same without any extra cost.

2.12.2 The supply and erection of any petty item required for the completion of the project such as double compression brass glands and brass glands, PG Clamps, all types of thimbles

along with the stand for Distribution transformer, HT and LT cable termination are within the scope of the contractor.

2.12.3 The scope of the contractor shall also include the connection of newly laid system to the distribution box through which service cables will be extended to connect to the consumer meter.

The contractor shall be responsible to provide adequate and robust earthing of the system as well as high level of safety in accordance with the prevailing standard.

2.13 Final Checking, Testing and commissioning

After completion of Works, final checking of lines shall be done by the Contractor to ensure that all the Foundation Works, equipment erection and cable laying etc. has been done according to specifications and as approved by the Employer. All the Works shall be thoroughly inspected keeping in view the following main points.

a) The earth filling of the dugout cable trenches has been properly done with adequate compacting.

b) The restoration of the dugout roads, streets, ramps etc. have been properly carried out.

c) All the cable out points from the ground have been properly secured by way of using clamps/ cleats/ fasteners/ or any other suitable installation etc., after getting the design approved.

d) All the RCC markers have been properly planted with desired inscription.

e) The insulation of line as a whole is tested by the Contractor by providing his own equipment, labour etc. to the satisfaction of Employer.

f) All the electrical equipment have been properly earthed to the satisfaction of employer.

g) All conductor and earth wire accessories are properly installed.

h) All other requirement to complete Work like fixing of danger plate, phase plate, number-plate, anti-climbing device (if applicable) etc. are properly installed.

i) The lines are tested satisfactorily before commissioning.

3. Contract Execution Procedure

3.1 Pre-construction Survey and Inception Report

Once the contract is awarded and the contractor mobilises its team, they are expected to survey the entire area and submit an inception report. The report shall break the tasks to be completed into subtasks with milestones. The subtasks shall include detail process associated and required support from the employer including shutdown permissions. Moreover, indicative drawings of the equipment to be supplied shall also be submitted in the inception report.

3.2 Detailed Survey of the site and design

The detailed survey for the line route and optimization of the pole location/underground cable laying along with profiling shall be carried out by the successful bidder. With the detail survey, the contractor shall carry out the complete design of Underground Distribution Network, overhead distribution network, communication system for distribution automation, distribution network reinforcement, RMUs, DTs and all the necessary civil structure and works including trenches, service pit, RMU foundation, DTs pad etc to complete the specified scope of work. The Contractor shall submit the detail design and survey report to the Employer for approval. With the approved design and drawings the contractor shall prepare the Bill of Quantity and submit to the Employer for approval. The provisional quantity has been indicated in the Bill of Material/ schedule of prices. The detailed survey shall be carried out by the bidder along the approved alignment.

3.3 Construction Procedure

The contractor will intimate in writing to the Project, regarding when he/they are starting the subtask under the project. Under no circumstances will the contractor undertake the work of the project without the prior intimation to the project and subsequent permission.

The entire stringing work of the ABC Cable, laying of underground cable and optical fibre cable under the ground and earth wire shall be carried out by standard practice. The bidder shall indicate in his offer the detailed description of procedure to be deployed for stringing operation/ laying of underground and Fibre Optic cable.

Any way-leave which may be required by the Contractor shall be arranged by the contractor. The Contractor shall inform the Project Manager whenever he wants to avail the 'Permit to Work' from the local distribution centre for erecting the new 11 kV line or augmenting the existing 11 kV line.

A minimum 7 days advance notice in writing for availing the shutdown on any live 11 kV feeder/LT lines shall be given to the Project. The 11 kV/ LT line on which permit is taken should be made clear from all the temporary earth, men and material before cancellation of the 'Permit to Work'. It is worth mentioning here that the 'Permit to Work' on existing line shall be arranged through the Project and the same shall also be got cancelled through the same agency only. No 'Permit to Work' shall be issued on any line directly to Contractor or his staff from any Sub-Station.

4. Specific Exclusions

The following items of work are specifically excluded from the scope of the specifications of the works:

(a) Supply of Distribution Transformers (DTs)

5. Physical and other Parameters

5.1 Location of the Project Site

Project site is in the Central and Northern side of the Kathmandu Valley.

5.2 **Meteorological data:**

a) Altitude above sea level: 1420 m

b) Ambient Air Temperature:

-5 ºC (minimum) to 40 ºC (maximum)

c) Average Humidity (in %) :

100 (maximum), 40 (minimum)

d) The project locations are lying in the Wind Speed Zone 4.

e) Seismic Requirement for Substations: 0.5 g (Horizontal peak acceleration value).

However, for design purposes, ambient temperature should be considered as 50 degree centigrade and Relative humidity 100%. Altitude (from MSL) to be considered as 1400 meter.

4.3 The fault level of all equipment to be supplied under present scope shall be as indicated below:

S.NO.	Voltage Level	Fault Level
1	11 kV	25kA for 3 Sec

6. Schedule of Quantities

The requirement of various items/equipment and civil works are indicated in Bid price Schedules.

All equipment/items and civil works for which bill of quantity has been indicated in BPS (Bid Price Schedules) shall be payable on unit rate basis/quoted rate basis.

Wherever the quantities of items/works are not indicated, the bidder is required to estimate the quantity required for entire execution and completion of works and incorporate their price in respective Bid price schedules. For erection hardware items, Bidders shall estimate the total requirement of the works and indicate module-wise lump sum price and include the same in relevant Bid price schedules. For module identification, Bidder may refer typical drawings enclosed with the specifications. Any material/works for the modules not specifically mentioned in the description in BPS, as may be required and shall be deemed to be included in the module itself.

The detailed bill of quantities of the mandatory spares is as per BPS.

Bidder should include all such items in the bid proposal sheets, which are not specifically mentioned but are essential for the execution of the contract. Item which explicitly may not appear in various schedules and required for successful commissioning of substation shall be included in the bid price and shall be provided at no extra cost to Employer.

7. Basic Reference Drawings

7.1 Single line diagram, and general arrangements are enclosed with the bid documents for reference, which shall be further engineered by the bidder. The reference drawings, which form a part of the specifications, are given at Chapter 3. The bidder shall maintain the overall dimensions of the equipment / line materials, phase to earth clearance, phase to phase clearance and sectional clearances.

7.2 In case of any discrepancy between the drawings and text of specification, the requirements of text shall prevail in general. However, the Bidder is advised to get these clarified from Employer.

Order of Precedence of Different Parts of Technical Specification

For the purpose of present scope of work, technical specification shall consist of following parts and they should be read in conjunction with each other.

1.	Chapter 1 : Project Specific Requirement	
2.	Chapter 2 : Standard Specifications	
3.	Chapter 3: Technical Specification of equipment	
4.	Chapter 4: Special Requirement for Execution	
5.	Chapter 5: Inspection, Testing and Commissioning	
6.	Chapter 6: Communication Network	

In case of any discrepancy between Chapter 1-PSR, Chapter 2, standard Specification & 3-Technical Specification, Chapter 1-PSR shall prevail over all other chapters.

In case of any discrepancy between Chapter 2- Standard Specification and Chapter 3, individual chapters for various equipment, requirement of individual equipment chapter 3 shall prevail.

8. Spares

Mandatory Spares

The Mandatory Spares shall be included in the bid proposal by the bidder. The prices of these spares shall be given by the Bidder in the relevant schedule of BPS and shall be considered for evaluation of bid. It shall not be binding on the Employer to procure all of these mandatory spares.

The bidder is clarified that no mandatory spares shall be used during the commissioning of the equipment. Any spares required for commissioning purpose shall be arranged by the Contractor. The unutilized spares if any brought for commissioning purpose shall be taken back by the contractor.

9. Special Tools and Tackles

The bidder shall include in his proposal the deployment of all special tools and tackles required for operation and maintenance of equipment. The special tools and tackles shall only cover items which are specifically required for the equipment offered and are proprietary in nature. However a list of all such devices should be indicated in the relevant schedule provided in the BPS. In addition to this the Contractor shall also furnish a list of special tools and tackles for the various equipment in a manner to be referred by the Employer during the operation of these equipment. The scope of special tools and tackles are to be decided during detail engineering and the list of special tools and tackles, if any shall be finalized**.**

10. Facilities to be Provided by the Owner

The Employer may provide the auxiliary power supply from NEA on chargeable basis as temporary consumer. The prevailing energy rates of the state shall be applicable. All further distribution from the same for construction and permanent auxiliary supply shall be made by the contractor. However, in case of failure of power due to any unavoidable circumstances, the contractor shall make his own necessary arrangements like diesel generator sets etc. at his own cost so that progress of work is not affected and Owner shall in no case be responsible for any delay in works because of non-availability of power.

11. Specific Requirement

a. The Bidders are advised to visit project site and acquaint themselves with the topography, infrastructure, etc.

b. The bidder shall be responsible for safety of human and equipment during the working. It will be the responsibility of the Contractor to co-ordinate and obtain Electrical Inspector's clearance before commissioning. Any additional items, modification due to observation of such statutory authorities shall be provided by the Contractor at no extra cost to the Employer.

c. The Contractor shall arrange all T&P (such as necessary supports, cranes, ladders, platforms etc.) for erection, testing & commissioning of the system at his own cost. Further, all consumables, wastage and damages shall be to the account of contractor.

d. Augmentation and integration work related to SCADA System

e. Erection, testing and commissioning of Load Break Switch (LBS), Distribution automation system, XLPE Cable, ABC Cable, RMU's, SCADA shall be done by the

contractors under the supervision of respective equipment manufacturers. Charges for the above supervision shall be included by the bidder in the erection charges for the respective equipment in the BPS.

f. The Contractor shall impart the necessary training to Employer's Personnel as per following details:-

- **Training at Manufacturer's works (As per BPS)**.

  The training shall be provided in the field of design, testing and maintenance at Manufacturer's works as per following:-

  1. RMU's, Feeder Pillars, Cable Jointing: 5 Days. (10 Nos. Trainees)
  2. Distribution planning with GIS based asset management: 15 Days. (5 Nos. Trainees)
  3. Fault Location equipment and Fault location: 5 Days. (10 Nos. Trainees)

- **On Job Training in Nepal (as per BPS):** The traveling and living expenses of Owner's personnel for the training programme conducted in Nepal shall be borne by the Owner.

  The training shall be provided to Employer's personnel in the field of erection, testing, operation and maintenance at project sites as per following:-

  1. XLPE Cable Laying and termination: 5 Days.
  2. Feeder Management: 5 days.
  3. ABC Cable Laying and termination: 5 days.
  4. Fault Location equipment and Fault location: 7days
  5. Equipment Maintenance: 5days

g. All RCC shall be of M-25 grade (Minimum) with mixed design conforming to relevant international standard/BS. All Reinforcement steel shall be of FE-500(Minimum) grade conforming to International standards /BS.

h. The Frequency range for the earthquake spectra shall be as per IEC-62271-300 for Circuit Breaker.

i. The reference of IS standard (i.e. Indian Standard) mentioned in the technical specification shall be read as equivalent IEC or BS or equivalent International Standard.

j. LIST OF PREFERRED MAKE/MANUFACTURER:

"It is preferred that the equipment be supplied from the manufacturers listed in ANNEXURE-II for mentioned equipment/items.

The bidders may offer equipment/brands other than those listed in ANNEXURE-II, that are better or equivalent with regard to quality and performance substantiated with appropriate documents.

12. Pre-commissioning, Commissioning, Trial-run & Completion

As soon as the Facilities covered by these specifications are physically completed in all respects, the Pre commissioning, Commissioning, Trial-run and Completion of the Facilities, as mentioned below, shall be attained in accordance with the procedure given in the Conditions of Contract, Vol.-I of the Bidding Documents.

(i) Pre commissioning**:** As per relevant Chapters

(ii) Commissioning: Charging of the Facilities at rated voltage

Further, wherever appearing in these specifications, the words – 'commissioning checks', 'installation checks', 'site tests', 'performance guarantee tests for fire protection system', are to be considered as 'pre commissioning checks'.

(iii) Trial-run : Operation of the Facilities or any part thereof by the Contractor immediately after the Commissioning for a continuous period of 72 (Seventy two) hours continuously. In case of interruption due to problem / failure in the respective equipment, the contractor shall rectify the problem and after rectification, continuous 72(Seventy two) hours period start after such rectification.

(iv) Completion : Upon successful completion of Trial-run.

13. Social Safeguard and Environment and Management Plan

The Contractor shall prepare Social Safeguard and Environment Management Plan to be implemented during execution of the Project. The following major activities shall be considered:

Labour recruitment: The Contractor shall give preference to the use of local and regional labour provided that it is consistent with the requirement of good workmanship based on the need of the project.

Staff training and sensitization: At the beginning of works the Contractor shall organize training and awareness-raising workshops intended for his teams to improve their understanding to prevent or minimize the impact of their activities on the environmental and social aspects to promote good relations with the local people.

Among others topics addressed should also include the following:

Likely environmental impact of works, good practices, preventive and corrective measures to be adopted; Rules and procedures for waste management at construction sites; Safety risks associated with the works, and preventive attitude to adopt; First aid and what to do in case of accident; General standards concerning relations with the local people; Risks and prevention of sexually transmitted diseases. The training and awareness sessions should be organized whenever new workers are recruited. Feedback and training during the works and after the monitoring and control exercise, additional training and awareness activities may be necessary if it happens that the previous sessions had failed to achieve the desired effects.

Demarcation, signing and closing of worksites: Setting up warning signs at worksites to limit the access of persons, machinery and equipment into construction areas and confine the works related to the construction process to the allocated areas.

Access to private property: Contractor shall coordinate with the Employer for the access of private property, if required. Crossing of private property shall be subject to prior notification to the owners and conducted in such a manner as to minimize damage to crops or other property on the land.

Discovery of relics of historical and archaeological importance: In the unlikely event of discovery of historical relics, the works will be interrupted temporarily and the discovery notified to the local authority responsible for cultural heritage in order to determine the appropriate course of action.

Restoration of sites: After the infrastructure has been put in place and the construction sites and equipment depots cleared, the sites should be rehabilitated without undue delay in the original condition or better, unless there are plans for future use requiring that such sites be left in their current state.

Storage and handling of hazardous substances: Hazardous substances such as oils, lubricants or other hazardous substances likely to contaminate surface or ground water and soil should be stored or handled in premises specially designed for this purpose, in order to protect the environment and human health. If the handling of oils and fuels is necessary, demarcated and waterproofed areas that may contain any spills must be provided.

Maintenance of equipment: Maintenance of equipment should not be performed immediately at the work site as far as practicable.

Air quality and noise pollution: Care must be taken to ensure that all equipment, machinery and vehicles used for works and equipped with a combustion engine are in good working conditions to limit undesired emission of air pollutants and noise nuisance.

Construction works that could cause noise should be performed only outside normal rest hours near residential areas. When noisy works must be carried out close to schools or other noise-sensitive receptors, working hours should be so scheduled as to limit the nuisance caused.

It is forbidden to burn in the open any kind of household, industrial and toxic or hazardous waste, project induced waste and all types of scrap metal.

Transportation of equipment: Equipment for overhead lines will be transported by existing roads up to the point nearest to the installation site. Thereafter, it will be transported manually to the site without opening up any access paths. When crossing the land between roads and installation sites, care should be taken not to damage vegetation, agricultural land or any other property on the land.

Erection of Poles: Vegetation should be removed only in so far as strictly necessary for opening foundations for poles and for such other operations as may be performed at each spot.

When erecting the poles, necessary precaution should be taken to minimize the impact on adjacent areas.

Unrolling of cables: When cables are being unrolled, necessary precaution should be taken to prevent impact on tree vegetation, crops and other property on the land crossed by the cables. If necessary, temporary gantry-like structures should be used to facilitate crossings.

Restoration or damage compensation: If the works on private property cause damage to crops or other property, the Contractor must proceed with the repair of such damage or, where this solution is not sustainable, with the fair and timely compensation of the owners.

Management of material from digging trenches: Uncontaminated soil from excavations will be reused to backfill the trenches of underground lines. Any such soil that cannot be reused is deemed to be waste and must be conveyed to its final destination. Its uncontrolled spread is prohibited in places where it could cause damage. Minimum dust on ground policy is to be used to prevent dust associated pollution after the construction.

Sensitive Areas: From an environmental point of view, wetlands, swamps, and bogs should be avoided when planning underground cable as these habitats may suffer severe or even irreparable harm. Also sensitive water flows and archaeological sites should factor in route planning process.

Disruption of pedestrian and automobile traffic: When trenches are opened along the road, they should be barricaded, fenced off and warning signs placed at the worksites to ensure the safety of pedestrians, motorists and the staff carrying out the works.

There must be continued access to land and buildings located along trenches through installation of secure and clearly signalled temporary structures. This also applies to trenches that cut across the roadways.

Upon completion of the underground cable installation, the trenches should be resealed and the pavement repaired as soon as possible, to ensure its durability and the absence of irregularities that may present a traffic hazard.

Regular sprinkling of water shall be done to avoid dust pollution till the roads/sidewalks are reinstated.

Public information on electrical hazards, behaviour and preventive measures: Before switching on the infrastructure installed as part of the project, the neighbouring populations should be informed in good time, through public meetings and/or distribution of information leaflets. The information provided to them should focus on the electrical hazards associated with the infrastructure and the behaviour that would allow them to avert such hazards. The population of these areas should be particularly targeted.

Unanticipated Impacts identified during the construction should be mitigated in coordination with environmental and social monitors employed by Contractor, Consultant and Government separately.

14. Safety of Personnel

The maximum safety consistent with good erection practices in the case of work above ground must be afforded to personnel directly engaged under this contract. Reasonable measures shall be taken to afford adequate protection against material falling from a higher level onto personnel below.

15. Service Level Agreement (SLA)

Support services (including Maintenance) for 3 years:

After the successful commissioning of the entire project, the contractor shall provide the support services which shall include maintenance of the system installed under the project for a period of 3 (three) years from the date of issuance of operational acceptance of the project.

The Scope of Work shall include the power infrastructure operation and maintenance support to be provided by the Contractor in respect of the system supplied under this project for a period of three years along with Supervision & Operation of the power distribution infrastructure along with communication network after the Operational Acceptance of the entire project, however during the execution of the infrastructure work it is expected that certain portion of the work if completed and put to service before the actual completion and commissioning of the entire project, then in that case also the support services including O&M shall be the responsibility of the contractor in accordance with this document, at no additional/ extra cost towards payment of support services (O&M) during this intervening period.

15.1 Single window service: The bidder shall provide a single window service to maintain SLA and in case of a joint bid only one organization shall be held responsible & accountable for the performance of the system as per defined SLA.

15.2 The bidder shall provide 24x7 support to NEA to comply with SLAs in case of any problem.

15.3 It shall be the responsibility of Contractor to resolve any related issues of underground system including HT, LT, DTs, RMUs and OPG Cable.

15.4 The Contractor is required to work with the Employer's technical personnel during whole SLA period. The Contractor shall support and build the capacities of local counterparts in the day-to-day management, operation and maintenance of the network. Contractor shall conduct on the job training for these counterparts to ensure that they are able to maintain and operate the network in a stable and reliable manner in accordance with established Prudent Utility Practices.

15.5 The Contractor is required to provide field personnel for support service including Engineers, Supervisors etc. The numbers of field personnel shall be negotiated.

15.6 Scope of work includes but not limited to:

i. Operation and running of the Power Distribution Network.

ii. Maintenance and Repair/ replacement of defective equipment installed under the project.

iii. Predictive and preventive maintenance of the infrastructure.

iv. Additions and deletions after the commissioning of the entire project in the power distribution network is a dynamic phenomenon and shall be catered by the contractor. The network analysis with respect to the additions/ deletions in the power distribution network and designing of the network configuration shall also be carried out by the contractor.

v. Services to bring up any or all power distribution systems upon its failure and to restore the functioning of the same etc.

vi. Any future planning, estimation, augmentation and execution work for strengthening of the existing system shall be done by the contractor during the O&M period. Any material required for the above work shall be provided by the contractor on the same rates as per the award of original project.

15.7 The cost for the SLA shall be deemed to be included in the cost of equipment in BPS.

16. Guarantee/Warranty

The Contractor shall correct, without any delay and at its own expense, at any portion of the Work during defect liability period and extended defect liability period including any required correction in defective design, errors, omissions, or changes in documentation, or by providing a non-defective replacement within 3 days of notification of the problem.

The costs of replacement shall be at the Contractor's expense and shall include all shipping costs, duties, fees, and taxes, both to and from the Contractor's facility, and the appropriate technical advice and direction for removal of the defect and installation of the corrected Work including On-Site Services as required. In the event the System or any portion thereof, is down, the Contractor will begin the dispatch process of appropriate personnel as specified.

The Contractor's liability shall be limited to adjusting, repairing, or replacing the defective article(s) and providing technical support and direction in the correction of the Work. In case of replacement of the equipment on or after 2 year a new warranty period shall apply, such new warranty period shall expire on the date 12 months from the date of such replacement, repair, or modification.

If the Contractor shall fail to correct any defect within a reasonable time, Employer shall have the right to employ others to do so. The Supplier shall be liable for all costs and expenses thereby incurred by Employer.

The Contractor shall furnish Employer with a Deficiency incident report upon completion of each visit by such Staff and upon resolution of each inquiry.

The Contractor shall provide to Employer, within 15 Days of the end of each calendar quarter, a list and description of all potential or actual problems.

17. Consultant for the Project

NEA has appointed M/S Power Grid Corporation of India in association with Jade Consult as the Post contract supervision consultant for this Project. The consultant shall be responsible for all work related to the execution of the project including billing of the project.

CHAPTER 2 – STANDARD SPECIFICATIONS

CHAPTER 2: STANDARD SPECIFICATIONS

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Chapter 2

STANDARD SPECIFICATIONS

1. General

1.1 These Standard Specifications, shall govern the performance of the Works and shall be the basis for inspection and acceptance of the Work by the Project.

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

1.4 System Parameter

11kV System

SL No	Description of parameters	11 kV System
1.	System operating voltage	11kV
2.	Maximum operating voltage of the system(rms)	12kV
3.	Rated frequency	50Hz
4.	No. of phase	3
5.	Rated Insulation levels	
i)	Full wave impulse withstand voltage (1.2/50 microsec.)	75 kVp
ii)	One minute power frequency dry and wet withstand voltage (rms)	28kV
6.	Corona extinction voltage	-
7.	Max. radio interference voltage for frequency between 0.5 MHz and 2 MHz at 92KV rms for 132KV system	-
8.	Minimum creepage distance (25mm/kV)	300mm
9.	Min. Clearances	
i.	Phase to phase	120 mm
ii.	Phase to earth	120 mm
iii)	Sectional clearances	
10.	Rated short circuit current	25 kA for 3 Sec
11.	System neutral earthing	Effectively earthed

Note :

1. The above parameters are applicable for installations up to an altitude of 1000m above mean sea level. For altitude exceeding 1000m, necessary altitude correction factor shall be applicable.
2. The insulation and RIV levels of the equipment shall be as per values given in the respective chapter of the equipment.

2. **Route of Circuits**

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

The arrangement of laying the cable en-route shall be submitted by Contractor during detailed engineering for Employer's acceptance. The Contractor shall also submit an inception report indicating detail description of procedure (Method Statement for Construction) to be deployed for laying of underground/ fibre optic cable, OH line including RMU, DTs and LT feeder panel. The Contractor shall propose optimum cable sizing based on load current, voltage drop, short circuit current and protective device requirement and also to maintain reliable ring main 11 kV supply.

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

3. **Survey and Staking**

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

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

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

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

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

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

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

3.8 The contractor shall prepare Web GIS application for visualizing the inventory data on maps and Google Earth satellite image using open source tools.

4. Technical Documentation

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

4.2 The list of drawings/documents which are to be submitted to the Employer shall be discussed and finalized by the Employer at the time of award. The Contractor shall necessarily submit all the drawings/ documents unless anything is waived.

4.3 The Contractor shall submit 4 (four) sets of drawings/ design documents /data / detailed inception report, bill of quantity, working methodology and 1 (one) set of test reports for the approval of the Employer. The contractor shall also submit the softcopy of the above documents in addition to hardcopy.

4.4 Documentation shall be prepared using the following mediums:

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

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

4.5 Structure Data Sheets (SDS) shall be prepared in accordance with the F1 format contained in Volume 2. Structure Data Sheets shall be prepared by the Contractor showing his proposed construction details for erection of facilities in accordance with the Construction Standards. The SDS shall be prepared after the centre-line survey and staking is completed, for any line section designated by Project, and shall be submitted to Project for approval prior to any construction of the facilities shown in SDS. Submission of SDS for

approval shall be in the form of A3 photocopy in clearly legible copy. Any unclear or illegible form entry or reproduction shall be rejected. Project may require any revisions to be made, at their sole discretion, prior to approval of the SDS for construction. An approved and field checked SDS is required for all Construction Units invoiced by the Contractor. Field checking of the SDS shall be performed jointly by the Contractor and Project representative. The SDS and As Built Plan are intended as permanent records for Project. Any construction performed prior to the Contractor's receipt of approved SDS from Project shall be completely at the Contractor's risk, and Project shall have the right to require any correction due to the un-approved construction activities.

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

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

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

4.9 Drawings

4.9.1 All drawings submitted by the Contractor shall be in sufficient detail to indicate the type, size, arrangement, material description, Bill of Materials, weight of each component, break-up for packing and shipment, dimensions, internal & the external connections, fixing arrangement required and any other information specifically requested in the specifications.

4.9.2 Drawings submitted by the Contractor shall be clearly marked with the name of the Employer, the unit designation, the specifications title, the specification number and the name of the Project. Employer/Consultant has standardized few drawings/documents of various make including type test reports which can be used for all projects having similar requirements and in such cases no project specific approval (except for list of applicable drawings along with type test reports) is required. However, distribution copies of standard drawings/documents shall be submitted as per provision of the contract. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be in SI units.

4.9.3 The review of these data by the Employer will cover only general conformance of the data to the specifications and documents interfaces with the equipment provided under the specifications, external connections and of the dimensions which might affect substation layout. This review by the Employer may not indicate a thorough review of all dimensions,

quantities and details of the equipment, materials, any devices or items indicated or the accuracy of the information submitted. This review and/or approval by the Employer shall not be considered by the Contractor, as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications and documents.

4.9.4 All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawings shall be at the Contractor's risk. The Contractor may make any changes in the design which are necessary to make the equipment conform to the provisions and intent of the Contract and such changes will again be subject to approval by the Employer. Approval of Contractor's drawing or work by the Employer shall not relieve the contractor of any of his responsibilities and liabilities under the Contract.

4.9.5 All engineering data submitted by the Contractor after final process including review and approval by the Employer shall form part of the Contract Document and the entire works performed under these specifications shall be performed in strict conformity, unless otherwise expressly requested by the Employer in Writing.

4.10 Approval Procedure

The scheduled dates for the submission of the drawings by the Contractor as well as any data/information to be furnished by the Employer would be discussed and finalized at the time of award. The following schedule shall be followed generally for approval and for providing final documentation.

i. Approval/comments by Employer on initial submission - As per agreed Schedule
ii. Resubmission (whenever required) - Within 3 (three) weeks from date of comments
iii. Approval or comments - Within 3 (three) weeks of receipt of resubmission.
iv. Furnishing of distribution copies (3 hard copies and one scanned copy (pdf format)) - 2 (two) weeks from the date of approval
v. Furnishing of distribution copies of test reports
   (a) Type test report (one scanned softcopy & one hardcopy) - 2 weeks from the date final approval
   (b) Routine Test Reports (one scanned softcopy & one hardcopy) -do-
vi. Furnishing of instruction / operation manuals (one scanned softcopy & one hardcopy) –As per agreed schedule
vii. GIS based as built drawings (one scanned softcopy & one hardcopy) - On completion of each 11 kV feeder and associated LT lines.

Note:

1) The contractor may please note that all resubmissions must incorporate all comments given in the earlier submission by the Employer or adequate justification for not incorporating the same must be submitted failing which the submission of documents is likely to be returned.

2) All drawings should be submitted in softcopy form, however design drawings like SLD, GA, all layouts etc. shall also be submitted in AutoCAD Version.
3) The instruction Manuals shall contain full details of drawings of all equipment being supplied under this contract, their exploded diagrams with complete instructions for storage, handling, erection, commissioning, testing, operation, trouble shooting, servicing and overhauling procedures.
4) If after the commissioning and initial operation of the substation, the instruction manuals require any modifications/ additions/changes, the same shall be incorporated and the updated final instruction manuals shall be submitted by the Contractor to the Employer.
5) The Contractor shall furnish to the Employer catalogues of spare parts.
6) All As-built drawings/documents shall be certified by site indicating the changes before final submission.

5. Material Storage

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

5.2 Worksite

a) Extended storage of materials along the routes of lines will not be permitted. All small items of material shall be provided to the work crews on a daily basis and no small items of materials may be stored on the worksite overnight.
b) Transformers, ABC cable, Cable and conductor reels may be spotted at the worksites for a short period prior to installation provided that crating and reel lagging are intact to protect the items. Poles may be spotted at structure locations for short periods prior to setting.
c) All poles, transformers, ABC cable and conductor placed at the worksites shall be located so that the items are not subject to damage and do not impede pedestrian or vehicular traffic.
d) Any damage caused by imprudent placement of equipment and materials by the Contractor at the worksites shall be corrected by the Contractor, in a manner acceptable to the Project, at the Contractor's cost.

5.3 Contractor Storage Facility

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

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

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

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

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

6. **Excavations**

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

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

6.3 A suitable rubber mat shall be used to cover the backfilled trenches to prevent the dust pollution. The mat shall be such that it can take the weight of the vehicles.

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

6.5 All excavations shall be backfilled with excavated material, or as specified for the installation. Backfill shall be free of foreign materials and shall be well tamped with excess backfill graded over the excavated area to prevent depressions resulting from eventual

natural compaction. Large amounts of excess backfill shall be removed from the site by the Contractor if so directed by Employer. If so directed by Project, the Contractor shall provide suitable backfill materials for excavations where existing removed materials is insufficient, or inappropriate, to provide suitable grading of the excavated area.

7. **Pole Setting**

7.1 Poles shall be set in accordance with the relevant standard and Construction drawings provided.

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

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

8. **Safety**

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

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

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

a) Work is being performed on lines adjacent, either in extension of, or parallel to, energized circuits.

b) Work is being performed on isolated circuits after conductors have been installed.

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

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

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

9. Tests

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

9.2 The Contractor shall megger all circuits installed with a motor-driven megger or equivalent instrument. All circuits installed with a motor-driven megger to demonstrate the acceptable insulation characteristics of the line prior to energization and Provisional Acceptance. Overhead circuits shall be tested at 2500/1000 volts AC.

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

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

10. Demolition

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

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

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

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

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

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

11. **Clean Up**

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

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

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

12. **Tree Cutting and Trimming**

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

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

13. **Interruptions to Existing Service**

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

14. PACKAGING & PROTECTION

14.1 All the equipment shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. On request of the Employer, the Contractor shall also submit packing details/associated drawing for any equipment/material under his scope of supply, to facilitate the Employer to repack any equipment/material at a later date, in case the need arises. While packing all the materials, the limitation from the point of view of availability of Railway wagon sizes should be taken into account. The Contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. Any demurrage, wharf-age and other such charges claimed by the

transporters, railways etc. shall be to the account of the Contractor. Employer takes no responsibility of the availability of the wagons.

14.2 All coated surfaces shall be protected against abrasion, impact, dis-colouration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protecting device. All ends of all valves and pipings and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage.

15.0 FINISHING OF METAL SURFACES

15.1 All metal surfaces shall be subjected to treatment for anti-corrosion protection. All ferrous surfaces for external use unless otherwise stated elsewhere in the specification or specifically agreed, shall be hot-dip galvanized after fabrication. High tensile steel nuts & bolts and spring washers shall be electro galvanized to service condition 4. All steel conductors including those used for earthing/grounding (above ground level) shall also be galvanized according to Equivalent International Standards.

15.2 HOT DIP GALVANISING

15.2.1 The minimum weight of the zinc coating shall be 610 gm/sq .m. and minimum average thickness of coating shall be 86 microns for all items having thickness 6mm and above. For items lower than 6mm thickness requirement of coating thickness shall be as per relevant ASTM. For surface which shall be embedded in concrete, the zinc coating shall be 610 gm/sq. m minimum.

15.2.2 The galvanized surfaces shall consist of a continuous and uniform thick coating of zinc, firmly adhering to the surface of steel. The finished surface shall be clean and smooth and shall be free from defects like discoloured patches, bare spots, unevenness of coating, spelter which is loosely attached to the steel globules, spiky deposits, blistered surface, flaking or peeling off, etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection.

15.2.3 After galvanizing no drilling or welding shall be performed on the galvanized parts of the equipment excepting that nuts may be threaded after galvanizing. Sodium dichromate treatment shall be provided to avoid formation of white rust after hot dip galvanization.

15.2.4 The galvanized steel shall be subjected to six one minute dips in copper sulphate solution as per ASTM.

15.2.5 Sharp edges with radii less than 2.5 mm shall be able to withstand four immersions of the Standard Preece test. All other coatings shall withstand six immersions. The

following galvanizing tests should essentially be performed as per relevant ASTM Standards.

- Coating thickness
- Uniformity of zinc
- Adhesion test
- Mass of zinc coating

15.2.6 Galvanized material must be transported properly to ensure that galvanized surfaces are not damaged during transit. Application of zinc rich paint at site shall not be allowed.

15.3 PAINTING

15.3.1 All sheet steel work shall be degreased, pickled, phosphated in accordance with the IS-6005/Equivalent International standard “Code of practice for phosphating iron and sheet”. All surfaces, which will not be easily accessible after shop assembly, shall beforehand be treated and protected for the life of the equipment. The surfaces, which are to be finished painted after installation or require corrosion protection until installation, shall be shop painted with at least two coats of primer. Oil, grease, dirt and swarf 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.

15.3.2 After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and oven drying. The phosphate coating shall be sealed with application of two coats of ready mixed, stoving type zinc chromate primer. The first coat may be “flash dried” while the second coat shall be stoved.

15.3.3 After application of the primer, two coats of finishing synthetic enamel paint shall be applied, each coat followed by stoving. The second finishing coat shall be applied after inspection of first coat of painting.

15.3.4 The exterior and interior colour of the paint in case of new substations shall preferably be RAL 7032 for all equipment, marshalling boxes, junction boxes, control cabinets, panels etc. unless specifically mentioned under respective chapters of the equipment. Glossy white colour inside the equipment /boards /panels/junction boxes is also acceptable. The exterior colour for panels shall be matching with the existing panels in case of extension of a substation. Each coat of primer and finishing paint shall be of slightly different shade to enable inspection of the painting. A small quantity of finishing paint shall be supplied for minor touching up required at site after installation of the equipment.

15.3.5 In case the Bidder proposes to follow his own standard surface finish and protection procedures or any other established painting procedures, like electrostatic painting etc., the procedure shall be submitted along with the Bids for Employer's review & approval.

15.3.6 For aluminium casted surfaces, the surface shall be with smooth finish. Further, in case of aluminium enclosures the surface shall be coated with powder (coating thickness of 60 microns) after surface preparation for painting.

16. TOOLS AND TACKLES

The Contractor shall supply with the equipment one complete set of all special tools and tackles for the erection, assembly, dis-assembly and maintenance of the equipment. However, these tools and tackles shall be separately, packed and brought on to Site.

17. AUXILIARY SUPPLY

17.1 The auxiliary power for station supply, including the equipment drive, cooling system of any equipment, air-conditioning, lighting etc shall be designed for the specified Parameters as under. The AC / DC supply for the instrumentation and SCADA system shall also confirm the parameters as indicated in the following.

Normal Voltage	**Variation in Voltage**	**Frequency in HZ**	**Phase/ Wire**	**Neutral connection**
400V	+ 10	50 + 2.5%	3/4 Wire	Solidly Earthed.
230V	+ 10	50 + 2.5%	1/2 Wire	Solidly Earthed.
220V	190V to 240V	DC	-	Isolated 2 wire System
110V	95V to 120V	DC	-	Isolated 2 wire System
48V or 24 V	_	DC	_	2 wire system (+) earthed

Combined variation of voltage and frequency shall be limited to + 10%.

18.0 CLAMPS AND CONNECTORS INCLUDING TERMINAL CONNECTORS

18.1 All power clamps and connectors shall conform to ANSI/NEMA CC1/ Equivalent International standard and shall be made of materials listed below:

i.	For connecting, ACSR conductors	- Aluminium alloy casting conforming to BS:1490/ Equivalent International Standard
ii.	For connecting equipment terminals made of copper with ACSR conductors	- Bimetallic connectors made from aluminium alloy casting conforming to BS: 1490 / Equivalent International Standard with 2mm thick bimetallic liner.
iii.	For connecting GI	- Galvanized mild shield wire
iv.	Bolts nuts and plain washers Spring washers for item 'a' to 'c'	- Electro-galvanized for sizes Plain, washers below M12, for others hot dip galvanized. - Electro-galvanized mild steel

18.2 Necessary clamps and connectors shall be supplied for all equipment and connections. The requirement regarding external corona and RIV as specified for any equipment shall include its terminal fittings. If corona rings are required to meet these requirements they shall be considered as part of that equipment and included in the scope of work.

18.3 Where copper to aluminium connections are required, bi-metallic clamps shall be used, which shall be properly designed to ensure that any deterioration of the connection is kept to a minimum and restricted to parts which are not current carrying or subjected to stress.

18.4 Low voltage connectors, grounding connectors and accessories for grounding all equipment as specified in each particular case, are also included in the scope of Work.

18.5 No current carrying part of any clamp shall be less than 10 mm thick. All ferrous parts shall be hot dip galvanized. Copper alloy liner of minimum 2 mm thickness shall be cast integral with aluminium body or 2 mm thick bi-metallic strips shall be provided for Bi-metallic clamps.

18.6 All casting shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off.

18.7 Clamp shall be designed to carry the same current as the conductor and the temperature rise shall be equal or less than that of the conductor at the specified ambient temperature. The rated current for which the clamp/connector is designed with respect to the specified reference ambient temperature, shall also be indelibly marked on each component of the clamp/connector, except on the hardware.

18.8 All current carrying parts shall be designed and manufactured to have minimum contact resistance.

18.9 Tests

18.9.1 Clamps and connectors should be type tested as per NEMA CC1/ Equivalent International Standard and shall also be subjected to routine tests as per NEMA CC1/ Equivalent International Standard. Following type test reports shall be submitted for approval as per

clause 9.2 above except for sl. no.(ii) & (iii) for which type test once conducted shall be applicable (i.e. the requirement of test conducted within last ten years shall not be applicable).

i) Temperature rise test (maximum temperature rise allowed is 35°C over 50°C ambient)

ii) Short time current test

iii) Resistance test and tensile test

19.0 CONTROL CABINETS, DISTRIBUTION BOXES FOR OUTDOOR EQUIPMENT

19.1 All types of boxes, cabinets etc. shall generally conform to & be tested in accordance with IEC-60439, as applicable, and the clauses given below:

19.2 Control cabinets, junction boxes, Marshalling boxes & terminal boxes shall be made of sheet steel or aluminium enclosure and shall be dust, water and vermin proof. Sheet steel used shall be at least 2.0 mm thick cold rolled or 2.5 mm hot rolled or alternately 1.6 mm thick stainless steel can also be used subjected to approval from Employer. The box shall be properly braced to prevent wobbling. There shall be sufficient reinforcement to provide level surfaces, resistance to vibrations and rigidity during transportation and installation. In case of aluminium enclosed box the thickness of aluminium shall be such that it provides adequate rigidity and long life as comparable with sheet steel of specified thickness.

19.3 A canopy and sealing arrangements for operating rods shall be provided in marshaling boxes / Control cabinets to prevent ingress of rain water.

19.4 Cabinet / boxes shall be provided with double hinged doors with padlocking arrangements. The distance between two hinges shall be adequate to ensure uniform sealing pressure against atmosphere. The quality of the gasket shall be such that it does not get damaged/cracked during the operation of the equipment.

19.5 All doors, removable covers and plates shall be gasketed all around with suitably profiled EPDM/Neoprene gaskets. The gasket shall be tested in accordance with approved quality plan, BS: 4255 / Equivalent International Standard. Ventilating Louvers, if provided, shall have screen and filters. The screen shall be fine wire mesh made of brass.

19.6 All boxes/cabinets shall be designed for the entry of cables from bottom by means of weather proof and dust-proof connections. Boxes and cabinets shall be designed with generous clearances to avoid interference between the wiring entering from below and any terminal blocks or accessories mounted within the box or cabinet. Suitable cable gland plate above the base of the marshalling kiosk/box shall be provided for this purpose along with the proper blanking plates. Necessary number of cable glands shall be supplied and fitted on this gland plate. Gland plate shall have provision for some future glands to be provided later, if required. The Nickel plated glands shall be dust proof, screw on & double compression type and made of brass. The gland shall have provision for securing armour of

the cable separately and shall be provided with earthing tag. The glands shall conform to BS: 6121 or equivalent standard.

19.7 Positive earthing of the cabinet shall be ensured by providing two separate earthing pads. The earth wire shall be terminated on to the earthing pad and secured by the use of self etching washer. Earthing of hinged door shall be done by using a separate earth wire.

19.8 The following routine tests along with the routine tests as per IEC 60529/ Equivalent International Standard shall also be conducted:

i) Check for wiring

ii) Visual and dimension check

a) The enclosure of bay marshalling kiosk, junction box, terminal box shall conform to IP-55 as per IEC 60529/ Equivalent International Standard including application of, 2.0 kV rms for 1 (one) minute, insulation resistance and functional test after IP-55 test.

20. TERMINAL BLOCKS AND WIRING

20.1 Control and instrument leads from the switchboards or from other equipment will be brought to terminal boxes or control cabinets in conduits. All interphase and external connections to equipment or to control cubicles will be made through terminal blocks.

20.2 Terminal blocks shall be 650V grade and have continuous rating to carry the maximum expected current on the terminals and non-breakable type. These shall be of moulded piece, complete with insulated barriers, stud type terminals, washers, nuts and lock nuts. Screw clamp, overall insulated, insertion type, rail mounted terminals can be used in place of stud type terminals. But preferably the terminal blocks shall be non-disconnecting stud type of Elmex or Phoenix or Wago or equivalent make.

20.3 Terminal blocks for current transformer and voltage transformer secondary leads shall be provided with test links and isolating facilities. The current transformer secondary leads shall also be provided with short circuiting and earthing facilities.

20.4 The terminal shall be such that maximum contact area is achieved when a cable is terminated. The terminal shall have a locking characteristic to prevent cable from escaping from the terminal clamp unless it is done intentionally.

20.5 The conducting part in contact with cable shall preferably be tinned or silver plated however Nickel plated copper or zinc plated steel shall also be acceptable.

20.6 The terminal blocks shall be of extensible design.

20.7 The terminal blocks shall have locking arrangement to prevent its escape from the mounting rails.

20.8 The terminal blocks shall be fully enclosed with removable covers of transparent, non-deteriorating type plastic material. Insulating barriers shall be provided between the terminal blocks. These barriers shall not hinder the operator from carrying out the wiring without removing the barriers.

20.9 Unless otherwise specified terminal blocks shall be suitable for connecting the following conductors on each side.

a) All circuits except CT/PT circuits - Minimum of two of 2.5 sq. mm copper flexible.

b) All CT/PT circuits - Minimum of 4 nos. of 2.5 sq. mm copper flexible.

20.10 The arrangements shall be in such a manner so that it is possible to safely connect or disconnect terminals on live circuits and replace fuse links when the cabinet is live.

20.11 At least 20 % spare terminals shall be provided on each panel/cubicle/box and these spare terminals shall be uniformly distributed on all terminals rows.

20.12 There shall be a minimum clearance of 250 mm between the First/bottom row of terminal block and the associated cable gland plate for outdoor ground mounted marshaling box and the clearance between two rows of terminal blocks shall be a minimum of 150 mm.

20.13 The Contractor shall furnish all wire, conduits and terminals for the necessary interphase electrical connections (where applicable) as well as between phases and common terminal boxes or control cabinets.

20.14 All input and output terminals of each control cubicle shall be tested for surge withstand capability in accordance with the relevant IEC Publications, in both longitudinal and transverse modes. The Contractor shall also provide all necessary filtering, surge protection, interface relays and any other measures necessary to achieve an impulse withstand level at the cable interfaces of the equipment.

21. LAMPS & SOCKETS

21.1 Sockets

All sockets (convenience outlets) shall be suitable to accept both 5 Amp & 15 Amp pin round plug as per Nepalese Standard. They shall be switched sockets with shutters.

21.2 Hand Lamp:

A 230 Volts, single Phase, 50 Hz AC plug point shall be provided in the interior of each cubicle with ON-OFF Switch for connection of hand lamps.

21.3 Switches and Fuses:

21.3.1 Each panel shall be provided with necessary arrangements for receiving, distributing, isolating and fusing of DC and AC supplies for various control, signalling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with miniature circuit breaker / switch fuse units. Selection of the main and Sub-circuit fuse ratings shall be such as to ensure selective clearance of sub-circuit faults. Potential circuits for relaying and metering shall be protected by HRC fuses.

21.3.2 All fuses shall be of HRC cartridge type conforming to IS: 9228/ Equivalent International Standard mounted on plug-in type fuse bases. Miniature circuit breakers with thermal protection and alarm contacts will also be accepted. All accessible live connection to fuse

bases shall be adequately shrouded. Fuses shall have operation indicators for indicating blown fuse condition. Fuse carrier base shall have imprints of the fuse rating and voltage.

ANNEXURE - A

LIST OF SPECIFICATIONS

GENERAL STANDARDS AND CODES

IEC-60060 (Part 1 to P4) -High Voltage Test Techniques

IEC 60068 - Environmental Test

IEC-60117 - Graphical Symbols

IEC-60156, - Method for the Determination of the Electrical Strength of Insulation Oils.

IEC-60270, - Partial Discharge Measurements.

IEC-60376 - Specification and Acceptance of New Sulphur Hexafluoride

IEC-60437 - Radio Interference Test on High Voltage Insulators.

IEC-60507 - Artificial Pollution Tests on High Voltage Insulators to be used on AC Systems.

IEC-62271-1 - Common Specification for High Voltage Switchgear & Controlgear Standards.

IEC-60815 - Guide for the Selection of Insulators in respect of Polluted Conditions.

IEC-60865 (P1 & P2) - Short Circuit Current - Calculation of effects.

ANSI-C.1/NFPA.70 - National Electrical Code

ANSI-C37.90A - Guide for Surge Withstand Capability (SWC) Tests

ANSI-C63.21, - Specification for Electromagnetic Noise and

C63.3 - Field Strength Instrumentation 10 KHz to 1 GHZ

C36.4ANSI-C68.1 - Techniques for Dielectric Tests

ANSI-C76.1/EEE21 - Standard General Requirements and Test Procedure for Outdoor Apparatus Bushings.

ANSI-SI-4 - Specification for Sound Level Metres

ANSI-Y32-2/C337.2 - Drawing Symbols

ANSI-Z55.11 - Gray Finishes for Industrial Apparatus and Equipment No. 61 Light Gray

NEMA-107T - Methods of Measurements of RIV of High Voltage Apparatus

NEMA-ICS-II - General Standards for Industrial Control and Systems Part ICSI-109

CSA-Z299.1-1978h - Quality Assurance Program Requirements

CSA-Z299.2-1979h - Quality Control Program Requirements

CSA-Z299.3-1979h - Quality Verification Program Requirements

CSA-Z299.4-1979h - Inspection Program Requirements

CIRCUIT BREAKERS

IEC-62271-100 - High-voltage switchgear and control gear - Part 100: Alternating current circuit-breakers

IEC-62271-101 - High-voltage switchgear and control gear - Part 101: Synthetic testing

IEC-62155 - Hollow pressurized and unpressurized ceramic and glass insulators for use in electrical equipment with rated voltages greater than 1 000 V

IEC-62271-110 - High-voltage switchgear and control gear - Part 110: Inductive load switching

IEC-62271-109 - High-voltage switchgear and control gear - Part 110: Inductive load switching

CURRENT TRANSFORMERS, VOLTAGE TRANSFORMERS

IEC-60044-1 - Current Transformers.

IEC-60044-2 - Inductive Voltage Transformers.

IEC-60044-4 - Instrument Transformers: Measurement of Partial Discharges

ANSI-C5713 - Requirements for Instrument transformers

BUSHING

IEC-60137 - Insulated Bushings for Alternating Voltages above 1000V

SURGE ARRESTERS

IEC-60099-4 - Metal oxide surge arrestors without gaps

IEC-60099-5 - Selection and application recommendation

ANSI-C62.1 - IEE Standards for S A for AC Power Circuits

NEMA-LA 1 - Surge Arresters

CUBICLES AND PANELS & OTHER RELATED EQUIPMENT

IEC-60068.2.2- Basic environmental testing procedures Part 2: Test B: Dry heat

IEC-60529 - Degree of Protection provided by enclosures.

IEC-60947-4-1 - Low voltage switchgear and control gear.

IEC-61095 - Electromechanical Contactors for household and similar purposes.

IEC-60439 (P1 & 2) - Low Voltage Switchgear and control gear assemblies

ANSI-C37.20 - Switchgear Assemblies, including metal enclosed bus.

ANSI-C37.50 - Test Procedures for Low Voltage Alternating Current Power Circuit Breakers

ANSI-C39 - Electric Measuring instrument

ANSI-C83 - Components for Electric Equipment

NEMA-AB - Moulded Case Circuit and Systems

NEMA-CS - Industrial Controls and Systems

NEMA-PB-1 - Panel Boards

NEMA-SG-5 - Low voltage Power Circuit breakers

NEMA-SG-3 - Power Switchgear Assemblies

NEMA-SG-6 - Power switching Equipment

NEMA-5E-3 - Motor Control Centers

1248 (P1 to P9) - Direct acting indicating analogue electrical measuring instruments & their accessories.

Disconnecting Switches/ Load Break Switch

IEC-62271-102- High-voltage switchgear and controlgear - Part 102: Alternating current disconnectors and earthing switches

IEC-60265 (Part 1 & 2)- High Voltage switches

ANSI-C37.32 - Schedule of preferred Ratings, Manufacturing Specifications and Application Guide for high voltage Air Switches, Bus supports and switch accessories

ANSI-C37.34 - Test Code for high voltage air switches

NEMA-SG6 - Power switching equipment

Protection and control equipment

IEC-60051: (P1 to P9) - Recommendations for Direct Acting indicating analogue electrical measuring instruments and their accessories.

IEC-60255 (Part 1 to 23)- Electrical relays.

IEC-60297

(P1 to P4) - Dimensions of mechanical structures of the 482.6mm (19 inches) series.

IEC-60359 - Expression of the performance of electrical & electronic measuring equipment.

IEC-60387 - Symbols for Alternating-Current Electricity meters.

IEC-60447 - Man machine interface (MMI) - Actuating principles.

IEC-60521 - Class 0.5, 1 and 2 alternating current watt hour metres

IEC-60547 - Modular plug-in Unit and standard 19-inch rack mounting unit based on NIM Standard (for electronic nuclear instruments)

ANSI-81 - Screw threads

ANSI-B18 - Bolts and Nuts

ANSI-C37.1 - Relays, Station Controls etc.

ANSI-C37.2 - Manual and automatic station control, supervisory and associated telemetering equipment

ANSI-C37.2 - Relays and relay systems associated with electric power apparatus

ANSI-C39.1 - Requirements for electrical analog indicating instruments

MOTORS

IEC-60034 (P1 to P19) - Rotating electrical machines

IEC-Document 2 - Three phase induction motors

(Central Office) NEMA-MGI Motors and Generators

Electronic equipment and components

MIL-21B, MIL-833 & MIL-2750

IEC-60068 (P1 to P5) - Environmental testing

IEC-60326 (P1 to P2) - Printed boards

Material and workmanship standards

ASTM - Specification and tests for materials

Clamps & connectors

NEMA-CC1 - Electric Power connectors for sub station

NEMA-CC 3 - Connectors for Use between aluminium or aluminium-Copper Overhead Conductors Hardware and insulators

IEC-60120 - Dimensions of Ball and Socket Couplings of string insulator units.

IEC-60137 - Insulated bushings for alternating voltages above 1000 V.

IEC-60168 - Tests on indoor and outdoor post insulators of ceramic material or glass for Systems with Nominal Voltages Greater than 1000 V.

IEC-62155 - Hollow pressurized and unpressurized ceramic and glass insulators for use in electrical equipment with rated voltages greater than 1000 V

IEC-60273 - Characteristics of indoor and outdoor post insulators for systems with nominal voltages greater than 1000V.

IEC-61462 - Pressurized and un-pressurized insulator for use in electrical equipment with rated voltage greater than 1000V – Definitions, Test methods, acceptance criteria and design recommendations

IEC-60305- Insulators for overhead lines with nominal voltage above 1000V-ceramic or glass insulator units for a.c. systems Characteristics of String Insulator Units of the cap and pin type.

IEC-60372 (1984) -Locking devices for ball and socket couplings of string insulator units: dimensions and tests.

IEC-60383 (P1 and P2) - Insulators for overhead lines with a nominal voltage above 1000 V.

IEC-60433 - Characteristics of string insulator units of the long rod type.

IEC-60471 - Dimensions of Clevis and tongue couplings of string insulator units.

ANSI-C29 - Wet process porcelain insulators

ANSI-C29.1 - Test methods for electrical power insulators

ANSI-C92.2 - For insulators, wet-process porcelain and toughened glass suspension type

ANSI-C29.8 - For wet-process porcelain insulators apparatus, post-type

ANSI-G.8 - Iron and steel hardware

CISPR-7B - Recommendations of the CISPR, tolerances of form and of Position, Part 1

ASTM A-153 - Zinc Coating (Hot-Dip) on iron and steel hardware

ASTM-B 230-82 - Aluminium 1350 H19 Wire for electrical purposes

ASTM-B 231-81 - Concentric - lay - stranded, aluminium 1350 conductors

ASTM-B 221 - Aluminium - Alloy extruded bar, road, wire, shape

ASTM-B 317-83 - Aluminium-Alloy extruded bar, rod, pipe and structural shapes for electrical purposes (Bus Conductors)

Batteries and batteries charger

Battery

IEC:60896-21&22- Lead Acid Batteries Valve Regulated types – Methods of Tests & Requirements

IEC: 60623 - Vented type nickel Cadmium Batteries

IEC: 60622 - Secondary Cells & Batteries – Sealed Ni-Cd rechargeable single cell

IEC: 60623 - Secondary Cells & Batteries – Vented Ni-Cd rechargeable single cell

IEC: 60896-11 - Stationary Lead Acid Batteries – Vented Type – General requirements & method of tests

IEEE-485 - Recommended practices for sizing of Lead Acid Batteries

IEEE-1115 - Sizing of Ni-Cd Batteries

IEEE-1187 - Recommended practices for design & installation of VRLA Batteries

IEEE-1188 - Recommended practices for design & installation of VRLA Batteries

IEEE-1189 - Guide for selection of VRLA Batteries

Wires and cables

ASTMD-2863 - Measuring the minimum oxygen concentration to support candle like combustion of plastics (oxygen index)

IEC-60096 (part 0 to p4) - Radio Frequency cables.

IEC-60183 - Guide to the Selection of High Voltage Cables.

IEC-60189 (P1 to P7) - Low frequency cables and wires with PVC insulation and PVC sheath.

IEC-60227 (P1 to P7) - Polyvinyl Chloride insulated cables of rated voltages up to and including 450/750V.

IEC-60228- Conductors of insulated cables

IEC-60230- Impulse tests on cables and their accessories.

IEC-60287 (P1 to P3) - Calculation of the continuous current rating of cables (100% load factor).

IEC-60304- Standard colours for insulation for low-frequency cables and wires.

IEC-60331- Fire resisting characteristics of Electric cables.

IEC-60332 (P1 to P3) - Tests on electric cables under fire conditions.

IEC-60502- Extruded solid dielectric insulated power cables for rated voltages from 1 kV upto to 30 kV

IEC-754 (P1 and P2) - Tests on gases evolved during combustion of electric cables.

Painting

ANSI-Z551 - Gray finishes for industrial apparatus and equipment

SSPEC - Steel structure painting council

PIPING VALVES & SPECIALITIES

BS:5150 - Specification for cast iron gate valves

Steel structures

ANSI-B18.2.1 - Inch series square and Hexagonal bolts and screws

ANSI-B18.2.2 - Square and hexagonal nuts

ANSI-G8.14 - Round head bolts

ASTM-A6 - Specification for General Requirements for rolled steel plates, shapes, sheet piling and bars of structural use

ASTM-A36 - Specifications of structural steel

ASTM-A47 - Specification for malleable iron castings

ASTM-A143 - Practice for safeguarding against embilement of Hot Galvanized structural steel products and procedure for detaching embrilement

ASTM-A242 - Specification for high strength low alloy structural steel

ASTM-A283 - Specification for low and intermediate tensile strength carbon steel plates of structural quality

ASTM-A394 - Specification for Galvanized steel transmission tower bolts and nuts

ASTM-441 - Specification for High strength low alloy structural manganese vanadium steel.

ASTM-A572 - Specification for High strength low alloy columbium-Vanadium steel of structural quality

AWS D1-0 - Code for welding in building construction welding inspection

AWS D1-1 - Structural welding code

AISC - American institute of steel construction

NEMA-CG1 - Manufactured graphite electrodes

Piping and pressure vessels

ASME - Boiler and pressure vessel code

ASTM-A120 - Specification for pipe steel, black and hot dipped, zinc-coated (Galvanized) welded and seamless steel pipe for ordinary use

ASTM-A53 - Specification for pipe, steel, black, and hot-dipped, zinc coated welded and seamless

ASTM-A106 - Seamless carbon steel pipe for high temperature service

ASTM-A284 - Low and intermediate tensile strength carbon-silicon steel plates for machine parts and general construction.

ASTM-A234 - Pipe fittings of wrought carbon steel and alloy steel for moderate and elevated temperatures

ASTM-S181 - Specification for forgings, carbon steel for general purpose piping

ASTM-A105 - Forgings, carbon steel for piping components

ASTM-A307 - Carbon steel externally threated standard fasteners

ASTM-A193 - Alloy steel and stainless steel bolting materials for high temperature service

ASTM-A345 - Flat rolled electrical steel for magnetic applications

ASTM-A197	-	Cupola malleable iron
ANSI-B2.1	-	Pipe threads (Except dry seal)
ANSI-B16.1	-	Cast iron pipe flanges and glanded fitting. Class 25, 125, 250 and 800
ANSI-B16.1	-	Malleable iron threaded fittings, class 150 and 300
ANSI-B16.5	-	Pipe flanges and flanged fittings, steel nickel alloy and other special alloys
ANSI-B16.9	-	Factory-made wrought steel butt welding fittings
ANSI-B16.11	-	Forged steel fittings, socket-welding and threaded
ANSI-B16.14	-	Ferrous pipe plug, bushings and locknuts with piple threads
ANSI-B16.25	-	Butt welding ends
ANSI-B18.1.1	-	Fire hose couplings screw thread.
ANSI-B18.2.1	-	Inch series square and hexagonal bolts and screws
ANSI-B18.2.2	-	Square and hexagonal nuts
NSI-B18.21.1	-	Lock washers
ANSI-B18.21.2	-	Plain washers
ANSI-B31.1	-	Power piping
ANSI-B36.10	-	Welded and seamless wrought steel pipe
ANSI-B36.9	-	Stainless steel pipe

CHAPTER 3

SPECIFICATION OF EQUIPMENT AND CONSTRUCTION MATERIALS

TABLE OF CONTENTS

GENERAL OPERATING CONDITIONS

1.	Ambient temperature	-5° C to 45° C
2.	Altitude	Approximately 1420 m above MSL
3.	Humidity	100% (max.)
4.	Mains voltage:	11 kV for HT and 400/230 V for LT
5.	System frequency	50 Hz

Note: The variation of frequency and voltage for design and operation is as per actual system operation i.e. ± 5 %.

A. PRESTRESSED CONCRETE POLE

1. Scope

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

2. Description

2.1 The pre-stressed concrete pole shall be designed and fabricated in full compliance with IS: 1678-1998, 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.

3. Load

3.1 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.

4. Design

4.1 The poles shall be as per following design parameters and the dimensions shall be as shown in Drawing.

Design Parameters:

Concrete mix:	M400
Minimum diameter of pre-stressing wire:	as per approved drawing; 8 nos. for 11m Pole and 4 nos. for 9m Pole
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.

4.2 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.

4.3 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:

Type of material:	as per relevant standard
Minimum diameter of strand:	as per approved design and drawing
Minimum cross-sectional area of strands:	as per approved design and drawing

Long Term Behavior:

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.

4.4 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.

4.5 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.

4.6 The amount of concrete cover on the outside of the pre-stressed reinforcement shall be not less than 20mm.

4.7 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.

4.8 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.

4.9 All poles shall be provided with lifting hooks at two points for loading and unloading of poles.

A complete design analysis shall be submitted to the Employer for approval before manufacturing of poles. The design analysis shall include all calculations, design criteria, applicable standards etc.

Table 1: Working Load

S. No.	*Pole Length (m)*	*Design Load (kgf)*
1	9	400
2	11	400 At 0.6m from Top

5) Tests

Definition of various types of loads:

Working load = Expected Load
Design Working Load = Expected Load x Factor of Safety (FOS)
Ultimate Transverse Load (UTL) = Load when applied at specified point of the pole, the failure occurs.

Minimum Ultimate Transverse Load (MUTL) = Load when applied at specified point of the pole, the first crack appears.
Design Transverse Load (DTL) = Design Working Load
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)
The **Design Ultimate Transverse Load (DUTL)** is less or equal to Ultimate Transverse Load

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.

5.2 *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.

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

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

5.4 All the poles selected in 5.3 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.

5.5 The number of poles which do not satisfy the requirements of overall strength, cross-section and uprightness shall not exceed the number given in 5.3. 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.

5.6 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.

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.

7. Bid Documentation

7.1 The Bidder shall furnish following documents together with Bid;

a. Two (2) clear copies of the standards, governing fabrication and testing of pre-stressed concrete poles and two (2) clear copies of other standards indicated in the specifications.

b. Two (2) clear copies of detailed design and drawings of each type of pole.

c. Two (2) clear certified copies of all tests performed on similar poles of same sizes and similar working loads.

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

7.2 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;
g) Minimum ultimate transverse load;
h) Transverse load at first crack
i) Concrete design mix and cement specification
j) Specifications of the pre-stressing strands, their tensile strength and sizes

Table: 2

Pole Attributes

Overall Length	**11m**	**9m**
Point of Application of Load from Pole Top	0.6m	0.6m
Minimum Depth of Planting	1.8m	1.5m

B. TELESCOPIC TUBULAR STEEL POLE

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C. XLPE CABLE

C1. 11 kV XLPE POWER CABLE

1 CABLE CONSTRUCTION DETAILS

1.1 The XLPE insulated cables shall conform to the requirements of IEC 60502-2 (applicable clauses only) for construction and IEC 60840 and other relevant standards for testing. The terminating accessories shall conform to IEC 60840/ IEC 62067 (as applicable). The offered cables and its terminating accessories shall be compatible with each other.

1.2 The 6.35/11 (12) kV XLPE cable shall be three core, armoured, stranded, compacted conductor Aluminum, core screening by a layer of semiconducting XLPE, treeing resistant XLPE insulation, insulation screening by a layer of semiconducting XLPE. The core screening, insulation and insulation screening to be triple extruded and dry cured. Helically wound copper wire screening with equalising tape, shall be provided on each conductor. The oversheath shall be black HDPE. Bidder may offer necessary layers such as water blocking, separation tape, binder tapes etc. additionally as per their manufacturing practices for meeting required performance of the offered cable.

1.3 The cable shall be suitable for installing in the climate conditions (as specified in this chapter**)**

1.4 Cable shall be designed to withstand all mechanical, electrical and thermal stresses under steady state and transient operating conditions.

1.5 Cable sheath shall be embossed “ELECTRIC CABLE 11000V”. The size of the lettering shall not less than 15% of the approximate cable diameter and shall not be larger than 13mm. The gap between the end of one set of embossed characters and the beginning of the next set shall be not greater than 250mm. In addition the manufacturer and year of manufacture shall be embossed on the cable at regular intervals and shall not affect the spacing of the other characters.

1.6 Each core shall be identifiable throughout the cable either by colour or numbering.

1.7 Repaired cables shall not be accepted.

1.8 Allowable tolerance on the overall diameter of the cables shall be ± 2 mm.

1.9 CONDUCTOR

The conductor shall be of as specified in the Bid Price Schedule **(BPS)**. The shape of conductor shall be compacted having high compactness and smooth surface finish.

1.10 CONDUCTOR SCREEN

The conductor screen shall consist of extruded semi-conducting XLPE. Semi-conducting separator tapes may be applied between conductor and the extruded semi-conductor XLPE. The conductor screen (non-metallic semi-conductive) shall be extruded in a single one-time process to ensure homogeneity and absence of voids. The aluminum

conductor shall comply with requirements specified in relevant IEC with latest amendments.

1.11 INSULATION

The conductor screen shall consist of extruded semi-conducting tape or insulation. Semi-conducting separator tapes may be applied between conductor and the extruded semi-conductor insulation. The conductor screen (non-metallic semi-conductive) shall be extruded in a single one-time process to ensure homogeneity and absence of voids.

1.12 INSULATION SCREEN

The insulation screen shall consist of extruded semi-conducting XLPE. Suitable bedding tapes shall be applied over the extruded semi-conducting XLPE in combination with 1 non-magnetic metallic shield.

1.13 INSULATION and Semi Conducting SCREENs

The XLPE insulation and semi conducting screens shall be triple extruded and dry cured.

1.14 MOISTURE BARRIER

Longitudinal water barrier:
The longitudinal water barrier shall be applied over insulation screen by a layer of non-woven synthetic tape with suitable water swellable absorbent.

1.15 METALLIC SCREEN:

The metallic screen shall be of plain copper wires, helically applied over the radial moisture barrier. A binder tape of annealed plain copper shall be applied in the form of an open helix over the copper wire screen. The copper wire screens shall be applied to each core. The thickness of the metallic screen will be as specified in the TDS. The short circuit current rating for the XLPE cables at maximum temperature of 250 deg.C shall be as specified below.

Conductor Size (mm²)	Short circuit current (1s) (kA)
150	14.17
300	28.34
400	37.79

1.16 OUTER SHEATH

The outer sheath shall consist of extruded black colored HDPE. The outer sheath shall be suitably designed by the addition of chemicals in the outer sheath for protection against termite and rodent attack.

Armouring:

The armour of cables shall consist of aluminum wires or strips. The armoring shall be applied such that the minimum area of coverage shall be 90% and the gap between any two armour strips/ wire shall not be more than the width of strip/ diameter of armour wire. The galvanized steel strips/wire shall comply with the requirements of IEC with latest amendments.

In case of Single core cable armouring shall be of Non-magnetic material with dimensions as per relevant IEC with latest amendments. No tolerance on the negative side shall be acceptable.

1.17 RATING

The contractor/ manufacturer shall declare current rating of cable for maximum conductor temperature of 90 degree C under continuous operation and 250 degree C during short-circuit condition. The contractor/ manufacturer shall also declare over load curve with duration for conductor temperature of 105 Deg C. A complete set of calculation made in arriving at the current rating shall be furnished, for laying condition envisaged under the project, during detailed engineering for Employer/Employer's reference.

1.18 CABLE JOINTING ACCESSORIES

1.18.1 The cable jointing accessories shall include all the straight through joints. Bidder shall arrange all special tools and tackles required for making these joints at his own cost. **Unless specified separately** in BPS, **cable end terminating kits** shall be deemed included as part of cable jointing accessories.

1.18.2 The joints shall be suitable for tropical conditions as specified in this chapter. Straight joints shall be heat shrink type with compression ferrules. Each joint shall include all necessary material and components for effecting a reliable and durable joint. Particularly importance is attached to the proper provision of stress relieving materials and tubing.

1.18.3 The straight through joints and cable end terminations shall be of proven design and should have been type tested as per relevant IEC standard. A list shall be furnished indicating supply of such cable jointing accessories which are successfully operating in other projects.

1.18.4 The detailed description on jointing procedure shall be furnished during detailed engineering.

1.18.5 The cable end terminations shall be of anti-fog type and shall be of Polymeric type suitable for withstanding the climatic conditions with required Creepage distance as specified in **bidding documents**. The cable end terminals for terminating the cables shall be complete with accessories & fully compatible with the cables to be supplied. The terminations shall also be capable to withstand mechanical forces during normal and short circuit operations.

2 CABLE DRUMS

2.1 Cables shall be supplied in returnable steel drums of heavy construction of suitable size and packed conforming to applicable standards. Maximum drum length shall be 500m.

2.2 Standard drum lengths for manufacturing shall be finalised during detailed engineering. Each drum shall carry the manufacturer's name, the employer's name, address and contract number and type, size and length of the cable, net and gross weight stencilled on both sides of drum. A tag containing the same information shall be attached to the leading end of the cable. An arrow and suitable accompanying wording shall be marked on one end of the reel indicating the direction in which it should be rolled.

2.3 Packing shall be sturdy and adequate to protect the cables from any injury due to mishandling or other conditions encountered during transportation, handling and storage. Both cable ends shall be sealed with heat shrink caps so as to eliminate ingress of water during transportation and erection.

3 TESTS ON CABLES

All XLPE insulated cables shall conform to all Type, Routine and Acceptance tests listed in the relevant IEC & shall submit the type test reports for Employer’s approval. If specified in Section-Project, Type tests shall be carried out on the EHV cable as per relevant standard.

4 TESTS ON ACCESSORIES

Contractor shall submit type test reports for accessories, as per IEC 60840:1999/ IEC 62067 for Employer’s acceptance. Contractor shall submit type test reports as per clause no. 9.2 of Technical Specification, Section: GTR for Employer’s acceptance.

5 TESTS AFTER INSTALLATION

All tests on cable system as prescribed in IEC 60840:1999/IEC 62067 (as applicable) shall be performed after installation in the presence of Employer. The result of the tests shall be well documented and submitted with the as built drawings.

6 LAYING AND INSTALLATION

6.1 The bidder is advised to visit the site and acquaint themselves with the topography, infrastructure etc. The contractor shall be fully responsible for providing all equipment, materials, system and services specified or otherwise which are required to complete the erection and successful commissioning of XLPE cables in all respects. In general the cable laying operation shall be in accordance with best internationally accepted practices and procedures and in accordance to manufacturers recommendation.

6.2 Cable drum shall be positioned in such a way that the axle of the drum is perpendicular to the cable trench. The cable shall come off the drum always at the lower part in order to minimize stress. If the laying is done by the winch it has to be equipped with a tension release in order to avoid any excess stresses on the cable. The cable tension as well as the continuity of the laying operation shall be monitored by instruments and shall not

exceed limits given by the manufacture's recommendation. Winching equipment which doesn't fulfil above requirements will be rejected.

6.3 Cable rollers shall be used to roll off the cables from the drums. The rollers shall ensure that the cable does not scuff on the ground during pulling operation. The rollers must be cleaned and lubricated properly.

6.4 Cables shall be laid in the trench throughout the route. Further, as per requirement of the field, the cables shall also have to be laid in the followings (with prior approval of employer):

a. In ducts
b. In HDPE ducts —Not necessary and very difficult to fill with any material. Providing the individual duct lengths are less than
c. In air at terminations
d. At varying depths due to obstructions
e. As per approved drawings

6.5 At places where the cables cross roads, gates of residential houses or buildings, the cables shall be laid in HDPE pipes of adequate strength.

6.6 Concrete trenches with precast covers may be used in exceptional cases in smaller portions, wherever bending of cables are involved and HDPE pipes can't be laid.

6.7 The arrangement of laying the cable en-route shall be submitted by contractor during detailed engineering for Employer's acceptance. The Bidder shall also submit inception report indicating detail description of procedure (Method Statement for Construction) to be deployed for laying of underground and fibre optic cable. The contractor shall propose optimum cable sizing based on load current, voltage drop, short circuit current and protective device requirement and also to maintain reliable ring main 11 kV supply.

6.8 Any damage occurred to existing utility services during cable laying shall be brought into notice of relevant authorities and rectified immediately.

7 TRENCHING

7.1 Trenches shall in general, unless impeded, be in accordance with the dimensions indicated in the cable installation specification included with this document.

7.2 The cable trench work involves earth excavation for cable trench, back filling and removal of excess earth from site. The work site shall be left as clean as possible.

7.3 Wherever possible sidewalks shall be used for the installation of cable. The trench shall be excavated using manual /mechanical modes as per field conditions. Most main roads are of asphalt surface and some of the roads with cement concrete surface. The sides of the excavated trenches shall wherever required, be well shored up.

7.4 Where paved footpaths, black topped roads or concrete slabs are encountered, the pavement slabs, roads shall be properly reinstated in original condition or better. Identification markers of other services shall be properly stored and reinstated. The

excavated material shall be properly stored and filled back within 24 hours of excavation to avoid obstruction to public and traffic movement.

7.5 Suitable barriers should be erected between the cable trench and pedestrian/ motorway to prevent accidents. The barriers shall be painted with yellow and black or red and white coloured cross stripes. Warning and caution boards should be consciously displayed. Red lights as warning signal should be placed along the trench during the nights.

7.6 The bottom of the excavated trench should be levelled flat and free from any object which would damage the cables. Any gradient encountered shall be gradual. All cables shall only be laid directly onto the bottom of the trench, if the surface is unlikely to cause damage to the outer sheath. Where a sand bedding material needs to be used for the base of a trench, the depth of the trench shall be increased by the appropriate amount to ensure that the required minimum depth of cover is achieved.

7.7 Following installation, cables shall be blinded to a compacted depth of 100mm above the cable or cable joint with soil taken from the excavated material or imported material. The blinding shall be free from materials that may damage the cable. Imported material for blinding (sand) shall only be used if all the excavated material is unsuitable.

7.8 The Contractor shall remove from site all rubbish and salvaged materials. The whole area shall be left in a neat and tidy condition to the satisfaction of Employer.

8 TREFOIL/FLAT FORMATION

Cables shall be laid in trefoil/flat formation **(as per bidding documents)** for entire route. The contractor shall submit drawings and arrangements for Employer's approval. If a single three core/triplex cable is installed, then the cable shall just be laid direct. If two or more 3 core cables are laid in the same trench then each cable needs to be horizontally separated by a minimum of 150mm.

9 CABLE HANDLING

The inspection of cable on receipt, handling of cables, paying out, flaking, cushioning with sand or sieved compacted soil, back-filling, reinstatement of road surfaces, providing and fixing joint markers, route indicators, precautions of joint holes, sump holes and all necessary precautions that are required shall be carefully planned and in accordance with acceptable standard practices/statutory requirements.

10 DAMAGE TO PROPERTY

The contractor shall take all precautions while excavation of trench, trial pits etc., to protect the public and private properties and to avoid accidental damage. Any damage so caused shall be immediately repaired and brought to the notice of the concerned and to the Employer. The contractor shall bear all responsibilities and liabilities and shall bear all costs of the damages so caused by him or by his workman or agents.

11 CABLE ROUTE MARKERS/CABLE JOINT MARKERS

Permanent means of indicating the position of joints and cable route shall be fabricated supplied and erected as per approved drawings.

Markers provided shall be as per the field requirement, if the route passes through open fields, markers should be conspicuously visible and above ground surface.

The marker should incorporate the relevant information such that the name of the Employer, voltage, circuit and distance of cable from the marker.

12 DEPTH OF LAYING OF CABLES

Depth of laying shall be as per **drawing enclosed with Specification**. Laying at varying depths due to obstructions/site conditions may be accepted in extreme cases with prior approval of Employer during detailed engineering.

13 PAYING OUT THE CABLE

The excavated cable trench shall be drained of all water and the bed surface shall be smooth, uniform and fairly hard before paying out the cable. The cable shall be rolled in the trench on cable rollers, spaced out at uniform intervals. The paying out process must be smooth and steady without subjecting the cable to abnormal tension. The cable on being paid out shall be smoothly and evenly transferred to the ground after providing the cushion. The cables shall never be dropped. All snake bends shall be straightened. Suitable size cable stocking pulling eye shall be used for pulling the cable. While pulling the cable by winches or machines, the tension/ loading shall be monitored by tension indicator and shall not exceed the permissible value for the cable. The cable laying shall be performed continuously at a speed as recommended by manufacturer.

The cable end seals shall be checked after laying and if found damaged shall immediately be resealed. Sufficient number of heat shrinkable cable end sealing caps shall be stocked at site stores for testing and jointing work. The integrity of the outer sheath shall be checked after the cable is laid in position.

14 SAND BEDDING

The cable shall be completely surrounded by well-compacted cable sand to such a thickness and of such size that the cable is protected against damage (applicable where cables are not to be laid in pipes).

15 SNAKING

Snaking shall be done at necessary places recommended by manufacturer with prior approval of Employer.

16 THERMAL BACKFILL

If specifically mentioned in Section-Project, Thermal Backfilling shall be carried out based on the evaluation of soil thermal resistivity along the cable route and after approval from the Employer the contractor shall design, specify, supply, lay and monitor the installation of thermal backfill surrounding the cables. Thermal back fill shall be of thermal resistivity of 1.20 K.m/W or better.

17 IMMEDIATE ENVELOPE TO CABLE

The option on the use of the material that immediately envelopes the cable viz., thermal backfill or sand or sieved native soil rests with the Employer/Employer. The contractor shall seek prior approval on the use of the envelop material from the Employer before execution of the works.

18 BACK FILLING

Normally back filling shall consist of the material earlier excavated. However, bigger stones or pieces of rock shall be removed.

19 WARNING TAPE

A pre-warning, Red colour plastic/ PVC tape, of at least 250 mm wide 100 microns thick, shall be laid at approx. 0.4 m above the cable specified depth, throughout the cable route. The tape shall carry the legend printed in black continuously as under CAUTION; EMPLOYER, VOLTAGE CLASS of CABLES. Protection concrete tiles shall also be used all along the route of the cable to protect the cables. For specification refer Section……

20 PREVENTION OF DAMAGE DUE TO SHARP EDGES

After the cables have been laid in the trench and until the cables are covered with protective covering, no sharp metal tool shall be used in the trench or placed in such a position that may fall into the trench. Straight and curved rollers used shall have no sharp projecting parts liable to damage the cable. While pulling through pipes and ducts, the cable shall be protected to avoid damage due to sharp edges. The cables shall never be bent, beyond the specified bending radius recommended by the manufacture.

21 ROAD, RAIL & CANAL CROSSINGS

21.1 The road cutting, whether cement concrete asphalt or macadam road surface; canal crossing shall be taken after obtaining approval for cutting/crossing from the concerned authorities i.e. office of the municipality, traffic police, telephone authorities, roads and water supply department etc., and work should be planned to be completed in the shortest possible time. Where necessary the work shall be planned during night or light traffic periods. HDPE pipes shall be used for crossing. HDPE pipes diameter shall be as specified in BPS.

21.2 **Trenchless Digging**:

It is envisaged that trenchless digging shall be used for crossing the National highways, and Canals etc. and the same shall be in the scope of bidder. Trenchless digging shall also be used where the concerned authorities do not permit open cut method and it is essentially required to carry out for installation of underground cables. The trenchless digging methods shall generally conform to ITU-T L.38. The various methods of trenchless digging such as hand/ manual auguring (up to 15m), impact moling (from 16m to about 40-50m), HDD (above 40-50m) shall be adopted based on the soil/site conditions and the requirement. The exact method for trenchless digging shall be finalized during detail engineering as per actual site/soil condition. The equipment used for HDD shall be capable of drilling at least 100m at one go. The contractor shall

propose the exact methods and procedures for implementation of trenchless digging at various crossings taking into consideration the following guidelines, for approval by the Employer.

a) Excavation and backfilling of trial pits and verification of soil condition
b) Excavation of entry and Exit pits
c) Erection of drill machine for Drilling of pilot hole
d) Placement and driving hand augur
e) Placement and carrying out impact moling
f) Reaming and widening of bore holes in steps (if required)
g) Pulling of product pipe

22 FOOTPATH CUTTING

The slabs, kerbstones, on the roads shall be removed and reinstated without damage. The Contractor shall ensure that all surfaces make smooth junction with existing works. In case of damages they have to be replaced by new ones.

23 REINSTATEMENT

After the cables and pipes have been laid and before the trench is backfilled all joints and cable positions should be carefully plotted and preserved till such time the cable is energized and taken over by the Engineer in charge. The protective covers shall then be provided, the excavated soil riddled, sieved and replaced. It is advisable to leave a crown of earth not less than 50 mm and not more than 100 mm in the centre and tapering towards the sides of the trench.

The temporary reinstatement of roadways should be inspected at regular intervals, more frequently in rainy season and immediately after overnight rain for checking settlement and if required the temporary reinstatement should be done.

After the subsidence has ceased the trench may be permanently reinstated and the surface restored to the best possible condition.

24 MANHOLES

Manholes shall be provided at every proposed joint location for jointing bays and as directed by the Employer. The bidder shall identify the location of the joint bays after carrying out detailed survey of the cable route and excavation of the trial pits. The delivery lengths of the cables shall match the location.

The Contractor shall get inspected, by a representative of the Employer, all manholes before carrying out the backfilling. Pipe & cable sealing, installation of joint box and cable service loops as per approved drawings shall be visually inspected and checked for tightness.

The contractor shall submit design and drawing of joint bay including manholes for withstanding a live load of 20 ton vehicle plus 30% for impact from moving vehicle. The Contractor shall propose a suitable procedure for testing the manhole for approval by the Employer. Manholes type approved by the Employer only shall be acceptable. The manhole shall include sufficient number of suitable entries.

25 TOOLS AND PLANTS

The successful bidder shall arrange, at his own cost, all necessary tools, plant and equipment to carry out the survey and cable installation work. The bidders are instructed to give all the details of equipment at their disposal, to carry out the work successfully and speedily.

26 BENDING RADIUS

The cables shall be treated with according to manufacturer's recommendation. Any overstress due to over-bending, excess pulling must be avoided. The minimum bending radius of XLPE insulated cables shall be 20XD where "D" means the Outer diameter of the cable.

27 JOINTING AND TERMINATION OF CABLES

The cable jointing personnel and his crew shall have good experience in the type of joints and terminations that are used. The jointing work shall commence as soon as two or three lengths of cables have been laid. All care should be taken to protect the factory-plumbed caps/ seals on the cable ends. The cable ends shall be protected all the times with heat shrink end caps.

Jointing of cables in carriage ways, drive ways under costly pavings, under concrete or asphalt surfaces and in proximity to telephone cables and water mains should be avoided whenever possible.

Cable overlap of at least 1.5 m shall be allowed for making the joints.

The joint bay should be of sufficient dimensions to allow the jointers to work with as much freedom of movement and comfort as possible. Sufficient space should be kept below the cable to be jointed.

The joints of different phases shall be staggered in the jointing bay.

27.1 SUMPHOLES

When jointing cables in water logged ground or under unforeseen rainy conditions, a sumphole should be made at one end of the joint bay, in such a position so that the accumulated water can be pumped or taken out by buckets, without causing interference to the jointing operation.

27.2 TENTS/COVERS

An enclosure or suitable protection cover shall be used in all circumstances wherever jointing work is carried out in the open, irrespective of the weather conditions. Joints shall be made in as clean an environment as practicable.

27.3 PRECAUTIONS BEFORE MAKING A JOINT

The cable end seals should not be opened until all necessary precautions have been taken to prevent circumstances arising out of rainy/ inclement weather conditions, which might become uncontrollable.

If the cable end seals or cable ends are found to have suffered damage the cables should not be jointed, without tests and rectification.

27.4 MEASUREMENT OF INSULATION RESISTANCE

Before jointing, the insulation resistance of both sections of cables shall be checked.

27.5 IDENTIFICATION

The identification of each phase, shall be clearly and properly noted. The cables shall be jointed as per the approved design. Each cable shall have identification for phase at joint bays.

27.6 MAKING A JOINT

Comprehensive jointing instructions should be obtained from the manufacture of jointing kits and meticulously followed.

The materials used in the joints like ferrules, screen/sheath continuity bonds, lugs etc., shall be of good quality and conform to standards.

The jointing tools shall be appropriate and as per the requirement of jointing XLPE cables.

All cable joints and terminations must be carried out by qualified personnel. The cable jointers must be in possession of a valid trade certificate for jointing works from a recognized institution. CVs of cable jointers shall be approved by Employer prior to commencement of works.

28 CABLE LAYING & TERMINATIONS

The preparation of the cable end for installing the terminations and the precautions to be taken before fixing the terminations shall be followed as in the case of the cable jointing procedures. The instructions furnished by the termination manufacturer shall be strictly followed. Cables shall be terminated at RMU, Distribution Transformers, Switches or LT distribution boxes.

At cable terminating end, the following provisions for supply and erections are to be included:

(i) A sufficient length of spare cable shall be left in the ground, for future needs.
(ii) The rise of the cable immediately from the ground shall be enclosed in PVC/PE pipe of suitable diameter to protect against direct exposure to the sun.
(iii) The cable shall be properly fastened using non-metallic clamps.

(iv) Appropriate labels shall be fixed identifying the phase circuit, voltage and date of commissioning etc., on the cable supporting structure.

29 BONDING OF SCREEN

The cable earth screens shall be bonded to earth at the termination positions.

As indicated previously, cross bonding is not necessary on 11kV systems.

30 CONNECTION OF RADIAL WATER BARRIER AND CABLE SCREEN

If the metallic radial water barrier is insulated from the metallic wire screen, a connection suitable to carry the currents occurring during operation must be installed between metallic radial water barrier of the cable and metallic wire screen in joints and sealing ends.

31 MEASUREMENT (for Civil Works)

The buried cable trench shall be measured in the running meters including excavation, back filling, thermal back filling (if applicable), compaction, laying of concrete/ reinforcement, placing of warning tape markers, dewatering as required as per the drawing & specification & any other job required for successful completion of work.

32 OPTICAL FIBRE CABLE (For Communication Equipment)

Optical fibre cable required for Communication Equipment shall also be laid in the same cable trench in separate HDPE pipe.

33 MISCELLENEOUS

All the civil works associated with laying of underground cable are described in **Civil Works**

34. INSPECTION AND TESTS

Through the work execution, various inspections and tests on the progressing works will be ordered to the Contractor by the Employer.

Following inspections and tests will be carried out after completion of the works section by section. The Contractor shall perform all the inspections and tests in accordance with IEC Standard.

(1) Underground Power Cables

a) Visual inspection of the underground cable lines
- Back filling and grade
- Cable and joint marks
- Cable termination and connection

b) Measurement insulation resistance of the lines

c) H. V. test

34.1 TESTS FOR 11 KV POWER CABLES, STRAIGHT JOINTS AND ACCESSORIES

(1) Test at works

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

(a) 11 kV XLPE power cable

i) Appearance check
ii) Conductor resistance measurement
iii) Capacitance measurement
iv) Insulation resistance measurement
v) A.C. withstand voltage
vi) A.C. long duration withstand voltage
vii) Impulse withstand voltage
viii) A.C. long duration breakdown voltage
ix) Impulse break-down voltage
x) Dielectric loss tangent
xi) Temperature-voltage characteristic
xii) Dimension
- Conductor outermost diameter
- Insulation thickness
- Sheath thickness
- Over-sheath thickness
- Thickness of each tape
- Interval of tape lapping
- Total diameter

xiii) Bending withstand characteristic
xiv) Over-sheath, tensile strength
xv) - do. - , thermal aging
xvi) - do. - , oil-proof
xvii) - do. - , non-inflammability
xviii)- do. - , thermal deformation
xix) - do. - , hardness

(b) Sealing/termination ends or straight joints

i) Construction
ii) A.C. long duration withstand voltage
iii) Impulse withstand voltage
iv) A.C. long duration breakdown voltage
v) Impulse breakdown voltage
vi) Porcelain or epoxy insulator, construction
vii) - do. - , power frequency flash-over voltage (dry)
viii) - do. - , power frequency flash-over voltage (wet)
ix) - do. - , 50% impulse flash-over voltage
x) - do. - , cantilever strength
xi) - do. - , thermal mechanical performance

(2) Test on Completion

After completely installing the 11 kV XLPE power cables, sealing ends and other conductors at site, the following tests shall be carried out by the Contractor.

(a) D.C. High voltage test

34.2 Special Requirement

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

34.3 Drawings, Data & Manuals

The following information shall be furnished along with the Tender.

(a) Manufacturer’s leaflets giving constructional details, dimensions and characteristics of different cables.

(b) Current rating of cables including de-rating factor due to grouping, ambient temperature and type of various installation.

(c) Write-up with sketches illustrating the manufacturer’s recommendation for splicing, jointing and termination of different types of cables.

(d) Type test report of power cables. The Bidder shall clearly describe the type and routine tests to be performed on cables.

(e) Drum length for each of cable.

34.4 PERFORMANCE GUARANTEE

The performance figures quoted on schedule of Technical Data shall be guaranteed within the tolerance permitted by relevant standards and shall become part of the Contract. In case of failure of the cables to meet the guarantees, the Employer reserves the right to reject the item. The Contractor shall have to rectify/replace the defect/defective part at no extra cost to the Employer and without delaying the commissioning schedule.

34.5 Spare Parts, tools & Instruments

The bidder shall also furnish Manufacturers recommended spare parts, tools & Instruments with price. The Contractor shall submit an itemized list of such equipments.

C2: LT XLPE POWER CABLE

LT single core, two core, three core, 3.5 core and four core Cross linked Polyethylene (XLPE) insulated, FRLS, PVC sheathed, armoured power cables.

1. Scope:

The specification covers design, manufacturing, testing, packing, supply & delivery of 1100 volts grade, LT Cable, multiple core, Cross linked Polyethylene (XLPE), FRLS, insulated, PVC sheathed, armoured power cables for effectively earthed systems.

Sizes:

Single Core: 16, 35, 50, 95, 120, 150, 185,240, 300, 400,500 & 630mm2
Two Core: 16, 35, 50, 95, 120, 150, 185,240, 300, 400,500 & 630mm2
Three Core: 16, 35, 50, 95, 120, 150, 185,240, 300, 400,500 & 630mm2
Three and half core: 35, 50, 95, 120, 150, 185,240, 300, 400,500 & 630mm2
Four Core: 35, 50, 95, 120, 150, 185, 240,300, 400,500 & 630mm2

2. Standards:

BS-5468	Cross-linked polyethylene insulation of electric cables
IEC-60540	Test methods for insulations and sheaths of electric cables and
IEC-60228/3-2004	Conductor for insulated cables
IEC-60502-1/2004	Power cables with extruded insulation and their accessories for rated voltages from 1kV(Um=1.2kV),up to 30kV(Um=36kV)-Part 1:Cables for rated voltages of 1kV (Um=1,2kV) and 3kVIUm=3.6kVI
ASTM G-53/DIN 56687	UV testing of XLPE insulation

3. Climatic conditions:

As per the General Operating Conditions.

Design, construction and technical parameters:-

4. Conductor:

The conductor of the cable shall be made from high conductivity, Electrolytic H4 Grade, stranded aluminum to form compacted and circular /shaped conductor having resistance within limits as specified in relevant IEC or equivalent with latest amendments.

Before stranding, the conductor shall be circular in cross section, uniform in quality, solid, smooth and free from scale, sharp edges and other defects.

Conductor shall conform to the standards for permissible number of joints in any one of the single wires forming every complete length of conductor, for location of joints in same

layer of conductors and for method of making such joints. No joint shall be made in any conductor after it is stranded.

5. Insulation:

The insulation shall be suitable for LT system voltage and the insulating material shall be cross linked Poly Ethylene (XLPE), and applied by extrusion process as per IEC and its latest amendments.

The insulating material shall have excellent electrical properties with regard to resistivity, dielectric constant and loss factor and shall have high tensile strength and resistance to abrasion. This shall not deteriorate at elevated temperatures or when immersed in water. The insulation shall be preferably fire resistant and resistant to chemicals like acids, alkalis, oils and ozone.
The insulation properties shall be stable under thermal conditions arising out of continuous operation at conductor temperature of 90°C rising momentarily to 250°C under short circuit conditions. It shall be free from any foreign material or porosity visible to the unaided eye. The insulation shall be so applied that it fits closely on the conductor and it shall be possible to remove it without damaging the conductor.
The average thickness of insulation shall not be less than the nominal value as specified in relevant IEC with latest amendments.
Tolerance on insulation thickness shall be as per relevant IEC. The insulation shall withstand mechanical and thermal stress under both steady state and transient operating conditions.

6. Core identification (for multiple core cables):

Individual core of multi-core cables shall be colour coded and/or numbered for proper identification.

All cores insulation shall be black colored. For cores identifications, a XLPE colored line (1mm width X 0.5 mm height) shall be extruded **over the insulation.**

Red line shall represent - R ph
Yellow line shall represent - Y ph
Blue line shall represent - B ph.

For Neutral: as core already black, extruded line not required over the insulation. In 2 core cables, phase core shall be red colored extruded line. The manufacture's name along with the order no. shall be printed (noncontact type) on the outer sheath.

7. Fillers and Laying up of cores (for multiple core cables):

In multi core cables, the cores shall be laid together with a suitable right hand lay. The interstices shall be filled with non-hygroscopic material. Further, the compounds used with fillers shall be such as to have no deleterious effect on other components of the cable and to be stable at cable temperatures.

8. Inner sheath (common covering):

The laid up cores shall be provided with inner sheath applied by extrusion process. It shall be ensured that the shape is as circular as possible. It shall be applied to fit closely on to the laid up cores and shall be possible to remove easily without causing any damage to the underlying insulated cores.
The thickness of the inner sheath shall be as per relevant IEC. No tolerance on the negative side shall be acceptable.

9. Armoring:

The armour of cables shall consist of either galvanized round steel wires or galvanized steel strips. The armoring shall be applied such that the minimum area of coverage shall be 90% and the gap between any two armour strips/ wire shall not be more than the width of strip/ diameter of armour wire. The galvanized steel strips/wire shall comply with the requirements of IEC with latest amendments.

In case of Single core cable armouring shall be of Non-magnetic material with dimensions of the galvanized steel strip/wire shall be as per relevant IEC with latest amendments. No tolerance on the negative side shall be acceptable.

The direction of lay of the armour shall be left hand. When one or more layers of proofed plastic tape are applied over the laid up cores as a binder, the thickness of such tapes shall not be construed as part of the extruded inner sheath.

The dimensions of armour round wires shall be as per IS-7098(Part-I):1988.

The joints in armour wire shall be made by brazing or welding and the surface irregularities shall be removed. A joint in any wire shall be at least 300mm from the nearest joint in any other armour wire in the completed cable. The single core cable shall not have any GI wire armour.

10. Outer Sheath

The outer sheath shall consist of extruded tough outer sheath of PVC compound insulation over the armouring. The colour of the outer sheath shall be black.

The outer sheath shall be applied by extrusion process, it shall be tightly applied:

a) Over the insulation ·in case of unarmoured single core cables.
b) Over the armouring in case of armoired cables.

11. General:

All materials used in manufacturing of cable shall be new, unused and of finest quality. All materials should comply with the requirements *I* tests as per applicable IEC specification, and any other relevant International standards.

12. Continuous Current rating:

As per Appendix -1

13. Short circuit Current rating:

As per Appendix -1

14. Operation:

i) Cable shall be suitable for operation under voltage and frequency variation as per Latest Indian Electricity rule.

ii) Cable shall be suitable for laying in air, in duct or buried underground directly or through trenchless boring.

iii) Cable shall have heat & moisture resistance properties. These shall be of type & design with proven record on distribution network service.

15. Tests:

Type tests:

All the cable types and sizes i.e. items offered should have been fully type tested as per IEC with amendments at any internationally accredited third party testing lab. The bidder shall furnish one set of authenticated copy of type test reports along with the offer. These type tests must have been conducted within last five years prior' to date of Bid opening. For any change between design/type of already type tested and the design / type offered against this specification, the purchaser reserves the right to demand repetition of type tests without any extra cost. For each type and size the type test shall be got carried out independently.

The purchaser also reserves the right to have tests carried out at his own cost from an independent agency, whenever there is a dispute regarding the quality of supply.

The type test certificates type tests as per IEC shall be furnished invariably with the offer:

(a) Tests on conductor:
  (i) Tensile test
  (ii) Wrapping test
  (iii) Resistance test
(b) Tests for armouring strips / wires. :
(c) Tests for thickness of insulation (eccentricity) and sheath.
(d) Physical tests for insulation. :
  (i) Tensile strength and elongation at break.
  (ii) Ageing in air oven
  (iii) Hot set
  (iv) Shrinkage test
  (v) Water absorption test (gravimetric)
(e) Physical tests for outer seath :
  (i) Tensile strength and elongation at break.
  (ii) Ageing in air oven
  (iii) Shrinkage test
  (iv) Hot deformation
  (v) Loss of mass in air oven
  (vi) Heat shock
  (vii) Thermal stability
  (viii) Carbon black content of polythene sheath.
(f) Insulation resistance test (volume resistivity)

(g) High voltage test

(h) Flammability test

(i) FRLS Tests-

The following FRLS tests are to be conducted as per the referred standard

- HCL gas evolution test (IEC - 754.1)
- Oxygen Index (ASTM-D-2863)
- Temperature Index (ASTM-D-2863) Smoke density test (ASTM-D-2863) Flammability test (IEC-332. 1)
  Swedish Chimney test (SS-424 14 75) Ladder Test (IEEE-383)

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

The LT XLPE cables shall be routine tested as per relevant IEC/IS

B. The first lot offered shall not be less than 10% of ordered quantity of each size of LT XLPE ARMORED CABLE. One sample from the 1st Lot of LT XLPE ARMORED Cable of each size as received in purchaser's store shall be selected and sealed by the inspecting officer nominated by purchasers for getting it type tested at any internationally accredited testing laboratory. The charges incurred towards type test of the material received in our stores shall be borne by Supplier.

In case sample from first lot fails then:

a. Supplier shall have to replace the full quantity of the respective inspected lot supplied to various stores and lying unused at stores.

b. Sample from next lot shall be selected again for type test. All test charges incurred towards type test of the material for second time shall be borne by the Supplier. In case sample again fails in the type test then further supplies shall not be accepted.

C. **Factory Acceptance test:**

The selection of sample pieces for Factory acceptance test shall be as per Appendix A of IS 7098 (Part-I), of each lot offered for inspection or part thereof. The minimum shall be one drum.

The acceptance tests shall be carried out as per IEC on the selected samples.

(a) Tensile test (for aluminum)
(b) Wrapping test (for aluminum)
(c) Conductor resistance test.
(d) Test for thickness of insulation and sheath

(e) Hot set test for insulation
(f) Tensile strength and elongation at break test for insulation and sheath.
(g) High voltage test.
(h) Insulation resistance (volume resistivity) test

All the acceptance tests shall be carried out by the Contractor, in the presence of purchaser's representative at the works. The firm shall give at least 15 days advance notice to the purchaser to enable him to depute the engineer for witnessing the tests. The test certificates for acceptance tests witnessed by inspecting officer/ engineer shall be submitted for approval before dispatch of material.

D. Routine Tests:

The following shall constitute the routine tests. The Inspector may also inspect the routine tests at the time of inspection.

(a) Conductor resistance test
(b) High-voltage test for 5 minutes [as per Clause 16.2 of IS: 7098 (Part-I).

16. Quality Assurance Plan:

A detailed list of bought out items which got into the manufacture of cables should be furnished indicating the name of the firms from whom these items are procured. The bidder shall enclose the quality assurance plan invariably along with offer followed by him in respect of the bought out items, items manufactured by him & raw materials in process as well as final inspection, packing & marking. The Company may at its option order the verification of these plans at manufacturer's works as a pre-qualification for technically accepting the bid

17. Identification mark:

The outer sheath of the cable shall bear following identification parameters embossed at intervals of length of one meter of cable, throughout the cable:-

i) Name of manufacturer
ii) Year of manufacture
iii) Voltage grade
iv) Size of cable
v) Cable code
vi) Name of purchaser "NEA"
vii) Successive length
viii) Marking for FRLS cable

18. Packing and forwarding:

18.1 The cable shall be wound on non-returnable wooden drums as per IEC and packed in drums suitable for vertical / horizontal transport, as the case may be and shall be suitable to withstand rough handling during transport and outer storage. The outer surface of the drum shall be painted with white aluminum paint. Similarly, the inside surface of drum shall have the protective layer of

varnish / paint.

18.2 The wooden drums shall be reinforced with steel bends and strips for better protection.

18.3 Length: The cable shall be supplied in standard drum length as per detail below:-

Size(sq.mm)	1C(meter)	2C(meter)	3C(meter)	3.5C& 4C(meter)
0-up to16	2000	1500	1000	1000
Above 16-up to 50	1500	1000	1000	1000
Above 50-up to 150	1000	750	750	750
Above 150-up to 300	750	500	500	500
Above 300	500	300	300	300

18.4 The ends of the cable shall be sealed by means of non- hygroscopic heat shrinkable sealing material.

18.5 The following information be stenciled on the drum with either water proof ink or oil paint:

i. Reference of IEC standard.
ii. Manufacturer's name or trademark.
iii. Type of cable and voltage grade.
iv. No. of cores.
v. Nominal cross-sectional area of conductor
vi. Cable code.
vii. Length of cable on the drum
viii. Gross weight
ix. Direction of rotation of drum (by means of an arrow)
x. Position of outer end of cable
xi. Year of manufacture
xiii Reference of Tender No. / P.O. No. date
xiv Property of "NEA".
xv. Name of consignee and the destination.

18.6 The firm shall be responsible for any damage to the cables during transit due to improper and inadequate packing. Wherever necessary, proper arrangement for lifting, such as lifting hooks, shall be provided. Any cable found short inside the packing cases shall be supplied by the supplier, without any extra cost.

18.7 Each consignment shall be accompanied by a detailed packing list,

containing the following information;

(a) Name of consignee
(b) Details of consignment
(c) Destination
(d) Total weight of consignment
(e) Handling and unpacking instruction
(f) Bill of materials, indicating contents of each package.

19. Inspection:

19.1 The inspection may be carried out by the purchaser at any stage of manufacture. The successful bidder shall grant free access to the purchaser's representative at reasonable time, when the work is in progress. Inspection and acceptance, of any cables under this specification by the purchaser, shall not relieve the supplier of his obligation of supplying cable in accordance with the specification and shall not prevent subsequent rejection, if the cables are not found as per the technical specifications .

19.2 The supplier shall keep the purchaser informed in advance about the programme of manufacturing of cables so that arrangement can be made for inspection.

19.3 The purchaser reserves the right to insist for witnessing the acceptance / routine tests of the bought out items.

19.4 At least 5% of total numbers of drums subject to minimum of 2 in each lot put up for inspection shall be selected at random to ascertain the length/workmanship of cable by the following method:

19.5 At the work of the manufacture, the cable shall be transferred from one drum to another for checking any manufacturing defects in the cable drum selected for conducting acceptance tests, at the same time measuring its length with the help of pulley & cyclometer graduated in presence of inspector. The difference in the measured length thus obtained from the declared length by the supplier in the packing list shall be applied to all the drums if the cable is found short during checking the sample lot (s).

19.6 The supplier shall present the latest Calibration Certificate(s) of testing instruments/equipment to be used for the testing of the material covered in the Purchase Order to the authorized inspecting officer /inspecting agency of the purchaser. The testing instruments / meters /apparatus etc. should be got calibrated by the supplier from time to time from an independent testing laboratory / house having valid accreditation from National Accreditation Board for testing and calibrating laboratories for the testing equipment or from original manufacturers having traceability to NABL /NPL. The calibration certificate(s) should not in any case be older than one year at the time of presenting the same to the inspecting officer / inspecting agency of the purchaser. The testing instruments / equipment should be duly sealed by the Calibrating Agency and mention thereof shall be indicated in the calibration certificate(s).

20. Documentation:

20.1 The bidder shall furnish following documents along with his offer - Sectional view, showing the General constructional feature with conductor / conductor screen / insulation / armoring / inner and outer sheath etc.

20.2 Drawing of cable drums with details of material dimension and paint etc.

20.3 All the required type test reports.

20.4 Literature, pamphlets for the supplied items.

21. Technical and guaranteed particulars:

The bidder shall furnish all Guaranteed Technical Particulars, as called for, in Appendix -2 of this Specification. Particulars, which are subject to guarantee, shall be clearly identified. Offer not containing these information will not be considered for acceptance.

22. Cable Laying and Installation:

Please refer to provisions above for HT cables.

Appendix -1

400V Single Core., two core, three Core, 3.5 core and four core, XLPE insulated Armoured Power Cables with aluminium conductor for earthed systems:-

1. Continuous current rating

Nominal cross sectional area of conductor (sq. mm)	Continuous current rating for Three core		Continuous current rating for single		Continuous current rating for two core cables	
	In ground	In air	In ground	In air	In ground	In air
10	57	53	59	57	57	53
16	78	70	76	73	78	70
35	116	117	117	140	116	117
50	140	140	138	170	140	140
95	200	221	204	255	200	221
120	225	258	230	300	225	258
150	255	294	265	342	255	294
185	285	339	295	385	285	339
240	325	402	340	450	325	402
300	370	460	390	519	370	461
400	435	542	450	605	435	542
500	481	624	500	700	481	624
630	537	723	555	809	537	723

Nominal cross sectional area of conductor (sq mm)	Continuous current rating for 3.5C core cables (amps)		Continuous current rating for 4C core cables (amps)	
	In ground	In air	In ground	In air
35	116	117	116	117
50	140	140	140	140
95	200	221	200	221
120	225	258	225	258
150	255	294	255	294
185	285	339	285	339
240	325	402	325	402
300	370	461	370	460
400	435	542	435	542
500	481	624	481	624
630	537	723	537	723

- Depth of laying: 900 mm; Ambient Air temp: 40 deg C; Ground Temp: 30 deg. C; Thermal resistivity of soil: 150 deg. C cm/w.
- While designing overall system suitable derating factor shall be take in to account as per the site condition.

2. Single core armoured cables - dimensional details

Nominal area of conductor (sq mm)	Nominal thickness of insulation (mm)	Minimum thickness of outer sheath (mm)
35	1.2	1.24
50	1.3	1.24
95	1.4	1.40
120	1.5	1.40
150	1.7	1.40
185	1.9	1.40
240	2.0	1.40
300	2.2	1.56
400	2.4	1.56
500	2.6	1.56
630	2.8	1.72

3. Two core armoured cables - dimensional details

Nominal area of conductor (sq mm)	Nominal thickness of insulation (mm)	Minimum thickness of inner sheath (mm)	Minimum thickness of outer sheath (mm)
10	0.70	0.3	1.24
16	0.70	0.3	1.40
35	0.90	0.3	1.40
50	1.00	0.3	1.40
95	1.10	0.4	1.56
120	1.20	0.4	1.56
150	1.40	0.5	1.72
185	1.60	0.5	1.88
240	1.70	0.5	2.04
300	1.80	0.6	2.20
400	2.00	0.7	2.36
500	2.20	0.7	2.68
630	2.40	0.7	2.84

4. Three core armoured cables - dimensional details

Nominal area of conductor (sq. mm)	Nominal thickness of insulation (mm)	Minimum thickness of inner sheath (mm)	Minimum thickness of outer sheath (mm)
35	0.90	0.3	1.40
50	1.00	0.3	1.40
95	1.10	0.4	1.56
120	1.20	0.4	1.56
150	1.40	0.5	1.72
185	1.60	0.5	1.88
240	1.70	0.6	2.20
300	1.80	0.6	2.20
400	2.00	0.7	2.52
500	2.20	0.7	2.68
630	2.40	0.7	2.84

Three and Half core armoured cables

Nominal area of conductor (sq. mm)	Nominal thickness of insulation (mm)	Minimum thickness of inner sheath (mm)	Minimum thickness of outer sheath (mm)
35	0.90	0.3	1.40
50	1.00	0.3	1.40
95	1.10	0.4	1.56
120	1.20	0.4	1.72
150	1.40	0.5	1.72
185	1.60	0.5	1.88
240	1.70	0.6	2.20
300	1.80	0.6	2.20
400	2.00	0.7	2.52
500	2.20	0.7	2.68
630	2.40	0.7	3.00

5. Four core armoured cables

Nominal area of conductor (sq mm)	Nominal thickness of insulation (mm)	Minimum thickness of inner sheath (mm)	Minimum thickness of outer sheath (mm)
16	0.70	0.3	1.40
25	0.90	0.3	1.40
35	0.90	0.3	1.40
50	1.00	0.3	1.40
95	1.10	0.4	1.56
120	1.20	0.5	1.72
150	1.40	0.5	1.88

185	1.60	0.5	2.04
240	1.70	0.6	2.36
300	1.80	0.7	2.36
400	2.00	0.7	2.68
500	2.20	0.7	2.84
630	2.40	0.7	3.00

6. Conductor resistance and Short Circuit Current Carrying Capacity

(common for 1C and 3C& 3.5C):

Nominal area of conductor (sq. mm)	Maximum DC resistance at 20 deg. C (Ohms/ km)	Short Circuit current for conductor (kA/ sec)
25	1.20	2.35
35	.8680	3.29
50	.6410	4.70
95	.3200	8.93
120	.2530	11.28
150	.2060	14.10
185	.1640	17.39
240	.1250	22.56
300	.1000	28.20
400	.0778	37.60
500	.0605	47.00
630	.0469	59.22

S No	DESRIPTION	UNITS	REQUIREMENT			
1	Voltage grade		1.1 KV			
2	System Voltage		415 v			
3	Type of cable		Aluminium conductor, XLPE insulated, PVC inner sheath, Round GI wire · armored cables and PVC outer sheathed cables.			
4	Material of conductor		Stranded compacted circular Aluminium conductor as per IS:8130 1984			
5	Conductor		H2/H4 grade Aluminum conductor as per class-2 of IS 8130-1984			
6	Insulation		XLPE insulation as per IS: 7098 (Part-I) - 1988			
7	Inner sheath		PVC Compound Type ST2 as per IS:5831-1984			
8	Armour		Galvanized steel wire as per IS:3975-1999			
9	Outer sheath		PVC Compound Type ST2 as per IS:5831-1984			
10	Standard length of cable drum with tolerance	m	500±5%			
A	**Size of cable**	sq.mm	**2C'10**	**2C'16**	**2C'25**	**2C'50**
1	**Conductor**					
a.	No. of cores	Nos.	2	2	2	2
b.	Maximum de resistance of conductor at 20°c	Ohm/ k m	3.08	1.91	1.2	0.641
c.	Short circuit capacity for one second	kA	0.94	1.5	2.35	4.7
d.	Continuous current rating at 40 dec. C	A	67	88	117	176
e.	Minimum number of wires in the conductor	Nos.	7	6	6	6
f.	Shape of conductor		Non-comoac ted	Stranded Compacted Circular or shaped		
2	**Insulation**					
a.	Nominal thickness	mm	0.7	0.7	0.9	1
b.	Minimum thickness (at any point of measurement)	mm	0.55	0.55	0.75	0.8
3	**Inner sheath**					
a.	Type		Pressurized Extruded			

b.	Minimum thickness (at any point	mm .,	0.3mm	0.3mm	0.3mm	0.3mm
4	**Armour**					
a.	Type of armour		GI wire			
b.	Nominal Diameter	mm	1.4	1.4	1.6	1.6
c.	Tolerance	mm	±0.04	±0.045	±0.045	±0.045
d.	No. of wires	Nos.	Total numbers shall be such that these are closely laid over inner sheath with a gap of less than the diameter of single wire in between the interstices			
e.	Type of Zinc coating		Mediu	Medium	Mediu	Medium
f.	Mass of Zinc coating	gtm•	95	95	95	95
g.	Number of dips		1 dip for 1	1 dip for 1	1 dip for 1	1 dip for 1 minute
5	**Outer Sheath**					
a.	Minimum thickness (at any point	mm	1.24	1.4	1.4	1.4

S.No	DESCRIPTION	UNITS	REQUIREMENT				
B	**Size of cable**	sq.mm	**4C*25**	**4C*50**	**4C*95**	**4C*150**	**4C*300**
1.	**Conductor**						
a.	No. of cores	Nos	4	4	4	4	4
b.	Maximum de resistance of conductor	ohm	1.2	0.641	0.320	0.206	0.100
c.	Short circuit capacity for one second	kA	2.35	4.7	8.93	14.1	28.2
d.	Continuous current rating at 40 deg. C	A	96	142	221	292	455
e.	Minimum number of wires in the conductor	Nos.	6	6	15	15	30
f.	Shape of conductor		Stranded Compacted Circular or				
2.	**Insulation**						
a.	Nominal thickness	mm	0.9	1.0	1.1	1.4	1.8
b.	Minimum thickness (at any point of measurement)	mm	0.75	0.80	0.90	1.20	1.55
4.	**Inner sheath**						
a.	Type		Extruded				
b.	Minimum thickness (at any point of measurement)	mm	0.3	0.3	0.4	0.5	0.7
3.	**Armour**						
a.	Type of armour		GI Wire				

b.	Nominal Diameter	mm	1.6	1.6	2.0	2.5	3.15
c.	Tolerance	mm	±0.045	±0.045	±0.050	±0.065	±0.080
d.	Type of Zinc coating		Medium	Medium	Medium	Medium	Medium
e.	Mass of Zinc coating	g/m	95	95	105	110	120
f.	Number of dips -		1 dip for 1 minute	1 dip for 1 minute	1 dip for 1 minute	1 dip for 1 minute and 1 dip for Y:z min	1 dip for 1 minute and 1 dip for Y:z min
5.	**Outer Sheath**						
a.	Minimum thickness (at any point of measurement)	mm	1.4	1.56	1.72	2.04	2.52

C3. CABLE TERMINATION KIT AND JOINT KIT FOR XLPE

1. Scope:

This specification covers the design, manufacture, factory test, supply and delivery of heat shrinkable, push on type termination and joint kits for 11 kV, 3 core screened, armoured, with aluminium conductor XLPE cables suitable for earthed system and confirming to relevant standard with latest amendment, if any.

The termination kits for the use on 50 Hz, 3 phase system with earthed neutral for working voltage of 11 KV.

2. Description:

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

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

2.3 The manufacturer of the termination and joint kit (Indoor, outdoor and straight-through) must have been accredited with ISO 9001 quality certification. The heat shrinkable/push on type terminations offered shall be of proven design and make, which have already been extensively used and fully type tested.

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

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

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

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

3. Other Requirements

3.1 The outdoor termination kits shall be suitable for terminating the cable at steel cross arm complete with brackets, terminals, saddles and all necessary materials for fixing the termination. The heat shrinkable termination kit to be supplied and installed under this scope of work shall be capable enough to cope with all the weather change. Terminations that do not require manually built stress relief cones or field pouring compound are preferred.

The term heat shrinkable refers to extruded or moulded polymeric materials which are cross-linked to develop elastic memory and supplied in expanded or otherwise deformed size/shape, subsequently heating in a non-constrained state to a

temperature above the shrink temperature resulting in the material recovering or shrinking to its original shape

3.2 Since the sealant or adhesives (to be used for environment sealing) between the heat shrinkable materials and XLPE cables shall be exposed to high electrical stresses, they must be track resistant.

3.3 The heat shrinkable polymer materials being used for external leakage insulation between the high voltage of conductors and grounds should be weather resistant.

3.4 All cuts/nicks inadvertently occurred to XLPE insulation must be rendered discharge free by using suitable discharge suppression compound.

3.5 The heat shrinkable tubing may be either extruded or moulded type.

3.6 Higher thickness of heat shrinkable sleeves shall be preferable to counter erosion due to pollution.

3.7 Push on type (Terminations only):

3.8 Rubber components should be made from proven quality of tuber with tested curing properties.

3.9 The semi conducting portion of the stress cone should be vulcanized with insulation so that both semi conducting and insulation portion becomes an integrated part.

3.10 The stress cone must be of proven design of stress control.

3.11 The moulding of rubber components should be aimed to achieve a smooth finish on interior and exterior of the components.

3.12 The stress cone should probably be reusable type.

3.13 In case of outdoor terminations, the suitable provision for covering the cable cores with re-useable protective system from the crotch seal to the bottom of stress cone should be made.

Accessories shall match the cable test ratings in all respects. The material and components not specifically stated in the specification, but which are essential for satisfactory operation of the equipment shall be included without any extra cost.

The termination and joint kits shall be of suitable for following cables:

- Outdoor and Indoor use for 11 kV, 3-cores Aluminium XLPE insulated Power cables.
-

4. Testing

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

- Appearance Test
- Construction Test
- High Voltage Test

5. Bid Documentation

1. The Bidder shall provide with the Bid two (2) clear copies of the manufacturer governing Standard of the termination and joints and kits two (2) clear copies of all other relevant standards referenced herein.
2. The Bidder shall provide certified type test results of the termination and joint kits as required by governing standards.
3. The Bidder shall provide complete description, catalogue and drawings of the termination and joint kits.
4. A clause-by-clause commentary on specification, specifying compliance and deviation, if any.
5. All data, drawing, catalogue and other technical documents supplied shall be bound separately from the Bid Document.

D. AERIAL BUNDLED CONDUCTOR (ABC)

D1. HV AERIAL BUNDLED CONDUCTOR (ABC)

1.0 Scope

This Specification covers the design, manufacture, factory test and supply of 6.35/11 (12) kV 150 mm2 three-core cross-linked polyethylene (XLPE) insulated, PVC outer sheathed with 50 mm2 high tensile galvanized steel strand messenger wire based aerial bundled conductors (ABC).

2.0 Description

2.1 The cable shall be manufactured and tested in accordance with relevant IEC Standard or latest revision thereof or any recognized international standards that ensure at least a substantially equal quality to the standards mentioned above.

2.2 The High Voltage ABC shall be supported with high tensile galvanized steel strand bare messenger wire of 50 sq. mm.

2.3 All conductors shall be stranded, compacted circular, high electrical conductivity, Aluminum, Grade H2/H4. The conductor shall be insulated by extruded black cross-linked polyethylene (XLPE) material.

2.4 The complete cable shall consist of three equal-size insulated conductors stranded together, and the direction of lay shall be right-hand. The type of construction shall cause the tensile load to be shared equally between four conductors.

2.5 The insulation of the cable shall be extruded cross-linked polyethylene (XLPE) complying with appropriate test requirements specified in Section 3 of IEC publication 60502. The minimum thickness of insulation shall not fall below the specified nominal value by more than 10%+0.1 mm.

2.6 The conductor shielding shall be non-metallic and shall consist of a layer of extruded semi-conducting compound. The insulation shielding shall consist of a non-metallic semi-conducting part in combination with a metallic part. The non-metallic part shall be applied directly upon the insulation of each core and shall consist of a layer of extruded semi-conducting compound. The metallic part shall be applied over the individual cores and shall consist of copper tape, in the thickness about 0.1 mm. A suitable binding tape shall be applied over the copper tape.

2.7 The outer covering of the R phase of the cable shall be embossed with the name of the manufacturer, name of the Purchaser " NEA-……", the cross sections, type of insulation followed by "Electric Cable: 6.35/11 kV" at the spacing of 5 meters. Every 2 meters of outer covering of the cable shall also be embossed with length of the cable.

2.8 The sheath shall consist of PVC compound complying with ST2 specified in IEC Publication 60502. The minimum thickness of the sheath shall conform to Table 1. The average thickness of the sheath shall be not less than the specified nominal value. The minimum thickness of the sheath shall not fall below the nominal value by more than (15%+0.1 mm).

2.9 The other technical specifications of the High Voltage ABC are given in Table 1: Technical Data.

3.0 Phase Identification

The identification of the conductors shall be provided by means of ribbing on the external surface of the insulation. R, Y and B phase conductors shall have one, two, and three ribs respectively. Space between the ribs in R, Y and B phases shall be 5 mm. Ribs shall be in rounded form.

4.0 Testing

4.1 Type tests

The Bidder shall submit the type test reports along with the Bid. The report shall be issued by a recognized independent testing authority. The tests shall comply with relevant IEC Standard or the latest equivalent standard. The Employer also reserves the right to have tests carried out at his own cost by and independent agency, whenever there is a dispute regarding the quality of supply. . The ABC shall be subjected to the following type tests:

(i) Mechanical strength of the conductors

(ii) Insulation resistance
(iii) Dielectric test
(iv) Impulse withstand
(v) Resistance of each phase of the conductor at 20^{o}C
(vi) A.C voltage test

4.2 Routine tests

The tests shall be made on the completed cables at the manufacturer's plant in accordance with governing standards including following tests:

a. Verification of diameters of conductor and insulated conductor, and thickness of insulation, and so on
b. Breaking load test
c. High voltage test
d. Conductor resistance at 20 deg C
e. Dielectric strength
f. Insulation resistance

5.0 Packaging

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

5.2 All conductors shall be furnished on non-returnable seasoned wooden reels or steel suitably protected against corrosion. All timber shall be treated to provide protection against rot and insects. Protective external lagging of sufficient thickness shall be provided and fitted closely on the reels. Binder consisting of steel straps shall be provided over the external laggings. The reel shall be new and sufficiently sturdy in construction to withstand ocean shipping, road transport, several loading and

unloading, storage in tropics, hauling and field erection of conductor without distortion or disintegration. The treatment process shall not have deleterious effect on the cable.

Before dispatch, the ends of the bundled conductors shall be sealed to prevent moisture ingress during transportation and storage. Both ends of every length of the assembled bundle shall be temporarily bound in such a manner as to prevent cores from separating.

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

a) Type of conductor
b) Size of conductor
c) voltage
d) Length in meters
e) Net weight of conductor and Drum Separately
f) Direction of rolling

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

Cable Size (sq. mm):	150
Normal Length of the Conductor (m):	500

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 ISO9000:9001
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,

6.0 Bid documentation

6.1. The Bidder shall furnish with the Bid two (2) clear copies of the Standard governing fabrication and testing of the ABC and two (2) clear copies of all other relevant standards for the fabrication and testing of XLPE insulated HV ABC.

6.2. The Bidder shall furnish two (2) sets of complete description, Standard catalogue, drawings showing general construction and size of the cables. The Bidder shall also furnish dimensional drawing of cable drum for each type of ABC.

6.3. The Bidder shall furnish two (2) clear certified copies of all type tests performed on all types of cables offered.

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

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

Table 1

S. No	Description		
1	Number of cores		3 Phase, Messenger 1
2	Nominal sectional area of conductor (mm^2)		150
3	Nominal conductor diameter (mm)		14.6
4	Nominal thickness of XLPE insulation (mm)		3.4
5	Metallic screening approx. thickness of copper tape (mm)		0.1
6	Nominal thickness of PVC outer sheath (mm)		2.3
7	Nominal diameter over sheathing (mm)		29.2
8	Messenger wire	Nominal cross-section area of messenger wires (mm^2)	50
		No. and Dia. Of messenger wires (No./mm)	7/3.15
		Overall diameter (mm)	9.45
		Minimum breaking load (kN)	62
		Material	Bare round stranded galvanized steel wire
9	Approx. overall diameter of bundled cable (mm) (Major dia.)		67
10	Approx. weight (kg/km)		4040
11	Max. conductor dc resistance at 20^0 C (ohm/km)		0.206
12	Min. Insulation resistance at 20^0 C (Megohm-km)		595
13	Earth fault current carrying capacity of metallic screen		
	at 1 second (1 core) kA		2.14
	at 3 second (1 core) kA		1.23
14	A.C. test voltage for 5 min.(kV)		15

D1.1 CABLE TERMINATION KIT AND JOINT KIT FOR 11kV ABC CABLES

1. **Scope:**

This specification covers the design, manufacture, assembly and testing of heat shrinkable / push on type terminations suitable for 11 KV armoured aluminum ABC cables suitable for directly earthed system and confirming to relevant standard with latest amendment, if any.

The termination kits for the use on 50 Hz 3 phase system with earthed neutral for working voltage of 11 KV.

2. Description:

2.2 All high voltage terminations and jointing kits shall be standard quality type. They shall be factory engineered kits containing all the necessary components.

2.2 The heat shrinkable termination and joint kit shall be manufactured and tested in accordance latest version of IEC, or any other national or international standard that ensures at least a substantially equal quality to the standard mentioned above will also be acceptable. The material to be used should be inert and capable of resisting degradat ion during the service of cable system. The kit shall be provided with protection against rodents and termite attack.

2.4 The manufacturer of the termination and joint kit (Indoor, outdoor and straight-through) must have been accredited with ISO 9001 quality certification. The heat shrinkable/push on type terminations offered shall be of proven design and make, which have already been extensively used and fully type tested.

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

3 Heat Shrinkable Type (Terminations) :

3.1 The term heat shrinkable refers to extruded or moulded polymeric materials which are cross-linked to develop elastic memory and supplied in expanded or otherwise deformed size/shape, subsequently heating in a non-constrained state to a temperature above the shrink temperature resulting in the material recovering or shrinking to its original shape.

3.2 Since the sealant or adhesives (to be used for environment sealing) between the heat shrinkable materials and cables shall be exposed to high electrical stresses, they must be track resistant.

3.3 The heat shrinkable polymer materials being used for external leakage insulation between the high voltage of conductors and grounds should be weather resistant.

3.4 All cuts/nicks inadvertently occurred to insulation must be rendered discharge free by using suitable discharge suppression compound.

3.5 The heat shrinkable tubing may be either extruded or moulded type.

3.6 Higher thickness of heat shrinkable sleeves shall be preferable to counter erosion due to pollution.

4 Push on type (Terminations only) :

4.1 Rubber components should be made from proven quality of tuber with tested curing properties.

4.2 The semi conducting portion of the stress cone should be vulcanized with insulation so that both semi conducting and insulation portion becomes an integrated part.

4.3 The stress cone must be of proven design of stress control.

4.4 The moulding of rubber components should be aimed to achieve a smooth finish on interior and exterior of the components.

4.5 The stress cone should probably be reusable type.

4.6 In case of outdoor terminations, the suitable provision for covering the cable cores with re-useable protective system from the crotch seal to the bottom of stress cone should be made.

5. Other Requirements

5.1 The outdoor termination kits shall be suitable for terminating the cable at steel cross arm complete with brackets, terminals, saddles and all necessary materials for fixing the termination. The heat shrinkable termination kit to be supplied and installed under this scope of work shall be capable enough to cope with all the weather change. Terminations that do not require manually built stress relief cones or field pouring compound are preferred.

5.2 The straight through joint kit shall be suitable for jointing single core of cables. The termination kits shall include all necessary components to join two alike cables sections together directly buried. Kits that do not require manually built stress relief cones or field pouring of compound are preferred.

5.3 Each of the above terminations and joint kits shall be complete in every respect and include clear, detailed instructions in English illustrating steps by step procedure in preparing the cable and applying the termination compounds.

5.4 Terminating and jointing kit shall be in a separate package, a list of materials indicating quantities and weights and an instruction sheet shall be included in the package.

5.5 The words “NEA” along with trade name of manufacturer, month/year of manufacturer, size etc. shall be embossed/engraved or suitably marked with indelible ink/paint for the purpose of identification.

5.6 The gripping tubing (termination boot) for the cable where trifurcation takes place, shall also be part of kit and covered under scope of this supply of this specification.

5.7 Accessories shall match the cable test ratings in all respects. The material and components not specifically stated in the specification, but which are essential for satisfactory operation of the equipment shall be included without any extra cost.

The termination and joint kits shall be of suitable for following cables:

- Outdoor or Indoor cubicle use for 11 kV, 3-cores Aluminium XLPE insulated Power cables.

6. Testing

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

- Appearance Test
- Construction Test
- High Voltage Test

D2. LV AERIAL BUNDLED CONDUCTOR (ABC)

1. Scope

This Specification covers the design, manufacture, factory test and supply of 0.6/1 kV cross-linked polyethylene (XLPE) insulated with insulated neutral messenger conductor supporting aerial bundled conductors (ABC) for use in the construction of 400/230V, 3-phase, 1-neutral, 1-street lighting, distribution systems.

2. Description

2.1 The cable shall be manufactured and tested in accordance with relevant IEC or latest revision thereof or any recognized international standards that ensure at least a substantially equal quality to the standards mentioned above.

2.2 The ABC shall be insulated aluminum neutral messenger conductor supported type.

2.3 The conductor shall consist of compact round stranded aluminum wires. The conductor shall be insulated by extruded black cross-linked polyethylene (XLPE) material.

2.4 The complete cable shall consist of five insulated conductors stranded together, and the direction of lay shall be right-hand. The type of construction shall cause the tensile load to be shared equally between conductors.

2.5 The outer covering of the R phase of the cable shall be embossed with the name of the manufacturer, name of the Purchaser " NEA- ", the cross sections, type of insulation followed by "Electric Cable: 600/1100 Volts" at the spacing of 5 meters. Every 2 meters of outer covering of the cable shall also be embossed with length of the cable.

2.6 The phase conductor shall be of multi-strand round compact hard drawn aluminum conforming to IEC 61089 with XLPE insulation. The detail technical specifications for phase conductor of the ABC are given in Table 1: Technical Data.

2.7 The lighting conductor shall be of multi-strand round compact hard drawn aluminum conforming to IEC 61089 with XLPE insulation. The detail technical specifications for lighting conductor of the ABC are given in Table 1: Technical Data.

2.8 The neutral messenger conductor shall be of multi-strand round compact hard drawn aluminum conforming to IEC 61089 with XLPE insulation. The detail technical specifications for street lamp conductor of the ABC are given in Table 1: Technical Data

3. Phase Identification

3.1 The identification of the conductors shall be provided by means of ribbing on the external surface of the insulation. R, Y and B phase conductors shall have one, two, and three ribs respectively. Space between the ribs in R, Y and B phases shall be 5 mm.. Ribs shall be in rounded form. The neutral messenger conductor shall be plain without any ribs.

4 Testing

4.1 Type tests

The bidder shall submit the type test reports along with the Bid. The report shall be issued by an independent accredited testing laboratory. The tests shall comply with relevant IEC Standard. The Employer also reserves the right to have tests carried out at his own cost by an independent agency, whenever there is a dispute regarding the quality of supply. The ABC shall be subjected to the following type tests:

(i) Mechanical strength of the conductors
(ii) Insulation resistance
(iii) Dielectric test
(iv) Impulse voltage withstand
(v) Resistance of each phase of the conductor at 20°C
(vi) Electrical resistance of phase, neutral and street lamp conductors.

4.3 Routine tests

The tests shall be made on the completed cables at the manufacturer's plant in accordance with governing standards including following tests:

(i) Verification of diameters of conductor and insulated conductor, and thickness of insulation, and so on
(ii) Breaking load test
(iii) High voltage test
(iv) Conductor resistance at 20 deg. C
(v) Dielectric strength
(vi) Insulation resistance

5. Packaging

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

5.2 All conductors shall be furnished on non-returnable seasoned wooden reels or steel suitably protected against corrosion. All timber shall be treated to provide protection against rot and insects. Protective external lagging of sufficient thickness shall be provided and fitted closely on the reels. Binder consisting of steel straps shall be provided over the external laggings. The reel shall be new and sufficiently sturdy in construction to withstand ocean shipping, road transport, several loading and unloading, storage in tropics, hauling and field erection of conductor without distortion or disintegration. The treatment process shall not have deleterious effect on the cable.

Before dispatch, the ends of the bundled conductors shall be sealed to prevent moisture ingress during transportation and storage. Both ends of every length of the assembled bundle shall be temporarily bound in such a manner as to prevent cores from separating.

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

(i) Type of conductor
(ii) Size of conductor
(iii) voltage
(iv) Length in meters
(v) Net weight of conductor and Drum Separately
(vi) Direction of rolling

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

Cable Size (sq. mm):	120 &95
Normal Length of the Conductor (m):	500

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.

7. Bid Documentation

7.1 The Bidder shall furnish with the Bid two (2) clear copies of the standard governing the fabrication and testing of XLPE insulated LV ABC and two (2) clear copies of the all other Standards referenced therein.

7.2 The Bidder shall furnish two (2) sets of complete description, catalogue, drawings showing general construction and size of the cables. The Bidder shall also furnish dimensional drawing of cable drum for each type of ABC.

7.3 The Bidder shall furnish two (2) clear certified copies of all type tests performed on all types of cables offered.

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.

TABLE 1

TECHNICAL DATA

MESSENGER WIRE CONDUCTOR SUPPORTING LV ABC

Number of phase conductor	3
Nominal cross sectional area of phase conductor, mm2	120 &95
Number of neutral messenger conductor	1
Nominal cross sectional area of neutral messenger conductor, mm2	95
Number of wires in conductor	37 & 19
Form of conductor	Stranded compacted circular
Min. diameter of conductor, mm	12.7 & 11.3
Nominal thickness of insulation mm	1.7
Nominal diameter over insulation mm	16.3 & 14.9
Max. continuous current carrying capacity per phase (A)	260 &225
Max. dc resistance of conductor at 20 deg. C, ohm/km	0.253 & 0.320
Min. breaking load of conductor, kN	17.2 & 13.3
Min. breaking load of cable, kN	67.2 & 53.2

D3: FITTINGS FOR HV AERIAL BUNDLED CONDUCTOR (ABC)

1. Scope

This Specification covers the fabrication and supply of fittings and associated apparatus for with HV aerial bundled conductors (ABC).

2. Description

2.1 The fittings, hardware and equipment shall be fabricated in accordance with International recognized standards such as IEC, NFC for Fittings and Associated Apparatus for use with HV ABC latest revision, and all referenced standards therein, or latest revision thereof or other recognized international standards that ensures at least a substantially equal quality to the standard mentioned above, will also be acceptable. The fitting and accessories shall be suitable for 11 kV nominal voltage applications.

2.2 The ABC Cable and Covered Conductor hardware manufacturing company shall have been accredited with ISO 9001 quality certification (including design for HV ABC accessories).

2.3 The fittings shall be for use in conjunction steel insulated stranded messenger wire of 50 sq. mm for 3-core, 150 sq. mm ABC cable.

2.4 Contractor shall get approval of all drawings and hardware sample from Purchaser before starting the fabrication of all hardware.

2.5 The fittings and accessories are as follows:

3. Anchor clamp (Dead End Clamp) with bracket:

The HV Anchor Clamp is used as an accessory for HV ABC System and shall be suitably designed to hold and grip the 11kV HV ABC 50 mm^2 galvanized stranded messenger steel wire to support it to 11m-12m long concrete poles /steel tubular poles via HV Anchor Clamp Brackets (Single or Double). The HV Anchor Clamp shall be capable of withstanding a minimum breaking load of 65 kN for 60 seconds.

The HV Anchor Clamp shall be made of weather resistant and corrosion-proof material of suitable grade and that there shall not be any undue deterioration in its safety, performance or appearance under normal service condition. The Pole bracket should be made of hard drawn aluminum alloy with corrosion resistant material.

3.1 Design and Construction

3.1.1 The hook of the HV Dead End Clamp (at the pole side) shall be fully insulated with adequate thickness and made of UV resistant material preferably epoxy.

3.1.2 The HV Dead End Clamp shall be supplied complete with proper and reliable clamping facility to hold and support the 50 mm2 galvanized stranded steel messenger wire of 150 sq. mm HV ABC.

3.1.3 The clamping facility shall be of conical wedge design to firmly grip the HV ABC galvanized stranded steel messenger wire via toothed jaw sliding in the sleeve grip and shall be made of high strength material.

3.1.4 Clamping the 50 mm2 galvanized stranded steel messenger wire to the Dead End Clamp shall not require any special tools.

3.1.5 With conical wedge design, the mouth of the conical wedge shall provide a funnel entry of the messenger wire but at the same time shall be capable to seal out the connection and the messenger wire against ingress of moisture and pollutants.

3.1.6 All steel and iron parts shall be galvanized in accordance to BS EN ISO 1461, IS 2629 & 2633 latest revision thereof or any international standard that ensures at least a substantially equal quality to the standard mentioned above.

3.1.7 The HV Dead End Clamp shall be so designed that it shall not have any loose parts.

3.1.8 The HV Dead End Clamp shall be allocated with a turnbuckle in the middle for fine adjustment of the HV ABC tensioning or sagging of up to 150 mm.

3.1.9 The HV Dead End Clamp shall be free from sharp edges; burrs flash or surface projections that could cause damage to the HV ABC or inflict injury to the installer or user. It shall be so designed that in normal use its performance is reliable and without danger to persons or surroundings.

4. Suspension clamps with bracket:

The HV Insulated Suspension Clamp is used as an accessory for HV ABC System and shall be suitably designed to hold and suspend the 11kV by using the 50 mm^2 galvanized stranded messenger steel wire of 150 sq mm HV ABC on to 10m-12m spun concrete poles/ steel tubular pole via MV Triangular Brackets (Single or Double). The HV Insulated Suspension Clamp shall be capable of withstanding a minimum breaking load of 20 kN for 60 seconds.

The HV Insulated Suspension Clamp shall be made of weather resistant and corrosion-proof material of suitable grade and that there shall not be any undue deterioration in its safety, performance or appearance under normal service condition. The Pole bracket should be made of hard drawn aluminum alloy with corrosion resistant material.

4.1 Design and Construction

4.1.1 The main body of the HV Insulated Suspension Clamp shall be of aluminum fully insulated with adequate thickness and shall be of UV resistant material; the movable link shall be made of special plastic material.

4.1.2 The HV Insulated Suspension Clamp shall be supplied complete with proper and reliable clamping facilities to hold and support the 50 mm^2 galvanized stranded steel messenger wire of 150 sq. mm HV ABC.

4.1.3 The complete assembly shall be so constructed that they are suitable for suspending the HV ABC in straight lines and angle positions (where the deviation is less than 90°) without causing any damage to the 50 mm^2 galvanized stranded steel messenger wire and the insulation of the phase conductors.

4.1.4 A bolt with lock nut on the clamp body is the preferred method to lock the galvanized stranded steel messenger wire to the clamp body. During the installation of the HV ABC, it will be possible to suspend the messenger wire in the open clamp so that it supports the cable before it is “locked” in place by the bolt.

4.1.5 Preferably, a hole with a preferred minimum size of 20mm x 2,5 mm is to be provided at the bottom end of the clamp body. The hole shall be suitable to be used for strapping a cable tie through it for supporting the phase conductor from sagging away from the clamp.

4.1.6 All steel and iron parts shall be galvanized in accordance to BS EN ISO 1461, IS 2629 & 2633 latest revision thereof or any international standard that ensures at least a substantially equal quality to the standard mentioned above.

4.1.7 The HV Insulated Suspension Clamp shall be so designed that it shall not have any loose parts.

4.1.8 The HV Insulated Suspension Clamp shall be free from sharp edges; burrs flash or surface projections that could cause damage to the HV ABC or inflict injury to the installer or user. It shall be so designed that in normal use its performance is reliable and without danger to persons or surroundings.

5. Insulated cable end caps

The insulated cable end caps shall be made of weather and age resistant insulating material and shall have wet flashover voltage not less than 65 kV. The cap shall be heat shrinkable type and shall be coated internally with a suitable sealant. The caps shall be suitable for 150 sq. mm ABC.

6. Outdoor end termination

The outdoor termination for 150 sq mm HV ABC shall be suitable to connect at the end of the cabling system the cable has to be connected with the transformer end or with the bare overhead line. It should be supplied with suitable crimping type lugs, proper stress control, adequate insulation and sufficient environmental sealing. The termination shall be of heat shrinkable dual wall single tube type. The ac high voltage and impulse voltage of the outdoor end termination shall not be less than 28.5 kV (rms) and 75 kV (peak) respectively. The other electrical and mechanical parameters should maintain as per IEC 60502 and IEC 60230.

7. Tee connection

The Tee connection for 150 sq mm HV ABC shall be suitable to use in main and branch cable. By the help of Tee off distribution transformer can be charged. The bus bar of Tee connection should be made of aluminum rectangular of 300 mm X 50 mm X 6 mm with provision for connecting two nos. of cable end terminations at both ends and tap off point at the center of the bus bar. The bus bar should be fully insulated with heat shrinkable bus bar tubing to prevent bird or any accidental contact.

Mechanical Properties (kN)	Electrical Properties (kV)
Specific cantilever load: 12.5	AC wet withstand voltage: 61
Maximum design cantilever load: 5.5	AC dry withstand voltage: 75
Tension load: 25	AC wet flashover voltage: 72
Test load: 12.5	AC dry flashover voltage: 104
	Impulse withstand voltage: 137

The Tee connection set shall be provided with all the accessories and necessary mounting for fixing it to the 10m-12m concrete poles/ steel tubular poles.

8. Straight through joint

The straight through joint for 150 sq mm HV ABC shall be suitable to connect at the end of one drum of the cable to continue the drawing of the cable from other drum has to be joined by mid-span inline straight through joints. The straight through joint should be supplied with suitable mechanical connector, proper stress control, adequate insulation and sufficient environmental sealing. The straight through joint shall be of heat shrinkable dual wall tube with extruded insulation and semiconducting layers. The ac high voltage and impulse voltage of the outdoor end termination shall not be less than 28.5 kV (rms) and 75 kV (peak) respectively. The other electrical and mechanical parameters should maintain as per IEC60502 and IEC 60230.

The Straight through joint shall be provided with complete accessories and pole mounting necessary for fixing it to the 10m-12m concrete poles/ steel tubular poles.

9. Jointing Sleeve for 50 sq mm messenger wire

The jointing sleeve shall be suitable to connect at the end of the one drum of the cable to another drum. The jointing sleeves shall be provided for 50 sq mm bare steel stranded galvanized wire. These shall be of the compression type which can afford the whole load of 150 sq mm ABC. The jointing sleeve shall be designed to have the full rate breaking strength of the steel alloy on which they are fitted.

10. Tests

10.1 Type tests

The bidder shall submit the type test report along with Bid. The report shall be issued by a recognized independent testing authority. The tests shall comply with relevant IEC Standard or the governing standard. The Employer also reserves the right to have tests carried out at his own cost by and independent agency, whenever there is a dispute regarding the quality of supply. In respect of the followings, fitting the test shall include, but not limited to the following:

Anchor clamps:

- Mechanical test
  - Tensile (high tension) test on bracket
  - Tensile on anchoring clamps
- Climate ageing test
  - voltage test
  - mechanical strength test
- Voltage test
- Corrosion test
- Dynamic test at low temperature
- Endurance test under mechanical and thermal stresses
  - slippage checking test
  - voltage test

Suspension clamps:

- Mechanical test
  - Tensile test on bracket
  - Tensile test on sub-assembly
- Slip test on the clamp
- Voltage test
  - on the supports
  - on sub-assembly
- Mechanical strength test
- Climate ageing test
- Corrosion test
- Endurance test under mechanical and thermal stresses
  - slippage checking test
  - voltage test

Tee connection:

- A.C. high voltage test (dry)
- A.C. high voltage test (wet)
- D.C. voltage withstand test
- Impulse voltage withstand test
- AC high voltage under influence of humidity and moisture
- Load cycle test
- Partial discharge test
- Mechanical test

Outdoor end termination:

- A.C. high voltage test (dry)
- A.C. high voltage test (wet)
- D.C. voltage withstand test
- Impulse voltage withstand test
- AC high voltage under influence of humidity and moisture
- Load cycle test
- Partial discharge test

Straight through joints:

- A.C. high voltage test (dry)
- A.C. high voltage test (wet)
- D.C. voltage withstand test
- Impulse voltage withstand test
- AC high voltage under influence of humidity and moisture
- Load cycle test
- Partial discharge test
- Mechanical test for connector

Tests for fittings and hardware shall be conducted in accordance with the NF C and IEC Standard or equivalent international standards including voltage and water tightness test wherever applicable.

10.2 Routine tests

Each batch of fittings shall be subjected to routine tests while manufacturing to confirm to the specified standard.

11. Quality Assurance Program

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

i. The structure of the organization;
ii. The duties and responsibilities assigned to staff ensuring quality of works;
iii. The system for purchasing, taking delivery and verification of materials;
iv. The system for ensuring quality of workmanship;
v. The quality assurance arrangement shall conform to relevant requirements of ISO9001; 2008
vi. Statement giving list of important raw materials, names of manufacturer for the raw materials, list of standards according to which the raw materials are tested, list of test normally carried out on raw materials;
vii. List of manufacturing facilities available;
viii. List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections;
ix. List of testing equipment available with the manufacturer for final testing of equipment specified and the test plant limitation, if any, vis-à-vis the type, special, acceptance and routine tests specified in the relevant standards.

12. Bid Documentation

12.1 The Bidder shall furnish with the Bid two (2) clear copies of the Standard governing fabrication and testing of the fittings and accessories for HV ABC and two (2) clear copies of all other relevant standards referenced therein.

12.2 The Bidder shall furnish two (2) sets of complete description, catalogue, dimensional drawings showing general construction and size of all fittings and accessories.

12.3 The Bidder shall furnish two (2) clear certified copies type test report for Anchor clamp, Suspension clamp, Tee connection, Outdoor end termination and straight through joints, failing which the bid shall be liable for rejection.

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

12.5 All technical data, drawings, catalogues and other technical documents shall be bound separately from the Bid documents. Drawings for Anchor clamp, Suspension clamp, Tee connection, Outdoor end termination and straight through joints must be submitted, failing which the bid shall be liable for rejection.

12.6 The NEA may ask to furnish the type test report for other accessories from the substantially responsive bidders.

12.7 The Bidder shall furnish the sample of accessories such as HV Dead End Clamp, HV Suspension Clamp and Straight through Joint (1- phase) along with the bid, failing which the bid shall be liable for rejection.

D4: FITTINGS FOR LV AERIAL BUNDLED CONDUCTOR (ABC)

1. Scope

This Specification covers the fabrication and supply of fittings and associated apparatus for with LV aerial bundled conductors (ABC).

2. Description

2.1 The fittings, hardware and equipment shall be fabricated in accordance with International recognized standards such as IEC, NFC for Fittings and Associated Apparatus for use with LV ABC of latest revision, and all referenced standards therein, or latest revision thereof or other recognized international standards that ensures at least a substantially equal quality to the standard mentioned above, will also be acceptable.

2.2 The fittings shall be for use in conjunction with insulated neutral messenger 3-core phase, 1-core neutral messenger and 1- core public lightning ABC of 185sq.mm, 120 sq. mm, 95 sq. mm and 50 sq. mm nominal cross-sectional areas.

2.3 Contractor shall get approval of all drawings and hardware sample from Purchaser before starting the fabrication of all hardware.

2.4 The fittings and accessories are as follows:

3. Anchor clamp with bracket:

The clamps should be designed to anchor insulated messenger of LVABC. The clamp should consists of an aluminum alloy corrosion resistant body, bail of stainless steel and self-adjusting plastic wedges which shall anchor/hold the neutral messenger without damaging the insulation.

The clamp should be installed properly with no losable part. It shall conform to the standard NFC33-041 or equivalent other international standards. The clamp body should be made of corrosion resistant aluminum alloy, bail should be of stainless steel to prevent from corrosion & climatic variations, a plastic saddle should be installed on the flexible bail to limit abrasion with hook/bracket and wedges should be of weather and UV resistant polymer. It should be fixed with pole by eye hook/bracket. Bracket should be made of corrosion resistant aluminum alloy. Ultimate Tensile Strength of the clamp should not be less than 12 KN for 50/70 sq.mm insulated messenger wire / 8 KN for 25/35 sq.mm insulated messenger wire. Slip load of the clamp should not be less than 5KN for 50/70 sq.mm insulated messenger & 3KN for 25/35 sq.mm insulated messenger wire. Design as per furnished drawing.

4. Suspension clamps with bracket:

The clamp should be designed to hang LV-ABC with insulated neutral messengers. The neutral messengers should be fixed by an adjustable grip device. A movable link should allow longitudinal and transversal movement of the clamp body.

The suspension clamp range to accommodate messenger shall be 25-95mm2. The clamp should be installed properly with no losable parts. The clamp shall conform to the standard NFC33-040 or other equivalent international standards. The clamp and

movable link made of weather and UV resistant thermoplastic polymer should provide additional insulation between the cable and the pole. The clamps and the movable links should be made of weather and UV resistant thermoplastic polymer. Clamps should be fixed with pole by eye hook/bracket. Bracket should be made of corrosion resistant aluminum alloy. The Suspension Clamp & the bracket will be preferably delivered together in order to minimize abrasion between two materials. Ultimate Tensile Strength of the clamp should not be less than 12 KN for 25-95 sq.mm insulated messenger wire. Maximum Allowable load of the clamp should not be less than 12 KN for 25-95 sq.mm insulated messenger wire. Slip load of the clamp should not be less than 300N for 25-95 sq.mm insulated messenger wire. The clamp should sustain to maximum angle of deviation of 60 degrees of the conductors. Design as per furnished drawing.

5. Insulated cable end caps

The insulated cable end caps shall be made of weather and age resistant insulating material and shall have wet flashover voltage not less than 6 kV. The cap shall be heat shrinkable type or without heat shrinkable and shall be coated internally with a suitable sealant. The caps shall be suitable for following sizes of ABC.

(i) 120 sq. mm, (3*120+1*95+1*16 sq. mm) ABC
(ii) 95 sq. mm, (3*95+1*95+1*16 sq. mm) ABC

6. Insulated insulation piercing connectors (IPC)

The insulated insulation piercing connector (or the connector for short) shall be suitable for using with aluminum ABC and concentric cables. It shall be made of high quality, weather, heat and age resistant insulating material having wet flashover voltage not less than 6 kV. It shall be watertight and suitable for making connections to the live lines. The piercing of main line and the tapping shall be done simultaneously. The design of the connectors shall be such that its removal is possible even after breaking of the shear head. The connector shall be provided with end cap for tapping end. The IPCs for the network application (Type A) shall be preferably of two bolt type and service application (Type B) shall be preferably of single bolt type. The IPCs for the network application shall withstand at least 5 kA fault current for 1s without damage. The connector shall be suitable for following cables.

Type	Main	Tapping
Type A	50-120 sq. mm, ABC	50-120 sq. mm, ABC
Type B	50-120 sq. mm, ABC	6-25 sq. mm, ABC/concentric cable

7. Core separators (pairs)

The core separators shall essentially comprise two wedges to facilitate the installation of connectors on tensioned ABC cable. The two separators shall be joined together with a nylon cord. The two separators, which shall be made from wither hardwood or rigid plastic, shall be so shaped as to be capable of being positively locked in position.

8. Jointing sleeves

The joint should be Pre-Insulated for Phases, neutral messengers and Street Lighting conductors. Sleeve should be made of Aluminum, insulated with an anti UV black

thermoplastic tube hermetically sealed two ends with 2 flexible rings to prevent water penetration. The sleeves shall be water tight with wet flashover voltage not less than 6kV upon installation.

9. Stainless Steel Strap and Buckle

The stainless steel strap shall be of 20x0.7mm size and be supplied in a roll of 50m. The breaking strength of the strap shall be at least 0.95 kN/mm2

10. Stainless Steel Strap Binding Tool

The strap binding tool shall be of ratchet type to be operated by the lines men by hand while working on the poles.

11. Tests

11.1 Type tests

The bidder shall submit the type test report along with the Bid. The report shall be issued by a recognized independent testing authority. The tests shall comply with relevant IEC Standard or the governing standard. The Employer also reserves the right to have tests carried out at his own cost by and independent agency, whenever there is a dispute regarding the quality of supply. In respect of the following fittings, the test shall include, but not limited to the following:

Anchor clamps:

- Mechanical test
  - Tensile (high tension) test on bracket
  - Tensile on anchoring clamps
- Climate ageing test
  - voltage test
  - mechanical strength test
- Voltage test
- Corrosion test
- Dynamic test at low temperature
- Endurance test under mechanical and thermal stresses
  - slippage checking test
  - voltage test

Suspension clamps:

- Mechanical test
  - Tensile test on bracket
  - Tensile test on sub-assembly
- Slip test on the clamp
- Voltage test
  - on the supports
  - on sub-assembly
- Mechanical strength test
- Climate ageing test
- Corrosion test
- Endurance test under mechanical and thermal stresses
  - slippage checking test

- voltage test

Insulation piercing connectors:

- Current carrying capacity test of the connector
- Temperature rise and over current test
  - Initial temperature test
  - Over current test
  - Final temperature test
- Electrical ageing test
- Climate ageing test
- Corrosion test
- Installation test at low temperature
- Mechanical test
  - Electrical continuity test
  - Mechanical tightening test
  - Mechanical strength of tap
- Electrical heat cycle test
- Voltage and water tightness test

Tests for fittings and hardware shall be conducted in accordance with the NF C and IEC Standard or equivalent international standards including voltage and water tightness test wherever applicable.

11.2 Routine tests

Each batch of fittings shall be subjected to routine tests while manufacturing to confirm to the specified standard.

12. Quality Assurance Program

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

i. The structure of the organization;
ii. The duties and responsibilities assigned to staff ensuring quality of works;
iii. The system for purchasing, taking delivery and verification of materials;
iv. The system for ensuring quality of workmanship;
v. The quality assurance arrangement shall conform to relevant requirements of ISO9001; 2008
vi. Statement giving list of important raw materials, names of manufacturer for the raw materials, list of standards according to which the raw materials are tested, list of test normally carried out on raw materials;
vii. List of manufacturing facilities available;
viii. List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections;
ix. List of testing equipment available with the manufacturer for final testing of equipment specified and the test plant limitation, if any, vis-à-vis the type, special, acceptance and routine tests specified in the relevant standards.

13. Bid Documentation

13.1 The Bidder shall furnish with the Bid two (2) clear copies of the Standard governing fabrication and testing of the fittings and accessories for LV ABC and two (2) clear copies of all other relevant standards referenced therein.

13.2 The Bidder shall furnish two (2) sets of complete description, catalogue, dimensional drawings showing general construction and size of all fittings and accessories.

13.3 The Bidder shall furnish two (2) clear certified copies of type test report for Anchor clamp, Suspension clamp and IPCs failing which the bid shall be liable for rejection.

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

13.5 All technical data, drawings, catalogues and other technical documents shall be bound separately from the bid documents. Drawings for Suspension clamp with bracket, Anchor clamp with bracket, Jointing sleeves and IPCs must be submitted failing which the bid shall be liable for rejection.

13.6 The NEA may ask to furnish the type test report for other accessories from the substantially responsive bidders.

13.7 The Bidder shall furnish the sample of accessories such as Type A IPCs along with the bid, failing which the bid shall be liable for rejection.

E. GANG OPERATED SWITCH

1. SCOPE

This specification covers the technical requirements of design, manufacture, testing at manufacturer's works, packing and forwarding, supply and unloading of 11 kV, 400 Amps Air Break Gang Operated Double Throw Triple Pole Switch at site / stores complete with all accessories for efficient and trouble free-operation. The specific requirements are covered in the enclosed technical data sheet. The switches shall be used on three phase 11kV 50 Hz A. C. Power system having solidly grounded neutral.

2. APPLICABLE STANDARDS & DESCRIPTION

a)

i) All material used for manufacturing 11 kV G.O. Switches i.e. 11 kV Post Insulators G.I. Pipe, MS Channel & Copper / Brass Male / Female contacts shall comply with the relevant IEC standard. However, Material manufactured as per any other international standard offering material, quality and workmanship of equivalence or better shall also be acceptable. The detailed description of equipment shall be as under:

ii) 11 KV, 400 Amps, double throw, triple pole gang operated, outdoor type, single break tilting type manual and motorized remotely operated. Air Break Switches, suitable horizontal mounting on structures 6 meters above ground level fitted with 3 no. 11 KV Post Insulators per phase, i.e. 9 no. Post Insulators per switch of standard make conforming to latest versions of relevant international standards or IEC. complete with fixed & moving contacts base of gun metal cast/, duly electroplated and jaw (U) fixed with spring able strips. The middle movable contacts arm rotate on rocker or bearing and blades will be made of gunmetal/brass/copper casting, duly electroplated. Multi- bolt type clamps of non-ferrous metal will be provided for incoming and outgoing connections. Fixed and moving contacts fitted on 11KV Post Insulators will be mounted on suitable MS Channel (horizontal).

iii) Phase coupler will be of 32mm diameter galvanized iron pipe. Operating rod shall be of 25 mm inner diameter and 32 mm outer diameter G. I. Pipe having free length of about 4 meter excluding the length of handle. The complete equipment shall be as per latest version of IEC. MS Channel, C.I. casting for lever and side plates are to be hot dipped Galvanized as per relevant standard. All other ferrous parts including nuts, bolts and washers are to be hot dipped galvanized. All Current carrying nuts, bolts and washers are to be hot dipped galvanized. The equipment supplied shall also conform to detailed specification with guaranteed technical particulars.

b) PARTICULARS OF SYSTEM.

The switches shall be used on three-phase 11 kV, 50 Hz Power system having solidly grounded neutral.

c) CLIMATIC CONDITIONS

As per the PSR.

d) GENERAL TECHNICAL REQUIREMENTS:

S. No.	Description	Requirement
1.	Installation	Outdoor
2.	Type	Double Throw Triple Pole
3.	Service Voltage	11 kV
4.	Rated Voltage	12 kV
5.	Rated Frequency	50 Hz
6.	Current Carrying Capacity	400 Amps
7.	Rated short time current	18 kA for 1 Sec
8.	Rated peak current in closed position	46 kA
9.	One minute power frequency withstand voltage Between	
	i) Earth & pole	28kV (r.m.s.)
	ii) Across terminal of open switch	32 kV (r.m.s)
10.	Rated lightning impulse withstand voltage between	
	i) Earth & pole	75kV (peak)
	ii) Across terminal of open switch	85kV (peak)
11	No. of Post per Phase	3

3. SWITCH INSULATION

Insulation to ground, insulation between open contacts and insulation between phases of the completely assembled G.O. Switches shall be capable of withstanding the dielectric test voltages specified in IEC. Insulation between open contacts of a pole shall at least be 15 % more than the insulation between the live parts of pole to ground, so that If any flash- over occurs when switch is open, it shalt be to the ground. All insulators provided to form a stack shall conform to the relevant Indian Standard Specifications. The porcelain shall be homogeneous and free from all cavities and flaws. Design of insulators shall ensure ample insulation, mechanical strength and rigidity for satisfactory operation under site conditions. The design shall also ensure that the losses caused by capacitive current or conduction through dielectric are minimum and that leakage due to moist and dirty insulators surfaces is least.

All metal caps and supports shall be cemented to the porcelain whereas the blades and contact blocks shall be bolted to the metal parts of the insulators thus making the replacement of damaged insulators easy. All ferrous metal parts, flanges, bolts and nuts etc. shall be galvanized.

The porcelain post insulators should be from the leading manufacturers.

4. G.O. SWITCH OPERATION AND OPERATING MECHANISM

5.

The switches shall be suitable for local manual and remote motorized operation. The Operating mechanism shall comprise of operating pipe with intermediate couplings and manual operating handle. Height of operating handle may vary from 1000 to 1300mm. The operating mechanism shall give good mechanical leverage with minimum loose/lost motions. There shall be suitable pad-locking arrangement for both 'ON and OFF' positions.

The GO Switch shall be suitable for remote operation through SCADA via Optical Fibre or RF communication or GSM. Therefore, suitable communication facility like FRTU etc. shall be provided within the operating mechanism box. The specification of FRTU and signal status shall be as mentioned in specification for RTU.

5. BEARING OR ROCKER

Graded cast rocking type levers supported on side plates/fabricated type as per drawings, Bearing housing shall be weather proof and facilities shall be provided for easy lubrication.

6. PACKING & TRANSPORTATI ON.

The supplier shall be responsible for suitable packing of all the material and marking on the consignment to ensure correct dispatch to the destination. All G.O. Switches shall be packed suitably capable of withstanding rough handling for transportation to the various consignees so as to avoid any shortage and damage occurring during transit. Separators shall be fixed between the post insulators and other breakable parts of GO Switch and also between individual GO Switches so as to prevent relative movement to avoid damage. All the labels used on each packing shall be of tin securely bounded with wire and shall have the descriptive marking stamped thereon. All GO Switches damaged during transportation shall be to the supplier's account.

7. DESIGN FEATURE

7.1 Contact System

The male and female contacts assemblies shall be of sturdy construction and design to ensure:

i. Electro dynamic withstand ability during short circuits.

ii. Thermal withstand-ability during short circuits.

iii. Constant contact pressure even when the live parts of the insulator stacks are subject to tensile stresses due to linear expansion of connected bus bar of flexible conductors either because of temperature variation or strong winds.

iv. Self-wiping action during closing and opening.

v. Self-alignment assuring closing of the switch without calling for any adjustment.

7.2 Temperature Rise

Maximum temperature attained by any part of the isolating switches when in service at site under continuous and exposed continuously to the direct rays of sun and the air having temperature of 50 degree centigrade shall not exceed the permissible limits fixed by latest edition of IEC. Maximum temperature rise under the above noted condition should not exceed the permissible limits when corrected for the difference between ambient temperature at site and the reference ambient temperature.

8. CURRENT CARRYING PARTS

All current carrying parts shall be of non-ferrous metal or alloys and shall be designed to limit sharp point edges. Design of isolating contacts shall permit easy maintenance and renewal of contacts.

9. NAME PLATE & MARKING

The Air Break GO Switch shall be provided with durable and legible name plate, effectively secured against removal. The name plate shall be indelibly and distinctly marked with all essential particulars as per the relevant standards along with the following:

The Name plate shall be embossed with tender number with date & "PROPERTY OF NEA".

1. Continuous operating Voltage
2. Rated Voltage
3. Rated Frequency
4. Manufacturer's Name
5. Type and Identification of the complete arrestor
6. Month/Year of Manufacture
7. Serial Number
8. Order reference.
9. Rated normal current in Amps.
10. Rated one second short-time current in Amps.

10. COMPLETENESS OF EQUIPMENT

All fittings, accessories or apparatus which may not have been specially mentioned in this specification but which are otherwise necessary for satisfactory working of GO Switches shall be deemed to have been included in the scope of supply.

11. ROUTINE TESTS

Routine tests as per latest edition of IS-9921 (part-I to V} shall be carried out at works of the manufacturer.

The following shall comprise Routine tests:-

(a) Power frequency voltage dry test

(b) Measurement of the resistance of the main circuit

(c) Operating test

Copies of Routine test certificates shall be supplied along with the acceptance tests carried out in the presence of purchaser's authorized representative. All tests reports shall

be submitted and shall be got approved by the purchaser or his authorized representative before dispatch.

12. DRAWINGS

The bidder shall submit two sets of detailed dimensional drawing indicating there in the material used for various components. Manufacture of material shall not be commenced before receipt of approved drawings from the purchaser.

Material not complying with dimensional drawings shall be rejected.

F. LIGHTNING ARRESTER

1.1 General

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

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

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

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

1.2 Equipment to be furnished

9 kV Lightening Arrestor

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

1.3 Design Requirements

1.3.1 The lightning arresters shall be pole mounted type, single pole, gap less type rated voltage 9 kV for 11 kV system. The nominal discharge current shall not be less than 10kA.

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

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

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

1.4 Test

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

(a) Construction test
(b) Insulation resistance test and leak current test

1.4.2 Type test certificates on similar equipment and routine test certificate carried out for following tests shall be furnished for approval of the Employer/Employer's Representative.

(a) Voltage withstand test

(b) Impulse voltage characteristic test

(c) Discharge voltage characteristic test

(d) Discharge current withstand test
(e) Duty cycle test

(f) Pressure relief test

(g) Contamination test

1.5 Drawings and Data

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

(a) Standard catalog identifying the models and ratings being furnished.

(b) Outline drawings including dimensions

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

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

1.6 Nameplate

Each lightning arrester shall be provided with a nameplate of weather resistant material fitted in a visible position showing the following items as a minimum.
(a) Manufacturer's name
(b) Manufacturer's serial number and type designation
(c) Year of manufacture
(d) Rated voltage
(e) Nominal discharge current

TECHNICAL PARTICULARS OF 9 kV LIGHTNING ARRESTER

1.	Type	Outdoor,
2.	Quantity required	As per Price Schedule
3.	Mounting	pole mounted
4.	Rated frequency	50Hz
5.	System voltage	11 kV
6.	Rated voltage	9 kV
7.	Impulse withstand voltage (BIL)	75 kV
8.	Power frequency withstand voltage	28 kV
9.	Nominal discharge current	10 kA

G. RING MAIN UNIT (RMU)

1. Scope

This specification for SF6 insulated Ring main Units (RMU) covers design, manufacture, shop testing, inspection, packing, delivery to site, erection, testing and commissioning. The units shall be of 11kV metal enclosed, panel type, extensible and suitable for indoor and outdoor applications. The units shall be fully type tested according to IEC 60298 standards.
The RMU's should be complete with all components necessary for effective operation along with all required associated equipment. All required components should be deemed to be within the scope of supply.

The design of the switchgear should be exclusive and specific responsibility of supplier and should comply with current good engineering practice, the relevant codes and recommendation and the project specific requirements.

The RMU's should be fixed type SF6, insulated. Circuit breakers either SF6 or vacuum, for transformer protection shall be equipped with an O/C & E/F relay. The RMU's shall effectively be maintenance free.

2. Standards and Reference Documents

2.1 Codes and Standards

The **RMU** should be designed, manufactured and tested according to the latest version of:
IEC 60694: Common specifications for high-voltage switchgear and control gear standards.
IEC 60298: AC metal-enclosed switchgear and control gear for rated voltages above 1kV and up to and including 72 kV and the IEC Codes herein referred.
IEC 60129: Alternating current Disconnector (isolators) and earthing switches
IEC 60529: Classification of degrees of protection provided by enclosures
IEC 60265: High-voltage switches -Part 1: Switches for rated voltages above 1kV and less than 52 kV
IEC 60056: Circuit breakers
IEC 60420: High-voltage alternating current switch-fuse combinations
IEC 60185: Current transformers
IEC 60186: Voltage transformers
IEC 60255: Electrical relays
Any other codes recognized in the country of origin of equipment might be considered provided that they fully comply with **IEC standards**.

The design of the switchgear should be based on safety to personnel and equipment during operation and maintenance, reliability of service, ease of maintenance, mechanical protection of equipment, interchangeability of equipment and ready addition of future loads.

3. Application

RMU's shall be used for indoor and outdoor applications. The Ring Main Unit shall be installed at 11kV junction points and sections such as to isolate faulty section. The RMU's shall be both extensible and non extensible according to the procurement as specified in the Bid Price Schedule (BPS). The RMU shall have front access with anti theft hinge arrangement with minimum of 3 hinges. The RMU shall be fitted with four numbers of lifting lugs.

Indoor:

- Extensible or as per the BPS
- The Equipment shall also be suitable for installation in a concrete building structure in substations;
- The Equipment shall require a mounting base;
- Metering unit (optional) can also be incorporated into the switchgear;
- Interfaces to Future SCADA system shall be provided.
- Modular design, panel type with front cable access.
- RMU's SF6 compartments must be made of robotically welded stainless steel.

1) **Outdoor:**

- The Equipment shall be suitable for mounting on a galvanized steel supporting stand and housed inside a naturally ventilated all-weather metal kiosk;
- The Equipment shall require a mounting base;
- Interfaces to Future SCADA system shall be provided.
- Hermetically sealed metallic Epoxy / Stainless steel enclosure for OUTDOOR RMU application. The manufacturers shall confirm the normal current ratings mentioned in Technical Data Sheet (TDS) at 50 degrees ambient without de-rating.
- Enclosure with IP54 standard protection.
- Offered RMUs must be extensible or as per BPS.
- Cable boxes shall be on Front / side/rear sides.
- Shall consist of Load Break isolators and circuit breaker as per the BPS.

- RMU enclosure must be shielded against solar irradiation and tested for ambient of 50 degrees C. The manufacturers shall confirm the normal current ratings mentioned in TDS at 50 deg. Ambient without de-rating.
- Metering unit (optional) can also be incorporated into the switchgear;

4. Insulating and Switching Mediums

Switch units shall be of vacuum or SF_6 gas interrupter type. Oil immersed or air- break switchgear will NOT be considered.

4.1 Vacuum Interrupters

Vacuum Interrupters may be used for Circuit Breakers and switch-disconnectors. The contacts for vacuum interrupters shall be positively driven in both the OPEN and CLOSE directions and in no way be dependent on the interrupter vacuum. The vacuum bottles shall be sealed for life.

4.2 SF_6 Gas Interrupters

SF_6 gas Interrupters may be used for Circuit Breakers and switch-disconnectors. The SF_6 gas used shall comply with the requirements of in accordance with IEC376 and shall be suitable in all respects for use in RMUs under the stipulated service conditions.

It is preferable to fit an absorption material in the tank to absorb the moisture from the SF6 / VCB gas and to regenerate the SF6 / VCB gas following arc interruption.

The SF6 / VCB insulating medium shall be constantly monitored via a temperature compensating gas pressure indicator offering a simple go, no-go indication.

The SF6 shall be tested for purity, dew point air hydrolysable fluorides and water content as per IEC 376,376A and 376B and test certificate shall be furnished to the owner indicating all the tests as per IEC 376 for each Lot of SF6 Gas AS 62271-200. Equipment that requires the periodic filling of SF_6 gas shall not be considered.

A stainless steel label shall be fixed to the RMU stating the total mass and volume of SF_6 gas present in the RMU at a specified date. The Vendor shall state in the Proposal the nominal SF_6 gas filling pressure and nominal fill temperature.

4.2.1 SF_6 Gas Annual Loss

The annual loss rate of SF_6 gas shall not exceed 0.1% of the total mass. The vendor shall guarantee that pressure of the SF_6 gas shall be above the operating limit throughout the lifetime of the equipment. The switchgear shall not remain energized with load connected if there is no SF_6 gas inside the tank.

4.2.2 SF_6 Gas Pressure Gauge/Non-return Valve & Low Gas Switch

A robust SF_6 gauge(s) shall be provided for visual indication of SF_6 gas pressure inside the switchgear chamber. The SF_6 gauge shall be readily visible from the front of the unit without the necessity to remove any covers and be clearly marked to indicate the normal gas pressure by a green area on the gauge face and the low gas pressure by a red area on the gauge face. The gauge shall incorporate temperature compensation or have a gauge face that corresponds to different temperature ranges.

The SF_6 gauge shall be fitted to a non-return valve that prevents loss of SF_6 gas. The non-return valve shall facilitate the following:

The switchgear and bus-bar housing containing SF_6 gas shall be sealed for life except one common access point for the SF_6 gas gauge sensor via the SF_6 gas non-return valve.

A separate low pressure SF_6 gas switch shall be provided for low pressure alarm. The low pressure switch is to be set to operate at pressure which will indicate loss of SF_6 within switchgear and will not generate false alarms as the SF_6 gas pressure drops due to the ambient temperature drop or change.

5. Design Criteria

5.1 Service conditions

The offered switchgear and control gear should be suitable for continuous operation under the basic service conditions indicated in this chapter. Installation should be in normal outdoor conditions in accordance with IEC 60694.

5.2 General structural and mechanical construction

The offered RMU's should be of the fully arc proof metal enclosed, free standing, floor mounting, flush fronted type, consisting of modules assembled into one or more units. Each unit is made of a cubicle sealed-for life with SF_6 / VCB and contains all high voltage components sealed off from the environment.

The overall design of the indoor switchgear should be such that front access only is required. It should be possible to erect the switchboard against a substation wall, with HV and LV cables being terminated and accessible from the front.

The units should be constructed from 3 mm thick hot rolled steel sheets, however SF_6 enclosures are stainless. The design of the units should be such that no permanent or harmful distortion occurs either when being lifted by eyebolts or when moved into position by rollers.

For outdoor RMUs a weather proofing process shall be carried out. Sheet metal must be grit Blazed / thermally sprayed and polyurethane painted with about 70 micron thicknesses, to achieve outdoor worthiness and corrosion proofness.

RMU enclosure must be shielded against solar irradiation and tested for an ambient of 50 degree centigrade without derating of the equipment.
The cubicle should be having a pressure relief device. In the rare case of an internal arc, the high pressure caused by the arc will release it, and the hot gases is allowed to be exhausted out at the bottom / top / rear of the cubicle. A controlled direction of flow of the hot gas should be achieved.

The switchgear should have the minimum degree of protection (in accordance with IEC 60529)

- IP 67 for the tank with high voltage components
- IP 2X for the front covers of the mechanism
- IP 3X for the cable connection covers
- IP 54 for the outdoor enclosure

6. General Technical Requirements

Fixed type SF6 gas insulated / Vacuum circuit breakers. It should be maintenance free, having stainless steel robotically welded enclosure for INDOOR RMU & hermetically sealed metallized Epoxy Enclosure / Stainless steel enclosure for OUTDOOR RMU application. The rating of enclosure shall be suitable for operation on three phase, three wire, 11 kV, 50 cycles, A.C. System with short-time current rating of 20 kA for 3 seconds for 11kV. Each switchboard shall be identified by an appropriately sized label which clearly indicates the functional units and their electrical characteristics.

The Switchgear and Switchboards shall be designed such that the position of the different devices is visible to the operator on the front of the Switchboard and operations are visible.

In accordance with the standards in effect, the switchboards shall be designed so as to prevent access to all live parts during operation without the use of tools.

Each RMU shall include its own power supply unit (including auxiliary power transformer, maintenance free batteries, and battery charger), which shall provide a stable power source for the RMU. The RMU will also supply 24VDC 500VA for FRTU and other purposes.

6.1 Each new RMU shall be equipped with main-line load break switches and a fault passage indicator (FPI). Furthermore, to protect each of its lateral / transformer feeders, it shall be equipped with a corresponding set of circuit breakers and self-powered numerical relays. The RMU shall include potential-free contacts and control contacts so as to connect to SCADA/DMS via FRTUs, so as to:

a) Monitor and control the open/closed status of the RMU circuit breakers and load break switches.

b) Monitor the local/remote position of RMU motorized (in case if failure of motor) manually-operated switches that can be used to enable and disable remote monitoring.

c) Monitor the health of the power supply, which will include battery failure and low voltage indications.

d) Monitor the open/closed status of RMU earthing switches.

e) Monitor the open/closed status of RMU enclosure doors in case of Hinge doors.

f) Monitor for low SF_6 gas pressure indication.

g) Monitor for circuit breaker relay operations.

h) Monitor for indication of main-circuit fault detected by the RMU's FPI.

i) Necessary current sensors / transformers for protection and metering (wherever required).

j) All necessary dry (potential-free) contacts for indications relevant to RMU monitoring status and control.

k) A PT Panel including auxiliary power transformer for measurement of system voltage and for charging the batteries OR Auxiliary supply from NEA Line.

l) Battery and battery charger, to provide stable as per motor rating, 24V DC power for the RMU's motor.

6.2 Busbars:

The three numbers of continuous Busbars made up of EC grade tinned copper of rating current 630A shall be provided. The Short time rating current shall be 20 kA for 3 seconds for 11 kV. The Busbar connections shall Anti- oxide greased. The bus bar should be integrated in the cubicle Bus bars should be rated to withstand all dynamic and thermal stresses for the full length of the switchgear.

6.4 Load Break Switches (Isolators)

The Load Break Isolators for Incoming and Outgoing supply must be provided and the load break isolators are fully insulated by SF6 gas. The operating mechanism

shall be spring assisted mechanism with operating handle for ON /OFF. Earth positions with arrangement for padlocking in each position. Also it shall have the provision of independent manual operations with mechanically operated indicator.

The earth switch shall be naturally interlocked to prevent the main and earth switch being switched 'ON' at the same time. The selection of the main and earth switch is made by a lever on the facial, which is allowed to move only if the main or earth switch is in the off position. The load break isolators should have the facility for future remote operation. Each load break switch shall be of the triple pole, gang operated and with integral earthing arrangement.

The rated current of Isolator shall be 630 Amps Continuous at Maximum Ambient temperatures. No derating shall be allowed.

Operation Interlock

6.5 Earthing of isolators and distribution transformer breakers (Earth Switch)

The unit shall consist of a 630A Tee Off spring assisted three position rotating arc type SF_6 circuit breaker unit, with integral fault making/dead breaking earth switch, the function shall be naturally interlocked to prevent the main and earth switch from being switched

`ON` at the same time and the CB not allowed to trip in `Earth On` position. The selection of the main/earth switch lever on the fascia, which is allowed to move only if the main or earth switches in the off position. The lever may be padlocked in either the main or earth position.

The cables shall be earthed by an integral earthing switch with short-circuit making capacity, in compliance with IEC 60129 standard. The earthing switch shall be operable through the main circuit mechanism and manual closing shall be driven by a fast-acting mechanism, independent of operator action.

6.6 Circuit Breaker (SF6 or Vacuum.)

The 3 pole circuit breaker for the protection shall be enclosed in the main tank. The rated breaking and making current at rated voltage shall be as follows:

For 11kV system:

Rated breaking capacity shall be 20 kA.

Rated short time current shall be 20kA for 3 second.

Rated making current shall be 50 kA.

Minimum number of operations at rated current (as per IEC 62271-100,102): Mechanical endurance M2 (2000), Electrical endurance-Class E3

Breaker status auxiliary contact: 2NO + 2NC wired to terminal block

Relay auxiliary contact for remote indication: Potential free contact 1 NO +1 NC wired to terminal block

The circuit breaker shall be fitted with a mechanical flag, which shall operate in the event of fault occurrences. The breaker indications ON and OFF positions shall be indicated by suitable flag. For ON position indication by Red flag and OFF position indication by Green flag shall be provided.

The circuit breaker shall be operated by the same unidirectional handle or switch. The rated operating sequence shall be O-3min-CO-3 min- CO.

The protection on the circuit breaker:

The circuit breaker unit fitted with 3 nos. protection CT's (tape wound) of ratio 100-50A/1A, 5P10 class, having low burden and trip coil and auxiliary switch assembly allowing the use of a self-powered non-directional IDMT (Inverse Definite Minimum Time) Over Current and Earth Fault Relays (Microprocessor based numerical). One Three Element Relay having two O/C elements and one E/F element shall be provided for this purpose. All these relays shall be of 3 seconds IDMT characteristics, the O/C elements current setting variable from 10% to 200% of CT secondary ratings, and the E/F elements having current setting variable from 10% to 40%. The protection curves and all other settings shall be adjustable from touch panel.

6.7 Bushings

All the bushings shall be of same height, parallel, on the equal distances from the ground and protected by a cable cover. It is preferable to have bushings accessible from the rear side of the RMU.

6.8 Cable Boxes

All cable boxes shall be air insulated suitable for dry type cable terminations. The cable boxes at each of the two ring switches suitable HV cables of size 3C x 300 sq.mm and circuit breaker cable suitable up to 3C x 400 sq.mm.

For indoor Cable boxes should be front access and interlocked with earth switch. No rear access required. For outdoor RMUs cable boxes shall be on sides/rear/front.

6.9 Voltage Indicator lamps and phase comparators

The RMU shall be equipped with a voltage indication. There should be a facility to check the synchronization of phases with the use of external device. It shall be possible for the each of the function of the RMU to be equipped with a permanent voltage indication as per IEC 601958 to indicate whether or not there is voltage on the cables. The capacitive dividers will supply low voltage power to sockets at the front of the unit, an external lamp must be used to indicate live cables.

Three outlets can be used to check the synchronization of phases with the use of an external device.

The voltage indicators are situated on the front cover, one for each module, and indicate the voltage condition of each incoming cable. Identification of the phases is achieved with labels L1, L2 and L3 on the front of the voltage indicators. The voltage indicator satisfies the requirements of IEC61243.

6.10 Extensible

Each combination of RMU shall have the provision for extension by load break isolators / breakers in future, with suitable trenching chamber, accessories and necessary Busbars. Extensible isolators and circuit breakers shall be individually housed in separate SF6 gas enclosures. Multiple devices inside single gas tank / enclosure will not be acceptable. In case of extensible circuit breakers, the Breaker should be capable of necessary short circuit operations as per IEC standard i.e. 20 kA for 3 second for 11kV system. The Breaker should have a rated current carrying capacity of 200 A.

6.11 Fault Passage Indicators / Earth Fault Indicators (FPI/EFI):

These shall facilitate quick detection of faulty section of line. The fault indication may be on the basis of monitoring fault current flow through the device. The unit should be self- contained requiring no auxiliary power supply. The FPI shall be integral part of RMU.

6.11.1 Each RMU shall be provided with FPI in the isolator to indicate the short circuit and earth fault. The Unit shall be self-powered and requiring no auxiliary power supply. The fault shall be displayed by means of LCD/LED which can be reset with manual/ auto with selectable time/ on restoration of supply

6.11.1 These shall facilitate quick detection of faulty section of line. The fault indication may be on the basis of monitoring fault current flow through the device. The unit should be self-contained requiring no auxiliary power supply. The FPI shall be

integral part of RMU, shall be capable of displaying the fault and phase currents. The FPI shall have LCD/LED display, automatic reset facility.

6.11.2 FPI Reset from SCADA will be through momentary closure of a potential free contact from FRTU. The FPI should be self-powered and should have internal lithium battery for external indication and setting of FPI in the absence of current.

6.11.3 The FPIs shall include**:**

i. Fault detection - Phase to phase and Phase to earth faults.

ii. One potential-free output contacts for hardwiring to RTUs. On this basis, the SCADA/DMS will be able to monitor phase / earth fault condition.

iii. Local fault indications - LCD display on FPI front panel along with LED indication on front panel of RMU enclosure.

iv. Multiple reset option –

a) End of time delay (Adjustable from 2 to 16 Hrs.)
b) Remote reset (Via potential free input contact of FPI)
c) Manual reset (Reset button on front panel of FPI)
d) Automatic reset on current restoration.

6.11.4 **The characteristics of the FPIs shall include:**

- Phase fault thresholds configurable from at least 100 to 800 A
- Earth fault thresholds configurable from at least 20 to 200 A
- Multiple number of steps for adjusting phase and earth fault thresholds.
- Fault current duration range configurable from at least 40 ms to 100 ms in 20 ms steps and further 100 ms to 300 ms in 50 ms steps.
- Variations with respect to these characteristics may be acceptable as long as they prove applicable and provide the same or better flexibility.

6.11.5 The sensors to be bushing/cable mounted. The number of FPI should be put in all the three phases of the outgoing branch of the RMUs

6.11.6 FPI should have suitable connectivity with the FRTUs for the SCADA purpose.

6.11.7 The FPI inside the RMU may be non-communicable and hard wired to the TB for the signals

a) Fault Passage indicator OK
b) Fault Passage indicator operated

6.11.8 The conventional practice is to have N numbers of FPI where N is number of LBS in a particular configuration of RMU.

6.11.9 Units fully **SCADA** Compatible. Retrofitting at site possible at a later date. Line switches (Load break switches) as well as T- OFF circuit Breaker can be operated by remote.

6.11.10 The RMU should have compatibility with MODBUS PROTOCOL SCADA system. The RMU shall provide DI/DOs for interfacing with FRTU. The protection relay shall have MODBUS protocol along with DOs. Ring Main Units capable of being monitored and controlled by the SCADA/DMS.

6.11.11 FRTU, MODEM, Power and I/O cable interface between FRTU and Control panel of RMU's are in the scope of supply.

6.11.12 Cable testing possible without disconnection of cables.

6.11.13 Compact in dimension.

6.11.14 All live parts should be inside a hermetically sealed metalized Epoxy enclosure / stainless steel enclosure for outdoor type RMU & 3mm stainless steel robotically welded enclosure for indoor RMU.

6.12 Auxiliary Transformer

The RMU's shall be outfitted with an auxiliary power transformer with its primary connected to the 11kV Bus voltage as applicable and the secondary providing a single phase 230V, 50HZ nominal to supply the various loads that comprise the battery charger in the FRTU (supplied by others with rating of 230VAC, 1A), light fixture in the RMU, receptacle (230VAC, 5A for powering local test equipment's) and AC load within the RMU if any as per manufacturers design. The auxiliary power transformer shall have a sufficient VA capacity of 150% of the load (load comprising of Battery Charger in FRTU plus RMU Power requirements) pertaining to the RMUs. The auxiliary transformer shall meet the applicable design standards as per IS/Equivalent standards.

6.13 Power Supply

6.13.1 Each RMU shall be fitted with a power supply, including batteries and battery charger, suitable for operating the motors of the On-load Isolators and Circuit Breakers. On this basis, the following operational specifications shall apply:

6.13.2 The power supply unit shall conform to the following requirements:

Input: 230 V AC nominal from the RMU's auxiliary power transformer allowing for possible variations from 190 to 300 V AC

Output: Stable 24 V DC.

Batteries: 24 V DC (2 Nos of 12 V DC each)

6.13.3 The auxiliary power transformer's inputs shall be equipped with surge protection devices in accordance with IEC 62305.

6.13.4 **Battery**

The Battery should be of reputed make with superior dry fit technology, maintenance free suitable for Automation of RMU. Following should be the features of the battery: -

24V, 20 AH plus the AH required for the 5 nos. of continuous opening and closing of all the three limbs. Capacity of the battery in any case shall not be below 20 AH of Dry/Gel NRLA type maintenance free batteries.

a. The position of the battery shall be kept at minimum heated area of the RMU
b. Exceptional energy" storage capacity combined with long life.
c. Maintenance free (no topping up) during the whole service life.
d. 5 year designed life.
e. Very low gassing due to internal gas recombination.
f. Short recharging time.
g. Completely recyclable.
h. Should have capacity for 5 Switching operations and 48 hours of operation of RTU / Modem / Communication for SCADA in the event of supply failure.

6.13.5 **Battery Charger**

24V on line Rectifier cum battery charger of sufficient capacity to drive motors and SCADA equipment with voltage regulation of +/-5% or less on full load shall be provided. Battery charger, offered shall be suitable for Dry fit batteries with the following technical features:

1. Modular type battery charger.
2. Input voltage 230 V AC +/ - 20%
3. Output voltage (as per requirement for the battery above).
4. Output adjustment range.
5. Series and parallel use should be possible.
6. The battery shall recharge to 80 % of its capacity in a maximum of 15 hours.
7. Batteries shall be disconnected at the manufacturer's specified minimum voltage.
8. Battery Low 'indication shall be available locally and remotely and shall include a battery test. The indication of "Battery Low" status shall allow for a further three RMU operations.
9. System Healthy and Power Fail indicators to be provided.
10. Technical specifications are to be indicated by the bidder on the battery charger are:

- The battery charger shall be fully temperature compensated.

- To prevent deep discharge of the batteries on loss of AC power source, the battery charger shall automatically disconnect all circuitry fed by the batteries following a user-adjustable time period or when the battery voltage falls below a preset value. If the battery voltage falls below the preset value, the time to fully recharge all batteries shall not exceed twenty-four (24) hours.
- An automatic battery checking device shall be provided to check the battery's health and initiate a battery-failed alarm signal in case battery deterioration is detected. Such detection may be based on comparing measurement values with set values (e.g., internal resistance, voltage, etc.).
- The battery charger shall be provided with an alarm displayed at the local control panel and remotely at the DAS to account for any of the following conditions:
    - Low battery voltage High battery voltage Battery failed
    - Battery charger overvoltage
    - Grounded battery/battery-charger
    - Others according to manufacturer's design

6.14 Motorization:

6.14.1 All the functions within the RMU i.e. Isolators/Breakers should be fitted with motor mechanism and closing coil making it suitable to make it ON from remote. (However, manual mechanism should be possible in case of failure/ non-working of motor)

6.14.2 Other Accessories (required with RMU):-

a) Shunt Trip Coil (Coil voltage shall be indicated later on)
b) Battery & Battery Charger.
c) 4NO+4NC auxiliary contacts.

6.15 **SCADA Connectivity**

6.15.1 Provision shall be made in all the RMUs with necessary take off terminal units for automations and connectivity with FRTU. All RMUs shall be motorized type and compatible for SCADA operation. All the I/O signals need to be brought to the Terminal Strip on a Din Rail, also the Din Rail should have space to mount the MFT's provided by SIA. All the DI's, AI's and DO's should be provided as potential free and control contacts. The CT/PT should provide metering grade core for connecting MFT provided with FRTU. The RMU will also supply 230VAC 500VA for FRTU.

The RMU should be provided with provision of following minimum signals available at separate SCADA terminal box.

Minimum Signals for SCADA- DMS	**To be wired to Separate TBs**	**Indication**
CB close / open	Potential free contacts -	Double Point
LBS close / open	Potential free contacts -	Double Point
LBS & CB Earth switch close /	Potential free contacts -	Single Point
Spring charge Status	Potential free contacts -	Single Point
SF_6 Gas pressure low	Potential free contacts -	Single Point
O/C operated	Potential free contacts -	Single Point
E/F operated	Potential free contacts -	Single Point
Local / Remote	Potential free contacts -	Single Point
Common power supply healthy	Potential free contacts -	Single Point
Motor MCB healthy status	Potential free contacts -	Single Point
Battery Charger Fail	Potential free contacts -	Single Point
RMU Door open	Potential free contacts -	Single Point
CB Trip coil healthy	Potential free contacts -	Single Point
CT & PT	For SCADA Metering	
FPI control	FPI remote resetting for SCADA -	Single command
CB control	Control from SCADA -	ON / OFF
LBS control	Control from SCADA -	

7 Technical Data

7.1 Ring Main Unit, Electrical data and service conditions

o	**Rated voltage**	kV	**12**
1	Power frequency withstand voltage	kV	28

2	Impulse withstand voltage	kV	95
3	Rated frequency	Hz	50
4	Rated current busbars	A	630
5	Rated current (cable switch)	A	630
6	Rated Current (T-off)	A	200
	Breaking capacities:		
7	active load	A	630
8	closed loop (cable switch)	A	630
9	off load cable charging (cable switch)	A	135
10	earth fault (cable switch)	A	200
11	earth fault cable charging (cable switch)		115
12	short circuit breaking current (T-off circuit breaker)	kA	20
13	Rated making capacity	kA	50
14	Rated short time current 3 sec.	kA	20
	Ambient temperature:		
15	Maximum value	°C	+ 50
16	Maximum value of 24 hour mean	°C	+ 35
17	Minimum value	°C	- 5
18	Altitude for erection above sea level	m	1500
19	Relative humidity		Max 100%

7.2 Ring Main Unit Technical Data (11KV)

No.	General data, enclosure and dimensions		
1	Standard to which Switchgear complies		IEC
2	Type of Ring Main Unit		Metal Enclosed, Panel type, Compact Module.
3	Number of phases		3
4	Whether RMU is type tested		Yes
5	Whether facility is provided with pressure relief		Yes
6	Insulating gas		SF6
7	Nominal operating gas pressure		1.4 bar abs. 20° C
8	Gas leakage rate / annum	%	0.1
9	Expected operating lifetime		30 years
10	Whether facilities are provided for gas Monitoring		Temperature compensated manometer to be delivered

11	Material used in tank construction		Stainless Steel sheet, 3 mm / metalized Cast resin
No	**Operations, degree of protection and colors**		
1	Means of switch operation		separate handle
2	Means circuit breaker operation		separate Handle
			and push buttons
3	Rated operating sequence of Circuit Breaker		O –3min-CO-3min-CO
4	Total opening time of Circuit Breaker		approx. 45ms
5	Closing time of Circuit Breaker		approx. 40ms
6	Mechanical operations of Switch	CO	1000
7	Mechanical operations of CO earthing switch		1000
8	Mechanical operations of circuit breaker	CO	2000
9	Principle switch / earth switch		3 position combined Switch /earth switch
	Degree of protection:		
10	High Voltage live parts, SF6 / VCB tank		IP 67
11	Front cover mechanism		IP 2X
12	Cable covers		IP 3X
13	Outdoor Enclosure		IP 54
	Colors:		
14	Front cover		
15	Side and cable cover		

(A) Load break switch (630A)

Load break switch should have the following

- LBS shall be of three pole type operated simultaneously by a common shaft.

-Motorized/ Manually operated 12 kV, 630A Load Break Switch (LBS) and Earthing Switch with making capacity

- "Live Cable" LED Indicators through Capacitor Voltage Dividers mounted on the bushings.
- Mechanical ON/OFF/EARTH Indication
- Anti-reflex operating handle
- Cable Testing facility without disconnecting the cable terminations, cable joints and terminal protectors on the bushings.

Cable terminations

- Cable boxes suitable for 1 X 3C x 300 sq. mm XLPE Cable with right angle Cable Termination Protectors.
- SCADA Compatible

(B) Circuit Breaker. (630A)

Circuit Breaker should have the following:

- Motorized / Manually operated 630A SF_6 / Vacuum circuit breaker and Earthing Switch with making capacity
- Mechanical tripped on fault indicator
- Auxiliary contacts 1NO and 1NC
- Anti-reflex operating handle
- "Live Cable" LED Indicators thru Capacitor Voltage Dividers mounted on the bushings.
- O/C + E/F self-powered relay
- Shunt Trip circuit for external trip signal
- Mechanical ON/OFF/EARTH Indication
- Cable boxes suitable for 2 X 3C x 400 sq. mm XLPE Cable with right angle Cable Termination / protectors / boots
- SCADA Compatible

7.3 Remote control of the RMU's

Remote operation of the RMU's line switches must be possible using motors fitted to the operating mechanism. It shall be possible to fit the motors either directly in manufacturing plant or on site as and when required. Installation on site shall be possible with the RMU fully energized and manufacturer should provide detailed instructions for installation to the control

mechanism. The fitting of the motors to the mechanism must not in any way impede or interfere with the manual operation of the switches or circuit breaker.
Units fully **SCADA** Compatible. Retrofitting at site possible at a later date. Line switches (Load break switches) as well as T- OFF circuit Breaker can be operated by remote.

7.4 Technical and Guaranteed Particulars

The bidders shall furnish all guaranteed technical particulars as called for in Schedule of this specification. Particulars which are subject to guarantee shall be clearly marked. Bids lacking information in Technical Data Sheet are liable to be rejected.

7.5 The Mechanisms

All mechanisms should be situated in the mechanism compartment behind the front covers outside the SF_6 / VCB-tank.

The mechanism for the switch and the ear thing switch is operating both switches via one common shaft. The mechanisms provide independent manual operation for closing and opening of the switch, independent closing of the ear thing switch and dependent opening of the ear thing switch.

The mechanism for the T-off switch and ear thing switch is operating both switches via one common shaft. The mechanism has stored spring energy and provide independent manual operation for closing and opening of the switch, independent closing of the ear thing switch and dependent opening of the ear thing switch. The mechanism has fuse- tripping device.

The mechanism for the vacuum circuit breaker (VCB) and disconnector- earthing switch is operating the VCB and the disconnector earthing switch via to separate shafts. The mechanism for the VCB has stored spring energy and provides independent manual operation for closing and opening of the VCB. The mechanism has a relay with related CT's and/or remote tripping device. The mechanism for the disconnector earthing switch provide independent manual operation for closing and opening of the disconnector, independent closing of the earthing switch and dependent opening of the earthing switch.

7.6 Front covers

The front cover contains the mimic diagram of the main circuit with the position indicators for the switching devices. The voltage indicators are situated on the front panels. Access to the cable bushings is in the lower part of each module.

7.7 Position indicators

The position indicators are visible through the front cover and are directly linked to the operating shaft of the switching devices.

7.8 Power connection

The cables are installed in the dedicated compartment below the mimic front cover. At the bottom of the cable compartment, an earthing bar system made of copper with a minimum cross section of 120 mm2 should be fitted. In each compartment the earthing bar should be fitted with 4 screws M10. The earthing system is connected to the tank by a copper bar, which rises up to the connecting point of the tank behind the rear partition wall on the middle of the switchgear.

7.9 Interlocking

The mechanism for the cable switch should be provide a built in interlocking system to prevent operation of the switch when the earthing switch is closed, and to prevent operation of the earthing switch when the switch is in the closed position.

The mechanism for the T-off switch should be provide a built in interlocking system to prevent operation of the switch when the earthing switch is closed, and to prevent operation of the earthing switch when the switch is in the closed position. In addition an interlocking device allows access to the fuses only when the earthing switch is in the earthed position and opening of the earthing switch is only possible when the fuse cover is closed and secured. The mechanism for the VCB and the disconnector-earthing switch should be have a built in interlocking system to prevent operation of the disconnector-earthing switch when the VCB is in the closed position.

8 Testing and Certification

8.1 Type Tests

Units should be type tested in accordance with IEC standards 60056, 60129, 60265, 60298, 60420, 60529 and 60694. The following type tests must have been performed and made available if required

- Short time and peak withstand current test
- Temperature rise tests.
- Dielectric tests.
- Test of apparatus i.e. circuit breaker and earthing switch
- Arc fault test
- Measurement of resistance of main circuit.

- Mechanical endurance test.
- Duty cycle test.
- Internal arc test for HT chamber.
- Degree of protection for IP –54 for OUT DOOR and IP2X for INDOOR RMU.

Type test reports for above type shall be submitted with the offer.

8.2 Routine Tests

Routine tests should be carried out in accordance with IEC 60298 standards. These tests should ensure the reliability of the unit.

Below listed test should be performed as routine tests before the delivery of units;

- withstand voltage at power frequency
- measurement of the resistance of the main circuit
- gas leakage test
- withstand voltage on the auxiliary circuits
- operation of functional locks, interlocks, signaling devices and auxiliary devices
- suitability and correct operation of protections, control instruments and electrical connections of the circuit breaker operating mechanism
- verification of wiring
- visual inspection

9 Documentation

An instruction manual should be provided with necessary information for receiving, handling, storage, installation, operation and maintenance.

Routine test certificate should be follow each unit and standard schematic drawings should be delivered for Ring Main Units. Compact Switchgear should be having drawings that consist of system single line drawings, general arrangement and schematic drawings for order specific units.
All drawings shall confirm to International Standards Organization (ISO) “A” series of drawing sheets/Indian Standards Specification IS: 11065. All dimensions and data shall be in ink and suitable for microfilming. All dimensions and data shall be in S.I. Units.

10. List of drawings and Documents

The bidder shall furnish four sets of relevant descriptive and illustrative published literature, pamphlets and the following drawings for preliminary study along with offer.

i. General outline drawings showing dimensions and shipping weights, quantity of insulating media.
ii. Sectional views showing the general constructional features of the circuit breaker including operating mechanism, arcing chambers, contacts with lifting dimensions for maintenance.
iii. Drawings showing control cabinets and circuit diagrams for operating mechanism. Schematic diagrams of breaker offered for control, supervision and auto reclosing. Structural drawings and loading data for support structures.
iv. Foundation plan and loading data and foundation design.
v. Drawings showing the complete operation cycle of the **RING MAIN UNIT** with description.

NAME PLATE:

Each RMU and its associated equipment s shall be provided with following information.

a) Name of manufacturer.
b) Type, design and serial number
c) Rated voltage and current
d) Rated frequency
e) Rated symmetrical breaking capacity
f) Rated making capacity
g) Rated short time current and its duration
h) Purchase Order number and date
i) Month and year of supply
j) Rated lighting impulse withstand voltage

11 Training:

Product training should be available at the manufactures' facility.

G.1 FEEDER REMOTE TERMINAL UNIT (FRTU)

1. Scope

The remote control interface shall include all the functions required to monitor and control Equipment within Control Station.

2. FRTU Architecture

The FRTU Architecture shall support convenient installation, maintenance and expansion features. The Architecture shall include a central processing module; and Digital and Analogue Input/ Output (I/O) modules.

The Central Processing Module (CPM) shall be suitable to handle all types of communication protocols, perform data acquisition, perform address recognition, receive command messages, assemble response messages and execute control requests. The CPM shall have an internal Real Time Clock for data collection coordination and time tagging and provide time synchronization accomplished by IEC 104 protocol. The CPM shall have user configurable capabilities to establish connections, link failures and reconnections. The CPM shall effectively communicate with main SCADA as well as its peer FRTUs for fault detection and control operations over the same structure as the main SCADA.

Each Digital and Analogue I/O module shall be capable of interfacing with the respective inputs and outputs. These I/O modules shall be replaceable without reprogramming, reconfiguration and rewiring. A control disable switch shall be provided with each module with its status indication so that when the switch is put off the control outputs shall be disabled.
The required no. of I/O modules shall be decided by the Bidder.

3. Functions

The FRTU shall meet following main requirements:

Monitoring and control of 11 kV cubicles.
Detection of amperometric faults, adjustable for each feeder.
Load current measurement on the line fitted with a fault detector.
Data transmission to the remote control center.
Chronological time-stamped event recording.
Energy supply and storage with 9-hour autonomy in the event of mains failure for:

- 24 VDC motor drives
- Transmission equipment
- Control unit

It shall be possible to view LBS/breaker status from the front mimic of FRTU.
It shall be possible to issue control command from the front panel of the FRTU with security button.
It shall be possible to retrieve and display on a PC the time-stamped events recorded at the enclosure.
The minimum storage capacity shall be 50000 events.
The FRTU shall have remote or local control mode switch on its front panel.

In remote control mode, the enclosure shall ensure:

- Transmission of remote measurements and time-stamped events.
- Possibility of electrical remote control.
- Inhibition of local electrical control pushbuttons.

In local mode, the enclosure shall ensure:

- Transmission of remote measurements and time-stamped events.
- Possibility of local electrical control of opening and closing operations by simultaneously pressing a pushbutton to select the unit to be operated and a validation pushbutton.
- Inhibition of opening/closing remote control.

- **DC Power Supply**

The FRTU main power supply is nominal 24VDC. The 24V DC battery shall be inbuilt and protected against over-voltages and over-currents.

4. Time-tagged data archiving

All the archived data shall be retrieved locally and remotely by means of the configuration and operating software supplied with the control unit.
The data shall also be downloaded locally or remotely to a PC as a .CSV file.
Event and measurement time-stamping shall be accurate to one millisecond and the discrimination between two events shall be 10 msec.

4.1 Time-stamped event archiving

Any change of information status shall generate a stored time-stamped event.
The minimum storage capacity of the events to be transmitted to the remote control center shall be 200 events.

4.2 Measurement archiving

Each measurement can be configured to be archived if required. A measurement declared archived can be stored:

- At regular intervals (the interval can be configured): mean or sampled value.
- When the high and low thresholds are exceeded (the thresholds can be configured).
- Daily: minimum and maximum daily values (the storage period can be configured: 24 hours, 7 days, and 14 days).
- The measurement storage conditions (configured individually) can be combined. The minimum storage capacity shall be 20000 measurements.

5 Communication with the remote control center

5.1 Communication protocol

The control unit shall have following communication protocols:

i) IEC 60870-5-101/104 protocol to transfer information to control center SCADA.
ii) Modbus protocol to communicate with field MFM (Multi-Functional Meters) on RS485.

5.2 Events transmission

It shall be possible to configure each time-stamped event to correspond to the appearance or disappearance of an "alarming event" or an "alarming" closure failure. A time-stamped event declared to be "alarming" establishes communication with the remote control center.

a. Communication ports

The control unit shall have following communication ports:

- Two Ethernet port for interfacing with the IP compatible communication equipment.
- One RS232 Console port and for connecting external modem.
- Required number of RS485 port to connect field IED's / Energy Meters on RS485.

It shall be possible to increase the number of communication ports in the FRTU if required in Future.

6. Local communication networks

The control unit shall have a Modbus RS485 port for communication with the station equipment/ Multi-Functional transducers:

- Power monitoring unit
- Multi-Function meters

The Modbus protocol shall be open; it shall be programmed by the control unit configurator. Information from this slave equipment can be stored and dated when the status changes (can be configured for each event).

7. Remote configuration and operating tool

Data shall be configured using a PC connected to the control unit via an Ethernet and/or USB port. It shall be possible to:

- prepare the configurations off-line and save them on a PC,
- restore a control unit configuration using a PC,
- save a control unit configuration to a PC.

It shall also be possible to configure data remotely using the operating and maintenance software supplied with the equipment in the case of GMS, GPRS and Ethernet networks.

7.1 Diagnosis

The diagnosis pages shall be used to retrieve station, switch and system data:

- Measurement and status display: this page is used to view in real time the TSS, TSD and TM status for each switch controlled by FRTU.
- Archived event retrieval.
- Users can acknowledge status locally.
- Protocol analyzer: This analyzer is used to observe the frames exchanged with the remote control center to facilitate maintenance operations.

8.2 Data loading

- Loading a configuration from a file saved on a PC.
- Loading a new version of the communication card or protocol software with protected switching
- Unit configuration and Events and measurements archived as a Word or Excel file.

8.3 Parameter and alarm configuration

- Control module parameters & Delayed no-voltage alarm
- Fault detector , Automation & Communication parameters
- General parameters (type of protocol, use of ports, type of modem, etc.).
- Protocol parameters: interoperability table, alarm

9. Switch connection

Orders and information shall be transmitted from the switchgear interface to the switch control unit via a single cable connected to the enclosure by a rack-out connector mounted on the lower part of the enclosure. Each connector has a fail-safe device to prevent reversal between the various electrical controls. The socket can be "plugged" for simulation and test purposes.

10. List of information to be provided

The slave stations shall process at least the following information for remote indication and/or local display purposes:

- open/closed position, earthing of each switch,
- absence of AC voltage and local/remote control operating mode,
- detection of phase-to-phase or earth fault current flow,

- load current measurement,
- charger fault,
- battery fault
- motor drive 24 V supply fault ,
- internal fault
- detailed diagnosis of the status of the uninterruptible power supply (charger, batteries).

11 FRTU should Support following Future Provisions

The FRTU must be capable to support PLC programming, in order to incorporate self-healing grid logic for faster restoration of supply in absence of control Centre SCADA. Self-healing grid requires multiple communication support from FRTU (Simultaneous communication of FRTU with SCADA along with FRTU Peer to Peer communication). Hence, FRTU must support this configuration of communication to achieve self-healing grid feature. The software shall be preferably window based.

12. TESTING

Type Testing:

The FRTU offered by the Bidder shall have passed the required Type tests at Government Accredited laboratory in accordance with latest and updated IEC standards. Test certificates for the same shall be submitted along with the Bid.

Routine Testing:

All tests shall be as per latest IEC standard.

H: FEEDER PILLAR BOX

1.0 Scope:

1.1 This specification covers design, manufacture, supply, delivery, installation and commissioning of LT distribution pillars made out of either Mild Steel enclosure with SMC doors or complete enclosure of thermosetting plastic i.e. glass reinforced polyester sheet moulding compound. The system shall be A.C. 3 phase, 4 wire, 400 V, 50 Hz with effectively grounded neutral.

1.2 It is not the intent to specify herein complete details of design and construction. The equipment offered shall conform to relevant standards with high quality and workmanship capable of performing continuous and satisfactory operations in the actual service conditions at site.

1.3 Bidder shall have proven experience of 5 years of manufacturing of similar products and supplying to electrical utilities.

2.0 Service Conditions:

The equipment to be supplied against this specification shall be suitable for satisfactory operation under the tropical conditions as mentioned in this chapter.

3.0 Standards:

All components used in the manufacture of the pillars shall confirm to the relevant IEC or equivalent International standard.

4.0 Technical parameters:

4.1	Rated Supply Voltage	: 3 phase, 400 V, 50 Hz
4.2	Rated Current	: 600A, 800A, 1000A (as per requirement)
4.3	Insulation level	: 1100V AC 50 Hz Continuous
		: 2.5 kV for 1 Min
		: 2000 V DC

4.4 Rated short circuit current: 80kA

5.0 General Technical Requirements:

5.1 Cubicle:

5.1.1 The cubicle of LT feeder pillars and mini pillars shall be made out of either 2.5 mm thick cold rolled M.S sheet steel, plates and shaped sections or thermosetting plastic i.e. glass reinforced polyester sheet moulding compound (SMC) as per the requirements specified. All panel edges and door edges shall be reinforced against distortion by rolling, bending etc. The complete cubical shall be rigid self-supporting and free standing. The enclosure shall be anti-corrosive, dust proof, rust proof, vermin and water proof, ultra violet stabilized and flame retardant property.

5.1.2 The LT feeder pillars shall have front and rear compartments. Front compartment shall be suitable for HRC fuses or MCCBs and the rear for cable terminations.

Asbestos sheet of at least 6mm thick shall be provided for separation between front and rear compartments. L.T. Feeder pillar shall have Air Circuit Breaker for incoming circuit as per the requirement and MCCB or Fuse Links for outgoing circuits as per the requirement with necessary interconnecting Bus Bars/ Links etc.

5.1.3 The cubicles shall have centre lift up type slanting roof rain hood. The depth and width of the rain hood shall be at least 120% of the depth and width of the pillars. The doors shall not be detachable after fixing the rain hood.

5.1.4 Standard General Arrangement of Air Circuit Breaker, MCCB, HRC fuse base with links, Link Disconnector, Bus Bars, connecting links, Cable termination arrangement etc. inside the L.T. pillars shall be as per the drawings attached with the specification for various types of L.T. Feeder pillars.

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5.1.5 The general overall dimensions of L.T. feeder pillars shall be suitable as per the site conditions.

The supplier shall submit the design and drawing for approval. Prototype shall be constructed and inspected by the representative of NEA before production.

5.1.6 The cubicles shall be provided with water proof non-detachable hinged doors made from good quality thermosetting plastic i. e. glass reinforced plastic sheet molding compound. Average minimum thickness of the sheet for door shall be 3.15 mm for the Mini Pillar, 2way/3way Pillar & 4mm for 4way/6way/8way Pillar.

5.1.7 The doors shall be centrally closed with triple position locking arrangement and shall be operational with a common handle from outside the door. Movement of handle will lock the doors at centre, top & bottom. One central lock with brass levers shall be provided inside the door. Key way with suitable cover shall be provided on the door for operating the lock from outside. Two keys shall be supplied for each pillar. In addition cleat arrangement shall be provided for putting two nos. of padlocks for each size of doors.

5.1.8 Four Louvers (two on each side) shall be provided to L.T. feeder pillars. Louvers with stainless steel wire mesh with shall be provided on both sides of the mini pillars and at the top and bottom of both sides of L.T. pillars. Mounting of components inside the enclosure shall allow free air circulation keeping the clearances as per specification

5.1.9 Suitable no. of detachable gland plates made up of 10 SWG MS sheets/SMC material shall be provided in the cubicle at the bottom. Gland plate shall be provided with suitable size cable gland & with four screws for fixing the plate from inside. Size & no. of the glands to be provided will be intimated to the successful tenderer along with approval of drawings.

5.1.10 A bayonet lamp holder complying with switch, a three pin plug & socket with necessary fuses & wiring shall be provided inside the pillar on the front bottom portion of the shade near the neutral busbar.

5.1.11 Rigid stand shall be made from M.S.angle or FRP Pultruded sections. Horizontal and vertical members of the cubicle shall be of size 50 x 50 x 6 mm.

5.1.12 Two galvanized earthing Bolts shall be welded from inside and projecting outside of the box. Two Nuts with washers shall be provided on each bolt.

5.1.13 Enamelled name plate of the supplier, type of pillar and Tender Number & date shall be displayed on front door.

5.1.14 Enamelled Danger Board with “DANGER 400 VOLTS” mark shall be displayed on the left hand side of front and back doors.

5.2 Air Circuit Breakers

Air Circuit Breakers of the following rating & technical specifications shall be provided for the Incomer of L.T. Feeder pillars with ACB, with split Bus bar type & with split with ACB as per the actual requirement.
ACB shall be of 440V, 50 HZ, 800/1000/1250 A (as per actual requirement) with short time current rating of 50KA for 1 sec. Other technical details shall be as follows:

Sr. No.	Particulars	Requirements
1.	Rated operational voltage (V) at 50 Hz	400V
2	Rated frequency (Hz)	50
3	Current rating Amps (rms)	800/1000/1250 A
4	Rated insulation voltage (V) at 50 Hz	1000
5	Number of poles	3
6	Mounting arrangement	Fixed type front mounting
7	Rated impulse withstand voltage(kV)	2 kV
8	Rated Ultimate Short circuit breaking capacity at 415 V, 50 Hz (kA rms) Icu	50
9	Rated Service Short circuit breaking capacity at 415 V,50 Hz (kA rms), Ics	50
10	Rated short circuit making capacity at 50Hz	2.1
11	Rated short time withstand current for1 sec at 50 Hz (kA rms), Icw, expressed	50 kA
12	Line-load reversibility	Required
13	Category of utilization	B
14	Shutters on ‘Trip’ & ‘Close’ push button with sealing facility	Required
15	Accessory mounting	Accessories shall be front accessible plug in type. Accessories namely motor shunt trip & closing coil, UVT etc. should be common for the entire range & shall be suitable for both AC & DC voltages.
16	Operating mechanism	Spring charging stored energy type , manual & Automatic
17	Mechanical life (Operating cycles)	20000
18	Electrical life (Operating cycles) per set of arcing contacts	5000

19	Indications	Breaker shall have following mechanical indications:
		1. ON, 2. OFF, 3. TRIP 4. SPRING CHARGE STATUS
20	Sensing	True RMS based
21	Type	Microprocessor based
22	Control Terminal	Control Terminal should be front accessible & minimum 25 pairs of contacts shall be available. Minimum ten Auxiliary NO / NC contacts shall be provided for electrical interlocking between ACBs.
23	Working temperature	Suitable for operation at 50ºC
24	Protection required	Following protections with selective ranges required.
24a.	Overload	Pick – up: 0.4 to 1.0 Time delay : 0.2 to 40 sec.
24b.	Short Circuit	Pick – up: 2 to 10 Time delay: 20 to 400 m/sec
24c	Instantaneous over current	Pick – up: 4 to 16 & OFF
24d.	Earth fault	Pick – up: 0.2 to 0.6 & OFF Time delay: 100 to 400 m/sec
25	Metering Required	Provision for following measurement functions shall be made on the ACB i)3 phase current ii)3 phase voltage iii) kWh iv) kVAh v) Power Factor vi) Max. demand (kVA) vii) Fault History of Minimum 50 events
26	Indication	Release shall give individual indication for each type of fault.
27	Power	Release shall be self-powered & Independent of incoming supply.
28	Safety	Local controls shall be secured by padlocking arrangement

For Air Circuit Breakers used for Bus coupler /split bus bar purpose, metering is not required to be provided as per requirement at S. no. 25 of the above table.

5.3 Busbar:

5.3.1 The bus bars shall be made up of electrolytic grade aluminium confirming to grade 63401 WP of IS: 5082.

5.3.2 The bus bars shall be painted with non-deteriorating type paint for full length as below.

Epoxy red colour for top bus bar
Epoxy yellow colour for middle bus bar
Epoxy Blue colour for bottom bus bar
Epoxy Black colour for neutral bus bar below bottom bus bar

Size of the bus bar shall be as tabulated bellow.

Type of Bus bar	Mini pillar with fuse	L. T. pillars without ACB				L. T. Pillar with ACB	L. T. Pillar with split bus & one ACB	L. T. Pillar with split bus & 3 ACBs
		2/3way	4 way	6 way	8 way	4way	6/8 way	6/8Way
For R,Y& B phase	50 x 6 mm	60 x10 mm	60x10 mm	60 x10 mm	60x10 mm	60 x10 mm	60 x 10 mm	60 x10 mm
For Neutral	50 x 6 mm	40 x 6 mm	50 x 6 mm	50 x 6 mm	50 x 6 mm	50 x 6 mm	50 x 6 mm	50 x 6 mm

5.3.3 Electrolytic grade aluminium twin flat cable terminals shall be provided in staggered formation for connecting cable cores for each phase from rear side in all L.T. pillars (except mini pillar). The arrangement shall be suitable for taking Load current reading with clip on type of meter. Meter shall be SCADA compatible.

5.3.4 Neutral bus bar shall have one terminal for each circuit way and shall be provided with two nickel plated, nuts, bolts, spring washers and plain washers at each end for earthing. Cross sectional area of neutral bus bas shall be at least 50% of cross sectional area of phase bus bar.

5.3.5 Suitable insulated phase barriers of at least 6 mm thick asbestos cement sheet shall be provided between front and rear compartment, between adjacent set of phase and neutral bus bars and between doors and bus bars with firm fixing arrangements.

5.3.7 Minimum clearances, wherever shown, shall be as per General Arrangement Indicative Drawing enclosed with this specification. Other clearances shall be as per requirement of relevant standards.

5.4 Fuse base assembly:

5.4.1 Fuse bases shall be suitable for HRC fuse links and strips. All fuse bases shall be identical and interchangeable and shall be capable to carry rated normal current without exceeding safe temperature.

5.4.2 The base of the HRC Fuse shall be of non-tracking, heat resistant insulating porcelain material of superior electrical and mechanical properties equivalent to Dough Molding Compound (DMC).

5.4.3 The contacts shall be made up of electrolytic grade copper alloy with corrugated terminal pad and spring action to yield high contact pressure.

5.4.4 Thermostatic bimetal device shall be provided between terminal pad and bus bars and between terminal pad and cable terminals to prevent bimetallic deterioration.

5.4.5 The complete assembly shall be so fixed and secured that there shall be no turn, fall out displacement and vibration of any part during inserting and removal of fuses/Links. Load current reading, cable end connection etc.

5.4.6 HRC Fuse Base should withstand the breaking capacity of the fuse link of 80kA.

5.5 Fuse links:

The HRC Fuse Links shall be sturdy in construction of "Din Type". Corrugated fuse links shall be made out of electrolytic grade copper flat of at least 4 mm thick and shall be capable of carrying the rated current of the fuse base and shall be suitable for inserting and pulling out by insulated fuse pulling handle. Breaking capacity shall be 80 kA. For fault indication red pop up indicator should come out instantly on fusing. Manufacturer's name, current rating, breaking capacity and type shall be marked on HRC fuse link.

5.6 Moulded Case Circuit Breaker (MCCB)

The MCCB shall be air break type and having quick make quick break with trip free operating mechanism.
Housing of the MCCB shall be of heat resistant and flame retardant insulating material. Operating handle of the MCCB shall be in front and clearly indicate ON / OFF / TRIP positions.

The electrical contact of the circuit breaker shall be of high conducting non-deteriorating silver alloy contacts.
The MCCB shall be provided with thermal / magnetic type bi-metal over load release and electro-magnetic short circuit protection device. All the releases shall operate on common trip busbar so that in case of operation of any one of the releases in any of the three phases, it will cut off all the three phases and thereby single phasing of the system is avoided.
The MCCB whenever called for in the appendix drawings shall provide an earth fault relay. The MCCB shall provide two sets of extra auxiliary contacts with connections for additional controls at future date.

1) 4Pole MCCB for Incomer & 3pole MCCB for outgoing feeder for individual tripping of each phase due to faults in the respective phases in the outgoing feeder, of reputed make to be specified in the tender along with test report from third party testing lab.
The in-coming cable should be connected to the terminals of the M.C.C.B. with Bi-metallic lugs preferably of Usha Martin make duly crimped with Die-less crimping tools. There should be a metallic/heat resistant insulating barrier between the individual M.C.C.Bs so that the heat generated during any fault inside the Box should not pass to the other M.C.C.Bs.

5.7 Painting:

5.7.1 The M.S. cubicles shall be provided with anti-corrosive high quality post office red colour paint from inside and outside to withstand the corrosive and humid atmosphere. The colour of SMC cubicle shall be red.

5.7.2 Corrokill rust converter shall be preferably applied as primer.

6.0 Tests:

A. **Type tests:**

Type test reports shall be submitted along with the offer for the type and rating of circuit breakers offered.

B. **Routine tests**:

Routine and acceptance tests as per relevant IEC or equivalent Standard shall be carried out at the original manufacturers' works on complete pillar and carried out on all boxes.

1. Overall Dimensions Checking.
2. Insulation Resistance Tests.
3. High Voltage Test at 2500 V, 50 Hz AC for one minute.
4. Operation Test HRC fuse base and fuse links.

7.0 Prototype Sample:

The successful bidders should manufacture 3 Nos. of prototype L.T. feeder pillars as per the specification and keep ready at their works for the purpose of sample inspection and testing. The NEA at their option may sent a team of Engineers to the works. Prior intimation of this inspection may not be given to the Bidder.

The supplier shall conduct voltage withstand test and operations tests at the time of inspection.

7.1 The supplier shall prepare a prototype and offer the same for inspection and approval before taking up mass production.

7.2 All routine & acceptance tests and inspection of material shall be carried out at the place of manufacturer. The manufacturer shall offer the Inspector (representing the purchaser) all reasonable facilities, free of charge at the time of Inspection.

7.3 The supplier shall offer inspection of the material at his works before dispatch. If required, the supplier shall also offer inspection of manufacturing painting and assembly processes and quality control system. If any material is not found in line with relevant specification the supplier shall carry out the modification and offer for re-inspection.

7.4 Inspection and acceptance shall not absolve the supplier of his responsibility to supply the material in accordance with the specifications. The purchaser reserves the right to reject the material not confirming the relevant specifications.

8.0 Drawings and documentation:

8.1 The successful bidder shall submit set of all drawings of the L.T. Pillar and its components for approval.

8.2 The tenderer shall furnish all details and clarifications required if any for scrutiny and evaluation of the offer.

8.3 Manufacture of material to be supplied shall be done strictly as per approved drawing.

Annexure A'

Specifications for Fiberglass Reinforced Plastic Sheet moulding compound used for Pillar Body and doors

1) FRP Sheet Moulding Compound shall conform to the relevant IEC standard
2) The Surface appearance of the door must be smooth, non-porous, and homogeneous, free of ripples, defects, and marks. No filler or fiber shall be visible at any place.
3) Other properties of SMC material shall be as follows & shall pass the test mentioned against the same.

S. No.	Characteristic	Requirement	Type of test
1.	Material.	Thermosetting Plastic	Acceptance
2.	Grade of material	SMC Electrical grade S3	Acceptance
3.	Grade of material for frame	FRP Pultruded sections	Acceptance
	Material requirement for Sheet Moulding Compound		
4.	Glass content, percent by mass (Min.)	20	Type
5.	Moulded shrinkage, linear % Max	0.25	Acceptance
6.	Flow, mm, Minimum	170	Acceptance
	Requirement for Moulded Sheet Moulding Compound		
7.	Water Absorption, % Max	0.20	Type
8	Izod impact strength (Notched), KJ/m^2	55	Type
9	Flexible Strength ,MPa , Min	170	Type
10	Power Arc Resistance Sec. Min.	180	Type
11	Modulus of Elasticity, 10^3 , MPa	12 to 15	Type
12	Tracking Resistance CTI, Min	1000	Type
13	Dielectric Strength at 90^oC in Oil kV/mm	11	Type
14	Dissipation factor (4 days at 80 % RH & 1 KHz)	0.01	Type
15	Heat Distortion Temperature, ^oC ,Min	150	Type
16	Oxygen Index,% Min	24	Type
17	Post shrinkage, % Max	0.01	Acceptance

18	Tensile Strength ,MPa , Min	70	Acceptance
19	Density of Moulding, g/ml	1.8 to 2.1	Routine
20	Surface resistivity (24 H in water), Ohm, Min	1×10^{13}	Routine
21	Volume resistivity, Ohm-cm, Min	1×10^{14}	Routine
22	Exposure to flame	Self-Extinguishing	
23	Melting Point	test up to 400ºC	
24	Cross Breaking Strength	(1723 Kg/sq.cm)	
25	Shear Strength	(879 Kg/sq.cm)	
27	Water absorption		
28	Mechanical Strength		
29	Marking, Dimensions and construction		

I. FIBRE OPTIC CABLE

This section describes the functional requirements, major technical parameters and Type testing and Factory Acceptance Testing requirements for underground fibre optic cables, HDPE pipes. Marking, packaging, transportation installation requirements have also been described. The distance of the under- ground FO cable route length has been specified in the BOQ. The payment will be made for the executed route length only. However, specified service loops and lengths for wastage, installation/working for FO cable & HDPE ducts shall be considered as required by the bidder for which no additional payment will be made. The unit rate (per Km) quoted shall include the required FO cable, pair of HDPE ducts and all other installation items/accessories including manholes, GI/Hume pipes for crossings, markers, duct jointing accessories etc. for one km of FO cable route irrespective of the type of soil along the route. Bidders are advised to survey at their own expenses to assess the requirement before bidding if desired by them.

1 Under Ground FO Cable

1.1 General

The underground fibre optic cable shall be unarmoured and shall be suitable for underground installation in pipes. The cable should be of low weight, small volume and high flexibility. The mechanical design and construction of each unit shall be inherently robust and rigid under all condition of operation, adjustment, replacement, storage and transport.

1.2 Applicable Standards

The cable shall conform to the standards named below and the technical specifications described in the following sections.

i) ITU-T Recommendations G.652

ii). Electronic Industries Association, EIA/TIA 455-78A, 455-3A, 455-62A, 455-164A/167A/174, 455-168A/169A/175A, 455-176, 455-59, EIA/TIA 598, EIA 455-104.

i i) International Electro technical Commission standards, IEC60304, IEC60794-1-2, IEC60811-5-1.

iv) Bellcore GR-20

v) TEC-spec no-G/OFC-01/03. Aug 99 (including all amendments up to September 2000)

1.3 Fibre Type(s) and Counts

The cable shall contain at least 6 nos. of Dual Window Single Mode (DWSM) fibers conforming to G.652 as per the Bill of the Quantity and the Technical parameters stipulated in the following sections.

1.4 Optical Characteristics

The attenuation coefficient for wavelength between 1525nm and 1575nm shall not exceed the attenuation coefficient at 1550nm by more than 0.05dB/km. The attenuation coefficient between 1285nm and 1330nm, shall not exceed the attenuation coefficient at 1310nm by more than 0.05dB/km. The attenuation of the fibre shall be distributed uniformly throughout its length such that there are no point discontinuities in excess of 0.1dB. The fibre attenuation

characteristics specified in table 3-1 shall be "guaranteed" fibre attenuation of any & every fibre reel.

DWSM fibres shall conform to the requirements specified in Table 3-1 below:

Table 3-1
DWSM Optical Fibre Characteristics

Fibre Description:	Dual-Window Single-Mode
Mode Field Diameter:	8.6 to 9.5 µm (± 10% of the nominal value)
Cladding Diameter:	125.0 µm ± 2µm
Mode field Concentricity Error:	≤1.0µm at 1310 nm
Core-Clad concentricity error:	≤1.0µm
Cladding non-circularity	≤ 2%
Cable Cut off Wavelength:	≤1260 nm
1550 loss performance	As per G.652
Proof Test Level	≤0.35 Gpa 50.76 Kpsi)
Attenuation coefficient	@1310nm ≤0.35 dB/Km @1550nm ≤0.23 dB/Km
Attenuation at water peak (1383nm)	≤2.1 dB/Km
Attenuation variation with wavelength **1285 nm - 1330 nm** **1525 nm – 1575 nm**	Attenuation coefficient @1310 ± 0.05 dB Attenuation coefficient @1550 ± 0.05 dB
Point discontinuities	≤ 0.1dB
Chromatic Dispersion; Maximum: **Zero Dispersion Wavelength: Zero Dispersion Slope:**	20 ps/(nm x km) @ 1550 nm 3.5 ps/(nm x km) @ 1288-1339nm 5.3 ps/(nm x km) @ 1271-1360nm 1300 to 1324nm -0.093 ps /(nm^2xkm) maximum
Polarization mode dispersion coefficient	≤ 0.5 ps /km^1/2
Temperature Dependence:	Induced attenuation ≤0.05 dB (-60^0C - $+85^0$C)
Bend performance:	@1310nm (75±2 mm dia. Mandrel), 100 turns; Attenuation rise ≤0.05 dB @1550nm (75±2 mm dia. Mandrel), 100 turns; Attenuation rise ≤0.10 dB @1550nm (32±0.5 mm dia. Mandrel), 1 turn; Attenuation rise ≤0.50 dB

1.4.1 General Construction

The optical cable shall consist of a central fibre optic unit protected by one or more layers of helically wound anti-hygroscopic tape or yarn. The central fibre optic unit shall be designed to house and protect the fibres from damage due to forces such as crushing, bending, twisting, tensile stress and moisture, wide temperature variations, hydrogen evolution etc. The fibre shall be of loose tube construction. The inner polyethylene jacket and outer sheath jackets shall be free from pinholes, joints, splits or any other defects. All fibre optic cable shall have a minimum service life span of 25 years.

1.4.1.1 Colour Coding & Fibre Identification

Individual optical fibres within a fibre unit, and fibre units shall be identifiable in accordance with EIA/TIA 598 or IEC 60304 or Bellcore GR-20 colour-coding scheme. The colour coding system shall be discernible throughout the design life of the cable. Colouring utilized for colour coding optical fibres shall be integrated into the fibre coating and shall be homogenous. The colour shall not bleed from one fibre to another and shall not fade during fibre preparation for termination or splicing. Each cable shall have tracability of each fibre back to the original fibre manufacturer's fibre number and parameters of the fibre. If more than the specified number of fibres are included in any cable, the spare fibres shall be tested by the cable manufacturer and any defective fibre shall be suitably bundled, tagged, and identified at the factory by the vendor. The colouring scheme shall be submitted along with the cable DRS/drawing for employer's approval.

1.4.1.2 Strength Members

The central fibre optic unit should include a central strength member of Fibre Reinforced Plastic (FRP) or other suitable material. Peripheral strength members and aramid yarns are also acceptable. The central FRP strength member may be of slotted type with SZ lay (reverse oscillation lay) of fibre units or it may be cylindrical type with helical lay of fibre units.

1.4.1.3 Filling Compound

The interstices of the central fibre optic unit and cable shall be filled with a suitable compound to prohibit any moisture ingress or any longitudinal water migration within the fibre optic unit or along the fibre optic cable. The water tightness of the cable shall meet or exceed the test performance criteria as per **IEC60794- 1-2-F5**. The filling compound used shall be a non-toxic homogenous waterproofing compound that is free of dirt and foreign matter, anti-hygroscopic, electrically nonconductive and non-nutritive to fungus. The compound shall also be fully compatible with all cable components it may come in contact with and shall inhibit the generation of hydrogen within the cable. The filling compound shall remain stable for ambient temperature up to +70□C and shall not drip, flow or leak with age or at change of temperature. Reference method to measure drip point shall be as per **IEC 60811-5-1** and drip point shall not be less than 70^{O}C.

1.4.1.4 The Sheath / Inner jacket

The sheath shall be black, smooth, concentric, and shall be free from holes, splits, blisters and other surface flaws. The sheath shall be extruded directly over the central fibre optic unit and shall also be non- hygroscopic. The cable sheath design shall permit easy removal without damage to the optical fibres or fibre units. The sheath shall be made from good

quality of weather resistant polyethylene compound (Black High Density Polyethylene- HDPE) and thickness shall be ≥ 1.8mm.

1.4.1.5 The Outer Jacket/ Termite protection

A circular jacket of not less than 0.65mm Polymide-12 (Orange Nylone-12) material should be applied over the sheath as an outer jacket. The outer jacket shall have smooth finish and shall be termite resistant.

1.4.1.6 Rip Cord: Suitable rip cord(s) shall be provided to open the outer sheath of the cable. The rip cord(s) shall be properly waxed to prevent wicking action and shall not work as a water carrier.

1.5 Mechanical Parameters & Tests

(A) **Tensile Strength:** The cable shall be of sufficient strength to withstand a load of value T(N)=9.81x2.5xW Newton or 2670 N whichever is higher (where W is the mass of 1Km cable in Kg). The load shall be sustained for 10 minutes and the strain of the fibre monitored. The load shall not produce a strain exceeding 0.25% in the fibre and shall not cause any permanent damage to any constituent part of the cable. The change in optical attenuation during or after the application of the rated tensile load in accordance with **IEC60794-1-2-E1** procedure shall not exceed 0.05dB/Km both for 1310nm and 1550nm wavelength. The attenuation shall be noted before strain, during strain and after release of strain for all the fibres.

(B) **Crush test (Compressive Strength):** The cable shall withstand a compressive force of at least 2000 N, applied for at least 60 seconds between two plates of 100mm X 100mm in accordance with IEC60794-1-2-E3 procedure. This compressive load applied in accordance with **IEC60794- 1-2-E3** shall not cause any permanent damage to any constituent part of the cable. The change in optical attenuation during or after the application of the compressive load shall not exceed 0.05dB both for 1310nm and 1550nm wavelength. The attenuation shall be noted before, during and after the test for all fibres.

(C) **Bend Radius:** The cable bend radius under no load shall be less than or equal to 20 times the cable diameter. The test method shall be according to the **IEC60794-1-2-E11 (procedure-1)**. The fibres and component parts of the cable shall not suffer permanent damage when the cable is subjected to 10 cycles of wrapping and unwrapping of 4 complete turns around a mandrel of dia equal to 20 times the cable diameter. The change in optical attenuation after the test shall not exceed 0.05dB both for 1310nm and 1550nm wavelength. The attenuation shall be noted before and after the test for all fibres. Outer Jacket shall not show any cracks visible to the naked eye when examined whilst still wrapped on the mandrel.

(D) **Cable Bending test (Repeated bending):** The cable shall withstand repeated bending when tested in accordance with **EIA-455-104** and shall not cause any permanent damage to any constituent part of the cable. The cable sample shall be at least 5 meters or more. The change in optical attenuation during or after the application of the repeated bending test shall not exceed 0.05dB. The attenuation shall be noted before and after the test for all the fibres. The test requirement shall be as mentioned below: -

Weight	5kg
Minimum distance from pulley centre to holding device	216 mm
Minimum distance from weight to pulley centre	457 mm
Pulley diameter	20 times to the cable dia
Angle of turning	90^{o}
Number of cycles	30
Time required for 30 cycles	2 min.

(E) **Impact Test:** The cable shall withstand at least 10 impacts of 50N load from a 0.5 metre height with impacting surface radius of 300mm. The 10 impacts when applied at the same place in accordance with **IEC60794-1-2-E4** shall not cause any permanent damage to any constituent part of the cable. The change in optical attenuation during or after the application of the impact load shall not exceed 0.05dB.The attenuation shall be noted before, during and after the test for all fibres.

(F) **Torsion test:** The cable shall withstand 10 cycles of ±180□□torsion with 100N load applied on a 2m sample. This load cycle applied in accordance with **IEC60794-1-2-E7** shall not cause any permanent damage to any constituent part of the cable. The change in optical attenuation during or after the application of the torsion load shall not exceed 0.05dB for all fibres. The attenuation shall be noted before, during and after the test.

(G) **Kink test (Resistance):** When a cable of sample length 10 times the minimum bend radius as defined above is subjected to kinking, it shall not result in any fibre breakage and the kink shall disappear after normalizing the cable. The change in optical attenuation after the application of the kink in accordance with **IEC60794-1-2-E10** shall not exceed 0.05dB for all the fibres.

(H) **Water ingress test (Resistance to water penetration):** The water ingress test of the cable shall meet or exceed the test performance criteria as per **IEC60794-1-2-F5** method B. Before applying the water tight seal at one end the outer jacket shall be stripped. A water-soluble fluorescent dye shall be used for testing. The duration of test shall be 7 days. In addition after the test the cable shall be ripped open and the distance up to which water has seeped shall be noted.

(I) **Drip Test (Seepage of Filling Compound):** For testing, a sample of 30 cm length of the cable with one end sealed by the end cap will be taken and outer jacket, sheath, binder tapes shall be removed by 5cms from open end of the sample. The filling compound will be wiped thoroughly and the sample be kept vertically with open end down ward in the oven for 24 hours at 70□C temperature with a filter paper under the sample. The filter paper should not indicate any sign of drip or oily impression. The reference test specification shall be as per **IEC60811-5-1** to measure drip point.

(J) **Environmental Test:** Temperature cycling test shall be carried out on one drum length of the cable to ensure stability of attenuation parameter of the cable when subjected to temperature change which may occur during storage, transportation, and operation. The permissible temperature range for storage and

operation will be from -20^{0}C to +70^{0}C. The rate of change of temperature during test shall be 1^{0}C per minute. The cable shall be kept for 12 hours at each of the following temperature and should follow the specification **IEC60794-1-2-F1.** Two cycles shall be performed.

TA2 : -20 deg. C

TA1 : -10 deg. C

TB1 : +60 deg. C

TB2 : +70 deg. C

The attenuation shall be measured at the end of each temperature range both at 1310nm & 1550nm.The change of attenuation of the fibre used shall be $\leq$ 0.05 dB/km for 1310 & 1550nm for entire range of temperature for all the fibres in each cycle.

(K) **Termite Resistance Test:** 3 (Three) Samples of optical fibre cables of 2(Two) meter length each shall be taken from the selected drums for Optical Fibre cable and the ends shall be sealed with metallic caps. These test samples will be sent to the reputed test lab for termite resistance test. The test Procedure and period shall be as per CAZRI, Jodhpur. All Samples shall be checked for any termite attack over the Nylone-12 jacket. The outer jacket shall be demonstrated to be termite resistant. Attack by termites shall be disregarded but termite should not penetrate or damage the Nylone-12 jacket of any sample.

Observation on any damage of the cable shall be recorded.

(L) **Abrasion Test:** To be conducted as per **IEC 60794-1-E2** or equivalent international test method.

(M) **Flexure Rigidity Test:** To be conducted as per **ASTM D-790**. The test shall not cause any permanent damage to any constituent part of the cable. The change in optical attenuation after the test shall not exceed 0.05dB/Km. The attenuation shall be noted before and after the test for all the fibres.

(N) **Figure of Eight Test:** 1000m of cable shall be uncoiled from the drum and arranged in figure of eight, each loop having a maximum dimension of 2m. It shall be possible to arrange cable in figure of 8 with relative ease and the cable shall not show any visible damages.

(O) **Cable Ageing Test:** After Environmental test the cable shall be subjected to a temperature of 85^{0}C for 168 hours. Cable shall then be brought to ambient temperature and stabilized for 24 hours. The change in optical attenuation after the test shall not exceed 0.05dB/Km for 1310 as well as 1550 nm wavelengths. The attenuation shall be noted before and after the test for all the fibres.

(P) **Embrittlement Test of Loose tube:** The minimum length of the test sample depends of the outside diameter of the loose tube and should be 85mm for tubes upto 2.5mm outside dia. The length of the bigger tubes should be calculated by using the following equation :

$Lo > 100 \times ((D^2 + d^2)/4)^{1/2}$

Where

Lo = Length of tube under test

D = Outside dia of loose tube.

d = inside dia of loose tube.

Both the ends of a buffer tube test sample may be mounted in a tool which is clamped in jaws of a tensile machine which exert a constant rate of movement. The movable jaw may move at a rate of 50 mm per minute toward the fixed jaw. Under load the tube will bend, so that the tube is subjected to tensile and compressive stresses. The fixture for holding the tube should be designed in a manner that the tube might bend in all directions without further loading. The tube should not get embrittled. No ink should appear on the tube upto the safe bend dia of tube (20 D) where D is the outside diameter of the loose tube. There should not be any physical damage or mark on the tube surface.

(Q) **Kink Resistance test on the loose tube:** A longer length of the loose tube is taken (with fibre and gel), a loop is made and loop is reduced to the minimum bend radius of loose tube i.e. 20 D. (where D is the outside dia of the loose tube). This test is to be repeated 4 times on the same sample length of the loose tube. No damage or kink should appear on the surface of the tube.

(R) **Drainage test for loose tube:** A tube length to 40 cm shall be cut and filled with filling gel ensuring there are no air bubbles and the tube is completely full. The filled tube is placed in a horizontal position on a clean worktop and cut 5 cm from each end so that the finished length of the sample is 30 cm. The filled tube shall be left in a horizontal position at an ambient temperature for 24 hrs. The sample tube is then suspended vertically in an environment heat oven over a weighed beaker. It is left in the oven at a temperature of 70 ^{0}C for a period of 24 hrs. At the end of the 24 hours period the beaker is checked and weighed to see if there is any gel in the beaker. There shall be no gel or oil in the beaker.

(S) **Check of easy removal of sheath:** The sheath shall be cut in circular way using a sheath removal tool and the about 300 mm length of the sheath should be removed in one operation. It should be observed during sheath removal process that no undue extra force is applied and no component part of the cable is damaged. It shall be possible to remove the sheath easily. Easy removal of both the outer jacket and the inner sheath shall be checked separately.

(T) **Effect of aggressive media on the cable surface (Acidic and alkaline behavior):** The test shall be conducted as per method no. ISO175. The two test samples of the finished cable each of 600 mm in length are taken and the ends of the samples shall be sealed. These test samples are put in the PH4 and PH10 solutions separately. After 30 days these samples are taken out from the solutions and examined for any corrosion etc. on the sheath and other markings of the cables. The sample should not show any effect of these solutions on the sheath and other marking of the cable.

1.5.1 Cable drums, Marking, Packaging and Transport

All optical fibre cable shall be supplied on strong wooden drums provided with lagging with adequate strength, constructed to protect the cabling against all damage and displacement during transit, storage and subsequent handling during installation. The cable drum shall be suitable to carry underground fibre optic cable of length upto 4 Km ±10% or 2 km ±10%. The

Contractor may offer higher cable drum length in straight routes subject to transportation, handling and installation limitations. However, the exact lengths for drums to be supplied for each link shall be determined by the Contractor during detailed engineering/survey. Drum schedule shall be approved by the Employer before manufacturing the FO cable. Both cable ends in the drum shall be sealed and shall be readily accessible. The drum shall be marked with arrows to indicate the direction of rotation. Both the ends of the cable shall be provided with pulling eye. The pulling eye and its coupling system should withstand the same tensile load as applicable to the cable. The following marking shall be done on each side of the cable drums.

1.5.1.1 Drum number
1.5.1.2 Consignee's name and address
1.5.1.3 Contractor's name and address
1.5.1.4 Type of cable
1.5.1.5 Number of fibres
1.5.1.6 Type of fibres
1.5.1.7 Year of manufacturing, month & batch no
1.5.1.8 Name of manufacturer
1.5.1.9 Total cable length
1.5.1.10 Inner end marking and Outer end marking

Packing list supplied with each drum shall have all the information provided on marking on the respective cable drum and following additional information: OTDR length measurement of each fibre and Ratio of fibre and cable length.

1.6 Optical fibre cable marking

A suitable marking shall be applied in order to identify this cable from other cables. Marking on the cable shall be indelible, of durable quality, shall last long and shall be applied at regular interval of one-meter length. Marking shall be imprinted and must clearly contrast with the surface and colors used must withstand the environmental influences experienced in the field. The accuracy of the sequential marking must be within $\pm$ 0.5% of the actual measured length. The sequential length marking must not rub off during normal installation. In case laser printing is used the marking shall not exceed 0.15 mm depth. The optical fibre cable shall have the following markings in every meter.

1.6.1 Type of Cable
1.6.2 Running meter length
1.6.3 Number of fibres
1.6.4 Type of fibre
1.6.5 Laser symbol & caution notice
1.6.6 Year of manufacture and batch no.
1.6.7 Manufacturer's name
1.6.8 Owner's Name " "

1.7 Operating Instructions

Complete technical literature in English with detailed cable construction diagram of various sub- component with dimensions and test data of the cable shall be provided. All aspects of installation shall also be covered in the handbook.

1.8 Test and Inspection:

The general conditions for Type and Factory Acceptance Testing shall be as per section 7.

1.8.1 Type Testing

The cable to be supplied should have been type tested either as per the requirement specified in this section or relevant TEC specifications including latest amendments. The Bidder shall submit along with their bid the earlier carried out type test reports and/or TEC certificates for the offered fibre optic cable meeting the requirement. The fibre should have been type tested as per relevant International standards for the tests listed in Table 3-2 and the Bidder shall submit the test reports and certificates along with the bid. The Contractor shall submit the type test reports of fibres meeting the minimum requirement specified in Tables 3-2 below. If the test reports are not submitted or if the submitted test reports do not meet the requirement, the Contractor shall carry out the type testing on the fibres as per requirement specified in Table 3-2 and on the FO cable as per 3.1.6 of this chapter with no additional cost to the Employer.

Table 1-2: Type Tests For Optical Fibres

S.N.	Test Name	Acceptance Criteria	Test procedure
1	Attenuation	TS Table 3-1	EIA/TIA 455- 78A
2	Attenuation Variation with wavelength	TS Clause 3.1..4	EIA/TIA 455- 78A
3	Attenuation at Water Peak	TS Table 3-1	EIA/TIA 455- 78A
4	Point Discontinuities of attenuation	TS Table 3-1	EIA/TIA 455-59
5	Attenuation With Bending (Bend Performance)	TS Table 3-1	EIA/TIA 455- 62A Method/procedure A/B
6	Mode Field diameter	TS Table 3-1	EIA/TIA 455-164A/167A/17
7	Chromatic Dispersion	TS Table 3-1	EIA/TIA 455-168A/169A/175A

Table 1-2: Type Tests For Optical Fibres

S.N.	Test Name	Acceptance Criteria	Test procedure
8	Cladding Diameter	TS Table 3-1	EIA/TIA 455-176
9	Core -Clad concentricity error	TS Table 3-1	EIA/TIA 455-176

1.8.2 Factory Acceptance Testing

The tests listed in Table 3-3 shall be carried out as Factory Acceptance Test for Underground fibre optic cable meeting the requirements specified in this section.

Table 1-3
Factory Acceptance Tests on Underground Fibre Optic Cable

S. No.	Factory Acceptance Test
1	Attenuation Coefficient (1310, 1550): By EIA/TIA 455- 78A or OTDR
2	Point discontinuities of attenuation: By EIA/TIA 455- 78A or OTDR
3	Visual Material verification and dimensional checks as per approved
4	Water Ingress test
5	Tensile strength test / Strain test
6	Impact test
7	Kink test
8	Environmental test
9	Crush Test
10	Drip test

Note: Sampling:
For test sl. No. 1 & 2 (10% drums of the lot offered). Test shall be conducted on all fibres of the selected drums.
For test Sl. No. 3, 4, 5, 6, 7, 9 & 10 shall be one drum per lot. For test No. 8, one drum per design/total project requirement.

I.1 PLB HDPE DUCT and ACCESSORIES

The following paragraphs describes the functional requirements & major technical parameters for Permanently Lubricant High Density Polyethylene (PLB HDPE) duct. PLB HDPE duct shall be suitable for underground fibre optic cable installation by blowing as well as conventional pulling. The PLB HDPE duct shall be suitable for laying in trenches by directly burying, laying through G.I./RCC hume pipe and laying through trench less horizontal directional drilling. The expected service life of HDPE duct and accessories shall not be less than 50 years.

1 Construction of PLB HDPE duct

The PLB HDPE duct shall have two concentric layers viz. outer layer and inner layer. The outer layer shall be made of HDPE material and the inner layer of solid permanent lubricant. These concentric layers shall be co-extruded and distinctively visible in cross-section under normal lighting conditions and generally conform to IS-9938. The colour of the PLB HDPE duct shall be orange and uniform throughout. In the finished PLB HDPE duct, the co-extruded inner layer of solid permanent lubricant shall be continuous and integral part with HDPE outer layer and preferably be white in colour. The inner layer of solid permanent lubricant shall not come out during storage, usage and throughout the life of the duct. The duct shall be supplied in a continuous minimum length of 1000 (one thousand) meters in coil form, suitable for transportation, installation and handling purposes.

Bidders may offer HDPE duct of a homogeneous construction (i.e. without a separate inner layer) as an alternative, meeting all the requirements of this specification.

The finished duct shall be of good workmanship such that the duct is free from blisters, shrink holes, flaking, chips, scratches, roughness, break and other defects. The duct shall be smooth, clean and in round shape, without eccentricity. The ends shall be cleanly cut and shall be square with axis of the duct.

2.1.1 General

The HDPE duct shall conform to the relevant standard and the technical specifications described in the following sections.

2.1.2 Material

The raw material used for the PLB HDPE duct shall meet the following requirements:-

(i) The anti-oxidant establishers, color master batch and other additive used shall be physiologically harmless and shall be used only to minimum extent necessary to meet the specification.

(ii) Usage of any additives used separately or together, should not impair the long- term physical and chemical properties of the PLB HDPE duct.

(iii) Suitable Ultra Violet stabilizers may be used for manufacture of the PLB HDPE duct to protect against UV degradation when stored in open for a minimum period of Eight months.

(iv) The base HDPE resin used for manufacturing outer layer of duct shall conform to any grade of IS-7328 or to any equivalent standard meeting the following requirement.

Density 940 to 958kg/m^3 at 27 ^{0}C
Melt Flow Rate (MFR) 0.2 to 1.1 g/10 minutes at 190 ^{0}C & 5 kg load

(v) In case of PLB HDPE duct of two concentric layer construction, the friction reducing, polymeric material to be used as the inner layer lubrication material shall be integral with HDPE layer. The lubricant materials shall have no toxic or dermatic hazards for safe handling.

2.1.3 Dimension of duct

The nominal size of the duct shall be 40mm and shall meet the following requirements.

(i)	Outside diameter	40 mm + 0.4 mm
(ii)	Wall thickness	3.5 mm (+0.2 mm/ -0.00 mm)
(iii)	Standard length	1000 meters □□100 meter
(iv)	Thickness of permanent lubricant,	≥ 0.4 mm
(v)	Maximum outer diameter of FO cable dia. that can be installed by blowing technique	16 mm or offered cable (whichever is higher)

2.1.4 Accessories of PLB HDPE duct

The following accessories are required for jointing the duct and shall be supplied along with the duct. The manufacturers shall provide complete design details, procedure for method of installation and type of the material used for the accessories.

i) Plastic coupler: The coupler shall be used to join two PLB HDPE ducts. The coupling shall be able to provide a durable water tight joint between two ducts without deteriorating the strength of the ducts. The strength of coupler shall match the primary strength of the PLB HDPE duct and threaded coupler is not acceptable.

ii) End plug: This shall be used for sealing the ends of empty duct, prior to installation of FO cable and shall be fitted immediately after laying of the PLB HDPE duct, to prevent entry of any unwanted elements such as dirt, water, moisture, insects/rodents etc.

iii) End cap: This cap is made of hard rubber, shall be fitted with both ends of PLB HDPE duct to prevent the entry of any unwanted elements such as dirt, water, moisture, insects/rodents during transportation and storage. No separate payment will be admissible for providing end caps with each piece of PLB HDPE duct supplied.

iv) Cable sealing plug: This is used to hold the cable and prevent entry of any unwanted elements, as specified above.

v) **Empty PLB HDPE duct with draw rope inside it:** A draw rope shall be provided in each PLB HDPE duct. The rope will have a braided multi-strand construction, 4mm diameter, polypropylene raw material and having breaking load strength of not less than 200kg. The PLB HDPE duct should be sealed at both ends with suitable sealing caps with hooks to tie the inner rope at both ends.

vi) Colour of each of the accessories shall be black or white.

2.1.5 Workmanship

The duct shall be free of blisters, shrink holes, break and other defects. The PLB HDPE duct ends shall be cut as square as possible to longitudinal aspects. The internal and external PLB HDPE duct surfaces shall be smooth. The color should be uniform throughout.

2.1.6 Marking

All the duct, shall be clearly marked at intervals of 1 meters with the following data which is not less than 5 mm high. The details of marking on duct shall be approved by Owner/Employer before commencement of manufacturing.

i) ”Name of utility”
ii) Manufacture’s name or trade mark
iii) Year of manufacturing
iv) Type of PLB HDPE duct and size
v) Running length marking

2.1.7 Packing and condition of delivery

The duct may be supplied in reels or coils after sealing both ends by end caps. The following marking shall be provided on each packing:-

(a) Code of product
(b) Name of Manufacturer
(c) Date of manufacturing
(d) Length of PLB HDPE duct
(e) Dimension of Outer Dia and Inner Dia
(f) Owner’s name “Name of utility”

2.1.8 Type Tests and Factory Acceptance Tests

The Bidder shall enclose in the bid valid type approval certificate from Telecom Engineering Centre (TEC), New Delhi of Department of telecommunication according to TEC specification no. G/CDS-08/01 or latest TEC for the proposed PLB HDPE duct meeting the specified requirements. The cable is liable to be considered non-compliant to the technical specifications in absence of type approval certificates as stipulated above as no separate type testing is envisaged for the material to be supplied by the Contractor (i.e. the successful Bidder).

The dimensional and marking checks of each reel or coil of PLB HDPE duct and their accessories as per the approved DRS shall be carried out as Factory Acceptance Test (FAT) which may be witnessed by the Employer. However, visual inspection of 100% of the item/material may be carried out by Employer/Owner on receipt of material at site and any visual damage observed on-site inspection on the supplied item/material would make the consignment liable for rejection.

2.2 INSTALLATION OF UNDERGROUND FIBRE OPTIC CABLE SYSTEM

This section describes the installation procedures and methods including survey, clearances, excavation of trenches and pits, trenchless digging, installation of PLB HDPE

pipes, installation of RCC Hume pipes and GI Pipes, marking, backfilling, installation of underground cable, construction of manholes, splicing, termination and site acceptance testing requirements of the underground fibre optic cabling system.

2.2.1 Survey

The choice of route is most important aspect in planning an underground cable system. The correct choice is essential to reduce the cost of laying pipes, keeping the pipes safe from damage and to attain their maximum utilization when they have been laid. The broad guidelines to be taken into consideration while choosing a route for the installation of underground fibre optic cable are given hereunder.

The Owner/Employer will provide the details of the existing PLB HDPE pipe routes to the extent possible. However, to carry out the fibre optic cable installation, the Contractor shall carry out the required survey of the routes at no additional cost to the Owner/Employer. The Contractor shall submit the survey report of these routes furnishing all details regarding position of joint boxes, manholes (existing and proposed), section distances etc.

2.2.1.1 Survey for underground fibre optic cable links:

The survey shall be carried out by the contractor for the proposed under-ground FO cable routes defined in the Appendices for selection of most optimal route. The contractor shall arrange topographical maps and the details of facilities belongs to other utilities along the proposed route.

2.2.2 Clearances

The Contractor shall be responsible for obtaining necessary clearances for excavation work from the authorities on behalf of the Owner and provide requisite copies of information, maps, survey report etc. to the authorities. The Owner/Employer shall assist the Contractor in obtaining such clearances by providing the authority letter or any other relevant document. The Contractor shall make an effort with the concerned authority to get clearances expeditiously and to negotiate the least cost to the Owner/Employer. The Owner/Employer shall furnish all required bank guarantees and make payments to the concerned authorities directly based on the demand letter obtained by the Contractor from the concerned authorities. The Contractor shall ensure quick and speedy clearances in order to implement the project within stipulated schedule. In case the authorities have some objections on certain sections of routes proposed and are unwilling to provide clearances, the Contractor shall propose an alternate route, promptly carry out the survey and submit specific survey report for that and reapply for clearance after taking into account the comments/objections of the authority.

2.2.3 Excavation and Backfilling

The Contractor shall carry out excavation and backfilling of trenches in all kinds of soil strata such as normal soil, soft rock, hard rock for laying PLB HDPE pipe, RCC hume pipe and GI pipe.

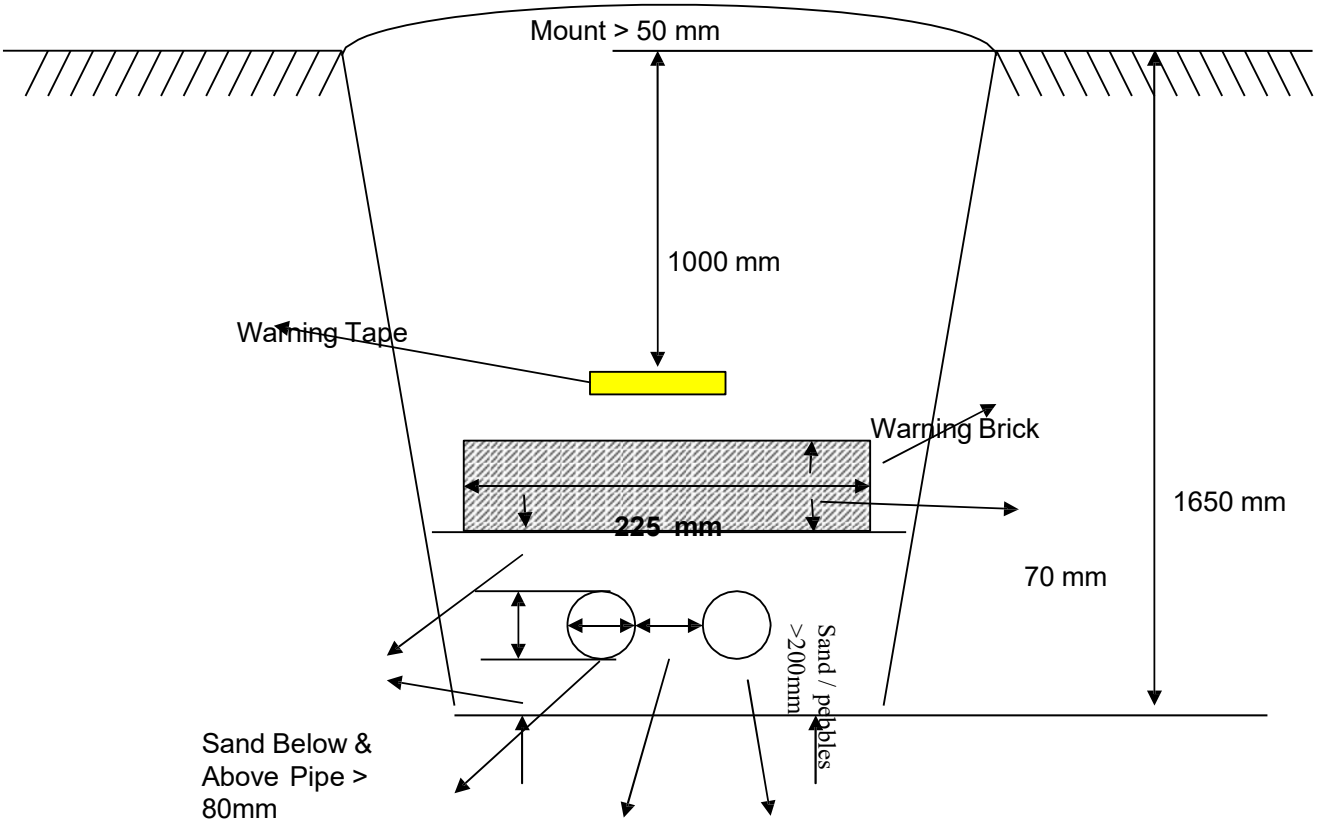


Figure 3-1: Trench in Normal Soil for 2 PLB HDPE pipes (Not to Scale)

2.2.4 Underground Fibre Optic Cable Installation

The cable shall be installed inside one of the 40 mm diameter PLB HDPE pipes installed under this package along the route(s). The cable shall be installed by compressed air blowing technique. The cable blowing machine shall be suitable for blowing the proposed section lengths of fibre optic cables.

As various utilities have already installed their fibre optic cables in the existing PLB HDPE pipe routes, the Contractor shall take due care and precaution during installation of fibre optic cable and the rectifications work to avoid possible damage of ducts / OFC of other utilities. The Contractor shall indemnify the Owner/Employer for all the damages and the Contractor shall be solely responsible for the damages and losses. The Owner/Employer shall not be liable for any such damages.

Bidder shall provide armored fibre optic cable (TEC approved design) in some of the sections, which are not suitable for unarmored cable installation in ducts (example: highly rat infected sections). The armored fibre optic cable shall also be installed inside the PLB HDPE pipe / GI pipe / RCC pipe, as applicable. The routes and types of installation shall be finalized during project execution based on the site survey report and actual requirements.

The Contractor shall propose the exact methods and procedures for installation taking into consideration the following guidelines, for approval by the Owner/Employer.

a. The Optical Fibre Cable Drums shall be handled with utmost care. The drum shall not be subjected to shocks by dropping etc. They shall not be normally rolled along the ground for long distance and when rolled, shall in the direction indicated by the arrow. The battens shall be removed only at the time of actual laying.
b. A blowing machine in association with an appropriate compressor shall be used for blowing.
c. Temporary blowing chambers (if required) shall be constructed and then backfilled after blowing operation is completed.
d. Locations along the route, which provide easy access points for blowing machine and compressor, shall be determined.
e. Before starting the cable blowing, both PLB HDPE pipes installed under this package shall be checked for obstacles or damage. The already installed PLB HDPE pipe wherein cable are to be installed under this package shall also be checked for obstacles or damage. Checking shall be done by using a proper sized mandrel equipped with a transmitting device.
f. Always blow downhill wherever possible.
g. Multiple blowing machines may be used in tandem if so required.

Installation by pulling may be permitted by the Owner/Employer in specific cases where installation by blowing is not feasible. In case pulling is used, the pulling speed shall be determined considering the site condition. Care must be taken not to violate the minimum bending radius applicable for the fibre optic cable. Tension in the cable during laying shall not exceed tension limit of the offered FO cable and the cable should not be damaged during or after the pulling.

While installing the cable, excess length of about 10 meters shall be stored at each joint location for each side. Excess length of 10 m shall be kept at one ends of a road crossing, culvert crossing and 20 meters at one end of bridges.

2.2.5 Optical fibre termination Splicing and Service

Termination and splicing of optical fibre cables shall be done as per manufacturer's instruction and following international practices. Connecter Unit shall be selected to suit terminating frame according to the manufacturer's specification. The termination shall be tested for transmission loss and strength. Unless otherwise specified in this chapter, service loop requirements shall also be provided.

2.2.6 Site Acceptance Testing (SAT)

General conditions for testing shall be as per specification. The tests, checks, adjustments etc. conducted by the Contractor prior to offering the equipment/material for SAT shall be called Pre-SAT activities. The Pre-SAT activities shall be described in the installation and Field Quality Plan documents.

SAT for optical fibre cable shall be carried out link by link from FODP to FODP.

Prior to installation, every spooled fibre optic cable segment shall be tested for compliance with the Pre- shipment data previously received from the manufacturer. This requirement will preclude the installation of cable segments that may have been damaged during shipment. Test requirements are as per table 3-1.

Optical fibre attenuation shall be measured after installation and before splicing. Any increase in attenuation or step discontinuity in attenuation shall not be acceptable and shall constitute a cable failure. The Contractor shall have to either replace the concerned cable span at its own cost or provide additional splicing, joint box and manholes required to rectify the fault at its own cost. The fibre attenuation shall be tested again after replacement or rectification of fault.

During the installation, spliced cable segments shall be tested and documented. In case it is found that the splices are bad (loss is unacceptable as per approved test procedures), the Contractor shall have to do re- splicing and provide new Joint Box wherever required at no additional cost to the Owner/Employer. After re-splicing the end to end testing shall be repeated. The splice testing requirements are indicated in table 3- 2.

Upon completion of a continuous cable path (FODP to FODP locations), all fibres within the cable path shall be demonstrated for acceptance of the cable path. Test requirements are indicated in table 3-3 and in no case losses attributed due to other factors viz. extra splice, kinks, will be acceptable to the limit determine by the following formula:

Max attenuation @ 1550nm: 0.23dB/km + 0.05dB x total no of splices + 0.5dB x connector

Max attenuation @ 1310nm: 0.35dB/km + 0.05dB x total no of Splices + 0.5dB x

connector as averaged over 100 km of fibre.

Table 3-1:
Fibre Optic Cable Pre-Installation Testing

Item:	Description:
1.	Physical Inspection of the cable assembly for damage
2.	Optical fibre continuity and fibre attenuation with OTDR at 1550 nm

Table 3-2:
Fibre Optic Cable Splice Testing

Item:	Description:
1.	Per splice attenuation with OTDR (bi-directional average) at 1550 nm
2.	Physical inspection of Joint Box for proper fibre routing techniques
3.	Physical inspection of sealing techniques, weatherproofing, etc.

Table 3-3:
Fibre Optic Cable Commissioning Testing

Item:	Description:
1.	Fibre continuity and link attenuation (bi-directional) between FODP connectors at two ends for each fibre at 1310 &1550 nm by OTDR
2.	Fibre continuity and link attenuation (bi-directional) between FODP connectors at two ends for each fibre at 1310 &1550 nm by Power Meter & Laser Source
3.	Average splice loss (bi-directional) for each splices and average splice loss for the link by OTDR at 1550 nm
-End of Table-	

2.2.7 SAT for Joint Box

20% Joint Box shall be tested for water penetration. Installed joint box shall be completely immersed in water for 1 hour under 1 meter head, then opened and observed for water/moisture ingress. The Joint Box shall then be sealed and installed again. In case any water/moisture is detected, test shall be declared failed and all the Joint Boxes shall be tested, all failed joint boxes shall have to be re spliced and resealed.

2.2.8 SAT for PLB HDPE pipe

For the new PLB HDPE pipes to be installed under this package, duct integrity tests shall be carried out as described below. The **Duct cleaning (Sponge test)** test shall be carried out on all the ducts before blowing/pulling of the cable while all other tests shall be carried out on spare ducts only. If Duct cleaning (sponge) test fails in the duct in which cable to be laid then other tests may be carried out to clean and rectify the problem, if any. The tests as described below shall be carried out between two consecutive manholes on the PLB HDPE pipes.

- **Duct cleaning (Sponge test)**

Compressed air should be blown through the PLB HDPE pipe in order to remove dirt and water, if any, with the help of suitable Air Compressor. A short blast of air about 2-3 Bar shall be blown through the PLB HDPE pipe for about 2 minutes. Sponge shall be blown through the duct to thoroughly clean the duct from inside.

- **Crush and deformity test**

Place a shuttle of length <15cm and O.D. 80% of the inner diameter of the offered PLB HDPE pipe. Connect the compressor pipe with a suitable flexible wire grip at the other end to catch the shuttle and start blowing operation to the pipe and check if shuttle reaches at the other end. If shuttle gets stuck perform the Radio transmitter detection test.

- **Radio Transmitter detection test**

For this test, a Radio shuttle shall be blown by a compressed air which shall also be stuck at the point of earlier shuttle. The place and position of the radio shuttle shall be identified with help of detector and obstruction (kink/deformation/ sharp bend) is removed and the test procedure shall be repeated, until the whole duct section is found cleaned for blowing.

- **Pressure testing**

For this test, seal one end of the PLB HDPE pipe with end coupler and connect valve with coupler at the other end and then pressurized the pipe up to 5 Bar with a compressed air from valve end coupler. After 30 minutes pressure drop shall not exceed by 0.5 Bar.

SAT for other items

Tests for other components such as FODP etc. shall be done as per approved Field Quality Plan.

J. HDPE PIPE and PPR PIPES

1. Scope

This Specification covers the fabrication and supply of 160 mm and 125mm (outer diameter) Flexible HDPE Pipe and PPR Pipes used for XLPE power cable in underground 11kV distribution system.

2. Description

The HDPE pipes are black and should suitable for inserting cable. The flexible conduit pipe shall be corrugated hard polyethylene pipe shall be used for installation of XLPE power cable. The flexible pipe shall be buried before the cable installation and, then the cables shall be pulled in. The HDPE pipe material should be Fire Retardant or non-Flammable.

The HDPE pipes shall be fabricated and tested in accordance with BS: 3412, Class N HDPE 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 pipe shall be 240 kg/cm2.

The HDPE pipe should be suitable for 4 kgf/cm^2 pressures with thickness not less than 6.5 mm and weight of the HDPE pipe should not be less than 2.5 kg per meter. The HDPE pipe shall have a minimum tensile strength of 3200 kg/mm^2. The HDPE pipes should have design at 27 deg. C for a stress of over 50 kg/cm^2 with safety factor of 1.3.

The flexible conduit pipe shall be strong enough to withstand the compression force from heavy trucks or lorries when it is buried more than 80 cm below the ground level and temperature rise up to 80 degree Celsius.

The PPR pipes shall be fabricated and tested in accordance with EN ISO 15874, Class PN20 and PN25 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 specific chemical structure of green PPR should be present to provide the well balanced mechanical properties and superior long term heat resistance.

A) FOR HDPE PIPE 160MM DIA

Sl. No.	Item Description	Unit	Requirement
1	M.F.R. (190°C, 5kg load)	gm/10 mins	0.20 to 1.10
2	Specified base densiiy	kg/mtr^3	940 to 958
3	Material Grade		PE-63
4	Wall Thickness	Mm	7.7 - 8.7
5	Carbon Black	%	2.5 ± 0.5
6	Ant1ox 1dant	% by mass	<0.3% by mass
7	Overall Migration	Mg/dm^2	10 Max
8	Reversion	%	<=3%
9	Hydraulic Characteristics		No sign of localized swelling, leakage or weeping (at 80°C for 48 & 165 hrs.)
10	Continuous Temperature withstand capacity	120 deg. C	

B. FOR HDPE PIPE 125 MM DIA

Sl. No.	Item Description	Unit	Requirement
1	M.F.R. C, 5kg load)	gm/10 mins	0.20 to 1.10
2	Specified base density	kg/mtr^3	940 to 958
3	Material Grade		PE-80
4	Wall Thickness	mm	4.9 - 5.6
5	Carbon Black	%	2.5 ± 0.5
6	Antioxidant	% by mass	<0.3% by mass
7	Overall Migration	Mg/dm^2	10 Max
8	Reversion	%	<=3%
9	Hydraulic Characteristics		No sign of localized swelling, leakage or weeping (at 80°C for 48 & 165 hrs.)
10	Continuous Temperature withstand capacity	Deg. C	110

c) Accessories

The flexible conduit pipe shall be provided with necessary accessories, such as joints and sealing material etc. The straight joint sleeve shall be made of high density

polyethylene black coloured and to be so designed as to be screwed on to flexible pipe.

Bell mouth shall be fixed to the end of corrugated pipe to facilitate cable pulling in. The bell mouth shall be so designed as to screw into the pipe. It shall be made of hard density polyethylene and colored black.

Water proof materials for pipes in manhole shall be mounted to an outlet of duct to keep the water tightness. The waterproof materials shall be comprised the components such as sand-proof seal, sealing tape, neo seal compound, VUL-CO tape, PVC tape and other necessary materials to complete the specified scope of works.

3. Tests

The type test and routine tests shall be carried out for the materials to be supplied according to the above mention technical specification in accordance with the governing standard.

4. Packaging

The packing should be done for the materials to be supplied accordingly.

5. Bid Documentation

5.1 The Bidder shall provide a complete description, and catalogue of materials.

5.2 The Bidder shall provide certified test report as required by governing standards for materials.

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

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

K. MISCELLANEOUS

K1. TRANSFORMER PLATFORMS

1. Scope

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

2. Material

2.1 The transformer platform shall be fabricated from hot-rolled channels, angles and steel members.

2.2 The steel channels and angles for transformer platform shall be fabricated in accordance with Indian Standards IS: 226-1975 and IS-808-1964 or any revision thereof or other equivalent national or international standard provided that ensure at least equal or better quality to the standard mentioned above will also be acceptable. The minimum tensile strength of the steel shall be 4200 kg/cm2.

3. Description

3.1 The platform shall be fabricated out of galvanized steel members, field assembled by bolting.

3.2 The platform will support the transformer above the ground and will be supported by two-pole structures of tubular steel or pre-stressed concrete (PSC) poles. Transformers will be bolted to the platform at four (4) points. Provision should be made for the mounting of transformers of different physical dimensions and ratings up to 300 kVA.

3.3 The platform shall be designed by the supplier and fabricated, in general, in accordance with the conceptual configuration shown in drawing 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.

3.4 The platform shall be supplied disassembled, complete with all required members and fastenings. Packing may be made by banding structural members. Fastenings shall be separately packed. Structural members shall be clearly identified for ease of assembly in accordance with the assembly drawing furnished by the supplier.

3.5 The platform shall be suitable for fixing to support tubular poles of 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.

4. Galvanizing

4.1 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.

5. **Tests**

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

- Visual Inspection;
- Verification of Dimensions;

K2. DROP OUT FUSES

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.

2. DESCRIPTION

2.1 The drop out fuse shall be suitable for use on three-phase, wye-connected, unigrounded, 50 Hz distribution circuits at an altitude up to 2000 meters.

2.2 The drop out fuse shall be tested in full compliance with ANSI C 37.41-1981, ANSI C 37.42 or IEC 60282-2.

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.

2.4 The fuse holder shall accommodate a non-expendable cap or an expendable cap determined by interrupting rating.

2.5 The drop out fuse shall be furnished with a galvanized steel-mounting bracket that may be adapted for steel channel (100x50x50x6mm) cross arm mounting.

2.6 The drop out fuse shall have clamp type terminals to accept copper or aluminium conductors ranging from 25 mm^2 to 150 mm^2.

2.7 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.

3. RATINGS

3.1 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 (Leakage to ground)	220
g) Temperature Rise Limit (In air)	
i. Copper contacts silver faced	65^0C
ii. Terminals	50^0C

Metal parts acting as spring. The temperature shall not reach such a value that elasticity of the metal is changed

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

4. GENERAL REQUIREMENTS/CONSTRUCTIONAL DETAILS

4.1 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;

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

4 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.

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 recognized 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

5.2 Routine Test

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

K3. FUSE LINK

1. Scope

This Specification covers the supply of button head fuse links commonly used in the

protection of distribution transformers.

2. Description

2.1 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.

2.2 The fuse link shall have fast characteristics and shall be suitable for protection of distribution transformers.

2.3 The fuse link shall be supplied in accordance with the type and ratings shown in the bid package.

K4. MOULDED CASE CIRCUIT BREAKERS

1. Scope

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

2. Description

2.1 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.

2.2 The manufacturer of MCCBs must have been accredited with ISO 9001 including design quality certification.

2.3 The MCCB shall be suitable for connection to 400/230 volt, 3 -phase, 4 wire, uni-grounded circuits.

2.4 The MCCB shall be rated in accordance with the parameters shown in Table 1.

2.5 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.

2.6 The MCCB shall have line load reversibility features.

2.7 Marking shall be in accordance with IEC-60947-2.

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.

2.9 The MCCB shall be provided with terminal connection of the screw-type or bus-bar type as specified in Table 1. For MCCB with bus bar connection certain additional hardware shall be furnished with each MCCB as specified in Table 2.

2.10 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) centimeters.

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:

Type Tests

b) Temperature rise test
c) Tripping limits and characteristics
d) Dielectric properties
e) Operational performance capability
f) Overload performance

g) Short-circuit breaking capacities
h) Shot-time withstand current

Routine or Sample Test

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

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 to 55 Degree C
Interrupting Capability	(IEC category P2)

Service Breaking Capacity:

a)	50-100 Amps.	25 kA
b)	100-500 Amps.	36 kA

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

The MCCB rated 250 - 500 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.

TABLE 2

MCCB W/BUSBAR TERMINALS

BREAKER RATING	ADDITIONAL HARDWARE TO BE FURNISHED WITH EACH BREAKER
100 – 500 AMPERES	4 x 95 sq. mm. compression type cable terminals and 16 x 50 sq. mm. compression type cable terminals mounted on MCCBs, 8 staking bus spacers and additional 4 x 95 sq. mm. bolted type cable terminals mounted on the bus bar.

K5 GROUND RODS AND CLAMPS

1. Scope

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

2. Description

Ground Rod

2.1 The ground rod shall be made of high carbon, open-hearth steel so as to achieve maximum strength. It shall be hot dip galvanized.

2.2 The ground rod shall be 19mm in diameter and 34,000 mm in overall length.

2.3 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.

2.4 The manufacturing process shall assure that ground rod does not bend when driven into hard soils.

Ground Rod Clamp

2.5 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.

2.6 The clamp shall suitably accommodate and clamp a 19 mm. ground rod and a stranded grounding conductor of 7/12 SWG size (SPECIFICATION: SP 4.5.2).

3. Galvanizing

3.1 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.

4. **Tests**

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

K6 GROUNDING CONDUCTOR

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.

2. **Description**

2.1 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.

2.2 The manufacturer of ground Conductor must have been accredited with ISO 9001:2000 with design and manufacturing quality certification.

3. **Galvanizing**

3.1 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.

4. Tests

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

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

L. STEEL BOLTS, NUTS AND MISCELLANEOUS FASTENING COMPONENTS

L1. STEEL BOLTS, NUTS

1. **Scope**

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

2. **Material**

2.1 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.

3. **General**

3.1 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**.

3.2 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.

3.3 The manufacturer must have been accredited with ISO 9001:2000 with design and manufacturing quality certification.

4. **Machine Bolt and Nut**

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

5. **Double-Arming Bolt and Nut**

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

6. **Galvanizing**

6.1 The stranded stay wire 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.

7. **Tests**

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

L2. BANDING MATERIALS AND TOOLS

1. Scope

This specification covers the supply of banding strap, buckles and application tools commonly applied as a fastening and binding system.

2. Description

Banding Strap and Buckle

2.1 The banding strap and buckle shall be made of stainless steel, and shall be:

a) Type 1: 19 mm. in width and 0.8 mm in thickness. Minimum breaking strength of the strap shall be 1250 kg minimum. The strap shall be come on strap winder made of weather resistant plastic. The strap winder shall have handle for carrying, box for buckles and it shall be suitable for field handling. One roll shall contain 50 m. of banding strap. Buckle shall be suitable for use with banding strap.

b) Type 2: 13 mm. in width and 0.8 mm. in thickness. Minimum breaking strength of the strap shall be 850 kg minimum. The strap shall be come on strap winder made of weather resistant plastic. The strap winder shall have handle for carrying, box for buckles and it shall be suitable for field handling. One roll shall contain 50 m. of banding strap. Buckle shall be suitable for use with banding strap.

Tools for application of banding strap and buckle

2.2 Tools for application of banding strap and buckle shall be suitably designed and sized for use with stainless steel banding and buckle described in paragraph 2.1 above. The tool shall be durable and suitable for long-term outdoor use.

3. Tests

The binding materials shall undergo type and routine tests in accordance with the relevant governing standard.

M. VEHICLE MOUNTED SINGLE PHASE MODULAR CABLE FAULT LOCATING EQUIPMENT SUITABLE FOR LOCATING FAULT ON LOW /MEDIUM / HIGH VOLTAGE POWER CABLES UP TO 33 kV

1.1 SCOPE :

1.2 This specification is intended to cover the design, manufacture, assembly, testing at manufacturer's works, supply, delivery, installation & commissioning of Special General Purpose pickup Van Mounted Single Phase Modular Cable Fault Locating Equipment Suitable for Locating Fault on Low /Medium / High Voltage Power Cables up to 33 kV Complete with all materials and accessories for efficient and trouble free operation.

1.3 It is not the intent to specify completely herein all details of the design and construction of equipment. However, the equipment shall conform in all respects to high standards of engineering, design and workmanship and shall be capable of performing in continuous commercial operation up to the Bidder's guarantee in a manner acceptable to the Purchaser, who will interpret the meanings of drawings and specifications and shall have the power to reject any work or material which in his judgment is not in accordance therewith.
The offered equipment shall be complete with all components necessary for its effective and trouble free operation along with associated equipment, interlocks, protection schemes etc. Such components shall be deemed to be within the scope of supply, irrespective of whether those are specifically brought out in this specification and/or the commercial order or not.

1.4 The scope covers complete design, engineering & supply of the Comprehensive Van Mounted Multifunctional Cable Fault Locator system shall be used for Cable Fault conditioning (burn-down), Pre-Location, Route Location, Pin-pointing & Testing of HT & LT cables of different types & sizes. The set shall be suitable to carrying out the above-mentioned multifunction on power cables of various voltage levels mainly 33KV, 11KV, 415V and control cables with 1.1 KV grade. The set shall be used for cable types namely XLPE, PVC, PILC with Al / Cu conductor. The cables are laid underground (under plain earth, trenches, or RCC surface, Horizontal Drilling in HDD Pipe), above ground or partly under & partly above ground with maximum cable length around 25 Km.

1.5 The several runs of cables of different voltage levels are laid on common racks / underground trench and during the cable fault identification process, nearby cables shall be in charged condition; hence the accuracy of the set being offered shall not suffer due to the above. The set shall be capable to identify and locate faults for all types of cable faults including high resistance, low resistance or intermittent / flashing faults using a single or combination of units in the set. Vendor shall specifically mention the use of individual unit being offered for the particular type of fault with range. The various units being offered by the vendor as a comprehensive multifunctional set shall be fully compatible with each other, wherever required.

1.6 The Technical specification required of the various units attached to the comprehensive multifunctional set for Cable Fault conditioning (burn-down), Pre-Location, Route Location, Pin-pointing & Testing are given below.

Point- wise conformity to the specifications shall be submitted along with the offer without which the offer shall be liable for rejection.

The comprehensive cable fault locator set shall be suitable for fault locating and pinpointing the following types of cable faults viz.

- High resistance
- Low resistance
- Intermittent type or flashing faults.
- Sheath Fault location

The type of faults The Comprehensive Vehicle Mounted Multifunctional Cable Fault Locator system shall be used for Cable Fault conditioning (burn-down), Pre-Location, Route Location, Pin-pointing & Testing of HT & LT cables of different types & sizes may be 3-phase short circuit, ground fault, phase fault and open circuit.

The cable fault locator set should be suitable to locate cable fault and trace cables in areas with multiple energized / de-energized cables in the same route without affecting the accuracy.

2.1 STANDARDS:

2.2 The equipment shall confirm to the latest edition of the relevant standard. The bidder shall mention the applicable standard and shall furnish a copy of the authentic English version of the standard along with the offer.

2.3 Equipment meeting with the requirements of any other authoritative standards, which ensure equal or better quality than the standard mentioned above shall also be acceptable. If the equipment offered by the Bidder conforms to any other standard adopted and the specific standards shall be clearly brought out in relevant schedule.

3.0 CLIMATIC CONDITIONS:

Equipment to be supplied against this specification shall be suitable for satisfactory continuous operation under the tropical conditions.

4.0 GENERAL REQUIREMENT

The system should be capable for conducting the following functions:

a) Cables to be tested up to 33kV.

b) Pre – locating of faults by the following method
- Pulse Reflection Method (Pulse Echo)/TDR Method
- Secondary Impulse Method / ARC Reflection Method (ARM)
- Impulse Current Method.
- Decay Method

c) DC Test set 0-32 kV or more.

d) Surge generator 0-32 kV

e) Pin Pointing of cable fault using acoustic method, coincidence method and delay time mode method with suitable display to indicate various parameters.

f) Cable route tracing by audio frequency generator or any other latest technique in order to give depth of the cable etc. on LCD display.

g) Cable identification from bunch of cables
h) Megger 0-10 kV (With 5 mA Short Circuit Current) (Reputed Make i.e. Megger, AVO)
i) Cable Drum Rack

4.1 The single phase measuring set up shall be provided with 50 mtr of HT cables, LT main cable, earthing cable, and RF cable.

Note: Cables shall conform to relevant standards.

4.2 The CFL vehicle shall have practical safety devices including automatic checks inter-locking circuit, built if forced discharge circuit and the high voltage can be prepared only after all prerequisites are checked by the safety circuit so as to ensure that no damage is caused to the equipment in case the surge lead is connected to a live HT cable accidentally that is necessary protection against back feeding to be provided in any of the cases described below.

4.3 The output voltage shall remain turned off or cannot be turned on in case of :

1. Undue voltage rise in the output on earthing connection on the surge capacitor.
2. Flash over in the testing mode.
3. Thermal overloaded of the voltage stages of particular component such that the cause of disconnection shall be indicated by signal lights (LED's).
4. If the back door/ HV side of the VAN is open.

4.4 The complete system shall be made operative via centralized control unit responsible for various functions i.e. testing, burning, surging and SIM mode and continuous monitoring of the safety circuits shall be indicated via LEDs.

4.5 The control unit shall be provided with suitable voltage meter and ammeters.

4.6 The system should be capable of locating all types of permanent and transient faults viz. core shorts, core to earth shorts, high impedance faults, core breaks, flash over etc.

4.7 The system should work on input supply of 220 V ± 10%. 50 Hz single phase supply to safeguard the equipment against the abnormally high / low voltage current, the power supply current with a suitable protection system should be incorporated in power supply system. The equipment should be suitable for operation in Kathmandu Valley where ambient temperature may go up to 37 deg. C. The supplier shall commission the equipment and train the project Engineers in the testing procedure with complete literature of the equipment.

5.0 CERTIFICATE AND INSTRUCTION BOOK:

The supplier/contractor shall be required to furnish to the owner, whichever is necessary the following documents along with the consignment.

- Printed pamphlets/catalogues.
- Instruction Book
- Test Certificates.
- Guarantee card.

6.0 DETAILED TECHNICAL SPECIFICATION:

The cable fault locating system shall consist of the following:

- Microprocessor based Transient Recorder/Fault Locator.
- D.C Test, Surge and Burn Units.
- A pin – pointing set, cable route tracer, cable identification set and measuring wheels etc. should be supplied. All necessary cables should be supplied suitably mounted on drums. The system shall work on input supply of 220 V ± 10%, 50 Hz, ± 5% single phase.
- Constant monitoring of all safety circuits such as monitoring circuits etc. to be in built in control unit.

6.1 COMPREHENSIVE INTEGRATED HV FAULT PRE-LOCATON & CONTROL UNIT:

Pre-location of faults in cables shall be carried out using the principle of Secondary Impulse Method/ Arc Reflection Mode with the help of highly sophisticated Menu driven microprocessor based Digital Fault Locator. The equipment should have at least following features:

6.1.1 Should be fully menu-guided
6.1.2 Should feature interactive menu-guidance
6.1.3 Should have automatic cursor setting for fault location
6.1.4 Should have measuring input voltage proof min 250 V
6.1.5 Display should be color LCD.
6.1.6 Should have facility for printer connection via RS 232/USB
6.1.7 Should have facility for data transfer to PC through RS 232/USB
6.1.8 Should have facility for memory up to 100 records.
6.1.9 Suitable software to be provided for handling, storage and analysis of results as a part of the unit.
6.1.10 It should have automatic far end indication and fault recognition with distance indication.
6.1.11 The instrument shall have the features to display the fault trace and continuous reflection traces. In addition the instrument should have a feature to display differential trace of faulty cable with respect to a healthy cable.
6.1.12 Should support following methods:
6.1.12.1 Pulse Echo Method / Time Domain Reflection (TDR)
6.1.12.2 Secondary Impulse Method (SIM)/Arc Reflection Method
6.1.12.3 Impulse Current Method (ICM)
6.1.12.4 Decay Method .

Technical data:

6.1.13 Output voltage of transmitting pulse: Min 10V up 60 V
6.1.14 Pulse width of transmitting pulse: (40ns … 04us) min
6.1.15 Voltage withstand: 250V AC (50/60 Hz)
6.1.16 Output impedance: 20-150 Ohms Auto ranging as well as manually selectable.
6.1.17 Measuring ranges @ v/2=80m/µs: 50m-50Kms Auto ranging as well

as manually selectable.

6.1.18 Measuring accuracy: Within 3Mtr in all ranges
6.1.19 Sampling rate: 200 MHz
6.1.20 Resolution: min 1.5 m
6.1.21 Propagation velocity v/2: 100-150 m/µs
6.1.22 Number of memories: at least 100
6.1.23 Display: LCD display
320x240 resolution

6.1.24 Power supply for operation and/or charging: 100-240V (50/60 Hz)
6.1.25 Operating temperature: -20 … +55°C
6.1.26 Storage temperature: -20 … +60°C

Dimensions : To be specified by the Bidder Weight
: To be specified by the Bidder

6.2 DC High Voltage Test set:

It shall also be possible to carry out the Insulation Testing and high voltage DC testing of the cable under test from the same unit. The comprehensive set shall be utilized for performing the high voltage DC testing of the cables for accessing the health of the cable insulation by measuring the leakage current. It shall have the following features:

(a) The unit shall be handy/Van Mounted and of rugged construction. It shall have built in discharge unit for automatic discharge after shutdown.
(b) The set shall have all the safety features necessary for the protection against high voltage e.g. auto discharging after switching off, high voltage ON/ OFF with security, Auto-OFF in case of break in power supply etc.
(c) The DC Cable Test Voltage of the Set shall have a range of 0 – 32 kV min DC Voltage.
(d) The set shall be provided with an adjustable leakage current range up to at least 50mA with a minimum resolution of 1 mA. It shall also be provided with a leakage current indicator.
(e) The set shall automatically trip on the leakage current exceeding the set limit value with the display of breakdown voltage.
(f) The unit shall include mains leads, earth cable, HV connecting cable, earth terminals, battery connecting cables with battery clips, all required and related accessories with carrying case and users' manual with complete operating and maintenance instructions.
D.C. Testing: 0-32kV min DC Continuously adjustable (Auto Ranging)

6.3 Surge Generator Unit:

The Surge Generator Unit shall be used as thumper for charging of cable under test (i.e. defective cable) till sufficient flashover is achieved at the point of fault. The set shall be used in conjunction with Surge Receiver Unit for fault pinpointing. It shall have following features:

(a) Surge Voltage Range: 0-4kV, 0–8 kV, 0–16 kV & 0–32 kV

(b) Surge Energy: Minimum 2000 Joules in each range except 0-4kV where it should be 1500 Joules

(c) The set should be provided with standard safety features like 'Zero start voltage interlock', 'High voltage ON lamp', automatic grounding upon shutdown, Auto-OFF in case of power supply break and overload protection with circuit breaker etc.

(d) Surge rate: continuously variable from 3 Sec to 8 Sec min. & Single impulse feature shall also be available.

(e) The unit shall be compatible for use with Surge Receiver Unit and Arc Reflection Unit.

(f) The unit shall include mains leads, earth cable, HV connecting cable, earth terminals, battery connecting cables with battery clips, all required and related accessories with carrying case and user's manual with complete operating and maintenance instructions.

Impulse : 0-32 kV in suitable steps of 0-8/0-16/0-32 kV and each step continuously variable.

Surge Energy : 2000 Joules (Min)

Impulse interval : Single shot, 20 per minute approx.

Safety Protection : - 2 automatic discharging devices (internal and external discharge)

- Reliable operated surge switch electromagnetic operated
- Separate system and protection grounding device
- Safety control circuit according to VDE 0104

Fault Burning : Up to 210mA (min.)

Surge Generator LT or Thumper

Voltage Range : 0-4kV Discharge Energy in Joules 1500J min

6.3.1 Filter Unit or ARC reflection Filter Unit or ARC Stabilizing:

Generally pulse echo or reflection method is applied for cable fault location however it may not be suitable for high impedance or resistance faults. Therefore to overcome these limitations in pulse echo method, a suitable band pass filter unit should be supplied to stabilize this ARC at the flashover or the point of fault.

The offered filter must simplify the operation causing less stress, causing minimum damage on the tested cables to detect the high resistive faults. There should be complete compatibility of TDR, Surge Generator/Thumper with the filter unit. This unit must filter or stabilize the arc at the fault point and record the same in the supplied TDR to compare it with previous trace recorded without the filter unit in the same core. Suitable coupler for coupling the filter unit with the TDR and Surge generator must be supplied.

The offered filter must contain switching elements necessary for the triggering and the coupling of the pulse. After the pre-location using the SIM/ARM method, there must a decoupling element which must by pass the surge

generator for making it ready for use in pinpointing the cable fault. The control unit should connect automatically the filters with appropriate coupler with the surge generator and TDR when ARM/SIM mode.

6.3.2 Inductive coupler:

Inductive Coupler for pre-location of high resistance faults with a Surge Voltage Generator according to the Impulse Current Method (ICM).

6.3.3 Capacitive coupler:

Capacitive voltage divider for location of intermittent cable faults up to 32 kV to perform the Decay Method.

6.4 Integrated Fault Conditioning Unit (Burn-Down Set):

This set shall be capable for burning down high resistance faults in cables to facilitate the fault pre-location. The Unit shall have the following features:

(a) The voltage range of the Burn-down Unit shall be at least up to 0-32 kV with adjustable current up or more 210 mA.
(b) The unit shall be provided with applied Voltage & fault discharge current meters.
(c) The Unit shall be provided with a thermal overload protection and shall have auto-reset feature.
(d) The Unit shall be provided with protective terminals to prevent accidental contact.
(e) The Unit shall be provided with safety earthing facility for safe operation.

6.5 Surge Wave Receiver Unit (Pin-Pointing Set):

It shall function as a directional acoustic listening device for pinpointing of flashover faults in underground power cables. It shall have the following features:

1. The unit shall be handy & rugged, and shall comprise of receivers, headphones, sensors, amplifiers and any other auxiliary items as necessary for operation of the unit. The set should provide detection of both acoustic and electromagnetic pulses emitted from an arcing fault when it is surged.
2. The set should be able to determine the proximity and direction to the cable fault by measuring electromagnetic surge and acoustic emission.
3. The set should be able to measure the time delay between acoustic and electromagnetic signals.
4. In the acoustic mode the set should have a feature to filter and eliminate background noise and electromagnetic interferences.
5. It should be able to pinpoint the exact location of the fault.
6. The instrument should be battery operated.
7. The set should have mute feature to activate while in motion.
8. It should have adjustable feature for adjusting the electromagnetic gain & acoustic gain.
9. It should have an LCD display with backlit feature.
10. The unit shall be provided with acoustic headphone set to receive the

acoustic signal for pin pointing the fault point.

11. The LCD display shall indicate the cable route through the electromagnetic signal in bar graph form & the proximity to fault point by a numeric display.
12. The unit shall include lightweight receiver with carrying straps, handy sensor, all required and related accessories with carrying case and user's manual with complete operating and maintenance instructions.

Features:

- Acoustic method including manhole distance location
- Accurate route tracing
- Digital indication of proximity of the fault
- Cable depth measurement in combination with the surge coil
- Water-resistant design
- Integrated head phone
- Large illuminated LCD display
- Digital filters for suppression of traffic noise
- Easy menu operation
- Lightweight

6.6 CABLE ROUTE TRACER:

The Cable Route Locator shall be suitable for cable fault location process of underground cables by identifying the cable from the surface, without excavation. The equipment shall be capable of tracing the buried cables with the ability to measure the depth of the cable. The unit shall have at least the following features:

a. The set shall comprise of a transmitter & receiver.
b. The set shall be battery operated (rechargeable) and portable type, rugged construction with necessary accessories & bag / case.
c. The cable tracing shall be done with audio & visual signals so as to make it easy to follow & trace the cable route.
d. It shall be possible to detect the depth of the cable (at least 4 meter) at any point by using sufficient wattage of the generator up to 45 watts at least.
e. Automatic impedance matching shall be required for better operations.
f. It shall also be possible to detect the AC signals (50 Hz) from a charged cable without transmitter.
g. Filters shall be provided to optimize the measurements and minimize the ambient noise.
h. The transmitter of the tracer should be capable of energizing the cable either by magnetic induction or by direct conductive connection to the cable.
i. The receiver should filter out electric noise and static noise.
j. The unit should also be able to determine the depth of the cable.
k. The unit should be suitable to trace cables in areas with multiple energized / de-energized cables in the same route.

a) Audio Frequency Generator:

The audio frequency generator should be ideal for locating the route of underground cable as well as for pinpointing of cable faults when used with receiver and identification of particular cable from the bunch of the cables.

Technical Specification:

LF output power:	0-50Watt or more (adjustable normally or automatically)
O/P Frequencies:	To be indicated by the bidder/contractor.
Output Adjustment	to be specified by the bidder
Permitted load resistance:	any short circuit, open circuit, continuous but with reactive load etc.
Power Supply:	Unit should be capable to work on mains AC
	Supply with built in charging and battery unit.

b) The audio frequency receiver:

The audio frequency receiver set should be battery operated and suitable to above frequencies. The receiver should be connected directly to the search coil. The coil can be rotated to 0-45 degree or 90 deg. spans in position for added veracity should have set forth high impedance and should provide maximum attenuation of external noise.

6.7 Cable Identification Set:

The system is to be used for selection of single core and multi core cables from a bunch of cables. The system should consist of a transmitter and Receiver unit and shall be light, portable, with facility to identify even live cables. The unit should be completely menu – driven, with graphic display.

Technical Data Transmitter

Output voltage	: 100V (min.) (15 pulses/min)
Output current	: 30A (min.)
Power Supply	: 230V, 50 Hz/ Battery operated

Receiver

Display	: Graphic LCD/ Analog signal
Sensitivity	: 100%; at 400 Ω loop resistance
Power Supply	: Battery operated

6.8 Connection Cables:

All the cables required for the operation of the cable Fault Locating system shall be at least 50 mtrs. Mounted on suitable drums along with RF cable of 50 mtrs. Cable for operating the fault locator in detached mode viz. earthing cable, main cables, HV cable, auxiliary earthing cable.

Cable drum rack

Hand operated cable drums with lockable brakes for accommodation of:

- 50 m high voltage cable
- 50 m mains cable 3x4 mm²
- 50 m ground cable 16 mm²

-50 m RF cable (TDR)

- 50 m Auxiliary Cable 16 mm2
-

High Voltage Cable

50 m flexible HV coaxial cable with coaxial plug, connection clamps and strain relief

Rated voltage: 80 kV
DC - Insulation material: EPR

Mains cable

50 m, 3x4 mm², with mains plug Mains plug type CEE 32A

Ground cable

50 m with tapping ferrules every 3 m, including clamps
Type: YF 16 mm² transparent

RF Cable

50 Meters for connecting the TDR to the faulty cable. This should be separate as the combination of HT and TDR cable shall not be suitable as the HT cable generally gets faulty in operation.

Auxiliary earth cable

15 Meters for creating an auxiliary earth in case of non-availability of system earth to safeguard the system.

6.9 Tools:

The following Tools shall be supplied.

- Discharging Rods 80 kV
- Measuring Wheel,
- Operator Cabin Fan
- Earth Spikes
- Digital Multi-meter Reputed make
- Megger 0-10 kV (5 mA short Circuit Current)
  Make: Megger, AVO or equivalent make
- Set of spanners, screw drivers etc.

Any other tool not mentioned above but otherwise required should also be supplied.

6.10 Safety Measure:

The control unit should be Computerized (menu driven) based and responsible for all the control operation of various functions such as Mode Selection Surge Test, Burn and

Arc Reflection, Range Selection, Voltage and current limit adjustment, Surge sequence selection, auto discharge, earth monitoring, etc. from a single button and no access to the high voltage side shall be available to the operator as well as Operator guidance with on-screen help texts.

The control unit should provide a visual indication of failure of safety circuits/incorrect selection etc. with possible corrective methods. Constant monitoring of all safety circuits such as earth monitoring circuit etc. should be inbuilt into the control unit, safety interlock monitoring etc. Safety function should be incorporated in the van suitably.

6.11 Mounting Van for the Comprehensive Set:

All the Units of the Comprehensive Van Mounted Multifunctional Cable Fault Locator system consisting of Cable Fault conditioning (burn-down), Pre- Location, Route Location, Pin-pointing & Testing of HT & LT cables shall be mounted on a suitable Equipment Mounting van with Power Supply connection arrangement fitted with at least four heavy duty wheels and one hook at the front for facilitating transportation by means of a vehicle. However, it shall be also possible to use each unit of the comprehensive set independently for the respective functions.

6.12 Mounting, Pre wiring and Mechanical fittings on Van:

Steel frame for mounting the following instruments:

i) Computer Aided fault locator

ii) High pressure test: All the equipment should be mounted on steel frames.

iii) Rotating cable drums should be provided for:

- HV cable drum-50m
- Mains cable drum-50m
- Earthing cable drum-50m
- Auxiliary earthing drum-50m
- R.F. cable drum-50m

iv) Safety screens be provided to isolate the HV area from operating area.

v) Suitable cupboards and tables for storing hand held instruments, writing desk.

vi) Revolving chair for operator and sitting arrangement of 4 persons.

vii) Diesel driven van with conditioning.

viii) Fully carpeted side walls & roof for Electrostatic Protection.

ix) Fully Insulated floor for safety.

7.0 Generator-set:

The generator-set shall meet the below mentioned specifications. & has to be placed at specially created housing in the van body / side body of the van.

Rated Output	5.6 kVA
Maximum Output	6.5 kVA
Rated Voltage	220 Volts
Frequency	50 Hz
Fuel	Petrol / 3 Ltr Per Hour

Starting	Self Start by key
Oil Alert	Provided
AVR	Automatic Voltage Regulation
Frame	Pipe Full Frame
Battery	Extra
Dimension (LxWxH) mm	708 x 548 x 493
Weight (Dry)	78 Kgs approx..

Preferred make: HONDA/TOSHIBA

8.1 Specifications for Fabrication of CABLE FAULT LOCATING VAN

I. Body Structure: The structure shall be made of steel sections as mentioned below & 12 mm thick Blata Packing with anti-vibration (Reinforced Rubberized Flat Section) over chassis frame:

(a) Runner / Strengthening member – MS Channel 100x50x5mm
(b) Cross Member - MS Channel 75x40x4mm
(c) Floor frame - MS Angle 40x40x5mm
(d) Super Structure (Hoop Sticks) - Top Flat section 40x40x2.5mm/ MS Square Tube 40x40x2mm
(e) Super Structure(Roof Curvature/ Taper & Flat surface) - Top Flat Section 40x40x2.5mm MS Square Tube 40x40x2mm
(f) Entire structure, spring Leaf Floor Angles are to be anti-corrosive treatment and paints.
(g) The pick-up/Van should be in one cabin.
(h) Rear End is to be provided with red reflectors.
(i) Mud Guards are to be provided.
(j) Ballata Packing (Rubber Packing between Chassis & body).
(k) Stairs should be with aluminium checkered plate.
(l) Lock Should be of good quality with OEM certificate

II. Paneling:

a) External - 18SWG G.L Sheet
b) Roof - 20SWG G.L. Sheet
c) Internal - Carpeting Over 3mm Fly.

III. Insulation: All Walls and roof will be insulated with 40mm thick thermocoal Sheet.

- Fully Carpeted side Walls & Roof for Electrostatic protection.

IV. Flooring: Base of Floor - Water Proof Ply 12mm thick Screwed through base floor of 3/6 mm MS .Sheet welded to floor frame.
Upper Layer - Vinyl Floor Sheet 2mm thick fixed over fly.

V. Doors:

a) Hinged type doors (Double leaf inside collapsible) shall be provided for Main Compartment.
b) Hinged Type outside open able (Ambulance type) rear doors
c) Rear door to be provided with cable cutout section (6”x6”)

VI. Windows: Adequate size of windows two way horizontal full sliding glass of 5mm thick Toughened glass encased in Aluminium Sections slide on Aluminium 'Z' Section in crew compartment. The window shall have including robust type locking arrangement from inside. In equipment portion both sides shall have fixed Window. All glass windows should be covered with removable metal frame with metal net. (Should be protected from Stone).

VII. Electrical Fitments:

a) 05 Nos. Light and 02 Nos. Light Battery Operated.

b) Fan (3 nos.)

c) Tube Lights and Fans should be mounted such that its frame should not be touch or isolated from vehicle body.

VIII. Painting: Complete body of the Van will be Painted OFF WHITE colour With P.U. Paint after surface treatment.

IX. Others: Van will be fabricated as per standard fabrication practice and Specifications confirming to All India Motors Vehicles Act or any similar international act. Provisions of Standards Fitment will be kept such as First Aid Box, Fire Extinguishers, Rear Bumpers, Stephney, Cradle, Tool Box, Rear View Mirrors etc.

X. Guarantee (For VAN): Notwithstanding to that specified in this specification, the supplier is responsible to provide all necessary component for satisfactory working of the system in locating the fault in the cable. The VAN should be guarantee as per the manufacturer's specifications. The supplier shall have to offer to **NEA** the same standard Guarantee card of the principal manufacturer of the Van. Registration of the van shall in the name of purchaser.

11.0 Detailed scope of work:

The overall scope comprises of supply and installation of cable fault locating machine, training and post installation support.

(i) Supply and Installation of fault locating machine:

Supply cable fault locating system at the project office.

All the items will be in the name of **NEA** / licensed to **NEA.**

(ii) Operation and Training:

To provide classroom training to the 20 Nos. personnel of the DC where the machines are to be supplied.

The vendor will provide training to DC Personnel at in at least one or more batches. Each batch will cover 5 people. The training will be provided by trained personnel who are competent in the subject.

NOTE: One trained personnel shall be provided at their own cost for operation of the cable fault locating system for one year. During this period the person would locate cable faults as appear from time to time using fault locating machine and at the same time provide onsite training to the engineers/technicians of the Owner.
The contractor shall make their own arrangement of boarding, lodging, travel etc. for its trainer/instructor(s).

(iii) Guarantee and post installation support:

All the supplied cable fault locating machines to have comprehensive onsite guarantee (inclusive of parts and labour) for 3 6 months from the date of installation & commissioning. Post installation support as per the given service levels.

S. N.	Item	Service level
1.	General Purpose Mini-Truck/ Van Mounted Single Phase Modular Cable Fault Locating Equipment Suitable for Locating Fault on Low /Medium / High Voltage Power Cables up to 33 KV.	To be attended within 12 hours The fault to be removed within 36 hours In case the problem remains unresolved for more than 72 hours then the Machine will have to be replaced with a standby. On repair of the fault the original machine will have be replaced with the standby machine If the repair is not removed within 1 Month, then the vendor will have to supply new Machine.

(iv) Extended Guarantee:

The extended guarantee period shall be for 5 (Five) years after expiry of the initial guarantee period of 3 (Three) years. The obligation of the contractor during extended guarantee period shall be same as defined in the initial guarantee period.

We intent to award post warranty annual maintenance and repairs contract for a period of five years. The annual maintenance & repairs rate contract includes cost of labour and materials/ components. A separate performance bank guarantee must be deposited by the successful tenderer at the rate of 5% of charges quoted for five year, before completion of the initial guarantee period of five years.

This would include minimum one monitoring visit, **once in a 3 month,** by the supplier's representative.

The extended guarantee contract may broadly include the following.

(a) Scheduled **monthly** inspection and maintenance of the equipment towards preventive maintenance based on specific need of the equipment.

(b) Unscheduled on call corrective and remedial maintenance services to set right any malfunctioning of the equipment, replacement of unserviceable components, as per the nature of the complaint so that the equipment is placed in to service again. It is expected that such calls shall be attended within a period of 12 hours of receipt of such intimation from the field officers so that there is minimum down time of the equipment.

(c) The format of reporting for said visit shall be mutually finalized after issue of order.

The extended guarantee contract shall form part of supply contract.

N CIVIL WORKS

1. SITE WORKS

1.1 Work Included

Furnishing all materials equipment and labor and performing all operations required for constructing access roads so indicated on the drawings, specified herein and as evidently necessary to complete to work as given in the price schedule.

1.2 Laying of underground cable

Contractor shall furnish all construction work for under grounding of 12 kV cables. This work shall include excavation, sand filling from the top.

2.1 Work Included

Furnishing all materials, equipment and labor and perform all operations required for the design and construction of all the concrete foundations for equipment and other structures, oil containment and cable trenches, as specified herein and as evidently necessary to complete the work.

2.2 Foundation Design

2.2.1 General

The Contractor shall design all foundations specified on the bid drawings. The design shall be based on assumed soil parameters. Upon completion of the detail soil test, actual soil conditions shall be investigated and shown to be in compliance with the assumed condition.

2.2.2 Submittals

The Contractor shall submit design calculations, detail drawings and reinforcement steel schedules to the Owner/Engineer for review and comment before construction commences, Review of the foundation design by the Owner/Engineer in no way relieves the Contractor of his responsibility for an adequate foundation design, even though this Specification sets forth the basis foundation design criteria. Upon receiving the Owner's /Engineer comments, the Contractor shall submit to the Owner/ Engineer final drawings of all foundation details, including reinforcement steel schedules on drawing sheet sizes for record file.

2.2.3 Design Load

The structure design loads are defined on the structure outline drawings and the loads used to design the foundation shall be actual working loads applied to the foundations by the equipment and structures. The foundations shall be designed to resist all vertical and lateral forces, uplift forces and overturning moments with a minimum factor of safety of 1.5.

2.2.4 Bearing Loads

The Contractor shall use an allowable soil bearing pressure of 1.0kg/cm2 for the design of the foundation for the purpose of bidding, but this is only reference value. After award of contract the Contractor shall carry out detail soil test and detail design

of foundation based on the soil test result. There may be variation in the volume of work in final design compared to the bidding design, for which the Contractor will not get any extra payment.

2.2.5 Uplift and Overturning Loads

The uplift and overturning resistance of concrete spread footing shall be assumed as the weight of a volume of earth in the form of an inverted frustum of cone or pyramid. The cone of pyramid height shall be 30cm less than the depth from finish grade to the top of the concrete mat, the base area shall be the top area of the mat and the top area shall be determined by the intersection of planes starting at the mat edges and sloping outward at a 20 degree cone angle from the vertical and the horizontal plane 30 cm below finish grade.

2.2.6 Unit weight for overturning resistance

The following unit weight shall be used for design:

a) Soil …….. 12,000kg/m3

a) Concrete…… 16,00kg/m3

2.2.7 Payment

No separate or direct payment will be made to the Contractor for design works. All costs incurred in connection therewith shall be included in the lump sum bid price for the construction of various works.

2.3 Soil Test

2.3.1 Ground bearing tests

The contractor shall carry out soil tests to determine the ground bearing capacity by means of a Standard Penetrations Test and Auger Boring and tests shall be performed in accordance with the following Specifications.

a) The Contractor shall perform soil investigation work according to the approved plan and details of tests. Report on test results including various data collected during the investigation works and Contractor's recommendations, on which the design will be based, shall be approved Owner/Engineer.

b) Sub surface investigation for soil strength of foundation for structures and equipment shall conform to the following requirements.

Number of boring shall be at least 2 borings at the locations specified below:

- One at take-off structure foundation
- One at transformers foundation

c) Thin-walled tube soil sampling in accordance with ASTM D-1587-63 T shall b made at every meter for the first three meter of depth.

d) Standard penetration tests in accordance with ASTM-D-1586-64T shall be made at every meter for the first three meter of depth and every two meters fort he further depth after this-walled tube soil samples have been taken.

e) Every undisturbed sample collected from thin-walled tube shall be subject to the following series of test.

- Natural moisture content
- Atterberg limits
- Sieve analysis
- Unit weight
- Specific gravity determination
- Unconfined compression tests.

f) Accurate log of all soil strata penetration resistance test unconfined compressive strength, soil classification, ground water table and other tests result shall be recorded in the reports submitted.

The Contractor shall provide all necessary equipment, materials and personnel to prepare conduct and report the tests.

2.3.2 Payment

Payment for the contract item. Soil Testing, will be made at the lump sum price bid. Therefore, in the schedule, the price shall include compensation for all costs incurred in furnishing all materials and labor and other operations related to soil testing.

2.4 Excavation and Backfill

2.4.1 The contractor shall excavate earth, rock, stumps and all the other materials encountered as required for construction of the foundations, oil containments and trenches and drainage pipes. The Contractor shall place all suitable excavated materials in backfill or in graded embankment in the immediate area at structures. Materials found to be unsuitable for foundation backfill or grading shall be wasted and disposed of at Contractor own expense, and shall be backfilled with select borrowing material.

2.4.2 Excavation shall be maintained in a clean, safe and sound condition until completion of the foundation construction and shall be dike to prevent flooding by surface runoff. Suitable pumping equipment shall be provided and used to dewater excavation so that all installation work and backfilling is performed in the dry state. Any previously prepared foundation bearing surface that is softened by water runoff or otherwise contaminated before placement of the structure foundation shall be excavated and replaced at the Contractor’s expenses.

2.4.3 In those excavation where the base is unstable, lies below groundwater level, or has been over excavated, the Contractor shall furnished and place a layer of crushed stone, or selected backfill, or borrow to stabilize the base for placement of foundation.

2.4.4 Backfill shall be place in not greater than 20cm lifts before compaction. Each lift shall be thoroughly compacted before the following lift is placed, Pneumatic or equivalent tempers shall be used on cohesive materials: vibratory compactors shall be used on non-cohesive materials. Compaction shall achieve a density at least equal to that of the surrounding undisturbed earth. Large stones or rock fragments may be used in the backfill provided they do not interfere with proper compaction. Particles larger than 25 cm shall be placed not nearer than 0.5 m of the structure and at least 1.0m below ground surface.

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

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

2.4.7 Payment

No separate or direct payment will be made to the Contractor for excavation and backfill. All costs incurred in connection therewith shall be included in the lump sum bid prices for the construction of the various foundation types.

2.5 Foundation Construction

2.5.1 General requirement

All materials and labor required to remove and replace at his expense any materials incorporated in the work that do not conform to these Specifications.

a) The Contractor will be required to remove and replace at his expenses any materials incorporated in the work that do not conform to these Specifications.

b) The Contractors shall furnished without extra cost all materials the Owner/Engineer may be required for testing. The cost of the tests shall be borne by the Contractor.

2.5.2 Measurement

Measurement for payment for the contract item. Concrete foundation, shall be on the basis of the actual number of each type of foundation constructed by the Contractor.

2.5.3 Reference to standard specifications

Standard referred to in these specifications are as follows.

a) ASTM refers to the latest edition of publications of American Society for Testing and Materials.

b) ACI refers to the latest edition of publications of American Concrete Institute.

2.5.4 Measurement Standard

Measurement standards referred to in these Specifications, gallons shall be understood to be U.S gallons.

a) Gallons – whenever used in these Specifications, gallons shall be understood to be U.S gallons.

b) Bag- Wherever used in these Specifications, bag will be understood to mean 50 kg bags of Portland cement.

2.5.5 Concrete

The Contractor shall design and test concrete mixes which have a 28 days specified compressive strength of 210kg/sq.cm.

a) At least on month prior to the placement of any concrete, the Contractor shall test cylinders for each trial mix under both field-cured and laboratory cured conditions. The test cylinders shall be made and tested in accordance with the applicable standards. Also for every new batch of cement purchased one set of test cylinders shall be taken before two weeks of using that cement.

b) The concrete mixes be of such proportions as to produce a plastic and workable mix which will not separate during placing and will finish sell without using excessive quantities of mixing water.

c) After the test results are known for the test cylinders, the Contractor shall submit test result to Owner/Engineer then Owner/Engineer will notify the Contractor of the acceptable design mixes.

d) When placing concrete in hot weather, the recommendations of the American Concrete Institute's publication "Recommended, Practice for Hot Weather Concreting"(ACI 605) shall be followed in so far and the Owner/Engineer nay direct. The use of set retarders will be at the Owner/Engineer's discretion. For concrete placed during extremely hot weather, the aggregate shall be collected by frequent water spraying in such a manner as to utilize the cooling effect of evaporation. Concrete with a temperature of 30 deg. C high before placement will be rejected and shall be wasted at the Contractor's expense.

2.5.6 Cement

In locations where conditions do not required high sulfate resistance, cement shall conform to the requirements of ASTM C150 type 1.

a) In locations where, in the opinion of the Owner/Engineer, the conditions required the use of high sulfate resistance cement, conforming to the requirements of ASTM C150 type V shall be used without any extra cost to the Owner.

b) The aggregates shall consists of clean, natural materials or, subject to the approval of the Owner/Engineer, manufactured aggregate may be used.

c) Aggregates shall be separated into sand and coarse aggregate before being used. No pit or crusher run materials will be permitted without prior approval of the Owner/Engineer.

d) Natural fine aggregate or sand grading shall be within the following limits and the fitness modules shall be between 2.5 and 2.8.02

Sieve Size	Amount finer than each Laboratory
U.S. Std.	Sieve, Weight Percent
3/8" (9.5mm)	100

# 4 (4.75mm)	95 to 100
# 8 (2.36mm)	80 to 10
# 16 (1.16mm)	50 to 85
# 30 (600micron)	25 to 60
# 50 (300 micron)	10 to 30
# 100 (100 micron)	2 to 10

c) Natural coarse aggregate grading shall be within the following limits, depending upon the nominal size of the coarse aggregate.

U. S Standard Sieve	Nominal 1-1/2”	Nominal ¾” (19mm)
2” (50.8mm)	100	
1-1/2” (25-38mm)	95-100	
1” (25mm)		100
¾” (19mm)	35-70	90-100
3/8” (9.5mm)	10-30	20-55
No. 4 (4.75mm)	0-5	0-10

2.5.7 Slump

All the concrete shall have a maximum slump of 102 mm and minimum slump of 75 mm at the time of placing. The water-cement ratio shall be determined by consideration of the specified strength, the water reducing admixtures, the slump required for proper placement, air entraining requirements, the available and maximum allowable aggregate size and its specific gravity the fitness modulus of the fine aggregate and its specific gravity and the amount of water carried on the aggregates. The slumps and maximum sizes of aggregate as well as the computation of trail mixes shall be as described in the American concrete Institute Recommended Practice of Selecting Proportions for Concrete (ACI 613) The minimum amount of cement per cubic meter of concrete using 8mm aggregate, shall be 6 bags (300kg) for a concrete design strength of 210kg/sq. cm. But if 210 kg/cm^2 strength of 28 days concrete can not be achieved with this cement content the more cement shall be used for which the Contractor will not get nay extra payment. The proportion of all materials in the concrete shall be subjected to approval by the Owner/Engineer. The Contractor shall provide all plant and equipment necessary to determine and control the actual proportion of materials entering the batch.

a) In calculating the total water in any mix. The amount of water carried on the aggregate shall be included, the water on the aggregate shall be determined periodically by test and the amount of free water on the aggregate subtracted from the water added to the mix. In all cases the amount of water to be used shall be the minimum amount required to produce a plastic mixture of the strength specified and of the required density, uniformity and workability. The consistency of any mix shall be that required for the specific placing conditions and methods of placements.

b) Water used in mixing and curing concrete shall not more than 1,000 parts per million chlorides no more than 1,3000 parts per million sulfates, shall not have a turbidity count greater than 2,000 parts per million and shall also be free of objectionable quantities of oil and organic materials.

2.5.8 Storage of materials

Cement and aggregate shall be stored at the site of the work in such manner as to payment deterioration or instruction of foreign matter. Special care shall be taken in storing cement to keep it thoroughly dry at all times.

a) Cement that has become caked in storage in still usable only if, when pressed between the thumb and fingers, it powders readily. Otherwise, its use will not be permitted.

b) When reinforcing steel is delivered to the job in advance of the Contractor's requirements, the Contractor shall provide suitable protection in order to prevent excessive rust developing on the reinforcing steel. It will be Contractor's responsibility to remove excessive rust.

c) Before starting the foundation construction all screened aggregates and sand shall be collected and stockpiled near site. So that it is free from clay, dust and other foreign materials.

2.5.9 Concrete mixing

Before any concrete mixing is begun all equipment for mixing, transporting and placing the concrete shall be cleaned of all dirt and debris. All dirt and debris shall also be removed from the places to be occupied by the concrete.

a) All mechanical equipment shall be checked before starting a concrete placement to as certain whether or not is in good operation condition and not shall be tuned-up, repaired or replaces to the satisfaction of the Owner/Engineer.

b) When a foundation location is ready for concrete placement, the Contractor shall inform Owner/Engineer at least 24 hrs. before concrete placing time so that Owner/Engineer may inspect to assure that the excavation is free of water, mud any debris : then the bottom surface of the excavation is a well leveled and properly compacted crushes stone sub-base; that the reinforcing steel is properly secured in place; and that the form-work is properly braced.

c) Rock surface shall be as flat as possible and projecting ridges shall be leveled off before the concrete is placed or space between the ridges shall have been filled with concrete to form a horizontal surface.

d) The Contractor shall ensure that all materials that is to be embedded in the concrete has been placed before the concrete is places. The contractor shall be responsible for the accurate location of all embedded materials. Any work in accurately or improperly set shall be relocated and rest reset at the Contractor's expense.

e) All batching components of the concrete shall be accurately measured. Measuring on a weight basis is preferred however measuring on a volume basis will be allowed as long as careful controls are maintained. Weight measurements shall be made using standards batching equipment for large quantities and wheelbarrow scales for small quantities. Volume measurements shall be made in batching boxes. The batching boxes shall be as large as is practical.

f) The batch mixer shall be rotated at a speed recommended by the manufacturer and mixing shall be continued for at least one and one half (1-1/2) minutes after all materials are in the mixes, unless the size of the batch is over 1.2 cu. M. when additional mixing time shall be required as advised by the Owner/Engineer. A mechanically operated batch mixer shall be used for concrete mixing.

g) The retempering of concrete, which has partially hardened, that ism remixing with or without additional cement, aggregate or water, will not be permitted.

h) Concrete shall be conveyed from the mixer to the place of final deposit within 30 minutes by methods which will prevent the segregation or loss of the materials. After 30 minutes of mixing the mixed concrete shall be rejected and replaced by fresh concrete at contractors own expense.

i) Equipments for chuting, pumping and pneumatically conveying concrete shall be of such size and design as to insured a practically continuous flow of concrete at the delivery end without separation of the materials. The chutes shall never be on a slope that is steeper than two vertical to three horizontal. Conveying equipment shall not any aluminum parts the come in contact with the concrete.

j) When the Concrete is to be placed on hard rock or other concrete, after the existing surface has been properly cleaned and otherwise prepared the existing surface is to be wetted until it is saturated. The first batch of concrete places shall be as required. The grout shall be evenly spread on the water-saturated surface and then normal concrete shall be deposited continuously and as rapidly as practicable.

k) The concreting shall be carried on at such a rate that the concrete is at all times plastic and flows readily into the spaces between the bars and so that each layer properly mixes with its predecessor. Successive layers shall be places within 15 minutes of the proceeding layer.

l) When placing concrete with free drops over 2 meters, sufficient numbers of hoppers and trunk must be provided of a size to allow for proper placing. The trunk sections shall reach within 500mm of the bottom of the placement.

m) The concrete shall be consolidated during and after depositing by vibration, the concrete shall be thoroughly worked around reinforcement and embedded items and into corners of forms.

n) All concrete must be consolidated by means of internal vibration expect where the Owner/Engineer has given written permission to use some other method of consolidation. The type and make of vibrator must have a speed of at least 6000 vibrations per minute (VPM) when the machine is being supplied, furnish efficient transformers, compressors, etc. of approved type to operate all vibrators at the voltage, pressure etc. specified by the manufacture.

o) The Contractor shall always have at least two vibrators in operating condition at the location of the concrete placement.

p) Vibrators shall not be used to transport concrete inside the forms.

2.5.10 The Contractors shall make at least one set of concrete compressive strength test cylinders each day or for each 100 cubic meters of concrete, or as directed by the Owner/Engineer. There shall be three cylinders to a set and the cylinders shall be made in accordance with ASTM C31. Only one cylinder shall be made from any batch containing less than ½ cubic meters of concrete.

a) The Contractors shall delivery cylinders to a location designated by the Owner/Engineer where they will be tested in accordance with ASTM C39. Two of the cylinder will be tested at 28 days. If the 28-days test cylinder shall be discarded. If the 28 days tests indicated a compressive strength of less than 210 kg/sq.cm. the remaining cylinder will be tested at 90 days. The cost of the tests will be borne by the Contractor.

b) If the 90 days compressive strength indicates a compressive strength of less than 210kg/sq.cm. the Owner/Engineer will determine what remedial measures are necessary and the Contractors shall perform the remedial measures at his own expenses. The remedial measurements may include, but are not limited to, the replacement of the entire foundation, The Contractor shall also pay for any additional concrete tests including core drilling and the repairs or replacements which may result from same, which the Owner/Engineer deems necessary strength.

2.5.11 Concrete formwork

Forms shall be used, wherever necessary to confine the concrete for structures and shape it to the required lines. OR to insure contamination of the concrete by materials caving or sloughing from adjacent surfaces lest by excavation.

a) Forms shall be provided with tie rods and clamps to have sufficient strength to withstand the pressure resulting from placement and vibration of the concrete and shall be maintained rigidly in position. Forms shall be sufficiently tight to prevent loss of mortar from the concrete. Molding strips shall be places in the corners of forms so as to produce chamfered edges on permanently exposed concrete surfaces. All exposed surfaces shall be formed with plywood or steel sheathing. Unexposed surfaces may be formed with any materials of adequate strength and tightness to hold the plastic concrete in proper position and prevent the loss of mortar.

b) If plywood or steel forms are not available, the Contractor may substitute wood planking provided exposed surfaces are remove to remove ridges.

c) Before concrete is places, the surfaces of all forms shall be coated with a form oil that effectively prevents sticking and will not stain the concrete surfaces. For steel forms, form oil shall consist of refined mineral oil. For steel forms, form oil consist or refined mineral oil. For steel forms, from oil shall consist of refined mineral oil compound.

d) Forms shall be removed only after 48 hours of concreting or when the strength of the concrete is such that form removal will not result in cracking, spalling, or breaking of edges of surfaces, or other damage to the concrete. Any concrete damages by forms shall be repaired immediately.

2.5.12 Concrete finishing and curing

a) The expose top surface of all concrete foundation piers shall be wood floated and steel troweled and shall be slightly sloped to prevent the accumulation of water.

b) Immediately after the removal of forms, the holes left by form tie rod fastener shall be filled with mortar and all damaged or defective concrete shall be repaired or removed and replaced to the satisfaction of the Owner/Engineer. Improperly consolidated concrete shall be removed by chipping and the clipped openings or recesses shall be of such depth and shape are required to insure that the patching materials placed in the openings or recesses will be thoroughly keyed and bonded to the concrete. “dry pack” mortar shall be used for filling relatively deep chipped recesses with small surface dimensions. Concrete will be required for the replacement of defective concrete where surface dimension of the shipped openings or recesses are relatively large. The depth of chipped recesses for concrete patches shall extend at least 25 mm beyond the nearest reinforcing steel.

c) To insure proper curing, all concrete shall be kept moist for a period of a least ten (10) days. Burlap or and equivalent materials or a curing compound shall be applied over exposed concrete surfaces, the burlap shall be kept moist at all times.

2.5.13 Membrane curing compound

Membrane curing compound shall be applied uniformly by spray, leaving no pinholes or gaps, at a rate not to exceed 4.91 square meters per liter. The curing compound shall be applied after finishing operations are completed and surface moisture has disappeared. If forms are removed prior to 7 days placing the concrete, the uncovered surfaces shall be coated with the curing compound as specified herein.

a) Foundations shall bot be backfilled before they have been inspected by Owner/Engineer to see that they are free from surface defects and voids, or that the defects and voids have been properly repaired,

b) The foundations shall not be subjected to any loads in addition to those existing at the time of placing of the foundation concrete until the curing period has elapsed.

2.5.14 Payment

No separate or direct payment will be made to the Contractor for concrete. All costs incurred in connection therewith shall be included in the lump sum bid price for the construction of the various foundation types and trenches.

2.5.15 Torsteel reinforcing bar

All torsteel reinforcing bar shall conform to the requirement of BS 1144 or equivalent and shall fabricated in accordance with the “Manual of Standard Practice” of the concrete Reinforcing Steel Institute.

a) Mill scale rust, oil and mud shall be removed from reinforcing steel by firm rubbing with burlap or equivalent treatment before the reinforcing steel is placed.

b) The minimum center-to-center distance between parallel bars shall be two and one-half (2-1/2) times the diameter of the bars. In no case shall be clear spacing between bars be less than 25 mm not less than one -one third (1-1/3) times the nominal maximum size of coarse aggregate.

c) All reinforcing steel shall have a protective concrete cover of not less than:

1) 80mm - on the bottom of footing and on any surface of concrete that will be exposed to salt water.

2) 50mm - concrete exposed to weather or ground

d) Reinforcing steel hall be accurately located and shall be secured in position by the use of annealed iron, no less than No. 16 gauge and shall be supported in a manner that will keep the reinforcement away from the exposed concrete surfaces. Concrete blocks shall be used to support the reinforcing steel in the foundation mat: broken stones or wooden blocks shall not be used to supporting the reinforcing steel.

No separate or direct payment will be made to the Contractor for concrete Reinforcement Steel. All costs incurred in connection therewith shall be included in the lump sum bid price for the construction of the various foundation types.

2.5.16 Grouting

Grouting for seating structural steel members and equipment on foundations shall be non-shrink (not-setting) Portland cement mortal grout or a suitable commercially available grout, at the Contractor's option. Grouting shall be done under pressure by means of an expanding agent or by means of static head. Propositioning and missing of grout shall conform to the following:

a) Mortal grout containing aluminum powder as an expansive agent mixture of 1 part cement and 2 parts sand, by weight, with a water cement ratio not exceeding 0.55. The quantity of aluminum powder used shall be approximately 0.005 percent of the weight of cement, the actual quantity to be determined from tests with materials to be used, and at the temperature and under the conditions of a placement. Aluminum powder shall be blended with cement in proportions of one part powder 10-50 parts cement, by weight and the blend shall be sprinkled over the dry batch. After all ingredients are added, the batch shall be missed 3 minutes. Grout, which has not been placed within 45 minutes, shall be wasted.

b) In lieu of use of an expensive agent. Settlement shall be reduced by extending the missing period or by delaying final mixture to minimize the interval between time to placement and initial set and placement the under static header pressure. The motor grout shall be mixture of one part cement and 2.5 parts sand, with a water cement ratio of approximately 0.50 slump shall be the minimum necessary to enable placement.

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

CHAPTER 3.1

TECHNICAL DATA SHEET

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.

Technical Data Sheets
(To be completed by Bidder)

Item: Pre-stressed Concrete Pole

	Description	Unit		
1.	Manufacturer			
2.	Reference Standard			
3.	Overall Length	meters		
4.	Dimensions:		9m	11m
	- Top Width	mm		
	- Bottom Width	mm		
	- Pole thickness	mm		
5.	Weight of the pole	kg		
6.	Guaranteed minimum Transverse Failure Load	kgf		
7.	Factor of Safety			
8.	Working load at 0.6 m from top	kgf		

Signed _____

On behalf of _____

Address _____

Date _____

Technical Data Sheets

(To be completed by Bidder)

11 kV XLPE Power Cable, 3 Core, 400 sq. mm Al. Conductor, XLPE & accessories				
	DESCRIPTION	**UNIT**	**NEA REQ.**	**DATA to be Filled**
			11 kV	**11 kV**
1	Manufacturer and Country of Origin			
2	Year of manufacturing experience	Years	5	
3	Catalogue/drawing submitted		Yes	
4	Applicable standard		IEC	
5	Copies of Standards Attached		Yes	
6	Type			
7	Number of Cores	No.	3	
8	Rated Voltage	kV	11	
9	Maximum System voltage	kV	12	
10	Rated Voltage between conductor and screen	kV	12/sqrt (3)	
11	Rated Voltage between two conductors	kV	12	
12	Conductor Material		**Aluminum**	
13	Cross section of the Conductor	mm^2	**400**	
14	Cross section of each wire	mm^2		
15	No.& diameter of wire in each conductor	No./mm		
16	Class of Stranding		Class 2	
17	Operating Capacitance	µF/km	0.2	
18	Maximum Conductor Temperature	°C	90	
19	Thickness of Conductor Screen	mm	0.6	
20	Thickness of XLPE insulation	mm	3.4	
21	Thickness of Insulation Screen	mm	0.7	
22	Thickness of Copper Screen	mm	0.1	
23	Nominal Thickness of PVC Inner sheath	mm	1.3	
24	Copper Screen with water tight design	yes/no	Yes	
25	Armour Sheath provided?	yes/no	Yes	
26	Nominal Thickness of PVC Outer Sheath	mm	3.5	
27	Overall Diameter of the Cable	mm		
28	Continuous current rating at 45 deg. C. ambient			
	- in ground	A		
	- in duct	A		
29	Short circuit current			
	- 0.1 sec	kA		
	- 1.0 sec (minimum kA)	kA		
30	Electrical parameter			
	- Resistance/km			
	- Reactance/km			
	- Capacitance/km			
31	Max. Partial Discharge			
32	AC Test Voltage for 5 min.	kV		
33	Insulation Level:			
	-Power frequency Withstand Voltage	kV		
	-Impulse Withstand, Crest	kV		

34	Min. Insulation Resistance	ohms		
35	Max. Conductor DC Resistance at 20 Deg. C	Ohm/km		
36	Geometric Mean Radius (GMR) of the Cable/Conductor	mm		
37	Fire resistance treated	Yes/No	Yes	
38	Is manufacturer is ISO 9001 holder?	Yes/No	Yes	
39	ISO 9001 (with design) certificate submitted?	Yes/No	Yes	
40	Type test certificate submitted?	Yes/No	Yes	
41	User's certificate submitted?	Yes/No	Yes	
42	Standard drum length	Meter		
43	Approx. Net Weight per Meter of cable	Kg		
44	Net weight of cable in drum	Kg		
	Straight Through Joint			
45	Manufacturer and Country of Origin			
46	Year of manufacturing experience	Years		
47	Catalogue Number			
48	Copies of Governing Standards Attached		Yes	
49	Applicable standard		IEC	
50	Copies of type test attached	Yes/no		
51	Type			
52	Is Splice Kit Performed or Tape			
53	Splicing voltage level	kV	12	
54	Power frequency withstand voltage	kV	28	
55	Impulse withstand voltage(BIL)	KV	75	
56	Installation Instruction attached	Yes/No	Yes	
57	Is ISO 9001 certificate submitted?	Yes/No	Yes	
58	Technical literature/drawings submitted?	Yes/No	Yes	

Deviations from technical requirements:
Signed…….

As Representative for……

Address: ……

Technical Data Sheets

(To be completed by Bidder)

11 kV XLPE Power Cable, 3 Core, 300 sq. mm Al. Conductor, XLPE & accessories				
	DESCRIPTION	**UNIT**	**NEA REQ.**	**DATA to be Filled**
			11 kV	**11 kV**
1	Manufacturer and Country of Origin			
2	Year of manufacturing experience	Years	5	
3	Catalogue/drawing submitted		Yes	
4	Applicable standard		IEC	
5	Copies of Standards Attached		Yes	
6	Type			
7	Number of Cores	No.	3	
8	Rated Voltage	kV	11	
9	Maximum System voltage	kV	12	
10	Rated Voltage between conductor and screen	kV	12/sqrt (3)	
11	Rated Voltage between two conductors	kV	12	
12	Conductor Material		**Aluminum**	
13	Cross section of the Conductor	mm^2	**300**	
14	Cross section of each wire	mm^2		
15	No.& diameter of wire in each conductor	No./mm		
16	Class of Stranding		Class 2	
17	Operating Capacitance	µF/km	0.2	
18	Maximum Conductor Temperature	°C	90	
19	Thickness of Conductor Screen	mm	0.6	
20	Thickness of XLPE insulation	mm	3.4	
21	Thickness of Insulation Screen	mm	0.7	
22	Thickness of Copper Screen	mm	0.1	
23	Nominal Thickness of PVC Inner sheath	mm	1.3	
24	Copper Screen with water tight design	yes/no	yes	
25	Armour Sheath provided?	yes/no	yes	
26	Nominal Thickness of PVC Outer Sheath	mm	3.5	
27	Overall Diameter of the Cable	mm		
28	Continuous current rating at 45 deg. C. ambient			
	- in ground	A		
	- in duct	A		
29	Short circuit current			
	- 0.1 sec	kA		
	- 1.0 sec (minimum kA)	kA		
30	Electrical parameter			
	- Resistance/km			
	- Reactance/km			
	- Capacitance/km			
31	Max. Partial Discharge			
32	AC Test Voltage for 5 min.	kV		
33	Insulation Level:			
	-Power frequency Withstand Voltage	kV		
	-Impulse Withstand, Crest	kV		

34	Min. Insulation Resistance	ohms		
35	Max. Conductor DC Resistance at 20 Deg. C	Ohm/km		
36	Geometric Mean Radius (GMR) of the Cable/Conductor	mm		
37	Fire resistance treated	Yes/No	Yes	
38	Is manufacturer is ISO 9001 holder?	Yes/No	Yes	
39	ISO 9001 (with design) certificate submitted?	Yes/No	Yes	
40	Type test certificate submitted?	Yes/No	Yes	
41	User's certificate submitted?	Yes/No	Yes	
42	Standard drum length	Meter		
43	Approx. Net Weight per Meter of cable	Kg		
44	Net weight of cable in drum	Kg		
	Straight Through Joint			
45	Manufacturer and Country of Origin			
46	Year of manufacturing experience	Years		
47	Catalogue Number			
48	Copies of Governing Standards Attached		Yes	
49	Applicable standard		IEC	
50	Copies of type test attached	Yes/no	Yes	
51	Type			
52	Is Splice Kit Performed or Tape			
53	splicing voltage level	kV	12	
54	Power frequency withstand voltage	kV	28	
55	Impulse withstand voltage(BIL)	KV	75	
56	Installation Instruction attached	Yes/No	Yes	
57	Is ISO 9001 certificate submitted?	Yes/No	Yes	
58	Technical literature/drawings submitted?	Yes/No	Yes	

Deviations from technical requirements:
Signed……

As Representative for……

Address: ……

Technical Data Sheets

(To be completed by Bidder)

11 kV XLPE Power Cable 150 sq.mm Al. Conductor, XLPE & accessories				
	DESCRIPTION	**UNIT**	**NEA REQ.**	**DATA to be Filled**
			11 kV	**11 kV**
1	Manufacturer and Country of Origin			
2	Year of manufacturing experience	Years	5	
3	Catalogue/drawing submitted		Yes	
4	Applicable standard		IEC	
5	Copies of Standards Attached		Yes	
6	Type			
7	Number of Cores	No.	3	
8	Rated Voltage	kV	11	
9	Maximum System voltage	kV	12	
10	Rated Voltage between conductor and screen	kV	12/sqrt (3)	
11	Rated Voltage between two conductors	kV	12	
12	Conductor Material		**Aluminum**	
13	Cross section of the Conductor	mm^2	**150**	
14	Cross section of each wire	mm^2		
15	No.& diameter of wire in each conductor	No./mm		
16	Class of Stranding		Class 2	
17	Operating Capacitance	µF/km	0.2	
18	Maximum Conductor Temperature	°C	90	
19	Thickness of Conductor Screen	mm	0.6	
20	Thickness of XLPE insulation	mm	3.4	
21	Thickness of Insulation Screen	mm	0.7	
22	Thickness of Copper Screen	mm	0.1	
23	Nominal Thickness of PVC Inner sheath	mm	1.3	
24	Copper Screen with water tight design	yes/no	yes	
25	Armour Sheath provided?	yes/no	yes	
26	Nominal Thickness of PVC Outer Sheath	mm	3.5	
27	Overall Diameter of the Cable	mm		
28	Continuous current rating at 45 deg. C. ambient			
	- in ground	A		
	- in duct	A		
29	Short circuit current			
	- 0.1 sec	kA		
	- 1.0 sec (minimum kA)	kA		
30	Electrical parameter			
	- Resistance/km			
	- Reactance/km			
	- Capacitance/km			
31	Max. Partial Discharge			
32	AC Test Voltage for 5 min.	kV		
33	Insulation Level:			
	-Power frequency Withstand Voltage	kV		
	-Impulse Withstand, Crest	kV		
34	Min. Insulation Resistance	ohms		
35	Max. Conductor DC Resistance at 20 Deg. C	Ohm/km		

36	Geometric Mean Radius (GMR) of the Cable/Conductor	mm		
37	Fire resistance treated	Yes/No	Yes	
38	Is manufacturer is ISO 9001 holder?	Yes/No	Yes	
39	ISO 9001 (with design) certificate submitted?	Yes/No	Yes	
40	Type test certificate submitted?	Yes/No	Yes	
41	User's certificate submitted?	Yes/No	Yes	
42	Standard drum length	Meter		
43	Approx. Net Weight per Meter of cable	Kg		
44	Net weight of cable in drum	Kg		
	Straight Through Joint			
45	Manufacturer and Country of Origin			
46	Year of manufacturing experience	Years		
47	Catalogue Number			
48	Copies of Governing Standards Attached		Yes	
49	Applicable standard		IEC	
50	Copies of type test attached	Yes/no	Yes	
51	Type			
52	Is Splice Kit Performed or Tape			
53	splicing voltage level	kV	12	
54	Power frequency withstand voltage	kV	28	
55	Impulse withstand voltage(BIL)	KV	75	
56	Installation Instruction attached	Yes/No	Yes	
57	Is ISO 9001 certificate submitted?	Yes/No	Yes	
58	Technical literature/drawings submitted?	Yes/No	Yes	

Deviations from technical requirements:
Signed……

As Representative for……

Address: ……

Technical Data Sheets
(To be completed by Bidder)

MULTIPLE CORE LT XLPE ARMOURED CABLES.

S. No		PARTICULARS	4 CORE XLPE ARMOURED CABLES IN GROUND				
			4CX300	3.5CX185	1Cx630		
1		Manufacturer's name and works address					
2		Standard specification to which the material shall					
3		VOLTAGE GRADE.					
4		NO. OF CORES.					
5		CONDUCTOR DETAILS:					
	A	Normal cross section area of :					
		Phase Conductor (Sq.mm)					
		Neutral Conductor (Sq.mm)					
	B	No. and size of strands (in mm)of:					
		Phase Conductor (Sq.mm)					
		Neutral Conductor(Sq.mm)					
	C	SHAPE OF CONDUCTOR					
	D	Whether compacted or non-compacted					
	E	DC Resistance at 20 ^{0}c					
		Phase Conductor ohm/km					
		Neutral Conductor ohm/km					
6		INSULATION					
	1	Type					
	2	Colour					
	3	Thickness					
	A	Phase Conductor (sq.mm)					
		Nominal (mm)					
		Minimum (mm)					
	B	Neutral Conductor (Sq.mm)					
		Nominal (mm)					
		Minimum (mm)					
7		Type of inner sheathing and colour					
8		Whether Binder Tape provided					
9		Armoring					
	A	Type					
	B	Dimension (mm)					
10		Outer Sheath					
	A	Material					
	B	Thickness					
		Nominal (mm)					
		Minimum (mm)					
	C	Standard to which it Confirm					
11	A	Type and size of filler used					
	B	MIN. WT. OF FILLER IN KG./KM					
12		MAX. OVERALL DIAMETER OF THE CABLE IN MM.					
13		Nature of Packing.					
14		**DRUM**					
	A	TARE WEIGHT OF DRUM					
	B	WHETHER DRUM IS WHELL					
	C	STANDARD SPECIFICATION TO WHICH					
	D	DRUM DETAILS & DIMENSIONS					

	E	Whether 2-Full Ply Flange Construction or 2-Full Ply plus 1 Segmental layer Flange Construction.						
15		**Drum size**						
	A	Flange Diameter (d1) (mm)						
	B	Barrel Diameter (d2) (mm)						
	C	Centre hole Diameter (d3) (mm)						
	D	Overall with (L1) (mm)						
	F	Travers (L2) (mm)						
	G	Thickness of Flange						
	H	Barrel End (Supporting disc or						
		1 Diameter (mm)						
		2 Thickness (mm)						
	I	Stretchers (core carrier Planks)						
		1 Number (Min)						
		2 Thickness x width (mm)						
	J	Barrel Battens thickness (core						
	K	Barrel Middle Supports (Middle						
	L	Thickness of External Lagging.						
	16	**DETAILS OF METAL**						
		A Clamping Studs with						
		1 Numbers						
		2 Diameter (mm)						
		B Square or Round Washers						
		1 Numbers						
		2 Diameter (mm)						
		C M.S. Bushes						
		1 Numbers						
		2 Thickness of Sleeve (mm)						
		3 Dimension of Sleeve (mm						
		4 Number of Bolts						
		5 Diameters of Bolts						
		D M.S. /C.I. Centre Plate						
		1 Numbers						
		2 Diameter of Bolts (mm)						
		3 Centre Plate Bolts.						
		A Numbers						
		B Diameter of Bolts (mm)						
		E Centre Hole Diameter (mm)						
		F Minimum Weight in kg/km						
		1 Aluminum						
		2 XLPE						
		3 PVC						
		G Standard Length of cable in meter & its Tolerance						

Technical Data Sheets
(To be completed by Bidder)

ABC HT CABLES.

S No	Description	Units·	Bidder's Data
1	Type of Cable		
2.	Size of Aerial Bunched cable		
3.	Rated Voltage		
4.	System Voltage		
5.	Nominal Area of Phase Conductor		
6.	Nominal Area of Messenger		
.7.	Rated Impulse withstand voltage		
8.	Rated Power frequency withstand voltage		
9.	Phase Core		
10.	Messenger Wire		
11.	Standard length of the cable with tolerance		
12.	Maximum conductor temperature during Continuous operation		
13.	Maximum conductor temperature-during short circuit		
14.	**Phase Core(RYBN insulated)**		
a)	**Conductor**		
(i)	Material		
(ii)	No. of Cores & Nominal Size·		
(iii)	Minimum number of wires		
(iv)	Max. DC Resistance at 20 deg. C		
(v)	Shape of Conductor		
(vi)	Short Circuit current rating of conductor for 1 sec		
(vii)	Continuous current rating in air at 40 Deg. C		
b)	**Insulation**		
i)	Material		
ii)	Nominal Thickness		
iii)	Minimum Thickness		
15)	**Street light core**		
a)	**Conductor**		
i)	Material		
ii)	Nominal size		
iii)	Nominal no. of wire		
iv)	Max DC resistance at 20 deg. C		
v)	Shape of conductor		
vi)	Minimum Breaking Load		
vii)	Current carrying capacity		
viii)	Maximum short circuit for 1 sec		
b)	**Insulation**		

ABC HT CABLES

i)	Material		
ii)	Nominal thickness -		
iii)	Minimum Thickness		
15)	**Messenger Wire**		
a)	Messenger wire		
i)	Material		
ii)	Nominal size		
iii)	No. and Nominal Dia. of each strand		
iv)	App. Calculated Breaking Load		
v)	Calculated Maximum resistance at 20 deg. C		
Vi)	Shape of conductor		
16)	Core Identification		
17)	Formation of cable		
18)	Weight of messenger		
19)	Continuous current rating in air at 40DegC		
20)	Maximum conductor temperature during continuous operation		
21)	Maximum conductor temperature during Short circuit		
22)	Short circuit rating for 1 sec		
23)	Standard Drum Length		
24)	Tolerance in Drum length		

Signed _____

On behalf of _____

Address _____

Date _____

Technical Data Sheets
(To be completed by Bidder)

ABC LT CABLES.

S No	DESCRIPTION	UNITS	REQUIREMENT	
B	**Size of cable**	sq.mm	**120 mm2 (3*120+1*95+1*16 sq. mm)**	**95 mm2 (3*95+1*95+1*16 sq.**
1.	**Conductor**			
a.	No. of cores	Nos.		
b.	Maximum resistance of conductor at 20'C	ohm/km		
c.	Short circuit capacity for one second	kA		
d.	Continuous current rating at 40 deg. C	A		
e.	Minimum number of wires in the conductor	Nos.		
f.	Shape of conductor			
g.	Weight of Aluminium conductor	kg/km		
2.	**Insulation**			
a.	Nominal thickness (at any point of measurement)	mm		
b.	Minimum thickness (at any point of measurement)	mm		
4.	**Inner sheath**			
a.	Minimum thickness (at any point of measurement)	mm		
3.	**Armour**			
a.	Type of armour			
b.	Nominal Diameter (at any point of measurement)	mm		
c.	Tolerance	mm		
d.	Type of Zinc coating			
e.	Mass of Zinc coating	g/m'		
f.	Number of dips			
5.	Outer Sheath			
a.	Minimum thickness (at any point of measurement)	mm		

Technical Data Sheets

(To be completed by Bidder)

11 kV, Out Door Termination Kit

	DESCRIPTION	UNIT	NEA REQ 11 kV	DATA to be Filled 11 kV
1	Manufacturer and Country of Origin			
2	Year of manufacturing experience	Years		
3	Catalogue Number			
4	Applicable standard		IEC	
5	Copies of Applicable Standards Attached	Yes/No	yes	
6	Type			
7	Copies of type test Attached			
8	Stress relief performed	Yes/no		
9	Terminator insulation level	kV		
10	Insulation Material		XLPE	
11	Maximum design voltage	kV	12	
12	Impulse withstand voltage(BIL)	KV		
13	Installation Instruction attached	Yes/no	Yes	
14	Fire resistance treated	Yes/no	Yes	
15	Smoke resistance treated	Yes/no	Yes	
16	Is ISO 9001 certificate submitted?	Yes/No	Yes	
17	Technical literature/drawings submitted?	Yes/No	Yes	

Deviations from technical requirements:

Signed…….

As Representative for……

Address: ……

Date: ……..

Technical Data Sheets

(To be completed by Bidder)

GANG OPERATED SWITCH

S. No.	Description	Units	NEA Requirement	Bidder
1.	**Installation**			
2.	Type			
3.	**Service Voltage**	kV (rms)		
4.	**Rated Voltage**	kV(rms)		
5.	**Rated Frequency**	(Hz)		
6.	Current Carrying Capacity	**Amps**		
7.	**Rated short time current**	kA		
8	**Rated peak withstand current**	kA		
9.	**Rated line-charging breaking capacity**	**Amps**		
10.	Rated Cable charging Breaking Capacity	**Amps**		
11.	**No. of Post Per Phase**	**Nos.**		
12.	**Minimum Creepage Distance**	mm		
13.	**Phase to Phase Clearance**	mm	600	
14.	Phase to Earth Clearance	mm		
15.	**Minimum distance between post insulator c**	mm	550	
16.	No. of Poles	Nos	3	
17.	**No. of position**	Nos	2	
18.	**One Minute Power Frequency withstand** Voltage (Dry & Wet)	kV		
19.	No. of Nuts & Bolts for Current Carrying **Connector**	**Nos.**		
20.	**Maximum Current Density**	**Amps/mm**	1.6	
21.	**Minimum Cross Section for Current carrying fixed contact**	**Sq.mm**		
22.	**Length of post insulator arm**	mm	650	
23.	**Size of post insulator arm**	mm	**75x40x6**	
24.	**Operating Pipe outer Dia.**	mm	32	
25.	**Operating Pipe inner Dia.**	mm	25	
26.	Length of operating Pipe (minimum)	**meters**	4	
27.	**Length of male contact on each side**	mm	162	
28.	**Thickness of male contact**	mm	6	
29.	**Width of male contact**	mm	40	
30.	**Angle between male contact**	Deg.	120 to 150	
31.	Length of female contact	mm	105	
32.	**Thickness of female contact**	mm	5	
33.	**Width of female contact**	mm	25	

Technical Data Sheet

(to be completed by the Bidder)

LIGHTING ARRESTOR

S. No	Description	Unit	NEA requirement	To be filled by Bidder
1	Manufacturer and Country of Origin Model No.			
2	Year of manufacturing experience	Years		
3	Applicable Standards		IEC	
4	Type		Outdoor, gapless, zinc oxide	
5	Voltage rating of LA	kV	9	
6	Nominal Discharge Current	kA	10	
7	Surge counter with insulating base furnished	yes/no	Yes	
8	Minimum power frequency spark over voltage	kV		
9	Maximum 1/50 impulse spark over voltage	kV		
10	Maximum front wave spark over voltage	kV		
11	Maximum switch surge spark over voltage	kV		
12	Number of section per pole			
13	Insulation level			
13.1	Impulse withstand voltage (peak)	kV	75	
13.2	Power frequency withstand voltage (1min rms)	kV	28	
14	Creepage distance	mm	300	
15	Earth terminal and accessories provided	yes/no	Yes	
16	Surge counter	yes/no	Yes	
17	ISO 9001 holder	yes/no	Yes	
18	ISO 9001 certificate submitted	yes/no	Yes	
19	Type test certificate submitted	yes/no	Yes	

Signed……..

As Representative for……..

Address……

Date……

Technical Data Sheet

(To Be Completed By the Bidder)

FLEXIBLE PIPE

	DESCRIPTION	UNIT	NEA REQ 11 kV	DATA to be Filled 11 kV
1	Manufacturer and Country of Origin			
2	Applicable standard			
3	Type		Corrugated hard polyethylene	
4	diameter of the pipe	mm		
5	Tensile Strength			
6	Compressive strength			
7	Bending Strength			
8	Technical Literature submitted	Yes/No	yes	
9	Type test certificate submitted	Yes/No	yes	
10	Technical literature/drawings submitted?	Yes/No	Yes	

Deviations from technical requirements:

Signed…….
As Representative for……
Address……...
Date…….

(To Be Completed By the Bidder)
(Use separate sheets for different RMUs)

Item: 11KV SF6 EXTENSIBLE/ Non Extensible RMU

Sr. No	Description	11 kV	Offered Data
1.0	SWITCHGEAR ASSEMBLY		
1.1	Make	Manufacturer to give details	
1.2	Type	Outdoor	
1.3	Reference Standard	IEC 56, IEC 129, IEC298, IEC694, IEC 265	
1.4	Voltage (Normal/Max.) kV	11kV/12 kV	
1.5	Phase (Nos.)	3 nos	
1.6	Frequency (HZ)	50 ± 3 Hz	
1.7	Short Circuit rating		
	a) Breaking Symmetrical (KA)	20 kA	
	b) Breaking Asymmetrical (KA)	20 kA	
	c) Short time for 1 Sec. (KA)	20 kA	
	d) Short time for 3 Sec. (KA)	20 kA	
1.8	Insulation Level		
	a) Impulse withstand (KV peak)	75 kVp	
	b) 1 Minute 50 Hz. Voltage withstand	28 kV	
1.9	Metal Clad Construction	Yes	
1.10	a) Degree of protection for outer enclosure b) Degree of protection for main tank :	IP 54 IP 67	
2.0	CONSTRUCTION		
2.1	Overall Dimensions	Mfg. to give details	
2.2	Overall Weight of RMU Unit	Mfg. to give details	
3.0	Bus bar		
3.1	Make	Mfg. to give details	
3.2	Material & Grade	Copper	
3.3	Reference Standard	IEC 129	
3.4	a) Cross sectional area (mm2)	400 sq.mm	
3.5	Continuous Current		
	a) Standard	630 A	
	b) At site conditions and within cubicle	630A	
3.6	Maximum temperature rise over ambient (c)	55 °C (above ambient of 50	
3.7	Short time current for 1 Sec. (kA)	20	
3.8	Minimum clearance from bare bus bar	Mfg. to give details	
	a) Phase to phase (mm)		

	b) Phase to Earth (mm)		
3.11	Bus Bar support spacing (mm)		
3.12	Bus support insulators		
	a) Make b) Type		
	d) Voltage Class (KV)		
	e) Minimum creepage distance		
	f) Cantilever strength Kg/mm2		
3.13	SF6 gas pressure (filing pressure at 20	Mfg. to give details	
4.0	SF6/VCB CIRCUIT BREAKER		
4.1	Make	Mfg. to give details	
4.2	Type (Vacuum/ SF6)	Mfg. to give details	
4.3	Reference Standard	IEC 56	
4.4	Rated Voltage	11 kV	
4.5	Rated Frequency	50 Hz	
4.6	No. Of Poles	3	
4.7	Rated Current		
	a) Normal (Standard) Amps	400 A	
	b) Rated (Site) Amps	400 A	
4.8	Maximum temperatures rise over ambient.(deg. C)	55 °C (above ambient of 50	
4.9	Rated operating Duty	O- 3min- CO-3min-CO	
4.13	a) Short time current for 1 Sec.(KA rms)	20	
	b) Short time current for 3 Sec.(KA rms)	20	
4.14	Transient Recovery Voltage		
	a) Rate of rise (KV/ms)	0.34 KV/micro sec(as per IEC)	
	b) Peak Voltage (KV)	23 (35 % DC component)	
4.17	Opening time Maximum No load condition (ms)	40-60	
4.18	Opening and closing time under SF6 gas loss or vacuum loss condition (ms)	40-60	
4.19	At 100% Breaking capacity		
	a) Opening time – max (ms)	40-60	
	b) Arcing time – max (ms)	6-9	

	c) Total break time (ms)	40-60	
4.20	At 60% Breaking capacity		
	a) Opening time – max (ms)	40-60	
	b) Arcing time – max (ms)	6-9	
	c) Total break time (ms)	40-60	
4.23	Number of breaks per pole	Single	
4.24	No of breaker operations permissible without requiring inspection replacement of contacts		
	a) At 100% rated current	2000 & 40 Nos at 20 kA	
	b) At 100% rated breaking current		
4.25	Type of contacts		
	a) Main	Copper chromium, Butt type	
	b) Arcing	Copper chromium	
4.26	Material of contacts		
	a) Main	Copper chromium	
	b) Arching	NA for VCB 1260 N (126 kg)	
	c) Whether contacts silver plated	NA	
	d) Thickness of silver plating	NA	
4.27	Operating mechanism- closing		
	a) Type	STORED ENERGY	
	b) No of breaker operations stored	One Tripp free	
	C) Trip free or fixed trip	NA (Anti reflex on Earthing)	
	d) Anti pumping features provided		
	e) Earthing for operating mechanism	Mfg. to give details	
	f) Earth terminal size and material	Mfg. to give details	
4.28	Operating mechanism- tripping		
	a) Type	Mfg. to give details	
	b) No of breaker operations stored	One	
	c) Trip free or fixed trip (V)	Trip free	
	d) Anti pumping features provided (%)	NA	
	e) Earthing for operating mechanism	Mfg. to give details	
	f) Earth terminal size and material		
4.29	Spring charging mechanism		

	2) Make		
	3) Type		
	4) Size		
	5) Rating		
4.30	Breaker suitable for capacity switching 4 operating duty 5Max.rating of capacitor bank that	Yes	
4.31	Tripping coil		
	a) Voltage		
	b) Permissible voltage variation (%)		
	c) Tripping current at rated voltage (A)		
	d) Power at rated voltage (W)		
	e) 2-Over current trip with TLF (5A) and 1-earth fault furnished as specified		
4.32	Breaker /Accessories such as control switch indication Lamps etc. furnished as specified :(please attach separate sheet giving details of all accessories, inter locks and safety shutters)		
	a) Mechanical safety Interlock	Yes	
	b) Automatic Safety Interlock	No	
	C) Operational Interlock	Yes	
	d) Emergency manual trip	Yes	
	e) Operation counter	Yes	
	f) Charge /discharge indicator	Yes	
	g) Manual spring charging facility	Yes	
4.33	Impact load foundation design (to include dead load plus impact value On opening at maximum	Mfg. to give details	
5.0	Isolators		
5.1	Make	Mfg. to give details	
5.2	Type	Mfg. to give details	
5.3	Reference standard	IEC129	
5.4	Rated voltage (KV)	12	
5.5	Rated Frequency HZ	50	
5.6	No. Of poles (No)	3	
5.7	Rated current		
	Normal (Standard) Amps	630	
	Derated (site) Amp	630	

5.8	Maximum temperature rise over ambient Deg. C	55 °C (above ambient of 50 °C)	
5.9	Rated operation duty	O – 3min-CO-3min-CO	
5.10	Rupturing Capacity at rated voltage MVA	Mfg. to give details	
5.11	Rated making current KA peak	Mfg. to give details	
5.12	Short time current		
	a) For 1 sec KA rms	20	
	b) For 3 sec KA rms	20	
5.13	Impulse voltage withstand on 1/50 full	75	
5.14	Maximum over voltage factor when switching off a) Loaded feeder cable	Mfg. to give details	
5.15	Operating SF6 Gas pressure		
5.16	No of isolator operation permissible without requiring inspection, replacement of contacts and other main parts At 100% rated current At 100% rated breaking current	Yes	
5.17	Isolator provided with the following Mechanical safety Mechanical ON, OFF, CABLE EARTH indicators Operation counter Manual spring charging facility	Yes	
5.18	Impact load for foundation design (To include dead load plus impact Values on opening at maximum interrupting rating) Kg	Mfg. to give details	
6.0	CURRENT TRANSFORMER		
6.1	Make	Mfg. to give details	
6.2	Type & voltage level	Mfg. to give details	
6.3	Reference standard	IEC 298	
6.4	C.T. ratio as specified	100-50/1 A	
6.5	Rated frequency	50	
6.6	Short circuit withstand Short time current for 1 sec. kA rms Short time current for 3 sec. KA rms	Mfg. to give details	

6.7	Class of insulation	Mfg. to give details	
6.8	Temperature rises over ambient. Deg.		
6.9	Basic insulation level		
6.10	For tripping CT RATIO Class of accuracy		
	Rated Burden VA		
	Knee Point Voltage V		
	Excitation Current at Vk/2 Amps		
	Rated Saturating Current Amps		
	Over Current Rating		
	Continuous % Over Load %		
7.0	Cable terminations		
7.1	Circuit Breaker		
	Type		
	Materials		
	Dimensions		
	Size		
	Height of Cable box from ground Level		
	Arrangement for supplying bus end cable box furnished for extensible ring main Unit	Mfg. to give details	
	Arrangement for mounting an extra cable box on each equipment furnished		
7.2	Isolator		
	Type		
	Materials		
	Dimensions		
	Size		
	Height of Cable box from ground Level		
	Arrangement for supplying bus end cable box furnished for extensible ring main Unit		
	Arrangement for mounting an extra cable box on each equipment furnished	Mfg. to give details	
8.0	Name Plate		
8.1	Material		

8.2	Thickness		
8.3	Size for		
	Breaker Cubicle		
	Instruments / Devices		
9.0	Painting		
9.1	Finish of Breaker		
	Inside		
	Outside		
9.2	Finish of Isolator		
	Inside		
	Outside		
10.0	Drawing / Data		
10.1	General arrangement for Panel Board	Mfg. to give details	
	Arrangement for mounting an extra cable box on each equipment furnished		

Signed……..
As Representative for……
Address……...
Date……..

Technical Data Sheet
(To Be Completed By the Bidder)

Technical Data Sheet of LT Feeder Panel with ACB

S. No.	Parameter Name	Offered Data
1.	Name or Trademark of Manufacturer.	
2.	Type of L.T. Pillar	
3.	Rated normal voltage	
4.	Material of construction of L. T. Pillar enclosure & doors	
5.	Thickness of SMC sheet / M.S.sheet for enclosure	
6.	Thickness of SMC sheet for doors	
7.	Colour of the L. T. Pillar enclosure	
8.	Dimensions of cubicle without rain hood – Width x Depth x Height (in mm)	
9.	Dimensions of rain hood – Width x Depth x Height of centre lift (in mm)	
10	Fiberglass Reinforced Plastic Sheet Moulding	
10(a)	Material (Thermosetting Plastic)	
10(b)	Grade of material (SMC)	
10(c)	Grade of material for frame (FRP Pultruded sections)	
10(d)	Heat deflection Temperature (min 150ºC)	
10(e)	Exposure to flame (Self-Extinguishing)	
10 (f)	Melting Point (Does not melt)	
10(g)	Fiberglass reinforcement (Minimum 25%)	
10(h)	Density of Fiberglass materials (450 gms. Per sq. m.)	
10 (i)	Maximum permissible Temperature(≥ 90º C)	
10 (j)	Door material (U.V. resistant & resistant to salty & humid atmosphere)	
10(k)	Insulation Resistance	
10 (l)	Specific Gravity of SMC material (1.8)	
10 m	Dielectric Strength (12kV /mm)	
10(n)	Tensile Strength (1058 Kg/sq.cm)	
10(o)	Cross Breaking Strength (1723 Kg/sq.cm)	
10(p)	Shear Strength (879 Kg/sq.cm)	
11	Hinges	
11(a)	Hinges : Type	
11(b)	Hinges : Length (50mm)	
11(c)	Hinges : Thickness of material	
11(d)	Hinges : pin Diameter	
11(e)	Number of hinges per door	
12	Type of locking arrangements	
13	Number of padlocking arrangements	
14	Number and size of ventilating louvers with wire mesh	
15	Details of painting	
16	Dimensions and details of asbestos sheets	
17	Dimensions and details of bakelite sheets	
18	Dimensions and details of gland plates	
19	Bus Bar, Fuse Base & Fuse Link	
19(a)	Size of bus bar	

19(b)	Size of neutral bus bar	
19(c)	Grade and specification of material of Bus bars	
19(d)	Rated normal current of Bus bars	
19(e)	Rated safe temperature of Bus bars	
19(f)	Make & Type of Fuse base assembly	
19(g)	Grade and specification of material of Fuse base	
19(h)	Thickness and dimensions of contacts of fuse base	
19(i)	Rated normal current of Fuse base	
19(k)	Make & Type of Fuse link	
19(l)	Rated normal current of Fuse link	
19(m)	Rated safe temperature of Fuse link	
20	Air Circuit Breaker	
20(a)	Make & Type	
20(b)	Rated Voltage (440V)	
20©	Rated Current (800/1000/1200 Amps as per requirement)	
20(d)	Rated Frequency (Hz)	

Signed……..
As Representative for……
Address……
Date……..

Technical Data Sheet

(To Be Completed By the Bidder)

High voltage Warning/Danger Plate

	DESCRIPTION	UNIT	NEA REQ	DATA to be Filled
1	Manufacturer			
2	Applicable standard			
3	Type of Material			
4	Size			
9	Technical literature/drawings submitted?	Yes/No	Yes	

Deviations from technical requirements:

Signed……..

As Representative for……

Address……..

Date…….

Technical Data Sheet

(To be completed by the Bidder)

Item: Transformer Platform

Description	***Unit***
1. Manufacturer	
2. Preliminary details drawing 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 _____

Technical Data Sheet

(To be completed by Bidder)

Item: Pole Clamps

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

Signed _____

On behalf of _____

Address _____

Date _____

Technical Data Sheet

(To be completed by Bidder)

Item: Ground (Earth Rods and Clamps)

Description	*Unit*
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 _____

Technical Data Sheet

(To be completed by Bidder)

Item: Grounding Conductor

Description	*Unit*
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 _____

TECHNICAL DATA SHEET
(To be completed by Bidder)

Item: Galvanized Steel Nuts and Bolts

	Description	*Unit*
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……..
As Representative for……
Address……
Date……..

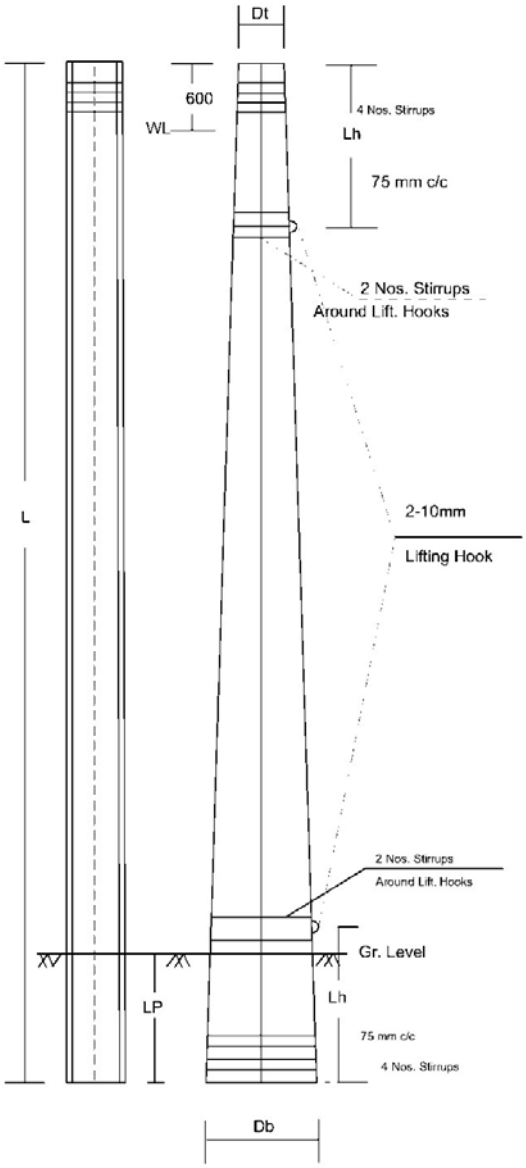
TECHNICAL DATA SHEET

(To be completed by Bidder)

48 Fiber unarmoured Underground Optical Fiber Cable

S.No.	Parameter	Unit	Value	To be filled by the Bidder
1	Fiber Description		Dual –Window Single - Mode	
2	MFD at 1310 MFD at 1550	µm	9.2+/-0.4 10.4 +/-0.6	
3	Core Diameter	µm	8.3	
4	Cladding Diameter	µm	125±2	
5	Cladding non-circularity	%	≤1	
6	Mode Field concentricity	µm	≤0.6 (Nominal 0.25)	
7	Attenuation (Fiber)	dB/Km		
	@1310		≤0.350	
	@1550		≤0.220	
	@1625		≤0.240	
8	Attenuation (Cabled)	db/Km		
	@1310		≤0.350	
	@1550		≤0.220	
	@1625		≤0.240	
9	Chromatic dispersion	Ps/nm.km		
	In 1288-1339		3.50	
	In 1271-1360		5.3	
	@1550		20	
10	PMD @ 1310 & 1550 Cabled	Ps/sq. root km		
	Individual fiber		≤0.2 (Nominal 0.1)	
	Link design value		≤0.1	
11	Zero Dispersion slope	Ps/(nm2.km)	≤0.092	
12	Water peak at 1383+3 nm	Db/km	≤1.0 (Nominal 0.5)	
	Water peak at 1385 nm	Db/km	≤0.310	
13	Zero Dispersion Wave	Nm	1300-1324	
14	Point Discontinuity	Db	≤0.05 at 1310, 1550 &	
15	Fiber Cut-Off	Nm	≤1320 (Nominal	
	Cable Cut-Off		≤1260	
16	Attenuation Vs Wavelength		Ref ƛ are 1310 & 1550	
	1285-1330 nm	Db/km	≤0.05 (Nominal 0.03)	
	1525-1575 nm		≤0.05 (Nominal 0.03)	
17	Refractive Vs Differences	%	Please Specify	
18	Effective group index of Refraction		Please specify Neff @ Nominal	
19	Coating geometry dia	Um	245+/-10	
20	Coating/cladding concentricity	Um	≤12	

Construction Standard Drawings



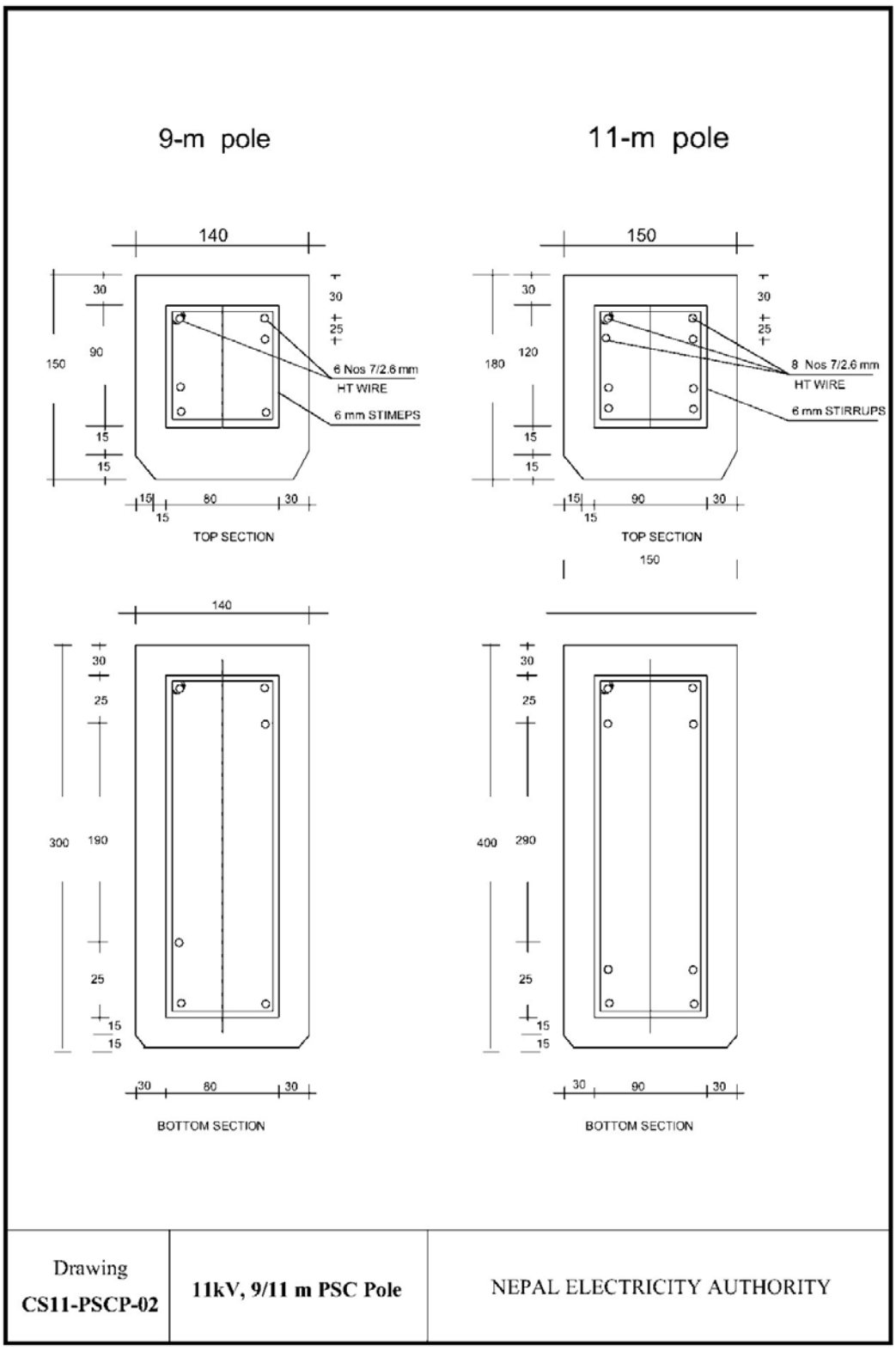
TECHNICAL PARTICULARS

ITEM	9 m Pole	11 m Pole
L(m)	9	11
Wl(kg)	200	350
W(mm)	140	150
Dt(mm)	150	180
Db(mm)	300	400
Lp(mm)	1500	1800
Lh(mm)	1750	2000
HT Wires (Nos.)	6	8
HT Wires Size (No/mm)	7/2.6	7/2.6
Concrete Cu.m.	0.2835	0.4785
W(kg)	680.4	1150.0

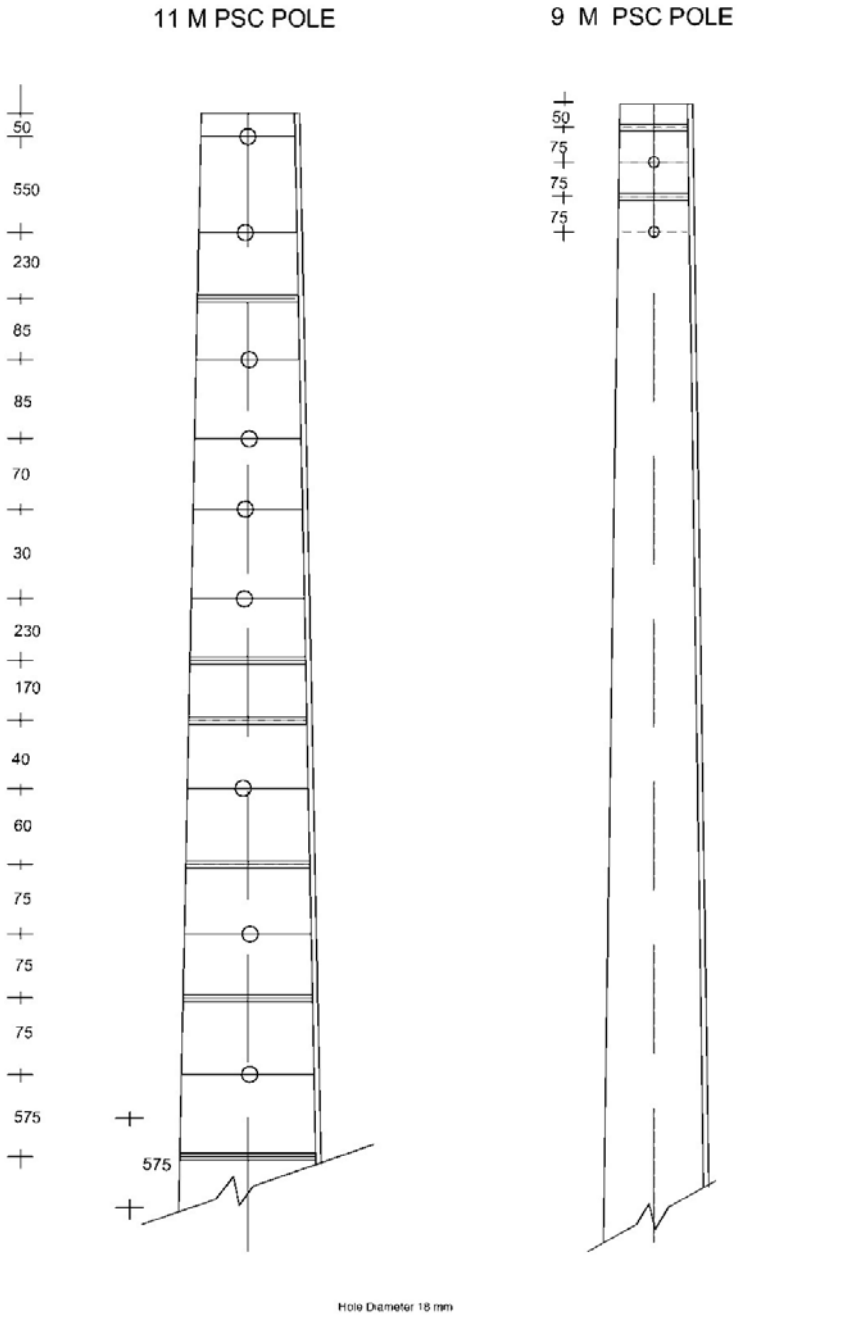
NOTES

1- All dimension are in mm.
2- Grade of Concrete M 400(Min).
3- Load Factor 2.5.
4- Release strength 250 kg/sq.cm(Min).
5- Chamfer 15mm shall be provided at bottom edge.
6- 12 Nos. stirrups(6mm MS) shall be provided with 4 nos. at each end, two nos. on sides of lifting hooks as shown.
7- Stirrups provided for end spitting tensile strength.
8- Hooks locations made equidistant from ends for operational convinience.
9- Dimensional Tolerances.
Length ± 15mm
Width ± 3mm

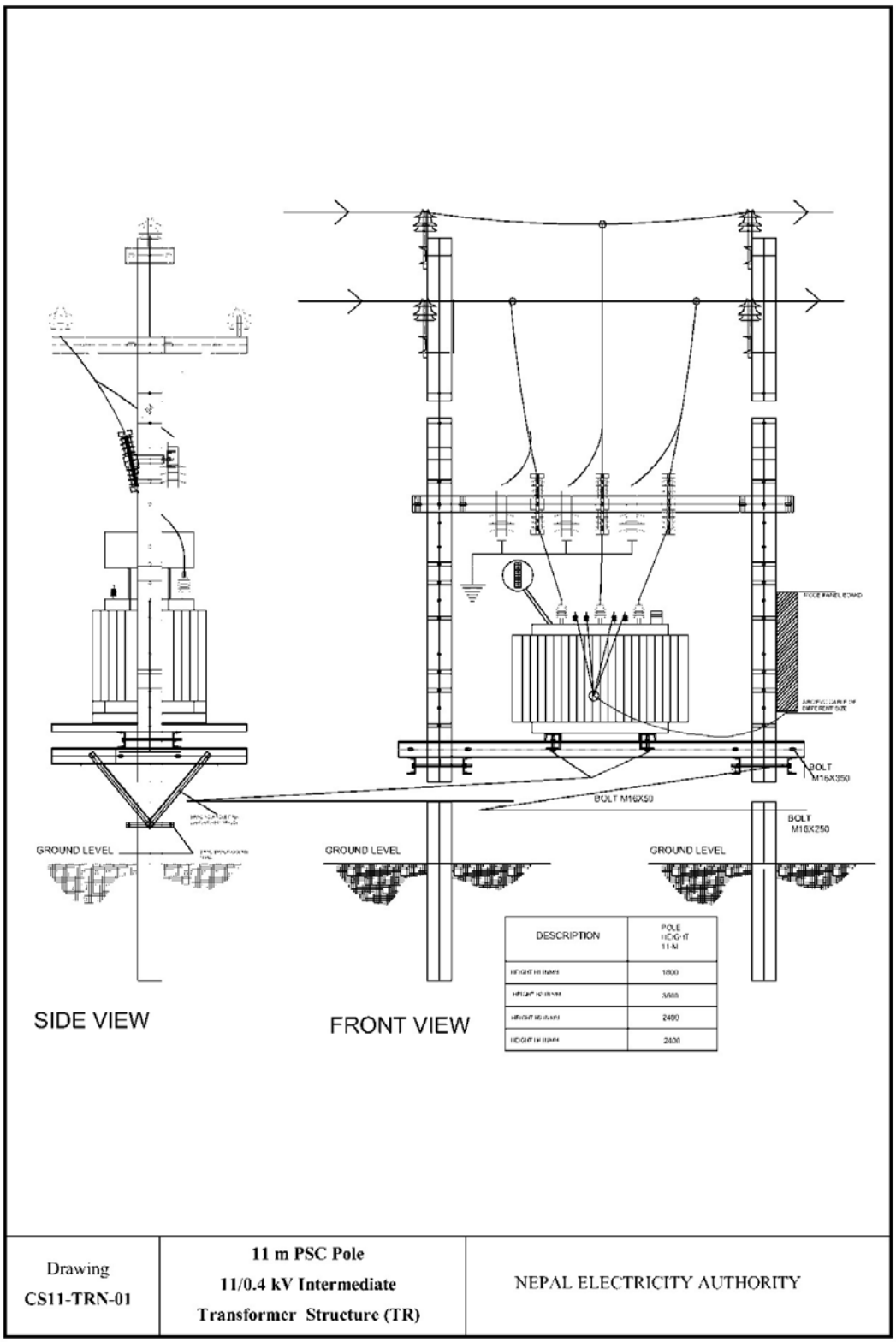
Drawing CS11-PSCP-01	11kV, 10/11 m PSC Pole Pole Details	NEPAL ELECTRICITY AUTHORITY



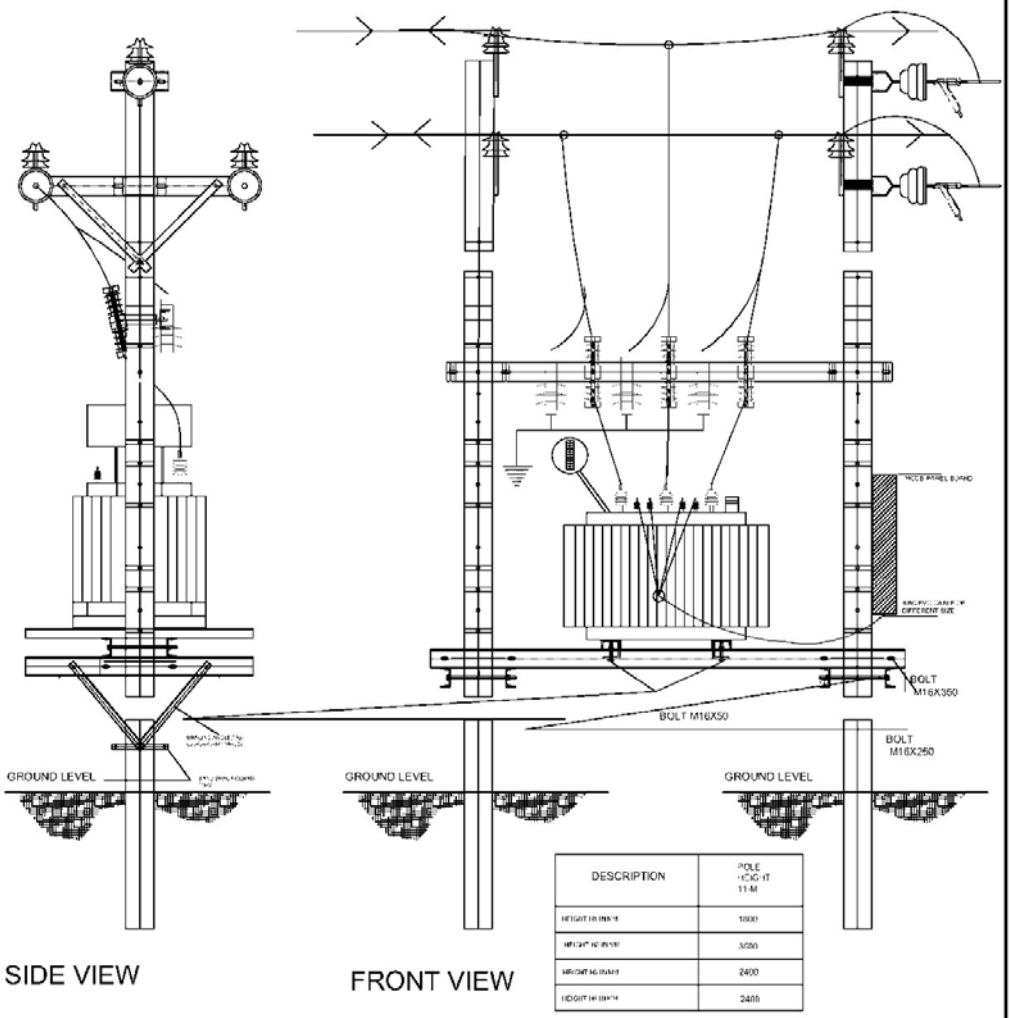
Drawing **CS11-PSCP-02**	**11kV, 9/11 m PSC Pole**	NEPAL ELECTRICITY AUTHORITY



Drawing	11m / 9m PSC Pole	NEPAL ELECTRICITY AUTHORITY
CS11-PSCP-03	Hole Patterns	

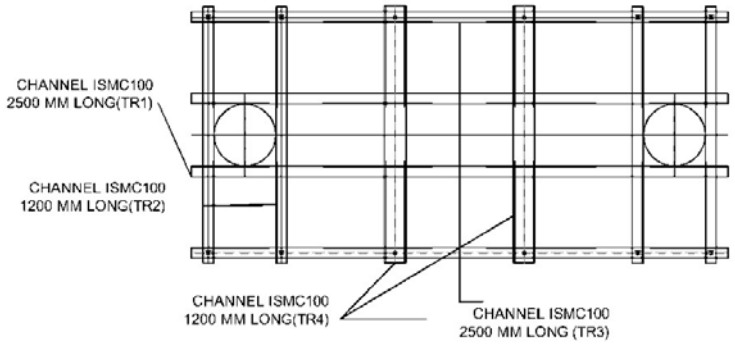


Drawing	11 m PSC Pole 11/0.4 kV Intermediate Transformer Structure (TR)	NEPAL ELECTRICITY AUTHORITY
CS11-TRN-01		

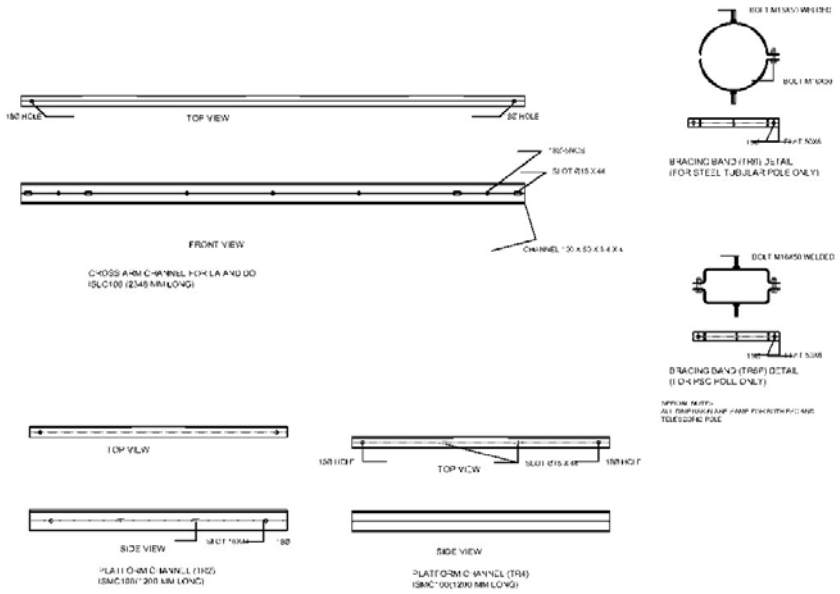


Drawing **CS11-TRN-02**	**11 m PSC Pole** **11/0.4 kV Dead End** **Transformer Structure (TR)**	NEPAL ELECTRICITY AUTHORITY

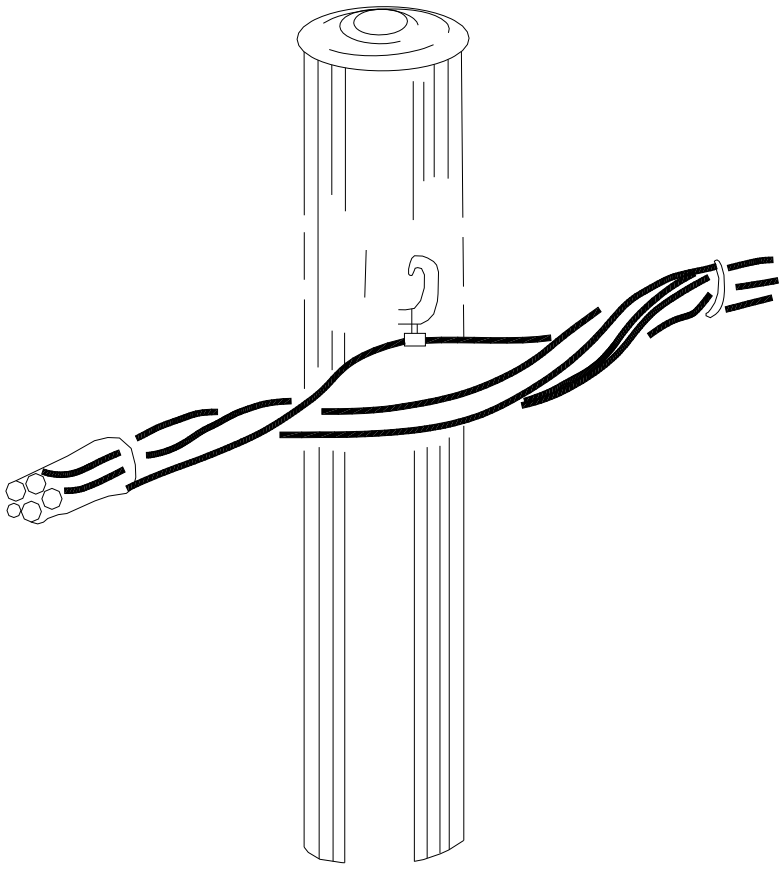
				Refer Drawing No: CS11 - TRN -	01 - 04
	S.No.	**QTY.**	**UNIT**	**MATERIAL**	
	1	6	NOS	PIN INSULATOR WITH PIN AND NUTS/WASHER	
	2	2	NOS	STEEL CROSSARM CHANNEL(50x100x6.4 x300) mm.	
	3	2	NOS	POLE CLAMP WITH NUTS, BOLTS AND WASHERS (PC1)	
	4	2	NOS	STEEL CROSSARM CHANNEL(500x100x 6.4 x 1200) mm.	
	5	2	NOS	POLE CLAMP WITH NUTS, BOLTS AND WASHERS (PC2)	
	6	4	NOS	FLAT CROSS ARM	
	7	3	NOS	9 kV SURGE ARRESTOR	
	8	3	NOS	DISTRIBUTION CUTOUT WITH FUSE HOLDERS	
	9	1	NOS	CHANNEL FOR LA & DO ISLC 1002348 MM	
	10	2	NOS	PLATFORM CHANNEL (TR1) ISMC 100 2500 MM	
	11	2	NOS	PLATFORM CHANNEL (TR3) ISMC 100 2500 MM	
	12	4	NOS	PLATFORM CHANNEL (TR2) ISMC 100 1200 MM	
	13	2	NOS	PLATFORM CHANNEL (TR4) ISMC 100 1200 MM	
	14	8	NOS	BRACING ANGLE (TR5) 50 X 50 X 5841 MM	
	15	2	SET	BRACING BAND (TR6 OR TR6P) WITH 2-M16 BOLT, 2-M16 X 50 BOLT, 8-M16 NUT, 8-M16 WASHER	
	16	16	NOS	M16 X 50 BOLT WITH 2-M16 NUT, 2-M16 WASHER	
	17	8-STTP 12-PSC	NOS	M16 X 250 BOLT WITH 2-M16 NUT, 2-M16 WASHER	
	18	8-STTP 12-PSC	NOS	M16 X 350 BOLT WITH 2-M16 NUT, 2-M16 WASHER	
	19	1	NOS	TRANSFORMER	
	20	3	NOS	TRANSFORMER EARTHING	
	21	AS REQ.	M	GROUNDING CONDUCTOR (COPPER)	
	22	6	NOS	PREFORM TIES	
	23	2	NOS	STEEL TUBULAR POLE/ PSC POLE	
CONSTRUCTION STANDARDS				**NEPAL ELECTRICITY AUTHORITY**	
11/0.4 kV TRANSFORMER STRUCTURE					
TELESCOPIC/PSC POLE (INTERMEDIATE)					



TRANSFORMER PLAT-FORM TOP VIEW



Drawing CS11-TRN-05	**Transformer Platform and Accessories**	NEPAL ELECTRICITY AUTHORITY

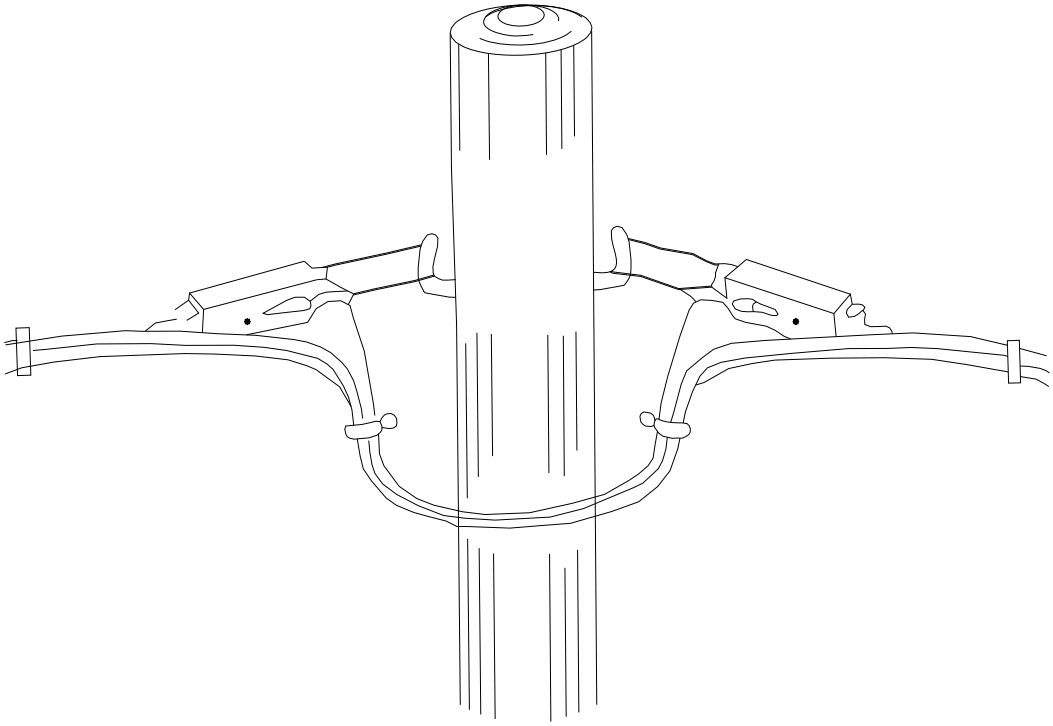


ANNEX L TYPICAL DRAWING	SUSPENSION ASSEMBLY TYPE "A 1"	NEPAL ELECTRICITY AUTHORITY

For PSC Pole

S.NO.	QTY.	UNIT	MATERIAL
1	1	NOS	SUSPENSION CLAMP
2	1 for STP 0 for PSC	NOS	POLE CLAMP WITH NUTS, BOLTS AND WASHERS (TC8)
3	1 for PSC 0 for STP	NOS	PIGTAIL WITH HEXAGONAL NUTS AND WASHERS (16 X 203) MM
4	1	NOS	POLE 9 METER

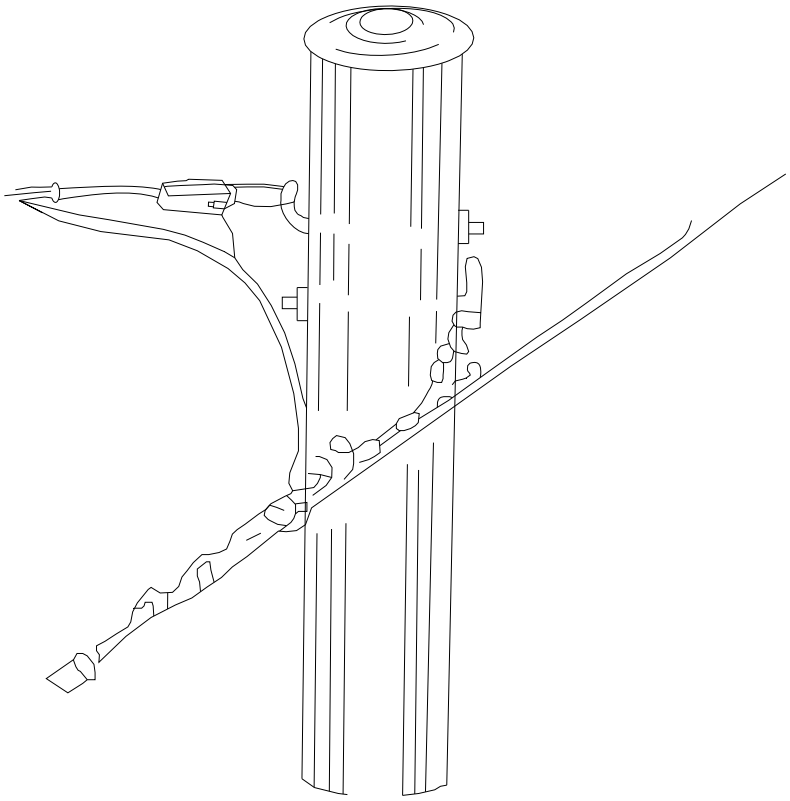
CONSTRUCTION STANDARDS **LV TYPE – A1 (Suspension Type)**	**NEPAL ELECTRICITY AUTHORITY**



ANNEX L TYPICAL DRAWING	ANGLE ASSEMBLY OVER 90° TYPE "A 2"	NEPAL ELECTRICITY AUTHORITY

S.NO.	QTY.	UNIT	MATERIAL
1	2	NOS	ANCHOR CLAMP
2	2 for PSC 0 for STP	NOS	PIGTAIL WITH HEXAGONAL NUTS AND WASHERS (16 X 203) MM
3	2 for PSC 0 for STP	NOS	EYE NUT
4	2 for STP 0 for PSC	NOS	POLE CLAMP WITH NUTS, BOLTS AND WASHERS (TC8)
5	1	NOS	POLE 9 METER
6	1	SET	LT STAY SET

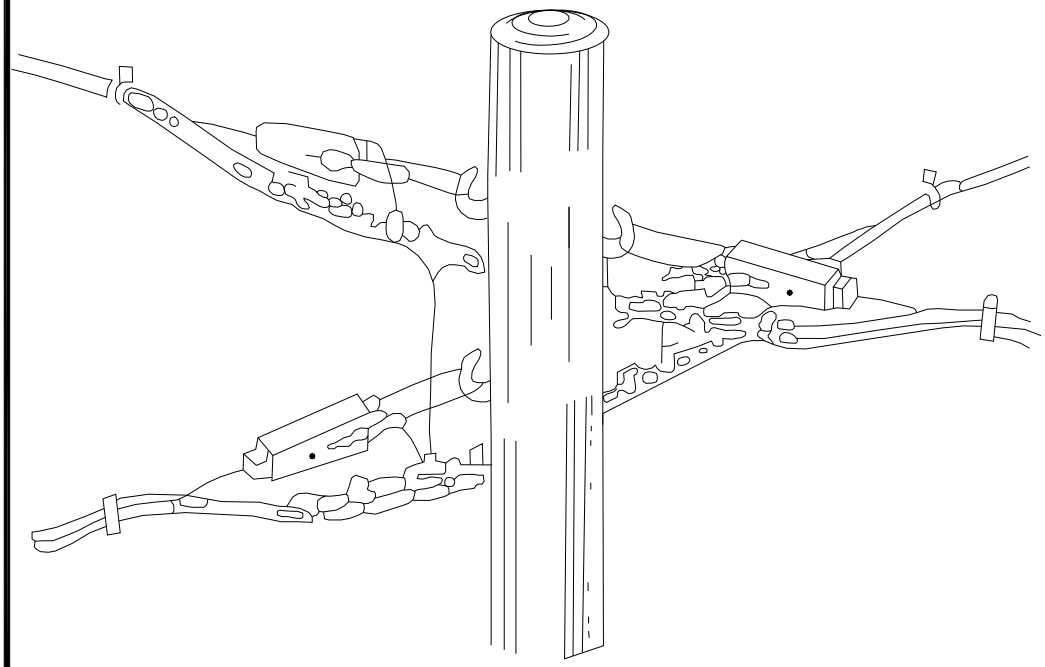
CONSTRUCTION STANDARDS LV TYPE – A2 (Suspension Type with Angle)	**NEPAL ELECTRICITY AUTHORITY**



ANNEX L TYPICAL DRAWING	INTERMIDIATE TAP TYPE "B"	NEPAL ELECTRICITY AUTHORITY

S.NO.	QTY.	UNIT	MATERIAL
1	1	NOS	SUSPENSION CLAMP
2	1	NOS	ANCHOR CLAMP
3	2 for PSC 0 for STP	NOS	PIGTAIL WITH HEXAGONAL NUTS AND WASHERS (16 X 203) MM
4	1 for PSC 0 for STP	NOS	EYE NUT
5	2 for STP 0 for PSC	NOS	POLE CLAMP WITH NUTS, BOLTS AND WASHERS (TC8)
6	5	NOS	INSULATED PIERCING CONNECTOR
7	5	NOS	INSULATED CABLE CAPS
8	1	NOS	POLE 9 METER
9	1	SET	LT STAY

CONSTRUCTION STANDARDS **LV TYPE - B (Suspension with an Anchor for Dead)**	**NEPAL ELECTRICITY AUTHORITY**



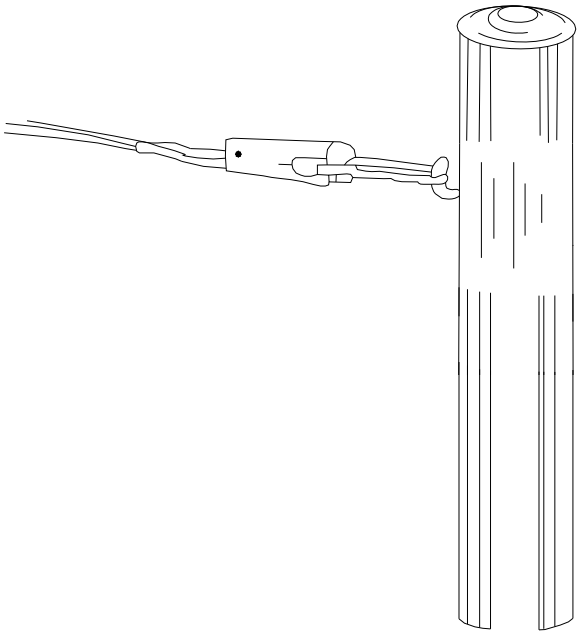
ANNEX L TYPICAL DRAWING	**LV Type 'C'** DOUBLE DEAD END WITH TAPS	NEPAL ELECTRICITY AUTHORITY

S.NO.	QTY.	UNIT	MATERIAL
1	4	NOS	ANCHOR CLAMP
2	2 for PSC 0 for STP	NOS	PIGTAIL WITH HEXAGONAL NUTS AND WASHERS (16 X 203) MM
3	1 for PSC 0 for STP	NOS	EYE NUT
4	2 for STP 0 for PSC	NOS	POLE CLAMP WITH NUTS, BOLTS AND WASHERS (TC8)
5	15	NOS	INSULATED PIERCING CONNECTOR
6	20	NOS	INSULATED CABLE CAPS
7	1	NOS	POLE 9 METER

CONSTRUCTION STANDARDS **LV TYPE - C (Four Anchor Dead End)**	**NEPAL ELECTRICITY AUTHORITY**

S.NO.	QTY.	UNIT	MATERIAL
1	1	NOS	SUSPENSION CLAMP
2	2	NOS	ANCHOR CLAMP
3	2 for PSC 0 for STP	NOS	PIGTAIL WITH HEXAGONAL NUTS AND WASHERS (16 X 203) MM
4	2 for PSC 0 for STP	NOS	EYE NUT
5	2 for STP 0 for PSC	NOS	POLE CLAMP WITH NUTS, BOLTS AND WASHERS (TC8)
6	10	NOS	INSULATED PIERCING CONNECTOR
7	10	NOS	INSULATED CABLE CAPS
8	1	NOS	POLE 9 METER

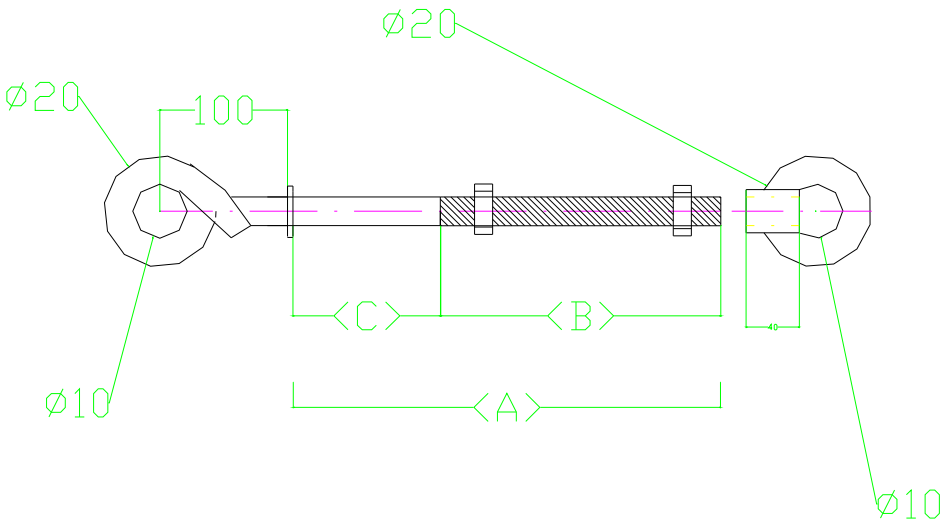
CONSTRUCTION STANDARDS **LV TYPE - D (One Suspension with two anchor dead end)**	**NEPAL ELECTRICITY AUTHORITY**



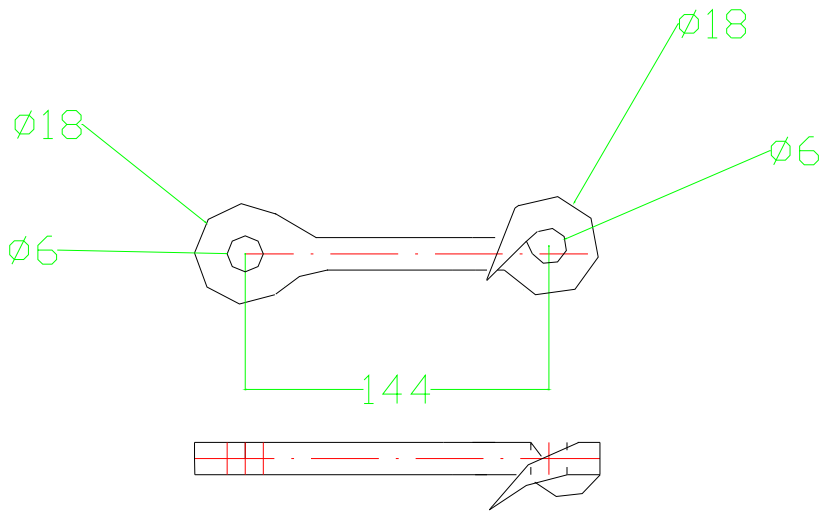
ANNEX L TYPICAL DRAWING	**LV Type 'E'** DEAD END ASSEMBLY	NEPAL ELECTRICITY AUTHORITY

S.No.	QTY.	UNIT	MATERIAL
1	1	NOS	ANCHOR CLAMP
2	1 for PSC 0 for STP	NOS	PIGTAIL WITH HEXAGONAL NUTS AND WASHERS (16 X 203) MM
3	1 for PSC 0 for STP	NOS	EYE NUT
4	2 for STP 0 for PSC	NOS	POLE CLAMP WITH NUTS, BOLTS AND WASHERS (TC8)
5	5	NOS	INSULATED CABLE CAPS
6	1	NOS	POLE 9 METER
7	1	SET	LT STAY

CONSTRUCTION STANDARDS **LV TYPE - E (Single Anchor Dead End)**	**NEPAL ELECTRICITY AUTHORITY**



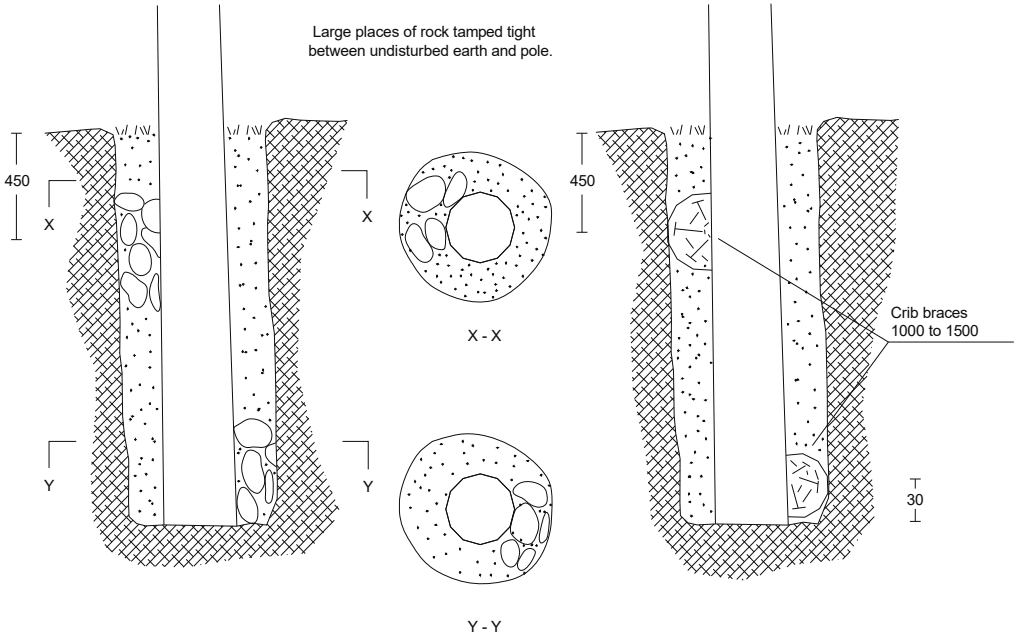
Particular	A , mm	B , mm	C , mm
Pig Tail A1	300	150	150
Pig Tail A2	200	120	80



CSLV-16	CONSTRUCTION STANDARDS Pig Tail with Adjustable Eye and Double Eye Fitting	NEPAL ELECTRICITY AUTHORITY N

PLOE LENGTH (m.)	DEPTH OF BURIAL (m.)
8	1.5
9	1.5
10	1.7
11	1.8

Direction Of STRAIN

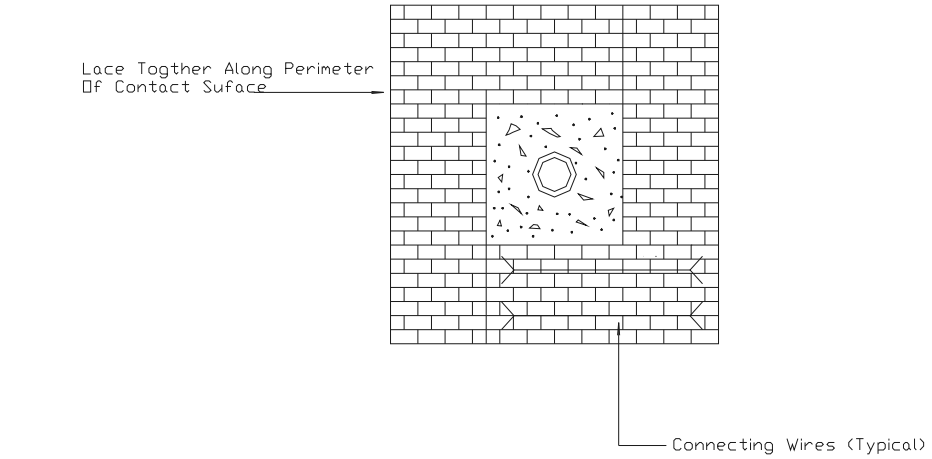


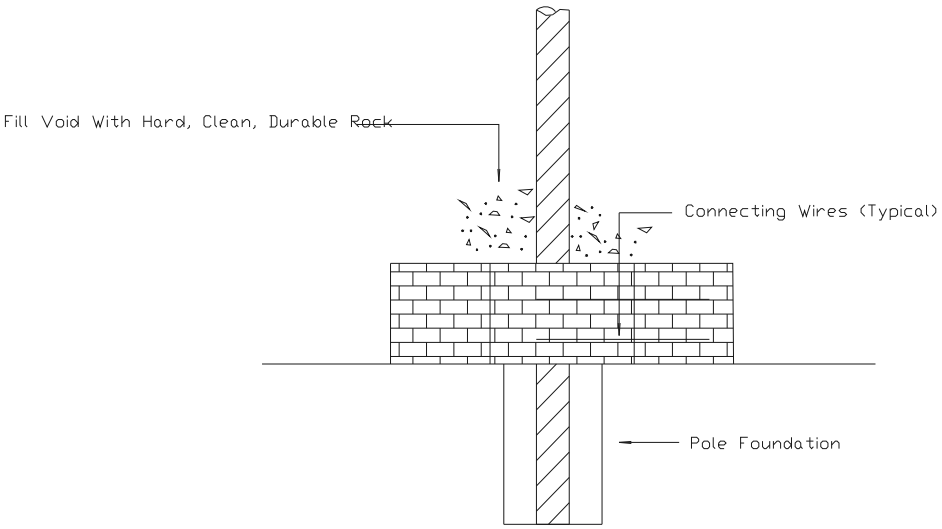
For use where ground is soild or compact.

For use where ground is soft

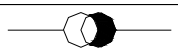
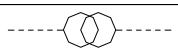
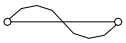
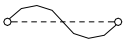
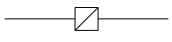
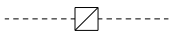
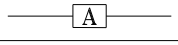
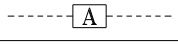
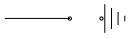
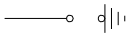
NOTE
CRIBBING FOR POLES WITHOUT CONCRETE FUNDATIONS.

CSG–05	CONSTRUCTION STANDARDS POLE BURIAL	NEPAL ELECTRICITY AUTHORITY

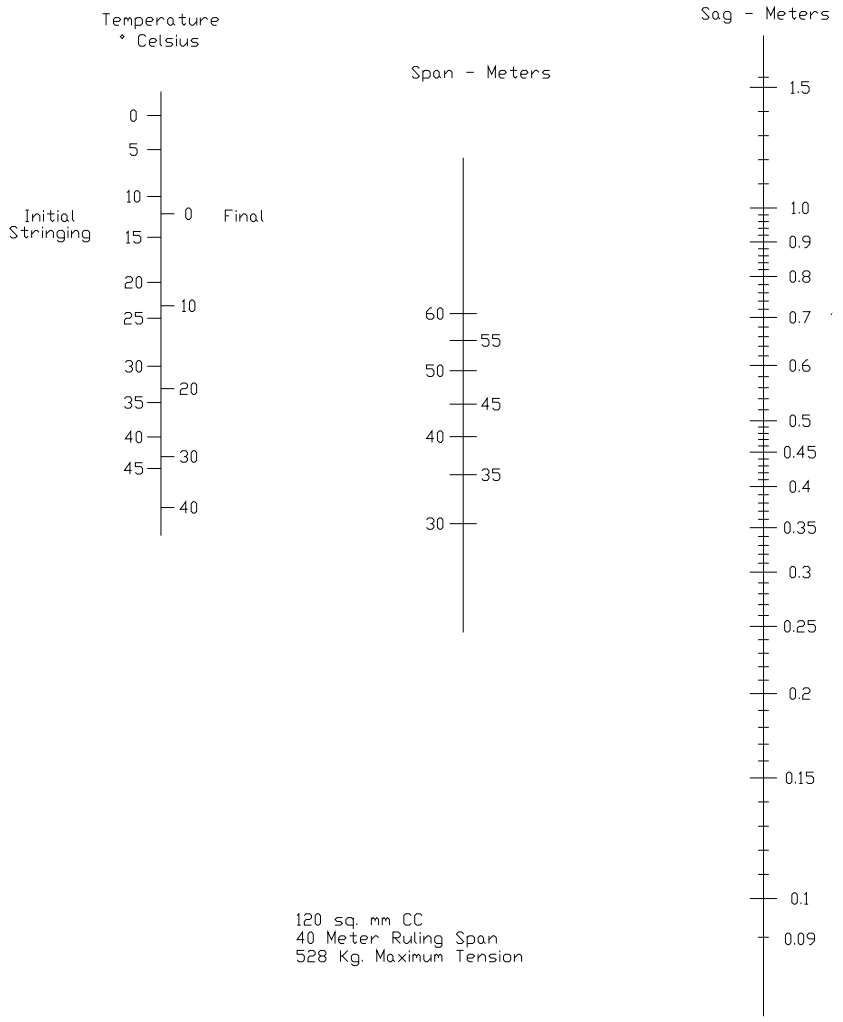




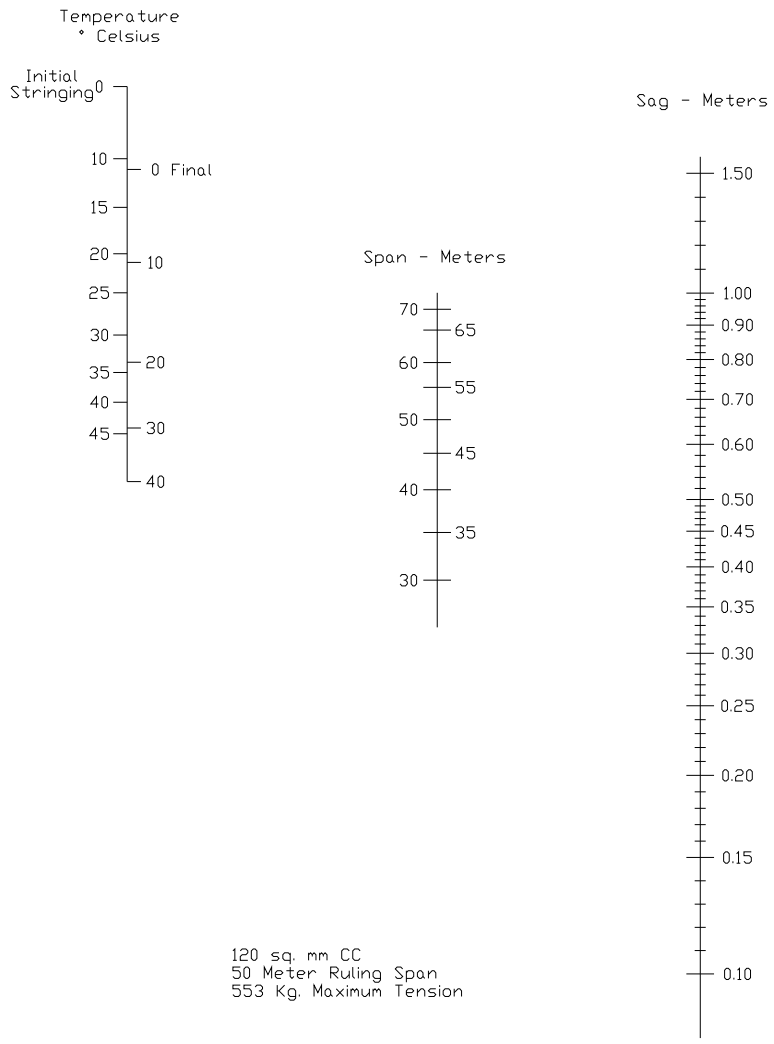
CSG-06	CONSTRUCTION STANDARDS POLE PROTECTION IN SHALLOW RIVER BEDS	NEPAL ELECTRICITY AUTHORITY

SN	ELECTRIC SYMBOLS	EXISTING	PROPOSED
1	Transformer		
2	Fuse Cutout		
3	Disconnecting Switch		
4	Load Break Switch		
5	Auto Reclosure		
6	Substation		
7	Lighting Arrester		
8	Pole Telescopic with Stay		
9	Pole P.S.C. with Stay		
10	Tapping Point		

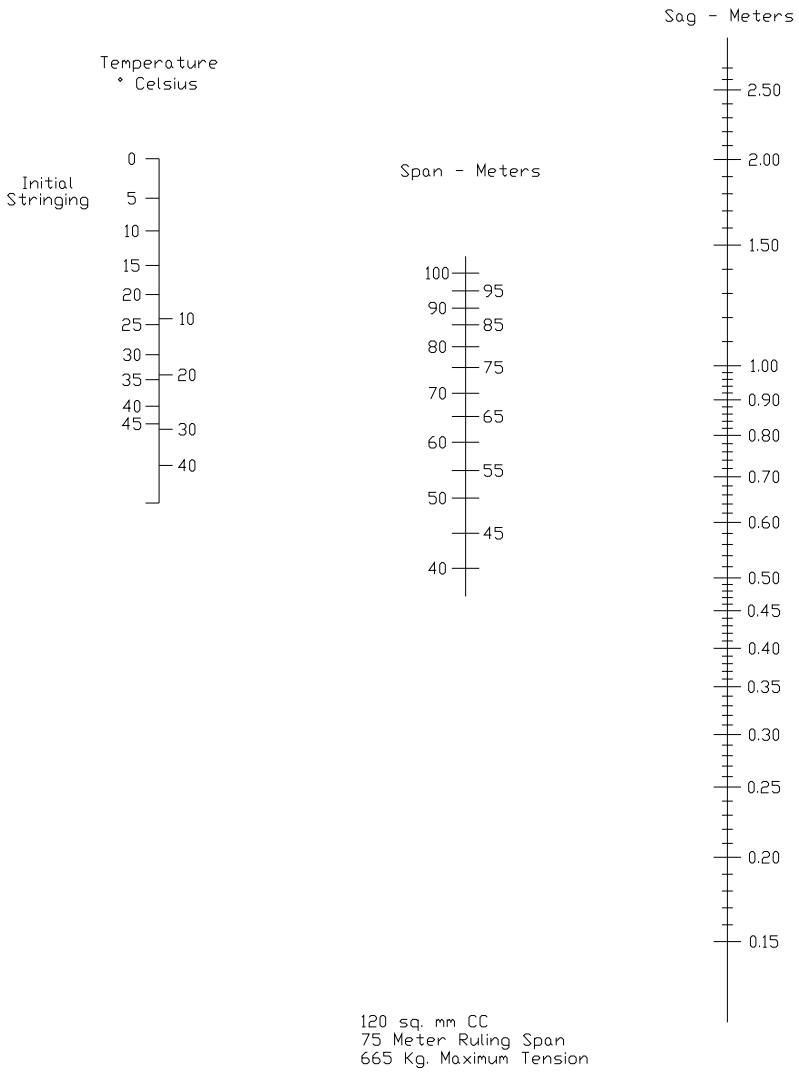
CSG-04	CONSTRUCTION STANDARDS ELECTRICAL SYMBOLS	NEPAL ELECTRICITY AUTHORITY



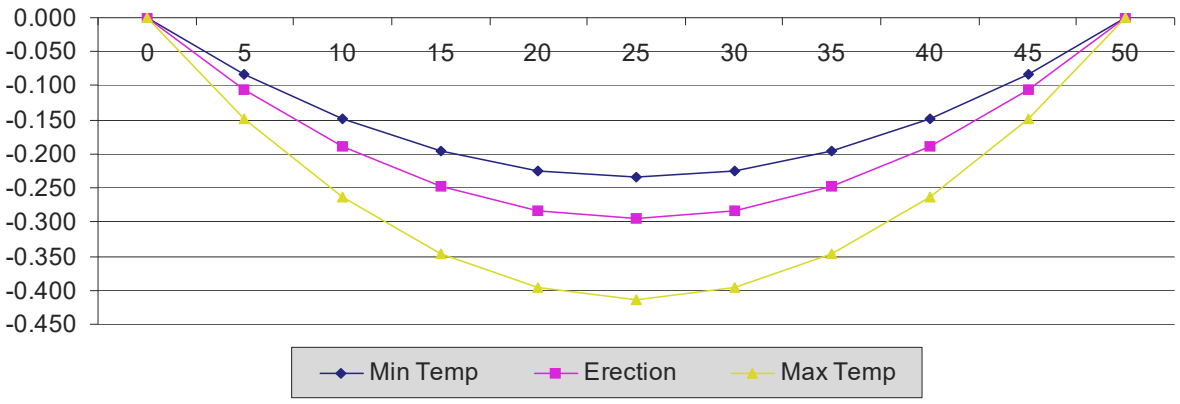
CSG-18	CONSTRUCTION STANDARDS SAG CHART 120 SQ.MM CC	NEPAL ELECTRICITY AUTHORITY



CSG-19	CONSTRUCTION STANDARDS SAG CHART 120 SQ.MM CC	NEPAL ELECTRICITY AUTHORITY



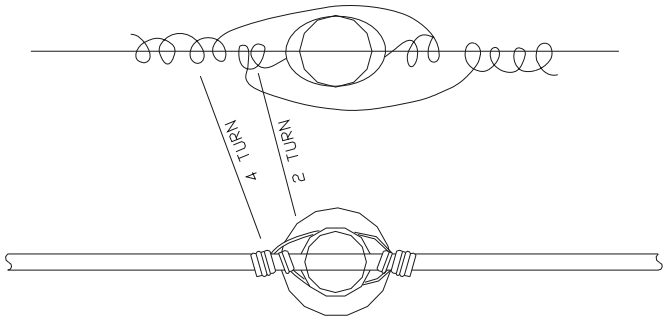
CSG-20	CONSTRUCTION STANDARDS SAG CHART 120 SQ.MM CC	NEPAL ELECTRICITY AUTHORITY



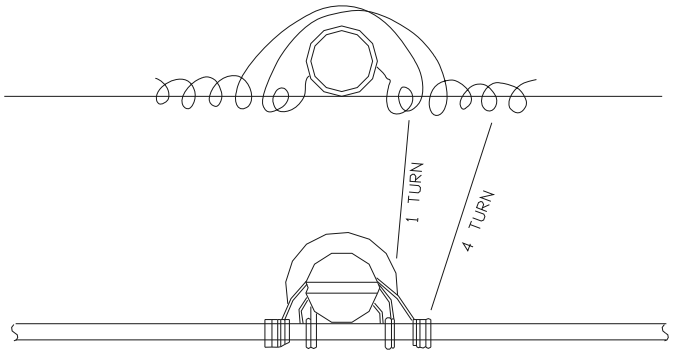
CSG-28	**CONSTRUCTION STANDARDS** **ABC-SAG CHART 70&95 SQ MM**	**NEPAL ELECTRICITY AUTHORITY**

JUMPER TIES

TOP GROVE



SIDE GROOV

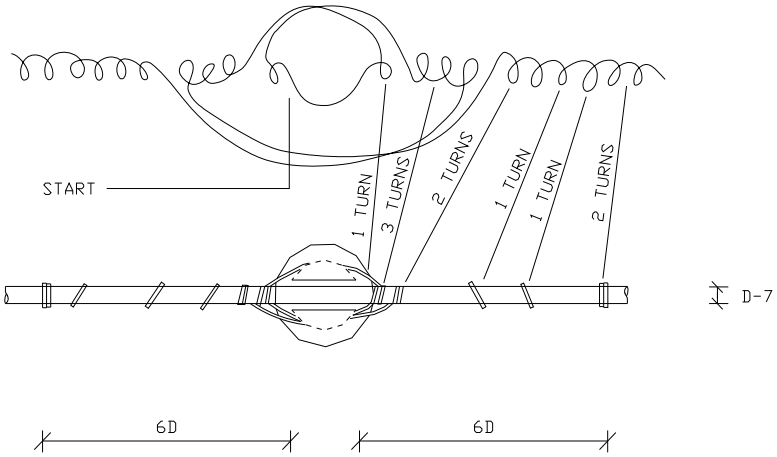


NOTES

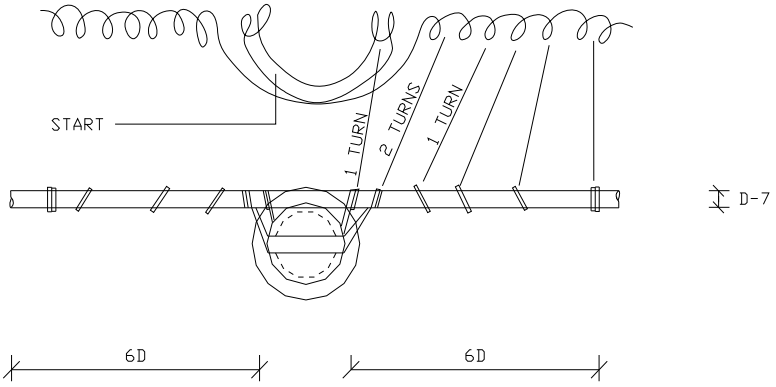
1. TIE WIRE ASSEMBLY SHOULD BE AS TIGHT AS CAN BE WRAPPED.
2. TURNS MAY BE IN EITHER DIRECTION, AS LONG AS ONE-HALF THE TURNS OPPOSE THE OTHER HALF TO PREVENT LOOSENING OF THE TIE.
3. USE ONLY FOR SECURING JUMPERS ON STRUCTURES.

CSG-29	CONSTRUCTION STANDARDS INSULATOR TIES	NEPAL ELECTRICITY AUTHORITY

TOP GROVE

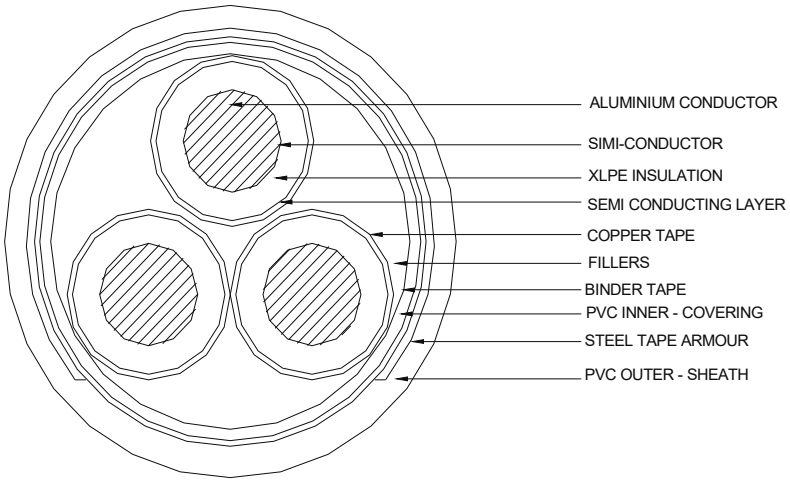


SIDE GROVE



NOTE
1. HAND TIES TO BE USED ONLY WHEN PREFORMED TIES NOT AVAILABLE.
2. CLINCH LAST TWO TURNS TIGHT WITH PLIERS.
3. SOFT DRAWN - TIE WIRE, TO BE USED FOR ALL TIES.

CSG-30	CONSTRUCTION STANDARDS INSULATOR TIES	NEPAL ELECTRICITY AUTHORITY

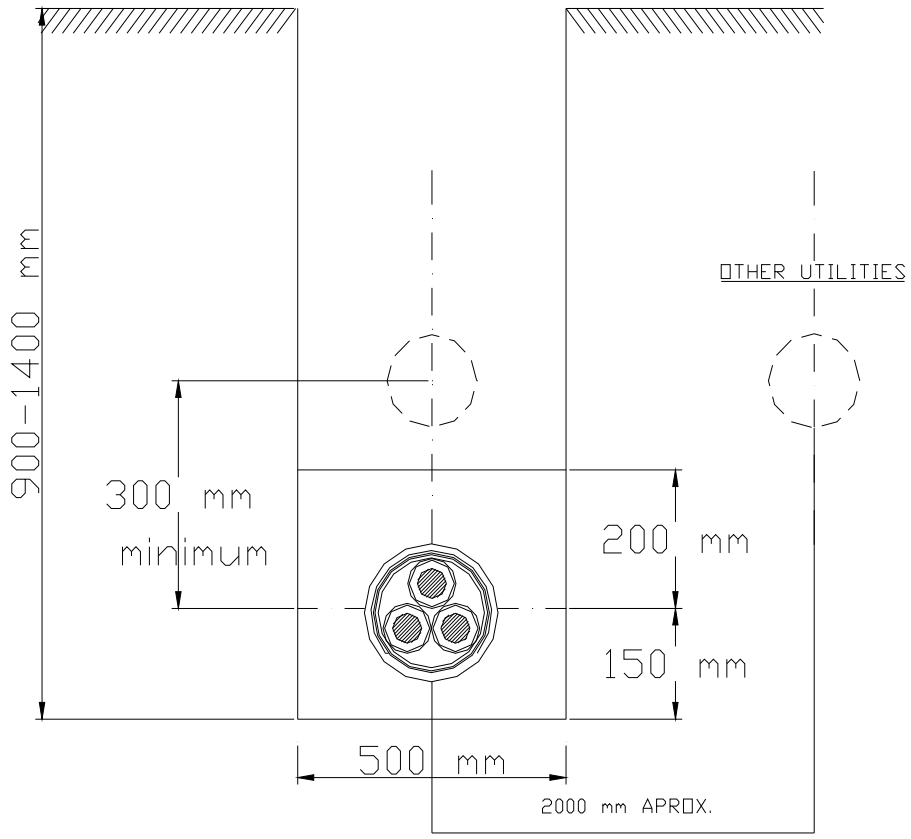


CSG-33	CONSTRUCTION STANDARDS 300 SQ. MM XLPE CABLE-CROSS SECTION	NEPAL ELECTRICITY AUTHORITY

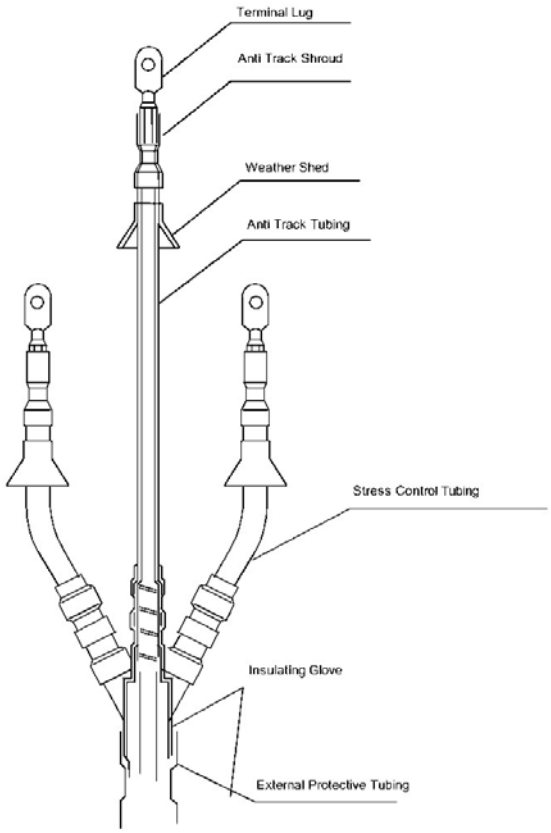
UNDERGROUND CABLE

CONSTRUCTION NOTES

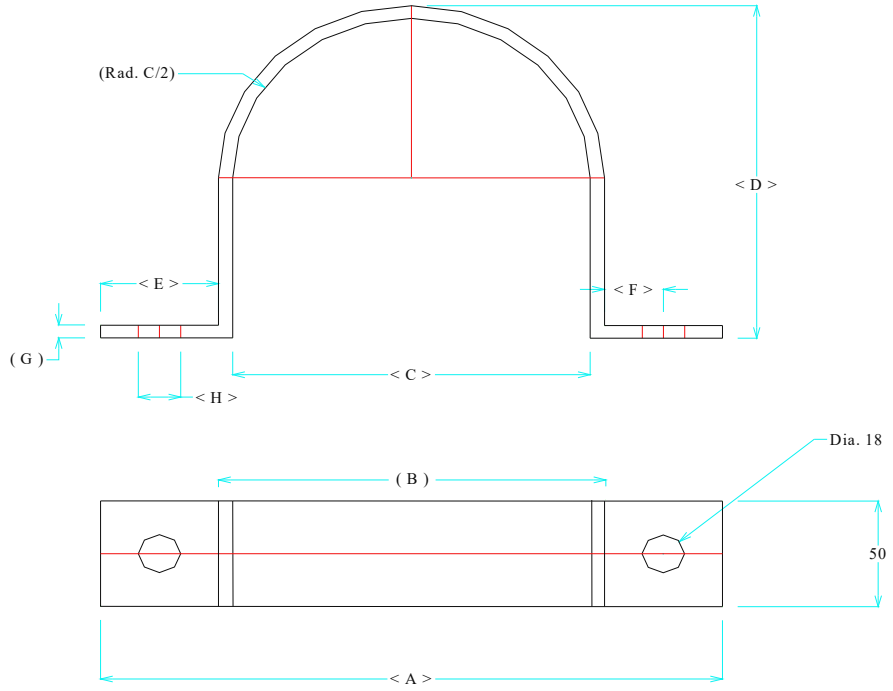
CABLES SHALL BE LAID LOOSELY IN THE TRENCH AND IN PARALLEL.
CABLE SHALL NOT CROSS OR LAY ON TOP OF ONE ANOTHER.
BACKFILL SHALL BE CLEAN AND FREE OF STONES AND SHARP OBJECTS 150 MM BELOW AND 200 MM ABOVE THE CABLE.
IF TELEPHONE IS PERMITTED IN THE SAME TRENCH IT MUST MAINTAIN A SEPARATION OF 300 MM ABOVE THE CABLE.
OTHER UTILITIES SUCH AS GAS, WATER, SEWER ETC, IF PARALLEL TO DIRECT BURIED ELECTRIC CABLES, SHOULD MAINTAIN A HORIZONTAL SEPARATION OF 2000 MM.



CSG-34	CONSTRUCTION STANDARDS 11 kV XLPE UNDERGROUND CABLE LAYING GENERAL INSTRUCTION	NEPAL ELECTRICITY AUTHORITY



Drawing	Outdoor Heat Shrinkable	NEPAL ELECTRICITY AUTHORITY
CS11-LM-10	**Cable Termination Kit**	

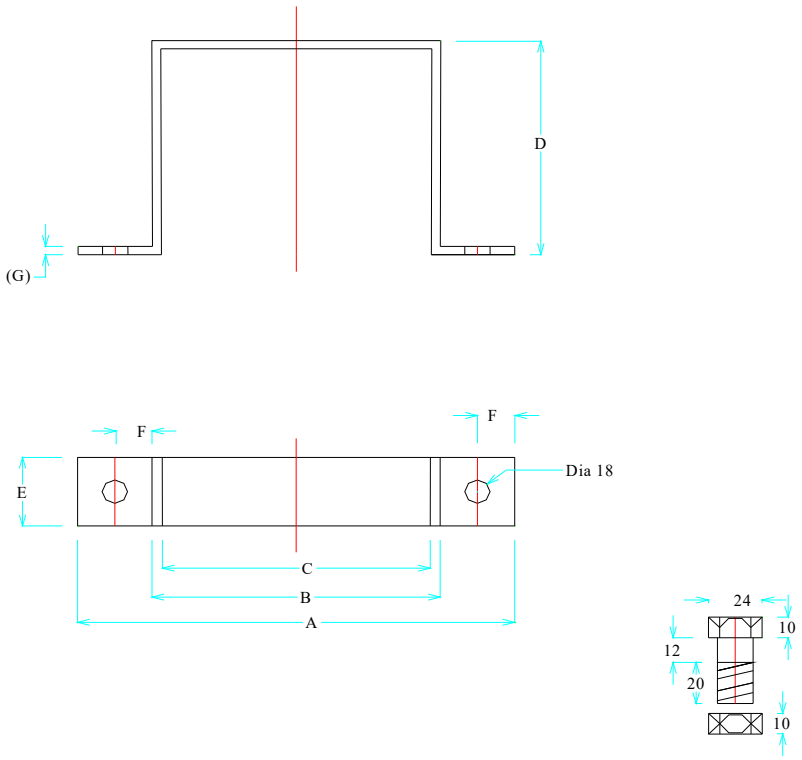


Type	Unit	A	B	C	D	E	F	G	H	Remarks
TC1	mm	285	185	173	179	50	25	6	18	
TC2	mm	297	197	185	191	50	25	6	18	
TC3	mm	307	207	195	201	50	25	6	18	
TC7	mm	334	234	222	228	50	25	6	18	
TC4	mm	347	247	235	241	50	25	6	18	
TC5	mm	397	297	285	291	50	25	6	18	

Note :- Dimensions are subject to approval prior to manufacture.

NEPAL ELETRICITY AUTHORITY

All Dimension in mm	Semicircular Clamp for Tubular pole DWG. 1H	Drawn by		
		Checked by		
		Approved by		

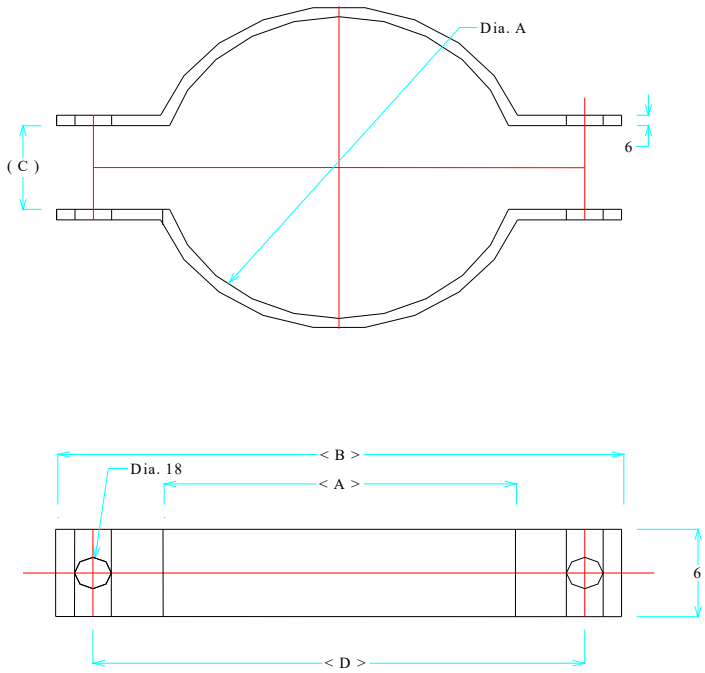


Type	Unit	A	B	C	D	E	F	G	Remarks
PC1	mm	295	195	183	150	50	25	6	
PC2	mm	306	206	194	150	50	25	6	
PC3	mm	262	162	150	204	50	25	6	
PC4	mm	316	216	204	150	50	25	6	
PC5	mm	354	254	242	150	50	25	6	
PC6	mm	402	302	290	150	50	25	6	

Note :- Dimensions are subject to approval prior to manufacture.

NEPAL ELETRICITY AUTHORITY

All Dimension in mm	Rectangular Clamp for PSC pole DWG. 2H	Drawn by		
		Checked by		
		Approved by		



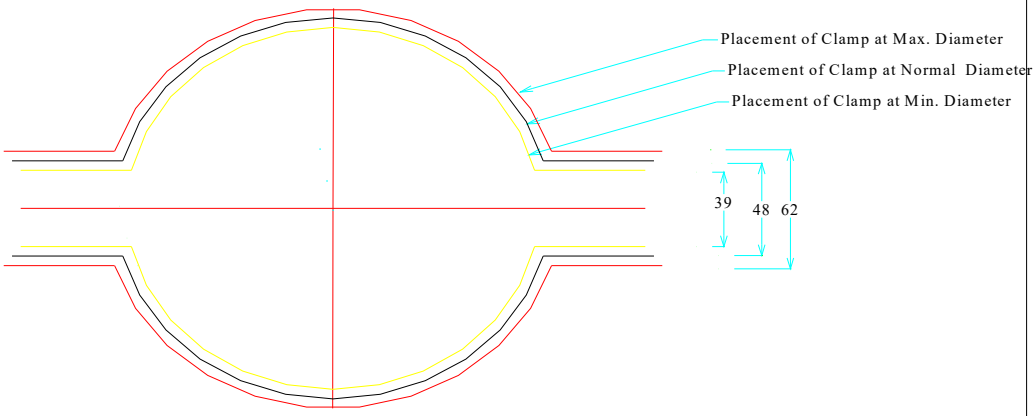
Type	Unit	A	B	C	D	Remarks
TC6	mm	200	302	50	268	
TC8	mm	155	257	50	223	

Note :- Dimensions are subject to approval prior to manufacture.

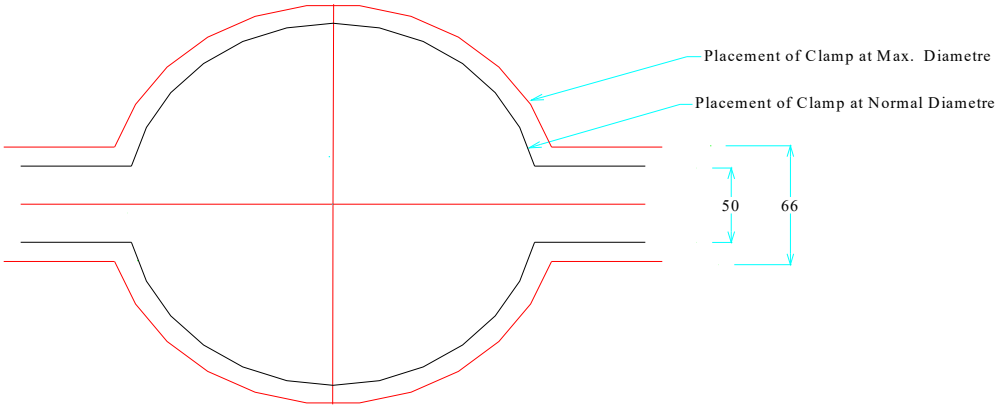
NEPAL ELECTRICITY AUTHORITY

All Dimension in mm	Semicircular Stay Clamp for Tubular Pole DWG. 3H	Drawn by		
		Checked by		
		Approved by		

Clamp for Stay TC6



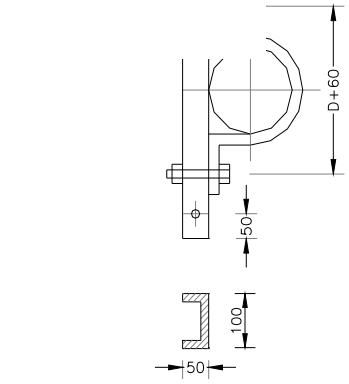
Clamp for Stay TC8

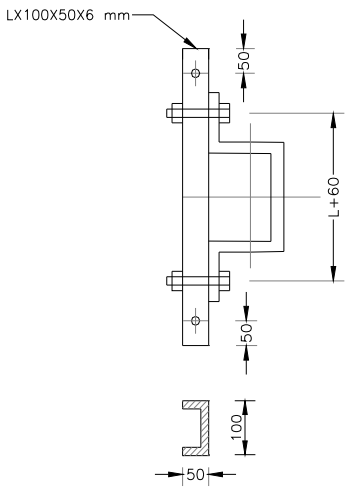


Note :- Dimensions are subject to approval prior to manufacture.

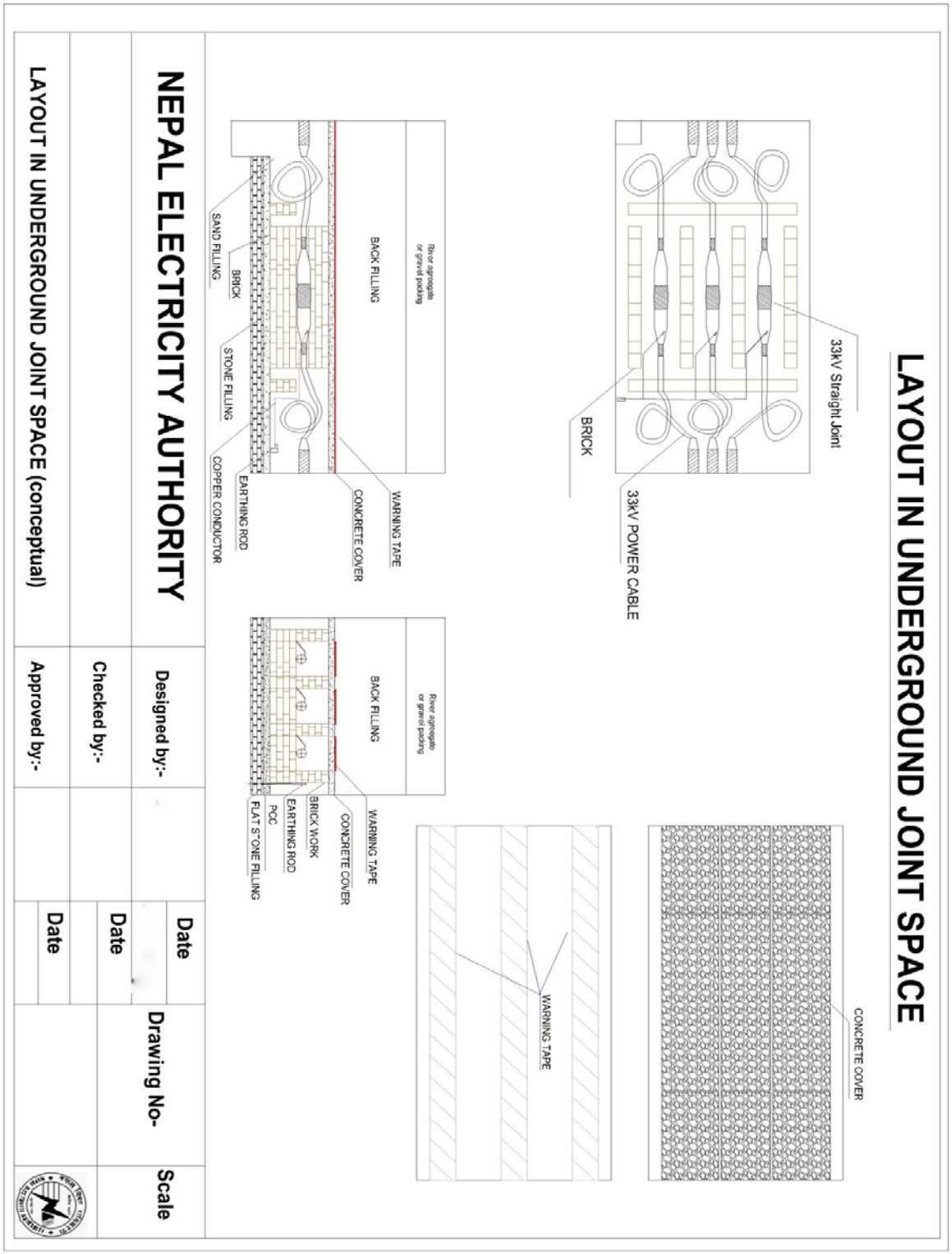
NEPAL ELECTRICITY AUTHORITY

All Dimension in mm	Placement of Semicircular Stay Clamp for Tubular pole DWG. 4H	Drawn by		
		Checked by		
		Approved by		



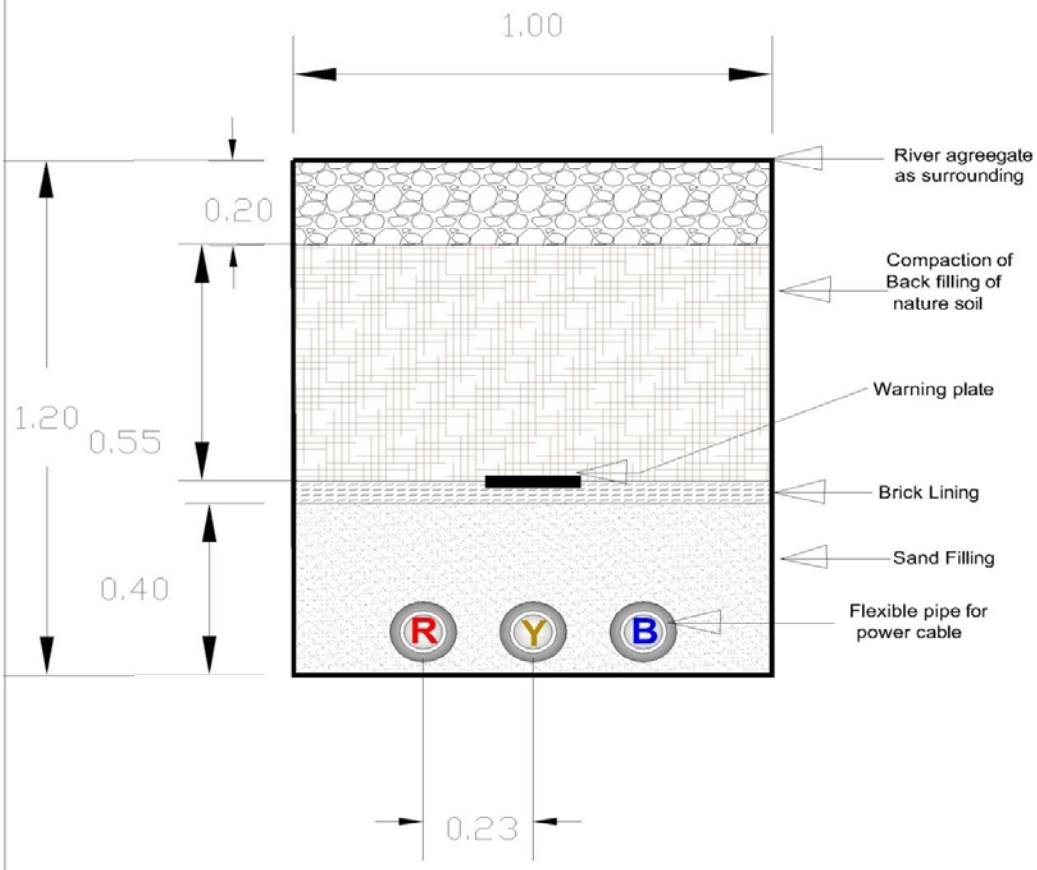


DRAWING NO.	POLE CLAMP	NEPAL ELECTRICITY AUTHORITY

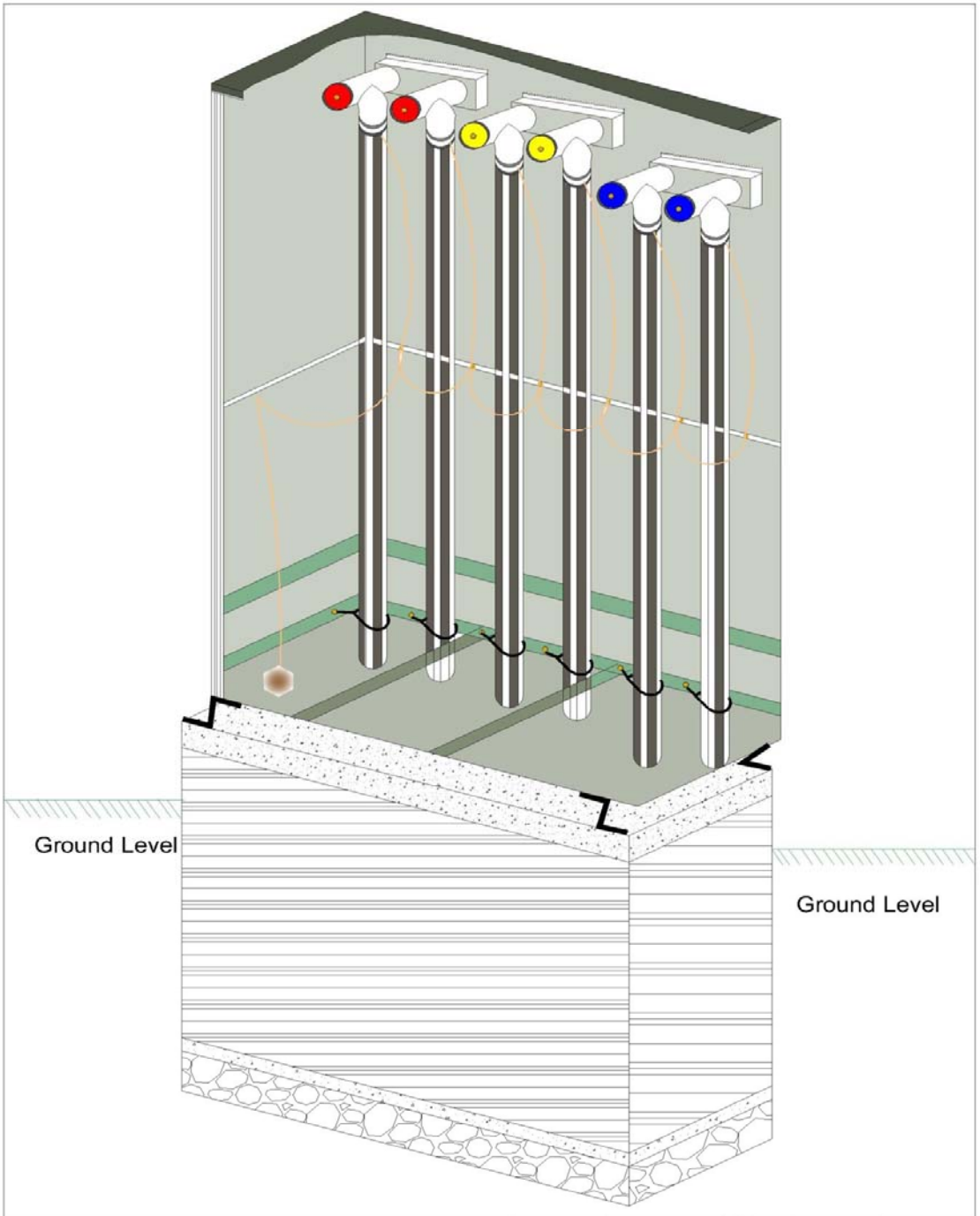

LAYOUT IN UNDERGROUND JOINT SPACE
33kV Straight Joint
BRICK
33kV POWER CABLE
CONCRETE COVER
WARNING TAPE
River aggregate or gravel packing
BACK FILLING
SAND FILLING
BRICK
STONE FILLING
COPPER CONDUCTOR
EARTHING ROD
CONCRETE COVER
WARNING TAPE
River aggregate or gravel packing
BACK FILLING
BRICK WORK
EARTHING ROD
PCC
FLAT STONE FILLING
CONCRETE COVER
WARNING TAPE
NEPAL ELECTRICITY AUTHORITY
Designed by:-
Date
Checked by:-
Date
Approved by:-
Date
Drawing No-
Scale
LAYOUT IN UNDERGROUND JOINT SPACE (conceptual)

DESIGN OF CABLE LAYOUT

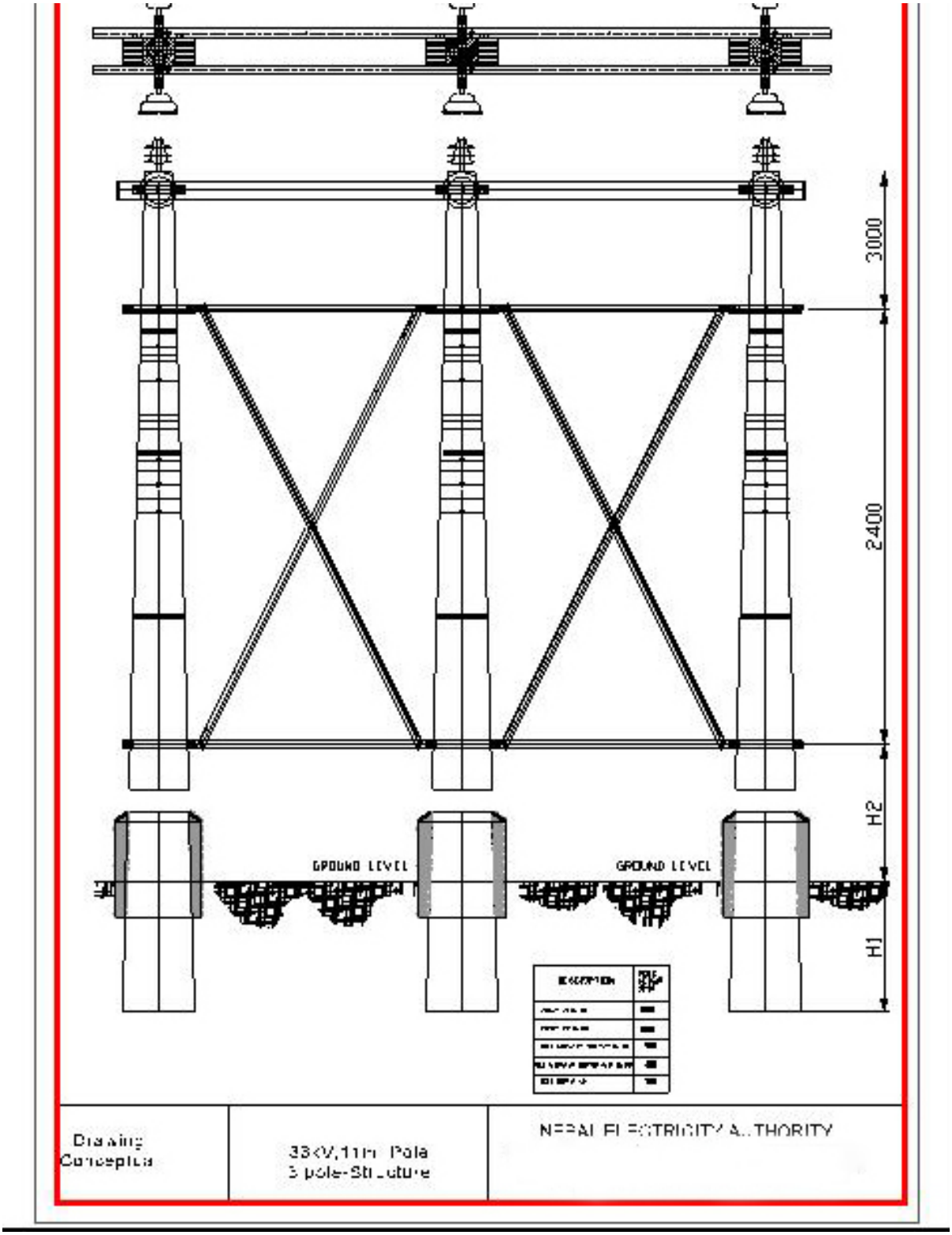
Single core,XLPE Power Cable,AL



NEPAL ELECTRICITY AUTHORITY	Designed by:-		Date	Drawing No-	Scale
	Checked by:-		Date		
LAYOUT IN UNDERGROUND CABLE (conceptnel)	Approved by:-		Date		



NEPAL ELECTRICITY AUTHORITY	Designed by:-		Date	Drawing No-	Scale
	Checked by:-		Date		
LAYOUT OF ABOVE GROUND LEVEL JOINT CABINET	Approved by:-		Date		


3000
2400
H2
H1
GROUND LEVEL
GROUND LEVEL
Drawing
Conceptual
33KV,11m Pole
3 pole-Structure
NEPAL ELECTRICITY AUTHORITY

SECTION VI-SPECIAL REQUIREMENTS FOR EXECUTION OF WORKS

(Distribution Line Construction Materials)

TABLE OF CONTENTS

1. Site Office Management

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

1.2 Prior to the beginning of construction works the contractor at his own cost shall establish a demonstration and training installation of 11/0.4 kV structures as listed in construction standards of tender document. The installation shall include at least 3 spans of AAAC conductor and ABC cable of each size to illustrate the type of materials used for tangent, angle and dead end construction for 11/0.4 kV line. Such structures need not be spaced more than 10 meters apart. The intent of establishing such arrangement shall be to provide visible examples of the application of the various materials to be used and to provide training and testing facility for the contractor's line construction personnel.

2. Contractor's key personnel and workforce

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

2.2 The line construction and supervisory staff of the contractor shall be examined by the employer to ensure their capability to perform proper quality of work as per Evaluation Criteria (Section 3) clause no. 2.5 before commencement of the work.

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

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

3. Tools and Equipment

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

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

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

SN	Description of Tools and Equipment	Unit	Quantity
1	Crane Truck (Minimum 3 Ton lifting capacity)	Nos.	3
2	General Purpose Truck (Minimum 10 Ton capacity)	Nos.	3
3	Max or Ratchet Puller suitable for HV/LV Cable Tensioning	Nos.	10
4	Come along Clamp suitable for HV/LV Cable Tensioning	No.	10
5	Crimping Device for jointing Cables	Nos.	10
6	Cable Pulling, Cable Laying Equipment	Nos.	10
7	Winches, Cable rollers	Nos.	10
8	Mini Excavator	Nos.	5
9	Ground Penetration Radar	Nos	10
10	Horizontal Directional Drilling Machine	Nos.	3

4. Approval of Drawings

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

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

5. Materials

5.1 Distribution Transformers shall be provided to the Contractor by the Project.

5.2 All materials and equipment of the Project shall be located at the Project's or such other areas where they are being stored. During issue and handling over of these materials it shall be the Contractor's responsibility to load all of them and provide all necessary lifting and handling equipment, labour and suitable transport as required to transport the various items of materials and equipment to the Contractor's site of storage and operations.

5.3 Accountability for all materials and equipment issued by the project shall be based on the material lists associated with the various construction drawings contained in the Construction Standards and the allowances referenced in clause 3 above. At the time of final material accounting, any deficit in the Contractor's material account shall be charged to the Contractor at the unit price rates enlisted by the project during handing over of the materials to the Contractor.

5.4 If the Contractor fails to account for all materials and equipment issued by the Project as set forth in clause 4 above, the Contractor shall be charged for the missing materials or equipment. The Project shall have the right to withhold money due or to become due to the Contractor, as reimbursement for the deficit in the Contractor's material.

5.5 Prior to the rehabilitation work, representative of the NEA's local branch office the Site Engineer and the contractor shall jointly inspect the materials to be dismantled and list down such materials. It shall be the contractor's responsibility to pack those goods appropriately, transport them to the nearest NEA store and get receipt. Such receipts shall be enclosed with the subsequent invoices claimed by the contractor.

6. Local Materials

6.1 Certain minor items of materials, including civil materials, required by the Construction Standards are designated Local Materials in the Standards and shall be furnished and installed by the Contractor as part of the completed unit of construction.

6.2 The contractor shall include the cost of such items of materials in his quoted construction unit prices and no other payments for such materials shall be made to the contractor.

6.3 It shall be the Contractor's responsibility to determine his requirements for any items of Local Material in a timely manner and make procurement accordingly. No delays shall be allowed, and no exceptions made to the required use of Local Materials due to the unavailability of such materials.

7. Construction Time Schedule

7.1 If the contractor fails to execute the any component of work within the period specified in the construction schedule, the employer shall have right to warn the contractor to make up for such delay in time. In case the contractor fails to overcome delay in different components of the works instead of repeated reminders by the employer, he shall be made fully responsible for any delay in final time schedule and no consideration shall be made for any extension of construction period for the whole work.

8. Measurement of work and material

8.1 The contractor after completion of work of any segment of work as per approved drawing of the project shall submit detail work measurement in structure data sheet (SDS) as per the format Sheet-1 in this section of the tender document.

8.2 Measurement of the work performed by the contractor shall be jointly checked by the contractor and the staff deputed by the employer. In case of any discrepancy or dissatisfaction of employer staff the contractor shall be notified for making corrections for the same and the contractor shall have to submit his revised measurement schedule.

8.3 While submitting running bill the contractor must submit details of quantity of materials issued to him, quantity consumed as assessed from the material measurement sheet and quantity in his possession. Materials issued, used and in contractor's possession must be reconciled as per the prescribed format Sheet-3 in this section of the tender document. The materials in possession of the contractor shall be the opening material balance for the next running bill. The contractor shall also submit copies of store vouchers showing details of materials issued to him. Statement of materials submitted shall be checked and certified by the employer before payment of each of the running bill.

9. Workmanship and quality of work

9.1 The contractor shall be attentive to maintain workmanship and quality of work while performing the work and shall obey to all the instructions of the field staff of the project time to time in this regard.

9.2 Special items such as concrete works, cable jointing works and transformer installation works etc. must be performed in presence of the project field staff. In case of the concrete works the project staff shall assess quantity of cement and steel to be used for each of the job and this must be followed for performing the job. Sand and aggregate must be supplied as per

the standard specification of the tender document. The project field staff shall check quality of such materials and the contractor shall use the same after his approval. Curing of concrete works must be carried as per standard practice. The field staff shall have right to ask the contractor to repeat concrete works in case of his failure to execute the job as above or in his absence.

9.3 Each and every item of the standard data sheet (SDS) shall also be checked by the project staff for the satisfaction of quality of workmanship as per the prescribed specification of the tender document. In case of failure of the contractor to execute any item of the work as per proper workmanship or quality, the project shall have right to ask the contractor to revise or remedy such work at the cost of the contractor.

10. Commissioning of work

10.1 After completion of entire work of any village or load centre, the project after necessary tests shall arrange to electrically charge the same. In case of successful operation in satisfaction to the project the contractor shall be issued a provisional certificate starting from the date of such commissioning.

10.2 The Project shall be authorized to change such date of commissioning in case of failure of the line due to any defect in the quality of construction.

10.3 Final acceptance of work shall be issued only after completion and satisfactory commissioning of whole work of the contract.

NEPAL ELECTRICITY AUTHORITY
MATERIAL DATA SHEET (MDS)

(SUBMITTED WITH R. B. No……..)

Tender No:- Site Office:-
Tender Details:- Scheme:-
Name of Contractor:- Load Centre:- SDS No:-
Running Bill No:- Running Bill Date:- Current Issue Date:-

C.U.	Description	Unit	Quantity	Material Used Qty. as per current bill
1	2	3	4	5

Submitted by:- Checked by:- Approved by:-

Contractor's Signature:- Site Supervisor:- Site In charge/Engineer:-

Contractor's Seal:

NEPAL ELECTRICITY AUTHORITY
MATERIAL RECONCELLATION REPORT (MRR)
(SUBMITTED WITH R. B. No……..)

Tender No:- Site Office:-
Tender Details:- Scheme:-
Name of Contractor:- Load Centre:- SDS No:-
Running Bill No:- Running Bill Date:- Current Issue Date:-

Item No.	Description	Unit	As per Contract		Issued to Contractor			Material Used			Balance with Contractor					Balance to be issued as per contract
			Qty	Amount	Upto previous issue	Current issue	Total	Upto previous bills	Current bill	Total	Open Balance	Current issue	Material used as per current bill	Closing balance	Amount of closing balance	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17

Contractor's Signature:- Site Supervisor:- Store Keeper:- Site In charge/Engineer:

NEPAL ELECTRICITY AUTHORITY

Structure Data Sheet

District:
VDC:
Scheme:

Tender No:
Tender Detail:
Name of Contractor:

SN	Line Length (m)			Pole Frame															Stay						Conductor (Sq.mm.) Length (km)				Transformer (kVA)			Switch	Remarks
				11m		HV							LV						HV			LV			HV	HV	COM	LV				Load Break Switch	
																									Covered Cond. (Km)	HV (Km)	LV ABC Cable 95 mm^2 (Km)	ABC Cable 95 mm^2 (km)					
	HV	COM	LV	HV 50 m span	COM 45 m span	SA	TO	DE	DA	DDE	HS	TR	A1	A2	B	C	D	E	S	D	F	S	D	F	120	120	95	95	300	200	100		

INSPECTION, TESTING AND COMMISSIONING

1.1 SCOPE OF WORK

The whole of the Works supplied under the Contract shall be subject to inspections and tests by the Employer or their Representatives during manufacture, erection and after completion. The inspections and tests shall include, but not be limited to, the requirements of this section of the Specifications.

The Contractor shall provide all costs, appliances, apparatus, supervision, labor and services necessary to carry out all tests, unless specifically stated otherwise.

The Contractor shall furnish the detailed schedule of his commissioning plan at least one month prior to the scheduled date. The schedule shall include the commissioning procedures, testing sequences and details of special testing equipment, tests and commissioning record formats, information about relevant standards etc.

The scope of the commissioning program includes the site testing and putting into successful operation of all the equipment supplied under the Contract, for 11kV, AC & DC plants and all secondary voltages systems. Testing of energy meters and certification of their accuracy shall also be included.

1.2 OBJECTIVES

The objectives of commissioning work, prior to the successful energization of Plant at full voltage and connection to the system, are the following:

- Confirm the integrity (correctness) of installation.
- Confirm the integrity of insulation, connections and phasing.
- Ensure proof of equipment characteristics.
- Review workmanship.
- Confirm the correct implementation of the design.
- Check equipment ratings.
- Check settings and operation of protective relays.
- Check and measure resistivity of earthing grid and earthing system.
- Confirm the proper functioning of SCADA system.

1.3 QUALITY ASSURANCE, INSPECTION AND TESTING

To assure that the supply and services under the scope of this Contract whether manufactured or performed within the Contractor's works or at his subcontractor's premises or at the Site or at any other place of work, are in accordance with the Specifications, the Contractor shall adopt suitable quality assurance program to control such activities at all points necessary. Such program shall be outlined by the Contractor and shall be finally accepted by the Employer after discussions before the award of the Contract. A quality assurance program of the Contractor shall generally cover, but not be limited to the following:

(a) His organization structure for the management and implementation of the proposed quality assurance program.
(b) Documentation control system.
(c) The procedure for purchases of materials, parts, components, and selection of sub-contractors' services including vendor analysis, source inspection, incoming raw materials inspection, and verification of materials purchases.
(d) System for shop manufacturing including process controls and fabrication and assembly controls.

(e) Control of non-conforming items and system for corrective actions.
(f) Control of calibration and testing of measuring and testing equipment.
(g) Inspection and test procedure for manufacture.
(h) System for indication and appraisal of inspection status.
(i) System for quality audits.
(j) System for authorizing release of manufactured products to the Employer.
(k) System for maintenance of records.
(l) System for handling storage and delivery.
(m) A quality plan detailing out the specific quality control procedure adopting for controlling the quality characteristics relevant to each item of supply.

The quality plan shall be mutually discussed and approved by the Employer after incorporating necessary corrections by the Contractor as may be required.

- Quality Assurance Documents

The Contractor shall be required to submit all the Quality Assurance Documents as stipulated in the Quality Plan at the time of Employer's inspection of material/equipment.

The Employer, through his duly authorized representatives, reserves the right to carry out Quality Audit and Quality Surveillance of the systems and the procedures of the Contractor's and the subcontractor's Quality Management and Control Activities.

- Inspection, Testing and Inspection Certificates

The provisions of the clauses on Test and Inspection of the General Conditions of Contract and Special Conditions of Contract shall be applicable to the supply and erection portions of the Works. The Employer shall have the right to re-inspect at his expenses, any material though it would have been previously inspected and approved by him at the Contractor's works before, and if, after the same are inspected at Site following the latter, material is found defective, then the Contractor shall bear the cost of this inspection and reinstatement according to specification.

1.4 TESTS AT MANUFACTURERS WORKS

1.4.1 General

Where no specific test is specified, then the various items of materials and equipment shall be tested in accordance with the relevant British, IEC Standards. Where no appropriate standard is available, tests shall be carried out in accordance with the maker's standard practice, which shall be subject to the Employer's approval.

At least fourteen days' prior notice, in writing or by tele-fax, shall be given to the Employer of the readiness of the plant for test or inspection and every facility shall be provided by the Contractor and sub-Contractor (s) to enable the Employer or their Representative to carry out the inspections and witness the tests. This includes progress, test rig and packing inspections also.

No equipment shall be packed, prepared for shipment, or dismantled for the purpose of packing for shipment, unless it has been satisfactorily inspected, or inspection has been waived by the Employer.

Functional electrical and mechanical tests shall be carried out on the completed plant after assembly in the Works. The extent and method of recording the results shall be agreed by the Employer in sufficient time to enable the tests to be satisfactorily witnessed or to make any changes to the proposed program of tests. All instruments

and apparatus used in the performance of the tests shall be subject to the approval of the Employer and, if required by the Employer, shall be calibrated to an agreed standard at a laboratory of national standing to be nominated by the Contractor and approved by the Employer. The costs of carrying out such calibration shall be borne by the Contractor in all cases.

The costs of making/performing any test shall be borne by the Contractor. This shall apply to tests performed at the site or elsewhere.

After receiving the prior information about the completion of manufacturing at the factory, the Employer will depute his personnel to the Contractor's factory to witness the fabrication, assembly and testing of any or all parts of major equipment. The cost associated with travel, lodging and fooding shall be borne by the Employer. The number of the Employer's personnel and equipment to be witnessed will be as listed below. The duration of such visits shall be as per inspection/testing requirements.

-RMU	6 persons, 3 visit
-XLPE Power Cable	6 persons, 3 visit
-ABC Cable	6 persons, 3 visit
-Hardware for ABC cable	2 persons, 1 visit
-PSC pole	2 persons, 1 visit
-Optical Fiber Cables	6 persons, 3 visit
-DO, LA, GO Switch	2 persons, 1 visit
- Feeder Pillar/Distribution Box	6 persons, 3 visit
-GI, HDPE and PLB-HDPE Pipes	6 persons, 3 visit

In addition the Consultant shall also witness the routine tests of RMU, XLPE Power Cable, HV and LV ABC Cable and Feeder Pillar.

The Employer or the Consultant also reserves the right to conduct all tests mentioned in this specifications at his own expenses on the samples drawn from the site at Contractor's premises. In case of evidence of non-compliance, it shall be binding on the part of the Contractor to prove the compliance of items to the technical specifications by repeat tests.

1.4.2 Test Certificates

After completion of the tests, triplicate sets of all principal test records, test certificates and performance curves shall be supplied to the Employer.

These test records, certificates and performance curves shall be supplied for all tests, whether or not they have been witnessed by the Employer or his representative. The information given on such test certificates and curves shall be sufficient to identify the material or equipment to which the certificate refers and should also bear the Contract reference title. Specified requirements shall be shown on each certificate for comparison with actual test results.

When all equipment has been tested, test certificates of all factory and site tests shall be compiled by the Contractor into volumes and bound in an approved form complete with index. Two copies of each volume shall be supplied to the Consultant and five copies to the Employer.

1.4.3 Type Tests

Type tests are required to prove the general design of the equipment and the Contractor may submit certificates of such design tests, which have been carried out on identical equipment. Notwithstanding any provision in BS, IEC or ANSI Standards,

the Employer shall have the right to accept such certificates in lieu of the specified type tests or to reject them.

The type tests prescribed shall be carried out at the Contractor's cost in all cases, where either such certificates are not available or are rejected by the Employer.

1.5 RESPONSIBILITIES

To ensure that the test jurisdiction and transfer of responsibilities is regulated by strict safety and handover procedures, the Contractor agrees the interface with the Employer to establish and implement handover procedures consistent with the terms of these Specifications.

The Employer shall retain full jurisdiction over all commissioning activities, which may affect the operation of the existing system. In these circumstances and when so requested, shall provide technical advices and assistances.

The Contractor shall be responsible for technical guidance and assistance in establishing the scope and method of tests, witnessing of the testing, assessment of results, and re-negotiation of the changes in test schedules which may be necessary as a result of other circumstances, such as delays in the delivery, possible equipment failures.

1.6 SAFETY PROCEDURES

The Contractor shall share the responsibility for safety procedures with the Employer. The Contractor shall establish and implement a work permit and tagging system and associated safety procedures (subject to the review of Employer) for all equipment, systems and areas not covered by the Employer’s safety procedures.

The Employer will assume responsibility for the establishment and implementation of tagging, safety and work permit procedures for the protection of personnel and equipment, as soon as equipment and systems are connected to or are energizeable from the existing system.

1.7 TRAINING OF THE EMPLOYER'S STAFF

The Contractor shall plan for the Employer’s staffs’ participation, either continuously or on a regularly recurring basis, in the commissioning work and:

- Allow the Employer’s staffs to become familiar with the operating and maintenance aspects of the new equipment supplied by him especially RMU, Feeder Pillar and also hands on training of cable terminations,
- Maintain a continuing assessment with the Employer of the precautions required in or possible consequences of, initial energization of equipment,
- Allow for the above two necessary objectives in the preparation of schedules.

The Contractor shall station at site, at least, two technical experts for a minimum of twenty four months continuously after commissioning to rectify any problems, as well as train the Employer's attending staffs. If required, the length of his stay shall be extended as per requirement, which shall be at the Employer's discretion.

1.8 COMMISSIONING STAFF

The Contractor shall provide commissioning personnel including skilled and unskilled labor as required. Submit a list with names, experience and proposed

duration of the stay of key personnel on site, consistent with the construction schedule, along with the commissioning program.

Ensure that only staffs assigned to commissioning fulfills that duty for the duration of the assignment.

Ensure that commissioning staffs have authorization, and the competence, to undertake minor repairs or to make temporary redesigns and to reconnect systems to meet the specified system performance to preclude delays in energization and putting into commercial service of any part of the works.

1.9 TEST EQUIPMENT

The Contractor shall ensure that all instruments, tools and other equipment required for testing and commissioning are available on site, ensure that the test equipment is of satisfactory quality and condition and, where necessary, is calibrated by an approved authority or standard.

Make arrangements for the provision of power supplies for testing with necessary vector configuration, voltage and current rating.

1.10 COMMISSIONING PROGRAM

Prepare a commissioning program for approval by the Employer and for incorporation into the Project master construction program. Allocate adequate time in this program to permit full commissioning of all components.

Carry out all testing during normal working hours as far as practicable. Tests, which involve existing apparatus and system outages, may be carried out outside normal working hours. Give the Employer sufficient notice to allow for the necessary outage arrangements to be made in conformity with the testing program.

Note that no tests listed in the agreed program will be waived except upon the instructions or consent of the Employer in writing.

1.10.1 Test Procedures

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

- Measurement of insulation resistance.
- AC withstand voltage test

1.10.2 Requirements for Field Tests

The field tests shall be carried out in presence of Employer under the following conditions:
AC withstand test voltages for conductors and outdoor equipment shall be normal operation voltage of the transmission line and, withstand voltage test shall be carried out for ten (10) minutes by the normal voltage mentioned above. The field tests shall be carried out by the Contractor after adjustment of all the equipment have been completed.
Expandable and lead wires and other materials required for the field tests shall be arranged by the Contractor. The Contractor shall be responsible for providing all measuring instruments, test equipment and tools required for the tests.
Preparation of the test record sheets and test reports shall be the responsibility of the Contractor and the results of the field tests shall be submitted by the Contractor for Employer's approval.

Measurement of insulation resistance of the equipment shall be performed by at least 1000 V megger.
After completion of the measurement of insulation resistance mentioned above, ac withstand voltage test shall be performed by the normal operation voltage of the existing power system in accordance with the following procedure:

- 11 kV Main Circuit: The 11 kV RMUs, circuit breakers and disconnecting switches, except for circuit breakers receiving power for the test from the existing power system through a transmission line, shall be closed, succeeding, normal operation voltage shall be charged on the equipment and bus conductors for ten (10) minutes for ac withstand voltage test. The indication value of meters mounted on the board during the ac withstand voltage test shall be recorded on the test record sheets prepared by the Contractor.

Submit test procedures, consisting of detailed test methods and samples of the related test record forms, for all equipment to be tested, to the Employer for approval along with the commissioning program. Strictly adhere to these procedures for the commissioning tests.

1.10.3 Records

Maintain an up-to-date record of all commissioning activities on site.

Record the results of the tests clearly on forms and formats approved by the Employer and with clear references to the equipment and items tested, so that the record can be used as the basis for maintenance tests, in future. Submit the required number of site test records to the Employer as soon as possible after completion of the tests.
Record the details of the test equipment and instruments used in the test sheets, in those cases where the instrument or equipment characteristics can have a bearing on the test results.

1.10.4 “As-Built” Drawings

Keep an ongoing record of all changes on a master set of drawings including updated GIS. Produce and supply a minimum of five complete sets of marked-up “As Constructed/As-Built” drawings before leaving the Site. Correct and re-issue the original drawings as soon as possible as per this specification.

1.10.5 Test Methods

Carry out all necessary tests for commissioning the OH lines, UG Cables. RMU, Feeder Pillars, distribution transformers etc. The following clauses detail the tests which are considered to represent the minimum required in addition to those specified under the appropriate IEC Publications, other approved standards and the manufacturer’s instructions for each item of equipment.

Strictly adhere to the methods of testing approved by the Employer.

A) Site and Commissioning Tests for Main and Auxiliary Equipment

General Checks:

Make a general check of all main and auxiliary equipment. Include a check of the completeness, correctness and condition of ground connections, labeling, arcing ring, paint surfaces, cables, wiring, pipe-work, valves, blanking plates and all other auxiliary and ancillary items.

Check for oil and gas leaks and that insulators are clean and free from external damage. Check that loose items, which are to be handed over to the Employer, e.g., blanking plates, tools, spares, etc. are in order and are correctly stored or handed over.

1.10.6 Challenge Clause:

The equipment/material offered/received after the inspection by the authorized inspecting officer may again be subjected to test for any parameter from any NEA laboratory or NEA approved laboratory & the results if found deviating/un-acceptable or not complying to Technical specification, the bidder shall arrange to supply the replacement within thirty (30) days of such detection at his cost including to & fro transportation and required custom. In addition, penalty @10% of cost of the inspected lot of material shall be imposed. Further, any additional inspections on the replaced equipment/material shall be borne by the Contractor.

1. COMMUNICATION NETWORK

NEA intends to design, supply, establish, install, testing, commissioning, operate and maintain Advanced Metering Infrastructure (AMI) for consumers & other Smart Grid Applications through other Contracts. NEA intends to deploy the RF communication network with its auxiliary system all across Kathmandu valley (Kathmandu, Lalitpur and Bhaktapur) within an area of 220 sq. miles.

Also, NEA intents to establish an electrical distribution management system and distribution control centre for Distribution & Customer Services that is capable to access real-time data and provide all information on a single console at the Distribution control centre in an integrated manner with the possibility to remotely control the entire network and reduce outages and increase operational efficiency. The RF canopy is to be established, using wireless technology, shall be in the form of a RF mesh with field devices like nodes, routers/repeaters, collectors/gateways etc.

NEA is currently planning for distribution automation of the distribution network within distribution centre in different phases. The distribution network is proposed to be connected though optical fibre communication and act as a back bone of the network. Through this specification NEA intends to develop Optical Fibre communication network with substation equipment and other field equipment's connected with the proposed underground and overhead system.

Initially under this project, distribution automation system will be installed at two distribution centre (NEA Branch), which will involve around mix of underground system and overhead ABC HT network which includes RMUs, GO switches and DTs. The scope under this project includes integration of the data and control signal from the field IEDs, FRTU and RTUs installed with the proposed RF mesh network and distribution centre.

Thus the work includes coordination with the other contractors during integration work, such that total automation is achieved. The Bidder shall be responsible for detailed design and engineering of overall system, subsystems, elements, system facilities, equipment, services, facilitate and integrate distribution automation.

Thus, the Contractor shall make ready all the equipment like RMU. DTs, FPI and GO switch to connect with the new distribution centre without any problems, like data acquisition from distribution field level (until Distribution Transformers) till monitoring and controlling of the overall electrical distribution network including Ring Main Units (RMUs), Sectionalizers, ARCBs (Auto Reclosure Circuit Breakers) and FPIs (Fault passage Indicators) within the network.

The design and engineering shall include provision of communication equipment in all the field equipment and substation equipment and execution of all interfaces with systems, equipment, material and services of Owner for proper and correct design, performance and operation of the project. Successful Bidder shall provide complete engineering data, drawings, reports, manuals and services offered etc. for NEA's review, approval and records.

The proposed system shall be compatible to operate with the RF network mentioned above and the optical fibre network under planning and construction. The control centre to be established under this project will be at NEA Head Office at Kathmandu, with a data back-up centre at NEA Training Centre, Bhaktapur.

All electrical equipment until distribution transformers will be monitored and remotely operated by the use of Field RTUs over a optical fibre communication network and backup RF mesh canopy. The distribution control centre shall also be connected with the AMI system mentioned in the previous chapters.

The communications system hierarchy will be as follows:

The FRTUs and IEDs shall report to the main and backup control centres using IEC-60870-5-104 protocol. The FRTUs and IEDs shall be connected to wireless Customer Premises Equipment (CPE) via Ethernet interfaces.

The Base stations will be connected with optical fiber to the nearest node in the existing SDH ring, which shall carry the signals to the control centres. The base stations will also have the capability to communicate with other base stations in the network using point to point (PTP) links.

The existing SDH network shall also be expanded by adding equipment at selected locations as required. The SDH network shall be expanded by adding STM-4/16 SDH equipment or as per existing equipment to the existing network. The expanded network shall be made in a ring configuration.

Annexure-I

LIST OF DRAWINGS

S. No.	DRAWING NO.	TITLE
	Project specific drawings	
1.	KVMDC /1	Single Line Diagram of RDC
2.	KVMDC/2	Schematic for Ring main system for RDC

ANNEXURE- II

LIST OF PREFERED (SHORTLISTED) MAKE

It is preferred that the following equipment be supplied from the manufacturers listed hereunder:

(i) M**ain Protection Relays, Automation System from:** ABB, AREVA / ALSTOM, SIEMENS, Fuji, Reyrolle, Toshiba, Mitsubishi, GE or equivalent.

(ii) MV **Circuit Breakers / LV Air CB:** ABB, AREVA/ALSTOM, Hitachi, Siemens, Mitsubishi, LG, Fuji, GE, Schnieder Electric or equivalent.

(iii) **Communication System:** NOKIA, NOKIA SIEMENS, SIEMENS, ABB, AREVA/ALSTOM or equivalent

(iv) **XLPE & ABC Cables:** KEI, Gupta Power Infrastructure Ltd., Diamond Power Infrastructure Ltd., Chongqing Taishan Cable Co. Ltd., TBEA Deyang Cable Co. Ltd. or equivalent

(v) **RMU:** ABB, Siemens, Schneider Electric, Shandong Taikai Power Switchgear Co. Ltd. or equivalent

(vi) **Cable Jointing Kit**: Densons, Prysmian, ENSTO, Raychem, 3M

The bidders may offer equipment/brands other than those listed above are better or equivalent with regard to quality and performance substantiated with appropriate documents. The bidder is required to submit all technical information, brochures, test reports of the proposed equipment for assessing equivalence with the shortlisted vendor during the bid submission.

ANNEXURE- III

LIST OF STREETS & ROAD WHERE UNDERGROUND IS TO BE DONE

It is tentative list where employer wishes to have underground system, but not limited to them. The areas will be finalized after submission of the study report. Other areas not listed is to be covered with ABC cables to replace existing overhead lines.

LAINCHAUR S/S

Narayanhiti Palace North Gate Road – Gairidhara Sadak – Subarn Samasher Marg – Neel Sarswati Marg – Thirbam Sadak – Bishalnagar Marg – Hadigau Marg

Kantipath – Jamal Road – Durbar Marg – Tridevi Sadak

Lekhnath Marg

Kantipath - Narayahiti Path – Hatisar Sadak – Narayanchaur – Tangal Marg

Samakhusi Marg

BALAJU S/S

Nayabazar Feeder: Swambhu Marg – Nayabazar Town Planning, Nayabazar

THAPATHALI SWHG

Tripura Marg

TEKU S/S

Kalimati Road – Tankeshwori Marg, Tripura Marg

SUNDHARA SWHG

Sundhara Marg – Naya Sadak – Khechapukhu Sadak
Kantipath (Sundhara To Dasartha Rangasala)

K-3 S/S

Putali Sadak – Tanka Prasad Sadak, Putali Sadak - DilliBazar Road – Charkhal Road – Thirbum Marg, Kalika Marg – Dillibazar Road – Maitidevi Marg – Pashupati Marg (Towards Jain Temple), Ratopul, Dillibazar Marg Towards Setopul – Tank Prasad Ghumati Sadak

K-2 S/S

Durbar Marg-Teen Dhara Marg-Pashupati Marg– Sama Marg
Baghbazar Sadak – Putali Sadak

Baneshwor To Baudha Line:

Mandan Bhandari Road – Ring Road (Tinkune – Gausala – Chabhil) – Boudhnatha Sadak

ANNEX IV

4. Metering Equipment (optional)

Requirements for Indoor Ring Main Units (only).

4.1 Design

Energy metering units (4-wire) shall be suitable for direct connection to adjacent extensible switch-disconnectors and fuse-switches or circuit breaker RMUs.

The design shall include a sealed and lockable marshalling enclosure that may be safely accessed from the front of the metering unit with the main busbars live. The bottom of the marshalling enclosure shall be located between 1.0 to 1.5 metres above ground level for easy access to secondary terminations during commissioning and testing. Only metering components and terminations as specified below shall be contained inside the marshalling enclosure. Such ancillary equipment as panel heater wiring and fusing shall be excluded from this compartment. An earth stud shall be provided within the marshalling enclosure with connection to the earth system via the main earth bar or conductor.

The Metering units shall have a continuous primary rating of 400 A at 11 kV, be equipped as detailed in sub-clauses set out below and shall be wired with ferrules numbered.

The metering unit design and construction shall facilitate the replacement of CT's and VT's in situ. The design shall also be such that all internal busbars lengths between CT's and VT's are minimised.

The Vendor shall submit with the Proposal, dimensioned outline drawings, schematic, layout and wiring diagrams of the metering units for review by Horizon Power.

Strong preference shall be given to Vendors offering metering units with all exposed busbars and associated mounting hardware fully shrouded and insulated from the environment.

4.1.2 Current Transformers

Three current transformers (CT) shall be provided with ratio 200/100/1 A for 11 kV metering units, of Class 0.5ME2 to AS 60044.1-2007, 15 VA output at unity burden. The CT shall comprise of two cores one for use by Horizon Power and the other by an MV Customer.

Accuracy requirements for both directions of current flow (P1 to P2 and P2 to P1), MUST be met at the marshalling enclosure terminals.

One CT shall be connected in each of the three phases and shall comply in all respects with AS 60044.1-2007. The current ratio change shall be made by tapped secondaries with all ratios brought out to the metering terminal block within

the marshalling enclosure.

The terminals provided within the marshalling enclosure shall be provided.

The CT terminal box shall have provision for sealing facilities.

4.1.3 Voltage Transformer

One three-phase or 3 single-phase voltage transformer(s) (VTs) shall be provided of ratio:

1) 11/√3 kV : 110/√3 V for 11 kV, and

2) 15 VA per phase, star/star connected, and

3) Class 0.5 M, and

4) Uniformly insulated secondary star point brought out and terminated in the metering cubicle as per drawing.

It is important to note that all secondary earthing points on the VT's shall be removed from inside the cubicle and terminated on the metering terminal block as indicated on M/D/4/08/4/1 (Rev A) (two meter connection diagram).

The accuracy requirement MUST be met at the marshalling enclosure terminals.

The voltage transformer must be suitable for operation with the high voltage star point connected to ground. The rated voltage factor shall be determined in accordance with AS 60044.2-2007. The voltage transformer(s) shall comply in all respects with AS 60044.2-2007. The VT terminal box shall have provision for sealing facilities.

The voltage transformer(s) shall be of the encapsulated type in air with substantial fault rated busbar connections and must NOT be fitted with fuse protection.

All connections from busbars to the voltage transformer(s) shall be rigid and self-supporting.

4.1.4 Secondary Wiring

All small secondary wiring within the metering unit shall be 4 mm² of stranded 7/0.85 mm cable, so laid up and restrained that there is no possibility of it coming in contact with the busbars or other live apparatus. VT and all tapped CT secondary terminations shall be wired out from their respective terminal boxes to the marshalling enclosure in their respective colours for the individual phases they represent. The S1 terminals from the three CT's shall be earthed locally to the main earth bar.

Terminals or intermediate connectors between CT or VT terminal boxes and marshalling enclosure shall not be used. Insulated crimp type lugs/connectors are not to be used in any of the CT / VT secondary wiring terminations. Non-insulated crimp connectors are permissible.

The terminals shall accommodate wire size up to 6 mm^{2} and be provided with test

plug sockets and short circuit bridges for the CT's secondary taps.

Wire identification shall be with white wire marking ferrules with engraved letters and numerals filled with non-deteriorating black paint. Ferrules shall be mounted as close as practicable to the termination point at both ends of the wire and assembled so that they may be read right-way-up from the normal viewing position.

Wiring must be installed such that it cannot suffer damage from stretching, pinching, fatigue or accidental interference during normal operation or maintenance. Mechanical barriers or protection shall be installed to prevent such wire damage.

The marshalling enclosure shall be accessible at all times while the busbars are live and have provision for sealing and locking the enclosure.

The marshalling enclosure provided with the extensible metering units shall be provided with a conduit hole 25 mm diameter for connection to a remotely mounted meter panel.

The marshalling enclosure provided with the metering unit shall be located within the metering cubicle provided by the Vendor.

The bottom of the marshalling enclosure shall be located between 1.0 to 1.5 metres above ground level for easy access to disconnect the secondary terminations during commissioning and testing. Only metering components and terminations shall be contained inside it. Such ancillary equipment as panel heater wiring and fusing shall be excluded from this compartment. An earth stud shall be provided within the marshalling enclosure with connection to the earth system via the main earth bar or conductor.

NOTE: The Vendor shall supply details of the current and voltage transformers and their characteristics. Factory test results are to be provided indicating compliance with the class of accuracy as specified below.

4.1.5 Terminal Markings of CT's and VT's

The following terminal markings are required and shall be clearly and indelibly marked or engraved and must be clearly visible from inside the MV chamber:

1) Voltage transformers (VT)
   a) Primary Winding:
      i) 'A, N' for Red Phase
      ii) 'B, N' for White Phase
      iii) 'C, N' for Blue Phase
   b) Secondary Winding:
      i) 'a, n' for Red Phase
      ii) 'b, n' for White Phase

iii) 'c, n' for Blue Phase

c) Phasing:

Ensure that when 'A' is positive with respect to 'N', 'a' is positive with respect to 'n' and similarly for 'B' and 'C'.

NOTE: Where 3 x single-phase electromagnetic VT's are star- connected the terminals 'N' and 'n' form the primary and secondary star points respectively.

2) Current transformers (CT)

a) Primary Winding:

P1 to P2 in the normal direction of current flow.

b) Secondary winding:

s1, s2, s3 - The polarity shall be arranged so that current flow into terminal P1 induces current flow out of terminal s1.

3) Labels P1 and P2 are to be placed inside the adjacent marshalling cubicle walls to indicate the orientation of Primary Current flow in the CT's with relation to the RMU housing.

4.1.6 Rating Plates of CT's and VT's

Rating plates shall be permanently attached to the CT's and VT's and copies of these labels shall be securely attached to the inside of the metering cubicle and shall be clearly visible while in service. The markings on these plates shall comply fully with the requirements of AS 60044.1-2007 and AS 60044.2-2007 respectively.