# TECHNICAL SPECIFICATION FOR 11/0.4KV,630/1000 KVA,CSS (DRY TYPE)

## 2.0 SCOPE OF WORK

### 2.1 GENERAL

- The scope of work includes design, detailed engineering, manufacture/ procurement of electrical equipment, shop testing, packing, transportation, loading & unloading, delivery, storage at site, handling, erection, pre-commissioning test and commissioning of all equipment/ system including preliminary acceptance test, performance guarantee and post commissioning services on a turn key basis.
- The scope shall also include insurance during transit, storage, erection and commissioning of all the equipment and accessories. Provision of commissioning spares required during testing and commissioning shall also be included in the scope.
- The contractor shall be responsible for completeness and working of the system with guaranteed technical parameters.
- Construction Power supply shall be arranged by the Tenderer.
- All civil works for shall be carried by the Tenderer. Tenderer shall take into consideration the following also:
    - Static and dynamic loading of the equipment
    - Clearances, approach, safety exits.

## 3.0 INSTRUCTIONS TO TENDERER

### 3.1 GENERAL

- This specification shall be read along with other documents like general conditions of supply and erection, etc. issued by the purchaser. In case of contradiction between the documents, the clauses of this Technical Specification shall prevail upon.
- Before submission of this Tender, the Tenderer is strongly advised to visit and examine the site and obtain all information required and satisfy himself regarding all matters such as access to site, proposed storage area for equipment, Transport and Communication facilities etc.
- Any exclusion / deviation from specification shall be clearly spelt out and listed at one place only and Tenderer shall substantiate the same. Otherwise it will be considered that Tenderer has accepted and followed the specification fully in word and spirit.
- Necessary stores (open and closed type) shall be made by the tenderer. Approx. area required shall be indicated to purchaser for space allocation. Security, watch and ward, fencing, buildings, lighting, storage, management of stores shall be in the scope of tenderer. All precaution shall be taken against theft.
- Identification labels shall be provided on all equipment. All labels shall be engraved on plastic (white letters with black background) and all text shall be in English language.
- For installation work at site, the contractor shall be fully responsible for arranging the supply of required tools and tackles, welding sets, pipe bending machine, crimping tools, gauges, scaffoldings, ladders, temporary water and construction Power.
- Tenderer shall supply necessary materials as required to ensure proper matching with the existing equipment / system of UPCL.
- Since the work is very critical, all precautions shall be taken before shut-downs, erection/modification and charging of the system. Written permission shall be taken by tenderer from purchaser for taking up any work. All efforts will be made to reduce the power shut–down periods and plan the work accordingly in 3 shifts basis.
- Before engaging any sub-contractor, the tenderer shall furnish full credentials of the sub-contractor and take written permission from UPCL.

- All clamps, brackets, bolts, nuts, screws, markers, ferrules, lugs and glands and other hardware necessary for erection work shall be included in the scope of work and shall be arranged by the contractor.
- Training facilities for the purchaser's engineers shall be provided in two parts:

  a) Operator training
  b) Maintenance training
- The Contractor shall ensure that all personnel employed do not stray into other areas .Any injury caused due to this shall be the sole responsibility of contractor.
- The contractor shall ensure that all the workmen and supervisors engaged by them or by their sub- contractor are provided with the proper safety appliances. Any violation in safety provisions or failure to maintain safe working conditions will lead to serious penalty on the contractor and finally may lead to termination of the contract.
- The contractor shall ensure that skilled labours required for specific works have necessary trade certificates and adequate experience of the job.
- The contractor must take sufficient care in moving his construction plants and equipment from one place to another so that those may not cause any damage to the property of the purchaser particularly to the overhead lines and underground cables and other service lines.
- When the work is carried out at night or in the obscure daylight, adequate arrangements for flood lighting in the working area shall be made by contractor at his own cost and got approved by the purchaser.
- The safety poster/ regulation for prevention of accidents shall be displayed by the contractor at appropriate places. Notices and warning signs shall be displayed for all source of dangers.

### 3.2 TIME SCHEDULE OF THE PROJECT

- The tenderer shall make the time schedule in the form of a bar chart / network diagram indicating the start and finish of all activities such as, placement of order, basic engineering, detail engineering (GA drawings, equipment layout drawings, civil foundation / structural drawings, control schemes, BOQ, Technical Specifications, terminal plan and interconnection diagram, cable schedule, cable layout drawings, etc., submission and approval of drawings, manufacture of equipments, inspection and testing at works, receipt of equipment at site, approval from electrical inspector, construction of civil facilities, erection of equipment, conducting PAT, FAT and commissioning of the complete equipment and system in individual and integrated manner.

### 3.3 COMPLIANCE WITH SPECIFICATION

- All equipment shall be suitable for voltage/freq. variations and other data given in Electrical System Design parameters.

### 3.4 STANDARDS AND REGULATIONS

- The Design, Manufacture, Performance, Testing and Installation (including safety earthing covered under this specification shall in general, comply with the latest issues of :
  - Applicable Standards and codes of practices published by BIS.
  - Central Board of Irrigation and Power.
  - Indian Electricity Act.
  - Central Electricity Authority.
  - Indian Electricity Rules.
- The make of equipment shall be limited to preferred makes indicated under 'List of preferred makes'
- Makes of other equipment and accessories are subject to prior approval by the purchaser.

- Similar equipment and components shall be of same make. Equipment of same type and rating shall be interchangeable
- The purchaser has the option of selecting the manufacturer of Electrical equipment, instruments and controls and any other specialized items in the interest of standardization. The successful tenderer shall have to supply equipment of the particular make.

### *3.5 SAFETY*

- All units with respect to their location, layout, general arrangement and design of equipment, structural design, etc shall be safe to the personnel and conform to the relevant safety rules and regulations/ statutory requirement issued by Uttarakhand Government and the Central Government but not limited to the following:
  - Indian Electricity Rules
  - Indian Electricity Act
  - Indian Explosives Manual
  - Fire Protection Manual issued by Tariff Advisory Committee (India)

### 3.6 EXPLOSIVES

- In case explosives are required for blasting of hard rock the same shall be arranged by the contractor at his own cost. Fulfillment of statutory obligations will be the responsibility of the contractor.
- Explosives shall not be used on the work by the Contractor without the permission in writing of purchaser and then only in the manner and to the extent to which it has been prescribed. Where explosives are used the same shall be stored in special premises. Contractor shall be liable for all damages, loss or injury to any person or property and shall be responsible for complying with all statutory obligations in these respects.
- The Contractor shall transport the explosive to the sites complying with statutory regulations at his own cost.
- The contractor shall engage only the licensed blasters and comply with all statutory regulations.

### 3.7 COMPLIANCE WITH RULES, REGULATIONS AND OBTAINING STATUTORY APPROVAL

- All equipment / materials shall be installed in accordance with the requirement of relevant standards, Indian electricity Rules and Acts .It is the responsibility of the tenderer to see that the electrical installation supplied and erected by him shall be to the entire satisfaction of Chief Electrical Inspector, Central Electricity Authority or any other statutory body having Jurisdiction in the area and also to the purchaser / consultant.
- The responsibility for obtaining the Electrical Inspectorate's approval for the installation to be carried out and commissioning shall rest entirely with the contractor .It shall be the responsibility of the contractor to prepare and submit all necessary drawings, calculations, test certificates and relevant details to the Electrical inspector and obtain prior approval for commencing the work and for the complete installation work done .The necessary statutory fee for inspection charged by Electrical inspectorate, shall be borne by the purchaser.

### 3.8 INSTRUCTION MANUALS

- Instruction manual shall give step by step procedure for:
  - Erection, testing and commissioning.
  - Operation & Maintenance

- Repair

- Maintenance instruction shall include tests for checking of proper functioning.
- Instruction manual shall also contain:
  - Manufacturer's catalogues with ordering specification for all items.
  - List of consumables with specifications, brand names and annual consumption figures.
  - Drawings relevant for erection, operation, maintenance and repair of the equipment.
  - Procedure for ordering spares.

3.9 SPARES

3.9.1 COMMISSIONING SPARES

- **The tenderer shall include in his offer sufficient quantity of commissioning spares required for commissioning of all equipment and for their efficient operation until their provisional acceptance after demonstration of satisfactory performance.**
- **A separate item wise list of commissioning spares indicating quantity of each item offered shall be furnished along with the tender. These items of commissioning spares shall be dispatched along with the main equipment.**
- However any additional spares required for successful commissioning shall be supplied free of cost.

3.9.2 TWO YEAR'S OPERATION & MAINTENANCE SPARES

- The list of two years recommended Operation & Maintenance spares shall be proposed by the tenderer & enclosed with the offer.
- The quotation shall include item-wise list of all spares indicating their unit rates and quantities.

3.10 CONSUMABLES AND FIRST FILL

The initial requirement of all consumables such as lubricants, transformer oil etc. for first filling, start-up, commissioning and performance test shall be provided along with the equipment in the main offer.

3.11 TESTS AND INSPECTION

- Routine tests shall be carried out on all equipment at manufacturer's work as per appropriate IS regulations. The contractor shall also carry out type tests on certain items .The contractor shall arrange all necessary facilities, free of cost for inspection and testing of the equipment by the purchaser. No equipment shall be dispatched to site without a provisional certificate of acceptance issued by the purchaser / consultant.
- Inspection and tests do not relieve the contractor of his contractual obligations regarding performance of the equipment at site/ in actual use.

3.12 INSTALLATION OF EQUIPMENT AND COMMISSIONING

- The contractor shall be fully responsible for the satisfactory Erection, Testing, Commissioning, start- up and performance test of equipment, not withstanding that he may be assisted by the purchaser's authorized representatives.
- The installation of all electrical equipment shall be carried out by an electrical contractor holding a valid license issued by the Uttarakhand State Government for carrying out installation work of the voltage classes involved under the direct supervision by persons holding valid certificates of competency for the same voltage classes .The tenderer shall furnish with his tender the particulars of the license held by him/ the electrical contractor he proposes to engage for carrying out the installation work against this specification .

3.13 Bidder will ensure the **Preventive maintenance of CSS & RMU, atleast 2 times in a year (once in six months) for the warranty period** by the manufacturer's service engineer only.

3.13 DRAWINGS/DOCUMENTS TO BE SUBMITTED BY THE TENDERER

3.13.1 DRAWINGS/DATA TO BE SUBMITTED ALONG WITH TENDER

1. Scope of work with general description of the system and equipment offered specifying the important features.
2. Bill of Quantities (un-priced) in specified format.
3. Detailed scope of work. Separately for electrical, civil, and yard structures.
4. Specific exclusions, if any, from scope of work.
5. Questionnaire as enclosed duly filled in.
6. List of deviations if any from Technical Specifications.
7. Estimated quantity of yard structures and civil work.
8. List of commissioning spares and consumables included with the main offer.
9. List of 1 years operation spares, recommended by the tenderer, equipment wise (unpriced).
10. Proposal for training of purchaser's personnel (equipment wise/man days basis).
11. Work schedule with bar chart indicating all activities.
12. List of performance tests proposed by the tenderer to demonstrate the guaranteed parameters.
13. Type test certificates for major categories of equipment issued by independent testing authority.
14. Reference list of similar jobs.
15. Type and make of protection relays for each type of 33 kV feeders along with write up and catalogues.
16. Instruction for storage of the equipment at site.
17. **Construction/ Erection /Testing Plan.**
18. Quality Assurance Plan (QAP) for each electrical equipment.

Note: **Failure to comply with above may itself be sufficient reason to reject the offer.**

**3.13.2 DATA / DRAWING TO BE SUBMITTED BY SUPPLIER AFTER PLACEMENT OF ORDER**

**3.13.2.1 GENERAL**

- Name of coordinators with address, telephone / FAX numbers for all sub contractors, pertaining to electrical job.
- List of equipment / tools and manpower proposed to be arranged for installation erection and site handling of the equipment.
- Name of site in charge with office/ organization and date of opening of site office.
- Quality Control manuals.
- Detailed list of drawings and documents.
- Monthly progress report furnishing status of planning, manufacture, transportation, erection testing and commissioning.

**3.13.2.2 APPROVAL CATEGORY DRAWINGS/ DOCUMENTS**

A. CALCULATIONS

- Earthing calculations
- Design calculations for steel structures used for mounting of electrical Equipment
- Design calculation for bus-bars to show adequacy of design parameters for:
  - Cantilever strength of post insulators
  - Vertical deflection of bus bars.
- Calculations to prove lux level of illumination for yard area and other areas.
- Relay settings with calculations and graph for justification of all relay settings (current and time both.)
- Calculation to justify CT/PT Parameters like VA burden etc for all cores.

B. OTHERS

- Single line diagram indicating transformers, isolators, CT/PT, all relays, meters, LA , cable sizes , details of CT/PT ratio, VA burden, $V_K$ value , type and make of all relays, their range nominal and short time ratings of breakers, busbars etc. for all switchyard equipment.
- Front view and GA diagrams for all panels
- Over all layout of the 33KV switchyard indicating sizes of all the premises, cable trenches, clearances etc.
- Control and schematics drgs. for control /protection for each equipment .
- Lightning protection drawing showing coverage of all equipment, structures, buildings etc.
- Earthing layout drawing covering internal /external rings and connections to equipment structures etc.
- Battery and charger schemes.
- Electrical equipment layout for all electrical premises.

#### 3.13.2.3 INFORMATION CATEGORY DRAWINGS/ DOCUMENTS

- Cable schedule indicating type of cables, from to via. route, total length size of cable and a final summary sheet indicating total requirement of all types of cables (for control and power both)
- Core wise control cable termination details indicating ferrule no. /terminal block no. for each cable /each equipment.
- Internal wiring diagram for all panels.
- Catalogues for each type of equipment, relays, meters etc.
- Installation and commissioning manuals for each equipment, relay etc.
- Operation and Maintenance Manuals indicating trouble shooting procedure for all Equipment.
- Type test certificates for all the major equipment.
- Details of test results, for test conducted at works for all equipment.
- Details of test results, for test conducted at site for all equipment.
- Spare part list number and ordering procedure for all recommended spares.
- Overall GA of all the panels/equipment.
- Fixing details of all the panels /equipment supporting structures etc.
- Static and dynamic loading of each equipment.
- Floor cutouts and wall opening details for cables and light conduits etc.
- Details and location of various inserts base plates, blots, etc. required to be provided for support of cable structure elect panel etc.
- As built drawings incorporating site changes along with reproducible.

### 3.14 FAMILIARIZATION OF THE SITE

The tenderer shall make himself familiar with the atmosphere, location, status and operating conditions at the site where the equipment included in the scope of supply are required to be installed. No extra claim shall be acceptable due to any modification/ diversions to be done later due to site conditions.

## 4.0 SYSTEM DESIGN PARAMETERS

### 4.1 CLIMATIC CONDITIONS

| | | |
|---|---|---|
| Maximum ambient temperature | : | 48 ° C |
| Minimuim ambient temperature | : | ( -) 2 ° C |
| Maximum relative humidity | : | 100 % |
| Altitude * | : | upto 1000M |
| Maximum wind load | : | 195 kg / $mm^2$ |
| Seismic level (Horizontal acceleration) | : | 0.3 g |
| Intensity of solar radiation | : | 1 KW / $M^2$ |

**4.2 SYSTEM PARTICULARS**

| | | |
|---|---|---|
| Highest system voltage | : | 12 kV for 11 kV system<br>36 kV for 33 kV system |
| Voltage variation | : | + 6 % and – 9 % for up to 33 kV<br>+ 6 % and –6 % for 11 kV & LV |
| System frequency | : | 50 Hz |
| Frequency variation | : | + 3 % and –3 % |
| DC supply voltage | : | 24 V DC |
| DC supply voltage variation | : | + 10 % and –15 % |
| No. of phases | : | 3 |
| Short circuit level | : | 20KA for 11 kV |
| System earthing | : | Solidly earthed |

As there is a wide variations in ambient temperature and altitude, Tenderer is required to submit derating/uprating factors for the same.

## 5.0 PERFORMANCE REQUIREMENT AND GUARANTEE

- The tenderer shall study the specification and satisfy himself thoroughly regarding the workability of the equipment and systems offered and also take full responsibility for the guaranteed operation and performance of the same as well as for their smooth, safe and reliable working.
- All equipment shall be guaranteed for workmanship, materials, design and satisfactory performance to the parameters in accordance with this specification. The guarantee for performance shall cover individual items as well as system as a whole.
- The suppliers shall conduct performance/ acceptance tests on each of the major items of equipment supplied to demonstrate that the equipment and system supplied are capable of

  achieving the performance parameters specified and contracted for. The performance test shall be carried over a period of twenty one consecutive days of continuous operation for twenty four hours each day. The test will comprise keeping energized all system and equipment at full load or whatever load available at that time. All system shall perform without any fault and temperature rises shall be within the specified limits for all equipment (to be demonstrated). In case of any fault/ defect within this period the tenderer shall rectify or replace the defective equipment / device free of cost. After the fault rectification, the test shall be undertaken afresh and shall be continued successfully for the specified duration.
- Should the tests specified show that the equipment has failed to achieve the guaranteed parameters the supplier shall carry out necessary modifications or part replacement to achieve the guaranteed parameters.
- Tenderer shall stand guarantee against obsolescence of equipment under their scope of supply for a minimum period of ten years and that discontinuity of production of any item offered as part of the system shall not effect the maintainability of the system.

## 9.0 INSPECTION AND TESTING

### 9.1 INSPECTION

#### 9.1.1 GENERAL

Inspection & testing of equipment covered under the Technical Specification shall be carried out by the Purchaser / Consultant at the manufacturers' works/ premises prior to despatch to ensure that their quality & workmanship are in conformity with the contract specifications and approved drawings.

#### 9.1.2 RESPONSIBILITY FOR INSPECTION

Any inspection by the Purchaser/ Consultant does not relieve the responsibility of quality assurance and quality control functions, as expected of the contractor to be performed by him for supply of plant & equipment as part of the contractual obligations.

**9.1.3 Extent of Inspection**

Routine test as per IS/IEC for 100% equipment.

Type test shall be carried out on each type of equipment for which the tenderer fails to produce Type Test Certificates carried on similar type of equipment within 5 years period.

**9.1.4 TESTS, TEST CERTIFICATES AND DOCUMENTS**

For each of the items being manufactured, following test certificates and Documents ( as applicable for each of the equipment ) in requisite copies shall be prepared and submitted to the Inspection Engineer for scrutiny & records.

Routine/ type/ calibration/ acceptance/ special test certificates for electrical items.

Certificates from competent authority for the items coming under statutory regulations.

Should the result of tests not come within the margin specified, the tests shall if required be repeated at Contractor's cost without any liability to the Purchaser.

**9.1.5 METHODS OF GIVING INSPECTION CALLS**

Inspection calls shall be given by the contractor with ten days notice period as per proforma (11.20 (DQM) F05/2 Rev.0).All calls shall accompany two sets of relevant test certificates and inspection report of the Contractor /sub-contractor after satisfactory completion of internal inspection and tests by them as per approved QAP .Inspection calls without enclosing relevant test certificates & internal inspection report shall not be entertained.

**9.2 TESTING**

Test of all equipment shall be conducted as per latest IS/IEC.

The site tests and acceptance tests to be performed by contractor are detailed below.

The contractor shall be responsible for satisfactory working of complete integrated system and guaranteed performance.

**ANNEXURE I**

**TECHNICAL SPECIFICATION FOR 11/0.433kV PACKAGE SUBSTATION AND 11KV INDOOR/ OUTDOOR RING MAIN UNIT**

1.0 **CODE & STANDARDS**:

1.1 All equipment and material shall be designed manufactured and tested in accordance with the latest applicable IEC standards. The 12KV Package Substation Design must be as per **IEC62271-202 only**.

1.2 The Package Sub-station offered shall in general comply with the latest issues including amendments of the following standards.

| **Title** | **Standards** |
|---|---|
| High Voltage Low Voltage Pre-Fabricated Substation | IEC:62271-202 |
| High Voltage Switches | IEC 60265 |
| Metal Enclosed High Voltage Switchgear | IEC 60298/ IEC62271-200 |
| High Voltage Switchgear | IEC 60694 |
| Low Voltage Switchgear and Control gear | IEC 60439 |
| Power Transformers | IEC 60076 |

1.3 The 11 KV packaged distribution substation shall be completed with all components and accessories, which are necessary or usual for their efficient performance and trouble free operation under the various operating and atmospheric conditions. The handling equipments required for operation & maintenance shall be in the scope of supply.

1.4 Such of the parts that may have not been specifically included, but otherwise from part of the 11 KV packaged distribution substation as per standard trade and/ or professional practice and/or are necessary for its proper operation, will be deemed to be also included in the specification. The successful bidder shall not be eligible for any extra charges for such accessories etc.

**2.0 DESIGN CRITERIA**

2.1 Package Sub-station consisting of **11KV 3-Way Non-Extensible SF6 Insulated Ring Main Unit with breaker as protection + Dry Type Transformer + Low Voltage Switchgear** with all connection accessories, fitting & auxiliary equipment in an Enclosure to supply Low-voltage energy from high-voltage system as detailed in this specification. The complete unit shall be installed on a substation plinth (base) as **Outdoor substation** located at very congested places. 11KV Isolators controls incoming-outgoing feeder cables of the 11KV distribution system. The Vacuum Circuit Breaker shall be used to control and isolate the 11kV/433V Distribution transformer. The transformer Low Voltage side shall be connected to Low Voltage switchgear. The connection cables to consumer shall be taken out from the Low Voltage switchgear

2.2 The prefabricated-package substation shall be designed for a) Compactness, b) fast installation, c) maintenance free operation, d) safety for worker/operator & public.

2.3 The Switchgear and component thereof shall be capable of withstanding the mechanical and thermal stresses of short circuit listed in ratings and requirements clause without any damage or deterioration of the materials.

2.4 For continues operation at specified ratings temperature rise of the various switchgear components shall be limited to permissible values stipulated in the relevant standard and / or this specification.

2.5 **Service Conditions**:

The Package substation shall be suitable for continuous operation under the basic service conditions indicated below

| | |
|---|---|
| Ambient Temperature: | 50 Deg C |
| Relative Humidity | upto 95% |
| Altitude of Installation | upto 1000m |

The Enclosure of High Voltage switchgear-control gear, Low Voltage switchgear-control gear & Transformer of the package substation shall be designed to be used under **normal outdoor service condition** as mentioned. The enclosure should take minimum space for the installation including the space required for approaching various doors & equipment inside.

## 3.0 SPECIFIC REQUIREMENT

3.1 The main components of a prefabricated- package substation are Transformer, High-voltage switchgear-control gear, Low-voltage switchgear-control gear and corresponding interconnections (cable, flexible , bus bars ) & auxiliary equipment. The components shall be enclosed, by either common enclosure or by an assembly of enclosure. All the components shall comply with their relevant IEC standards.

3.1.1 **Ratings**:

| **Description** | **Unit** | **Value** |
|---|---|---|
| Rated Voltage / Operating Voltage | kV rms | 11 |
| Rated frequency & Number of phases | Hz & nos. | 50 & 3 |
| kVA Rated maximum power of substation | kVA | 630/1000 |
| Rated Ingress protection class of Enclosure | IP: | IP-23 for Transformer Compartment and IP-54 for LT & HT Switchgear Compartment. |
| ***HV Insulation Level*** | | |
| Rated withstand voltage at power frequency of 50 Hz | kV rms | 28 |
| Rated Impulse withstand Voltage | kV peak | 75 |
| ***HV Network & Busbar*** | | |
| Rated current | Amp | 630A |
| Rated short time withstand current | kA rms / 3 sec | 21KA |
| Making capacity for switch-disconnector & earthing switches | kA peak | 50kA |
| Breaking capacity of Isolators ( rated full load) | A | 630A |
| ***LV Network*** | | **Incomer from Transformer:** 50KA, 50Hz ,4P, Manual drawout type Microprocessor based Air Circuit Breaker (ACB). **Outgoings:** 36KA, 3P, Fixed type Moulded Case Circuit Breakers with Microprocessor based release. |

**OUTDOOR ENCLOSURE**

3.2 **Outdoor enclosure**:

3.2.1 The outdoor enclosure shall be made of galvanized Sheet Steel tropicalised to local weather conditions.

3.2.2 The metal base shall ensure rigidity for easy transport & installation.

3.2.3 Substation will be used in outdoor application hence to prevent enclosure from rusting/corrosion, welding should be avoided.

3.2.4 Outdoor type enclosure having construction of Galvanized Sheet Steel of thickness 1.5/2mm and having 4 mm base frame. The enclosure shall have IP54 degree of protection for HT & LT switchgear compartment & IP23 degree of protection for transformer compartment. The Enclosure exterior shall be Powder coated (Colour Light Gray & D.A.Gray). Each compartment will be provided with the door and pad locking arrangement. The Compartment illumination lamp with door operated switch shall be provided for each compartment. Roof of CSS should be slant to avoid water and ice logging.

3.2.5 Package substation should be type tested for internal arc for IAC-AB for 20KA for 1 Sec as per IEC62271-202**.**

3.2.6 Considering the outdoor application of the substation the doors shall be provided with proper interlocking arrangement for safety of operator and to avoid corrosion door should have stainless steel hinges. Door should be provided with stoppers.

3.2.7 Interconnection between HT switchgear and transformer shall be using 1Cx3x95 sq. mm Al unarmored XLPE cable and between transformer and LT switchgear shall be using Al busbar.

**3.2.8 Internal Fault**: Failure within the package substation due either to a defect, an exceptional service condition or mal-operation may initiate an internal arc. Such an event may lead to the risk of injury, if persons are present. It is desirable that the highest practicable degree of protection to persons shall be provided. The Design shall be tested as per IEC61330/62271-202. **Type test report of arcing due to internal fault should submit with offer.**

3.2.9 **Covers & Doors**: Covers & doors are part of the enclosure. When they are closed, they shall provide the degree of protection specified for the enclosure. Ventilation openings shall be so arranged or shielded that same degree of protection as specified for enclosure is obtained. Additional wire mesh may be used with proper Danger board for safety of the operator. All covers, doors or roof shall be provided with locking facility or it shall not be possible to open or remove them before doors used for normal operation have been opened. The doors shall open outward at an angle of at least $90^0$ & be equipped with a device able to maintain them in an open position.

3.2.10 **Earthing**: All metallic components shall be earthed to a common earthing point. It shall be terminated by an adequate terminal intended for connection to the earth system of the installation, by way of flexible jumpers/strips & Lug arrangement. The continuity of the earth system shall be ensured taking into account the thermal & mechanical stresses caused by the current it may have to carry. The components to be connected to the earth system shall include :

- **a)** The enclosure of Package substation,
- **b)** The enclosure of High voltage switchgear & control gear from the terminal provided for the purpose,
- **c)** The metal screen & the high voltage cable earth conductor,
- **d)** The transformer tank or metal frame of transformer,
- **e)** The frame &/or enclosure of low voltage switchgear,

3.2.11 There shall be an arrangement for internal lighting activated by associated switch for HV, Transformer & LV compartments separately.

3.2.12 **Labels**: Labels for warning, manufacturer's operating instructions etc. shall be durable & clearly legible.

3.2.13 **Cleaning & Painting :**

The paints shall be carefully selected to withstand tropical heat and rain. The paint shall not scale off or crinkle or be removed by abrasion due to normal handling.

**TECHNICAL SPECIFICATION OF 11KV SF6 INSULATED METAL ENCLOSED OUTDOOR RING MAIN UNIT (RMU).**

This RMU should be complete with all components necessary for its effective and trouble free operation along with associated equipment etc. such components should be deemed to be within the scope of supplier's supply.

The RMU should be fixed type SF-6 insulated, combination of Load Break Switch and Vacuum Circuit Breakers with O/C & E/F relay for the protection of the transformer. It should be maintenance free equipment, having on magnetic and non ferrite grade stainless steel robotically welded IP67 enclosure.

## 4.0 STANDARDS AND REFERENCE DOCUMENTS

### *5.1 Codes and Standards*

The **RING MAIN UNIT (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/ IEC 62271-200: A.C metal-enclosed switchgear and control gear for rated voltages above 1KV and up to and including 72KV and the IEC Codes herein referred.
IEC 60129/ IEC 62271-102: Alternating current disconnections (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 standard**s.

**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.**

### 5.2 Salient Technical feature of "SF-6 Insulated RMU."

11KV SF6 INSULATED NON-EXTENSIBLE in case of CSS and Extensible in case of Outdoor installation, Ring Main Unit (RMU), comprising of combination of Load break Switches and Vacuum "T"OFF Circuit Breaker with (3 O/C & 1E/F) Relays, each consists of:

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**(A) Load Break Switch (LBS) (630A)**

Load break switch should have the following

-Manually operated 12 KV, 630A Load Break switch 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 possible without disconnection of cables.

-Cable boxes suitable for 1R X 3C x 300 sq mm XLPE Cable with right angle Cable terminal Protectors.

-Cable boxes should be Arc Proof and interlocked with respective Earthing Switches. For safety of operator it should not be possible to open the cable box unless the earth switch is ON.

-Each RMU should consist of Fault Passage Indicator with re-set facility and SCADA Compatibility.

**(B) Circuit Breaker. ( 630A)**

Circuit Breaker should have the following:

- Manually operated 630 A 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.
- 3O/C + 1E/F self powered relay with Low and High set for Over current and Earth Fault. Relay should have facility to display the maximum loaded phase current also. Relay should have facility to trip the breaker from remote commands without shunt trip coil.
- Mechanical ON/OFF/EARTH Indication

Loose Material:

i) Operating handle

## INDOOR RMU FOR CSS

1. Modular design, panel type.
2. RMU must be made of robotically welded non magnetic and non ferrite grade stainless steel with all live parts inside stainless steel tank
3. Offered RMU must be **Non extensible.**
4. Maximum Modules can be accommodated in a single Stainless steel Tank so as to make it more compact and reliable.
5. Cable covers must be interlocked with Earth switch to have complete safety of operating person.

## RMU FOR OUTDOOR INSTALLATION

1. Modular design, panel type.
2. RMU must be made of robotically welded non magnetic and non ferrite grade stainless steel with all live parts inside stainless steel tank
3. **Offered RMU must be Both Side Extensible type.**
4. Maximum Modules can be accommodated in a single Stainless steel Tank so as to make it more compact and reliable.
5. Cable covers must be interlocked with Earth switch to have complete safety of operating person.

6. Outdoor RMU shall enclosed in IP54 enclosure.

### 5.3 DIELECTRIC MEDIUM

SF6 GAS shall be used for the dielectric medium for 11KV RMU's in accordance with IEC376. It is preferable to fit an absorption material in the tank to absorb the moisture from the SF6 gas and to regenerate the SF6 gas following arc interruption. The SF6 insulating medium shall be constantly monitored via a temperature compensating gas pressure indicator offering a simple go, no-go indication.
The RMU should have provision of Gas filling at site, in case there is some leakage of the gas.

### 5.4 GENERAL TECHNICAL REQUIREMENTS

5.4.1 Fixed type Vacuum Circuit Breakers insulated in SF6 gas. It should be maintenance free, having non magnetic and non ferrite grade stainless steel robotically welded enclosure for INDOOR/ OUTDOOR RMU application.
5.4.2 Low gas pressure devices. RMU should have full rating with 0.0 Bar gas pressure.
5.4.3 Live cable indicators- High operator safety.
5.4.4 Fully Rated integral earthing switch for Switches and Breakers.
5.4.5 Self powered Microprocessor Based 3O/C + 1E/F self powered relay with Low and High set for Over current and Earth Fault - Does not require any external source of power.
5.4.6 Units fully SCADA Comaptible. 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.
5.4.7 Cable testing possible without disconnection of cables.
5.4.8 Compact in dimension.
5.4.9 Low pressure, sealed for life equipment,
5.4.10 Cable earthing switch on all switching device-standard, for operator safety.
5.4.11 All live parts should be inside a hermetically sealed Stainless Steel enclosure for indoor RMU.
5.4.13 Indoor unit should be classified as sealed pressure system with gas leak rate of less that 0.1% per year requiring no gas filling for 30+ years of functional life.

### 5.5 TECHNICAL AND GUARANTEED PARTICULARS.

The bidders shall furnish all guaranteed technical particulars as called for this specification.

## 5.0 DESIGN CRITERIA

### 6.1 *Service conditions*

The offered switchgear and control gear should be suitable for continuous operation under the basic service conditions indicated below. Installation should be in normal indoor conditions in accordance with IEC 60694.

Ambient temperature -1oC to +45oC
Relative humidity up to 95%
Altitude of installation up to 1000m, IEC 60120

### *6.2 General structural and mechanical construction*

The offered RMU 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 SF6 and contains all high voltage components sealed off from the environment.

The units should be constructed from non magnetic and non ferrite grade stainless steel sheets. 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.

The cubicle should be have 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 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 Outdoor Enclosure

## 6.0 TECHNICAL DATA

### 7.1 *Ring Main Unit, Electrical data*

**Electrical data and service conditions**

| **No** ***Rated voltage*** | KV | ***12KV*** |
|---|---|---|
| 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 | 630 |
| ***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 swich) | A | 200 |
| 11 earth fault cable charging (cable switch) | A | 115 |
| 12 short circuit breaking current (T-off circuit breaker) | kA | 20kA (Outdoor)/ 21kA (Indoor) |
| 13 Rated making capacity | kA | 50 |
| 14 Rated short time current 3 sec. 21kA (Indoor) | kA | 20kA(Outdoor)/ |

***Ambient temperature:***

| | |
|---|---|
| 15 Maximum value | °C + 50 |
| 16 Maximum value of 24 hour mean | °C + 35 |
| 17 Minimum value | °C 0 |
| 18 Altitude for erection above sea level 4m | ...1000 |
| 19 Relative humidity | Max 95% |

### *7.2 Ring Main Unit Technical data (11KV) INDOOR/ OUTDOOR*

***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 | as per IEC |
| 8 Gas leakage rate / annum % | 0.1% per annum |

| | | |
|---|---|---|
| 9 Expected operating lifetime | | 30 years |
| 10 Whether facilities provided for gas | Yes, | temperature compensated manometer monitoring can be delivered |
| 11 Material used in tank construction | | Non -Magentic and Non ferrite grade Stainless steel sheet |

***Operations, degree of protection and colours***

| | |
|---|---|
| 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. 40-50ms |
| 5 Closing time of Circuit Breaker | approx. 30-45ms |
| 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 | 3position combined switch |

***Degree of protection:***

| | |
|---|---|
| 10 High Voltage live parts, | SF6 tank IP 67 |
| 11 Front cover mechanism | IP 2X for Indoor |
| 12 Cable covers | IP 3X for Indoor |
| 13 Outdoor Enclosure | IP 54 for Outdoor |

***Colours:***

| | |
|---|---|
| 14 Front cover | 7035 |
| 15 cable cover | 7035 |
| 16 Outdoor enclosure | IS 632 Dark Admiral grey |

## 7.0 PANEL(MODULE) DESCRIPTION

### 8.1.1 Incoming cable module

It should be consist of an SF6 cubicle housing a switch disconnector and an earthing switch. Bus bars and all electrical connections are located inside the tank. The operating shafts for the switches should be have rotary seals where they enter the SF6 cubicle. The operating mechanisms should be located outside on the front of the SF6 tank. Cable bushings should be located in a separate cable compartment. Front covers containing the mimic diagram and having a degree of protection IP2XC close the fronts.

### 8.1.2 The T-off circuit breaker module (630 A)

The T-off circuit breaker module should be consisting of an SF6 cubicle housing a Vacuum/ SF6 circuit breaker unit and a disconnector- earthing switch. An integrated relay and related CTs is used for tripping of the circuit breaker. Bus bars and all electrical connections should be located inside the tank. The operating shafts for the switches should be have rotary seals where they enter the SF6 cubicle. The operating mechanisms are located outside on the front of the SF6 tank. Cable bushings should be located in a separate cable compartment. Front covers containing the mimic diagram having a degree of protection IP2X seal off the fronts.

Off load isolator shall be provided after the Vacuum circuit breaker for maintenance purpose.

## 8.2 CIRCUIT BREAKERS

Vacuum bottles should be use as interrupters of the currents. The circuit breaker main circuit should be connected in series with a three-position disconnector –earthing switch. The operation between circuit breaker and disconnector ear thing must be interlocked.

1.VCB must self tripping and has a self powered relay

## *8.0* OTHER MAIN FEATURES

### *9.1 Bus bars*

Comprising the 3 single phases electrolytic grade copper bus bars and the connections to the switch or circuit breaker. 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.

***9.2 The cable switch***

It should be a switch-disconnector and ear thing switch using SF6 gas as an arc-quenching medium. The switch positions are closed – open – earthed. In the open position the switch satisfies the disconnector requirements.

***9.3 Earthing Switch***

Earthing switches should be rated equal to the switchgear rating.
Earthing switches should be quick make type capable of making Rated Fault Current.Earthing switch should be operated from the front of the cubicle by means of a removable handle.

***9.4 The mechanisms***

All mechanisms should be situated in the mechanism compartment behind the front covers outside the SF6-tank. The mechanism for the switch and the earthing switch is operating both switches via one common shaft. The mechanism provide independent manual operation for closing and opening of the switch, independent closing of the earthing switch and dependent opening of the earthing switch.

The mechanism for the T-off switch and earthing 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 earthing switch. 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.

***9.5 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.

***9.6 Position indicators***

The position indicators are visible through the front cover and are directly linked to the operating shaft of the switching devices.

***9.7 Voltage indicator***

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.

***9.8 Cable compartment***

It should be possible to terminate up to a 1x 3c x300sqmm core HV cables in each cable compartment. The access to the compartment will be possible by removing the cable cover, ORHinged to the main frame only when earth switch is ON. Cable Compartments of RMU should be Arc Proof and interlocked with respective Earth Switches.. Each module has a separate cable compartment that is segregated from each other by means of a partition wall. A partition wall should be fitted to divide the cable compartment from the rear side of the switchgear. In case of an arc inside the tank, followed by the opening of the pressure relief, the partition wall prevents the hot gases flowing out from the

pressure relief to enter the cable compartments. All covers are removable. The ground continuity is achieved when the covers are in place by means of Hinged connections.
Interconnection between HT switchgear and transformer shall be using 1Cx3x95 sq.mm Al. unarmoured XLPE Cable.

**9.9. 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/GI with a minimum cross section of 120 $mm^2$ 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/GI bar, which rises up to the connecting point of the tank behind the rear partition wall on the middle of the switchgear.

***9.10 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. The mechanism for the VCB and the disconnector-earthing switch should be has a built in interlocking system to prevent operation of the disconnector-earthing switch when the VCB is in the closed position.

Further is should not be possible to Open the Cable doors unless the Earthing Switch is TurnedON. In case the Cable door is accidentally left open a positive interlock shall prevent operation of Load Break Switch and Isolators / Breaker from any operation.

**9.11 Current Transformers**

All current transformers should be complying with IEC 60185.
Current transformers should be of dry type, with ratings and ratios as required.
Cable current transformers used in circuit breaker modules should be maximum 100mm wide. Current transformer shall be placed in the cable covers so that it can be easily replaced at site without removing the bushings.

**9.12 Auxiliaries.**

The switchgear should be prepared for options like motor operation, auxiliary contacts and short-circuit indicators. Necessary terminal blocks and wiring etc. should be placed behind the front cover of each module.

**9.13 Fault Passage Indicators.**

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 to avoid thefts. The FPI shall have clear display, automatic reset facility and shall be SCADA compatible.

**1 No FPI shall be provided in each Isolator.**

**9.0 TESTING AND CERTIFICATION.**

***10.1 TYPE TESTS.***

Units should be type tested in accordance with IEC standards 60056, 60129, 60265, 60298,60420,60529 and 60694. The following type tests should perform on the HT Switchgear and report should submit with offer.

- 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.

Type test reports for above type shall be submitted with the offer.

***10.2 ROUTINE TESTS.***

Routine tests should be carried out in accordance with IEC 60298 standards. These tests should be 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
- Withstand voltage on the auxiliary circuits
- Operation of functional locks, interlocks, signalling 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
- Time travel characteristics measurement facility for Breaker should be available with the manufacturer to asses the quality of RMU.

***DRY TYPE DISTRIBUTION TRANSFORMER IN CSS***

This specification covers the requirements of design, manufacture, testing and supply of cast resin dry type transformers complete with all the accessories and fittings for efficient and trouble-free operation.

**10.1 CODES & STANDARDS**

The equipment covered by this specification shall, unless Other wise stated to be designed, constructed and tested in accordance with latest revisions of relevant Indian standards / IEC publications.

| | | |
|---|---|---|
| IS 1271 | - | Classification of Insulating Materials. |
| IS 2026 | - | Power transformers (part I - V) |
| IS 2099 | - | Bushing for alternating voltages above 1000 V |
| IS 2705 | - | Current transformers |
| IS 3202 | - | Code of practice for climate proofing |
| IS 3639 | - | Power transformer fittings and accessories |
| IS 4257 | - | Porcelain bushings for transformers |
| IS 11171 | - | Dry type Transformer |
| IS 8478 | - | Application guide for tap-changers |
| IS 10028 | - | Code of practice for selection, installation andmaintenance of transformers. |

**10.2 GENERAL DESIGN FEATURES**

10.2.1All transformers shall be of the latest design, dry type Cast Resin only.

10.2.2 The type of cooling shall be Natural Air cooled (AN) and the corresponding ratings for each transformer shall be as indicated in the specific requirements.

10.2.3 Each transformer shall be suitable for operation at full rated power on all tapings without exceeding the applicable temperature rise.

10.2.4 It shall be possible to operate the transformer satisfactorily, with the loading guide specified in IS-6600. There shall be no limitations imposed by bushings, tap changers, auxiliary equipment to meet this requirement.

10.2.5 The transformers shall be designed to be capable of with-standing, without injury, the thermal and mechanical effects of short-circuits between phases or betweenphase and earth at the terminals of any winding with full voltage applied across the other winding for periods given in relevant standards. There shall be no limitations imposed by any part/component of the transformer/off load tap links to meet the short circuit level Specified.

10.2.6 Each transformer shall be designed for minimum no-load and load losses within the economic limit and shall be able to have minimum loss at the rated load condition.

10.2.7 All electrical connections and contacts shall be of ample cross sections for carrying the rated current without excessive heating.

10.2.8 The transformer shall be capable of continuous operation at full load rating under the following conditions.

a) Voltage variation = ± 10%

b) Frequency variation = ± 5%

c) Combined voltage and frequency variation (Absolute sum) = 10%

**10.3 CONSTRUCTION**

10.3.1 The transformer shall be dry type, AN cooled suitable for Compact substation application.

10.3.2 The core-clamping frame shall be provided with lifting eyes having ample strength to lift the complete core and winding assembly.

10.3.3 Off circuit tapings shall be provided on the HV windings. Tap changing is done by means of off-circuit links accessible through openings provided.

10.3.4 The lifting lugs and rollers shall be provided. A winding temp. Scanner shall be provided and is actuated by means of resistance temperature detectors embedded in LV windings of all three phases. It should have alarm and trip contacts at a specified temperature.

10.3.5 The transformer shall be of IP00 protection class and will be installed in the transformer compartment of compact substation having IP23 protection class.

**10.4 WINDINGS**

10.4.1 The winding insulation shall be Class 'H' and temperature rise limit to Class H i.e 115 deg.C as required.

10.4.2 Windings shall be of electrolytic copper conductors (circular in shape) of high conductivity and 99.9% purity.

10.4.3 Windings shall be designed to withstand the specified thermal and dynamic short circuit stresses.

10.4.4 The windings shall be duly sectionalised. Accessible joints brazed or welded and finished smooth shall connect similar sections. No corona discharge shall result on the winding upon testing the transformer for induced voltage test as specified in IS.

10.4.5 The end turns of the high voltage windings shall have reinforced insulation to take care of the voltage surges likely to occur during switching or any other abnormal condition.

10.4.6 The high voltage and low voltage winding are shall be made of copper Conductors. HV winding will be always be resin casted under vacuum while LV winding can either be casted or pre-impregnated with resin.

**10.5. CORE**

10.5.1 The double wound Core shall be constructed from non-ageing cold rolled Grain oriented steel sheets. The built core shall be painted with high temperature resistant paint to prevent corrosion at the edges of core plates and to withstand high temperatures. By using different core material optimisation of core losses shall be achieved. The yokes shall be firmly clamped between yoke channels or plates. The top & bottom yoke frames shall be secured to each other by means of tie-rods, which help in securing the winding in place.

10.5.2 The design of the magnetic circuit shall be such as to avoid static discharges, development of short circuit paths within itself or to the earthed clamping structure and the production of flux component at right angles to the planes of laminations which may cause local heating.

**10.6 OFF-CIRCUIT TAP CHANGING LINKS**

10.6.1 Off circuit tapings are provided on HV windings. Tap changing is done by means off circuit links. Use of tap changing links eliminates any moving parts as against a manually operated tap changer.

**10.7 Terminal Arrangement**

HV side and LV side of transformer will have the top busbar arrangement for connection of HT side by means of cable and LT side by means of busbar.

**10.8 Technical particulars of dry type transformer**

| SR. NO. | DESCRIPTION | PARTICULARS |
|---|---|---|
| 01 | Type | Three Phase, 50 Hz, Core type, two winding, Cast Resin Dry type Transformer |
| 02 | Rating ( KVA ) | 630/1000 Kva |
| 03 | Winding material | Copper |
| 04 | No load voltage ratio | 11 / 0.433 KV |
| 05 | Connection<br>a) HV<br>b) LV | <br>Delta<br>Star with neutral |
| 06 | Vector group | Dyn 11 |
| 07 | Insulation level (KVp/ KVrms)<br>a) HV<br>b) LV | <br>75 / 28<br>-/ 03 |
| 09 | Type of Tap Changer for giving voltage variation to HV | Off ckt tap links |
| 10 | Tapping range | +5 % to –5 % in step of 2.5% |
| 11 | Temperature rise winding over ambient temperature | 115 °C |
| 12 | Class of Insulation | Class 'H' |
| 13 | Enclosure | IP 00 ( Without Enclosure ) |
| 14 | Method of Cooling | AN (Air Natural) |
| 15 | No load losses (IS Tol.) | 2600W or as per IS Tolerance |
| 16 | Full load loss (IS Tol.) | 9800W or as per IS Tolerance |
| 17 | Termination<br>HV<br>LV | <br>Busbar<br>Busbar |
| 18 | Fittings for Dry type | 2 Numbers Earthing Terminals, Rating and Diagram Plate, Bi-Directional Rollers, Lifting Lugs, Winding Temp Scanner. |
| 19 | Paint | Enamel-RAL 7032 (Siemens Grey) |

**10.8 PAINTING**

10.8.1 All steel surfaces shall be thoroughly cleaned by sand blasting or chemical agents as required to produce a smooth surface free of scale, grease and rust

10.8.2 The external surface, after cleaning, shall be given a cost of high quality red oxide or yellow quoted primer, followed by filler coats.

**10.9 Routine Test**

All Routine Tests in accordance with IEC 60076 / IS 2026 shall be carried out on each transformer.

# LT DISTRIBUTION PANEL IN CSS

**11 12.1 System**:-

a) **Declared voltage** :– 3 Phase,400V (±6%) 50 Hz,
b) **Neutral** :– Solidly earthed at substation.
c) **Busbar**– Aluminum

**12.2 General finish**:- Tropical, totally enclosed, metal-clad, weather-proof, vermin and dustproof.

**12.3 Construction :**

**Enclosure**:- Dead Front type of enclosure shall be able to provide the degree of Protection IP:4X. Each LT incomer/ outgoing switchgear should be mounted in separate compartment to ensure added safety.
**Provision shall be made to mount TVM Meter of UPCL in main incomer.**

**12.4 Circuit Ways:**

**I) 630/1000kVA Transformer – a) Incomer** –1No. 2000A, 4P, 50kA Microprocessor based Air Circuit Breaker (ACB) with O/c, E/f & S/c protection.
**b) Outgoing** – 4Nos. 630A, 3P, 36kA Microprocessor based Moulded Case Circuit Breaker (MCCB) with O/c, E/f & S/c protection.

Air Circuit breaker will be of 4P, 50KA Manual drawout microprocessor based over current, short circuit and earth fault release.
Moulded case circuit breaker will be of 3P, 36kA fixed manual microprocessor based Overload, Earth Fault and short circuit release.

The design of the LT panel should be type tested for the short circuit, temperature & Ingress protection test and type test report should submit with offer**.**

**12.5 GENERAL CHARACTERISTICS OF ACB**

12.5.1) Conformity with Standards

The air circuit-breakers used in low voltage installations are constructed and tested in accordance with the IEC 947/IS 947 Standards and respect the following EC directives:

– "Low voltage Directive" (LVD) No. 73/23 EEC
– "Electromagnetic compatibility Directive" (EMC) No.89/336 EEC

12.5.2) Functional characteristics

– The circuit-breakers must have a rated service voltage of 690 V AC and a rated insulation voltage of 1000 V.
– The circuit-breakers must have a rated impulse withstand voltage of 12 kV.
– The rated uninterrupted current must be between 800 and 6300 A with the possibility of selection of ratings from 320 A.
– Different versions shall be available with rated ultimate short circuit breaking capacity(Icu) from 50kA at 415V and shall have rated short circuit service breaking capacity(Ics) equals to Icu.
– Different versions of circuit-breakers shall be available with rated short-time withstand current (Icw -1 sec) for 50kA for 1sec in category B.
– It must be possible to supply the circuit-breakers both from the top and bottom terminals without derating their performances and without jeopardising their functionality.
– The mechanical life must be at least 25000 operations, with regular ordinary maintenance.
– The electrical life must be at least 10,000 operations, with regular ordinary maintenance.
These values are intended to be valid only for CAT B circuit-breakers.

12.5.3) Environmental characteristics

– Operating temperature: -25 °C...+70 °C (-13 °F...158 °F)
– Storage temperature: -40 °C...+70 °C (-40 °F...158 °F)
– Altitude: operation without derating up to 2000 m a.s.l. (6600 ft), and with derating up to 5000 m a.s.l. (16500 ft)
– Suitability for use in a hot-humid environment. With regard to this, the circuit-breakers must undergo a tropicalisation process which makes them suitable for use in a hot-humid environment, as established by the prescriptions of the main shipping registers and in accordance with the international IEC 60068-2-30 Standards.

12.5.4) Construction characteristics

- The circuit-breaker structure must be made of steel sheet.
- There must be total segregation between power and front shield, using double insulation where suitable so as to guarantee maximum operator safety.
- Total segregation between the phases must be guaranteed for safety reasons.
- The main contacts must be separate from the arcing contacts in cat. B circuit-breakers only.
- It must be possible to inspect easily the arcing chambers easily and to check main contact wear with the circuit-breaker racked-out, by removing the arcing chambers.
- All the circuit-breakers in the range have the same height and depth with the aim of standardising the supporting structures of the switchgear and the switchgear itself as far as possible.
- The circuit-breakers must indicate the precise position of the main contacts and the condition of springs charged/discharged on the front, by means of certain and reliable signals.
- The operating mechanism must be of the stored energy type with operation by means of precharged springs fitted with antipumping device. The springs are charged manually by activating the front lever, or by means of a geared motor, supplied on request.
- The whole range of air circuit-breakers must be fitted with electronic protection releases. It must be allowed the interchangeability of protection releases from skilled personnel.
- ACBs shall have minimum watt losses in order to restrict temperature rise inside the breaker.

### 12.5.5 RELEASES

1) Release (Protection functions)

- The release must not require auxiliary power supplies since the power is taken from the current transformers.
- The signals supplied by the release must not operate with power supply supplied by internal batteries. The basic version of the release must provide:
- protection against overload with trip with inverse long time delay (L)
- protection against instantaneous short-circuit (I)
- Selective short-circuit (S)
- Earth fault (G)

## 12.6 General aspects of MCCB with microprocessor based release

*Standards conformity*

Molded case circuit-breakers (MCCB) installed in the low voltage plant must be designed, manufactured and tested according with the international standards IEC 60947-1, IEC 60947-2,IEC 60947-3, IEC 60947-4-1, IEC 61000 or with the corresponding harmonized national standards, the CE "Low Voltage Directives" (LVD) n° 73/23 EEC and "Electromagnetic Compatibility Directive" (EMC) n° 89/336 EEC.

### 12.6.1 Molded case circuit breakers functional features

- Rated insulation voltage (Ui) for MCCB shall be 800 VAC or more.
- Rated Impulse withstand voltage (Uimp) for mccb's shall be 8kV.
- Rated service voltage(Ue) for the moulded case circuit breaker shall be standard as 690V, however performance on short circuit level shall be consider based on system operating voltage.
- Rated uninterrupted current between varying from 160 and 3200 A with trip units settings starting from 10A
- Rated short circuit breaking capacity shall be considered as per bill of material and the rated service short circuit breaking capacity (Ics) shall be in 100% of rated ultimate short circuit breaking capacity (Icu). (Ics=Icu)

- According to IEC 60947-2 (§ 4.4) starting from 400 A the circuit breakers must be category B, however other small rating category A shall be confirmed.
- MCCBs must be available with different ultimate short breaking capacities between 16kA and 200kA @ 380/415 V AC.
- Both line up and line down supplying must be possible without decreasing MCCBs performances or functionality
- MCCB shall confirms to current limiting type and this feature shall ensure less amount of let through energy at the time of opening on fault. The mccb shall have opening time less then 10msec for current rating upto 630A, and less them 15msec for current rating upto 1600Amps.
- A test bottom for the correct functionality checking (moving contacts opening) must be place in front of the breaker.

### 12.6.2 Ambient characteristics

- Operating temperature: -25 °C .. +70 °C (ambient temperature)
- Storage temperature: -40 °C .. +70 °C (ambient temperature)
- Maximum relative humidity: 98%
- Maximum altitude: 2000 m above sea level, 5000 m above sea level with derating
- Suitability for being used in hot-humid places.
- Circuit-breakers fitted with electronic trip units must comply with the prescriptions of the International Standards on electromagnetic compatibility.

### 12.6.3 Construction characteristics

- The range of moulded case circuit-breakers must cover a range of rated uninterrupted currents from 160 to 3200 A.
- By means of the double insulation technique, moulded case circuit-breakers must guarantee complete separation between the power circuits and the auxiliary circuits.
- Moulded case circuit-breakers must have an operating lever which always indicates the exact position of the circuit-breaker contacts (positive operation), by means of safe and reliable signals (I= closed, O= open, yellow-green line= open due to trip unit).
- Moulded case circuit-breakers must be suitable for isolation in compliance with § 7.2.7 of the IEC 60947-2 Standard. This indication must be clearly and indelibly marked on the circuit-breaker (in accordance with § 5.2 of IEC 60947-2) and in a position where it is visible with the circuit-breaker installed.
- Moulded case circuit-breakers with rated uninterrupted current up to 250 A shall have a 45 mm high face which makes them suitable for installation on modular panels.
- The same depth must be guaranteed from 320 A up to 1000 A, in order to standardize both switchboards and their supports.
- All the installation positions must be possible without jeopardizing the function of the apparatus. Starting from 630 A up to 1600 A the withdrawable version shall be mounted and operated horizontally.
- For the front parts of the circuit-breakers the degree of protection of at least IP20 (excluding the terminals) must be guaranteed.

### 12.6.4 Protection trip units

- From the 250 A size circuit-breakers, the trip unit must be interchangeable.
  Electronic overcurrent releases
- The electronic overcurrent trip units must be self-supplied and must be able to guarantee correct operation of the protection functions even in the presence of a single phase supplied with a current value equal to 20% of the phase current.
- They must be unaffected by electromagnetic interference in compliance with the EMC directive on the matter.
- The basic version shall be fitted with protection functions against overload (function L) and against short-circuit. The latter function can either be of the instantaneous type (function I) or, alternatively, with intentional delay (function S). The function of protection against short circuit must be excludable. A basic version shall also be provided with only the protection threshold against instantaneous short-circuit which cannot be excluded.

- The minimum performances of the protection functions of the electronic protection trip unit for distribution, where present, must be:
    1. Function **L**:adjustable trip threshold I1= (0.4…1) x In, trip curves for the basic version with times from 3 to 12 seconds – 2 different trip curves - (at 6 times the set threshold). Cannot be excluded.
    2. Function **S**: adjustable trip threshold I2= (1…10) x In, trip curves for the basic version with times from 0.1 to 0.25 seconds – 2 different trip curves – (at 8 times the rated current of the trip unit.Can be excluded.
    3. Function **I**: adjustable trip threshold I3= (1…10) x In for the basic version (instantaneous trip). Can be excluded.
- All the protection functions must be characterized by threshold and time tolerances according to the International Standards.

The size of the current sensors must be a minimum of 10 A to a maximum of 3200 A so as to cover the widest possible current range.

**14.0 Earthing**:

Earthing arrangement shall be provided for earthing of each cable, PVC cable gland, neutral busbar, chassis and frame work of the cubicle with separate earthing terminals at two ends. The main earthing terminals shall be suitably marked .The earthing terminals shall be of adequate size, protected against corrosion, and readily accessible. These shall be identified by means of sign marked in a legible manner on or adjacent to terminals.

Neutral bus bar strip shall be connected to Earthing terminal with help of GI strip of suitable capacity & nut-bolt arrangement.

**TYPE / ROUTINE TEST ON PACKAGE SUBSTATION**

**15.0. TYPE TESTS FOR THE PACKAGE SUBSTATION:**

15.1 The Package Substations offered must be type tested as per IEC 61330/62271-202 in the last 5 years. The copy oftype test summary should be submitted along with the tender.

15.2 **Routine Tests**: The routine tests shall be made on each complete prefabricated substation.

**a)** Voltage tests on auxiliary circuit.

**b)** Functional test.

**c)** Verification of complete wiring.

15.3 **Test Witness:** Routine test shall be performed in presence of Owner's representative if so desired by the Owner. The Contractor shall give at least fifteen (15) days advance notice of the date when the tests are to be carried out.

**15.4 Test Certificates:**

Certified reports of all the tests carried out at the works shall be furnished in three (3) copies for approval of the Owner.

## BILL OF MATERIAL FORCOMPACT SECONDARY SUBSTATION:

### A) 11/0.433kV CSS:

| | The 11kV Outdoor Package Sub-Station shall be consisting of following | Quantity |
|---|---|---|
| **A** | **HT Switchgear** | |
| | 11kV, 630A, 20kA SF6 insulated Non-Extinsible Ring Main Unit consisting of 2Nos. Load Break Switch with Fault Passage Indicator in each LBS and 1No. of fixed manual Vacuum Circuit Breaker in SF6 insulated enclosure with series trip,self powered microprocessor based self powered numerical over current relay (IDMTL + Inst.) with Flag Indication, protection. | 1No. |
| **B** | **Transformer** | |
| | 1000 kVA, 11/0.433kV, Dyn11, Cast Resin, Dry Type Transformer with Off Circuit Tap Links of rating -5% to +5% @ 2.5% with class "H" insulation and temperature rise of 115deg C over ambient temperature. No Load Losses – 2600W (sub to IS Tol.), Load Losses – 9800W (sub to IS Tol.) along with WTI Scanner. | 1No. |
| **C** | **LT PANEL** | |
| | 433V LT Indoor panel with Aluminium Bus bars of suitable size, Fabrication using 1.5/2 MM CRCA sheet steel , Ingress protection IP4X , complete with internal wiring. (provision to mounted TVM Meter as per UPCL specifications. | |
| | **Incomer from Transformer:** 2000 A,433 V, 4P,50 Hz,50KA, Manual drawout type Air Circuit Breaker with microprocessor based release for overcurrent, short circuit and earth fault protection with Ammeter & Voltmeter and provision to mounted TVM Meter as per UPCL specifications. | 1 No. |
| | **Outgoings:** 630 A,433 V, 3P, 50 Hz, 36KA, Fixed Manual Moulded Case Circuit Breaker with microprocessor based release for over current and short circuit protection with ground fault. | 4 Nos. |
| **D** | **Outdoor Enclosure** | |
| | Outdoor type enclosure having construction of Galvanised Sheet Steel of thickness 1.5/2mm and having 4 mm base frame. The enclosure shall have IP54 degree of protection for HT & LT switchgear compartment & IP23 degree of protection for transformer compartment. The Enclosure exterior shall be Powder coated (Colour Light Gray &D.A.Gray). Each compartment will be provided with the door and pad locking arrangement. The Compartment illumination lamp with door operated switch shall be provided for each compartment. Roof of CSS should be slant to avoid water and ice logging. Package substation should be type tested for internal arc for IAC-AB for 20KA for 1 Sec as per IEC62271-202. | 1 Set |
| **E** | **Interconnection & Earthing** | |
| | Interconnection Between HT switchgear & Transformer using 1Cx3x95Sq.mm XLPE Single core Aluminum unarmoured cable & Interconnection between Transformer & LT switchgear using Aluminum Busbars. Internal earthing connections by using 50x6 mm GI strips. | 1 Set |

**MATERIAL FOR OUTDOOR RING MAIN UNIT (RMU):**

## A) 11kV OUTDOOR 3-WAY RMU WITH 2NOs. LOAD BREAK SWITCH & 1NO. VACUUM CIRCUIT BREAKER:

**11kV SF6 Load Break Switch – 2Nos.**
Load Break Switch is a cable switch module with a three position load break switch and earthing switch, busbars, interlocking and earthbar.

1 Cable switch 12kV, 20kA, 630A
1 Snap action mech. for manual operation.
1 Cable cover standard with Interlocking
1 Cable bushings interface C (400 bolted), 630 A, standard
1 Earth Fault Indicator
1 Capacitive voltage indication fixed type VPIS 9-15 kV
1 Aux. switch for load break switch position 2NO + 2NC
1 Cable support bars, standard for 1-way unit

**11kV SF6 Insulated Vacuum Circuit Breaker – 1No.**
Vacuum circuit breaker module with vacuum circuit breaker, three position isolator/earthing switch, busbars, interlocking, earthbar and stored spring energy mechanism (A-mech.).

1 SafePlus type V: Vacuum circuit breaker 12kV, 20kA, 630A
1 Manometer
1 Stored energy mech. for manual operation
1 Cable cover standard with Interlocking
1 Self Powered Over Current and Earth Fault protection relay.
1 Capacitive voltage indication fixed type VPIS 9-15 kV
1 Cable bushings interface C (400 bolted), 630A
1 Aux. switch for vacuum circuit breaker position 2NO + 2NC
1 Cable support bars, standard for 1-way unit
3 Ring core current transformer type 120/1 A, 2.5VA, 10P10 for protection
1 Mechanical Interlocking for Outgoing 11KV Isolators.

# Chemical Electrode Earthing

In Chemical Electrode earthing following important factor are taking into the consideration:

(a) The hollow pipe used in the chemical pipe earthing is fitted with a G.I. strip 40x6mm and CCM (Crystalline conducive mixture) is compressed in to the pipe and pipe is sealed at both the end.
(b) CCM is a semi metal and the hollow pipe filled with CCM behave like a salt pipe and therefore the current carrying capacity increases substantially.
(c) The CCM has a high melting temperature of 2500°c and unlike coal it will not burn into ashes under high temperatures of 1500°c under high fault currents occurring due to phase to phase or phase to earth fault.
(d) The humidity factor (The moisture level) is maintained by Bentonite surrounding the electrode in a slurry form. The Bentonite has a property of absorbing water 15 times its weight and doesn't dissolve in the water. It remains moist and soft throughout the life. A minimum rain fall of 2.5 cm in a year makes the Bentonite moist and humid for next one year and therefore the cycle keeps on repeating year of year. Therefore, because of quality of Bentonite no additional watering is done whether in summer, winter or rainy season i.e. under any climatic condition.
(e) In India the technology is only 11 years old and the failure record is almost negligible. The earthing system properly installed under the guidance of manufacturers can safely vouch for minimum ten years.

**COST OF MAINTENANCE:-**

**A. COPPER PLATE:-**

In the pit type earthing some cost is required as under:

(a) The cost of labour for watering at periodical interval.
(b) The cost of water it is not free everywhere.
(c) The cost of maintenance of the water pipe going to the pit which gets choked due to scale formation and flow of water will be restricted or blocked.
(d) The cost of charging by putting salt and charcoal which is undesirable and not permitted for safety reason.

**Detail Schedule of Installation:-**

- The Earthing electrode will be installed as per the following schedule of work:
- The location of the site to be decided or identified by the staff of DCW, Patiala (Electrode should never be installed in the proximity to a metal fence).
- The respective boring will take place of appropriate depth of 3 meters and minimum 250 mm Diameter.
- The bore will be watered for 48 hours in case the soil condition is good then watering will be carried out for 24 hours at the discussion of our technical support engineer and staff.
- After the appropriate watering is done and the bore is cleared off mud etc. formed their in the bore then the electrode will be inserted at the centre of the bore.
- The GBFC compound which is supplied in the packs of 30 Kg. each will be mixed with the water of appropriate quantity to make thick slurry of the compound and pour it around the sides of the electrode gradually to reach upto the ground level. The slurry of the GBFC poured in the bore around the electrode will take curing time of seven days to mix up with the soil and attain the natural properties of surrounding soil.

1. The first testing of ohmic values for preliminary result will be carried out on the day of installation and the final results are taken after the seven days of installation.
2. The earthing electrode can be connected after the preliminary test and safety of the equipment can be insured.
3. In certain cases of rocky and stony areas where it is not possible to go 3 meter Deep then the manufacturers recommendation for or to install horizontal electrode of L-shape where the small arm of the L will be of 600mm.In such cases the GBFC compound will be 50% more than the vertical installation.

**Procedure of laying the connecting strip from earth station to equipment underground:-**

- The G.I. strip of appropriate dimension say e.g. 65mmx8mm shall be laid into a trench on the ground.
- The trench will be 250mm deep and about 20mm wide where in the G.I strip will be laid into embedded with the GBFC compound in two or more layers below and the above the strip.

The details of earthing shall be as follows:-

| Sl. No. | Items | Unit | Qty. |
|---|---|---|---|
| 1 | 2 | 3 | 4 |
| 1 | GI pipe size 2500mm x 80 mm dia x 4 mm thick | No. | 1 |
| 2 | Galvanized MS Rod size 2575 mm x 20 mm | No. | 1 |
| 3 | Insulator (epoxy) 150 mm length x 72 mm withstanding voltage of 28 kV rms | No. | 1 |

| | | | |
|---|---|---|---|
| 4 | Highly conductive chemical | Kg. | 8 |
| 5 | Fabrication of electrode | Job | 1 |
| 6 | Cost of highly conductive substances for treatment of soil | kg | 42 |
| 7 | GI strip 35 x 6 mm (1.7kg /mtr.) 6 mtr. long for connecting transformer body / neutral with earth electrode | kg | 10 |
| 8 | Sundry items ( Nut, Washer, Greesh, Bituminy Paint etc.) | LS | 1 |

# TECHNICAL SPECIFICATION FOR JOINTING/TERMINATION KITS (INDOOR/ OUTDOOR) FOR 11 KV XLPE CABLE

1.1 **SCOPE:**

The specification covers design, manufacturer, testing, packing, inspection and delivery of cable terminations and joints employing Heat Shrinkable technology suitable for 11 KV (E) , 3 core XLPE insulated screened and armoured cables as per IS 7098, having compacted circular stranded conductor of sizes 35 mm2 to 400 mm2.

1.1.2 It is not the intent to specify completely herein all details of design and construction of Equipment /system. 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 vendor's guarantee in a manner acceptable to the purchase who will interpret the meaning of the drawings and specification and shall have the power to reject any work or materials, which in his juSEent are not in full accordance therewith.

1.1.3 Tenderer has to submit all relevant papers & copies of all the relevant documents. Failing to do so may amount to the bids being considered non-responsive and outright rejection. The information as asked for is to be mentioned specifically and not be narrated as 11 KV as per ISS, relevant standard, reference to other pages of tender bid etc.

1.2 Technical data sheet annexed has to be filled in completely and separately for Indoor /outdoor terminations and straight through joints where ever asked for. Copies of the documents where asked for are to be enclosed for each requirement.

1.3 The tender documents have to be completely filled in and submitted even if there is repetition of the information. The offer must have a clause wise affirmation of the technical requirements. Deviations/non conformance / alternatives /equivalents must be all separately listed as deviations.

2.0 **APPLICABLE STANDARDS**:

2.1 Applicable standards for testing of heat shrink joints

1 .VDE-0278 Power Cable Accessories with rated voltage up to 36KV

2. IS-13573/1992- Including Amendment No. 1 March 1996-Joints & Terminations, for polymeric cables for working voltage 6.6 KV up to and including 33KV -Type test requirements.

3. ESI-09 -13-Electricity Supply industry specification-performance requirements of heat shrinkable components.

4. IEEE-48-Standards Test procedures and requirements for high voltage alternating current cable termination.

5. ASTM-D-2303-Liquid contaminant inclined plane Tracking and erosion test.

6. IEC-243- Recommended methods of test for electric strength of solid insulating material at power frequencies.

7. IS: 7098 (Part-II) for XLPE Cable, Bidders shall enclose copies of type/sequence test reports as per IS: 13573-1992 conducted and test reports for materials properties wherever asked for without fail.

8. IEC 61238-1 for Mechanical Connectors for Power Cables with Copper of Aluminium Conductors –Test Materials and Requirements

3.0 **DESIGN REQUIREMENTS:**

**A. STRAIGHT THROUGH JOINTS:**

The Straight through Joints should be Heat Shrink type, suitable for underground burial.

**Conductor Connection**

3.1 Mechanical connectors with torque controlled shear head bolts shall provide conductor connection. These connectors should be suitable for Aluminium and Copper conductor both. The connectors should meet the specifications as defined in IEC 61238-1.Mechanical Connectors shall be of water block type and the shear bolt heads shall be hexagonal.

3.2 Heat shrinkable tubing having volume resistivity of minimum 107ohms-meter shall provide the stress control function at the screen cut back. Relative Permittivity of the stress control tubing shall be minimum 15. The impedance of stress control tubing shall not change over a range of temperature from 0oC to 125oC.

**Stress Control , Non-Tracking**

3.3 The stress control tubing at each cable end in combination with the stress grading mastic at the screen cut provide a precisely defined impedance characteristic which smoothes the electrical field. For ease of installation, a stress control patch (Zinc Oxide patch/high Permittivity mastic) is applied around the mechanical connector which shall also be used as void filler over the connector.

3.4 To minimize interfaces, single- triple extruded hybrid tubing combining heat shrink and elastomeric technology shall reinstate the insulation & screening function. This allows extremely tight electrical interfaces due to the shrink force generated.

The elastomeric insulation characteristic combined with the rigid outer heat Shrinkable screen layer enables the joint to follow the thermally induced dimensional changes of the cable insulation. The inner layer of elastomer and outer two layer of heat shrink shall provide a tight interface and an active pressure on the cable. The outer heat shrink layer shall be conductive.

**Earth/Screen Continuity/Termination System**

3.5 Screen continuity by using tinned copper mesh and earth continuity by using tinned copper braids of appropriate sizes, shall be provided for transfer screen / earth in straight through joints. VB Can is to be provided for mechanical protection.

3.6 Adhesive lined, abrasion resistant re-jacketing heat shrink sleeves shall be used for outer jacketing & sealing. Adhesives and sealants shall be provided kits for environmental sealing against ingress of moisture and aggressive gases. The adhesives and sealants will flow due to heating of heat shrinkable components or otherwise during installation and will fill all voids and adhere to metal components and cable sheaths.

B. **OUTDOOR/INDOOR TERMINATIONS:**

The Outdoor/Indoor terminations shall be of Heat Shrink type, suitable for outdoor use and should be Class I terminations as per IEEE 48.

**Conductor Connection**

3.7 Conductor connection shall be provided using a mechanical lug with Shear head bolts.

3.8 At the steps caused by semi-conductive screen cut back, high Permittivity hot melt mastic is to be provided to prevent discharge activity at the step.

**Stress Control , Non- Tracking & Environmental Sealing**

3.9 Co-extruded Dual Wall Heat Shrinkable flexible Polymeric Tubing, coloured red, and possessing non-tracking erosion and weather resistant properties and having a polymer matrix doped with calcinated zinc oxide powder as an inner layer for stress control and sealing, shall be used as an external covering for the cable cores for both indoor and outdoor terminations. The zinc oxide layer should have extreme non-linear characteristics.

**Provision of additional creepage for Outdoor terminations**

3.10 Rain sheds (skirts) shall be used for outdoor terminations providing additional creepage& shall be of the same material as the non-tracking tube.

3.11 The trifurcation for 3 core cables shall be done with conducting Heat shrink trifurcating boots and sleeves. The breakout should be adhesive lined.

**Earth/Screen Continuity/Termination System**

3.12 Screen continuity by using tinned copper mesh and earth continuity by using tinned copper braids of appropriate sizes, shall be provided for transfer screen / earth.

4.0 **Units of measurement**

In all correspondence, in all technical schedules and drawings metric units of measurement shall be used.

5.0 **Packing and Marking**

The joint/termination kit shall be properly packed with all the shrinkable tubings, moulding components and connectors, lugs, other accessories as required to form a self contained kit. The packing shall be of such design as to prevent moisture and dust ingress and shall also protect the contents against mechanical damage.

External packing shall carry a label with the following information clearly marked:

- Name of Manufacturer
- Manufacturers reference
- Year of Manufacture/ Purchase order No.
- Expiry date whenever applicable

The kits shall also include the following:

(a) Installation Instruction sheet manuals containing complete step by step instructions in the English language.

(b) A check list stating the quantities and description of components contained in the kit shall be supplied in each kit.

Each component of the kit shall be separately packed in polyethylene and component name/part number shall be marked on the polyethylene packing.

All materials and components comprising the kit shall be clearly and permanently marked in a prominent position with the supplier's/manufacturer's name, product identification, batch number and year of manufacture. The batch number shall allow for full traceability of manufacture including the new materials which make up the polymeric compounds used in extrusion and moulding processes. Extruded components (tubing and wrap-around) shall additionally be marked with their expanded and fully recovered internal diameter. They may alternatively be marked with the upper and lower diameters of their range of application.

Markings on extruded components shall be repeated along the length with gaps not exceeding 200mm. Components which cannot be marked shall have the above information provided on immediate packaging.

Packed kits shall be packed in carton boxes which shall be placed in wooden pallets in order to facilitate fork-lift handling.

6.0 **Storage**

Components and kits shall be capable of being stored without deterioration in an ambient air temperature 5°C to 50°C when protected from direct sunlight.

7.0 **Inspection and testing**

All materials covered by this Specification shall be subject to inspection and test by the Authority during manufacture and before final despatch from manufacturer's works. The approval of the Authority of any such inspection or test will not, however, prejudice the right of the Authority to reject the materials or any part thereof, if it does not comply with the

specification when erected or does not give complete satisfaction in service. The Manufacturer shall make available to the Authority for the inspection and testing all required personnel and offer facilities (equipment, testing instruments etc.) at no cost to the Authority. The Authority may, however, use his own instruments and apparatus as a check.

Before any part of the jointing materials is packed or despatched from the manufacturers works, all tests called for are to have been successfully and satisfactorily carried out in the presence of the Inspector and a certificate issued to that effect by the Inspector in writing.

Adequate notice is to be given when any part of the jointing materials is ready for inspection or test and every facility is to be provided by the Manufacturer to enable the Inspector to carry out the necessary inspection and witness the tests. Duplicate copies of all principal Test Records and Test Certificates are to be supplied to the Inspector for all tests carried out in accordance with the provisions of this specification.

The jointing materials and all component parts thereof are to be fully tested in accordance with the provisions of the latest relevant standards as mentioned in this Specification or as may be agreed in writing with the Inspector. Test Certificates are to be forwarded to the UPCL together with the invoices.

8.0 **Guarantee.**

The straight through jointing kits shall be guaranteed for a period as per tender specification.

9.0 **Samples**

Tenderers are required to submit with their tenders One No samples of the kits offered as to be delivered in case of order. The kits shall include the installation instructions.

Tenders without samples shall not be considered. The samples shall be returned to the tenderers, after the award, at their own expenses.

10.0 **Training**

Tenderers are required to provide periodic training for Deptt. staff /Jointers, if required.

11.0 **TESTS**

11.1 **Type Tests on Components**

The Tenderer shall submit with the tender documents test certificates tested not more than 5 years to prove that shrinkable or elastic or moulded components connectors used for cable joints and termination kits comply with the performance specification as indicated IS 13573 1992 with latest amendments and EATS 09-13. Test certificates shall be submitted with the tender documents. Type Test Reports shall be from CPRI / ERDA or International Accredited Lab.

11.2 **Routine Tests on Components**

Tenderer must submit with their tenders routine tests certificates as per the requirements of applicable standards (ESI-09-13 / EATS 09-13).

In addition, during the acceptance testing of the first and any other subsequent consignment, components will be randomly selected by the Inspector from jointing kits and will be subjected to the following routine tests

a) Visual examination
b) Dimension
c) Flame Retardance
d) Packing and markings.

9.0. Tenderers must submit

1 Test certificates certified by CPRI as per IS 13573 1992 with latest amendments not more than 5 years..

1. Test certificates certified by CPRI as per EATS 09-13 not more than 5 years.
2. Test certificate as per IEC 61238-1 for Mechanical Connectors not more than 5 years.

3. Documentary evidence including graphs showing the effects of temperature and thermal ageing on the impedance of the stress control material offered.
4. A technical explanation as to how the correct electrical properties of the material Vs volume resistivity, permittivity and AC impedance, have been derived
5. The recommended lengths of the stress control material.
6. Proof of accelerated laboratory and long term field usage to confirm the retention of the properties within permissible limits under variations of temperature and thermal ageing
7. Full set of dimensioned drawings including installation instructions
8. Transport, storage and installation requirements
9. Acceptance letter of One sample to be submitted

**GAURANTEED TECHNICAL PARTICULARS 11 KV -HEAT SHRINKABKE TYPE INDOOR/OUTDOOR TERMINATION & STRAIGHT THROUGH JOINT**

| Sl. No. | Particulars | 11 KV | Bidder's To Confirm |
|---|---|---|---|
| 1. | Name of Manufacturer | | |
| 2. | Applicable Standards | IS: 13573-1992 | |
| 3. | Rated Voltage of Cable accessories | 6.35/11kV | |
| 4. | AC Voltage Withstand (Dry) | 35 kV AC for 1 minute | |
| 5. | AC Voltage Withstand (Wet) (for Outdoor termination) | 28 kV AC for 1 minute | |
| 6. | DC Voltage Withstand | 48 kV DC for 30 minute | |
| 7. | Partial Discharge | Less than 20 pC at 2U0 | |
| 8. | Impulse Voltage | 75 kVp | |
| 9. | Load Cycle test | | |
| | a. Each cycle heating duration | 5 hours | |
| | b. Temperature | 100° C | |
| | c. Cooling Duration | 3 hours | |
| | d. Continuous Phase to earth Voltage withstand | 16 Kv | |
| 10. | Humidity Test | 100 hours duration withstand at 7 kV AC | |
| 11. | Salt Fog Test | 1000 hours duration withstand at 7 kV AC | |
| 12. | Thermal Short Circuit test | As per Cable cross section and material of conductor | |
| 13. | Dynamic Short circuit test | 2.55 times the thermal short circuit current | |
| 14. | Method of Stress Control | Heat Shrinkable type | |
| 15. | Tubing's & Molded parts | Heat Shrinkable type | |
| 16. | Non Tracking material | Confirming as per ASTM D-2303 | |
| 17. | Di-electric strength of insulating material | 10 kV/mm min | |
| 18. | Co-extruded Dual wall Tube (Terminations) | | |
| 19. | Single Triple Extruded Hybrid Tube (Joints) | | |
| 20 | Mechanical Connectors with Shear Head Bolts | | |

*

## LIST OF MAKES:

| S. No. | Equipment Description | List of Makes |
|---|---|---|
| 1.0 | 11/0.433kV 630/1000kVA CSS | Siemens/ Schneider/ ABB |
| 2.0 | 11/0.433kV 630/1000kVA Dry type Transformer in CSS | Siemens/ Schneider/ ABB |
| 3.0 | 11kV RMU | Siemens/ Schneider/ ABB |
| 4.0 | Low Voltage Switchgear: | |
| 4.1 | Air Circuit Breaker (ACB) | ABB ( E-Max), SIEMENS ( 3WL),Schneider (NW), L&T ( U Power) |
| 4.2 | Moulded Case Circuit Breaker (MCCB) | ABB ( E-Max), SIEMENS ( 3WL),Schneider (NW), L&T ( U Power) |
| 5.0 | 11kV HT Termination (Indoor/ Outdoor) | Reychem/ 3M |
| 7.0 | 11kV HT XLPE Power Cable | RPG/ Polycab/ Universal/ Finolex/ CCI |
| 8.0 | LT XLPE Power Cable | RPG/ Polycab/ Universal/ Finolex/ CCI |
| 9.0 | LT Lugs & Glands | UPCL approved makes only |
| 10.0 | LT Panel | CPRI Approved Manufacturer |

# LT CABLE SPECIFICATION

| Guaranted Technical Particulars | | | |
|---|---|---|---|
| **S.No.** | **Particulars** | **1x240** | **1x400** |
| 1 | Name of Manufacturer | | |
| 2 | Type of cable | A2XFaY | A2XFaY |
| 3 | Voltage Grade V | 1100 | 1100 |
| 4 | No of cores x size in sqmm | 1x240 | 1x400 |
| 5 | **Conductor** | | |
| a . | Material | H2/H4 Grade Aluminium as per class 2 of : 8130 / 84 , latest | H2/H4 Grade Aluminium as per class 2 of : 8130 / 84 , latest |
| b | Max d.c resistance of conducture at 20 C(OHM/KM) | 0.125 | 0.0778 |
| C | Shape of the conductor | stranded circular | stranded circular |
| 6 | Insulation | | |
| a . | Material | XLPE as per IS 7098 (Pt-1) / 88 , latest | XLPE as per IS 7098 (Pt-1) / 88 , latest |
| b | Nominal thickness (mm) | 2 | 2.4 |
| c | Core Indentification | Black | Black |
| 7 | **Inner Sheath** | | |
| a . | Material | NA | NA |
| b | Mininum thickness (mm) | NA | NA |
| 8 | **Armouring** | | |
| a . | Material | Aluminium | Aluminium |
| b | Type of armouring | Flat strip | Flat strip |
| c | Nominal size of armour (mm) | 4. 0x 0.8 | 4. 0x 0.8 |
| 9 | **Outer Sheath** | | |
| a . | Material | Extruded PVC Type ST2 AS Per IS: 5831/84 | Extruded PVC Type ST2 AS Per IS: 5831/84 |
| b | Thicness (mm) | 1.40(Min) | 1.56(min) |
| c | colour of outer sheath | Black | Black |
| 10 | Electrial parameters | | |
| a . | Max a.c resistance of conductor at 90 C (ohm/km) | 0.162 | 0.102 |
| b | Calculated cable reactance (ohm/km) | 0.0854 | 0.0824 |
| c | impedance of cable (ohm/km | 0.183 | 0.131 |
| d | Approx cable Capacitance (mfd/km) | 0.69 | 0.73 |
| 11 | Maximum conductor temperature under normal opearting conditions | 90 °C | 90 °C |
| 12 | Maximum conductor temperature At the termination of short circuit | 250 °C | 250 °C |
| 13 | Short circuit rating of conductor for the duration of 1 sec (KA) | 22.68 | 37.79 |
| 14 | Continuous Current carrying capacities | | |
| a . | In ground at 30 C (A) | 335 | 429 |
| b | IN Air 40 C (a) | 434 | 589 |

| | | | |
|---|---|---|---|
| 15 | Applicable Standard | IS 8130/ 84, IS 7098 part 1/88, IS 5831/84 IS 3975/88 ETC . WITH Latest up to date amendments | IS 8130/ 84, IS 7098 part 1/88, IS 5831/84 IS 3975/88 ETC . WITH Latest up to date amendments |
| 16 | Approx overraLL diameter of the cable in mm | **27.0±2.0** | **33.0±2.0** |
| 17 | Mininum bending radius | 15 times overall diameter | 15 times overall diameter |
| 18 | Max. Tensile Strength | 9 x $D^2$, D is the cable OD in mm | 9 x $D^2$, D is the cable OD in mm |
| 19 | **Printing** | Year, electric 1100Volts gradeXLPE, Cable size, cable type with sequential marking at every one meter interval | Year, electric 1100Volts gradeXLPE, Cable size, cable type with sequential marking at every one meter interval |
| 20 | Standard Drum Length (Mtr) | 500 ± 5% | 500 ± 5% |
| 21 | Non- standard Drum Length (Mtr) | Maximum 5% of Order quantity | Maximum 5% of Order quantity |

# TECHNICAL SPECIFICATIONS OF 11KV XLPE OF CABLE SIZE OF (ARMOURED CABLE)

1 **SCOPE:**

This specification covers design manufacture inspection, testing and supply of 11KV XLPE Cable of Size 3x300Sq.mm XLPE cable for use with effectively earthed distribution system of Uttarakhand Power Corporation Ltd.,.

2. **STANDARD:**-

2.1 The XLPE cable shall comply in all respect with IS: 7098(PART-II) 1985 with latest amendments & CEA norms, unless otherwise stipulated in this specification or any other international standard which ensure equal of higher quality of material.

2.2 Offers confirming to standard other than IS: 7098, shall be accompanied with English version of relevant standards in support of the guaranteed particulars to be furnished as per enclosed annexure.

3. **GENERAL REQUIREMENTS**:-

All cables shall be suitable to meet the low / high ambient temp. high humid tropical/ seasonal snow covered climatic conditions of Uttarakhand. Cables shall be designed to withstand the mechanical electrical and thermal stresses under the unforeseen steady state and transient conditions and shall be suitable for proposed method of installation.

3.1 **CONDUCTOR:**

The conductor shall be made from uniform, good quality, free from defects aluminum to form stranded compact circular conductor having resistance within limits as specified in IS: 8130/1984 and any amendment thereof.

3.2 **CONDUCTOR SHIELD**:

The conductor shall have a semi – conducting screen, which will ensure perfectly smooth profile to avoid stress concentration. The conductor screen shall be extruded in the same operation as the insulation.

3.3 **INSULATION:**

The XLPE insulation shall be suitable for specified 11 kV system voltage. The manufacturing process shall ensure that insulation shall be free from voids. The insulation shall withstand mechanical and thermal stresses under steady state and transient operating conditions. The extrusion method shall give very smooth interface between semi – conducting screen and insulation. The insulation of the cables shall be of high standard quality and conform to IS: 7098 (Part-II) 1985 or latest amendment thereof.

3.4 **INSULATION SHIELD:**

To confine electrical field to the insulation, insulation screening consisting of two parts, namely metallic (non- magnetic) and non metallic( semi conducting) shall be provided. The non-metallic semi- conducting shield shall be put over the insulation of each core. The insulation shield shall be extruded in the same operation as the conductor shield and insulation by triple extrusion process. The insulation shield shall be bonded and strippable on adequate heat treatment. Metallic shield shall be provided over non – metallic portion as per provision of IS: 7098 (Part – II) 1985 and amendment thereof.

3.5 **INNER SHEATH:**

The inner- sheath shall be suitable to withstand the operating conditions and the desired temperature rating of the cable . It shall be of adequate thickness, consistent quality and free from all defects. The PVC sheath shall be extruded type. The binding tape used over the lead up cores shall not be construed as part of the inner sheath . The inner sheath shall conform to the provisions of IS : 7098 (Part –II) 1985 or latest amendment thereof.

3.6 **ARMOURING:**

Galvanized steel strip armoring shall be provided . The dimensions of steel strip shall be as per IS : 7098 (Part-II) 1985 and its latest amendment and strip shall conform to latest provision of IS: 3975 :1988 and amendment thereof. Armouring shall have minimum 90% coverage. Breaking load of the joints shall be minimum 95% of the normal armour.

3.7 **OUTER SHEATH:**

Extruded PVC outer sheath of types ST – 2 as per IS: 5831/ 1984 and its latest amendment shall be applied over armoring with suitable additives to prevent attack by rodent and termites and its thickness shall be in accordance with Clause 17.32 of IS : 7098 (Part –II) 1985 and latest amendment thereof.

Outer sheath shall be of black colour with cable size and voltage grade embossed on it. Sequential marking shall be to every 1 meter distance. Word “FRLS” ( Flame Retardant Low Smoke) shall also be embossed on it at every 5meter distance.

Outer sheath shall have the following properties:

(a) Oxygen Index: Min 29( as per ASTMD 2863)
(b) Acid Gas Generation: Max 20% ( as per IEC 754-1)
(c) Smoke density rating: 60% ( Max) ( as per ASTMD 2843)
(d) Flammability test: As per Swedish chimney test F3 as per SS 4241475 as per IEC part-3 ( Category B)
(e) Minimum bending radius shall be 15XOD.

Note: Repaired cables shall not be acceptable.

4.0 **CONSTRUCTION:**

4.1 The cable shall have suitable PVC fillers laid up with insulated cores to provide substantially circular cross section before the inner sheath in applied. The fillers shall be suitable for operating temperature of the cable and compatible with the insulating material.

4.2 All materials used in the manufacture of cable shall be new, unused and finest quality. All material shall comply with the applicable provisions of the tests of the specification, IS, Indian Electricity Rules, Indian Elect. Act and any other applicable statutory provisions, rules and regulations.

4.3 The PVC material used in the manufacture of cable shall be of reputed make. No recycling of the PVC is permitted . The UPCL reserves the right to ask for documentary proof of the purchases of various materials to be used for the manufacture of cable and to check that the manufacturer is complying with quality control.

5. 0 **WORKMANSHIP AND QUALITY ASSURANCE:**

The workmanship shall be neat, clean and of highest grade / quality.

6.0 **QUALITY ASSURANCE:-**

6.1 A quality assurance plan including customer hold points covering the manufacturing activities of the material shall be required to be submitted by the tenderer to the UPCL alongwith the tender. The quality assurance plan shall be submitted along

with tender document, if found suitable, will be approved by SE (I&QA) , UrjaBhawan , Kanwali Road, Dehradun after award of the tender.

6.2 The contractor shall follow the approved quality assurance plan in true spirit. If desired by UPCL, he shall have to give access to all the documents and materials to satisfy the UPCL that the quality assurance plan is being properly followed.

7.0 **CURRENT RATING:**

7.1 Normal current rating shall not be less than that covered by IS: 3961(Part-II) 1967 or subsequent amendments vendor shall be submit data in respect of all cables in the prescribed format.

7.2 Tables given de-rating factors for various conditions of cable installation including the following for all types of cables shall be furnished.

(i) Variation in ambient air temperature.
(ii) Variation in ground temperature
(iii) Depth of laying
(iv) Cables laid in the ground
(v) Cables laid in trench
(vi) Cables laid in ducts
(vii) Soil resistivity
(viii) Grouping of cable.

7.3 The value of short circuit withstand current ratings of all cables shall be indicated for a short circuit for 1sec duration and should also the maximum temperature during short circuit.

7.4 Formula for calculating circuit current for different duration or curve showing short time current v/s time for different sizes of cables shall be furnished by vendor.

8.0 **OPERATION:**

8.1 Cable shall be suitable for laying in ducts and direct in ground.

8.2 Cables shall have heat and moisture resistant properties. These shall be of type and design, with proven record of distribution network service.

8.3 It is essential that accessories which are used in the cable system with mechanical and / or soldered connections are suitable for the temperature adopted for the cables.

9.0 **STANDARD LENGTHS:**

All power cables shall be supplied in single length of either 250m or 500m depending on the size of cable. Each drum shall contain one continuous length of cable. UPCL shall have the option of rejecting cable drums with shorter lengths. The cable length per drum is allowed a tolerance of ±5% but the tolerance allowed on total quantity of each size is ±2%.

Where the ordered quantity in not multiple of 250m & 500m and the incremental quantity is very small, the same may be wounded in one of the drums.

10.0 **PACKING:**

10.1 The cable shall be supplied on non-returnable wooden or steel drums of heavy construction and drum shall be properly seasoned , sound and free from defects. Wood preservative shall be applied to the entire drum.

10.2 The drums shall be suitable for wheel mounting and letting of the cable under a minimum controlled tension of the order of 5KN. The drums shall be provided with necessary clamping arrangements so as to be suitable for tension stringing of power cables.

10.3 The bidders should submit their drawings of the cables drums along with the bid. After placement of letter of intent the supplier should submit four copies of fully dimensioned drawing of the UPCL's approval the drum design should be in accordance to IS: 10418-1982 or subsequent amendments, being suitable for transport by goods road.

10.4 A layer of water proof paper shall be applied to the surface of the drums and over the outer most cable layer.

10.5 A clear space of at least 40mm shall be left between the cables and the logging.

10.6 All ferrous parts shall be treated with a suitable rust preventive finish or coating to avoid rusting during transit or storage.

10.7 Both cables ends shall be sealed with PVC / Rubber caps so as to eliminate ingress of water during transportation and erection.

Each drum shall have the following information marked on it with indelible ink along with other important information including technical data:-

(a) UPCL with tender specification No.
(b) Consignee & Destination Station.
(c) Trade name or trade mark , if any
(d) Name of the manufacturer.
(e) Nominal sectional area of the conductor of the cable.
(f) Drum No.
(g) No. of cores.
(h) Type of cable & voltage for which it is suitable
(i) Gross weight of the drum (Approx.)
(j) Length of cable in the drum with individual lengths if more than one.
(k) Net weight of the cable.
(l) ISI certification mark, if available
(m) Month & year of manufacture.

11.0 **IDENTIFICATION MARKING:**

For the identification of individual cores, coloured strips of red, yellow and blue colours shall be used to identify phase conductors.

The manufacturer shall engraved on cable.

(a) Property of UPCL
(b) Name of Manufacturer
(c) Year of manufacture
(d) Specification No.
(e) Voltage grade and size of cores & UPCL at the interval of one meter length throughout the length of the cable. The identification should be well engraved and shall be done on the outer sheath.

12. **TESTS:-**

**12.1 TYPE TEST:**

1. Test on conductor
   ( I) Tensile tests.
   (II) Wrapping tests.
   (III) Resistance test.
2. Test for armouring wires / strips.
3. Test for thickness of insulation and sheath.
4. Physical tests for insulation.
   (i) Tensile strength and elongation at break
   (ii) Ageing in air oven.
   (iii) Shrinkage test.
   (iv) Hot test.
   (v) Water absorption (gravimetric)

(5) Physical tests for outer sheath .
   (i) Tensile strength and elongation at break
   (ii) Ageing in air oven.
   (iii) Hot deformation.
   (iv) Shrinkage test.

(6) Bleeding and blooming test ( for outer sheath)
(7) Partial discharge test.
(8) Bending test.
(9) Dielectric power factor test.
   (I) As a function of voltage.
   (II) As a function of temperature.
(10) Insulation resistance ( Volumes resistively ) test.
(11) Heating cycle test.
(12) Impulse with stand test.
(13) High voltage test.
(14) Flammability test.

12.2 **ACCEPTANCE TEST:** The following shall constitute acceptance tests.
   (i) Tensile tests.
   (ii) Wrapping tests.

(iii) Conductor resistance test.
(iv) Test for thickness of insulation
(v) Hot set test for insulation
(vi) Tensile strength and elongation at break test for insulation and sheath.
(vii) Partial discharge test ( for screened cables only)
(viii) High voltage test.
(ix) Insulation resistance (volume resistance) test.

12.3 **ROUTINE TESTS:-**

(i) the following constitute routine test.
(ii) Conductor resistance test.
(iii) Partial discharge test.
(iv) High voltage test.

12.4 **OPTIONAL TEST:**

Cold impact tests for outer sheath (IS:5831-1984) shall constitute the optional test.

13.0 **TEST CERTIFICATE :**

The tenderer shall furnish an authenticated copy of result of successful TYPE TEST and short circuit withstand ( 1 second ) test as carried out over the cable of same design , size and type to prove that the design has successfully passed through required tests. The test should be carried out in any government authorized & well known institutions / test house.

14. **INSPECTIONS &TESTING :**

14.1 If successful type tests and short circuit withstand test for one second have been carried out the cable of same design, size type and manufacturing process during last five years ( counted from the date of tender opening ) repetition of these tests is not required provided the manufactured material conform to IS : 7098 (Part-II) 1985 with latest amendment thereof in respect of type and Short circuit withstand test.

14.2 On the other hand, if the offered design is not type tested during last five year, the sample of the cable marked out of the first lot offered for inspection shall be subjected to short circuit withstand test for one second and all type tests in accordance with IS : 7098 (Part-II) 1985 and amendment thereof in presence of UPCL's representatives at test houses / institutions mentioned in Schedule 'B' . All charges / fee/transportation etc. to conduct these tests shall be borne by the contractor. Subsequent inspection and regular supply of material shall commence only after successful type testing and short circuit withstand testing and despatch authorization of first lot from competent authority.

14.3 The UPCL reserves the right to get the cable type tested at any stage during the pendency of contract at its own expenses in any reputed test house mentioned in Schedule 'B'. The transportation and arrangement of testing of sample to test laboratory shall be responsibility of the contractor.

14.4 Routine and acceptance tests as laid down in IS: 7098 (Part-II) 1985 with latest amendment thereof shall be carried out by the inspecting officers of the UPCL on sample selected at random as per relevant ISS.
In addition to above , length check on one drum per inspection lot shall also be carried out by the inspecting of Officers for which contractor shall make all necessary arrangement and provide all necessary facilities at his own cost.

LT Feeders.

The MCCBs installed in the low voltage distribution boxes must be designed, manufactured and tested according with the international standards IEC 60947-1, IEC 60947-2, IEC 60947-3, IEC 60947-4-1, IEC 61000 or with the corresponding harmonized national standards, the CE "Low Voltage Directives" (LVD) n° 73/23 EEC and "Electromagnetic Compatibility Directive" (EMC) n° 89/336 EEC.

**Requirement of MCCBs:**

The moulded case circuit breakers should comprise of a switching mechanism and a tripping unit contained in a compact moulded case cover made of high strength, heat resistance and flame

retardant thermo-insulating materials. They should consist of a spring assisted quick make/ quick break type independent manual trip free mechanism rendering it easy to manual trip free mechanism rendering it easy to manually operate the MCCBs and capable of clearly indicating "TRIPPED", "ON" AND "OFF" positions from the position of operating handle. The contact tip should be made of a suitable alloy having arc resistance and a long electrical and mechanical life needing no replacement. The breaker should be designed with a common trip bar to break and make all the three phases together even when fault occurs on any of the phases. The breaker should provide protection against sustained overloads and short circuits through Microprocessor/ thermal-magnetic/ fully magnetic releases. These MCCBs along with terminal blocks are intended to be housed in the distribution boxes made of steel of 2mm gauge. The assembly of the MCCBs and the terminal blocks should be compact, reliable for operation point of view and safe to the operating personnel. As already mentioned earlier, the MCCBs should be fully maintenance free.

**Technical parameters of MCCBs**
The rated short circuit breaking capacity of the MCCBs shall be as follows:

| S. No. | Rating of MCCBs (Amps) | Rated short circuit breaking capacity of the breaker in kilo-amps |
|---|---|---|
| 1. | 63 to 150 | 10kA |
| 2. | Above 150 to 250 | 25kA |
| 3. | Above 400 | 36kA |

**Distribution Box**
Panels shall be completely metal enclosed and shall be dust, moisture and vermin proof and fully compartmentalized. The enclosure shall provide a degree of protection not less than IP-54 (for outdoor) in accordance with IS: 2147. It should be free standing, floor mounting type and smooth finished, cold rolled sheet steel of thickness not less than 3 mm for weight bearing members of the panels such as base frame, front sheet and door frames, and 2.0mm for sides, door, top and bottom portions. There shall be sufficient reinforcement to provide level transportation and installation. Design, and workmanship shall be such as to result in neat appearance, inside and outside with no welds rivets or bolt head from outside, with all exterior surfaces tune and smooth. Anti vibration strips made of shock absorbing materials that shall be supplied by the contractor, shall be placed between panel & base frame. The color of the finishing paint shall be light grey in accordance with shade no.697 of IS: 5 or in matching color of other existing Panels. There shall be space heater, illumination lamp with one 3-pin power point with socket in the panel. For further requirement/detail of equipment & component to be in the part of ACDB, which are not covered here, are with station lighting specification.

The distribution box shall house a four pole MCCB of adequate rating at incomer and single pole MCCBs equal to numbers of outgoing feeder circuits on outgoing side, as per below details:

| S. No. | Rating of Distribution Box | Rating & Nos. of MCCB in Incomer | Rating & Nos. of MCCBs as Outgoing |
|---|---|---|---|
| 1. | 400A | 400A, 4P, 35kA Microprocessor based MCCB – 1No. (with inbuilt protection –O/L, S/C and ground fault.) | i) 400 Amp Bus Bar |
| 2. | 250A | 250A, 4P, 25kA Microprocessor based MCCB – 1No. (with inbuilt protection –O/L, S/C and ground fault.) | i) 250 Amp Bus Bar |

Light emission diode shall be provided for all outgoing phases to indicate the availability of supply and when switched off due to tripping/ manual operation of MCCBs to indicate that the same is off. LED are to be provided inside the box, with Ammeter in all incoming feeders.

The front door shall be having locking facility. The box should be provided with single door in front and having internal locking arrangement with two keys. Extra Padlock arrangement shall also be provided. The latches provided inside the door, which are locked in position by the keys, should be such that the door gets locked just by closing (for opening the door, keys will then be required). The backside cover shall be screwed type and should be fixed with 4Nos. 8mm size allen screws at four corners.

Neoprene rubber gasket shall be used on front door as well as back door.

**Painting of Box.**
All sheet steel surface of the box shall be thoroughly degreased and shall be followed by antacid cleaning so as to produce smooth and clean surface free from scale grease and dust. After cleaning, the surface shall be given phosphate coating followed by two coats of anti-rust paint primer (i.e. red zinc chrome primer). After which, two coats of synthetic paint of light grey colour (no. 631 as specified in IS 5 of 1961) shall be applied on internal and external, surface of the steel structure of the box with a spray gun. The box shall be backed in the oven so as to give an elegant and durable finish to the box.

Leakage proof: The box shall be vermin proof and weatherproof.

The assembly, comprising of the enclosure, framework and the circuit breaker shall be provided with earthing terminals readily accessible and of adequate size two earthing studs of 12mm dis size shall be welded to the enclosure on either side and shall be provided with locking nuts and washers. All the nuts, bolts and washers should be galvanized iron. The earthing terminals shall be clearly marker.

Ventilation louvers with wire mesh shall be provided on both the sides as per requirement. In addition to this, louvers with wire mesh of suitable sizes and numbers also required on backside cover of box. Detailed drawing showing size of openings and size of brass mess shall be submitted by the bidder for approval prior to manufacture.

Knock-out Holes:

Knockout holes for incoming and outgoing cable will be provided. The holes shall be suitable to accommodate single core aluminium conductor LT cable of appropriate size. These holes should be provided direct contact with and gets out by the metal adges.

The holes should be in alignment with the terminals of incomer and outgoing MCCBs so that the cable may be directly crimped with lugs. Bending of cable inside the box for terminal connection should not be required.

**Bus Bars and Cabling:**

i) The incoming and outgoing 3.5C and single core cable shall enter from the bottom of the enclosure.
ii) Electrolytic grade aluminium shall be used for bus bar and links used inter-connection of incoming and outgoing MCCBs. The rating shall be 1sq MM = 0.8 Amp.
iii) Bimetallic/ suitable connectors are required for connecting the MCCBs terminals to Bus Bars.
iv) The bus bar/ links shall be covered with casting of through setting compound to avoid possibility of shorting due to movement of lizards etc.
v) All the bolts used in the bus bars joints shall be provided with check nuts in addition to spring washers. The size of nuts bolts connecting the busses to other bus etc, should be such that clearances between phases to phases or phase to neutral should not be less than the prescribed limit.
vi) Crimping type aluminium lugs of suitable size shall be used for all incoming and outgoing and cable connection.
vii) The minimum clearance of 25mm between phases and 20mm between phases and neutral/ earth shall be maintained for the bus bars.
viii) Loading on each piller shall not be more than 50-60% of the rated capacity.

**Tests and Test Certificates:**

Manufacture of the Distribution box and Bus Bar Box shall be CPRI tested and relevant experience of supplying LT distribution boxes in utilities in past 5 years with performance certificate for atleast one year for successful installation from supplied agency/ end customer.

All the panels shall be tested in accordance with relevant BS: 214/ 1956 before dispatch of material.

Panels need to be offered for inspection to UPCL before dispatching from works to site