SECTION – 8B

TECHNICAL SPECIFICATIONS

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Sl. No.	Section No.	Description
1	SECTION - 01	GENERAL
2	SECTION - 02	DAS Specified Ring Main Unit
3	SECTION - 03	COMPACT Ring Main Unit
4	SECTION - 04	H.T 11 K.V UNDER GROUND CABLE.
5	SECTION - 05	L.T 1.1 K. V UNDER GROUND CABLE.
6	SECTION - 06	ABC CABLE (L.T)
7	SECTION - 07	ALUMINIUM LEAD WIRE (PVC INSULATED)
8	SECTION - 08	GOS 200AMPS, 400AMPS.
9	SECTION - 09	ACSR RABBIT CONDUCTOR
10	SECTION -10	HORN GAP FUSE UNIT
11	SECTION - 11	LIGHTNING ARRESTOR
12	SECTION - 12	PIN INSULATOR 11 K. V
13	SECTION - 13	L.T PROTECTION KIT
14	SECTION - 14	FEEDER PILLAR BOX
15	SECTION -15	JOINT KITS
16	SECTION - 16	SPUN POLE
17	SECTION - 17	PSCC POLE
18	SECTION - 18	EARTHING ARRANGEMENT
19	SECTION - 19	L.T DISTRIBUTION BOXES & H.T METERING CUBICLE.
20	SECTION - 20	LED LIGHTINING, SWITCHES, METERING.
21	SECTION - 21	MISCELLANEOUS
22	SECTION - 22	CONCRETE
23	SECTION - 23	DRAWINGS
24	SECTION-24	COMPACT SUB STATION
25	SECTION-25	POLES AND HIGHMASTS

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SECTION -1

1. GENERAL

1.1 General

1.1.1 These Specifications contained herein shall be read in conjunction with other tender documents.

1.1.2 The Work shall be carried out in accordance with the approved drawings and designs as would be submitted by the contractor and approved by the Engineer duly signed and stamped or issued to the Contractor by the Engineer duly signed and stamped by him as the case may be. The Contractor shall not take cognizance of any drawings, designs, specifications, etc. not bearing Engineer's signature and stamp. Similarly, the Contractor shall not take cognizance of instructions given by any other Authority except the instructions given by the Engineer in writing.

1.1.3 The work shall be executed and measured as per metric units given in the Schedule of Quantities, drawings etc. (FPS units where indicated are for guidance only).

1.1.4 Absence of terms such as providing, supplying, laying, installing, fixing etc. in the descriptions does not even remotely suggest that the Contractor is absolved of such providing, supplying etc. unless an explicit stipulation is made in this contract.

1.1.5 The specifications have been divided into different sections / sub-heads for convenience only. They do not restrict any cross-references. The Contractor shall take into account inter-relations between various parts of works/trades. No claim shall be entertained on the basis of compartmental interpretations.

1.1.6 The classification of various items of works for purposes of measurements and payments shall be as per Bills of Quantities (BOQ). Except where distinguished by BOQ, the rates apply to all heights, depths, leads, lifts, sizes, shapes and locations. They also cater for all cuts and wastes.

1.1.7 Reference to the Standard Codes of Practice.

1. The contractor shall make available at site all relevant Codes of practice as applicable.
2. Legend:

BS	British Standard
CPWD	Central Public Works Department
IRS	Indian Railway Standards
IS	Indian Standards

1.1.8 Other Publications: - DELETED

1.1.9 Contractor to Provide:

The Contractor shall provide and maintain at site throughout the period of works the following at his own cost and without extra charge, except for the items specified in the Bill of Quantities the cost being held to be included in the Contract Rates:

1. General works such as site clearance before and on completion of works.

2. All labour, materials, plant, equipment and temporary works, overhead charges as well as general liabilities, obligations, insurance and risks arising out of GCC, required completing and maintaining the works to the satisfaction of the Engineer.

3. Adequate lighting for night works, and also at other times whenever and wherever required by the

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Engineer.

4. Temporary fences, barricades, guards, lights and protective work necessary for protection of workmen, supervisors, engineers, General public and any other persons permitted access to the site. Contractor shall provide proper signages as directed.

   All fences, barricade shall be painted with colour shades as specified by the Engineer. The barricading should be of adequate height to ensure visual obstruction of work from public view.

5. All equipment, instruments, labour and materials required by the Engineer for satisfactory completion of works.

6. Design mixes and test them as per relevant clauses of specifications giving proportion of ingredients, sources of aggregates. and binder along with accompanying trial mixes. Test results to be submitted to the Engineer for his approval before adoption on works.

7. Cost of Preparation and compliance with provision of a quality assurance control program.

8. Cost of safeguarding the environment as per SCC.

9. Contractor has to provide Method statements ie detailed work procedure for all the works.

1.1.10 Quality Assurance & Quality Control

1. The work shall conform to high standards of design and workmanship, shall be structurally sound and aesthetically pleasing. The Contractor shall conform to the Quality standards prescribed, which shall form the backbone for the Quality Assurance and Quality Control system.

2. At the site, the Contractor shall arrange the materials, their stacking/storage in as per the standards manner to ensure the quality. The Contractor shall provide all the necessary equipment and qualified manpower to test the quality of materials, assemblies etc., as directed by the Engineer. The tests shall be conducted at specified intervals and the results of tests properly documented. The cost of all such testing shall be included in the quoted rates and nothing extra shall be paid for in this regard. In addition, the Contractor shall keep appropriate tools and equipment for checking alignments, levels, slopes and evenness of the surfaces.

3. (a) The Engineer shall be free to carry out such tests as may be decided by him at his sole discretion, from time to time, in addition to those specified in this document as per provisions of General Conditions of Contract. The Contractor shall provide the samples and labour for collecting the samples. Nothing extra shall be payable to the Contractor for samples, or for the collection of the samples.

   (b) The test shall be conducted at the Site laboratory that may (to) be established by the Contractor at his cost or at any other Standard Laboratory selected by the Engineer.

   (c) The Contractor shall transport the samples to the laboratory for which nothing extra shall be payable. In the event of the Contractor failing to arrange transportation of the samples in proper time the Engineer shall have them transported and recover two times the actual cost from the Contractor's bills.

   (d) All testing shall be performed in the presence of Engineer or his authorized representative. Testing may be witnessed by the Contractor or his authorized representative if permitted by the

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Test House. Whether witnessed by the Contractor or not, the test results shall be binding on the Contractor.

4. All materials which do not conform to these specifications shall be rejected. In the event of contractor not being able to arrange the material conforming to these specifications or in the event of failure of the contractor to get the sources approved within the agreed schedule submitted by contractor, the Engineer shall have the powers to cause the Contractors to purchase and use such materials from any particular source, as may, in the Engineer's opinion, be necessary for the proper execution of work.

1.1.11 Dimensions

1. Figured dimensions on drawings shall only be followed and drawings to a large scale shall take precedence over those to a smaller scale. Special dimensions or directions in the specifications shall supersede all others. All dimensions shall be checked on site prior to execution.

2. The size, measurements and other information concerning the existing site as shown on the drawings are believed to be correct, but the Contractor should verify them for himself and also examine the nature of the ground as no claim or allowance whatsoever will be entertained on account of any errors or omissions in the levels or the description of the ground levels or strata turning out different from what was expected or shown on the drawings.

1.1.12 Setting out of Works-DELTED

1.1.13 Materials

1. **Source of Materials**
   It shall be the responsibility of the contractor to procure all the materials required for construction and completion of the contract. The contractor shall indicate in writing the source of materials well in advance to the Engineer, after the award of the work and get it approved from the Engineer before commencing the work. If the material from any source is found to be unacceptable at any time, it shall be rejected by the Engineer.
2. **Quality**
   All materials used in the works shall be of the best quality of their respective kinds as specified herein, obtained from sources and suppliers approved by the Engineer and shall comply strictly with the tests prescribed hereafter, or where tests are not laid down in the specifications, with the requirements of the latest issues of the relevant Indian & other Standards.

3. **Sampling and Testing**
   All materials used in the works shall be subjected to inspection and test in addition to test certificates. Samples of all materials proposed to be employed in the permanent works shall be submitted to the Engineer at least 15 days in advance for approval before they are brought to the site.

   Samples required for approval and testing must be supplied sufficiently in advance in required quantity and number to allow for testing and approval, due allowance being made for the fact that if the first samples are rejected further samples may be required. Delay to the works arising from the late submission of samples will not be acceptable as a reason for delay in completion of the works.

   Materials shall be tested before leaving the manufacturer's premises, source. Materials shall also be tested at site and they may be rejected if not found suitable or in accordance with the specifications, notwithstanding the results of the tests at the manufacturer's works or elsewhere or test certificates or any approval given earlier.

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The contractor will bear all expenses for sampling and testing, whether at the manufacturer's premises at source, at site or at any testing laboratory or institution as directed by the Engineer subject to the provisions of No extra payment shall be made on this account.

4. **Dispatch of materials**
   Materials shall not be dispatched from the manufacturer's works to the site without written authority from the Engineer.

5. **Test certificates**
   All manufacturer's certificates of test, proof sheets, etc showing that the materials have been tested in accordance with the requirement of these specifications and of the appropriate Indian Standards are to be supplied free of charge to the Engineer.

6. **Rejection**
   Any materials that have not been found to conform to the specifications or otherwise not acceptable to the Engineer will be rejected forthwith andshall be removed from the site by the Contractor at his own cost within three days or as instructed by the Engineer.

1.1.14 Storing of Materials at site

All materials used in the works shall be stored on racks, supports, in bins, silos, go-downs, under cover etc. as appropriate to prevent deterioration or damage from any cause whatsoever to the entire satisfaction of the Engineer.

The storage of materials shall be in accordance with IS 4082 "Recommendation on stacking and storage or construction materials on site" and as per IS 7969 "Safety code for handling and storage of building materials".

The materials shall be stored in a proper manner at places at site approved by the Engineer. Should the place, where material is stored by the Contractor, be required by the Employer for any other purpose, the Contractor shall forthwith remove the material from that place at his own cost and clear the place for the use of the Employer within the time as communicated by the Engineer and at no extra cost to the Employer.

1.1.15 Water

1. **Water from approved source:**
   Potable water only shall be used for the works. Contractor shall have his own source of water duly tested and approved by Engineer. The water shall be free from any deleterious matter in solution or in suspension and be obtained from an approved source. The quality of water shall conform to IS 456.

2. **Storage:**
   The Contractor shall make his own arrangements for storing water, if necessary, in drums or tanks or cisterns, to the approval of the Engineer. Care shall be exercised to see that water is not contaminated in any way.

3. **Testing:**
   Before starting any concreting work and wherever the source of water changes, the water shall be tested for its chemical and other impurities to ascertain its suitability for use in concrete for approval of the Engineer. No water shall be used until tested and found satisfactory. Cost of all such Tests shall be borne by the contractor.

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1.1.16 Workmanship

1. Any work not to the satisfaction of the Engineer or his representative will be rejected and the same shall be rectified or removed and replaced with work of the required standard of workmanship at no extra cost.

1.1.17 Load Testing on Completed Structures -DELETED

1.2 STRUCTURAL WORK-DELETED

1.2.1 Supply of Monthly Progress Photographs and Album-DELETED

1.2.2 Supply of Monthly Progress Video CD's-DELETED

1.2.3 Survey Work-DELETED

1.2.4 Barricading

The work covers barricading for the work done along the Existing IR track, median and areas affecting road or rail traffic. Barricading for other areas like casting yard, batching plant, storage, and other working area shall be done at own cost by the contractor. The detailed scope of work is:

a. Providing and installing the barricade of the design and type as shown in the typical sketch furnished as per the approved plan firmly to the ground and maintaining it during the progress of work.

b. Providing adequate road and IR track safety devices. A tentative list given hereunder identifies minimum items, which may be required. However, actual numbers required shall be as per plan approved by the Engineer and clearance obtained from traffic department, Bangalore and concerned division of Railway officials. During execution of works, if any additional cost to this list is required then the contractor shall not be paid any extra cost.

c. Dismantling of barricade, other temporary installation from the site and cleaning the site shall be as per direction of Engineer upon completion and acceptance of work.

Tentative Road or IR track Safety Devices are mentioned below or any other safety devices as per site requirement.

1. Supply of Red portable traffic cones of 750mm height with white reflective tape bands on 100mm width all around.
2. Hazard warning light flashes with rechargeable. Maintenance free battery & charging system.
3. Safety light island post with 11 nos. parallel reflective.
4. Red reflective arrow fitted on enabled mild steel board of 360 x 220mm size.
5. Traffic Triangular Tripod made of fluorescent cloth fitted on steel frame.
6. Retro-reflective tape (I) 50mm width.
7. Fluorescent Jackets with reflective tape all around.
8. Yellow reflective cat eyes of size 115 x 11 x 22 mm made of ABS material having 19 glass beads on each side.
9. Metal Tabular Delineator of 610mm height with reflective tapes.

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10. Retro-reflective arrows diversion board 450 x 900mm with crystal clear protective transparent coat to avid damage on 14-gauge Mild Steel sheet with and without pole.
11. Retro-reflective "Men at Work" triangular board of size 900mm with crystal protective transparent coat to avoid damage on 14-gauge Mild Steel board with and without poles.
12. Retro-reflective board for "Go Slow Work in Progress" of size 1200 x 750mm with crystal clear protective transparent coat to avoid damage to the Mild Steel board with and without pole.
13. Retro-reflective advance direction signs cum Diversion Boards of size 1200 x 900mm with crystal clear protective transparent coat to avoid damage to the 14-gauge Mild Steel sheet with and without pole.
14. Retro-reflective speed limit circular sign Boards of 600mm Diameter with crystal clear protective transparent coat to avoid damage on 14-gauge sheet (without pole).
15. SORRY FOR INCONVENIENCE' Retro-reflective Boards of size 900 x 300mm size with crystal clear protective transparent coat to avoid damage on 14-gauge Mild Steel sheet (without pole).
16. HAZARD MARKERS (Yellow & Black) must be put all over the construction sites. This Retro-reflective board is of size 300 x 900mm with crystal clear protective coat to avoid damage and the 14-gauge Mild Steel with or without pole.
17. 'CAUTION' tape which is normally yellow tape of special Polyether Material having 75mm width 'CAUTION' is written all over with Black colour is rolls of 300 meters.
18. For running trains, Retro-reflective speed limit as per IR Specifications.

1.2.4.1 Measurement-DELETED

1.2.5 Transplantation of Trees -DELETED

1.2.6 Measurement-DELETED

1.2.7 Sub-Contractor-DELETED

1.3 Guarantees and Maintenance: - DELETED

1.3.1 Responsibility for Shop drawings, Samples and Mock-ups: - DELETED

1.3.2 Cleaning - DELETED

1.3.3 Expansion bolts/ fasteners: -DELETED

1.4 Applicable Codes, Standards & Publications for Electrical works

The important Codes, Standards and Publications to Contract are listed here under:

Sl.no	Standard	Description
1	IS:3427	AC metal enclosed switchgear and control gear for rated voltages above 1 KV and up to and including 52 KV.
2	IS 12063	Classification of degrees of protection provided by enclosures of electrical equipment
3	IS 9920 (Parts 1 to 4):	High Voltage Switches.
4	IS 9921 (Parts 1 to 5):	Specification for AC disconnectors and earthing switches for voltages above 1000 V
5	IS 13118	HV AC Circuit Breakers

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6	IS 12729	General requirements of switchgear and control gear for voltages exceeding 1000 V
7	IS 10601	Dimensions of terminals of HV Switchgear and Control gear.
8	IEC 1330	High voltage/Low voltage prefabricated substations
9	IEC 60694	Common clauses for MV switchgear standards.
10	IEC 6081	Monitoring and control.
11	IS 2705	Current Transformers
12	IS 3156	Voltage transformers
13	IS 8686	Specification for Static Protective Relays
14	IEC 62271-200	Standards for high voltage metal clad switchgear up to 52 KV.
15	IS 8130	Conductors for insulated electrical cables and flexible cords.
16	IS 10810(series)	Methods of tests for cables.
17	IS 10418	Drums for electric cables.
18	IS 7098 (Part 2)	Cross-linked Polyethylene insulation for Cables
19	IS 5831	Specification for PVC insulation sheath for electric cables
20	IS 7098 (Part-II) 13573,1992	Power cables with extruded insulation and their accessories for rated voltages from 1 kV (Um = 1,2 kV) up to 30 kV (Um = 36 kV) - ALL PARTS
21	IS 3043	Code of Practice for Earthing
22	IS 398-part II	Aluminium Conductor for Overhead Transmission Purpose
23	IEC-99-4	Gapless Lightning Arrestor
24	IS 3070 P-III	Metal Oxide Surge Arrestors without gaps for AC Systems
25	IEC 99 P-III	Artificial Pollution Testing of Lightning Arrestor
26	IS 2071	Methods of H V Testing
27	IS 694	PVC Insulated cables for working voltages up to and including 1000V
28	IS 14786/2000	Specification for high voltage prefabricated Sub-station
29	IS 1180	Power Transformer
30	IS 3637	Gas Operated relays
31	IS 1347	Low Voltage Switchgear and Control gear
32	IS 1255	Code of practice for installation and maintenance of power cables up to and including 33 kv rating
33	IS 13158	Prestressed concrete circular spun poles for overhead power, traction and telecommunication lines -- specification
34	IS 785	Reinforced concrete poles for overhead power and telecommunication lines - specification

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35	IS 4091	Code of practice for design and construction of foundations for transmission line, tower and poles

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SECTION – 2

RMU: DAS
RMU FOR OUTDOOR USE IN 11KV DISTRIBUTION CABLE SYSTEM

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Technical specification for DAS Ring Main Unit

1 Introduction

This document contains the Technical Specifications that apply to DAS Ring Main Units of 3- Way, 4-Way and 5-Way configurations, which covers the supply of Ring Main Units (RMUs).

2. Key RMU Components

Key RMU components are listed as follows:

- Two (2) load break switches (LBSs) with earthing switches, also known as Operating Devices (ODs), connecting the RMU to incoming and outgoing main loop, 11 kV,630 Amp capacity capable to connect XLPE cables of size 240/400 mm^2 cross section.
- One (1) to three (3) circuit breakers (CBs) with earthing switches, also known as Vertical Lines (VLs), connecting the RMU to distribution loop, 11 kV, 400 Amp capacity capable to connect XLPE cables of size 95/240 mm^2 cross section.
- One (1) to three (3) numerical relays for overcurrent (OC) and earth fault (EF) protection in conjunction with the corresponding circuit breaker(s).
- One (1) Fault Passage Indicator (FPI) in the RMU's main loop circuit to provide indications that feeder downstream phase or earth faults have occurred.
- All necessary voltage and current sensors for metering and protection.
- All necessary dry (potential-free) contacts for indications relevant to RMU monitoring and control.
- Two (2) multifunction meters serving as Intelligent Electronic Devices (IEDs) to provide voltage, current, power, energy and power factor readings that correspond to the RMU'smain-line circuits.
- A power supply unit, including auxiliary power transformer and battery backup, to provide stable 24 V DC and 12 V DC sources of power for a separately supplied RTU and radio respectively as well as necessary sources of power for the RMU's spring-charge motors, FPI, relays, and multifunction meters. The power supply shall also provide for RMU enclosure lighting fixtures and power-plug receptacles for maintenance/test equipment.
- Capacitor voltage dividers serving live-line cable indicators.

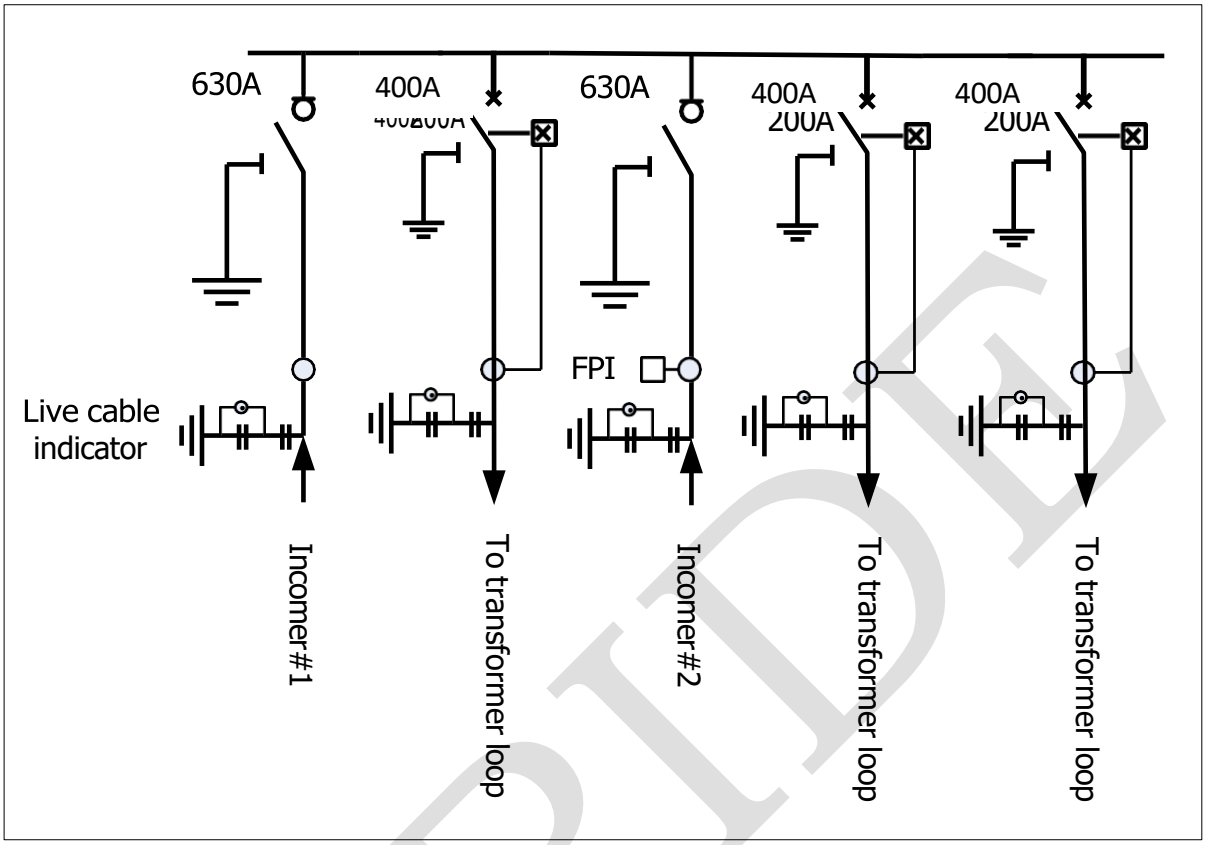
A typical five-way RMU configuration is illustrated in Figure 1-1. In this case, the RMU has six enclosures, one for each of the two load break switches, one for each of the three circuit breakers or VLs, and one for the RMU's auxiliary power supply unit and the necessary SCADA monitoring and control equipment. The SCADA monitoring and control equipment includes the RTU and radio as supplied by others and referenced elsewhere in these specifications.

3. Ring Main Units

Each RMU shall include its own power supply unit (including auxiliary power transformer, batteries, and battery charger), which shall provide a stable power source for not only the RMU, but also the RTU and radio that the RMU must be capable of housing.

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Figure 1-1: Typical RMU Configuration



Each new RMU shall be equipped with main-line load break switches and a fault passage indicator (FPI). Furthermore, to protect each of its lateral circuits, it shall be equipped with a corresponding set of circuit breakers and numerical relays. The RMU interrupters of reputed make shall be enclosed in an SF_6 or vacuum medium and the RMU will include all necessary voltage and current sensors and potential-free contacts so that, as a minimum, the DAS via its RMU remote interface can:

- Monitor and control the open/closed status of the RMU circuit breakers and load break switches.
- Monitor the local/remote position of RMU manually operated switches that can be used to enable and disable remote monitoring and control of individual ODs (Operating Device) and VLs (Vertical Lift).
- Monitor the health of the power supply, which will include battery failure.and low voltage indications.
- Monitor the open/closed status of RMU earthing switches.
- Monitor the open/closed status of RMU enclosure doors.
- Monitor for low SF_6 gas pressure readings.
- Monitor circuit breaker and load break switch spring charge (switch readiness) status.
- Monitor for circuit breaker relay operations.
- Monitor for main-circuit fault currents detected by the RMU's FPI (Fault Passage Indicator).
- Monitor the number of operations of the RMU's circuit breakers and load break switches.
- Monitor voltage, current, power, energy, and power factor values corresponding to the RMU's main circuits and the phase currents corresponding to the RMU's lateral circuits.

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4. Specification Organization

These Technical Specifications for DAS RMUs are organized as follows:

- **Clause 1: RMU Design Features.** This clause includes design features related to RMU availability, maintainability, expandability, life span and relevant physical and electrical properties.

- **Clause 2: RMU Characteristics.** This clause describes the main characteristics that relate to the functional and design aspects of RMU components such as line sensors, FPIs, protection relays, multi-function meters, motors, auxiliary transformers, power supply equipment, and enclosures.

- **Clause 3: Inspection and Test.** This clause includes requirements related to inspections, test procedures, test records, factory acceptance tests, site acceptance tests, and commissioning.

5. Applicable Standards

The RMUs shall be manufactured to the highest quality consistent with best practice and workmanship and in full accord with the Contractor's quality assurance plan. The RMUs and the work associated with their installation shall also conform to the Indian and equivalent international standards that are applicable. These include the standards listed in Table 1-1 below.

The Contractor shall provide an English language copy of the applicable Indian and equivalent international standards met by the proposed RMU.

6. Environmental Conditions

All materials supplied shall be capable of operating without fault in a tropical climate, which exhibits high level of ultra-violet radiation and severe thunderstorms. Relevant environmental conditions are listed as follows:

- Maximum ambient air temperature: 45 ºC
- Minimum ambient air temperature: 10 ºC
- Maximum relative humidity: 90 %
- Average thunderstorm days per annum: 50
- Average rainfall per annum: 900 mm
- Maximum wind speed: 119 km/hr.
- Altitude above mean sea level: 1000 m

7. Distribution Network Electrical Parameters

The main parameters of the BMAZ distribution network are as follows:

- Nominal system voltage: 11 kV (rms)
- Highest system voltage: 12 kV (rms)
- Number of phases: 3
- Frequency: 50 Hz
- Variation in frequency: 49 Hz to 50.5 Hz
- Type of earthing: Solid
- Power frequency withstand voltage: 28 kV
- Basic impulse withstand voltage: 75 kV

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Table 1-1: Applicable Standards

Standard	Description
IS 3427	AC metal enclosed switchgear and control gear for rated. voltages above 1 kV and up to and including 52 kV
IS 12063	Classification of degrees of protection provided by enclosures of electrical equipment
IS 9920 (Parts 1 to 4)	High Voltage Switches
IS 9921 (Parts 1 to 5)	Specification for AC disconnectors and earthing switches for voltages above 1000 V
IS 13118	HV AC Circuit Breakers
IS 10601	Dimensions of terminals of HV Switchgear and Control gear
IS 12729	General requirements of switchgear and control gear for voltages exceeding 1000 V
IEC 1330	High voltage/Low voltage prefabricated substations
IEC 60694	Common clauses for MV switchgear standards
IEC 6081	Monitoring and control
IS 2705	Current Transformers
IS 3156	Voltage transformers
IS 8686	Specification for Static Protective Relays
IEC 62271-200	Standards for high voltage metal clad switchgear up to 52 KV.

8. Testing

The specified RMUs shall be subject to type tests, routine tests, and acceptance tests. Where applicable, these tests shall be carried out as per the standards stated above. Prior to testing, the Contractor shall prepare and submit a detailed test plan for review and approval by the Employer.

9. RMU Design Features

All design features of the proposed DAS RMU shall be fully supported by the equipment actually delivered. The key design features include those that relate to:

- Availability, maintainability, expandability, and life span
- Ability to operate in severe outdoor environmental conditions.
- Immunity to electrical stress and disturbance
- Acceptable insulation properties
- Acceptable surge suppression characteristics
- Convenient RTU interconnection features

In these and all other specified respects, the RMU shall meet or exceed the cited standards or, where appropriate, other equivalent industry standards.

1. Availability, Maintainability, Expandability, and Life Span

1.1.1 Availability

The RMU shall be designed to have a fully enclosed metal housing combined with the single-phase insulation of all primary live parts to reduce the risk of internal faults to an absolute minimum and to provide a high degree of safety as well as availability. Nevertheless, manufacturer standard designs shall be used to the fullest extent possible.

Each RMU shall exhibit an availability of greater than 99.5%. To ensure this high degree of availability, the

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RMUs shall be fabricated, assembled, and finished with workmanship of the highest production quality and shall conform to all applicable quality control standards. All materials comprising the RMU shall be new, unused, and of the best industrial grade, and the RMU shall incorporate all recent improvements in both design and materials. All components shall be of current production from reliable component manufacturers.

1.1.2 Maintainability

The Employer intends to be self-reliant for RMU maintenance. To this end, the Contractor shall provide the support, documentation, and training necessary to operate and repair the RMU. This shall include but shall not be limited to the maintenance manuals and repair kits applicable to the Contractor's RMU design.
The Employer prefers RMU designs that do not require periodic preventive maintenance and inspections.
To facilitate expansion and maintenance, modularity shall be employed in the design of the equipment. All major subassemblies shall carry permanent labels providing a cross-reference to the Contractor's corresponding documentation.

1.1.3 Expandability

The RMUs shall be designed such that, in the future, they can be expanded to accommodate additional enclosures containing circuit breakers and associated equipment that will allow the RMU to supply power to additional distribution circuits. In this respect, for example, the 3-way RMU shall be expandable in the field to a 5-way RMU.

1.1.4 Life Span

Each RMU shall have a design life of at least 20 years from the date of final acceptance. The Contractor shall make available, at no cost to the Employer, the manufacturing designs, drawings, and the rights to manufacture any subassemblies that the manufacturer will not support or discontinues to support during this life span. The specific components of each sub-assembly shall be identified and referenced in Contractor-supplied documentation.

2. Outdoor Features

2.2.1 General

The RMUs shall be designed specifically for outdoor installation and, in this respect, shall be suitable for continuous operation in a tropical climate that includes exposure to severe frequently occurring thunderstorms. They shall also be suitable for conditions in which they will be exposed to heavy industrial pollution, salt-spray, and high levels of airborne dust.

The equipment in the proposed outdoor RMU shall be conformably coated to meet these climatic conditions. In this respect, standards such as IEC 60870-2-2 covering equipment, systems, operating conditions, and environmental conditions shall apply along with IEC 60721, which covers the classification of such conditions. In particular, the RMU equipment shall have been type tested for continuous operation under the environmental conditions.

In addition to the above, materials promoting the growth of fungus or susceptibility to corrosion and heat degradation shall not be used, and **steps shall be taken to provide rodent proof installations**.

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2.2.2 Corrosion Protection

Except for stainless steel, all steel surfaces that are not galvanized shall be treated to protect against corrosion. As a minimum, corrosion treatment shall include the following procedures:

- The surface shall be cleaned to bare material by mechanical or chemical means.
- One or more phosphatizing or priming coats of paint shall be applied to the bare surface using a zinc-based or lead-based primer.

- A finish coat with high scratch resistance or epoxy powder finish paint shall be applied over the primer. The coat thickness shall be of the order of 50 to 70 micrometers. The Employer shall approve the finish-coat color. The RAL-code will be agreed upon with the Contractor during the early design phases of project implementation.

2.2.3 Galvanizing

Except for stainless steel, and unless otherwise stated, all structural steel and all exterior and interior steel surfaces of the RMUs, as well as nuts and bolts associated with galvanized parts, shall be hot- dipped galvanized in accordance with IS 802 or an equivalent international standard.

3. Immunity to Electrical Stress and Disturbance

The electrical and electronic components of the DAS RMU shall conform to relevant standards concerning insulation, isolation, and immunity from electromagnetic interference, radiated disturbance, and electrostatic discharge. The ability to meet these requirements shall be verified by type tests carried out by accredited test laboratories that are independent of the bidder and/or the manufacturer of the RMU components. Certified copies of all available type test certificates and test results shall be furnished prior to supply.

4. Minimum Insulation of Equipment

The RMUs shall be of SF_6 gas-insulated type. Otherwise, from an insulation perspective, the DAS RMU shall be designed so as to minimize exposure to electrically live terminals when visual inspection or maintenance of the internal components is being conducted.

5. Surge Voltage Suppression

The DAS RMU equipment shall be designed to operate on input power containing voltage spikes. Equipment shall be protected against part failure or malfunction such as intermittent firing of triggering devices due to surge voltage spikes occurring randomly over the instantaneous supply voltage.

6. Nameplate Information

RMU nameplate information shall be determined in agreement with the Employer. This information may include for example:

- Name of manufacturer and country
- Type, design, and serial number
- Rated voltage and current.
- Rated frequency.
- Rated symmetrical breaking capacity.
- Rated making capacity
- Rated short time current and its duration
- Rated lightning impulse withstand voltage

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- Purchase Order number and date
- Month and year of supply

Each DAS RMU shall also exhibit a Danger Board to indicate the presence of high voltage (11000V).

7. Interconnecting Cables, Wiring, Connectors and Terminal Blocks

The Contractor shall provide all interconnecting wires, cables, connectors, terminations and other wiring accessories such as terminal blocks required by the RMU.

7.1 Metallic Cables

All metallic cables and wiring shall be of required cross-section solid or multiple strands of round copper conductors and have flame retardant insulation. All wiring shall be neatly laced and clamped.
All wire and cable connectors and terminators shall be permanently labeled for identification. All connection points for external cables and wires shall be easily accessible for connection and disconnection and shall be permanently labeled. Conductors in multi-conductor cables shall be individually color-coded.

7.2 Connectors

Plug-type connectors with captive fasteners shall be used for all interconnections. The connectors shall be polarized to prevent improper assembly.

7.3 RMU-RTU Connectors

For ease of installation and maintenance, the interconnection between the RMU and the RTU, i.e., the RTU to be installed by others in a separate RMU enclosure, shall be supported by having a multi-pin connector installed in each and every DAS RMU enclosure.
To accommodate all of the DAS RMU equipment points to be monitored and controlled, the connector installed in the enclosure (the Control Cabinet) containing the RTU shall in all cases be sized to accommodate a 5-way RMU, e.g., whether the RMU is 3-way or 5-way, the connector for interconnecting the RMU and RTU shall consist of six (6) multi-pin connectors as illustrated in Figure2-1.

The following concepts shall apply:

- The Control Cabinet's fixed connector shall consist of 6 individual multi-pin connectors having 24 female inserts and contacts capable of being wired to the RTU and to single multi-pin connectors of female type fixed within the other RMU enclosures via separate hooded plugs having 24 male inserts and contacts attached to cables of suitable length. The RTU male connector and its cable will be provided by the RTU contractor.
- All cabling for the RMU's analog and status input points, control output points, and auxiliary contacts shall be brought out to the single multi-pin connectors in the RMU enclosures. Modbus communication cable shall be adequate size (Minimum 1.5 sqmm) with outer sheath screen cable
- Wiring between the single female connectors in the OD and VL enclosures and the female connectors in the Control Cabinet shall take the form of Contractor-provided cables having at both ends a corresponding male connector.
- The female multi-pin connectors shall contain a locking lever so that, in combination withthe male connectors, they shall act as a mechanical locking device between male and female connector pairs. The lever shall only be fully locked if the two connectors are mated correctly.

7.4 Terminal Blocks

Apart from the connectors described above Clause, heavy-duty terminal blocks with screw type terminals for 5

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mm minimum machine screws shall be provided by the Contractor for other necessary metallic cable terminations. Terminals for auxiliary relays shall equal or exceed the relay wiring requirements. In using a terminal block, no more than two cables or wires shall be connected to any of its individual terminals.

Self-extinguishing fireproof vinyl marking strips shall be used to identify all external connection blocks. Marking tags shall be read horizontally. All terminals to which battery or other high voltages are connected shall be provided with fireproof covers.

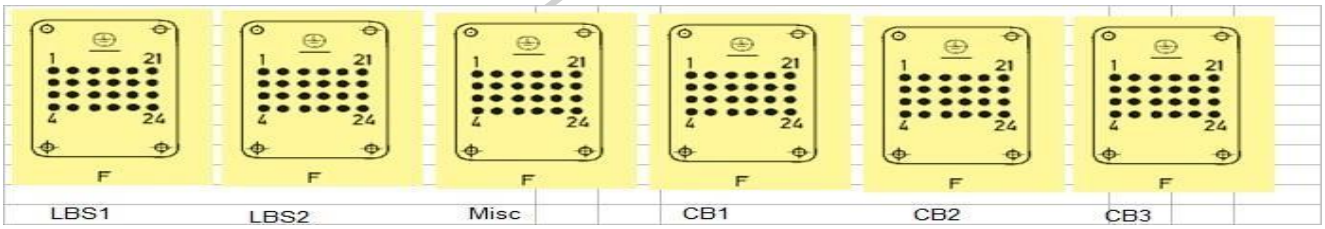
All individual status input, AC voltage input, and control output points shall be isolatable without the need to remove wiring by means of individual terminal blocks of the removable link type. In order to avoid open circuits on the secondary side of CTs, termination blocks with by-pass bridges shall be provided for all AC current inputs.

Terminal blocks shall comply with IEC 60947-7-1 (2009): Low-voltage Switchgear and Control Gear,Part 7-1: Ancillary Equipment, Terminal Blocks for Copper Conductors.

Figure 2-1: RMU/RTU Connector Pin-Out

		LBS 1	Pin nrs		LBS 2	Pin nrs		Miscellaneous	Pin nrs		CB1	Pin nrs		CB2	Pin nrs		CB3
1	2	LBS 1: closed	1	2	LBS 2: closed	1	2	SF6 Pressure: low	1	2	CB 1: closed	1	2	CB 2: closed	1	2	CB 3: closed
3	4	LBS 1: open	3	4	LBS 2: open	3	4	Charger AC: fail	3	4	CB 1: open	3	4	CB 2: open	3	4	CB 3: open
5	6	Spring 1: charged	5	6	Spring 2: charged	5	6	Voltage DC: low	5	6	Spring 1: charged	5	6	Spring 2: charged	5	6	Spring 3: charged
7	8	Earth switch 1: closed	7	8	Earth switch 2: closed	7	8	Battery alarms: Battery-failed, etc.	7	8	Earth switch 1: closed	7	8	Earth switch 2: closed	7	8	Earth switch 3: closed
9	10	Earth switch 1: open	9	10	Earth switch 2: open	9	10	Spare	9	10	Earth switch 1: open	9	10	Earth switch 2: open	9	10	Earth switch 3: open
11	12	Spare	11	12	FPI: overcurrent operated	11	12	Spare	11	12	Overcurrent relay 1: operated	11	12	Overcurrent relay 2: operated	11	12	Overcurrent relay 3: operated
13	14	Spare	13	14	FPI: earth fault operated	13	14	Spare	13	14	Earth fault relay 1: operated	13	14	Earth fault relay 2: operated	13	14	Earth fault relay 3: operated
15	16	LBS1: Local/ Remote Status	15	16	LBS2: Local/Remote Status	15	16	Spare	15	16	CB1: Local/Remote Status	15	16	CB2: Local/Remote Status	15	16	CB3: Local/Remote Status
17	18	LBS 1 control: close	17	18	LBS 2 control: close	17	18	Spare	17	18	CB 1 control: close	17	18	CB 2 control: close	17	18	CB 3 control: close
19	20	LBS 1 control open	19	20	LBS 2 control open	19	20	Spare	19	20	CB 1 control: open	19	20	CB 2 control: open	19	20	CB 3 control: open
21	22	Door: open	21	22	Door: open	21	22	Spare	21	22	Door: open	21	22	Door: open	21	22	Door: open
23	24	Spare	23	24	FPI: reset	23	24	Spare	23	24	Spare	23	24	Spare	23	24	Spare

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10 . RMU Characteristics

As a minimum, the RMUs shall be equipped with main-line load break switches and a fault passage indicator (FPI), circuit breakers, and numerical relays for the protection of laterals, and multifunction meters providing voltage, current, power, energy, and power factor readings. The Load Break Switches and the Circuit Breakers used in the RMU shall be of SF_6 insulated and vacuum interrupter type.

In addition, each RMU shall be equipped with all necessary connectors, terminal blocks, and other accessories that will allow the RTU it will house to send required RMU/distribution network indications and measurements to the DAS via the communications system.

1. General Requirements

Each RMU shall include its own power supply, including battery and battery charger, and provisions for supplying a stable source of power for the RTU and radio to be housed by the RMU. Thus, the RMU shall also provide the necessary space for housing the RTU and radio. In addition, space mustbe provided for the RMU's auxiliary power transformer, which shall serve as the power supply's230 V AC input, along with all other RMU devices such as the PTs and CTs for deriving voltage and current signals.

Within this context, the general requirements of the RMU shall include, but shall not be limited to provision of the following monitoring and control features:

- Positions of local/remote switches as used to control local and remote access to circuit breakers and load break switches
- Power supply indications including battery failure and voltage alarms
- Open/closed position of load break switches, circuit breakers, and earthing switches
- Enclosure door-open indications
- SF6 gas-pressure low alarm
- Circuit breaker and load break switch spring charge (switch readiness) indications
- Circuit breaker relay indications
- Indications of fault current in the RMU's main feeder circuit as detected by the FPI
- Measurement of 11 kV voltage, current, power, energy, and power factor values
- Load break switch and circuit breaker open/close control
- FPI reset control
- Relay settings control

Commissioning of the RMUs shall not be complete until they have been demonstrated on a point-to- point basis to be fully interoperable with the DAS.

2. Parameter Requirements

The RMUs shall be suitable for main cable networks of 630 Amps and loop cable networks of 400 Amps. The minimum design parameters to which their major components shall conform or exceed are summarized in the following tables.

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Table 3-1: System Parameters

Parameter	Value
Nominal System Voltage	11 kV
Highest System Voltage	12 kV
Rated Voltage	12 kV
System frequency	50 Hz
Number of Phases	3 Phase/3 Wire

Table 3-2: Circuit Breaker Parameters

Parameter	Value
Lightning Impulse Withstand Voltage Phase-to-Phase & Phase-to-Earth:Across Isolating Distance:	75 kV (peak) 85 kV (peak)
Power Frequency Withstand Voltage to Earth, Between Poles, & Across Opening SpanAcross Isolating Distance	28 kV rms for 1 minute 32 kV rms for 1 minute
Rated Short Time Withstand/Breaking Current:	20 kA (rms)
Rated Duration of Short Circuit:	3 seconds
Rated Normal Current:	400 Amps (rms)

Table 3-3: Load Break Switch Parameters

Parameter	Value
Rated Short Circuit Making Capacity	50 kA peak at rated voltage (both LBS & Earthing Switch)
Rated Load Interrupting Current	630 Amps
Rated Cable Charging Interrupting Current	25 Amps

The RMU switchgear shall be capable of withstanding the specified currents without damage in accordance with the latest versions of IEC 60694 (Common Specifications for High-Voltage Switchgear and Control Gear Standards) and IS 3427 (AC Metal Enclosed Switchgear and Control Gear for Rated Voltages above 1 kV and up to and including 52 kV).

2.1 Design Details

- The RMU shall be designed to operate at a rated voltage of 12 kV. It shall consist of two (2) numbers of 630 Amp SF_6 insulated Load Break Switches as incomers and up to three (3) numbers of 400 Amp SF_6 insulated Circuit Breakers.
- It shall include, within the same metal enclosure, earthing switches for each Load Break Switch and Circuit Breaker.

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- Suitable fool-proof interlocks shall be provided to the earthing switches to prevent inadvertent or accidental closing when the circuit is live, and the concerned Load Break Switch/Circuit Breaker is in its closed position.

- Cast-resin enclosures filled with gas at suitable pressure to ensure adequate insulation and safe operation shall be used. The assembly shall not require further gas processing during its expected operational life of 30 years as per Clause GG
  2.3 and 3.3 of IS 3427.

- The degree of protection required against prevailing environmental conditions, including splashing water and dust, shall be not less than IP 54 as per IS 12063.
- The active parts of the switchgear shall be maintenance free. Otherwise, the RMU shall be of low-maintenance type.
- The tank shall be made of an adequate thickness of stainless steel or metallized cast resin and shall be internally arc tested.
- The RMU shall be suitable for mounting on its connecting cable trench.

- For each RMU enclosure, a suitably sized nameplate clearly identifying the enclosure and the electrical characteristics of the enclosed devices shall be provided.
- The positions of the different devices shall be clearly visible to an operator when standing in front of each enclosure with its door open. Device operations shall be clearly visible.

- The RMU design shall be such that access to live parts shall not be possible without the use of Constructor-supplied tools.
- The design shall incorporate features that prevent any accidental opening of the earth switch when it is in the closed position. Similarly, accidental closing of a Circuit Breaker or Load Break Switch shall be prevented when the same is in an open position. This includes protection against accidental closing resulting from the release of any latch or spring in tension due to vibrations caused externally or internally.

2.2 Earthing

There shall be continuity between metallic parts of the RMUs and cables so that there is no dangerous

- electric field in the surrounding air and the safety of personnel is ensured.
- The RMU frames shall be connected to the main earth bars, and the cables shall be earthed by an Earthing Switch having the specified short circuit making capacity.
- The Earthing Switch shall be operable only when the main switch is open. In this respect, a suitable mechanical fail-proof interlock shall be provided.
- The Earthing Switch shall be provided with a reliable earthing terminal for connection to an earthing conductor having a clamping screw suitable for the specified earth fault conditions. The connection point shall be marked with the earth symbol. The flexible connections between the earthing blade and the frame shall have a cross-section of at least 50 mm^2 copper or equivalent in aluminum.
- The Earthing Switch shall be fitted with its own operating mechanism. In this respect, manual closing shall be driven by a fast-acting mechanism independent of the operator's action.

2.3 Incomer Load Break Switches

- The Load Break Switches shall be maintenance free. With enclosure doors open, the position of power contacts and earthing contacts shall be clearly visible from the front of the RMU.

- The position indicator shall provide positive contact indication in accordance with IS 9920. In addition, the manufacturer shall prove the reliability of indication in accordance with IS 9921. These switches

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shall have three positions (or states), i.e., Open, Closed, and Earthed, and shall be constructed in such a way that natural interlocking prevents unauthorized operations.

- The switches shall be fully assembled, tested, and inspected in the factory.
- Manual opening and closing shall be driven by a fast-acting mechanism independent of manual operator action.
- The Load Break Switches shall be provided with a motorized operating mechanism suitable for SCADA control.
- A facility shall be provided with an electrical operating mechanism allowing an operator at the RMU site to operate the Load Break Switches without any modification of the operating mechanism and without de-energizing the RMU.
- The switch and earthing switch mechanisms shall have a mechanical endurance. of at least5,000 operations. Otherwise, these mechanisms shall conform to IS 9920 (High Voltage Switches Part 1: High Voltage Switches for Rated Voltages above 1 kV and less than 52 kV).

2.4 Circuit Breakers

The Circuit Breakers shall be maintenance free and, when standing in front of the RMU with enclosure doors open, their positions shall be clearly visible. The position indicator shall provide positive contact indication in accordance with IS 9920. In addition, the manufacturer shall prove the reliability of indication in accordance with IS 9921: Alternating Current Disconnectors (Isolators) and Earthing Switches for Voltages above 1,000 V.

The breakers shall have three positions (or states), i.e., Open, Closed, and Earthed, and shall be constructed in such a way that natural interlocking prevents unauthorized operations. They shall be fully assembled, tested, and inspected in the factory.

An operating mechanism shall be used to manually close the Circuit Breaker and charge the mechanism in a single movement. It shall be fitted with a local system for manual tripping. There shall be no automatic reclosing. The Circuit Breaker shall be capable of closing fully and latching against the rated making current. Mechanical indication of the OPEN, CLOSED, and EARTHED positions of the Circuit Breaker shall be provided.

When the Circuit Breaker closing mechanism is of the spring-operated type, it shall not be possible for the Circuit Breaker to close until the spring is fully charged and the associated charging mechanism is fully ready for closing. Wherever an external spring charging handle is required to charge the spring, it shall be ensured that the same is not allowed to move during release of the spring energy. Alternatively, it shall not be possible to release the spring energy until the charging handle is completely disengaged from the mechanism. A visual mechanical indicating device shall be provided to indicate the status of the spring, i.e., SPRING CHARGED or SPRING FREE. It shall be possible to change the spring when the Circuit Breaker is closed and, if the spring is released, the Circuit Breaker shall not open. Nor shall this operation result in any mechanical damage to the component of the Circuit Breaker or its operating mechanism. Alternatively, a fast-acting reflex mechanism for Circuit Breakers is also acceptable.

Each Circuit Breaker shall operate in conjunction with a suitable protection relay under lateral circuit phase and earth fault conditions. In addition, the Circuit Breaker shall be provided with a motorized operating mechanism that can be remotely controlled by the DAS.

2.5 Cable Termination

Bushings shall be conveniently located for working with the specified cables and shall allow for the termination of these cables in accordance with the prevailing practice and guidelines of cable manufacturers. The dimensions of the terminals shall be in accordance with IS 10601.

A non-ferro-magnetic cable clamp arrangement shall be provided for each cable to be terminated in the RMU. Special clamps to avoid mechanical load of the terminated cable on the bushing.

A suitable arrangement for the Circuit Breakers, Earthing Switches, and Load Break Switches shall be provided

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so that these devices can be padlocked in the "Open" and "Closed" positions.
A permanent "Live Cable" indication as per IEC 61958 (High-Voltage Prefabricated Switchgear and Control Gear Assemblies - Voltage Presence Indicating Systems) shall be provided for each cable using a capacitor voltage divider.
It shall be possible to test the core or sheath insulation of the cables without de- energizing the remaining section of the RMU, accessing the cable compartment, or disconnecting the cable.

2.6 Safety of Equipment

With respect to the RMU's SF_6-filled equipment, any accidental overpressure inside the sealed chamber shall be limited by the opening of a pressure-limiting device in the enclosure so that the gas will be released away from the operator without endangering the operator or anyone else in the vicinity of the RMU.
All manual operations shall be carried out from the front of the RMU. The effort required to be exerted on the lever as used by the operator shall not exceed 250 N.

2.7 Front Plate

The front plate shall include a clear mimic diagram indicating RMU functionality. The position indicators shall correctly depict the position of the main contacts and shall be clearly visible to the operator. The lever operating direction shall be clearly indicated.

3. Line sensors

The RMU shall be provided with current sensors and voltage sensors. These sensors shall meet the electrical and mechanical ratings as per the relevant standards referenced in Table 1-1.

3.1 Current Sensors

A panel shall be provided in each load break switch enclosure to mount a three-phase, single-core, CT for metering purposes. A similar panel shall be provided in each circuit breaker enclosure to mount a three-phase, single-core, CT for protection purposes. CT access for maintenance or any other purpose shall be from the front, back, or top of these panels.
The CTs shall conform to IS 2705. The design and construction shall be sufficiently robust to withstand thermal and dynamic stresses during short circuits. Secondary terminals of CTs shall be brought out suitably to a terminal block, which will be easily accessible for testing and terminal connections.
Further characteristics and features distinguishing CTs used for metering from CTs used for protection are listed as follows:
CTs for Metering:

- Material: Epoxy resin cast
- Burden: 2.5VA
- Ratio: 400-200/1 A
- Accuracy Class: 0.5

CTs for Protection:

- Material: Epoxy resin cast
- Burden: 2.5VA
- Ratio: 200-100/1 A
- Accuracy Class: 5 P 10

The RMU's other CTs, i.e., those used by Fault Passage Indicators (FPIs), shall be supplied by the FPI manufacturer. These CTs shall be an integral part of the FPI's design to ensure that they properly match the requirements of the FPI.

3.2 Voltage Sensors

Three (3) potential transformers shall be provided. The burden per transformer shall be no more than 50 VA and the voltage ratio shall be 11000/110 V. The accuracy class shall be 0.5. HRC fuses shall be provided on the HV side.

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The PTs shall be of cast epoxy-resin construction, and they shall conform to IS 3156. Their design and construction, in particular, shall be sufficiently robust to withstand the thermal and dynamic stresses during short circuits.

4. Fault Passage Indicator

Each RMU shall be outfitted with one non-communicable FPI. The FPI shall be mounted in the nominal outgoing OD (Load Break Switch) enclosure along with its integral CT for phase and earth fault monitoring.

The FPIs shall include:

- Fault indicator units for feeder phase and earth faults.
- Potential-free output contacts for hardwiring to RTUs. On this basis, the DAS will be able to monitor fault passage indications. Two such output contacts per FPI are desirable, one for phase and one for earth fault monitoring.
- Potential-free input contacts for hardwiring to RTUs to allow the DAS to reset FPI's following their detection of phase or earth faults.
- Configuration ports for configuring the equipment in the field. Such ports are desirable, but not mandatory.

Local fault indications shall be provided in addition to remote indications through the RTU. The local indications shall use LEDs on the front panel of the RMU enclosure.

The characteristics of the FPIs shall include:

- Phase fault thresholds configurable from at least 100 to 600 A
- Earth fault thresholds configurable from at least 20 to 100 A
- Number of steps for adjusting phase and earth fault thresholds at least four
- Fault current duration range configurable from at least 40 ms to 500 ms
- Protection Relay

The RMU shall be equipped with numerical relays as used to trip the RMU circuit breakers.

4.1 General

The Circuit Breaker enclosures in the RMU shall be outfitted with a communicable- type numerical (feeder protection) relay, i.e., one for each outgoing circuit breaker. The protection relay's auxiliary contacts shall be hardwired to the RTU. The relay shall also interface with the RTU via an RS 232/485 port in order to send, as a minimum, real-time phase current readings using the MODBUS protocol.

The numerical relay shall be powered by the RMU's power supply unit and be provided with Inverse Definite Minimum Time (IDMT) and Instantaneous protection characteristics. On this basis, the relay as a minimum shall provide:

- Phase Overcurrent Protection (50/51)
- Earth Fault Protection (50N/51N)

The feeder protection relay shall be provided with an input for remote tripping, which shall be realized via an electric output pulse even without presence of phase current. A flag indicator shall be installed for signaling the occurrence of trip conditions.

4.2 Features and Characteristics

The numerical relay shall have the following minimal features and characteristics noting that variations may be acceptable as long as they provide similar or better functionality and/or flexibility:

- It shall be housed in a flush mounting case and powered by the RMU power supply unit.
- The Relays shall be of 24V DC auxiliary type.
- It shall have three phase overcurrent elements and one earth fault element.
- IDMT trip current settings shall be 20-200% in steps of 1% for phase overcurrent and 10- 80% in steps of 1% for earth fault.
- Instantaneous trip current settings shall be 100-3000% in steps of 100% for phase overcurrent and 100-1200% in steps of 100% for earth fault.
- Selectable IDMT curves shall be provided to include, for example, Normal Inverse, Very Inverse,

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Extreme Inverse, Long Time Inverse, and Definite Time. Separate curve settings for phase overcurrent and earth fault shall be supported.

- For IDMT delay multiplication, the Time Multiplier Setting (TMS) shall be adjustable from 0.01 to 0.1 in 0.1 steps.
- The relay shall have local independent LED indications for Healthy, Trip, I>, I>>, IN>, and IN>> conditions.
- The relay shall also be provided with:
  - Alphanumeric Liquid Crystal Display (LCD) for measurement and relay setting.
  - Communications via a MODBUS RS232/RS485 port to provide the RTU (and hence the DAS) with phase current measurements. It is also desirable that this same means of communication can be used by the RTU to send setting and control commands to the relay.
  - Front USB port for local communications with a laptop PC.
  - Parameter change capability that is password protected.
  - Capability to record up to 5 of the latest fault records duly time stamped and stored in non-volatile memory for subsequent reading via the above referenced USB port.

5. Power Supply

Each RMU shall be outfitted with a power supply, including batteries and battery charger, suitable for operation of a 5-way RMU even if the RMU, for example, is only 3-way. This is to allow for the possible addition of future automated VLs. On this basis, the following operational specifications shall apply:

- The power supply unit shall conform to the following requirements:
  - Input: 230 V AC nominal from the RMU's auxiliary power transformer allowing for possible variations from 190 to 300 V AC
  - Output: Stable 24 V DC and 12 V DC
  - Batteries: 24 V DC and 12 V DC
  - Receptacles: 2 x 230 V AC (for test equipment)
  - Lighting Fixtures: One for each enclosure
- The auxiliary power transformer's inputs shall be equipped with surge protection devices in accordance with IEC 62305.
- The 24 V DC batteries shall have sufficient capacity to supply power to the following devices with a nominal backup of 4 hours:
  - RMU's spring-charge motors for a minimum of six (6) operations
  - RMU's trip coils, close coils, FPI, multifunction meters, and relays
  - RTU as supplied by others.
- The 12 V DC batteries shall have sufficient capacity to supply power to the radio (supplied by others) with a nominal backup of 8 hours.
- The batteries shall be of sealed lead acid VRLA or dry type and shall have a minimum life of five (5) years at 25°C.
- The battery charger shall be fully temperature compensated.
- To prevent deep discharge of the batteries on loss of AC power source, the battery charger shall automatically disconnect all circuitry fed by the batteries following a user- adjustable time period or when the battery voltage falls below a preset value. If the battery voltage falls below the preset value, the time to fully recharge all batteries shall not exceed twenty-four (24) hours.
- An automatic battery checking device shall be provided to check the battery's health and initiate a battery-failed alarm signal in case battery deterioration is detected. Such detection may be based on comparing measurement values with set values (e.g., internal resistance, voltage, etc.).
- The battery charger shall be provided with an alarm displayed at the local control panel and remotely at the DAS to account for any of the following conditions:
  - Low battery voltage
  - High battery voltage
  - Battery failed
  - Battery charger overvoltage
  - Grounded battery/battery-charger
  - Others according to manufacturer's design

6. Multi-Function Meter

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The RMU main incoming and outgoing OD circuits shall be equipped with Intelligent Electronic Devices (IEDs) in the form of communicable multi-function meters capable of providing distribution system voltage, current, power factor, power, and energy readings.

6.1 Operational Features

The multi-function meters shall have an accuracy class of 0.5 and shall provide data on an RS 232/485 communications port using the MODBUS protocol.

Each multifunction meter shall have the following minimum features:

- It shall be housed in a flush mounting case & powered by the RMU DC power supply unit.
- Measurement, display, and communications capability of up to 31 parameters
- THD measurement and power quality data
- True rms measurement
- Digital communications
- Fully programmable PT and CT ratios
- Simple menu driven interface.
- High quality LED display
- Able to monitor:
  - Voltage: line-to-line and line-to-neutral
  - Current: phase and neutral
  - Frequency
  - Power factor
  - Power (active, apparent, and reactive)
  - Energy (active and reactive)
  - Total harmonic distortion

6.2 Specifications

The following table summarizes the specifications applicable to the multi-function meter.

Table 3-4: Multi-Function Meter Specifications

Parameter	Value
Input Voltage: Nominal input voltage (AC rms) Max continuous input voltage	 57.7 – 277 V L-N, 100 - 480 V L-L 120% of nominal value
Input Current: Nominal input current System CT primary values Max continuous input current	 1 or 5A AC rms (programmable on site) Standard values up to 4 kA (1 or 5 A) 120% of rated value
Overload Withstand: Voltage Current	2 x rated for 1 sec, repeated 10 times at 10 sec intervals 20 x rated for 1 sec, repeated 5 times at 5 minutes
Operating Measuring Ranges	5 to 120% of rated value
Current	5 to 120% of rated value
Frequency	40 to 70 Hz
Power Factor	0.5 lag to 0.8 lead
Accuracy Reference Conditions: Reference temperature Input waveform Input frequency Auxiliary supply voltage Auxiliary supply frequency Power Factor	 23°C ± 2°C Sinusoidal (distortion factor 0.005) 50 or 60 Hz ±2% Rated Value ±1% Rated Value ±1% 0.866 lag to 0.866 lead
Accuracy: Voltage Current	 ±0.5% over 50 to 100% of rated value ±0.5% over 10 to 100% of rated value

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Frequency Active Power Re-Active Power Apparent Power Active Energy (kWh) Reactive Energy (kVArh) Apparent Energy (kVAh) Phase Angle and Power Factor	0.15% at mid frequency ±0.5% over 10 to 100% of rated value ±0.5% over 10 to 100% of rated value ±0.5% over 10 to 100% of rated value 1% (IEC 62053-21) from 0.866 lag to 0.866 lead 1% (IEC 62053-21) from 0.866 lag to 0.866 lead 1% 1 %
Applicable Standards: EMC Immunity Safety IP for water and dust	 IEC 61326 IEC 61000-4-3 (10V/m minimum, Level 3) IEC 61010-1-2001 (permanently connected use) IEC 60529
Environmental:	
Operating temperature	-10 to +55°C
Relative humidity	0 to 90% non-condensing

7. Distribution Automation System Interface

The RMU shall be equipped so that it can be monitored and controlled via the DAS. In this respect, it shall interoperate with the RTU that will be housed in the RMU Control Cabinet. The RTU in turn will interoperate with the DAS via the remote radio and the communications system to which the radio is linked.

The RMU shall have provisions for opening and closing its switches using output from the RTU. The RMU shall also supply analog and status signals to the RTU for monitoring the condition of the RMU's distribution network circuits as well as the components of the RMU. A list of input/output points required for 3-way and 5-way RMU configurations is presented in Table 3-5 below.

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Table 3-5: Data Points per RMU Configuration

3-Way RMU

DIGITAL INPUT	CONTROL OUTPUT	IED DATA
LBS 1 ▪ LBS 1: closed ▪ LBS 1: open ▪ Spring 1: charged ▪ Earth switch 1: closed ▪ Earth switch 1: open ▪ LBS 1: local/remote status ▪ Door: open LBS 2 ▪ LBS 2: closed ▪ LBS 2: open ▪ Spring 2: charged ▪ Earth switch 2: closed ▪ Earth switch 2: open ▪ LBS 2: local/remote status ▪ Door: open FPI (assuming 2 contacts) ▪ Overcurrent operated ▪ Earth fault operated CB1 ▪ CB 1: closed ▪ CB 1: open ▪ Spring 1: charged ▪ Earth switch 1: closed ▪ Earth switch 1: open ▪ Overcurrent relay 1: operated ▪ Earth fault relay 1: operated ▪ CB 1: local/remote status ▪ Door: open Miscellaneous ▪ SF6 Pressure: Low ▪ Charger AC: Fail ▪ Voltage DC: Low ▪ Battery alarms: Battery-failed,etc. **Total (with spare): 40**	LBS 1 ▪ LBS 1: close ▪ LBS 1: open LBS 2 ▪ LBS 2: close ▪ LBS 2: open CB 1 ▪ CB 1: close ▪ CB 1: open FPI ▪ Reset **Total (with spare): 8**	Multifunction Meter Communication on MODBUS through RS-232/485 ports (2 meters) No. of Measurements: ▪ Voltage: 6 ▪ Current: 6 ▪ Active power: 6 ▪ Reactive power: 6 ▪ Power factor: 2 ▪ Active Energy: 2 ▪ Reactive Energy: 2 **Total Measurements: 30** Feeder Protection Relay Communication on MODBUS through RS-232/485 ports (One protection relay). Minimum No. of Points: ▪ 3 points per relay **Total Points: 3**

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4-Way RMU

DIGITAL INPUT	CONTROL OUTPUT	IED DATA
BS 1 ▪ LBS 1: closed ▪ LBS 1: open ▪ Spring 1: charged ▪ Earth switch 1: closed ▪ Earth switch 1: open ▪ LBS 1: local/remote status ▪ Door: open LBS 2 ▪ LBS 2: closed ▪ LBS 2: open ▪ Spring 2: charged ▪ Earth switch 2: closed ▪ Earth switch 2: open ▪ LBS 2: local/remote status ▪ Door: open FPI (assuming 2 contacts) ▪ Overcurrent operated ▪ Earth fault operated CB1 ▪ CB 1: closed ▪ CB 1: open ▪ Spring 1: charged ▪ Earth switch 1: closed ▪ Earth switch 1: open ▪ Overcurrent relay 1: operated ▪ Earth fault relay 1: operated ▪ CB 1: local/remote status ▪ Door: open CB2 ▪ CB 2: closed ▪ CB 2: open ▪ Spring 2: charged ▪ Earth switch 2: closed ▪ Earth switch 2: open ▪ Overcurrent relay 2: operated ▪ Earth fault relay 2: operated ▪ CB 2: local/remote status ▪ Door: open Miscellaneous ▪ SF6 Pressure: Low ▪ Charger AC: Fail ▪ Voltage DC: Low ▪ Battery alarms: Battery-failed, etc. **Total (with spare): 47**	LBS 1 ▪ LBS 1: close ▪ LBS 1: open LBS 2 ▪ LBS 2: close ▪ LBS 2: open CB 1 ▪ CB 1: close ▪ CB 1: open CB 2 ▪ CB 2: close ▪ CB 2: open CB 3 ▪ CB 3: close ▪ CB 3: open FPI ▪ Reset **Total (with spare): 16**	Multifunction Meter Communication on MODBUS through RS-232/485 ports (2 meters) No. of Measurements: ▪ Voltage: 6 ▪ Current: 6 ▪ Active power: 6 ▪ Reactive power: 6 ▪ Power factor: 2 ▪ Active Energy: 2 ▪ Reactive Energy: 2 **Total Measurements: 30** Feeder Protection Relay Communication on MODBUS through RS-232/485 ports (3 protection relays). Minimum No. of Points: ▪ 3 points per relay **Total Points: 9**

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5-Way RMU

DIGITAL INPUT	CONTROL OUTPUT	IED DATA
LBS 1 ▪ LBS 1: closed ▪ LBS 1: open ▪ Spring 1: charged ▪ Earth switch 1: closed ▪ Earth switch 1: open ▪ LBS 1: local/remote status ▪ Door: open LBS 2 ▪ LBS 2: closed ▪ LBS 2: open ▪ Spring 2: charged ▪ Earth switch 2: closed ▪ Earth switch 2: open ▪ LBS 2: local/remote status ▪ Door: open FPI (assuming 2 contacts) ▪ Overcurrent operated ▪ Earth fault operated CB1 ▪ CB 1: closed ▪ CB 1: open ▪ Spring 1: charged ▪ Earth switch 1: closed ▪ Earth switch 1: open ▪ Overcurrent relay 1: operated ▪ Earth fault relay 1: operated ▪ CB 1: local/remote status ▪ Door: open CB2 ▪ CB 2: closed ▪ CB 2: open ▪ Spring 2: charged ▪ Earth switch 2: closed ▪ Earth switch 2: open ▪ Overcurrent relay 2: operated ▪ Earth fault relay 2: operated ▪ CB 2: local/remote status ▪ Door: open CB3 ▪ CB 3: closed ▪ CB 3: open ▪ Spring 3: charged ▪ Earth switch 3: closed ▪ Earth switch 3: open ▪ Overcurrent relay 3: operated ▪ Earth fault relay 3: operated ▪ CB 3: local/remote status ▪ Door: open Miscellaneous ▪ SF6 Pressure: Low ▪ Charger AC: Fail ▪ Voltage DC: Low ▪ Battery alarms: Battery-failed, etc. **Total (with spare): 56**	LBS 1 ▪ LBS 1: close ▪ LBS 1: open LBS 2 ▪ LBS 2: close ▪ LBS 2: open CB 1 ▪ CB 1: close ▪ CB 1: open CB 2 ▪ CB 2: close ▪ CB 2: open CB 3 ▪ CB 3: close ▪ CB 3: open FPI ▪ Reset **Total (with spare): 16**	Multifunction Meter Communication on MODBUS through RS-232/485 ports (2 meters) No. of Measurements: ▪ Voltage: 6 ▪ Current: 6 ▪ Active power: 6 ▪ Reactive power: 6 ▪ Power factor: 2 ▪ Active Energy: 2 ▪ Reactive Energy: 2 **Total Measurements: 30** Feeder Protection Relay Communication on MODBUS through RS-232/485 ports (3 protection relays). Minimum No. of Points: ▪ 3 points per relay **Total Points: 9**

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7.1 Multi-Function Meter Interface with RTU

The Contractor is required to furnish the RMU meter information that pertains to interfacing the meter with the RTU through an RS 232/485 serial communications link. The protocol details along with the MODBUS mapping data as implemented in each meter shall be provided. In this respect, the Contractor in cooperation and coordination with the RTU contractor shall share the responsibility of ensuring effective communications is attained between the meter and RTU, i.e., all parameters read bythe meters shall also be immediately available to the RTU.

7.2 Numerical Relay Interface with RTU

The Contractor is required to furnish the numerical relay information that pertains to interfacing the relay with the RTU through an RS 232/485 serial communications link. The protocol details along with the MODBUS mapping data as implemented in each relay shall be provided. In this respect, the Contractor in cooperation and coordination with the RTU contractor shall share the responsibility of ensuring effective communications is attained between the relay and RTU, i.e., all parameters read by the relay shall also be immediately available to the RTU.

8. Construction

The RMU shall be sufficiently sturdy to withstand handling during shipment, installation, and start-up without damage. The configuration for shipment shall adequately protect the RMU equipment from scraping, banging, or any other damage. The Contractor shall assume responsibility for correction of all such damage prior to final acceptance of the equipment.

9. Enclosures

All Contractor-supplied enclosures shall be sized to provide convenient access to all enclosed components. It shall not be necessary to remove any component to gain access to another component for maintenance purposes or any other reason.

The enclosures shall also be designed to ensure that the enclosure remains rigid and retains its structural integrity under all operating and service conditions with and without the enclosure door closed.
If made from stainless steel (304L or 316L), the thickness of the enclosure panels shall be at least 1.5 mm. Otherwise the thickness of all enclosure panels shall be at least 2 mm.

The appropriate corrosion treatment and finish requirements of Clause 2.2.2 shall apply to both inside and outside enclosure surfaces. Other required features are as follows:

- Constructed of stainless steel (304L or 316L) according to IEC 60529 with IP rating 54 or better. Alternatively, the RMU metal parts shall be made of high thickness high tensile steel which must be grit/shot blasted, thermally sprayed with Zinc alloy, phosphate, and subsequently painted with polyurethane based powder paint, the overall paint layer thickness including Zinc spraying shall be of the order of 100 to 130 microns.
- Means, such as insulated heat shields and/or air vents, to prevent high temperatures from damaging the RMUs enclosed components. If air vents are installed, these vents shall in no way reduce the effectiveness of the enclosure's protective characteristics.
- A metal pocket attached to the inside of the front door to hold documentation, maintenance log sheets, and other such information.
- Door opening mechanism with built-in key-lock facility suitable for padlocking. An opening mechanism that is less prone to breaking than a projecting door handle is preferred, e.g., a push-button opening mechanism.
- A grounding terminal including grounding bolt and lock washer for connecting a 50 mm^2 galvanized steel grounding conductor. The grounding bolt and lock washer shall be made of

stainless steel.

- Means of preventing moisture from condensing on electronic components mounted inside the enclosure proposed for housing the RTU. If necessary, heaters providing adjustable thermostat-control within the range 20 to 60 ºC shall be installed in the enclosure for this purpose.
- Means of protection against rainwater, corrosive salt formations, and high levels of airborne dust.
- Means of enabling the DAS to monitor the open/closed status of the enclosure door. A DAS equipment alarm shall be produced whenever the enclosure door is open.

10. Control Cabinet

The RMU shall be outfitted with a separate enclosure, referred to herein as the Control Cabinet, to house the following equipment as a minimum:

- Auxiliary transformer
- SCADA terminal blocks
- Power Supply Unit including Charger and Batteries
- RTU
- Radio (supplied and installed by others)
- Multi-pin connector consisting of plug and socket fittings and angled terminal block.
- Other equipment according to manufacturer's design

The Control Cabinet shall be similar in style and finish as the other RMU enclosures. This shall include having a minimum protection class of IP 54. It shall be tested in accordance with the latest IEC 60529 standard.

The cabinet shall have a hinged front access door with a three-point latch locking system and a latch operating lockable handle. The door shall be fitted with a perimeter flange and gasket (rubber or neoprene) to prevent the entrance of water. In addition, a means of monitoring and indicating that the door is open shall be provided.
A metal screen with holes shall be provided on the top and bottom of the control cabinet to provide ventilation aimed at avoiding condensation inside. Venting however shall in no way reduce the effectiveness of the control cabinet's water-tight, dust-tight, and corrosion-resistant characteristics. To augment the cabinet's effectiveness in preventing the ingress of dust, insects, vermin, and small objects, all electronic parts within the control cabinet shall be enclosed in modules. Such parts and modules shall be separated from the power supply modules as also installed in the cabinet.
The Control Cabinet shall include a weather-sealed hole with a double compression cable gland, approximately 30 mm in diameter, on the top of the cabinet for routing an antenna cable that will be supplied and installed by BESCOM. This will enable the cable to connect the radio housed in the cabinet to its externally mounted antenna. To house the radio, and the RTU to be supplied and installed by BESCOM, the Control Cabinet shall include a minimum contiguous space of 600 mm (W) x 500mm (D) x 600 mm (H).

If made from stainless steel (304L or 316L), the thickness of the enclosure panels shall be at least 1.5 mm. Otherwise the thickness of all enclosure panels shall be at least 2 mm.
The control cabinet shall also be provided with:

- Weatherproof fittings for control cables.
- **Provision for handle and padlock. In addition to this, a Metal number lock of adequate size shall be provided.**
- Grounding terminal, with solderless clamp type connector suitable for steel stranded conductor of suitable diameter and complete with lock washer of stainless steel or better.
- Provision for separately grounding the RMU's electronic items.
- Thermally controlled small fan for circulating air when necessary to maintain temperatures within the Control Cabinet to acceptable levels.
- Circuit diagram of control unit for maintenance purpose affixed permanently.
- Others according to manufacturer's design.

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11. Auxiliary Transformer

The RMU shall be outfitted with a single-phase auxiliary power transformer with a turn's ratio of 11000/sqrt (3) to 230, i.e., it shall be connected line-to-neutral to the RMU 11 kV bus and used to provide the required 230 V AC input to the RMU's power supply. The auxiliary power transformer shall have a capacity of at least 1,000 VA. During project implementation, however, the Contractor shall assess this requirement by taking into account the actual load corresponding to the RTU and radio (supplied by others) as well as the load represented by the RMU motors, etc. In this respect, with a suitable margin approved by the Employer, the auxiliary transformer must be capable of supporting the power supply requirements that correspond to a 5-way RMU. HRC fuses shall be provided on both the HV and LV sides of the transformer.

12. Motors

The RMU shall be retrofitted with spring charge motors of insulation Class E or better allowing the circuit breakers and load break switches to be operated without manual intervention. Motor speed shall ensure springs can be charged within 1 to 2 seconds. Independently of DAS control, the mechanism shall ensure that the motors start up immediately once the spring becomes discharged, so that the breaker becomes ready for the next operation.

In addition to allowing circuit breaker tripping by the RMU's protection relays, the motorized operating mechanism shall be suitable for remote control by the DAS.

The motors along with a Contractor supplied control panel shall allow Employer personnel to electrically operate the circuit breakers and load break switches at site without any modification of the operating mechanism and without de-energizing the RMU.

The motors shall be of a reputable make in the form of a universal 24 V DC type. They shall be enclosed and completely dust proof and sized with a suitable margin to meet the torque requirement of the spring charge mechanism.

13 Inspection and Test

Inspections and tests shall be performed to ensure RMU compliance with these Technical Specifications. Responsibility for conducting the inspections and tests shall rest with the Contractor. The Employer will participate in the RMU inspections and will witness the testing as described in the following sub-clauses.

13.1 Inspections

Employer representatives shall be allowed access to any Contractor or other facility where the RMU or its parts are being produced or tested. Such access will be used to verify by inspection that the RMUs are being or have been fabricated and tested in accordance with the Technical Specifications.

The Contractor shall give the Employer 15 days' notice in writing concerning the date and place at which the equipment will be ready for inspection or testing. The Contractor shall provide all the necessary assistance and facilities to Employer representatives to carry such inspections and test witnessing.

The Employer representatives will also visit Employer sites where the RMUs have been delivered and are being or have been installed and tested to ensure the installations and testing are proceeding or have been completed in the manner intended.

The Contractor shall provide any and all documentation that is necessary to complete the inspections. The Employer shall be allowed to inspect the Contractor's quality assurance standards, procedures, and records. Inspections, as a minimum, shall include checks on inventory, general appearance, cabling, drawing conformance, and labelling.

Where applicable, the Employer's inspections will be performed in conjunction with witnessing the RMU tests. The Contractor shall take all necessary steps to address and resolve any concerns that Employer representatives may raise as a result of these activities in a timely fashion.

This may result in further inspections and tests until the representatives are fully satisfied that the inspections and tests have been completed successfully.

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13.2 Test Procedures

The Contractor shall provide test plans and detailed procedures for all required testing. The plans and procedures shall ensure that each test is comprehensive and verifies proper performance of the RMU under test and, in this respect, shall be submitted for review and approval by the Employer.

The test plans shall include all routine tests and acceptance tests as per relevant BIS/IEC standards and shall describe the overall test process including the responsibilities of the test personnel and how the test results will be documented.

The test procedures shall describe the individual tests segments and the steps comprising each segment, particularly the methods and processes to be followed.

13.3Test Reports

The Contractor shall maintain complete records of all test results. The records shall be keyed to the test procedures.

Upon completion of each test, the Contractor shall submit a test report summarizing the tests performed and the results of the tests. The test report shall include the following information:

13.1.1Test Log - A chronological record of all events related to execution of the tests.

13.1.2Test Incident Report – A detailed description of any event during the testing process that required investigation.

13.1.3 Test Summary Report – A presentation of results pertaining to the designated test activities and a summary of all relevant recommendations and conclusions based on these results.

13.1.4Variance Report – A summary of the problems detected during testing and the corresponding resolutions.

13.1.5 Official Certification – A formal declaration that the required testing was performed and, if applicable, was completed successfully.

13.1.6 Signatures – As designated representatives of the Contractor and/or Employer, the signatures of witnesses for each completed test, whether successful or not successful, along with relevant dates. Witness names and contact information shall also be provided.

13.2 Factory Acceptance Test

A formal factory acceptance test shall be conducted to ensure that the RMUs have been designed to meet the Employer's functional requirements in all respects. Employer representatives shall witness the test on a representative RMU, and the test shall be carried out in accordance with the Contractor's test plan and procedures as approved by the Employer. Should the factory acceptance test prove unsatisfactory in any way, the Employer reserves the right to have further tests conducted and, if applicable, request further improvements in the Contactor's RMU design.

To the extent possible, the test shall demonstrate the capability of the RMU to interoperate with the RTU. It is also the intent of the Employer that the test shall make use of the Data Acquisition (DAC) Simulator to be supplied by BESCOM. The DAC Simulator (representing the DAS) together with the RTU will reduce the risk of discovering interoperability problems subsequent to RMU installation at site. Thus, in preparation for the factory acceptance test, the Contractor shall make every effort to cooperate and coordinate all such activities with these other contractors.

13.3 Routine Factory Tests

These tests shall be carried out during RMU manufacture as a quality control measure, i.e., to ensure each RMU to be delivered meets the Employer's minimum requirements including all relevant standards. Recording and reporting the routine test results shall be the responsibility of the Contractor.

At the Employer's discretion, Employer representatives will witness such testing. This may include requesting the Contractor to perform tests on RMUs selected at random from each batch of RMU s at the Contractor deems ready to be delivered to site. Should any such test prove unsatisfactory, the Employer reserves the right to have further tests conducted and for delivery not to take place until a mutually agreed course of action has

been reached.

13.4 Field Performance Tests

13.4.5 Unit Test

Each and every RMU shall be tested at site. This shall include unit testing by the Contractor at the time of installation of each RMU to ensure all components can be powered up and are in good working order.

13.4.6 Site Acceptance Test

Each RMU shall undergo a Site Acceptance Test (SAT) to demonstrate to the Employer that the RMU is fully operational with respect to its functional capabilities and intended use at its specifically assigned site. In this respect, site acceptance testing shall be carried out in such a way as to verify that the RTU can be used to monitor and control the site's associated distribution network devices.

Such testing shall be conducted in a way that will minimize power interruptions. Any need for power interruptions in order to conduct the testing shall be arranged in full and timely coordination with the Employer's system operations staff. Otherwise, the functional capabilities shall be exercised using non-outage techniques such as simulating analog and status inputs and checking for control output signals at points of connection that may need to be temporarily isolated from the distribution network.

During SAT, it shall be demonstrated that the RMU and RTU can interoperate successfully in all respects. To this end, the intent is to make use further use of the DAC Simulator to be provided by the DAS supplier. Thus, SAT shall verify that the RMU interface is fully operational and capable of meeting or supporting all applicable DAS functional performance requirements.

13.4.7 RMU Commissioning

The end-to-end tests for RMU operations and communicability features of the relay and meter shall serve as a means of commissioning the RMU. The Contractor, therefore, shall support end-to-end testing by having adequate Contractor personnel on hand to witness these tests in consultation with DAS.

Prior to starting the warranty period, the Contractor shall submit a report clearly identifying the results of all end-to-end tests from the perspective of the RMUs. This shall include a summary of the variances detected and whether or not these variances were successfully corrected. Where necessary, for Employer consideration, the report shall include the Contractor's plan for resolving any and all variances not yet corrected.

No RMU installation shall be accepted as complete until the Employer is satisfied that all variances associated with an individual site have been corrected and that the RMU is SCADA ready, i.e., can be considered fully integrated with the DAS.

Documentation

It is the intent of the Employer to become self-sufficient in all aspects of the field device. In order to ensure that the Employer has the opportunity to become self- sufficient in a timely and orderly manner, it is necessary that the Contractor provide high quality documentation.

13.4.8 Equipment Manuals

Equipment manuals shall contain the following:

- 13.4.8.1 Description of the function of the equipment
- 13.4.8.2 Installation, setup, and operating instructions
- 13.4.8.3 Block diagram showing logical and physical interconnections amongmajor components.
- 13.4.8.4 Expansion and upgrade capabilities and instructions
- 13.4.8.5 Preventive maintenance instructions
- 13.4.8.6 Detailed functional, logical, electrical, and mechanical characteristics of all equipment including protocol descriptions.
- 13.4.8.7 Troubleshooting and repair guides, including descriptions and instructions for the diagnostics furnished

14 Operating Manuals

The Contractor shall submit, for review and approval, operating manuals for all RMU components including items such as FPI, Relay, and MFM. These manuals shall be in English. They shall include the RMU operating instructions. Context sensitivity shall be used to go directly to the appropriate place in the manual.

The manuals shall be organized for quick access to each detailed description of the operator procedures that are required to interact with the RMU functions. This shall include the procedures to define, build, edit, and expand all data points provided with the RMU.

The manuals shall present in a clear and concise manner all information that operators, including maintenance personnel, need to know to understand and operate RMUs satisfactorily. The manuals shall make abundant use of diagrams and/or photographs to illustrate the various procedures involved.

15 As-Built Documents and Drawings

The Contractor shall submit as built documents including applicable drawings for review and approval. All deliverable documents and drawings shall be revised by the Contractor to reflect the as- built RMU components including all the FPI, Relay, and MFM devices. Any errors in or modifications to an RMU resulting from its factory and/or site acceptance test shall be incorporated. Within this same context, all previously submitted documents that are changed because of engineering changes, contract changes, errors, or omissions shall be resubmitted for review and approval.

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SECTION – 3

RMU: COMPACT RMU FOR OUTDOOR USE IN 11KV DISTRIBUTION CABLE SYSTEM

B1-RIDE

TECHNICAL SPECIFICATION FOR 11 KV COMPACT RING MAIN UNITS FOR OUT DOOR USE IN 11 KV UNDERGROUND CABLE SYSTEM

1. SCOPE:

1.1 This specification covers the design, manufacture, testing and delivery at site for erection and commissioning of "Compact RMU" to be erected in the underground cable distribution system.

1.2 The Compact RMU shall be suitable for main cable network of 800Amps and loop cable network of 800Amps /630Amps and shall consist of the following:

(a) Two Load Break Switches with Earthling Switches for incoming and outgoing main loop 11 KV XLPE cables of size 240/400 sq.mm cross section aluminum conductor,

(b) One Circuit Breaker with Earthing Switch for connecting Distribution Transformer loop 11 KV XLPE cables of size 95 sq.mm cross section aluminum conductor, and

(c)Provision for adding more number of Circuit Breakers of the type mentioned in item (b) above.

1.3 These shall comply with the following system parameters:

1.	Nominal System Voltage:	11 KV
2.	Highest System Voltage:	12 KV
3.	Rated Voltage:	12 KV
4.	System frequency:	50 Hz
5.	Number of Phases:	Three Phase - Three Wire

1.4 The Load Break Switches with Earthing Switches, and the Circuit Breakers with Earth Switches used in the Compact RMU shall be of Vacuum or SF_6 gas filled type meeting the following criteria:

1.	Lightning Impulse Withstand Voltage (a) Phase - to - Phase & Phase - to - Earth: (b) Across the Isolating distance:	 75 KVp 85 KVp
2.	Power Frequency Withstand Voltage: (1)to earth, between poles and across opening (2)switch device (3)across isolating device	 28 KV rms for minute 32 KV rms for 1 minute
3.	Rated Short Time Breaking Capacity	21 KA for 3 sec
4.	Rated duration of Short Circuit:	3 seconds
5.	Rated Normal Current for Circuit Breaker:	200 Amps rms

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6	Load Break Switches:	
	a) Rated Short Circuit making capacity:	(a) 50 KA peak at rated voltage (both the earth switch and Load Break Switches)
	b) Rated Load Interrupting Current:	800 Amps / 630 A rms
	c) Rated Cable Charging Interrupting current	25 A

1.5 The configuration of the Compact RMU shall be generally as per BESCOM. Provision should be made to extend the Compact RMU by installing additional Circuit Breakers of similar design.

1.6 All the switchgear shall be capable of withstanding the specified current without any damage being caused, in accordance with the latest versions of IEC 60694 and IS 3427.

1.7 Suitable Meter & CT's along with suitable wiring and other accessories shall be provided as per BESCOM Metering specifications / norms.

2. SERVICE CONDITIONS:

2.1 The equipment shall be suitable for installation at location having the following climatic conditions:

a	Annual average ambient temperature:	40°C
b	Maximum ambient temperature:	45°C
c	Temperature rise due to solar absorptio	10°C
d	Maximum relative humidity:	95%
e	Annual rainfall:	1000 to 1200 mm
f	Duration of rainy season:	May to October
g	Altitude:	up to 1000 M above MSL
h	Environmental condition:	Exposed to sun and rain by the side of road and subject to dust and Pollution from the heavy vehicular Traffic

3. STANDARDS:

3.1 The equipment's and all the components shall meet the requirements of the latest versions of the following standards:

(a) IS 3427: AC metal enclosed switchgear and control gear for rated voltages above 1 KV and up to and including 52 KV.

(b) IS 12063: Classification of degrees of protection provided by enclosures of electrical equipment.

(c) IS 9920 (Parts 1 to 4): High Voltage Switches.

(d) IS 9921 (Parts 1 to 5): Specification for AC disconnectors and earthing switches for voltages above 1000 V

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(e) IS 13118: HV AC Circuit Breakers.
(f) IS 12729: General requirements of switchgear and control gear for voltages exceeding 1000 V
(g) IS 10601: Dimensions of terminals of HV Switchgear and Control gear.
(h) IEC 1330: High voltage/Low voltage prefabricated substations
(i) IEC 60694: Common clauses for MV switchgear standards.
(j) IEC 6081: Monitoring and control.
(k) IS 2705: Current Transformers
(l) IS 8686: Specification for Static Protective Relays.

4. DESIGN:

4.1 The compact RMU shall be designed to operate at the rated voltage of 12 KV. It shall consist of Two numbers of 630 Amps Vacuum or SF_6 Insulated Load Break Switches as Incomers and the required numbers of 200 Amps Vacuum or SF_6 Circuit Breakers suitable for control of 11 KV Transformer loop circuits consisting of several distribution transformers; total load of which do not exceed 3500 KVA. It shall also include, within the same metal or earth screened cast resin enclosure, earthing switches for each Load Break Switch and Circuit Breaker for earthing each of the devices. Suitable fool-proof interlocks shall be provided to these earthing switches to prevent its inadvertent or accidental closing when the circuit is live and the concerned Load Break Switch/Circuit Breaker is in closed position. The limiting dimensions shall be preferably around 1800-mm width x 1100-mm depth x 1900- mm height for the initial two Load Break Switches and one Circuit Breaker. Suitable width for each addition of the Circuit Breaker is allowed. Provision should be made for extension of few more Circuit Breakers or Load Break Switches on a future date. In case of gas filled units, the switchgear and bus bars shall be contained in stainless steel/earth screened cast resin enclosure filled with gas at relative pressure between 0.2 and 0.8 bar to ensure adequate insulation and safe operation. The assembly should not require further gas processing during its expected life of operation of 30 years as per Clause GG 2.3 and 3.3 of IS 3427. The degree of protection required against environment shall be not less than IPX4 of IS 12063. The Compact RMU shall have at least an IP54 Protection Index as per IS 12063 against dust and splashing of water. The active parts of the switchgear shall be maintenance free and the Compact RMU shall be of low-maintenance type.

4.2 The tank shall be made of suitable stainless steel of adequate thickness or earth screened cast iron resin and shall be able to withstand any accidental internal over pressure of at least 3 bars.

4.3 The Compact RMU shall be suitable for mounting on its connecting cable trench. A suitably sized name plate clearly indicating its functional units and their electrical characteristics shall identify each unit. The positions of the different devices shall be clearly visible to the operator on the front of the compact RMU and the operations shall be clearly visible. The compact RMUs shall be such that access to live parts shall not be possible without the use of tools.

4.4 The design shall incorporate such features to prevent any accidental opening of the earth switch when it is in closed position. Similarly, accidental closing of Circuit Breaker or Load Break Switch shall be prevented when the same is in open position from the release of any latch or spring in tension due to vibrations caused externally or internally and shall prevent accidents.

5. EARTHING:

5.1 There shall be continuity between metallic parts of the Compact RMUs and cables so that there is no dangerous electric field in the surrounding air and safety of the personnel is ensured. The frames should be connected to

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the main earth bars. The cables should be earthed by an Earthling Switch having the specified short circuit making capacity. The Earthling Switch shall be operable only when the main switch is open and suitable mechanical fail-proof interlock shall be provided for the same.

5.2 The Earthling Switch shall be provided with a reliable earthling terminal for connection to an earthling conductor having a clamping screw, suitable for the specified earth fault conditions. The diameter of the clamping screw shall be at least 12 mm. The connection point shall be marked with the earth symbol. The flexible connections between the earthling blade and the frame shall have a cross section of at least 50 square mm copper or equivalent in aluminum.

5.3 The Earthling Switch shall be fitted with its own operating mechanism and manual closing shall be driven by a fast-acting mechanism, independent of operator's action. The moving contacts of the Earth Switch shall be visible in the closed position through transparent covers. Mechanical interlocking system shall be such that the operating staff shall be prevented from closing the Earthing Switch when the main switch is closed.

6. INCOMER LOAD BREAK SWITCHES:

6.1 The Load Break Switches shall be maintenance free. The position of power contacts and earthing contacts shall be clearly visible on the front of the Compact RMU. The position indicator shall provide positive contact indication in accordance with IS 9920. In addition, the manufacturer shall prove the reliability of indication in accordance with IS 9921. These switches shall have three positions, viz. Open, Closed and Earthed and shall be constructed in such a way that natural interlocking prevents unauthorized operations. The switches shall be fully assembled in the factory. Manual opening and closing shall be driven by a fast-acting mechanism, independent of operator's action.

6.2 Facility for remote operation in future shall be provided with an electrical operating mechanism in a remote location, without any modification of the operating mechanism and without de-energizing the Compact RMU. The switch and earthing switch mechanism shall have a mechanical endurance of at least 5000 operations.

7. CIRCUIT BREAKERS:

7.1 The Circuit Breakers shall be maintenance free. The position of power contacts and earthing contacts shall be clearly visible on the front of the Compact RMU. The position indicator shall provide positive contact indication in accordance with IS 9920. In addition, the manufacturer shall prove the reliability of indication in accordance with IS 9921. These switches shall have three positions, viz. Open, Closed and Earthed and shall be constructed in such a way that natural interlocking prevents unauthorized operations. They shall be fully assembled, tested and inspected in the factory.

7.2 An operating mechanism can be used to manually close the Circuit Breaker and charge the mechanism in a single movement. It shall be fitted with a local system for manual tripping. There should be no automatic reclosing. The Circuit Breaker shall be capable of closing fully and latching against the rated making current. Mechanical indication of the "OPEN" and "CLOSED" position of the Circuit Breaker shall be provided. The breakers of the same type and rating shall be interchangeable.

7.3 When the Circuit Breaker closing mechanism is of the spring-operated type, it should not be possible for the Circuit Breaker to close until the spring is fully charged and the associated charging mechanism is fully ready for closing. Wherever external spring charging handle is required to charge the spring, it should be ensured that the same is not allowed to move during the release of its spring energy. Alternately, it should not be

possible to release the spring energy till the charging handle is completely disengaged from the mechanism. A visual mechanical indicating device shall be provided to indicate the status of spring viz., "SRING CHARGED" or "SPRING FREE". It shall be possible to charge the spring when the Circuit Breaker is closed and if the spring is released the Circuit Breaker should not open; nor this operation result in any mechanical damage to the component of the Circuit Breaker or its operating mechanism. Alternatively, fast acting reflex mechanism for Circuit Breakers is also acceptable. However, the Circuit Breakers shall be suitable for up gradation to remote operation without any changes.

7.4 The Circuit Breaker shall be provided with a suitable protection system that will operate without any auxiliary power supply under fault conditions. The protection system shall comprise of three numbers of Current Transformers of 10P10- accuracy clause and have a rated burden of 15 VA and an electronic relay.

7.5 The Current Transformers shall have a separate metering core of accuracy clause 1.0 and burden 3.5 VA for future use. The Current Transformers and Static Relays shall conform to IS 2705 and IS 8686 respectively. The over current protection shall have two separate settings, one low setting with IDMT and the other high setting of definite time type. The earth fault protection shall operate by residual current measurement using the sum of sensory secondary currents. The relay shall be self- powered to operate and trip the Circuit Breaker. The relay shall be provided with a testing port in front of the relay. The range of relay settings from a range of 8 Amperes to 200 Amperes corresponding to the rating of underground cable network shall be available in the protection system.

8. CABLE TERMINATION:

8.1 The bushing should be conveniently located for workings with cables specified and allow for the termination of these cables in accordance with the prevailing practice and guidelines of cable manufacturers. The dimensions of the terminals shall be in accordance with IS 10601. A non-Ferro-magnetic cable clamp arrangement shall be provided for each cable to be terminated in the Compact RMU. Suitable locking arrangement of the Circuit Breakers, Earthing Switches and Load Break Switches with padlocks in the "Open" or "Closed" position shall be provided.

8.2 A “Cable Alive" indicator lamp in the front of Compact RMU shall be provide for each cable using a capacitance voltage divider.

8.3 It must be possible to test the core or sheath insulation of the cables without de- energizing the remaining section of the Compact RMU without accessing the cable compartment and without disconnecting the cable.

9 SAFETY OF EQUIPMENT:

9.1 In case of SF6 filled equipment, any accidental overpressure inside the sealed chamber shall be limited by the opening of a pressure-limiting device in the rear part of the enclosure so that the gas will be released away from the operator.

9.2 All manual operations shall be carried out on the front of the Compact RMU. The effort required to be exerted on the lever by the operator shall not exceed 250 N.

10 FRONT PLATE:

10.1 The front plate shall be provided with IP2X degree of protection conforming to IS 12063. The front plate should include a clear mimic diagram indicating the functions. The position indicators shall correctly depict the position of the main contacts and shall be clearly visible to the operator. The lever operating direction shall be clearly

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indicated.

11 TESTS:

11.1 Type test reports for all the type tests required to be conducted as per the standards mentioned in these specifications shall be furnished prior to supply.

11.2 Routine tests and acceptance tests shall be conducted in accordance with these standards in presence of the purchaser's representatives. The contractor shall give at least 15 days advance notice for witnessing these tests. Copies of test reports of all these tests shall be furnished to the purchaser for approval. Each completely wired Compact RMU shall be tested to ensure all of its protective; control and interlock systems operate satisfactorily. The tenderer shall indicate the tests to be carried out in the field after the installation and before commissioning.

12 INSTRUCTION MANUALS:

12.1 Three copies of installation, operation and maintenance manuals shall be supplied along with the equipment. Two additional copies of these manuals shall be supplied at the time of commencement of works before the materials are supplied. These manuals shall be complete in all respects furnishing the constructional and operational features of the equipment. The same shall contain all the details and required drawings and/or illustrations along with the overall procedures to enable to identify all the parts and consumable spares, which may have to be identified readily for ordering purpose.

13 FORMATION OF COMPACT RMU:

13.1 The compact RMU shall be of single bus bar, outdoor type, tropicalized in accordance with the relevant clauses mentioned in these specifications. An earth fault passage indicator using a core balance Current Transformer shall be provided for the Incomers to assist in identifying the faulty cable section in order to isolate the same.

13.2 The Incomer panel shall comprise of, but not limited to the following:

1. A triple pole Vacuum / SF_6 Load Break Switch rated 630 Amps or higher, with a rated making capacity under fault conditions with short circuit levels of 25 KA or above at 11 KV
2. Core balance Current Transformer and earth fault passage indicators (The indicator flag of the relay shall be visible till such time the relay is reset manually) These shall not require any external Power Supply and must be suitable for unattended places.

13.3 The transformer loop circuit control panels shall consist of but not limited to the following:

1. A triple pole Vacuum/SF_6 Circuit Breaker rated 200 Amps or higher, with a rated making capacity under fault conditions with short circuit levels of 25 KA or above at 11 KV
2. Manually charged spring closing mechanism
3. Electronic relay with associated 15 VA burden Current Transformers of accuracy clause 10P10 and tripping mechanism
4. Mechanical "ON", "OFF" indicator
5. Manual tripping device
6. Mechanical "Spring Charged", "Spring Free" indicator in case of stored energy devices.
7. Provision for retrofitting meters and SCADA System.

14 ACCESSORIES:

14.1 The following accessories shall be provided for each compact RMU:

1. Pad locks for all doors with one set (3 Nos.) Master keys
2. Earth bus formed out of 50X6 mm GI earthing flats.
3. Wire guard protective mesh on the front doors and back for prevention of pasting of papers etc.
4. Base channel with foundation bolts

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5. Ventilating louvers with weld mesh
6. Live part shrouds, danger plates, caution boards, name plates, rating plates etc. as per requirements
7. Bus bar supports (Porcelain insulator support) as required.
8. All other components, even though not specifically mentioned, but required for the safe operation of the unit.

15 INFORMATION TO BE FURNISHED PRIOR TO SUPPLY:

The following information shall be furnished:

1. Completely filled in the "Guaranteed Technical Particulars" given below.
2. Catalogues describing the equipment duly indicate the model.
3. Literature describing the operational features.
4. Typical GA drawings
5. Type Test Certificates
6. Foundation drawings.

16 GUARANTEED TECHNICAL PARTICULARS FOR 11 KV CIRCUIT BREAKERS AND LOAD BREAK SWITCHES

A) SF6 / Vacuum Circuit Breaker:

a)	Type	
b)	Rated Voltage	
c)	Breaking Current	
d)	Making Current	
e)	Rupturing Capacity	
f)	Rated Current	
g)	No. of Poles	
h)	Operating mechanism	

B) Load Break Switches:

a)	Type	
b)	Duty cycle	
c)	Rated current	
d)	Rated breaking capacity	
e)	Fault making capacity	
f)	Rupturing Capacity	
g)	No. of poles	
h)	Operating mechanism	
i)	SF6 tank	
j)	Interlocks	
k)	Operation safety	

C) BUS BAR:

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a)	Material	
b)	Type	
c)	Rated Current	
d)	Short time rating for 3 / 1 Sec.	

D) Protection:

a)	**Protection:**	

GUARANTEED TECHNICAL PARTICULARS FOR RMU

The Tenderer shall furnish the following data for the Load Break Switches and Circuit **Breakers used in the Compact RMU:**

1. Rated Voltage
2. Rated Insulation Level
3. Rated Frequency
4. Rated Normal Current
5. Rated cable charging breaking current.
6. Rated short circuit breaking current.
7. Rated transient recovery voltage for terminal faults.
8. Rated characteristics for short line faults.
9. Rated short circuit making current.
10. Rated duration of short circuit
11. Rated opening time, break time and closing time.
12. Type test certificates
13. Constructional features
14. Details of operating mechanism
15. Overall dimensions of Compact RMU
16. Limits of gas pressure (in case of SF6 filled equipment)
17. Clearances between live parts and contacts
18. Total transportation weight
19. Special features if any
20. Foundation loads and details
21. Internal Arc Test for Outdoor applications.

BIDRIDE

SECTION – 4
U.G. CABLE OF ROUND ARMOURED AND PRESSURE EXTRUDED 11KV CLASS XLPE

Bi-RIDE

TECHNICAL SPECIFICATIONS FOR CROSS LINKED POLYETHYLENE INSULATED 3 CORE 11KV CABLES.

1.00.00 **SCOPE:**

1.01.00 The scope of this package, covers the design, manufacture, stage inspection at works, inspection, and testing of finished cables at manufacture's works, testing at independent test house, packing, transport and delivery to consignee's address of
6.35/11KV Three Core, aluminum conductor, XLPE insulated, screened, underground Cables as per specified construction.

1.02.00 Technical Requirement: Three Core 6.35/11KV grade, 90^0C rating heavy duty power cable with stranded compacted circular aluminum conductor shielded with extruded semi conducting compound, cross linked polyethylene insulated, shielded with extruded semi conducting compound and copper tape, shielded cores laid up with fillers, inner sheath of extruded PVC, Galvanized round steel wire Armour and PVC ST-2 overall sheath.

1.03.00 The cables should be suitable for use in solidly earthed system.

1.04.00 The Stranded Aluminum Conductor for different sizes of cable shall have the short circuit rating specified in this document, in schedule of requirement, schedule-I, Annexure TS-1.

2.00.00 **STANDARDS:**

2.01.00 The 11KV UG Cables shall, in general, meet the requirements of the latest edition of the Bureau of Indian Standards, (generally referred as IS) IS 7098 (Part-2) 1985. The cables manufactured to and meeting the testing requirements of international standards, like B.S.S. IEC or equivalent standards are also acceptable. The bidders shall enclose a copy of the equivalent international standard, in English Language, along with the Bid.
The extracts from IS 7098 (Part 2) are given in Annexure TS-3.
The cables and components in general shall meet the requirement Indian Standards with latest amendments or equivalent International Standards.

IS: 7098 (Part 2)	1985 :	Specification for cross linked polyethylene insulated PVC sheathed cables
IS: 8130	1984 :	Specification for conductors for insulated Electric Cables
IS: 3975	1979 :	Specification for mild steel wires, strips and tapes for armoring of cables.
IS: 10810 (Part 1 to 55)	1984 :	Specification for test on cables
IS: 5831	1984 :	Specification for PVC insulation and sheath of electric cables
IS: 10418	1982 :	Specification for drums for electric cables
IS: 10462 (Part-I)	1983 :	Fictitious calculation method for determination of dimensions of protective covering of cables: Part-I Elastomeric and thermoplastic insulated cables.

2.02.00 11KV underground cables shall be manufactured to the highest quality, best workmanship with scientific material management and quality control. The Bidder shall furnish the quality plan, giving in details the quality control procedures/management system.
The successful bidder shall give sufficient advance notice to the purchaser of not less than fifteen days to arrange for stage inspection and inspection of quality assurance programme during manufacture, at the works.

3.00.00 **SYSTEMS DETAILS:**

General Technical Particulars:

1)Nominal System Voltage (rms) (u)	-	11 KV
2)Highest System Voltage (rms) (um)	-	12 KV
3)Phase to Earth Voltage (uo)	-	6.35 KV
4)Number of Phases (for 3 core cables)	-	3

5)Frequency	-	50 Hz
6)Variation in frequency	-	±3%
7)Type of Earthing	-	Solidly Earthed
8)Basic impulse level (1.2/50 Micro Second Wave	-	75 KV
9)Total relay & circuit break operating time	-	15-20 Cycles
10) One minute power frequency withstand voltage	-	28 KV

4.00.00 **INSTALLATION CONDITIONS**:

a) Mostly directly buried in ground, partly in RCC/Hume pipes or stoneware pipes at road crossing in case of 3 core cables.
b) If more than one circuit is laid in the same trench, then laid in flat formation for 3 core cables.
c) Metallic coverings are connected solidly to earth at both ends of the run for 3 core cables and.
d) Normal depth of laying is 900 mm to 1000 mm (from top of round to entre of cable).
e) Nature of soil – Heterogeneous, sandy.
f) Soil resistivity: variable 18 to 100 Ohm – meter
g) Soil Thermal resistivity (assumed) 120 to 150 dig. C. Cm/w.

5.00.00 **CLIMATIC CONDITIONS**:

The climatic conditions at Bangalore City where these 11KV Cables will be installed are as under:

1	Location	Karnataka (28.58 N, 77.38E)
2	Altitude	1000 M above MSL
3	Max. ambient air temperature	45^0 C
4	Max. daily average air temp.	38^0 C
5	Minimum ambient air temp.	10^0 C
6	Ground temperature at depth of laying assumed	35^0 C (Max.)
7	Isoceranic level	5^0 C (Min.)
8	Avg. annual rainfall	As per IS:45
9	Avg. number of rainy	1450 Sq.mm.
10	Climate	Tropical Moderately hot and humid
11	Soil	Normally dry. As per IS:1200 Part-I, 1974, likely hood of subsoil water at certain location at depth of burial of cables.

6.00.00 **DESIGN CRITERIA**:

6.01.00 The cables that are covered in these specifications are intended for use in the Karnataka Power distribution system, under the climatic conditions and installation conditions descried in the technical specification.

6.02.00 Any technical feature, not specifically mentioned here, but is necessary, for the good performance of the product, shall be incorporated in the design. Such features shall be clearly brought out under technical deviations schedule only in the offer made by the Bidder, giving technical reasons, and justifying the need to incorporate these features.

6.03.00 For continuous operation of the cables, at specified drawing, the maximum conductor temperature shall be limited to the permissible value as per the relevant standard, generally not exceeding 90^0C under normal operation and 250^0C under short-circuit conditions.

6.04.00 The cables in service will be subject to daily load cycles, of two peaks during day, morning peak and evening peak with reduced loading during the nights.

6.05.00 The materials used for sheaths shall be resistant to oils, acids and alkalies.

6.06.00 The cables shall be designed to withstand the thermo mechanical forces and electrical stresses during normal operation and transient conditions.

The Cables shall be designed to have a minimum useful life span of forty years.

Core identification: The core identification for 3 core cables shall be provided, by suitable means, like, by application of colored stripes, or by numerals or by printing on the cores as per clause 13 of IS:7093.

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7.00.00 **MANUFACTURE PROCESS, CROSS LINKING OF INSULATION:**

7.01.00 Cross linking of the insulation materials (pre compounded polyethylene) shall be conforming to IS:7098 (Part-II).

7.02.00 The conductor screen shall be of extruded semi conducting compound. The insulation screen shall consist of the nonmetallic part extruded semi conducting compound with non-magnetic metallic port. The XLPE insulation and the shields for conductor and insulation shall be extended in one operation.

8.00.00 **MATERIALS:**

8.01.00 CONDUCTOR: The conductor shall be of stranded construction. The material for conductor shall consist of plain aluminum of H2 or H4 grade as per clause-3 of IS:8130/1984.
The number of wires in the conductor shall be not less than the appropriate minimum number given in Table-2 of IS:8130/1984.

8.02.00 INSULATION: The insulation shall be cross linked polyethylene conforming to the requirements given in Table-1 of IS:7098 Part-II.

8.03.00 SCREENING: The screening shall consist of semi conducting compound. The metallic screen for core shall consist of copper tape. The metallic screen with Armour shall be designed to carry the minimum short circuit rating for 1 second. (The design calculations shall be furnished by the tenderer).

8.03.01 The semi-conducting compound shall withstand the operating temperature of the cable and shall be compatible with the insulting materials.

8.04.00 **Filler and inner sheath for Multi Core Cables:**
For Multi Core cables, the interstices at the center shall be filled with a non-hygroscopic material.
The interstices around the laid-up cores shall be covered with PVC compound type S.T-2. This will form the inner sheath for Multi Cores Cables.

8.05.00 **ARMOURING FOR 3 CORE CABLES:**
The armor shall be galvanized round steel wire, complying with the requirements of IS:3975. The Single Core Cables shall be armored with hard drawing Aluminum round wire. A binder tape may be applied on the armor.

8.06.00 **OUTER SHEATH**:
The outer sheath shall consist of Poly Vinyl Chloride (PVC) compound, confirming to the requirements of Type ST-2 of IS:5831 suitable additive shall be added to give anti termite protection.

9.00.00 **CONSTRUCTION:**
The general constructional features of the cables shall be as follows:

a) **3 Core Cables**: Stranded, Compacted, Circular, Aluminum Conductor, Conductor Screen of extruded semi conducting compound, Cross linked polyethylene insulation, shall be conforming to IS:7098 (Part-II).
Insulation screen consisting of non-metallic part of extruded semi conducting compound and the metallic part of copper tape(s).
Pressure Extruded PVC inner sheath Armour
(Galvanized Steel round wire)
Other PVC sheath with anti-termite treatment.

10.00.00 **CONDUCTOR:**

10.01.01 The conductor shall be stranded, compact, circular of aluminum wires of H2 or H4 grade plain aluminum wires.

10.01.02 The conductor shall be clean, uniform in size and shape smooth and free from harmful defects.

10.01.03 Not more than two joints shall be allowed in any one of the single wire forming every complete length of conductor and no joint shall be within 300 mm of any other joint in the same layer. The joint shall be made by brazing, silver soldering or electric or gas welding.

10.01.04 No joints shall be made in the conductor after it has been stranded.

10.02.00 CONDUCTOR **SCREEN**: The conductor screen shall be provided over the conductor consisting of extruded nonmetallic semi conducting compound.

10.03.00 **INSULATION**: The insulation shall be provided over the screened conductor with cross linked polyethylene, applied by extrusion and shall be of high quality, cross linked, shall be conforming to IS:7098 (part 2).

10.03.01 **THICKNESS OF INSULATION**: The average thickness of XLPE insulation shall not be less than the nominal value subject to the applicable tolerance as specified in table 2 of IS: 7098.

10.03.02 The insulation shall be applied to closely fit on the conductor screen, and it shall be possible to remove it without damaging the conductor.

10.03.03 The thickness of semi conducting screen over insulation should not be included in the thickness of

Insulation.

10.04.00 **INSULATION SCREENING:** The Insulation screen shall be applied over the Insulations.

10.04.01 The Non-Metallic part of the Insulation screen shall consist of extruded Semi conducting compound.

10.04.02 The metallic part of the insulation screen shall consist of non-magnetic material, consisting of copper tape or tapes, and shall be applied over the non-metallic part. The metallic tape(s) shall be designed to carry the rated short circuit current.

10.05.00 L A Y I N G **UP OF CORES:** For multi-core cables, the cores shall be laid together with a suitable right hand lay. The interstices at the center shall be filled with a non- hygroscopic material.

10.06.00 **INNER-SHEATH FOR MULTI CORE CABLES:**

10.06.01 The cores shall be laid up with a suitable right hand lay and the interstices should be filled with PVC compound type ST2 conforming to IS:5831 or equivalent standard. The filling up of interstices shall be by pressure extrusion and this circular shape and shall bind the cores also.

10.06.02 The minimum thickness of the inner sheath shall conform to Table 3 of IS: 7098 (Part- 2), 1985 or equivalent standard.

10.06.03 The inner sheath shall be so applied that it fits closely on the laid-up cores, and it shall be possible to remove it without damage to the insulation cables.

10.07.00 **ARMOURING FOR 3 CORE CABLES:**

10.07.01 **Application**: The armor consisting of Galvanized steel wire shall be applied over the inner sheath for multi core cables.

10.07.02 The armor wires shall be applied as closely as possible.

10.07.03 The diameter of the galvanized round steel and hard drawn aluminum wires shall conform to IS: 7098 Part (2).

10.07.04 A binder tape may be applied on the armour.

10.07.05 The Joints in the armour wires shall be brazed/welded with joint surface and rendered smooth. The joints shall be staggered by at least 300 mm from the nearest joint in any other armour wire in the completed cable.

10.08.00 **OUTER SHEATH:**

10.08.01 The PVC outer sheath with anti-termite treatment shall be extruded over the armouring for 3 core cables.

10.08.02 The color of the outer sheath shall be black.

10.08.03 The thickness of outer sheath shall be not less than the minimum value specified in column 5 of Table 5 of IS: 7098 (Part-2) 1985.

10.09.00 I D E N T I F I C A T I O N **:** The outer-sheath shall have the following information embossed or indented on it, the manufacturer's name or trade mark, the voltage grade, the year of manufacture and the letters "BESCOM". The identification shall repeat every 300/350 mm along with length of the cable.

11.00.00 **INSPECTION**:

11.01.00 Q u a l i t y Control: The Bidder shall furnish a complete and detailed quality plan for the manufacturing process of the cable. All raw materials shall conform to relevant applicable standards and tested for compliance to quality and requirement.

During the manufacturing process, at all stages, inspections shall be made to check the physical and dimensional parameters, for verification to compliance to the standards.

11.02.00 The Bidder shall arrange, for inspection by the purchaser, during manufacture, if so desired by the purchaser, to verify the quality control process of the Bidder.

12.00.00 **TYPE TESTS**:

Notwithstanding, that type test has been conducted earlier, the successful bidder each member of JV shall conduct all type tests as per IS:7098 part (2), 1985 with up-to-date amendments or equivalent international standard at his cost at either CPRI or any other accredited national laboratory/testing house and materials offered for inspection. Only after approval of the test reports from the purchaser materials shall be offered for inspection.

12.01.00 All type tests, routine, acceptance test shall be conducted in the presence of the purchaser, representative.

12.02.00 The successful Bidder shall give 15 days' advance notice for inspections and witnessing of tests by the purchaser or his representative.

12.03.01 The following type tests will be conducted on the cable.

a) Test on conductor
b) Test on armor wires

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c) Test for thickness of XLPE insulation and inner and outer sheaths
d) Physical test on XLPE insulation
e) Physical test for outer sheath
f) Partial discharge test
g) Bending test
h) Di-electric power factor test
   (i) As a function of voltage
   (ii) As a function of temperature
i) Insulation resistance (Volume resistivity) test
j) Heating cycle test
k) Impulse withstands test
l) High voltage test
m) Flammability test

12.03.02 The following test shall be performed successively on the same test sample of completed cable, not less than 10 M in length between the test accessories.

a) Partial discharge test
b) Bending test followed by partial discharge test
c) Dielectric power factor as a function of voltage
d) Dielectric power factor as a function of temperature
e) Heating Cycle test, followed by dielectric power factor and function of voltage and partial discharge test.
f) Impulse withstands test
g) High voltage test.

12.04.00 **ACCEPTANCE TEST**:

12.04.01 The sampling plan for acceptance test shall be as per IS:7098 Part (2) 1985, Appendix 'A'.

12.04.02 The following shall constitute the acceptance test.

a) Tensile test for aluminum
b) Wrapping test for aluminum
c) Conductor resistance test
d) Test for thickness of insulation
e) Test for thickness of inner and outer sheath
f) Hot-set test for insulation
g) Tensile strength and elongation at break test for insulation and outer sheath
h) Partial discharge test (on full drum length)
i) High voltage test
j) Insulation resistance (volume resistivity) test.

12.05.00 **ROUTINE TEST**:

The following shall constitute routine tests:

a) Conductor resistance test
b) Partial discharge test on full drum length
c) High voltage test

13.00.00 **PACKING**:

13.01.01 The cables, as per specified delivery lengths, shall be securely wound/packed in non- returnable, well-seasoned sturdy wooden drums, with strong reinforcements so as to withstand rough handling during transport by Rail, Road etc., The packing should withstand storage conditions in open yards. The cable drums shall conform to IS:10418-1982 or equivalent standard.

13.01.02 The drawing of cable drums with full detail shall be furnished and got approved before dispatch.

13.02.00 **SEALING OF CABLE ENDS ON DRUMS**:

13.02.01 The Cable ends shall be sealed properly so that ingress of moisture is completely prevented.

13.02.02 The individual core endings shall be sealed effectively with water resistant compound applied over the core and provided with a heat shrinkable cap of sufficient length with adequate cushion space so that the conductor does not puncture the cap in case of movement of the core during unwinding or laying. Before sealing, the semi conducting layer on the cores may be removed for about 2 mm at each end, to facilitate checking the insulation resistance from one end, without removing the sealing cap at the other end.

13.02.03 The three cores should have an overall heat shrinkable cap with adequate end clearance, and sufficient cushioning to prevent puncturing of the overall sealing cap due to stretching of the cores. The sealing

cap shall have sufficient mechanical strength and shall prevent ingress of moisture into the cable.

13.02.04 **CABLE LENGTHS**: The cables shall be supplied in continuous lengths of 250/500 m in case of 3 core cables with a tolerance of ± 5% of drum length.

13.02.05 **QUANTITY TOLERANCE**: ±5% tolerance shall be allowed on the ordered quantity.

14.00.00 **MARKING**:

The packed cable drum shall carry the following information, clearly painted or stenciled.

a) The letters "BESCOM"
b) Reference to Standard and ISI Mark
c) Manufacture's Name or trademark
d) Type of Cable & Voltage grade
e) Number of cores
f) Nominal cores sectional area of conductor
g) Cable code
h) Length of cable on the drum
i) Direction of rotation
j) Gross weight
k) Country of Manufacture
l) Year of Manufacture
m) Purchase Order No. and Date
n) Address of consignee.

15.00.00 Cross sectional drawings of the cables giving dimensional details for each size of cable.

a) An illustrated literature on the cable giving technical information, on current ratings, cable constants, short circuit ratings, derating factors for different types of installation packing date weights and other relevant information.

SCHEDULE-I

Annexure: TS-1

Schedule of requirement of 3 core armoured, 1 core armoured, 6.35/11KV (E) aluminum conductor, XLPE UG Cables

Sl. No.	Cross sectional area of conductor (Sq.mm.)	Minimum current rating (Amps) in ground	Minimum short circuit rating (KA/1 Sec)	Delivery length per drum (± 5%)
1	3 x 95	190	8.9	500 M
2	3 x 240	315	22.5	250 M
3	3 x 400	395	37.6	250 M

The approximate current ratings in column 3 are for the following standard installation conditions.

i)	Maximum conductor temperature for continuous operation	90 Deg. C.
ii)	Ambient air temperature	40 Deg. C.
iii)	Ground temperature	30 Deg. C.
iv)	Thermal resistivity of soil	150 Deg. C.
v)	Depth of laying	90 cm
vi)	Maximum conductor temperature at the end of short circuit	250 Deg. C.
vii)	Method of installation	Installed single directly buried in ground

BRIDE

SCHEDULE-II
Annexure: TS-2

For the information of Bidder, the important extract from the Indian Standard IS:7098 (Part 2) 1985; "Specification for cross linked polyethylene insulated PVC sheathed cables are furnished here for their reference and to supply for the XLPE Cables called for in the bid specification

TABLE-1:- PROPERTIES OF XLPE INSULATION

Sl. No.	Property	Requirement
1	Tensile Strength	12.5 N/Sq.mm. Min.
2	Elongation at break	200 percent, Min.
3	**Ageing in air over**: a) Treatment: Temperature Duration b) Tensile Strength Variation c) Elongation Variation	 135 ± 3 Deg. C 7 Days ± 25% Max. ± 25% Max.
4	**Hot Set**: a) Treatment: Temperature Time under load Mechanical stress b) Elongation under load c) Permanent Elongation (Set after cooling)	 200 ± 3 Deg. C 15 minutes 20 N/Sq.mm. 175% Max. 15% Max.
5	**Shrinkage**: a) Treatment: Temperature Duration b) Shrinkage	 130 ± 3 Deg. C 1 Hour 4% Max.
6	**Water absorption (gravimetric)**: a) Treatment: Temperature Duration b) Water absorbed	 85 ± 2 Deg. C 14 Days 1 Mg/Sq.mm. cm. Max.
7	**Volume resistivity**: a) At 27 Deg. C b) At 90 Deg. C	 1×10^{14} ohm-cm. Min. 1×10^{12} ohm-cm. Min.

.

TABLE-2:- NOMINAL THICKNESS OF INSULATION

Nominal Area of Conductor in Sq.mm.	Nominal thickness of insulation (ti) in mm. 6.35/11KV – 3 Core
95	3.6
240	3.6
400	3.6

1) Thickness of insulation: The average thickness of insulation shall not be less than the nominal value (ti)

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specified in Table-2.

2) Tolerance on thickness of insulation: The smallest of the measured values of thickness of insulation shall not fall below the nominal value (ti) specified in Table-2 by more than 0.1 mm + 0.1 ti.

TABLE-3:- THICKNESS OF INNER SHEATH (All dimensions in mm)

Calculated diameter over laid up cores (ref. IS 10462 Part 1, 1983) *		Thickness of inner sheath (Min.)
Over	Up to & including	
(1)	(2)	(3)
-	25	0.3
25	35	0.4
35	45	0.5
45	55	0.6
55	-	0.7

(*) Fictitious calculation method for determination, dimensions of protective coverings of cables: Part-I Electrometric and Thermoplastic Cables.

TABLE-4:- DIMENSIONS OF ARMOUR GALVANIZED STEEL ROUND WIRES AND STRIPS

NOTE: The dimensions of Galvanized steel wires or strips shall be as specified in Table-4.

Calculated diameter for Armor (ref. IS 10462 Part 1, 1983) *		Nominal thickness of steel strip	Nominal diameter of round wire
Over	Up to & including		
1	2	3	4
a) For all diameter in excess of 13		0.8	Nil
-	13	-	1.40
13	25	0.8	1.60
25	40	0.8	2.00
40	55	1.4	2.50
55	70	1.4	3.15
70	-	1.4	4.00

Note: (a) and (b) indicate two methods of practice in the application of armouring.

* Fictitious calculation method for determination of dimensions of protective covering of cables: Part-I Electrometric & Thermoplastic Insulated Cables.

TABLE-5:- THICKNESS OF OUTER SHEATH (All dimensions in mm)

Calculated diameter under the outer sheath (ref. IS:10462 Part 1, 1983) *		Nominal thickness of steel strip		Minimum thickness of outer sheath for Armoured Cables
		Nominal (ts)	Minimum	
Over	Up to & including			
1	2	3	4	5
-	15	1.8	1.24	1.24
15	25	2.0	1.40	1.40
25	35	2.2	1.56	1.56
35	40	2.4	1.72	1.72
40	45	2.6	1.88	1.88
45	50	2.8	2.04	2.04
50	55	3.0	2.20	2.20
55	60	3.2	2.36	2.36
60	65	3.4	2.52	2.52
65	70	3.6	2.68	2.68
70	75	3.8	2.84	2.84
75	-	4.0	3.00	3.00

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(*) Fictitious calculation method for determination of dimensions of protective covering of cables: Part-I Electrometric & Thermoplastic Insulated Cables.

Note: Armored Cables: The thickness of outer sheath shall be not less than the minimum value specified in column 5 of Table-5.

Extracts from IS:7098 (Part 2), 1985, on Tests on Cables:

i) Partial Discharge Test: The Partial discharge magnitude at test voltage equal to 1.5 Uo shall not exceed 20 PC.

ii) Bending Test: The diameter of test cylinder shall be (20D ±5) percent, where D is the overall diameter of the completed cable.

iii) Dielectric Power Factor Test:

a) Tan 'delta' as a function of voltage:

The measured value of tan 'delta' at Uo shall not exceed 0.004 and the increment of tan 'delta' between 0.5 Uo and 2 Uo shall not be more than 0.002.

b) Tan 'delta' as a function of temperature:

The measured value of tan 'delta' shall not exceed 0.004 at ambient temperature and 0.008 at 90 Deg. C.

iv) Heating Cycle (As per IS: 10810 Part 49):

After their cycle, the sample shall be subjected to dielectric power factor as a function of voltage and partial discharge test.

v) Impulse withstand test:

The impulse voltage level for cables of rated voltage 6.35/11KV is 75 KV. No breakdown of insulation shall occur during the test.

vi) High voltage test (As a type test/Acceptance test) for 6.35/11KV rated voltage cables:

The cable shall withstand without breakdown an A.C. Voltage equal to 3 Uo but not less than 17 KV (rms when applied to the sample between conductor and screen/metallic tape/armour, the voltage shall be gradually increased to the specified value and maintained for a period of 4 hours.

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General Technical Parameters

Sl. No.	Particulars	unit	HT UG Cable
1	Cables		
	a) Name of manufacturer		
	b) Place of manufacture		
2	Cable Type		A2XWY
3	Applicable specification & standards voltage Grade		IS: 7098 (Part-2) /11kV
4	Suitable for effective Earth/Unearth system		
6	Permissible voltage & frequency variation for satisfactory operation		
7	**Continuous current for standard condition as per IS:**		
	a) In air (45^0 C)	Amps	
	b) In Ground (30^0 C)	Amps	
	c) In Duct	Amps	
8	**Conductor**		
	a) Material		Aluminum (H2/H4 Grade)
	b) Shape of conductor		Standard compacted circular
	c) Geometrical cross-sectional area	mm^2	
	d) Number of wire: (min)	No	
	e) Diameter of Wire : mm before compacting & strand Diameter	mm	
	f) Maximum DC resistance of the conductor at 20^0 C	Ω/KM	…….. (**CR value only for reference)**
	g) Sampling batch for test		10% of ordered quantity
9	**Conductor Screening**	-	
-	a) Material	-	Pressure Extruded Semiconducting compound
	b) Process		Triple Extrusion
	c) Thickness (Min)	mm	
	d) Continuous working temp	deg.C	90
	e) Max allowable temp at termination of short circuit	deg.C	250
10	**Insulation:**		
	a) Material		XLPE
	b) Thickness of Insulation (Nom)	mm	
	i) Between Cores	mm	
	ii) Between Cores & Inner Sheath		
	c) Minimum thickness of insulation at any one point	(mm)	
	d) Extrusion Type		Pressure Extruded

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	e) Specific insulation resistance at 90^0 C	Ohm-cm	
	f) Hot Set test:		
	a) Elongation under load	%	…..... Max
	b) Maximum Permanent elongation after cooling	%	… .....Max
	c) Tensile Strength at break	N/mm²	… ..... Minimum
	d) Elongation at break	%	…..... Min
11	**Insulation Screening:**		
	a) Material		Extruded Cross linked semi conducting compound
	b) Min. Thickness of extruded semi conducting layer	mm	
	c) Metallic Part: (Material)		Plain copper tape
	d) Size of copper Tape	mm	0.045
	e) Whether over lapping provided		Min 5% of Overlapping
	f) Short Circuit rating in 1 sec.	KA	
12	**Inner Sheath**		
	a) Material		PVC -ST2
	b) Extrusion Type		Pressure Extruded
	c) Thickness (Min)	mm	
	d) Nominal Dia over Inner Sheath	mm	
13	**Armoring**		
	a) Material		Galvanized Steel
	b) Type of armoring		Round wire
	c) Nominal Dimension of Armor wire	mm	……. Dimension and % of Tolerance
	d) Minimum Number of Armor wire		……. Numbers (Minimum)
	e) Whether Galvanized		
	f) Mass of Zinc coating	gm/mm²	
	g) Nominal Dia over Armoring	mm	
	h) Short Circuit rating in 1 sec	KA	
14	**Outer Sheath**		
	a) Material		Extruded PVC Compound Type ST-2
	b) Extrusion type		Extruded
	c) Min. thickness of sheath	mm	
	d) Nominal Overall diameter of cable	mm	
	e) Thermal stability test for sheath	Minutes	**100 minutes (Min)** Number of test specimen:6 Test results shall be within the range of ± 5% variation.
15	Short circuit withstand capacity		
	a) Short Circuit withstand capacity	KA	
	b) Duration of short circuit	sec	one

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16	AC resistance per core at operating temperature	ohm/km	
17	Reactance Ohm/Km	ohm/km	
18	Capacitance per core	µF/Km	
19	Allowable maximum conductor temperature when carrying current		
20	Insulation resistance at 27^0 C	ohm-cm	
21	Loss tangent		
22	Maximum cable charging current at normal operating volt	A/km	
	Additional data		
23	Core identification		Application of colored stripes Red, Yellow & Blue
24	Standard Packing Length and Tolerance	Mtrs	
25	Scheme of identification of the cable		manufacturer's name or trademark, voltage grade, year of manufacture and the letters "BESCOM". The identification shall repeat every 300/350 mm along with length of the cable.

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SECTION – 5

1.1 KV CROSS-LINKED POLYETHYLENE INSULATED ARMOURED PVC SHEATHED U.G. CABLE

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TECHNICAL SPECIFICATION FOR 1.1 KV CROSS-LINKED POLYETHYLENE INSULATED (HEAVY DUTY) ARMOURED PVC SHEATHED UG CABLE.

1. SCOPE:

The scope of this specification covers the design, manufacture, stage inspection at work, inspection and testing of finish cables at manufacturers works, testing at independent test house, packing, transport and delivery to consignee address of 1.1 KV stranded aluminum, XLPE insulated heavy duty armored and sheathed power cable for working voltages up to and including 1100 volts underground cables as per specified construction.

2. TECHNICAL REQUIREMENT:

1.1 KV grade, 90º C rating heavy duty power cable with stranded circular shaped aluminum conductor cross linked polyethylene insulated inner sheathed of extruded PVC, galvanized steel strip armored and PVC ST-2 overall sheathed.

The cable should be suitable for use in solidly earthed system.

3. STANDARDS:

3.01 The 1.1 KV UG cable shall, in general meet the requirements of the latest edition of the Bureau of Indian Standards (Generally refereed as IS), IS: 7098 (Part-I) 1988.

3.02 The cables and components in general shall meet the requirements of the following standards with latest amendments or equivalent international standards.

IS:7098 (Part-I)	1988	:	Specification for cross linked polyethylene insulated PVC sheathed cables.
IS:8130	1984	:	Specifications for conductors for insulated Electric Cables.
IS:3975	1988	:	Specification for mild steel wires, strips and tapes for armoring of cables.
IS:10810 (Part 1 to 55)	1984	:	Specification for test on cables.
IS:5831	1984	:	Specification for PVC insulation and sheath of electric cables.
IS:10418	1982	:	Specification for drums for electric cables.
IS:10462	1983	:	Fictitious calculation method for determination of dimensions of protective coverings of cables: part 1 elastomeric and thermoplastic insulated cable.

3.03 The 1.1 KV underground cables shall be manufactured to the highest standard quality, best workmanship with scientific material management and quality control. The bidder shall furnish the quality plan, giving in detail the quality control procedures/management system.

3.04 The successful bidder shall give sufficient advance notice to the purchaser of not less than fifteen days to arrange for stage inspection and inspection of quality assurance program during manufacture, at the works.

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3.05 Cable complying with other internationally accepted standards such as IEC, VDE, IPCEA etc., will also be considered in case they ensure performance and constructional features equivalent or superior to standards listed above. In such a case, the Bidder shall clearly indicate the standard/standards adopted and furnish a copy of English version of the latest revision of standard(S) along with a tender and shall clearly bring the salient features for comparison.

3.06 In case of any conflict between the referred specification code or standards and this technical specification, the latter shall prevail to the extent of such difference.

3.07 1.1 KV Grade Power Cables to be supplied under this package shall be ISI approved and marked as such. Noncompliance of above shall not be accepted.

3.08 However, if cable to be supplied under this specification are manufactured outside India and conform to other internationally accepted equivalent or superior standards the above clause shall not be applicable.

4. DESIGN CRITERIA:

4.01 The cables that are covered in these specifications are intended for use in the Karnataka Power distribution system, under the climatic conditions and installation conditions described in the technical specification.

4.02 Any technical feature, not specifically mentioned here, but is necessary for the good performance of the product, shall be incorporated in the design. Such features shall be clearly brought out under technical deviations schedule only in the offer made by the bidder, giving technical reasons and justifying the need to incorporate these features.

4.03 For continuous operation of the cables, at specified rating the maximum conductor temperature shall be limited to the permissible value as per the relevant standard, generally not exceeding 90º C under normal operation and 250º C under short-circuit conditions.

4.04 The cables in service will be subject to daily load cycles of two peaks during day, morning peak and evening peak, with reduced loading during the nights.

4.05 The materials used for sheaths shall be resistant to oils, acids, alkalis, and chemicals.

4.06 The cables shall have the mechanical strength required during handling and laying.

4.07 The cables shall be designed to withstand the thermo-mechanical forces and electrical stresses during normal operation and transient conditions.

4.08 The cables shall be designed to have a minimum useful life span of forty years.

4.09 Core identification: the core identification for cables shall be provided, by suitable means, like, by application of colored stripes or any numerals or by printing on the cores as per Clause-10 of IS: 7098.

4.10 For identification-colored stripes, red, yellow & blue colors shall be used to identify the phase conductors & black to identify reduced neutral conductor.

5. MANUFACTURE PROCESS, CROSS LINKING OF INSULATION:

5.01 Cross linking of the insulation material (Pre compounded polyethylene) shall be conforming to IS:7098 (Part-I).

5.02 The conductor shall be of extruded semi conducting compound. The insulation screen shall consist of the non-magnetic metallic part. The XLPE insulation and the shields for conductor and insulation shall be extruded in one operation.

6. MATERIALS:

6.01 Conductor: the conductor shall be of stranded Construction. The material for conductor shall consist of plain aluminum of H2 or H4 grade as per Clause –3 of IS: 8130/1984.
The No. of wires in the conductor shall be not less than the appropriate minimum number given in Table-2 of IS: 8130/1984.

6.02 INSULATION**:** The insulation shall be cross linked polyethylene conforming to the requirements given in Table-1 of IS: 7098 Part-I.

6.03 For multicore cables, the interstices at the Centre shall be filled with a non-hygroscopic material. The interstices around the laid-up cores shall be covered with PVC compound type S.T.2. This will form the inner sheath for multicores.
ARMOURING: The armour shall be galvanized steel strip, complying with the requirements of IS: 3975.

6.04 OUTER SHEATH:
The outer sheath shall consist of Poly Vinyl Chloride (PVC) compound, conforming to the requirements of Type ST-2 of IS: 5831 suitable additives shall be added to give anti termite protection.

7. CONSTRUCTION:

7.01 The general constructional features of the cables shall be as follows:

a) Stranded circular shaped Aluminum conductor. Cross linked polyethylene insulation, cross linked shall be conforming to IS: 7098 (Part-I) 1988 with its latest amendment. Extruded PVC inner sheath. Armour (Galvanized steel strip). Outer PVC sheath with anti-termite treatment.

b) Cables with reduced neutral conductor shall have sizes as given in table-2 of IS: 7098 Part-I.

8. CONDUCTOR:

8.01 The conductor shall be stranded circular shaped Aluminum wires of H2 or H4 grade plain aluminum wires.

8.02 The conductor shall be clean, uniform in size and shape smooth and free from harmful defects.

8.03 Not more than two joints shall be allowed in any one of the single

8.04 Forming every complete length of conductor and no joint shall be within 300mm of any other joint in the same layer. The joint shall be made by brazing silver soldering or electric or gas welding.

8.05 No joints shall be made in the conductor after it has been stranded.

8.06 INSULATION: The insulation shall be provided over the conductor with cross linked polyethylene, applied by extrusion and shall be of high quality, cross linked, shall be confirming of IS:7098 (Part-I).

8.07 THICKNESS OF INSULATION: The average thickness of XLPE insulation shall not be less than the nominal value subject to the applicable tolerance as specified in table 3 of IS: 7098.

8.08 The insulation shall be applied to closely fit on the conductor screen and it shall be possible to remove it without damaging the conductor.

9. LAYING UP OF CORES:

9.01 For multicore cables, the core shall be laid together with a suitable right hand lay, where necessary the interstices at the center shall be filled with a non-hygroscopic material.

9.02 Inner sheath for Multi core cables:

9.03 The cores shall be laid up with a suitable right hand lay and the interstices should be filled with PVC compound type ST-2 conforming to IS: 5831 or equivalent standard.

9.04 The minimum thickness of the inner sheath shall conform to Table 5 of IS: 7098 (Part-I), 1988 or equivalent standard.

9.05 The inner sheath shall be so applied that it fits closely on the laid-up cores and it shall be possible to remove it without damage to the insulation.

10. ARMOURING:

Application

10.1 Armoring shall be applied over the insulation in case of single core cables and over the inner sheath in case of twin, three and multicore cables.

10.2 The armor stripes shall be applied as closely as practicable.

10.3 The direction of lay of the armor shall be left hand. For double strip armored cables, this requirement shall apply to the inner layer of strips. The outer layer shall, except in special cases, be applied in the reverse direction to the inner layer and there shall be a separator of suitable non-hygroscopic material.

10.4 DIMENTIONS: The dimensions of galvanized steel stripes shall conform to table 6 of IS: 7098 (Part-I).

10.5 A binder tape may be applied on the armor.

10.6 JOINTS: The joints in armor strip shall be made by brazing or welding and the surface irregularities shall be removed.A joint in any strip shall be at least 300 mm from the nearest joint in any other armor strip in the completed cable.

11 **OUTER SHEATH:**

11.1 The PVC outer sheath with anti-termite treatment shall be extruded over the armoring for multi core cables and single core cables.

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11.2 The color of the outer sheath shall be black.

11.3 The thickness of outer sheath shall be not less than the minimum value specified in column 5 of Table 8 of IS: 7098 (Part-I) 1988.

12 **IDENTIFICATION:**

12.1 The outer sheath shall have the following information embossed or indented on it, the manufacturer's name or trademark, the voltage grade, the year of manufacture and the letters "BESCOM". The identification shall repeat every 300/350 mm along the length of the cable.

13 **CABLE DRUMS:**

12.2 Cables shall be supplied in 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.

12.3 Standard length of each size of power cable to be supplied by the bidder shall be 500/1000 meters. The cable length per drum shall be 500/100 meters. The cable length power drum shall be subjected to a tolerance of ±5% of the standard drum's lengths. Acceptance of smaller lengths of cables are subjected to approval of purchaser. Smaller lengths of less than 100 meters will not be accepted.

12.4 A layer of waterproof paper shall be applied to the surface of the drums and over the outer most cable layer.

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

12.6 The cable drum shall carry KST marking with the following information stenciled on both sides of the drum. A tag containing the same information shall also be attached to the leading end of the cable.

- **a.** Reference to the Indian Standards.
- **b.** Manufacturer's Name, Brand Name or Trade Name.
- **c.** Purchase's name, contract No. and date.
- **d.** Type of cable and voltage grade.
- **e.** Number of cores.
- **f.** Nominal cross section area of the conductor.
- **g.** Cable code.
- **h.** Length of the cable on the drum.
- **i.** Number of lengths on drum.
- **j.** Direction of rotation of drum (by means of an arrow).
- **k.** Net and gross weight.
- **l.** Country of manufacture.
- **m.** Year of manufacture.

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

13 **QUALITY ASSURANCE PLAN:**

13.2 The successful bidder shall submit following information to the owner:

13.3 Test certificates of the raw materials and bought out accessories.

13.4 Statement giving list of important raw materials, their grades along with names of sub- suppliers for raw materials, list of standards according to which the raw materials are tested. List of tests normally carried out on raw materials in presence of bidder's representative.

13.5 List of manufacturing facilities available.

13.6 Level of automation achieved and lists of areas where manual processing exists.

13.7 List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections.

13.8 List of testing equipment's available with the bidder for final testing of equipment along with valid calibration reports.

13.9 The manufacture shall submit manufacturing quality plan (MPQ) for approval & the same shall be followed during manufacture and testing.

13.10 The successful bidder shall submit the routine test certificates of bought out raw material/accessories and central excise passes for raw material at the time of inspection.

14 **Guarantee:**

14.1 The supplier of cables shall guarantee overall satisfactory performance of the cables.

14.2 At least three copies of type test reports shall be furnished. One Copy shall be returned duly certified by the

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owner, only after which the commercial production of the concerned material shall start.

14.3 Copies of acceptance test reports shall be furnished in at least Three (3) copies. One copy shall be returned duly certified by the Owner, only after which the materials shall be dispatched.

14.4 Record of routine test reports shall be maintained by the supplier at his works for periodic inspection by the owner's representative.

14.5 Test certificates of test during manufacture shall be maintained by the supplier. These shall be produced for verification as and when desired by the owner.

15 **Inspection:**

15.1 The owner's representative shall at all times be entitled to have access to the works and all places of manufacture, where cable, and its component parts shall be manufactured and the representatives shall have full facilities for unrestricted inspection of the supplier's and sub-supplier's works, raw materials, manufacture of the material and for conducting necessary test as detailed herein.

15.2 The material for final inspection shall be offered by the supplier only under packed condition. The owner shall select samples at random from the packed lot for carrying out acceptance tests. The lot offered for inspection shall be homogenous and shall contain cables manufactured in 3-4 consecutive weeks.

15.3 The supplier shall keep the owner informed in advance of the time of starting and the progress of manufacture of material in their various stages so that arrangements could be made for inspection.

15.4 No material shall be dispatched from its point of manufacture before it has been satisfactory inspected and tested unless the inspection is waived off by the owner in writing. In the latter case also the material shall be dispatched only after satisfactory testing specified here has been completed.

15.5 The acceptance of any quantity of material shall in no way relieve the supplier of his responsibility for meeting all the requirements of the specifications and shall not prevent subsequent rejection if such materials are later found to be defective.

16 **QUALITY CONTROL:** The Bidder shall furnish a complete and detailed quality plan for the manufacturing process of the cable. All raw materials shall conform to relevant applicable standards and tested for compliance to quality and requirement.

During the manufacturing process, at all stages, inspections shall be made to check the physical and dimensional parameters, for verification to compliance to the standards.

The Bidder shall arrange for inspection by the purchaser, during manufacture, if so desired by the purchaser to verify the quality control process of the Bidder.

17 **TYPE TESTS:**

17.1 Not withstanding that type test have been conducted earlier, the successful bidder each member of JV shall conduct all type tests as per IS: 7098 (Part-I) 1988, with up-to-date amendments or equivalent international standard and supplies made only after approval of test reports from the purchaser.

17.2 All type tests, routine, acceptance test shall be conducted in the presence of the purchaser, representative.

17.3 The successful bidder shall give FIFTEEN days advance notice for inspections and witnessing of tests by the purchaser or his representative.

17.4 The owner reserves the right to get the cable type tested at any of the BESCOM recognized testing house/laboratory at his own expense for any further tests to verify the compliance with the specifications and to reject the cables in case they are found not satisfying the qualifying requirements as per relevant standards.

17.5 The following type tests will be conducted on the cable as per IS: 7098 (Part-I).

a) Test on conductor.
b) Test on armor strip.
c) Test for thickness of XLPE insulation and inner & outer sheaths.
d) Physical test on XLPE insulation.
e) Physical test on out sheath.
f) Insulation resistance (volume resistivity) test.
g) High voltage test.
h) Flammability test.

17.6 **ACCEPTANCE TEST:**

The sampling plan for acceptance test shall be as per IS: 7098 (Part-I) 1988.

17.7 The following shall constitute the acceptance test.

a) Tensile test for aluminum.
b) Wrapping test for aluminum.
c) Conductor resistance test.
d) Test for thickness of insulation.
e) Test for thickness of inner and outer sheath.
f) Hot-set test for insulation.
g) Tensile strength and elongation at break test for insulation and sheaths.
h) High voltage test.
i) Insulation resistance (Volume resistivity) test.

18 **ROUTINE TEST:**

The following shall constitute routine tests:

a) Conductor resistance test.
b) High voltage test.

19 **SEALING OF CABLE ENDS ON DRUMS:**

19.01 The cable ends shall be sealed properly so that ingress of moisture is completely prevented.

19.02 The individual core endings shall be sealed effectively with water resistant compound applied over the core and provided with a heat shrinkable cap of sufficient length with adequate cushion space so that the conductor does not puncture the cap in case of movement of the core during unwinding or laying. Before sealing, the semi-conducting layer on the cores may be removed for about 2mm at each end, to facilitate checking the insulation resistance from one end, without removing the sealing cap at the other end.

19.03 The multi cores should have an overall heat shrinkable cap with adequate end clearance and sufficient cushioning to prevent puncturing of the overall sealing cap due to stretching of the cores. The sealing cap shall have sufficient mechanical strength and shall prevent ingress of moisture into the cable. The ends of single core cables shall also be sealed on the same lines to prevent entry of moisture.

19.04 **CABLE LENGTHS:**

The cables shall be supplied in continuous lengths of 250-500 Mtrs in case of multi core cables with a tolerance of ±5% of drum length.

20 **GUARANTEED TECHNICAL PARTICULARS:** Guaranteed technical particulars of the cables to be supplied is enclosed.

21 **SCHEDULE OF DELIVERY:** The details regarding the delivery schedule are given in the Purchase Order/Dispatch instructions.

22 **DRAWING & LITERATURE:** The following shall be furnished along with the tender.

a) Cross sectional drawings of the cables, giving dimensional details for each size of cable.
b) An illustrated literature on the cable, giving technical information on current ratings, cable constants, short circuit ratings, derating factors for different types of installation, packing date, weights and other relevant information.

General Technical Parameters:

Sl. No.	Particulars	unit	LT UG Cable
1	Cables		
	a) Name of manufacturer		
	b) Place of manufacture		
2	Cable Type		A2XFY
3	Applicable specification & standards voltage Grade		IS: 7098 (Part-1) /1.1kV
4	Suitable for effective Earth/Unearth system		
5	Permissible voltage & frequency variation for satisfactory operation		

BRIEF

6	**Continuous current for standard condition as per IS:**		
	a) In air (45^0 C)	Amps	
	b) In Ground (30^0 C)	Amps	
	c) In Duct	Amps	
7	**Conductor**		
	a) Material		Aluminium conductor H2 OR H4 Grade
	c) Nominal cross-sectional area	mm²	
	b) Form of conductor		Standard circular, class-2 as per IS:8130
	d) Number of Strands:	Nos	

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	e) Diameter of Wire: mm before bunching	mm	
	f) Nominal continuous operation	deg C	
	g) short circuit condition	deg C	
	h) Maximum DC resistance of the conductor at 20^{o} C	Ω/KM	…..... (**CR value only for reference)**
	i) Sampling batch for test		10% of ordered quantity
	j) Weight of the conductor	Kg/Km	
8	**Process of Curing**		
9	**Insulation:**		
	a) Material		XLPE
	b) Thickness of Insulation (Nom)	mm	
	c) Minimum thickness of insulation at any one point	mm	
	Hot Set test:		
	a) Elongation under load	%	……. % minimum
	b) Maximum Permanent elongation after cooling	%	……. % minimum
	c) Tensile Strength at break	N/mm²	……. % minimum
	d) Elongation at break	%	……. % minimum
10	**Inner Sheath**		
	a) Material		PVC ST-2
	b) Whether extruded		
	c) Min Thickness	mm	
	d) Colour of Inner Sheath		
11	**Armouring**		
	a) Material		Galvanized Steel Strip
	b) Type of armouring		
	c) Nominal Dimension of Armour wire	mm	……. Dimension and % of Tolerance
	d) Minimum Number of Armour wire		……. Numbers (Minimum)
	Armour Restivity (Max)	ohm cm	
	f) Mass of Zinc coating	gm/mm²	
12	**Outer Sheath**		
	a) Material		PVC Compound Type ST-2
	b) Whether extruded		
	c) Min. thickness of sheath	mm	
	d) Nominal Overall diameter of cable	mm	
	e) Thermal stability test for sheath	Minutes	
	colour		
13	Short circuit withstand capacity		

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	a) Short Circuit withstand capacity	KA	
	b) Duration of short circuit	sec	one
14	AC resistance per core at operating temperature	ohm/km	
15	Reactance Ohm/Km	ohm/km	
16	Capacitance per core	µF/Km	
17	Allowable maximum conductor temperature when carrying current		
	Additional data		
19	Scheme of Identification		
20	Standard Packing Length and Tolerance	Mtrs	
21	Bending Radius	mm	
22 Scheme of identification of the cable			manufacturer's name or trademark, voltage grade, year of manufacture, project details and the letters "BESCOM". The identification shall repeat every 300/350 mm along with length of the cable.

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SECTION – 6

L.T. AERIAL BUNCHED CABLE & ITS ACCESSORIES

Bi-RIDE

TECHNICAL SPECIFICATION FOR THE L.T AERIAL BUNCHED CABLES.

1.0 SCOPE:

1.1 This specification covers the design, manufacture, testing, inspection, packing, transportation and delivery of Crosslinked polyethylene (XLPE) insulated Aluminum Cables twisted over a central aluminum alloy insulated messenger wire (along with associated accessories) for use on LT overhead distribution feeders, supply of required accessories and installations. The cable should be suitable for use on three-phase AC (Earthed) system for rated voltage up to and including 1100 Volts and UV protected.

1.2 The cables should be suitable for use where the combination of ambient temperature and temperature rise due to load, including temperature exposure to direct sunlight results in conductor temperature not exceeding the following:

Table: 1

Type of Insulation	Normal continuous Operation	Short circuit Operation
Cross linked polyethylene	90° C	250° C

2.0 APPLICABLE STANDRADS:

The following standards with latest updates shall be applicable unless otherwise specified:

a. IS:14255-1995 Aerial Bunched cable for working voltage up to and including 1100 Volts.
b. IS:10810 (Series) – Methods of testing cables.
c. IS : 8130 – 1984 for Aluminum conductors for insulated electric cables.
d. IS : 398 (Part-IV) 1994 : For all Aluminum Alloy Conductors (AAC) for overhead transmission purposes.-PART 4 Aluminum alloy stranded Conductors (aluminum– magnesium-silicon type).
e. IS:1885 (Part32) – Electro technical vocabulary: Part32 Electric Cables.
f. IS: 6474 for insulation.

2.1 LT Aerial Bunched Cables:

Electrical Data:

a. The rated voltage of the cables shall be 1.1kV.
b. Highest system voltage: 1.2 kV.
c. Test Voltage: i) 2.5 kV / 50 Hz/ 5 min for routine tests.
ii) 4 kV / 50 Hz/ 4 Hrs. for type tests.
d. Max. short circuit current 1.0 kA for 1 Sec..
e. Current carrying capacity at different ambient air temperatures of different sizes of phase conductors are tabulated at Table - 2.

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THE CURRENT RATING AND SHORT CIRCUIT CAPACITY SHALL BE AS GIVEN BELOW:
Table - 2

Nominal sectional area	Current rating at 40°C (approx) Amps	Short Circuit capacity KA/1Sec.
(mm2)	XLPE	
16	74	1.50
25	100	2.35
35	125	3.29
50	150	4.70
70	186	6.58
95	230	8.93

3.0 GENERAL:

The insulated phase conductors shall be twisted around the insulated aluminum alloy messenger wire, which shall take all the mechanical stress. The messenger wire shall also serve as the earth-cum-neutral wire and shall be insulated.

3.1. CONDUCTORS:

3.1.1 The phase conductor shall be of Aluminum round, stranded and compacted aluminum wires confirming to H2 or H4 grade aluminum complying with requirements of IS:8130, the nominal cross sections and corresponding conductor diameter and number of wires etc., shall be as per clause 3.1.8 of this specification.

3.1.2 The phase and neutral conductors shall be insulated with black weather resistant Cross-linked polyethylene insulation by extrusion process and suitable for 1100V insulation. The insulated conductors shall generally conform to the relevant IS standards as noted in clause 2.0 above. The thickness of insulation shall not exceed the limits specified in clause No.7.2, Table 4 and tolerance shall be as per clause No. 7.3 of IS:14255.

3.1.3 The power / outer –insulated neutral / street lighting conductors shall confirm to flexibility class 2 of IS 8130. The messenger cum neutral conductor or otherwise shall either be stranded circular or compacted circular type and shall have minimum of 7 strands. The surface of the conductor shall be smooth.

3.1.4 The messenger cum neutral conductor shall be heat treated aluminum magnesium – silicon alloy wires containing approx. 0.5% magnesium and 0.5% silicon confirming to IS 398 Part-4 with latest revision thereof.

3.1.5 A protective barrier shall be applied between conductor and insulation. The barrier shall be compatible with insulating material and suitable for operating temperature of the cable.

3.1.6 The size of the street lighting conductor shall be 16sqmm.

3.1.7 DIMENSIONAL AND ELECTRICAL DATA.

3.1.8 The dimensional and electrical data for the cable and street lighting conductor shall be as given in Table 3, below. The resistance values are the maximum permissible.
Table 3:

Nominal sectional area (mm2)	No of strands	Dia. Of compacted conductor (mm)	Approx. mass (Kg/km)	Max. DC resistance at 20C/KM	Insulation Thickness (mm)
(1)	(2)	(3)	(4)	(5)	**(6)**
16	6	4.4	42	1.91	1.2
25	6	5.5	65	1.20	1.2
35	6	6.8	95	0.868	1.2

50	6	7.9	127	0.641	1.5
70	12	9.6	184	0.443	1.5
95	15	11.3	254	0.320	1.5
120	15	12.9	315	0.253	1.5

Note: a). The Resistance value given in col. 5 are max. permissible.
b). Tolerance of + 5% is allowable on diameter shown in col.3

3.1.9 Phase Identification:

Durable and clearly visible longitudinal ridges shall be provided as follows on each insulated conductors as indicated below for identification of phases.

For phase conductors (3 Core Cable) For = R, Y, B
Street Light Conductor = SL
For Neutral/Messenger Conductor = N

Approx. ridge dimensions are:

- Width = 1.00 mm
- Height = 0.4 mm
- Distance between consecutive ridges = 2.7 mm.

4.0 INSULATED MESSENGER (NEUTRAL CONDUCTOR) :

4.1.1 The messenger shall be an All-Aluminum Alloy conductor composed of 7 Wires each of nominal dia 3.55 mm Dia drawn from rod, which is manufactured in a continuous casting and rolling procedure. The properties for the individual wires before stranding shall be.

- Tensile strength not less than 294 N/mm^2
- Elongation on 200 mm not less than 4%.
- Resistivity at 20 Deg. C not exceeding 0.0328-ohm Sq.mm/m
- Density at 20 Deg. C 2.7 Kg/cubic – m.

4.1.2 No joints are allowed in the messenger except those made on the base rod or wire before final drawing. The messenger shall be round, stranded and compacted to have smooth round surface.

4.1.3 The messenger takes all the mechanical stress and also serves as neutral conductor. The size and requirement of messenger conductor for minimum DC resistance and minimum breaking load shall be as per clause No.6.5 and Table 4 of IS: 14255.

Table-4

Sl. No.	Nominal Cross-Sectional Area of Phase Conductor mm^2	Messenger Conductor		
		Nominal Cross-Sectional Area mm^2	Maximum DC Resistance at 20° C ohm/km	Minimum Breaking Load kN
1.	16	25	1.38	7.0
2.	25	25	1.38	7.0
3.	35	25	1.38	7.0
4.	50	35	0.986	9.8
5.	70	50	0.689	14.0
6.	95	70	0.492	19.7

Note: While the limiting values in Col. 4 & 5 are to be guaranteed, a tolerance of +5% will be permissible on values in Col.2.

5.0 DESIGN:

5.1.1 The cable consists of three phase aluminum conductors and one street light aluminum conductor with black weather resistant special high-density Cross-linked polyethylene insulation, shall be twisted around a insulated all aluminum alloy messenger which is also the neutral conductor without fillers with lay not

exceeding 35 times the diameter of the insulated phase conductor.

5.1.2 The thickness at any place may be less than the specified average value, provided that the difference does not exceed 0.1 mm + 0.1(ti) of the specified average value in clause No.7.2, Table 5 and tolerance shall be as per clause No. 7.3 of IS:14255.

5.1.3. The insulation shall be applied that fits closely on the conductor (or barrier, if any) and it shall be possible to remove it without damaging the conductor. Further, for the thickness of insulation, six measurements are made radially on a piece of insulation, as far as possible equally spaced around the circumference but not on the ridges.

5.1.4. The insulation shall be black weather resistant suitable for 1100V and confirming to IS:6474.

5.1.5. The properties of XLPE insulation shall confirm to clause No. 5.1, Table 1 and 2 of IS: 14255.

5.1.6. The insulation shall be XLPE of nominal thickness and its properties shall confirm to IS: 7098 & IS: 6474. The black carbon content in XLPE shall be 2% only.

6.0. Designation and parameters of the Finished Cables:

The designation and parameters of the finished cables shall be as given in the Table 5 below. The first part of the designation refers to the Number & size (cross sectional area in sq.mm) of the Phase Conductor, the second part refers to the (cross sectional area in sq.mm) of the Messenger.

Table: 5: Sizes

Description of Sizes	**Complete Cable**	**Bunched**
	Approx. Overall dia. (mm)	**Approx. Cable mass (Kg/Km)**
3x16+1x16+1x25	19	310
3x25+1x16+1x25	22	390
3x35+1x16+1x25	24	490
3x50+1x16+1x35	32	640
3x70+1x16+1x50	34	890
3x95+1x16+1x70	39	1180
3x95+1x25+1x70	41	1260
3x95+1x35+1x70	43	1360
3x120+1x16+1x95	42	1430

7.0 TYPE TESTS ON LT AB CABLE:

Unless otherwise stated in this specification, the type tests and routine/acceptance tests shall be carried out in accordance with the appropriate clauses of IS:14255 and IS:10810.

8.0 TYPE TESTS AS PER CL.10.1 AND 11.4 OF IS:14255/1995:

a) Tests on phase/street light conductor
   - i) Tensile Test
   - ii) Wrapping Test
   - iii)Resistance Test

b) Tests on messenger conductor
   - i) Breaking Load
   - ii) Elongation Test
   - iii)Resistance Test

c) Physical test for XLPE Insulation:
   - i) Tensile strength and elongation at break
   - ii) Ageing in Air oven
   - iii)Hot set test
   - iv)Shrinkage test
   - v) Water absorption (Gravimetric)
   - vi)Carbon black: content dispersion

d) Test for thickness of insulation

e) Insulation resistance (volume resistivity)

f) High voltage test
g) Bending test on complete cable
h) Ultraviolet test on cable to withstand ultra violet radiation.

8.1 ACCEPTABLE as per Cl.10.2 of IS: 14255/1995:

a. Tensile tests for phase/street light conductor.
b. Wrapping Test for phase/street light conductor.
c. Breaking load test for messenger conductor.
d. Elongation test for messenger conductor.
e. Conductor resistance test.
f. Test for thickness of insulation.
g. Tensile strength and elongation at break
h. Hot set Test for XLPE Insulation.
i. Insulation resistance test.
j. High voltage test
k. High Voltage Test on DRUM, immersed in water & apply test voltage 3.5kV AC for 5 min.
l. Weather ability test for withstanding weather conditions.
m. Adherence test on insulated messenger wire

8.2 ROUTINE TESTS as per Cl.10.3 of IS: 14255/1995:

a. Conductor Resistance Test.
b. High Voltage Test

8.3 OPTIONAL TEST: This test to be insisted as part of Acceptance tests during inspection.

Bending Test on the Complete Cable:

The test shall be performed on a sample of complete cable. The sample shall be bent around a test mandrel at room temperature for at least one complete turn. It shall then be unwound and the process shall be repeated after turning the sample around its axis 180 Deg. The cycle of these operations shall then be repeated more. The diameter of the mandrel shall be 10 (D + d).
Where D= actual diameter of the cable (i.e., minimum circumscribing circle diameter in mm) d= actual diameter of the conductor in mm. No cracks visible to the naked eye are allowed.

Type Test Report:

The bidder shall submit type test reports for the particular sizes asked in the tender for the type tests carried out from NABL accredited Laboratory and the reports should not be older than 5 years as on the date of opening of tender. The bid not carrying valid type test reports will not be considered for evaluation.

8.4 SAMPLING OF CABLES:

In any consignment the cables of the same size manufactured under essentially similar conditions of production shall be grouped together to constitute a lot. Samples shall be taken and tested from each lot for ascertaining the conformity of the lot to the requirement of the specification. The number of drums(n) to be selected from the lot of drums(N) of consignment of cables shall be in accordance with column 2 and 1 of following table:

Table 6: Number of Drums to be selected Sampling and permissible Number of Defectives.

Number of Drums in the Lot (1) N	**Number of Drums to be Taken as Sample (2) n**	**Permissible Number of Defectives (3) A**
Up to 50	2	0
51 to 100	5	0
101 to 300	13	0
301 to 500	20	1
501 and above	32	2

The sample shall be taken at random. In order to ensure randomness of selection, random number table shall be used as per IS 4905.

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Number of tests and criteria for conformity: Suitable length of test sample shall be taken from each of the drums selected. The test sample shall be subjected each of the acceptance test. A test sample is defective if it fails in any of the acceptance test. If the number of defectives is less than or equal to the corresponding permissible defective(a) given in the table 9 the lot shall be declared as conforming to the requirements of acceptance test, or otherwise not.

9.0 PACKING AND MARKING:

The Cable shall be wound on non-returnable wooden drums conforming to IS: 10418 /1982 with latest amendment thereof. The ends of the cable shall be sealed by means of non-hygroscopic sealing materials. The drum shall be marked with the following.

a. Manufacturer's Name or Trade Mark.
b. Type of cable and voltage grade.
c. Drum number or identification number.
d. Number of cores and size of cable.
e. Number and length of pieces of cable in each drum.
f. Gross / Net mass of the cable.
g. Direction of rotation of drum. (By means of an arrow).

9.1 The drums shall be of such construction as to assure delivery of conductor in the field free from displacement and damaged and should be able to withstand all stresses due to handling and the stringing operation so that cable surface is not dented, scratched or damaged in any way during transport and erection. The cable shall be properly lagged on the drums. The cable drum shall be suitable for wheel mounting.

9.2 The min. drum length of cable shall be 500 mtrs, the tolerance ± 5%.

9.3 MARKING OF CABLE:

All the cables shall have the following marking embossed on the insulated phase conductors for identification: letters **BESCOM; Ref P.O & Date** in addition to manufacturer's name or trademark year of manufacture at regular intervals of not more than one meter. The cables with cross linked polyethylene insulation shall be identified throughout the length of the cable by the legend 'XLPE 90'.

10.0 QUALITY ASSURANCE PLAN

10.1 The successful bidder shall submit following information to the owner.

10.2 Test certificates of the raw materials and bought out accessories.

10.3 Statement giving list of important raw materials, their grades along with names of sub- suppliers for raw materials, list of standards according to which the raw materials are tested. List of tests normally carried out on raw materials in presence of bidder's representative.

10.4 List of manufacturing facilities available

10.5 Level of automation achieved and lists of areas where manual processing exists.

10.6 List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspection.

10.7 List of testing equipment's available with the bidder for final testing of equipment along with valid calibration reports.

10.8 The manufacture shall submit manufacturing quality plan (MPQ) for approval & the same shall be followed during manufacture and testing.

10.9 The successful bidder shall submit the routine test certificates of bought out raw material/accessories and central excise passes for raw material at the time of inspection.

11.0 GUARANTEE:

The supplier of AB Cable shall guarantee overall satisfactory performance for minimum period of 5 years.

11.1 At least three copies of latest type test reports shall be furnished. One copy shall be returned duly certified by the owner, only after cable shall be supplied.

11.2 Copies of acceptance test reports shall be furnished in at least three sets. One copy shall be returned duly certified by the owner, only after which the materials shall be dispatched.

11.3 Record of routine/internal test reports shall be maintained by the supplier at his works for periodic inspection by the owner's representative.

11.4 Test certificates of test during manufacture shall be maintained by the supplier. These shall be produced for verification as and when desired by the owner.

12.0 INSPECTION:

12.1 The owner's representative shall at all times be entitled to have access to the works and all places of manufacture, where AB Cables and its component parts shall be manufactured and the representatives shall have full facilities for unrestricted inspection of the supplier's and sub-supplier's works, raw materials, manufacture of the material and for conducting necessary test as detailed herein.

12.2 The material for final inspection shall be offered by the supplier only under packed condition. The owner shall select samples at random from the packed lot for carrying out acceptance tests. The lot offered for inspection shall be homogenous and shall contain AB Cables manufactured in 3-4 consecutive weeks.

12.3 The supplier shall keep the owner informed in advance of the time of starting and the progress of manufacture of material in their various stages so that arrangements could be made for inspection.

12.4 No material shall be dispatched from its point of manufacture before it has been satisfactory inspected and tested unless the inspection is waived off by the owner in writing. In the latter case also, the material shall be dispatched only after satisfactory testing specified here in has been completed.

12.5 The acceptance of any quantity of material shall in no way relieve the supplier of his responsibility for meeting all the requirements of the specifications and shall not prevent subsequent rejection if such materials are later found to be defective.

12.6 The prospective bidders should furnish the GTP of AB Cables

1.1kV LT AB Cable as per IS 14255:1995 with high quality class XLPE Insulation		
SL. No.	**Particulars**	
	Name of the Manufacture	
1	Standard/specification	
2	Size of Aerial Bunched cable	
3	**CONDCUTOR**	
3.1	phase conductor - Alu portion	
	i) Material of conductor	Aluminum wire (H2 or H4)
	ii) Applicable standard	IS 8130
	iii) Nominal area of cross-section of bare conductor (Sq.mm)	
	iv) No. of strands	
	v) Nominal diameter of strand(mm)	
	vi) Maximum DC resistance of the conductor at 20°C	……..
	vii) Diameter of bare conductor (mm)	
3.2	**Street Light conductor-Alum. Portion**	
	i) Material of conductor	Aluminum Alloy (AAAC)
	ii) Applicable standard	IS 398 Part IV- 1994
	iii) Nominal area of cross-section of bare conductor (Sq.mm)	
	iv) No. of strands	
	v) No. diameter of strand in mm	
	vi) Maximum DC resistance of the conductor at 20°C	……..
	vii) Diameter of bare conductor (mm)	

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3.3	**Messenger/actual conductor-AAA portion**	
	i) Material of conductor	
	ii) Applicable standard	
	iii) Nominal area of cross-section of bare conductor(Sq.mm)	
	iv) Number of strands	
	v) Nominal diameter of strand(mm)	
	vi) Maximum DC resistance of the conductor at 20°C	
	vii) Diameter of bare conductor (mm)	
	viii) Lay Ratio	
	ix) Tensile strength (min)/breaking load (KN)	
4	Sampling batch for test	
5	**Phase conductor - Insulation**	
	i) Material	
	ii) Insulation Thickness(mm)	
5.1	**Street Light conductor - Insulation**	
	i) Material	
	ii) Insulation Thickness(mm)	
5.2	**Messenger/neutral- Insulation**	
	i) Material	
	ii) Insulation Thickness(mm)	
6	**Complete AB cable**	
	i) Code or method of cable identification	Phase conductors in Black color, Ridges to be provided as 1,2,3 for identification as per clause no.8 of IS 14255/1995
7	**Tests on XLPE Insulation**	
7.1	**Hot set test**	
	a) (Max. elongation under load)	
	b) (Max.permanent Elongation After cooling)	
7.2	a) Min Tensile Strength	
	b) Min Elongation	
7.3	Water Absorption test: a) Max. water absorbed	
7.4	Carbon Black Content Shall be ranging	
8	Total Weight of the conductor (Aluminium and Aluminium Alloy)	
9	**Electrical Data:**	
	i) Short Circuit current for 1 Sec. Max (KA)	
	ii) Current carrying capacity (amps) at various ambient temp.deg.of 10^0C, 20^0C, 30^0C, 40^0C & 50^0C	
10	**BENDING RADIUS OF CABLE:**	12D

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11	**Scheme of the identification of the cable**	marking shall be embossed on the insulated phase conductors for identification: letters **BESCOM ..... Project/Phase/Agency Name in** addition to manufacturer's name or trademark year of manufacture at regular intervals of not more than one meter. The cables with cross linked polyethylene insulation shall be identified throughout the length of the cable by the legend. 'XLPE 90'.

TECHNICAL SPECIFICATION FOR INSULATION PIERCING CONNECTORS, ANCHOR (DEAD END) & SUSPENSION ACCESSORIES & OTHER ACCESSORIES FOR AERIAL BUNCHED CABLES FOR WORKING VOLTAGE UPTO AND INCLUDING 1100 VOLTS.

1.0 SCOPE

This specification covers the design, manufacture, assembly, testing and supply of Accessories for anchoring, suspending & making connections to Aerial Bunched Cables rated 1100 volts and insulated with cross-linked polyethylene.

2.0 STANDARD

The design, performance and test requirements shall confirm to this specification and the following standards. However, in case of any conflict, the requirements of this specification shall prevail.

1.0 NFC 33-020 Insulation Piercing Connectors
2.0 NFC 33-004 Electrical Ageing Test
3.0 NFC 33-040 Suspension Equipment's
4.0 NFC 33-041 Anchoring Devices
5.0 IS 14255 LV Aerial Bunched Cables

The Devices shall also be compatible with the cables of sizes & dimensions as defined in the Cable Specifications for the cables with which they are intended to be used.

3.0 CABLE DATA

The standard sizes and characteristics of the phase and street lighting conductors, messenger wires shall be as specified in IS: 14255-1995.

The Accessories of LT XLPE Insulated Aerial Bunched Cables (ABC) with insulated messenger cum neutral are specified below:

a) The ABC accessories should be of proven design with minimum 2 years record of satisfactory operation with a major utility. Order copies and Performance Certificates should be enclosed with the offer.
b) Since ABC accessories are to be used with insulated neutral-cum-messenger, their design should incorporate specific features to prevent damage to the insulation which meeting the required electrical, mechanical & thermal requirements.
c) All mechanical, electrical & thermal ratings should meet or exceed 90% of the corresponding ratings of the cable, or the values specified herein, whichever are more stringent.
d) The accessories should provide "Double Insulation" so that a single point failure of insulation will not result in the system tripping.

4.0 THE ABC ACCESSORIES

The ABC Accessories shall consist of the following:

a)	Insulation Piercing Connectors (IPC)	**:**	For making tap-off/branch connectors/service connector to an ABC line.
b)	Anchoring Assembly (AA)	**:**	For fitting onto a pole for anchoring the end of a length of ABC, or for a major change in direction.
c)	Suspension Assembly (SA)	**:**	For supporting a length of ABC at an intermediate pole in a length, with small angle of deviation.
d)	Service clamp (SC)	**:**	For anchor Insulated service lines (armored or unarmored)
e)	Transformer Connections	**:**	For connection to the transformer bushing.
f)	Junction Sleeves	**:**	For Phases, neutral messengers & Street lighting conductor.
g)	ABC Service Main Distribution Box	**:**	For Distribution of multiple no. of Service Connections from Main AB cable.
h)	Stainless steel strap & buckles	**:**	For fixing clamps to pole through aluminum bracket for dead end & suspension clamps.

5.0 Insulation Piercing Connectors (IPC)

Insulation Piercing Connectors (IPC) are used for making Tee/Tap-off/ Service connectors to an ABC/Bare Overhead Line. Insulation Piercing Connectors are designed to make a connection between the uncut main conductor and a branch cable conductor without having to strip either cable to expose the conductor instead the tightening action of the IPC will first pierce the Insulation, then make good electrical contact between the main end and branch conductor while simultaneously insulating and sealing the connection.

5.1 Constructional Features of IPC.

1. The housing shall be made entirely of mechanical and weather resistant plastic insulation material and no metallic part outside the housing is acceptable except for the tightening bolt.
2. Any metallic part that is exposed must not be capable of carrying a potential during or after connector installation.
3. Screws or nuts assigned for fitting with IPC (Insulating Piercing connector), must be fitted with torque limiting shear heads to prevent over tightening or under tightening (min & max torque values to be specified by Manufacturer).
4. The IPC must perform piercing and connection on Main and Branch cable simultaneously using single bolt for tightening as multiple bolts do not ensure even tightening.
5. The IPCs shall be waterproof and the water tightness shall be ensured by appropriate elastomer materials and not by grease, gel or paste alone.
6. Design of IPC should be such as to not cause damage to insulation of adjacent conductors due to vibration and relative movement during service.
7. All the metallic parts of the connector should be corrosion resistant and there should not be any appreciable change in contact resistance & temperature after overloads & load cycling.
    - The contact plates should be made of tinned copper/aluminum alloy.
    - Connector teeth should be factory greased & sealed to retard water or moisture ingress & corrosion.
    - The Insulation material should be made of weather & UV resistant reinforced polymer.
    - The outer metallic part should have potential free tightening bolts to allow safe installation on live lines.

5.2 Mechanical Tightening and Electrical Continuity:

Connectors shall be tightened up to 70% of the minimum torque indicated by the Manufacturer. At this torque electrical contact should have occurred between conductors to be joined. Then connectors shall be tightened up to the breakdown of the shear heads and lastly, upto 1.5 times the maximum torque indicated by the manufacturer, and there shall be no breakdown of any part of the connector or the core conductor.
Maximum rated torque shall not exceed 20 N.m for conductor <95 sq.mm and 30 for >95 but <150 Sq.mm.
Tightening screws shall have hex. Heads of 10 mm, 13 mm or 17 mm only.

5.3 Effect of Tightening on Main Core of IPC:

The connector shall be fitted approx. at the center of the main core, which is secure between two anchoring points 0.5 mtr. To 1.5 mtr. apart. At the time of fitting the connectors, the main core shall be under longitudinal tension at 20% of the load indicated in Table-1:

Table – 1

Nominal Cross – section (Sq mm.)	Tensile Strength (Newton)
16	1200
25	1800
35	2500
50	3500
70	5000
150	10000

Tensile strain shall be increased to the full value indicated in the Table 1 and held minute. There should be no breakdown of the core conductor.

5.4 Effect of Tightening on Branch Core of IPC

Test specimen shall be made up as in clause 5.3 except that this shall be do the smallest cross sections of main and branch conductors within its range.

An increasing tensile load shall be applied to the Branch Conductor along the axis of the recess for the Branch cable. Load shall increase at 100 – 500 N/minute until it reaches the value specified in the Table 2 and maintained for 1 minute. No slippage or breaking of conductor shall occur.

Table – 2

Nominal Cross – section (Sq mm.)	Tensile Strength (Newton)
16(Alu)	290
25	450
35 & above	500

5.5 Dielectric & Water Tightness Test of IPC

1. The connector is tightened up to the minimum torque indicated by the manufacturer.
2. Connectors are mounted on
   - Minimum cross section of main core.
   - Maximum cross section of main core.
3. In each case Branch is of minimum cross section.
4. Protection caps for the branch cable are to be used in accordance with the requirements of clause 5.1.7. An additional watertight cap of any design may be used to seal one end of the main cable if it is immersed under water. No additional gel or any protection is to be provided while installing connector.
5. The entire assembly shall be immersed at a depth of approx. 30 cms. For 30 minutes with the free ends of main and branch cable out of water.
6. An AC voltage of 6 kV shall be applied between the water bath and each of the cores in turn for 1 minute. There shall be no flashover or electrical tripping with a trip setting of 10 mA + 0.5mA.

5.6 Electrical & Ageing Test of IPC.

1. Any one of the two test configurations are used according to Table 3 with the Connections tightened to the minimum torque specified by their manufacturers and resistance recorded.

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Table – 3

Configuration	Main core cross section	Branch core cross section Tensile Strength (K.N)
1st Configuration	Minimum main	Maximum branch
2nd Configuration	Maximum main	Maximum branch

2. The configurations are subjected to 200 heat cycles by injecting suitable current into them. In each cycle the temperature of the branch conductor shall be raised from ambient to 120 + 5°C as, measured by a thermocouple.
3. The duration of each heating cycle is chosen to maintain a sufficiently steady temperature of 120 + 5°C for 15 minutes. The duration of each cooling cycle is chosen to bring the conductor temperature to within 2°C of ambient. The test configuration shall have 6 IPC connected in 3 parallel loops of main and branch with three such loops being in series. The initial scatter between the six values for connector resistance (one value for each connector) at cycle zero shall be lower than or equal to 0.30
4. Nominal heating current is indicated in the Table-4. It shall be permissible to accelerate the temperature rise by using a current up to 1.5 times the nominal current and to accelerate the cooling period by use of a fan or air blower.

Table – 4

Nominal Cross – section (sq. mm.)	Nominal Heating Current (A)
16	102
25	139
35	175
50	225
70	283
95	350
120	412
150	480
185	545
240	670

5. The over current test of Clause 5.1.9 shall be done after 50 cycles if the connector is a safety connector designed to ground a phase connector while the line is being worked on.
6. At the end of the 200 cycles the resistance shall again be measured. It shall not differ from the initial value by more than 12%. For each connector, maximum and minimum of difference between reference core temperature and connector temperature shall be within+_10 C of mean of difference between the reference core temperature and connector temperature. Maximum temperature of nay connector should not exceed reference core temperature.

5.7 Over Current Test of IPC (as applicable to size):

Over current test is required to establish the performance of Safety Connectors that are intended to provide a safe path to ground for the phases while the line is de-energized for working. It establishes the performance of the connector under short term overload conditions. Over Current Test of IPC: This test is applicable for network connectors since it may be subjected to overloads or short circuits which are not restricted by protection devices.

- After the first 50 cycles of clause 5.6.2, the connectors are subjected to 4 over currents of 1 sec duration each.

- The conductor temperature at the start of the over current test should be not more than 35OC.
- Current density during over current shall be 100 A/Sq mm for Aluminum and 95 A/Sq mm. for Aluminum – Alloy Conductor.
- Variation in time of over current is permissible between 0.85 sec & 1.15 sec., provided if maintains the relationship I2t = K where,

I = rms value of over current in Amps. t = time in seconds
K= Constant

- After the over current test, the electrical ageing test shall be resumed.

6.0 Anchoring Clamp for Insulated Messenger:

The clamps should be designed to Anchor LT-AB cable with insulated messenger. The clamp should consist of an Aluminum alloy corrosion resistant casted body or climatically resistant polymer material, bail of stainless steel and self-adjusting plastic wedges which shall anchor/hold the neutral messenger without damaging the insulation.

- No losable part in the process of clamping arrangement
- The clamp should conform to the standard NFC 33041 and 33042 or
- equivalent I.S. if any.
- The clamp body should be made of corrosion resistant Aluminum alloy or climatically resistant polymer material, bail should be of stainless steel and wedges should be weather and UV resistant polymer. λ Ultimate tensile strength of the clamp should not be less than 15 kN for 50/70 sq.mm insulated messenger wire / 10 KN for 25/35 sq.mm insulated messenger wire.
- Slip load of the clamp should not be less than the values specified in clause 4.0.c and Table 6 of the standard for various sizes.

Anchoring assemblies are used to firmly attach the messenger of ABC to a support and transmit the mechanical tension.

- at the end of a run or to the supporting structures
- at a major change in direction.

6.1 Each **Anchoring Assembly** shall include.

- One number tension bracket.
- One number wedge type tension clamp
- Flexible Rope for fixing tension clamp to bracket.

Anchoring assemblies shall be supplied in sets to ensure compatibility of the materials against corrosion or wear of moving parts.

6.2 Tension Bracket of AA

The tension bracket shall be made out of a single piece of Aluminum alloy suitable for attachment to a pole either by

b) 16mm (galvanized) steel bolt (s) or
c) Two stainless Steel straps of 20 +_0.2x 0.7 +_0.5mm and buckle with aluminums bracket. The SS strap shall have tensile strength of 7.5KN min, elongation 30% min, finish of 2B, and of corrosion & wear resistant stainless-steel material.

Material = SS202, Raw material Composition tolerance= As per ASTM 'A480'

The tension bracket should be designed to ensure the Flexible rope cannot slip out at any angle. The inner side of the bracket should be min 100 mm from the surface of the pole. (NFC-33-041)

The tension bracket should be rated and tested for the loads specified in Table-5. The load shall be applied at an angle of 45° from the normal to the surface of mounting of the bracket.
The bracket design should be in such a way that minimum distance between the pole and the anchoring clamp fixing point shall be 100+_20mm.
The Rope should be of length to maintain at least 150mm distance between bracket and body clamp and shall have sufficient mechanical strength to withstand the mechanical test for the complete assembly tests in this specification.

Table – 5

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Conductor Size (Sq mm.)	Rating	Load for deformation <10mm (Newtons)	Load for deformation <30mm & no-break (Newtons)
25-35	1500 Kg	12,000	15,000
50-95	2000 Kg	15,600	19,500

6.3 Flexible Rope of AA

1. The Anchoring assembly shall be supplied with a stainless-steel flexible Rope to connect the Tension Clamp to the Tension Bracket.
2. The rope should have sufficient flexibility to ease the torsional movement of the ABC System.
3. The Rope should be pre-fitted with compression type end fittings to secure the tension clamp or through any other suitable means.
4. A wear resistant moveable saddle should be un-loosably fitted on the Rope to prevent abrasion at the point of fitting into the tension bracket.
5. Rope should have sufficient mechanical strength to withstand the mechanical test for the complete assembly tests in this specification.

6.4 Wedge Type Tension Clamp of AA

1. Wedge type clamps shall be used for clamping the messenger without damaging the insulation.
2. The clamp shall be capable of clamping an uncut messenger so that it can continue without break to the connecting point or next span.
3. The clamp shall be fully insulating type of mechanical and weather resisting thermoplastic.
4. No bolts or loose parts are allowed as part of the Clamping system.
5. No tools shall be needed for fitting the messenger into the clamp.
6. The clamp shall be self-tightening and capable of holding without slippage the load specified in the Table-6.

Table – 6

Conductor size		Rating (kg)	T start (1Minute) (Newtons)	T final (1Minute) (Newtons)
Sq mm	Dia (mm)			
25-35	8-11	1000	8,000	10,000
50-70	12-14	1500	12,000	15,000
70-95	13.5-16	2000	12,000	15,000

After fitting the insulated messenger in the clamp, load T start will be held for 1 minute & then load increased to T final at rate between 5000 – 7,500 N/mtr. In each case there shall be no breakdown of any part of clamp and slippage of messenger in relation to the clamp.

6.5 Voltage Test on Clamp of AA

- Voltage test is carried out on anchor clamps to ensure no damage is caused to the insulated messenger.
- A conductive rod of dia. corresponding to the average dia. that can be accommodated in the clamp is fitted into the clamp, protruding by approx. 50mm at each end of the tightening piece.
- The rod and clamp is subjected to tensile load as stated in Table 7 below when fixed to a support in its

normal manner.

Table – 7

Conductor Size		Normal Rating (kg)	Load Applied (N)
Sq mm	Dia (mm)		
25-35	8-11	1000	2000
50-70	12-14	1500	4000
70-95	13.5-16	2000	6000

- A power frequency voltage of 6 kV is applied for 1 minute between the rod and conductive part of the clamp, or fixation point in absence of conductive part.
- No breakdown or flashover shall occur. There shall be no tripping due to leakage with a setting of 10 + 0.5 mA.

6.6 Endurance under Mechanical & Thermal Stress of AA

1. The test is done on clamp with largest cable in its range and also to comply with loads specified in table 8 of the standard.
2. A neutral messenger is fitted between two anchor clamps, with clamp spacing approx. 5 mtr. & 1 mtr. Of messenger protruding from the end. Marks are made to enable measurement of slippage.
3. The sample is subjected to 500 cycles of 90 minutes each as described below.
4. Messenger temperature is raised by passing an AC current to 60 +3OC within 15 minutes. This temperature is maintained for at least 30 minutes to give a total heating period of 45 mts. Per cycle.
5. Messenger is allowed to cool naturally to ambient for further 45 minutes to complete 90mts. Cycle time.
6. Mechanical load is applied during the cycle as per table 8 below. Load F1 is applied throughout the cycle, except for a short period of 5 sec. to 60 sec. when it is gradually increased from F1 to F2 at any time during the last 15 minutes of the 90-minute cycle.

Table – 8

Conductor size		Rating (kg)	F1 (Newtons)	F2 (Newtons)
Sq mm	Dia (mm)			
25-35	8-11	1000	2,200	5,000
50-70	12-14	1500	4,000	7,500
70-95	13.5-16	2000	4,500	10,000

7. There should be no slippage greater than 4 mm after 2 cycles or greater than 8 mm after 500 cycles.
8. Voltage test is done at the end of the 500 cycles by immersing the test specimen of neutral messenger and clamps in water of resistively not less than 200 Ohm mtr. For 30 minutes.
9. A voltage of 10 kV ac is applied for 1 minute between messenger and water bath using a trip setting of 10 + 0.5 am. There should be no breakdown or tripping.

7.0 Suspension clamp for insulated neutral messenger:

The clamp should be designed to hang L.T – AB cable with insulated neutral messengers. The neutral messengers should be fixed by an adjustable grip device. A movable link should allow longitudinal and transversal movement of the clamp body.

- No losable part in the process of clamping arrangement.
- The clamp should conform to the standard NFC 33040 or equivalent I.S, if any.
- The clamp and the link made of Polymer should provide an additional
- insulation between the cable and the pole.
- The clamps and movable links should be made of weather and UV resistant glass fiber reinforced polymer.

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- Clamps should be fixed with pole by eye hook / aluminum bracket by means of movable link securely fitted. Bracket should be made of corrosion resistant aluminum alloy. Or, Clamp should be fixed with pole by SS bands plus bracket.
- Ultimate tensile strength of the clamp should not be less than 15 KN for 50/70 sq.mm. Insulated messenger wire 10 KN for 25/35 sq.mm. insulated messenger wire.

Suspension Assembly is used for supporting an ABC by installation on the messenger at an intermediate point of support such as a pole. It can accommodate small angles of deviation up to 30°.

Each Suspension Assembly shall consist of:

- One number Suspension Bracket.
- One number moveable (articulated) connecting link.
- One number Suspension Clamp.

Suspension Assemblies shall be supplied in sets to ensure compatibility of the materials against corrosion or wear of rotating/moving parts.

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7.1 Suspension Bracket of SA

The Suspension Bracket shall be made from single piece aluminum alloy suitable for attachment to a pole by either.

a) 16 mm galvanized steel bolt or
b) Two stainless steel straps.

The Suspension Bracket shall be provided with an upper bulge to prevent the clamp from turning over on the Bracket for more than 45° from the horizontal or to within less than 60 mm from the pole / fixing structure.
The Suspension Bracket should be so designed to ensure that the articulated link cannot slip out of it.
Suspension Brackets shall be designed to withstand a load applied at the anchoring point of the movable link as per Table – 9 below without deformation of more than 10mm or breakdown at 33O below horizontal (there should be no longitudinal component of load parallel to the plane of fixing).

Table – 9

Conductor Size		**Normal Rating (kg)**	**Load Applied (N)**
Sq mm	**Dia (mm)**		
25-54	8-15	1500	12,500
70-95	13-17	2000	14,000

7.2 Movable (Articulated) Link of SA

Movable Links are used between the Suspension Bracket and Suspension Clamp to allow a degree of movement and flexibility between the two.
Moveable Links should be made fully of insulating type of mechanical and weather resistant thermoplastic. A metallic wear resistant ring should however be fitted at point of contact between the Suspension Bracket and the movable link.
The Movable link should be unlosable fitted to the Bracket and the Clamp.

7.3 Suspension Clamp of SA

- Suspension Clamps are used for locking the messenger of the ABC bundle without damaging the insulation or allowing the messenger to become dismounted from the fitting.
- The Suspension Clamp shall accommodate messenger wires from 25 -54 sqmm and 70-95 sq.mm as in Table 9 above.
- The Suspension Clamp shall be made fully of insulating type of mechanically strong and weather resistant plastic.
- Bolts should not be used for clamping / locking the messenger in the Clamp.
- There shall be no losable parts in the Suspension clamp.
- The Suspension Clamp should be unlosable fitted to the rest of the Suspension Assembly.

7.4 Mechanical Test on Clamp of SA

The Sub Assembly shall be subjected to a vertical load applied as per drawing in accordance with Table-10. There shall be no breakdown or permanent deformation at load T initial for 1 minute or when the load is increased to T final and released.

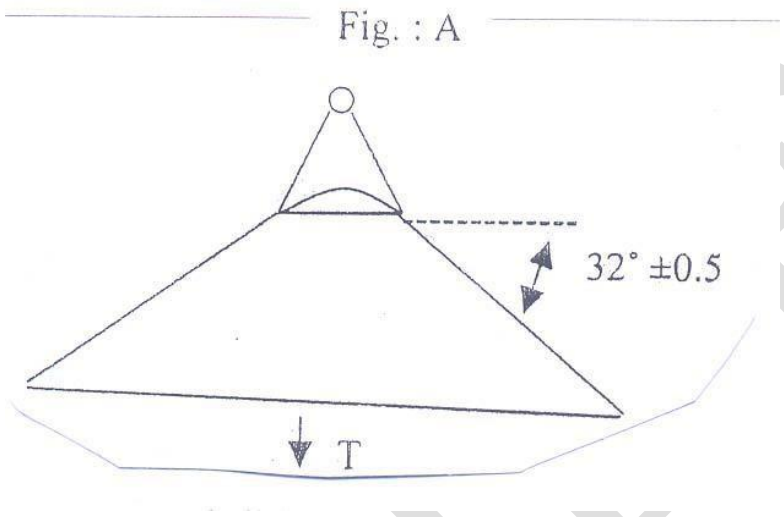
Table – 10

Conductor size	**Rating (kg)**	**T start (1Minute)**	**T final (1Minute)**

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Sq mm	Dia (mm)		(Newtons)	(Newtons)
25-54	8-15	1500	9,600	12,000
70-95	13-17	2000	12,800	16,000

Fig A



A sample messenger shall be fitted into a fixed suspension clamp and subjected to a gradually applied longitudinal load of 300 N. There shall be no permanent slippage.

7.5 Voltage Test of SA

A copper foil is wrapped at the clamping point around the maximum size of messenger allowed in that clamp. An ac voltage of 6 KV is applied between the copper foil and nearest conductive point of the clamp or into its absence to the point of fixation. The voltage should be withstood for 1 minute without breakdown or flashover.

7.5 Test Under Mechanical & Thermal Stress (as applicable)

The test specimen is made up of approx. 10mts. Of messenger wire strung between two anchor clamps with a Suspension Clamp fixed in the middle. Masses of 40 Kg. are suspended at a distance of 1-2mtr. On either side of the Suspension Clamp with a fixing mechanism of mass 2 + 1 Kg.

The specimen is subjected to 500 cycles of 90 minutes each. Each cycle consists of the following:

a) For first 75 minutes a constant longitudinal tension of 4000 N is applied to the messenger for rating of 1500 Kg. and of 4500 N rating of 2000 Kg. while 64 cycles right and left oscillation are produced on the clamp 32O on either side of the vertical.
b) During the first 45 minutes an intermittent current of 4-5 A/sq.mm is applied to maintain the conductor temp at 60 + 3 O C.
c) During the next 45 minutes of the cycle the conductor is allowed to cool down naturally to the ambient.
d) At the 75th minute, after having completed 64 oscillations, the oscillations are stopped, and the longitudinal tension is increased to 7500 N for 1500 kg. Rating and 10000 N for 2000 Kg. Rating.

5.3.9.3 - No messenger slippage should occur within the Suspension Clamp during the 500 cycles.

5.3.9.4 - At the end of the 500 cycles, the messenger is immersed in water for 30 minutes. It is then tested to withstand 10 kV ac for 1 minute with a trip setting of 10 + 0.5 mA. There should be no breakdown or flashover.

8.0 Acceptance Tests

8.1 The following shall constitute Acceptance Tests for **Insulation Piercing Connectors (IPC)** : (* please refer table below)

- Visual *
- Dimensional (as per SCD and overall dimensions submitted with
- Tender Offer)*
- Electrical Ageing Test ***
- Dielectric and Water Tightness Test. **
- Mechanical Tightening Test for shear head behavior, electrically continuity and over- tightening **
- Effect of Tightening on Main Core **
- Effect of Tightening on Branch Core **

The above tests are to be carried out as per sampling plan below. However electrical ageing test on IPC (marked***) is to be done on only one connector of each type and size.
In case of random failure/defect, double the sample lot is to be drawn and there should be no failure/defect exceeding half the permissible defects (rounded down) shown in the chart.

Lot Size	**For test marked *** **Sample Size**	**Max permissible defects**	**For test Marked **** **Sample Size**	**Max permissible defects**
Up to 100	2	Nil	2	Nil
101 to 1000	6	Nil	4	Nil
>1001	0.01% subject to min. 6 pieces	0.1% of pieces checked	4	Nil

8.2 The following shall constitute acceptance tests for **Anchor Assemblies**:

- Visual *
- Dimensional (as per SCD and overall dimensions submitted with Tender Offer) *
- Mechanical Test on Bracket**
- Mechanical Test on Clamp **
- Voltage Test *

8.3 The following shall constitute acceptance tests for **Suspension Assemblies:**

- Visual *
- Dimensional (as per SCD and overall dimensions submitted with Tender Offer) *
- Mechanical Test on Bracket**
- Mechanical Test on Clamp **
- Voltage Test *

The above tests (for AA & SA) are to be carried out as per sampling plan below. In case of random failure/defect, double the sample lot is to be drawn and there should be no failure/defect exceeding half the permissible defects (rounded down) shown in the chart.

Lot Size	**For test marked *** **Sample Size**	**Max permissible defects**	**For test Marked **** **Sample Size**	**Max permissible defects**
Upto 100	2	nil	1	Nil
101 to 500	5	1	2	Nil
501 – 2500	10	2	2	Nil

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501 – 2500	10+0.2%	2+10% pf addl sample quantity	4	1

9.0 Type Test:

For all accessories, the Type Test Report should be submitted from an Independent NABL Accredited Laboratory like CPRI or the ILAC MRA signatory Laboratory in case of a foreign manufacturer covering the following (on any convenient size of fitting of same design made from the same materials). The type test should not be older than 3 years as on the date of tender opening. The bidder shall submit the type test reports along with the bid.
The installation of the connectors shall be done in the laboratory following instructions provided by the manufacturer. The Test report shall record the embossing and marking on the connector.

The following shall constitute Type Tests:

9.1 For Insulated Piercing Connectors:

a) Electrical Ageing Test
b) Dielectric and Water Tightness Test.
c) Mechanical Tightening Test
d) Effect of Tightening on main Core
e) Effect of Tightening on Branch core

Over-current Test (if applicable for the size)

9.2 Type Test for Suspension Assembly (SA)

a) Mechanical Test
b) Voltage Test
c) Climatic Aging Test
d) Corrosion Test
e) Endurance Test under Thermal & Mechanical Stresses (if applicable)

9.3 Type Tests for Anchoring Assemblies (AA)

a) Mechanical Test
b) Voltage Test
c) Dynamic Test
d) Climatic Aging Test
e) Corrosion Test
f) Endurance Test under Thermal & Mechanical Stresses

GA drawing and approximate dimensions shown in the Annexed drawings are for illustration purpose only. The bidder/manufacturer shall furnish his drawings confirming to the technical requirements of this specification.

10.0 SERVICE CLAMP

The clamps should be designed to anchor insulated service lines (armored or unarmored) with 2/4 conductors.

- The clamps should be made of weather and UV resistant polymer.
- The service clamp should accommodate cables from 6 mm sq to 35 sq mm in the same clamp.
- The gripping mechanism shall consist of two insulated self-wedges that are un-loosable from the body and do not require any hand tools to grip the cable.
- The clamp should conform to the standard NFC 33042 or equivalent I.S., if any. No losable
- Breaking Load of the clamp should not be less than 3 KN.

11.0 STAINLESS STEEL STRAP ASSLY

The stainless-steel strap assembly shall consist of

a) Stainless steel strap of size 20+_0.2mm x 0.7+_0.05mm and shall have tensile strength of 7.5KN min., elongation 30% Min, finish 2B, and the stainless-steel material shall be of corrosion and wear resistant.

b) The buckle to suit above strap shall be used.

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12.0 TRANSFORMER CONNECTION

- The connection to the transformer should be made with pre-insulated lugs.
  for phase and street lighting conductors and with an Aluminum Lug for neutral Messenger. If the Bus-bars-bars are of copper, the Lugs should be preferably Bi- metallic type.

- The Barrel of the lug normally insulated with an Anti-UV black Thermoplastic tube sealed with a flexible ring. Die reference, size and strip length are to be indicated on the plastic.
- Sizes covered 16-70 & up to 150 m2 Aluminum XLPE insulated cable.
- Reference standard NFC 33021 or equivalent I.S. if any.

13.0 JUNCTION SLEEVES (Mid span joints)

- The sleeves should be pre-Insulated for phases, neutral messengers, and street lighting conductors.
- Sleeve should be made of Aluminum, insulated with an Anti-UV black thermoplastic tube hermetically sealed two ends with 2 flexible rings.
- Die reference, size and strip length are indicated on the sleeve itself.
- Sizes needed: 16-70 & up to 150 mm2 for Aluminum XLPE insulated cable.
- Reference standard: NFC 33021 or equivalent I.S. if any.
- Design as per furnished drawing or equivalent.

14.0 EYE HOOKS

- Eye looks should be designed to hold suspension clamps and Dead-end clamps and to be installed with the pole clamp.
- Eyehooks should be made of forged Galvanized steel.
- The clamps corrosion resistance should conform the standards I.S. 2629 & I.S 2633.
- Bolts and nuts should be made of hot dip Galvanized steel according to VDE 0210 and VDE 0212.
- Ultimate Tensile strength (UTs) of the clamp should 20 KN.
- Design as per furnished drawing.

15.0 SERVICE MAIN DISTRIBUTION BOXES

15.1 **Scope**

This Distribution Box should be Weather & Moisture Proof with Spring loaded; Bolt & Nut type Bus Bar system & should be able to carry a current according to specified capacity. It can have 1/3-phase input & provision of 6 Nos. of 3-phase or 1-phase outputs. The box should have the provision for special key for locking & Proper arrangement of sealing. The boxes should be assembled on the pole using Metal Tapes & Buckles or Bolts. No. of Boxes per pole may vary with supporting arrangement for more no. of service connections. The Spring used should be of stainless steel having required capacity to provide suitable pressure in the connector.

15.2 **Construction details.**

Distribution Boxes should be designed with Bus Bars with spring action contact. For spring action contact only insertion of the conductor into the specified groove of the Busbar is sufficient for proper connection. The springs should provide sufficient force to ensure good contact and are to be made of stainless steel only.

It should be used for multiple connections (3-phase or 1-phase) in low voltage Distribution Network. The boxes should be suitable for 1/3-phase (4 cores) inputs & provision for 6 nos. of 3-phase or 1-phase outputs. Bus bars should be with a continuous pair of contact bars with color code to facilitate the identification of the correct energy phase. The minimum clearance between phases shall be 35mm.

The box should be able to incorporate the input or output cable suitable for incoming cables of up to 50 sq mm aluminum and outgoing cables up to 35 sq. mm aluminum.

The Boxes should consist of special type Lock & key system as well as provision for sealing for complete protection of the service connection contacts. The boxes should be supplied with mounting channel arrangements.

15.3 Current Ratings

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The maximum current rating should be 140A/200A/250A & concerned authority should have the liberty to choose among the above ratings as per their requirement.

15.4 Voltage Ratings:

The maximum voltage withstand capacity should be 600V.

15.5 Working Temp

Safe working temperature should be around 90C for Outer Box & 100C for metallic Busbars.

15.6 Materials

The box/enclosure shall be made of Injection Moulded Glass Filled Fire Retardant engineering plastic or UV resistant Thermos plastic 2.0 mm minimum thickness, capable of withstanding boiling water for 10 minutes without deformation of plastic. The heat deflection temperature of the plastic should be 125°C @ 0.45mpa. The engineering plastic shall be UV protection & flame/fire retardant made up of Vo as per UL- 94. The color of the box may be dark grey or as approved by the purchaser.

The Busbars shall be made of EC grade copper and with a total cross section of 75sq. mm approx. The minimum clearance between phases shall be 35 mm.
Moulded casing of Bus Bar shall be made of Nylon glass filled capable of withstanding fire retardancy test (Glow wire test) at 950^{0}C as per Specification No. IEC Publication 695–2–1
The box shall have built in type hinges, no screws/rivets visible from outside. Suitable gasket shall be provided all around the cover to ensure sealing.
The box should have built in Earth Plate. The gland plate shall be of metallic with No of holes equal to the No of circuit provided.
Material used in the manufacturing process of the components of this product should be specified in the respective product drawings & can be summarized as follows.

- Outer Box (Base & Cap) : With UV protection & Flame retardant characteristics (V_O, as per UL 94-Tests for Flammability of Plastic materials type HB is not acceptable).
- Cable Grommets: Ethylene-Propylene Rubber:
- Safety Key: PA 6.6 (Nylon).
- Safety Screw: Stainless Steel or Plating Finished steel.
- Ingress protection as per IP 55.
- Bus bars or Terminal Blocks: PA 6.6 (Nylon), Stainless Steel & Copper.
- Button & Cable Holder: PA 6.6 (Nylon) with 50% Glass Fiber.
- Busbar Insulation: Polyamide.

15.7 Locking System

The boxes should consist of Special type Lock & Key arrangement as well as provision for sealing for complete protection of the service connection contacts.

15.8 TYPE TESTS /Routine/Acceptance Tests.

Type Test Reports have to be submitted for the following tests done on any one model of similar Distribution Box with total outgoing connections not less than those required in this tender from any NABL accredited laboratories only.

Sl No	Standard	Clause	Requirement	Test Particulars		
				Type	Routine	Acceptance
1	IS:14772	7	Marking	T		A
2	AS per specs & GTP	-	Dimensions	T	-	A
3	IS:14772	9	Protection against electric shock	T	R	_
4	IS:14772	12	Resistance to aging to humid conditions, to ingress solid object & to harmful	T	-	-
			ingress of water IP:55			

5	IS:14772	13	Test for mechanical strength	T	-	-
6	IS:14772	14	Resistance to heat	T		
7	IS:14772	16	Resistance to rusting	T		
8	IS:14772	17	Resistance to tracking	T		
9	IS:14772/ IEC 695-2-1		Glow wire test at 95°C	T		
10	IS:8623		Verification of dielectric properties	T		
11	IS:13411		Heat deflection test of 150°C at 0.45 MPa	T		
12	IS:4249	3.5.1	Test for self-extinguishing properties	T		
13	IS:11731-II		Flammability test	T		
Following tests are to be conducted for bus bar						
14			Temperature rise at 200 Amp	T		
15	IS:2683-I		Verification of electric properties of molded casing of bus bar at 2.5KV	T		
16	IS:11000-I/ IEC 695-2-1		Glow wire test at 95°C of molded casing of bus bar	T		

15.9 G.A. DRAWINGS ETC.

- A drawing / picture clearly showing principal parts & dimensions for all products should be submitted prior to supply of item.

- The principal outer dimensions of each item, l x b x w in mm and weight in kgs should be submitted along with the offer.
- The Purchaser may call for samples for verification & evaluation purposes.

16.0GENERAL CONDITIONS OF MANUFACTURE – Annexure – 2

17.0GTP

The Guaranteed Technical Particulars should be filled up in the given format of GTP.
- Annexure-3 to 5.

18.0 TESTING STANDARD – Given in Annexure 5 & 6.

ANNEXURE – 1

METEOROLOGICAL DETAILS

Sl. No. Parameters Unit Value

1.	Maximum ambient air temperature	39°C
2.	Maximum temperature of air in shade	25 °C
3.	Maximum daily average temperature	38 °C
4.	Maximum yearly average temperature	30°C

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5.	Maximum yearly weighted average temperature	28°C
6.	Minimum ambient air temperature	12°C
7.	Maximum relative Humidity	80%
8.	Average annual Rainfall	3175 mm
9.	No. of months of tropical monsoon -	(June-Oct.)
10.	Maximum wind pressure	100Kg/m2
11.	Seismic Zone as per IS: 1893 – 1984 -	III & IV
12.	Maximum height above mean sea level	1000Mtrs.

Note:

1) Any specific meteorological data other than those listed above applicable for a particular equipment/item will be available in the technical specification for that equipment/item.
2) When values specified above contradicts with respective equipment TS, the later will prevail for that equipment.
3) The atmosphere in the area is laden with industrial and town gases and smoke with dust in suspension during the dry months and subject to tough colder months.
4). Heavy lightning is usual in the area during the months from May to November.

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ANNEXURE-2

GENERAL CONDITIONS FOR MANUFACTURE

The products shall be in accordance recognized standards used in L.T. ABC or equivalent I.S., if any.

Marking: Each product shall be clearly identified with manufacturer name or trademark, reference and capacity of the item and batch no.

Packaging: Manufacturer shall mention the packaging of each item. Installation Instruction should be included in packaging.

Type test: Each supplier should provide type test reports with the offer, carried out in accordance with one of the reference standards in NABL Accredited or equivalent Laboratory. The reports shall not be older than THREE years as on the date of tender opening.

Routine test: Supplier shall provide a quality control plan, which will be implemented on each item. The manufacturer should have complete Routine Test facilities in house. Routine test reports should be submitted by the manufacturer with inspection call. The buyer reserves the right to inspect the materials at manufacturer's premises before dispatches. The manufacturer shall provide all facilities for routine tests.

Quality: Only ISO-9000 certified manufacturer will be considered for supply.

- Anchoring and suspension clamps should be installable on existing poles using existing cross arms wherever feasible by means of hooks, brackets etc. Use of stainless-steel straps with buckles and aluminum bracket arrangement is also acceptable. If MS pole clamps are used, they should be hot dip galvanized.

- All crimping should be done for jointing sleeves etc., with mechanical or hydraulic hand crimping tools.

ANNEXURE – 3

GUARANTEED TECHNICAL PARTICULARS FOR ANCHOR (DEAD END) CLAMPS / SUSPENSION CLAMPS SUITABLE FOR INSULATED SERVICE LINE CABLE.

Sl No	Parameters	Unit	Bidder's Offer
1	Type of Clamp		
2	Name of the Manufacturer		
3	Standard		
4	Place of Manufacturer		
5	Range of conductor size	Mm (Dia)	
6	Type of design		
7	Installation (with / without disassembly)		
8	Type & grade Metallic / Nonmetallic Material		
9	Marking		
10	Colour of Nonmetallic parts		
11	Dimensions	mm	

K-RIDE

12	Approximate weight kg	kg	
13	Breaking Load kN	kN	
14	Test voltage (Min 6 KV AC for 1 minute)		
15	Maximum load holding capacity (Kg.)		
16	Max. vertical load sustained by clamp. (Kg.)		
17	Max. longitudinal load sustained by clamp		
18	Is type test report enclosed		

ANNEXURE – 4

GUARANTEED TECHNICAL PARTICULARS FOR INSULATING PIERCING CONNECTORS (IPC)

Sl No	Parameters	For Street Light	For DB Charging	For ABC to ABC TEE
1	Name of the Manufacturer			
2	Is the Manufacturer of accessories as ISO 9001-2000 company? a)Copies of certificate enclosed. b)Are GA Drawing enclosed			
3	Applicable standard			
4	Type of connectors Main:	5. 16-95sqmm Tap: 1.5-10 sqmm	Main: 16-95sqmm Tap: 4-35 sqmm	Main: 25-95sqmm Tap: 25-95 sqmm
5	Application	For 1.1 KV	For 1.1 KV	For 1.1 KV
6	Is any metallic part carrying potential in operation exposed during installation			
7	Are end caps of branch cable. a)Slide on type b)Rigid			
8	Are torque limiting shear heads provided to tightening bolts			
9	Range of cable sizes accommodated for main & branch	Main: 16-95 sqmm Tap: 1.5-10 sq.mm	Main: 16-95sqmm Tap: 4-35sqmm	Main: 25-95sqmm Tap: 25-95sqmm
10	Min. & Max. torque defined			

B-RIDE

11	Torque for establishing connection between main and branch			
12		**For Street Light**	**For DB Charging**	**For ABC to ABC TEE**
13	Max. tensile load for no breakdown of main conductor (for each cross section)			
14	Max. tensile load on branch conductor for no break/slippage			
15	Voltage withstands under water emersion			
16	Is electrical Ageing test report enclosed			
17	No. of Cycles			
18	Max. temp. at each cycle			
19	Marking and embossing on the connection			
20	Is type test report enclosed?			

Bi-RIDE

ANNEXURE -5

GUARANTEED PARTICULARS FOR DISTRIBUTION BOX

Sl No	Particulars	Unit	Bidder's Offer
1	Name of the manufacturer		
2	Offered type of DB		
3	Material of DB enclosure		
4	Is spring loaded system offered		
5	Thickness 2mm min.		
6	Ingress protection class offered		
7	Suitable for cable of size (max) Incoming- Outgoing-	 mm mm	
8	Material of bus bar		
9	Cross sectional area of bus bar		
10	Insulation level		
11	Is built in Earth Plate provided		
12	Is type test reports enclosed		

Bi-RIDE

ANNEXURE – 6

TESTING STANDARDS:

The Insulating Piercing Connector should conform to following std.:

Tests	Tests Standard / Test Procedure
Corrosion Qualification Test	As per NF C 33-020 (Jun '98), or equivalent I.S., if any. Exposure in Saline Environment: The exposure should be carried out as per NF en 60068-2-11 (Aug. '99) std. requirement. The concentration of Saline solution must be of 5% + 1% in mass, & the temperature of the test chamber must be maintained at 35°C + 2°C. Exposure in Sulphur environment saturated of humidity – The exposure should be carried out as per NF T 30-055 (Mar. '74) std. requirement. SO2 concentration in the chamber should be 0.067% in volume. The temperature of the test chamber should be increased to 40°C + 3°C. The total test should include four identical periods of 14 days, in which 7 days of exposure in Saline environment & in other 7 days –8 hrs. Cycles in SO2 environment & 16 hrs. in laboratory environment.
Electrical Ageing Test	As per NF C 33-020 & NF C 33-004 (Jun '98) or equivalent I.S., if any. Total no. of cycles 200, Heating time -60 mins, Cooling time -45 mins, Pause time – 2 mins.
Dielectric Investigation Test in	As per NF C 33-020 (Jun '98) or equivalent I.S., if any. The connector should be placed in an ambient temperature between Water 15°C & 30°C & relative humidity between 25% & 75%. The tightening of the connectors should be at minimal value of the torque indicated by the manufacturer. The sample should be placed in tank full of water on 30 cm height, after an immersion length of 30 mins. The set is subjected to a dielectric test under a voltage of 6KV at industrial frequency during 1 min. No flashover / breakdown should occur at 6 KV during 1 min.
Mechanical Tests	As per NF C 33-020 (Jun '98) or equivalent I.S., if any. For checking electrical continuity, shear heads & mechanical behavior of the connector's suitable tests as per the above Specifications have to conduct.

Bi-RIDE

Capacity needed:
For ABC 16 to 95 mm2
Model 1 for customer service: Main 16 to 95 mn2 Tap
2.5 to 10 mm2 (For Street lighting)
Design as per furnished drawing
Model 2 for customer service: Main 16 to 95 mm2 Tap
04 to 35 mm2 (for distribution box charging)
Design as per furnished drawing
Model 3 for customer service: Main 25 to 95 mm2 Tap
25 to 95 mm2 (For ABC to ABC Tee Joint)
Design: As per Standards & typical drawing
furnished.

ANNEXURE – 7

TESTING STANDARDS

Impact Resistance should be according to UL 746C. Ingress Protection should be as per IP 55. The Quter Plastic box should conform to following std. –

Test / Standard	Requirements	Test Procedures
Degree of Protection IEC 60529	IP 55 – Protected against the penetration of solid objects exceeding 1.0mm in diameter and against penetration of water jets that may affect the product operation.	First Digit: A 1.0mm diameter test wire should not penetrate in any apparent opening (force = 1 N + 10%) Second Digit: A spray nozzle is used to spread a water jet in all possible directions.
Impact Resistance UL 746-C	After the test the product should not show any evidence of: - Live electrical parts accessible to the test probe, as described in this test specification. - Any results, which may affect the mechanical performance of the product. - Any results, which may increase the probability of electrical shocks.	The impact should be generated by dropping a steel ball – with a diameter of 50.8 mm and a mass of 0.535 kg – from a specified height sufficient to produce an impact energy of 6.8 J (0.69 13 kg.m.)
UV Resistance UL 746-C	The sample physical properties average value after an accelerated aging with UV radiation – should not be lower than 70% of its initial value, without aging, that is, a variation of + 30% is allowed.	According to ASTM G26, Exposure Method 1, Xenon Arc Lamp Type B or ASTM G 155, Exposure Cycle I, with continuous exposure to light and intermittent exposure to water jets, with programmed cycles of 120minutes, consisting of a 102minutes light-only exposure and a 18 minutes exposure to light and water jets.
Withstanding Voltage UL 746-C	Product should withstand the specified voltage	A 5 kV voltage should be applied to the samples after the 40 hours conditioning cycle at 23 + 2°C and 50 + 5% relative humidity plus 96 hours at 35 + 2OC and 90+5% relative humidity.

B-RIDE

Flammability UL 94	After the UV radiation accelerated aging, the material should maintain the same original flammability level (HB).	The test can be applied to test samples molded with the same material used for the base and the cap of the box or taking a piece of these components.
Flexural Strength ASTM D790	After UV radiation accelerated aging, the average value for	A group of test samples without aging should be tested and the average values
UL 746-C	this test should not be lower than 70% of the original value, that is, a maximum variation of 30% is allowed.	calculated. Another group should be aged under UV radiation then it should be tested, and the new average should be calculated and compared to the initial average value.
Tensile Strength ASTM D638 UL 746-C	After aging with UV Radiation, the average value should not be lower than 70% of the initial values, that is, a maximum variation of 30% is allowed.	One of the test bodies must be tested without being submitted to accelerated aging and is computed over mean values. Another group is submitted to the radiation induced aging and then tested and the new mean value is computed and compared to the first computed. mean value.

Bi-RIDE

SECTION – 7
L.T. PVC INSULATED SINGLE CORE ALUMINIUM LEAD WIRE (MULTI STRAND)

Bi-RIDE

Technical Specification for L.T. PVC Insulated Single Core Aluminum Lead Wire (Multi Strand).

1. The PVC Aluminum lead wire (multi strand) shall be of 1,100 volts grade and shall be single core. The cable shall be supplied in coils of 100 Mtrs. Length.
2. The lead wire (multi strand) shall be manufactured, tested, and supplied as per IS-694 of 2010 with latest amendments if any.
3. The conductors shall be composed of Aluminum wires complying with IS-8130 of 1984 with latest amendments, if any. The conductor particulars shall be as noted below.

Note: The conductor shall satisfy the requirement of resistance as per IS-8130 and also the nominal cross section specified below:

Sl. no	Cable	Conductor	Weight of Aluminum in kgs/100m	Remarks
1.	50Sq. mm	19/1.83mm	14.40	Un Sheathed
2	70 Sq.mm	19/2.17mm	20.17	Un Sheathed
3	95 Sq mm	19/2.52mm	27.40	Un Sheathed
4	120 Sq mm	37/2.03mm	34.58	Un Sheathed
5	150 Sq mm	37/2.27mm	43.22	Un Sheathed
6	185.0 Sq .mm	37/2.52 mm	53.30	Un Sheathed
7	240.0 Sq .mm	37/2.85 mm	70.30	Un Sheathed

(The weights of Aluminum conductor given above are as per IEEMA circular)

4. The conductor shall be provided with PVC insulation applied by extrusion and the PVC compound shall be type 'A' of IS5831 of 1984 with latest amendments, if any and shall satisfy test requirements for PVC insulation stipulated in IS 5831.
5. The color of the cable and sheath shall be Black.
6. Packing & Marking:

6.1 The Marking shall be as per IS: 694 of 2010 with the following details.

A.On the Lead Wire:

i) Reference of Indian Standard IS 694.
ii) Manufacturer's name, Brand name or Trademark.
iii) The letter "BESCOM".
iv) Year of manufacture
v) Type of cable and Voltage Grade.
vi) Nominal cross-sectional area of conductor.
vii)Cable code.

K-RIDE

viii)Color of core.
ix) The word 'suitable for outdoor use' ;
The printing, indentation or embossing shall be done on the insulation. The distance between any two consecutive printings, indentations or embossing shall be not more than 1m.

B. On the Drum/ Reel:

i) Length of the cable on the reel, drum, or coil.
ii) Direction of rotation of drum (by means of arrow);
iii) Approximate Gross Weight in kgs.
iv) Year of manufacture.
v) Purchase Order reference and Date.

6.2 The packing of the cable reel or drum shall also be marked with the standard markings and BESCOM Purchase order reference.

7. **Test Certificates: -**

a)All the type test certificates on conductors, PVC insulation etc. stipulated in IS 694 of 2010 with latest Amendments, if any shall be submitted for approval.
b)In case of an order, all the acceptance tests stipulated in IS 694 shall be conducted in presence of BESCOM/ KRIDE representative.
c)Routine tests shall be conducted and test reports in the form of test certificates signed by a responsible officer of the firm shall be submitted to this office for approval before dispatch of the material.

GUARANTEED TECHNICAL PARTICULARS		
	Name of the bidder	
Sl. No	**Particulars**	**Particulars to be furnished by the bidder**
		…..Sq.mm lead wire
1	Size of Cable	
2	Nominal area of cross section in square mm	
3	Number of strands and dia of each strand	
4	Voltage class	
5	Radial thickness of insulation in mm	

K-RIDE

6	Nominal overall diameter of cable in mm	
7	Name of manufacture (Brand Name)	
8	Color of Cable	
9	Maximum resistance of the conductor per KM at 20 Deg C.	
10	Length of cable per coil	
11	Estimated conditional rating in amps corresponding to the temperature of 80 Deg C.	
12	Weight of Aluminum/ coil of 100 Mtrs.	
13	Total weight of the Cable / Coil of 100 mtrs.	
14	Purity of Aluminum rods.	

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SECTION - 8
GOS - 200AMPS & 400AMPS

Bi-RIDE

TECHNICAL SPECIFICATION FOR 11KV 200AMPS SINGLE BREAK GROUP OPERATION SWITCHES

1.0 **Scope**: This specification covers the manufacture, testing and supply of 11KV Group operating switches of single break 200 Amps. Capacity complete with accessories, such as operating pipe, connecting pipe guides, supporting insulators, link work and locking arrangement, etc., complete conforming to IS-9921(Part 1 to 5) and the enclosed typical drawings.

2.0 **Weather Conditions**: The switches are to be installed at places with the following weather conditions.

Temperature: Maximum ambient - 45°C
Daily average: Average - 35°C
: Minimum - 5°C
: Altitude - Not to exceed 1000 Mtrs.above sea level.

3.0 The equipment offered shall conform to IS–9921 and latest amendments thereof. The switches shall be suitable for horizontal upright mounting.

4.0 **Construction**:

4.1 The base shall be made of robust rolled M.S. channel section of size 75 x 40x6 mm. All ferrous parts shall be hot dip galvanized and all copper parts shall be tinned. The rotating parts shall be fitted with suitable bearing.

4.2 The blades and contacts shall be made of best quality electrolytic copper and shall be capable of carrying the rated current without exceeding the temperature limits specified in table-4 of IS-9921 (part-II).

4.3 The insulators shall be of post type, brown glazed porcelain pedestal post type design. E.22 as per ISS:5350 (Part-III)/1971 with cap screws and spring washers and to technical specification enclosed conforming to IS:2544-1973 with amendments thereof.

4.4 The operating pipe shall consist of Tandem pipe (spindle rod) of length 2000 mm and the vertical pipe of length 5400 mm. The pipe shall be seamless 25mm diameter "B" type class (i.e., medium class) G.I. Pipe. The G.I. Pipe used shall conform to IS-1239- Part-I-1979 and amendments thereof. A guide shall be provided to the vertical operating pipe an intermediate position to arrest its lateral movement. Necessary fixing arrangements of the guide to the pole should also be supplied.

4.5 The Tenderer shall clearly indicate in the tender, the Brand name of the insulators used in manufacture of 200 Amps Single Break GOS along with relevant type test reports. The successful bidder should get the insulator make approved by BESCOM/ KRIDE, before making supplies.

Bi-RIDE

4.6 95 Sqmm heavy duty long barrel tinned copper lugs-6 Nos., suitable for terminating Weasel/Rabbit ACSR Conductor shall be provided for connecting conductor to the copper flats in the GOS.

4.7 All the iron parts shall be hot dip galvanized and shall conform to the relevant IS specifications with latest amendments those of.

4.8 **Arcing Horns**: The switches shall be supplied with hot dip galvanized arcing horns so that while closing or opening the switches, arcing takes place between the arcing horns and not between the main contacts.

4.9 **Locking Arrangements**: Suitable locking arrangements shall be provided for the operating handle.

4.10 The switches shall be designed to withstand the test voltage as per IS: 9921 or its latest revision thereof. The switches shall be designed to have the following current ratings.

Continuous current carrying capacity.	
Without over heating	: 200A
Short Time Current for 1Second rating	: 8 kA
Rated peak dynamic withstand current	: 20kA

5.0 **Test and Test Certificate**:

5.1 **Routine Tests**: The Routine test as per IS:9921 shall be conducted on each G.O.S in the presence of KRIDE representative and certificate shall be submitted duly signed by a responsible officer of the tenderers/organization before dispatch of consignment.

5.2 BESCOM/ KRIDE reserves the right to get the type test conducted as per IS:9921 on a selected G.O.S in the presence of BESCOM/ KRIDE's testing staff at the cost of the supplier.

1) Impulse Voltage dry test
2) Power frequency voltage dry test
3) Power frequency voltage wet test
4) Temperature rise test.
5) Measurement of resistance
6) Test for rated peak short circuit current.
7) Operation test
8) Mechanical endurance test

5.3 **Packing**: The group operating switches shall be securely packed to withstand rough handling during the transit and storage.

5.4 **Name Plate**: The group operating switch shall be provided with the name plate legibly and indelibly marked with the following information:

1) Name of materials
2) Name of the manufacturer/Trademark
3) Letters (BESCOM)
4) Purchase order No. and Date
5) Type-designation and Sl. No.
6) Rated voltage.
7) Rated current.
8) IS specification.

TECHNICAL SPECIFICATION FOR 11KV PEDESTAL POST INSULATORS

1.0 **General Requirements**: The tenderer shall clearly indicate in the tender, the brand name of the insulator used in manufacture of GOS along with relevant type test reports failing which, the offer will not be considered. The successful bidder should get the insulator make approved by BESCOM/ KRIDE, before making supplies.

2.0 The porcelain shall be sound, free from defects, thoroughly vitrified and smoothly glazed, the glaze on insulators shall be brown in color and should cover all exposed porcelain parts except those areas which serve as supports during fixing are required to be left unglazed as detailed in IS:2544-1963.

3.0 Precaution shall be taken during design and manufacture to avoid the following:

a) Stress due to expansion and contraction which may lead to deterioration.
b) Stress concentration due to direct engagement of the porcelain with the metal fittings.
c) Retention of water in recesses of metal fittings and shape which do not facilitate easy cleaning by

K-RIDE

normal methods.

4.0 All metal parts except those of stainless steel shall be hot dip galvanized after machining zinc coating shall satisfy the requirement of relevant IS specification. The finished galvanized surface shall be smooth.

5.0 The threads of the tapped holes on the post insulator metal fittings shall be cut after galvanizing and shall be protected against rust by greasing or other similar means. All other threads shall be cut before galvanizing.

6.0 The post insulator unit shall be assembled in a suitable jig to ensure the correct positioning of the top and bottom metal fittings relative to one another. The faces of the metal fittings shall be parallel and at right angles to the axis of the insulator and the corresponding holes in the top and bottom metal fitting shall be in vertical plane containing the axis of the insulator.

7.0 **Technical Particulars**:

Individual Units	: 11kV stacking units.
1) Rating	: 11kV
2) a) Unit description (as per ISS:5350/Part-III/1971)	: E-22 (Except torsion strength : as specified)
b) Mechanical strength as per Clause 3.2 of IS:5350/ III/1971.	: Strength class 'C' 7.5 to 12KN Prt-
3) Highest system voltage	: 12 kV (rms)
4) Impulse withstand voltage	: 75 KV (peak)
5) One minute Power frequency withstand Voltage.	
Dry	: 35 kV (rms)
Wet	: 35 kV (rms)
6) Power Frequency Puncture withstand voltage (rms)	: 1.3 times the actual dry flash cover. voltage of the unit.
7) Visible Discharge test voltage	: 9 KV (rms)
8) Creepage distance	: 230 mm
9) Failing load (as per IS:5350 Part-III/1971)	
(a) to (d) in Newtons and (e) in Newton meters	
a) Upright	: 9000 N
b) Under hung	: 4500 N
c) Tension	: 20000 N
d) Compression	: 40000 N
e) Torsion	: 340 Nm
10) Height of insulator (Min)	: 254mm (Tolerance ±1mm)
11) Insulating part dia (Max)	: 152 mm
12) Top metal fitting pitch circle dia	: 57 mm
13) Bottom metal fitting pitch circle dia	: 57 mm
14) a) No. of bolts	: 4 Nos.

K-RIDE

a) Bolts holes dia : 10 mm tapped holes at the top and 12 mm plain holes at the bottom.

b) Nominal dia of mounting face not to exceed. : 85 mm

8.0 **Marking**: Each insulator shall be legibly and indelibly marked with the following.

a) Name or trademark of the manufacture
b) Month and year of manufacture
c) ISI certificate mark if any

Marking shall be durable and shall be printed by the transfer process before firing.

NOTE: Manufacturer's Test Certificate and type test certificate conducted on similar sample insulator shall be submitted for approval before commencement of supplies.

9.0 **Marking :** Bill of Materials as per Drawing.

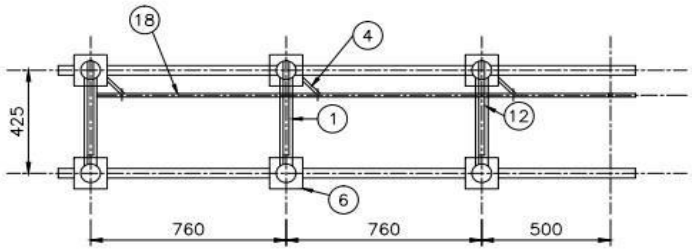
GUARANTEED TECHNICAL PARTICULARS FOR 11 KV 200 AMPS SINGLE BREAK GOS

Sl. No.	Details	Results
I	Material	
1	Name of the manufacturer	
2	Type	
3	No. of poles	
4	Frequency	
5	Voltage Rating	
6	Current Rating in Amps a) Normal b) Maximum	
7	Temperature rise of the following at full rated current in O. Cover ambient temperature	
8	Whether contacts are silver coated, or tin coated along with thickness of coating in mm.	
9	Voltage drops across terminals of poles	
10	Short time current and duration	
11	Material of fixed contact	
12	Material of moving blade	
13	Material of terminal connector	
14	Type Diameter and length of operating handle	
15	Materials of arcing horns	
16	Size and length of base mounting channel	
17	Whether the Air brake switch is complete with all accessories	
18	Whether Dimensional drawing is enclosed with the tender	
19	Minimum clearance between phase (The center distance between the insulators of adjacent phase in the assembled position of switch)	
20	Center to center distance between insulators of the consecutive poles of the same phase in the assembled position of switch (in mm)	
21	Whether mechanical interlock has been provided for arcing switches	
22	Type of bearings use in: 1. Rotating insulator stack. 2. To earth and between poles	

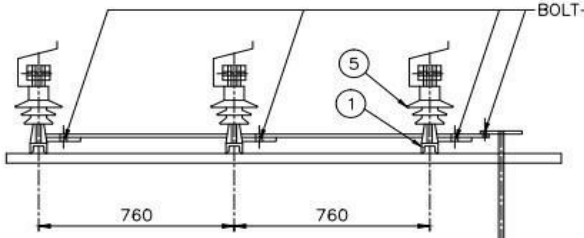
K-RIDE

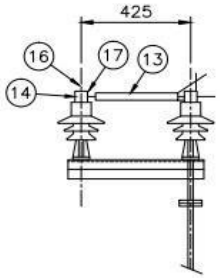
23	Impulse withstand voltage with 1/50 M.S wave positive and negative polarity.	
24	One minute power frequency withstand voltage across isolating distance3 to earth and between poles.	
II	**PARTICULARS OF INSULATORS**	
1	Type of insulators	
2	Name of manufacturer of insulators	
3	Height of the insulators	
4	Diameter of the largest shell	
5	Number of uni9ts per stack	
III	**ELECTRICAL CHARACTERISTICS**	
1	Flash over voltage	
2	Dry power frequency	
3	Wet power frequency	
4	Impulse voltage of 1/50 micro-sec(+ve)	
5	Impulse voltage of 1/5-micro-sec(-ve)	
6	Power frequency puncture withstand voltage of unit	
IV	Mechanical characteristics:	
	a. Cantilever strength under upright b. Cantilever strength under torsional c. Torsional strength d. Tensile Strength	
V	General Characteristics a) Minimum Creepage conforms. b) Weight of complete unit	
VI	Standard to which insulator conforms	
VII	Number of Insulators per set	

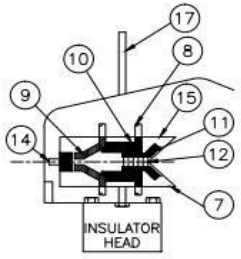
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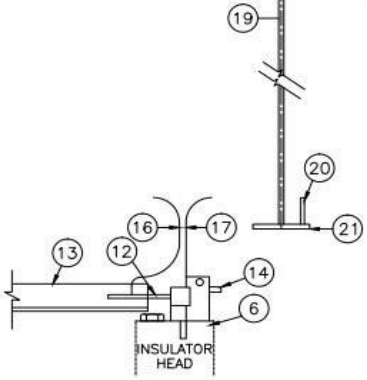
11KV 200A GOS (SINGLE BREAK)



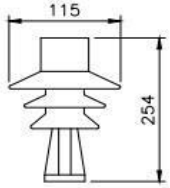




TOP DETAILS IN SECTIONAL ELEVATION



REAR SIDE VIEW



INSULATOR DETAILS

SL. NO.	DESCRIPTION	SIZE	SECTION IN mm	QUANTITY
1.	M.S CHANNEL	500mm	75x40x6	3 NOS.
2.	GUN METAL BUSH (TOP) FOR SPINDLE (STANDARD PARTS NOT SHOWN IN THE DRG.)	10mm HT.	25mmø	3 NOS.
4.	SPINDLE PLATE WITH SPINDLE	290mm	75x6mm	3 NOS.
5.	11KV POST INSULATOR	–	–	6 NOS.
6.	TOP PLATE	100mm	50x6mm	6 NOS.
7.	CONTACT BOX (BOTTOM)	110x16mm L.3mm Th	42mm W	3 NOS.
8.	COPPER CONTACT PIN (TINNED)	8mm ROD	50mm L	12 NOS.
9.	PHOISPHUR BRONZE COPPER STRIPS (TINNED)	100 (0.5Th.)	25mm W	12 NOS.
10.	SPRING(STAINLESS STEEL)	25mm Long	14G	12 NOS.
11.	COPPER CONTACT (TINNED)	90mm	25x6	6 NOS.
12.	COPPER KNIFE (TINNED)	460mm	32x6	3 NOS.
13.	MOVABLE ANGLE	400mm	45x45x5	3 NOS.
14.	LEADING FLAT, COPPER (TINNED)	190mm	25x6	3 NOS.
15.	CONTACT BOX (TOP)	110x16mm	3mm Th. 32mm W	3 NOS.
16.	MOVABLE ARCING HORN	300mm	8mmø	3 NOS.
17.	FIXED ARCING HORN	300mm	8mmø	3 NOS.
18.	HORIZONTAL G.I PIPE	2000mm	25mmø B–CLASS	1 NO.
19.	VERTICAL G.I PIPE	5400mm	25mmø B–CLASS	1 NO.
20.	HANDLE PIPE	500mm	25mmø B–CLASS	1 NO.
21.	LOCKING ARRANGEMENT	PLATES 6mm	210x90, 100x90 360x90, 300x50	4 NO.
22.	NUT & BOLTS 80 x 10mm – 24 NO, 25mm LONG– 5 NO, 30mm – 18 NO, 32mm LONG – 60 NO. ABOVE MENTIONED NUT & BOLTS ARE 10mm ø			
23.	64 x 12mm – 4 NO. ABOVE MENTIONED NUT & BOLTS ARE 10mm ø			

NOTES:–

1. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE STATED.
2. THE INSULATORS USED IN GOS SHALL BE GOT APPROVED BEFORE PLACING THE PURCHASE ORDER.
3. ALL COPPER PARTS ARE TO BE TIN PLATED.
4. ALL BOLT NUTS USE FOR OPERATING ANGLE SHALL BE WITH SPLIT PIN.
5. THE CONNECTING END OF BOTH MOVING AND FIXED CONTACT SHOULD BE FITTED WITH WEDGE CONNECTORS (RABBIT TO RABBIT)
6. CREEPAGE DISTANCE OF POST INSULATOR SHALL BE 320mm(Min.)
7. ALL FERROUS PARTS SHALL BE HOT DIP GALVANIZED.

	Signatures	All dimensions are in mm unless otherwise stated.	
Chd	AGM (QS&S)	11 KV, 200A SINGLE BREAK ISOLATOR	BESCOM Approved: General Manager,(Elec.) QS&S
Sub	DGM (QS&S)		DRG.NO.BESCOM/GM/QS&S/23 REV–004 DATED:24–01–2022
	SCALE: N.T.S		

Technical Specification for 11 KV Class 400 Amps Double Break Group Operating Switches

1.0 **SCOPE:**

This specification covers the manufacture, testing at works and supply/erection of 11 KV Isolators of 400 Amps capacity, double break, complete with accessories such as operating pipe, connecting pipe, supporting insulators, link work, terminal connectors and locking arrangements as per IS 9921 of 1981 and to the owner's drawings.

2.0 The equipment offered shall confirm to IS 9921 of 1981 and latest amendments there off. The switches shall be suitable for horizontal upright mounting.

3.0 **CONSTRUCTION:**

3.1 The base shall be made of robust rolled M.S. Channel Section of size 75 x 40 mm. All ferrous parts shall be hot dip galvanized and all copper parts shall be tinned. The rotating shall be fitted with suitable bearings.

3.2 The blades and contacts shall be of best quality electrolytic copper and shall be capable of carrying rated current continuously without exceeding the temperature limits specified in Table 41 IS:9921 (part-II)

3.3 The insulators shall be of post type, brown glazed porcelain pedestal part type design E22 as per IS 5350 (Part-III)/1971 with cap screws and spring washers and to technical specifications enclosed conforming to IS 2544 of 1973 with amendments thereof. The insulators baked in temperature-controlled kilns only shall be used. The insulator used shall be as per relevant IS and BESCOM approved.

3.4 The operating pipe shall consist of Terminal pipe (spindle rod) of length 2450mm and vertical pipe of length 5400 mm. The pipes shall be 25 mm diameter class 'B' (Medium Class). The G.I pipe used shall conform to IS 1239 part-1 1979 and amendments thereof. A guide to the vertical pipe of the operating pipe shall be provided to arrest its lateral movement. Necessary fixtures for fixing the guide to the pole shall also be supplied.

3.5 The Tenderer shall clearly indicate in the tender, the Brand name of the insulators used in manufacture of 400 Amps Double Break GOS along with relevant type test reports. The successful bidder should get the insulator make approved by BESCOM/ KRIDE, before making supplies.

3.6 185sq mm Copper tinned Heavy duty long barrel lugs suitable for terminating Rabbit / Coyote ACSR conductor shall be provided for connecting conductor to the copper flats in the GOS.

3.7 All the Iron parts shall be hot dipped Galvanized and shall conform to the relevant IS specifications with latest amendments thereof.

3.8 **ARCING HORNS:**

The switches shall be supplied with hot dip galvanized arcing horns so that while opening/closing the G.O.S and arcing takes place between arcing horns not between the contacts.

3.9 **LOCKING ARRANGEMENTS:**

Suitable locking arrangement shall be provided for arresting the operating handle.

4.0 **CHARACTERISTICS:**

a) System voltage – 11 KV
b) Rated Voltage – 12 KV
c) Rated Insulation Level:
    1. To earth and between poles 75 KV (Peak)
    2. Across Isolating Distance 85 KV
d) Rated one minute power frequency withstand test Voltage.
    1. To earth and between poles 28 KV
    2. Across Isolating distance 85 KV
e) Rated normal current – 400 Amps.
f) Rated duration of short circuit – 3 Secs.
g) Rated short time withstand current – 10 KA
h) Type of break – horizontal, double break.

5.0 **TYPE TEST CERTIFICATE:**

The following shall constitute type tests.

a) Impulse voltage dry test
b) Power frequency voltage dry test.
c) Power frequency voltage wet test
d) Temperature rise test.

e) Measurement of Resistance
f) Test for rated peak short circuit current.
g) Operation tests
h) Mechanical endurance tests.

6.0 **ROUTINE TESTS:**

The routine tests as per IS 9921 shall be conducted on each G.O.S

7.0 **NAME PLATE:**

The group operating switch shall be provided with the name plate legibly and indelibly marked with the following information:

1. Name of materials
2. Name of the manufacturer/Trademark
3. Name of the Purchaser i.e., the Letters (BESCOM).
4. Purchase order No. and Date
5. Type-designation and Sl. No
6. Rated Voltage
7. Rated Current
8. IS Specification

TECHNICAL SPECIFICATION FOR 11KV PEDESTAL POST INSULATORS

1.0 **General Requirements**: The Tenderer shall clearly indicate in the tender, the Brand name of the insulators used in manufacture GOS along with relevant type test reports. The successful bidder should get the insulator make approved by BESCOM/ KRIDE, before making supplies.

2.0 The porcelain shall be sound, free from defects, thoroughly vitrified and smoothly glazed, the glaze on insulators shall be brown in color and should cover all exposed porcelain parts except those areas which serve as supports during fixing are required to be left unglazed as detailed in IS:2544-1963.

3.0 Precaution shall be taken during design and manufacture to avoid the following:

a) Stress due to expansion and contraction which may lead to deterioration.
b) Stress concentration due to direct engagement of the porcelain with the metal fittings.
c) Retention of water in recesses of metal fittings and shape which do not facilitate easy cleaning by normal methods.

4.0 All metal parts except those of stainless steel shall be hot dip galvanized after machining zinc coating shall satisfy the requirement of relevant IS specification. The finished galvanized surface shall be smooth.

5.0 The threads of the tapped holes on the post insulator metal fittings shall be cut after galvanizing and shall be protected against rust by greasing or other similar means. All other threads shall be cut before galvanizing.

6.0 The post insulator unit shall be assembled in a suitable jig to ensure the correct positioning of the top and bottom metal fittings relative to one another. The faces of the metal fittings shall be parallel and at right angles to the axis of the insulator and the corresponding holes in the top and bottom metal fitting shall be in vertical plane containing the axis of the insulator.

7.0 **Technical Particulars**:

Individual Units		: 11kV stacking units.
1)	Rating	: 11kV
2)	a) Unit description (as per ISS:5350/Part-III/1971)	E-22 (Except torsion strength : as specified)
	b) Mechanical strength as per Clause 3.2 of IS:5350/ Prt-III/1971.	: Strength class 'C' 7.5 to 12KN
3)	Highest system voltage	: 12 kV (rms)
4)	Impulse withstand voltage	: 75 KV (peak)
5)	One minute Power frequency withstand Voltage Dry	: 55 kV (rms)

Wet : 35 kV (rms)

6) Power Frequency Puncture withstand voltage (rms) : 1.3 times the actual dry flash cover voltage of the unit.

7) Visible Discharge test voltage : 9 KV (rms)

8) Creepage distance : 230 mm

9) Failing load (as per IS:5350 Part-III/1971)

(a) to (d) in Newtons and
(e) in Newton meters

a) Upright : 9000 N
b) Underhung : 4500 N
c) Tension : 20000 N
d) Compression : 40000 N
e) Torsion : 680 Nm

10) Height of insulator (Min) : 254mm (Tolerance ±1mm)

11) Insulating part dia (Max) : 152 mm

12) Top metal fitting pitch circle dia : 57 mm

13) Bottom metal fitting pitch circle dia: 57 mm

14) a) No. of bolts : 4 Nos.
b) Bolts holes dia : 10 mm tapped holes at the top and 12 mm plain holes at the bottom.
c) Nominal dia of mounting face not to exceed. : 85 mm

8.0 **Marking**: Each insulator shall be legibly and indelibly marked with the following.

d) Name or trademark of the manufacture
e) Month and year of manufacture
f) ISI certificate mark if any

Marking shall be durable and shall be printed by the transfer process before firing.

NOTE: Manufacturer's Test Certificate and type test certificate conducted on similar sample insulator shall be submitted for approval before commencement of supplies.

9.0 **BOM**: Bill of Materials as per Drawing.

GUARANTEED TECHNICAL PARTICULARS FOR 11 KV 400 AMPS DOUBLE BREAK GOS

Sl. No.	Details	Results
I	Material	
1	Name of the manufacturer	
2	Type	
3	No. of poles	
4	Frequency	
5	Voltage Rating	

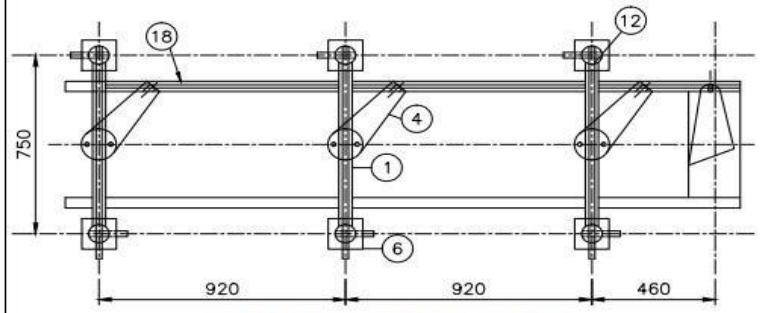
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6	Current Rating in Amps c) Normal d) Maximum	
7	Temperature rise of the following at full rated, current in O. Cover ambient temperature	
8	Whether contacts are silver coated, or tin coated along with thickness of coating in mm.	
9	Voltage drops across terminals of poles	
10	Short time current and duration	
11	Material of fixed contact	
12	Material of moving blade	
13	Material of terminal connector	
14	Type Diameter and length of operating handle	
15	Materials of arcing horns	
16	Size and length of base mounting channel	
17	Whether the Air brake switch is complete with all accessories	
18	Whether Dimensional drawing is enclosed with the tender	
19	Minimum clearance between phase (The center distance between the insulators of adjacent phase in the assembled position of switch)	
20	Center to center distance between insulators of the consecutive poles of the same phase in the assembled position of switch (in mm)	
21	Whether mechanical interlock has been provided for arcing switches	
22	Type of bearings use in: 3. Rotating insulator stack. 4. To earth and between poles	
23	Impulse withstand voltage with 1/50 M.S wave positive and negative polarity.	
24	One minute power frequency withstand voltage across isolating distance3 to earth and between poles.	
II	**PARTICULARS OF INSULATORS**	
1	Type of insulators	
2	Name of manufacturer of insulators	
3	Height of the insulators	
4	Diameter of the largest shell	
5	Number of uni9ts per stack	
III	**ELECTRICAL CHARACTERISTICS**	
1	Flash over voltage	
2	Dry power frequency	
3	Wet power frequency	
4	Impulse voltage of 1/50 micro-sec(+ve)	
5	Impulse voltage of 1/5-micro-sec(-ve)	
6	Power frequency puncture withstand voltage of unit	
IV	Mechanical characteristics:	
	e. Cantilever strength under upright f. Cantilever strength under torsional g. Torsional strength h. Tensile Strength	

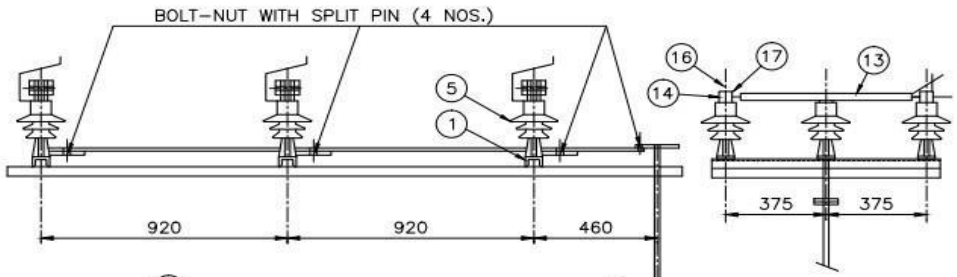
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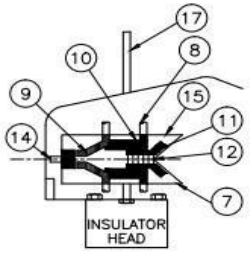
V	General Characteristics c) Minimum Creepage conforms. d) Weight of complete unit	
VI	Standard to which insulator conforms	
VII	Number of Insulators per set	

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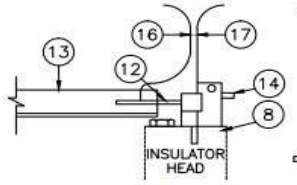


11KV 400A GOS (DOUBLE BREAK)

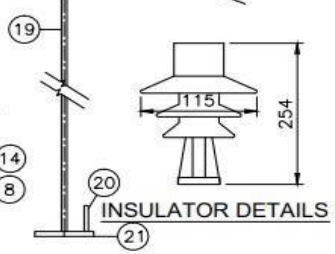




TOP DETAILS IN SECTIONAL ELEVATION



REAR SIDE VIEW



INSULATOR DETAILS

SL. NO.	DESCRIPTION	SIZE	SECTION IN mm	QUANTITY
1.	M.S CHANNEL	825mm	75x40x6	3 NO.
2.	GUN METAL BUSH (TOP) FOR SPINDLE (STANDARD PARTS NOT SHOWN IN THE DRG.)	10mm HT.	25mmø	3 NO.
3.	GUN METAL BUSH (BOTTOM) FOR SPINDLE (STANDARD PARTS NOT SHOWN IN THE DRG.)	10mm HT.	20mmø	3 NO.
4.	SPINDLE PLATE WITH SPINDLE	280mm	75x6mm	3 NO.
5.	11KV POST INSULATOR	–	–	9 NO.
6.	TOP PLATE	155mm	145x6mm	6 NO.
7.	CONTACT BOX (BOTTOM)	100mm L.3mm Th	42mm W	
8.	COPPER CONTACT PIN (TINNED)	8mm ROD	50mm L	24 NO.
9.	PHOISPHUR BRONZE COPPER STRIPS (TINNED)	110 (0.5Th.)	25mm W	48 NO.
10.	SPRING(STAINLESS STEEL)	25mm Long	10mmø	24 NO.
11.	COPPER CONTACT (TINNED)	90mm	35x6	12 NO.
12.	COPPER KNIFE (TINNED)	760mm	40x6	3 NO.
13.	MOVABLE ANGLE	580mm	45x45x5	3 NOS.
14.	LEADING FLAT, COPPER (TINNED)	190mm	40x6	6 NO.
15.	CONTACT BOX (TOP)	160mm	3mm Th. 32mm W	6 NO.
16.	MOVABLE ARCING HORN	440mm	10mmø	6 NO.
17.	FIXED ARCING HORN	300mm	10mmø	6 NO.
18.	HORIZONTAL G.I PIPE	2450mm	25mmø B–CLASS	1 NO.
19.	VERTICAL G.I PIPE	5400mm	25mmø B–CLASS	1 NO.
20.	HANDLE PIPE	500mm	25mmø B–CLASS	1 NO.
21.	LOCKING ARRANGEMENT	PLATES 6mm	210x90, 100x90 360x90, 300x50	4 NO.
22.	NUT & BOLTS 80 x 10mm – 24 NO, 25mm LONG– 5 NO, 30mm – 18 NO, 32mm LONG – 60 NO. ABOVE MENTIONED NUT & BOLTS ARE 10mm ø			
23.	64 x 12mm – 4 NO. ABOVE MENTIONED NUT & BOLTS ARE 10mm ø			

NOTES:–

1. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE STATED.
2. THE INSULATORS USED IN GOS SHALL BE GOT APPROVED BEFORE PLACING THE PURCHASE ORDER.
3. ALL COPPER PARTS ARE TO BE TIN PLATED.
4. ALL BOLT NUTS USE FOR OPERATING ANGLE SHALL BE WITH SPLIT PIN.

	Signatures	All dimensions are in mm unless otherwise stated.	BESCOM
Chd	AGM (QS&S)	11 KV, 400A DOUBLE BREAK ISOLATOR	Approved: General Manager,(Elec.) QS&S
Sub	DGM (QS&S)		
SCALE: N.T.S			DRG.NO.BESCOM/GM/QS&S/22 REV–002 DATED:24–11–2018

SECTION -9
ACSR - RABBIT CONDUCTOR

Bi-RIDE

TECHNICAL SPECIFICATION FOR RABBIT ACSR CONDUCTOR

1 SCOPE:
This specification covers manufacture, testing at manufacture's works and supply of Rabbit ACSR conductor.

2 The basic technical and other particulars of the equipment and the various components are specified in the following sections and tender schedule.

3 CONSTRUCTION:

3.1 **ACSR Conductor:** The conductor shall comply in all respects with the latest edition of IS-398 (Part-II) 1996 with its latest amendment. The Aluminum wires used in the manufacture of the conductor shall be of the highest electrical quality and free from scratches, die marks and other surface imperfections. They shall be reinforced with a central core of galvanized high tensile steel wire having negligible Sulphur and phosphorous contents.

3.2 The steel wire shall not be subject to any heat treatment after being galvanized. The zinc coating of steel wires shall be smooth and of uniform thickness. There shall be no bare spots owing to adherence of scales or other causes.

3.3 **Joints in wires:** Joints in the individual Aluminum, wires are permitted but no two such joints shall be within 15 meters apart in the complete stranded conductors. There should be no joints in the galvanized steel wire except those made in the base rod or wire before final drawing forming the core of steel reinforced Aluminum.

3.4 The resistance of the individual Aluminum wire shall be determined separately before stranding by means of standard tests on sample wires. The test samples shall be of sufficient length to give an accuracy of at least one part in a thousand.

3.5 The ACSR conductor size and standard lengths shall be as per IS 398 (Part-II) 1996 with its latest amendments and as indicated below.

Code Name of Conductor	Nominal Aluminum Area	Dia of wires in mm		Sectional Area of Aluminum (mm^2)	Total Sectional Area (mm^2)	Extended Calculated Resistance at 20° C (max)	Appx. Calculated breaking load in KN	Appx. Over all dia (mm^2)	Std, Length in Mtrs	Appx. Mass Kg./Km.
		Aluminum	Steel							
Rabbit	50 Sq.mm	6/3.35	1/3.35	52.88	61.70	0.5524	18.25	10.05	1400	214

4 STANDARD SIZES OF WIRES: The Aluminum wire and galvanized steel wire for the standard construction of conductors have diameter specified as shown below, as per Tables 1&2 Section of IS 398 (Part-II).

TABLE-I: Aluminum Wire used in the construction of Aluminum Conductors Galvanized Steel Reinforced.

Diameter in mm			**Cross Sectional area of nominal dia wire**	**Mass**	**Resistance at 20° C ohm/Km**	**Breaking load**	
Nominal	**Minimum**	**Maximum**				**Before Stranding**	**After Stranding**
3.35	**3.32**	**3.38**	**8.814 mm^2**	**23.82 Kgs/Km**	**3.265**	**1.43 KN**	**1.36 KN**

TABLE-2: Steel wire used in the construction of Aluminum conductors galvanized steel reinforced.

BHRIDE

Diameter in mm			Cross Sectional area of nominal dia wire	Mass	Breaking load	
Nominal	Minimum	Maximum			Before Stranding	After Stranding
3.35	3.28	3.42	8.814 mm²	68.75 Kg/Km	11.58 KN	11.0 KN

5 LAY RATIO: Ratio of the axial length of a complete turn of the helix formed by the individual wire in a standard conductor to the external diameter of the helix.
The lay ratio shall be as shown below.

TABLE-3: Lay Ratios of aluminum Conductor, Galvanized Steel Reinforced.

Number of Wires		Ratio of Aluminum wire dia to Steel wire dia	Lay Ratio for Steel Core		Lay Ratio for Aluminum Outside Layer	
Aluminum	Steel		Minimum	Maximum	Minimum	Maximum
6	1	1.00	-	-	10	14

Note: For the purpose of calculation, the mean lay ratio shall be taken as the arithmetic mean of the relevant minimum and maximum values given in this table.

6 TESTS & INSPECTION OF RAW MATERIAL AT SUPPLIER'S WORKS:

6.1 Within two weeks of receipt of each consignment of raw materials viz., steel, Electrolytic aluminum rods, etc., at the manufacturers works, the contractor shall furnish to the purchaser in triplicate the raw material manufacturers certificates.

6.2 The test certificates shall cover all tests on required number of samples as stipulated in clause 13.1 of IS. [Part-II] 1996 with latest amendments if any.

6.3 The manufacturer shall not commence manufacturing the conductor ordered prior to purchaser's approval of the test certificate for raw materials.

6.4 Test certificates in triplicate for tests on the finished ACSR conductor shall be submitted. The suppliers shall furnish along with RCs, the number of pieces of conductor in each reel and the length of individual pieces.

6.5 All tests as detailed in clause 13 of IS-398 (Part-II) 1996 with its latest amendments shall be carried out on conductors covered by this specification and shall be submitted by the contractor for purchasers' approval within four weeks of the acceptance of the letter of intent. No change in the schedule of tests, unless desired by the purchaser shall be subsequently made by the contractor or his subcontractors of the manufacturers without prior - consent of the purchaser.

6.6 The purchaser may at any time call for any tests that are laid down in the specification as optional tests. The contractor shall arrange to carry out such tests expeditiously at his own cost. The certificates for such optional tests shall be submitted to the purchaser for approval.

6.7 The contractor shall notify the purchaser, at least fifteen days in advance, the time of manufacture so that inspection of materials during manufacture and or witnessing of the tests can be arranged. If the purchaser waives inspection, he will advise the contractor accordingly. Inspection shall also include method of packing and stacking of finished materials in the works.

7 Packing:

The ACSR conductor reels shall be of dimensions approved by the purchaser and made of seasoned wood sufficient strong and in sound condition to ensure that the reels shall reach the site intact with lagging end free from damage due to transport hazards by rail and over land. These reels shall conform to IS 1778/1981 with latest amendments if any.

a) The standard length of the ACSR conductor shall be as per schedule of materials

K-RIDE

specification. Longer lengths are acceptable. However, short lengths not less than one Km. each are acceptable to the minimum extent of 5% of the quantity ordered.

b) The contractor shall submit in duplicate detailed packing specification for the conductors for the purchaser's approval at least fifteen days prior to commencement of dispatch. Finally approved specification shall be furnished along with the dispatch documents.

8 REEL OR DRUM SHALL BEAR THE FOLLOWING INFORMATION:

a. Reel or drum number
b. Size and description of contents
c. Length of each piece of conductor (on reels)
d. No. of pieces in each package/reel
e. Gross weight
f. Net weight
g. Purchase order No. & Date
h. Place and designation of consignee

The above details shall be legibly and indelibly marked.

9 The Bidder shall furnish the guaranteed technical particulars as per the Proforma enclosed to this specification.

Name of the bidder		
Sl. No.	**Particulars**	**Bidder**
1	Maker's Name, Address & Country	
	a) Aluminum rods	
	b) Steel wire/rods	
	c) Complete Conductor	
2	Stranding and Wire Diameter (mm)	
	a) Aluminum	
	b) Steel	
3	Nominal Aluminum area in Sq.mm.	
4	Sectional Area of Aluminum Strands in Sq.m.m.	
5	Total Sectional area in Sq.mm.	
6	Cross sectional area of nominal diameter wire in Sq.mm.	
	a) Aluminum wire	
	b) Steel Wire	
7	Overall diameter of conductor in mm.	
8	Breaking load of conductor in Kg.	
9	Minimum breaking load in Kg. for	

K-RIDE

	a) Aluminum wire	
	b) Steel Wire	
10	Zinc coating of steel wire	
	a) Uniformity of coating No. and duration of dips (Process test withstood I min. X Nos.)	
	b) Minimum weight of coating (grm./Sq.mm.)	
11	Mass in Kg. per Km.	
	a) Aluminum wire	
	b) Steel Wire	
	c) Conductor	
12	Resistance in Ohms per Km. at 20 Deg.C.	
	a) Continuous maximum current rating of conductor (Amps) in still air or 45 Deg.C ambient temperature.	
	b) Temperature rise for the above current Deg. C.	
13	Purity of Aluminum Rods	
14	Maximum working tension for complete conductor Kg.	
15	Modulus of Elasticity (Kg/sq cm X 10^6)	
	a) Aluminum	
	b) Steel	
	c) Conductor	
16	Co-efficient of linear expansion per degree	
	a) Aluminum	
	b) Steel	
	c) Conductor	
17	Standard length of each piece in Km.	
18	Tolerance, if any on standard length	
19	No. of standard lengths in one reel	
20	Approximate dimensions of the reel in Cms.	
21	Mass of the conductor in one reel in Kg.	
22	Gross mass of the reel including mass of the conductor.	

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23	Mass of the reel in Kg.	
24	Standard according to which the conductor will be manufactured and tested.	
25	Date of commencement of production of conductor.	
26	Other Particulars	

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SECTION - 10
H.G FUSE UNIT

Bi-RIDE

SPECIFICATION FOR 11KV H.G. FUSE UNITS WITH 11 KV SOLID CORE INSULATORS

1.0 **Scope**: This specification covers the manufacture, testing at manufacturer works and supply of 11kV Horn Gap Fuse Units along with 11 kV Solid Core Insulators. The Fuse units shall conform to the enclosed drawing.

2.0 **Atmospheric Conditions**: The fuse units are to be installed at places with the following weather conditions.

Temperature : Maximum ambient - 50°C
: Average - 32°C
: Minimum - 05°C
: Altitude - Max. 1000 Mtrs. above sea level

3.0 **Construction:**

3.1 The construction of the fuse units shall be of high quality as it is intended to ionize the fault current at the time of expulsion. The fuse shall generally conform to IS, dealing with high voltage expulsion and drop out fuses.

3.2 The fuse units shall be suitable for horizontal mounting only. The mounting shall be by using 45x45x5 cleat welded to 25x6 M.S. flat fixed to the central portion of the insulator. All the M.S. Parts should be hot dip galvanized as per relevant IS.

(A) COMPLETENESS OF SUPPLY:

The component offered shall be complete and operative in all aspects and shall conform to high standard of Engineering design and workmanship.

(B) Deviation from technical specifications: Tenderer shall furnish the details of deviations/modification proposed by him if any towards improvement of the said offer.

4.0 **INSULATORS**:

4.1 The insulator used shall be of 11KV solid core type, brown glazed porcelain suitable for highest system voltage of 12 KV. The Insulators shall generally conform to IS: 5350 (part-II) and as per the enclosed drawing.

4.2 The insulator shall be in one piece. The stresses due to expansion and contraction in any part of the insulator shall not lead to its deterioration. The insulator shall be glazed effectively on all the surfaces except for the parts on which the particulars are supported during firing which may be left unglazed. The solid core insulator shall be baked in Temperature controlled kilns only.

4.3 Insulators shall pass visual test, dimensional test, porosity test, puncture test, temperature cycle test as per relevant ISS.

Following tests shall be conducted and test certificate duly signed by a responsible officer of the supplier's organization shall be submitted.

1. Dry Power Frequency voltage withstand test.
2. Dry Power Frequency voltage flashover test.
3. Wet Power Frequency voltage withstand test.
4. Wet Power Frequency voltage flashover test.
5. High voltage impulse voltage withstand test.
6. High voltage 50% impulse voltage flashover test.
7. High voltage visible discharge test.
8. Electromechanical failing load test.

4.4 **MARKING:** Each insulator shall be legibly and indelibly marked with the following:

1)Name of trademark of the manufacturer.
2)Month and year of manufacture.
3)ISI certificate mark if any

The marking shall be durable and shall be printed by the transfer process before firing. Stickers are not permitted.

The bidders can use insulators conforming to relevant ISS and having ISI Mark.

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The successful bidder should get the insulator make approved by BESCOM, before making supplies/take up bulk production.

5.0 **ARCING HORNS**: The H.G. Fuse unit shall be provided with arcing horns of 8mm diameter hot dip galvanized iron rod. The other particulars like G.I. Strip, brass wing nuts, G.I. Flats etc., are furnished in the drawing enclosed.

6.0 The H.G. Fuse units shall be designed to withstand the voltage that is indicated for solid core insulators.

7.0 Type tests on one H.G. Fuse unit as per the provisions of the relevant shall be conducted at CPRI or in a recognized laboratory approved by BESCOM and the test certificates along with the drawing attested by the concerned laboratory shall be submitted for approval before commencing supplies.

8.0 **PACKING**:

The H.G. Fuse Units shall be securely packed in crates or boxes so as to withstand rough handling during transit and storage.

9.0 **INSPECTION**:

9.01 All tests and inspection shall be generally made at the place of manufacturer. Purchaser (BESCOM/ KRIDE) shall be provided with all reasonable facilities, without charge, to satisfy him that the material is being furnished in accordance with this specification. Purchaser and its representative shall at times be entitled to have access to the works and to all places of manufacture where insulators are manufactured and the supplier shall afford all facilities to them for unrestricted inspection of the works, inspection of materials and inspection of manufacturing process of insulators for conducting necessary tests and specified herein.

9.02 The supplier shall keep the Purchaser informed in advance of the time of Starting and progress of manufacture of insulators in various stages so that arrangements could be made for inspection.

9.03 No material shall be dispatched from its point of manufacture unless the material has been satisfactorily inspected and tested.

9.04 The BESCOM/ KRIDE has the right to have the tests carried out by an independent agency, when considered necessary.

10.0 NAME PLATE:

Each H.G. Fuse Unit shall be provided with a Name plate of minimum size 50x40mm and shall be fixed with the following details which are legibly and indelibly marked.

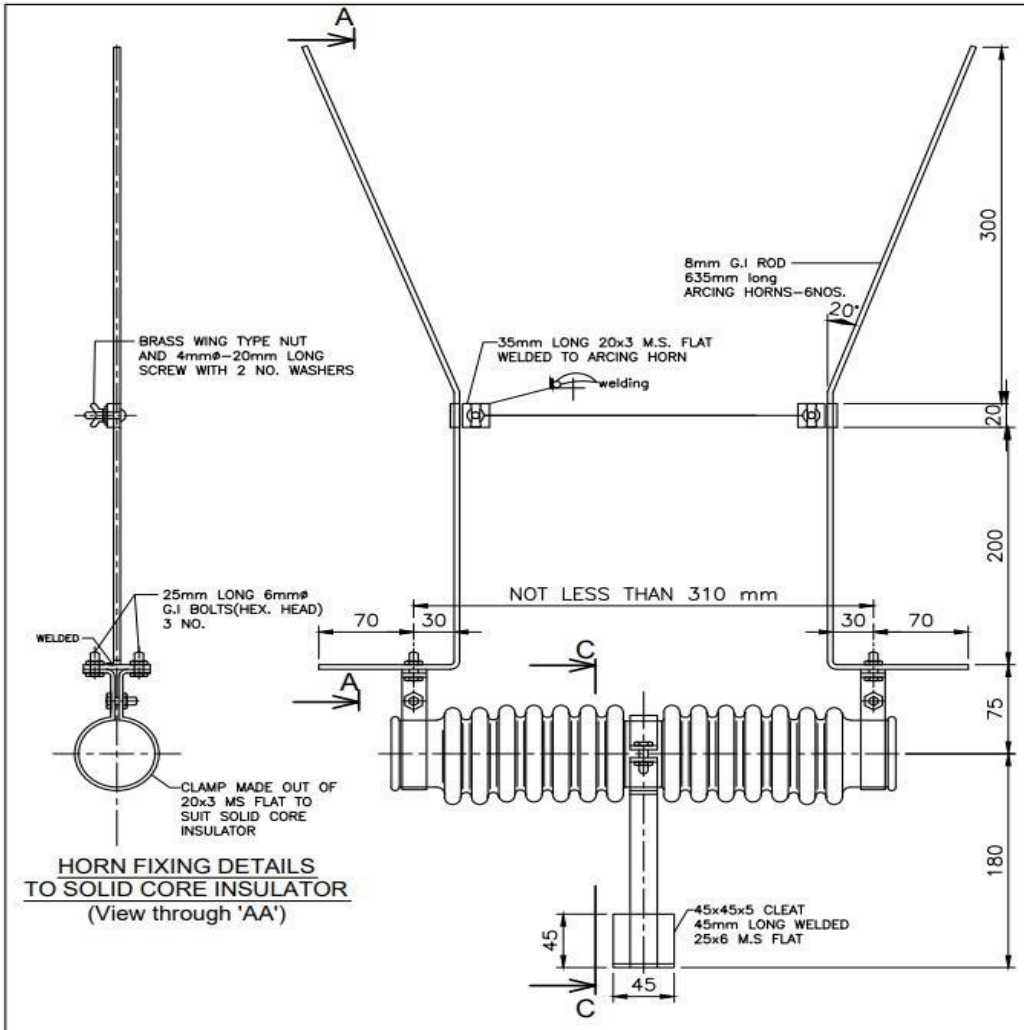
1) Name of Manufacturer
2) BESCOM
3) Purchase Order No. and Date
4) Sl.No.

11.0 SAMPLE

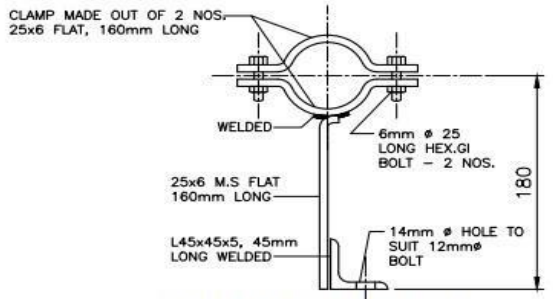
The Contractor shall submit two samples and get them approved by the competent authority before taking up the manufacture. The approved samples will be kept as under

i) One approved sample will be with the manufacturer at the manufacturing premises so that so that the inspecting officer can inspect the materials offered for inspection with reference to the approved sample.

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HORN FIXING DETAILS
TO SOLID CORE INSULATOR
(View through 'AA')



DETAILS OF CLAMP TO FIX
SOLID CORE INSULATOR
TO CROSS ARM
(View through 'CC')

BILL OF MATERIALS/SET

SL. NO.	DESCRIPTION	QTY.
1.	11KV CLASS SOLID CORE INSULATORS	3 NOS.
2.	G.I HORNS USING 8mm ø ROD AS DETAILS SHOWN THROUGH AA WITH CLAMPING ARRANGEMENT USING 20x3 M.S. FLAT AND G.I BOLTS.	6 SETS
3.	CLAMPS MADE OUT OF 25x6 M.S FLAT & L 45x45x5 CLEAT AS SHOWN IN DETAIL THROUGH CC WITH REQD. BOLTS	3 SETS
4.	P.G CLAMP ONE GROOVE SUITABLE TO 8 mm ø G.I ROD AND OTHER GROOVE SUITABLE TO 8 TO 10 mm ø ACSR CONDUCTOR.	6 NOS.

NOTES:–

1. THE DRAWING HAS BEEN PREPARED BASED ON WORK SHOP SAMPLE USED IN FIELD.
2. ALL METALLIC PARTS SHALL BE HOT DIP GALAVANISED.
3. FOR SOLID CORE INSULATOR REFER DRAWING NO:–BESCOM/GM/QS&S/29

	Signatures	All dimensions are in mm unless otherwise stated.	BESCOM
Chd	AGM (QS&S)	11 KV HORN GAP FUSE USING SOLID CORE 11KV INSULATORS	Approved: General Manager,(Elec.) QS&S
Sub	DGM (QS&S)		DRG.NO.BESCOM/GM/QS&S/21 REV–002 DATED:24–11–2018
SCALE: N.T.S			

SECTION - 11
LIGHTENING ARRESTOR

B1-RIDE

TECHNNICAL SPECIFICATION FOR GAPLESS METAL OXIDE DISTRIBUTION TYPE SURGE ARRESTERS WITH POLYMERIC HOUSING FOR USE IN 11KV SYSTEM

1.0 SCOPE

This specification covers design, manufacture testing and supply of gapless Metal Oxide Distribution type surge arresters with polymeric housing for use in the 11kV overhead distribution system, to protect electric power systems from expose to over voltages which might over stress the dielectric strength of equipment used. Over voltages can be caused by lightning strokes (lightning over voltages). Switching and circuit breaking (Switching over voltages) or certain load flow conditions (Temporary over voltages).

2.0 APPLICABLE STANDARDS

2.1 Standards

Following Indian/International standards, which shall mean latest revision, with amendments/changes adopted and published, unless specifically stated otherwise in the specification, shall be referred while accessing conformity of polymeric surge arresters with these specifications.

2.1.1 In the event of supply of polymeric surge arresters conforming to standards other than specified, the Bidder shall confirm that these standards are equivalent or better to those specified. In case of award, salient features of comparison between the standards proposed by the bidder and those specified in this document will be provided by the supplies to establish equivalence.

Sl. No.	Indian standard	Title	International Standard
1	IS 15086 part-4 2017	Polymeric surge arresters, Part -4: Surge arresters without gapes for A.C. Systems overhead lines above 1000V	IEC:60099-4 2014, Edition-3 or latest if exists
2		Polymeric surge arresters – 5 selection & application recommendations	IEC:6009-5, 2013 or latest if exists
3		Polymer burning behavior	IEC:60707 & UL94
4	IS:13134	Guide for the selection of Polymeric surge arrestor with respect of to polluted conditions	IEC:60815
5		Thermal Mechanical performance test and mechanical performance test on Polymeric surge arrestors	IEC:60575
6		Hydrophobicity Classification Guide	STRI guide:1.92/1
7		Radio interference characteristics of overhead power lines and high voltage equipment	CISPR:18-2 Part 2
8	IS:8263	Methods of RI Test of HV surge arresters	IEC:60437
9		Standards for surge arresters- composite – Distribution Dead – end Type	ANSI C29.13
10		Hot dip zinc coating on structural steel & other allied products	ISO:1459 ISO:1461
11	IS:2629	Recommended practice for Hot, Dip Galvanization for iron and steel	ISO:1461(E)
12	IS:6745	Determination of Weight of Zinc coating on Zinc coated iron and steel articles	ISO:1460
13	IS:3203	Methods of testing of local thickness of electroplated coatings	ISO:2178
14	IS:2633	Testing of Uniformity of coating of Zinc Coated articles	
15		Standard specification for glass Fiber standards	ASTM D 578-05

BIDDE

16		Standard test method for Compositional analysis by thermogravimetric.	ASTM E 1131-03
17	IS:4699	Specification for refined secondary Zinc	

3.0 Technical Description of Polymeric Surge arresters

3.1 Service condition

The polymeric surge arresters to be supplied shall be suitable for satisfactory continuous operation under conditions as specified below:

Maximum ambient temperature :50ºC
Minimum ambient temperature : -5º C
Relative humidity : 0 to 1005

3.2 System Parameters

The arresters must be able to operate under the system parameters mentioned in this specification:

Nominal voltage system kV(rms)	11kV
Frequency	50Hz
Grounding of neutral	Solidly
Temporary over voltage (Earth fault factor)	10.4kV rms for 10sec.
Highest system voltage kV(rms)	12kV
Short circuit levels	16kA
Equipment Insulation withstand level	75kV
Wet Power Frequency withstand voltage	38kV

3.3 Surge arresters' requirements:

a) Mechanical requirements:

Creepage length	300mm (Min.)
Pull strength	1000N (Min.)
Cantilever load	75Nm (Min.)
Torsion	30Nm (Min.)

b) Electrical requirements:

Arrester Max. Continuous Operating voltage Uc	8kV rms
Arrester Rated voltage Ur	12kV rms, with distribution medium - DH class as per latest Edition
Arrester Class / Nominal discharge current	DL / In=10kA
Min repetitive charge transfer capability: Qrs	Minimum 0.4C
Max. Lightning Impulse residual voltage @ In	29kVp
Max. Steep Impulse residual voltage @ In	32kVp
Minimum Thermal Charge rating for two impulses	Qth : 1.1C
TOV values	1 secs : kV 10 Sec : kV 100 Sec : kV
Surge arrester housing Insulation withstand voltages. i) Lightning Impulse (Dry) ii) Power Frequency (Wet)	As per IEC 60099-4 / IS 15086 Part-4 Standard

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High current impulse withstands (4/10 micro second value) kA (peak)	100kA
Pressure relief current High current Low current	16kA, High & low currents as per IEC 60099-4 / IS 15086 Standards
Partial Discharge	≤ 10 pC
Pollution Condition	Heavy
Minimum Bending load (kgm) SSL SLL Terminal torque	50kgf 25kgf 2.5kgm

3.3.1 The polymeric surge arresters shall be suitable for 3 Phase, 50Hz, effectively earthed 11kV O/H distribution system in a heavily polluted atmosphere.

3.3.2 Bidder must be an indigenous manufacture and supplier of polymeric surge arresters of rating 11kV or above OR must have developed proven in house technology and manufacturing process for polymeric surge arresters of above rating OR possess technical collaboration/association with a manufacture of polymeric surge arresters of rating 11kV or above.

3.3.3 Polymeric surge arresters shall have sheds with good self – cleaning properties, surge arresters shed profile, spacing, projection etc., and selection in respect of polluted conditions shall be generally in accordance with the recommendation of IEC-60815/IS:13134.

3.4 Dimensional Tolerance of polymeric surge arresters

The tolerance on all dimensions e.g., diameter, length and creepage distance shall be allowed as follows:
± (0.04d + 1.5) mm when d<300 mm.
± (0.025d + 6) mm when d>300 mm.
Where, d being the dimensions in millimeters for diameter, length or creepage distance as the case may be.
However, no negative tolerance shall be applicable to creepage distance.

3.5 Interchangeability

The surge arresters including the end filling connection shall be of standard design suitable for use with the hardware fittings of any make conforming to relevant IEC/IS standards.

3.6 Corona and RI Performance

All surface arresters shall be clean, smooth, without cuts, abrasions, or projections. No part shall be subjected to excessive localized pressure. The surge arresters and metal parts shall be so designed and manufactured that it shall avoid local corona formation and not generated any radio interference beyond specified limit under the operating conditions.

3.7 Maintenance

3.7.1 The surge arresters offered shall be suitable for use hot line maintenance technique so that usual hot line can be carried out with ease, speed, and safety.

4.0 BASIC FEATURES:

4.1 Design and construction

Surge arresters having one or several non-linear metal oxide resistors with highly non-linear voltage – current characteristics, connected in series, but having no integrated series or parallel gaps. The surge arresters shall be of cage design/ warp design.

Cage: Using FRP rods which can be used as mechanical supporting part to accommodate the stack of MO elements. The Silicon rubber insulation is then moulded directly on to the MO elements without any internal gas volume left.

The MO elements is safely kept in place by the cage together with the high compressive force and they are embedded in to silicon rubber. Thus, the active part is almost protected from mechanical impact resulting in high transports safety.

Wrap design: The Mechanically supporting part of the housing is formed by a wrapped FRP using Prepreg glass roving's or pre-impregnated bands that are wound around the MO resistor stack and cured. The resulting wrap, surrounding the varistor stack, to have open "windows" molded with silicone rubber for relieving the short circuit. Shall be void free construction.

Since, there is a direct contact of the MO elements with the polymer material in cage and wrap designs, heat produced by the MO elements is more easily dissipated through the housing into the environment. This increases thermal stability and follows utilize more than MO elements with respect to electrical stress.

4.1.1 Cage:

It shall be a glass –fiber reinforced epoxy resin rod of high strength (FRP rod). Glass fibers and resin shall be optimized in the FRP rod. Glass fibers shall be Boron free electricity corrosion resistant (ECR) glass fiber or boron free E-Glass and shall exhibit both high electrical integrity and high resistance to acid corrosion. The matrix of the FRP rod shall be Hydrolysis resistant. The FRP rod shall be manufactured through pultrusion process. The FRP rod shall be void free.

4.1.2 Housing (Sheath)

The surge arrester with housing made of silicon Rubber (SR) material without air voids neither between the housing and the metal oxide resistors nor the housing itself. Arresters must have directly moulded, housing FRP rod shall be covered by a seamless sheath of a silicon rubber compound of thickness of 3mm minimum.

It should protect the FRP rod/ FRP tapes shall be covered against environmental influences, external pollution, and humidity. It shall be extruded or directly molded on the core and shall have chemical bonding with the FRP rod. The strength of the bond shall be greater than the tearing strength of the polymer. Sheath material in the bulk as well as in the sealing/bonding area shall be free from voids.

4.1.3 Weather Sheds

The weather sheds made of silicon rubber shall be firmly bonded to the sheath, vulcanized to the sheath or molded as part of the sheath and shall be free from imperfections. The weather sheds should have silicon content of minimum 30% by weight. The strength of the weather shed to sheath interface shall be greater than the tearing strength of the polymer. The interface, if any, between sheds and sheath (Housing) shall be free from voids and shall be resistant against UV- radiation as well as tracking.

Silicone Rubber (RTV – 2/LSR) shall have inherent burning behavior, shall pass the test of IEC 60707 and UL94 with the highest class Vo, i.e. self- extinction within 10 seconds without development of burning drops. The limiting oxygen index (LOI) is greater the 35% i.e. to continue burning after inflaming an oxygen content of more than 355 is required.

4.1.4 End Fittings

The End fittings transmit the mechanical load to the core. They shall be made of spheroidal graphite cast iron, malleable cast iron or forged steel or aluminum alloy. They shall be connected to the rod by means of a controlled compression technique. The gap between fitting and sheath shall be sealed by a flexible silicone rubber sealing performance between housing i.e. seamless sheath and metal connections. The sealing must be moisture proof. End fitting shall be of type to suitable for vertical and horizontal mounting and should match all mechanical and electrical requirements specified for the arrester. Terminals shall be made of M10 bolts allow the connections of line and ground leads.

4.1.5 Disconnector

Disconnectors withstand.

When an arrester is fitted or associated with a disconnector, this device shall withstand, without operating, each of the following tests:

a. Test to verify the retitive charge transfer rating, Qrs (see clause 8.5.2 of IS 15086(part 4):2017).
b. Operating duty test with rated values of thermal charge rating, Qth (see clause 8.7.2 of IS 15086(part 4):2017).
c. Mechanical tests on agreement between manufacturer and user (see NOTES 1 and 2 8.9.4.1 of IS 15086(part 4):2017).

Disconnector operation

Three values of current according to clause 8.9.3 of IS 15086(part 4): 2017.There shall be clear evidence of effective and permanent disconnection by the device.

5.0 Workmanship

5.1 All the materials shall be of latest design and conform to the best engineering practices adopted in the high voltage field. Bidders shall offer only such surge arrester as are guaranteed by them to be satisfactory and suitable for

continued good service in power Distribution System.

5.2 The design, manufacturing process and material control at various stages shall be such as to give maximum working load, highest mobility, best resistance to corrosion, good finish and elimination of sharp edges and corners.

5.3 The design of the surge arrester shall be such that stresses due to expansion and contraction in any part of the arrester shall not lead to deterioration.

5.4 The MO shall be sound and free of cracks and voids that may adversely affect the arrester.

5.5 Weather sheds shall be uniform in quality. They shall be clean, sound, and smooth and shall be from defects and excessive flashing at parting lines.

5.6 End fittings shall be free from cracks, seams, shrinks, air holes and rough edges. End fittings should be effectively sealed to prevent moisture ingress; effectiveness of sealing system must be supported by test documents. Al. surfaces of the metal parts shall be perfectly smooth without projecting points or irregularities, which may cause corona. All load bearing surfaces shall be smooth and uniform so as to distribute the loading stresses uniformly.

5.7 All ferrous parts shall be hot dip galvanized to give a minimum average coating of zinc equivalent to 610gm/sq.m or 87mm thickness and shall be in accordance with the requirement of IS:4759. The zinc used for galvanizing shall be of purity 99.5% as per IS:4699. The zinc coating shall be uniform, adherent, smooth, reasonably bright, continuous and free from imperfections such as flux, ash rust strains, bulky white deposits and blisters. The galvanized metal parts shall be guaranteed to withstand of least four successive dips each lasting for one(1) minute duration under the standard test. The galvanizing shall be carried out only after any machining.

6.0 Equipment Marking:

6.1 Each surge arrester's unit shall be legibly and indelibly marked with the following details as per IEC- 60099-4, Latest Edition

(a) Month & Year of manufacture.
(b) Manufacturer's name/Trademark, Model no and identification Serial No.
(c) Maximum Continuous operating voltage.
(d) Rated Voltage
(e) Nominal discharge current and class of arrester
(f) Repetitive Charge Transfer Capability in Columbs
(g) Pressure relief class: Type A or Type B, Rated short circuit current in kA rms
(h) Cantilever strength-SSL/SLL/Terminal torque
(i) Total leakage and resistive leakage current-Ir at MCOV value (before installation)
(j) Purchase order reference

6.2 Each ZnO element's Aluminum sprayed surface shall be printed with information like:

a. Batch No.
b. Designation with thermal energy and charge transfer rate
c. Rating & MCOV
d. Nominal Discharge current
e. AC reference voltage measured at reference current.
f. Residual voltage measured at nominal discharge current.
g. Type of the block (design code given by manufacturer)
h. Manufacturer's name

The manufacturers may use QR code printed on the block in case of size limitation.

7.0 Drawing

7.1 The Bidder shall furnish full description and illustration of the material offered.

7.2 The Bidder shall furnish the outline drawing (3 copies) of arrester unit including a cross sectional view prior to supply.

7.3 After placement of award, the supplier shall submit full dimensioned manufacturing arrester drawings containing all the details in four (4) copies to the owner for approval. After getting approval from owner and successful completion of all the type tests, the supplier shall submit 10 more copies of the drawing to the Owner for further distribution

and field use.

7.4 After placement of award the supplier shall also submit fully dimensioned arrester crate drawing for different type of surge arresters, drawing (cross sectional view) of ZnO elements used inside arrester for approval of the owner. The drawings shall be submitted with the following details: For the arrester:

a) Manufacturer name
b) Class and model no of arrester
c) Rated and MCOV of arrester.
d) Nominal discharge current
e) Pressure relief type and current (High current and low current)
f) Thermal energy rating
g) Repetitive Charge Transfer rating: Qrs.

For the ZnO element:

a. Batch No.
b. Designation with thermal energy and charge transfer rate
c. Rating & MCOV
d. Nominal Discharge current
e. AC reference voltage measured at reference current.
f. Residual voltage measured at nominal discharge current.
g. Power loss value measured at continuous operating voltage.
h. Type of the block (design code given by manufacturer)
i. Manufacturer's name

8.0 Tests and Standards

Polymeric surge arrester offered shall be manufactured with the same configuration and raw materials as used in the Surge arrester for which design and type test reports are submitted. The manufacturer shall submit a certificate for the same. The design & type test reports submitted shall not be more than 5 years old.

8.1 Design Tests

Manufacture should submit test reports for design Tests as per relevant clauses of IEC-60099-4 / IS15086 Part-4 Latest Editions & IEC – 60099-5 / IS 15086 Part-5 latest Editions Standards prior to supply of item. Additionally following tests shall be carried out or reports for the tests shall be submitted after award of contract:
UV test: The test shall be carried out in line with clause 7.2 of ANSI IC29.13.

8.2 Type Tests

The following type tests shall be conducted on a suitable number of individual Surge arrester, components, and materials.

8.2.1 The bidder shall submit type test reports as per IEC 60099-4 / IS prior to supply of item. Additional type tests as required above shall be carried out by the manufacturer after award of contract for which no additional charges shall be payable. In case the tests have already been carried out, the manufacturer shall report for the same.

Sl No.	Description of type test	Test procedure / Clause as per standards IEC 60099-4 / IS 15086 Latest Editions

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1.	**Residual Voltage Tests on elements** • **Steep Current Impulse residual voltage** • **Lightning Current Impulse 8/20 µS.** • **Switching impulse residual voltage test**	**8.3 / 10.8.3** **8.3.2 / 10.8.3.2** **8.3.3 / 10.8.3.3** **8.3.4 / 10.8.3.4**
2	**Test to verify long term thermal stability. under continues operating voltage / Accelerated ageing test**	**8.4 / 10.8.4**
3.	**Repetitive charge transfer rate**	**8.5 / 10.8.5**
4.	**Heat Dissipation behavior of Test sample**	**8.6 / 10.8.6**
5.	**Operating duty test on prorated sections / Switching surge energy rating (IEEE)**	**8.7 / 10.8.7**
6.	**Power frequency vs time test / TOV test**	**8.8 / 10.8.8**
7	**Repetitive charge transfer test on Disconnectors**	**8.9.2/ 10.8.9.2**
8	**Operating duty test on Disconnectors**	**8.9.2 / 10.8.9.2**
9	**Disconnector Operation Tests**	**8.9.3/ 10.8.9.3**
10	**Short circuit test**	**8.10 / 10.8.10**
11.	**Bending moment test**	**8.11 / 10.8.11**
12	**Environmental test on arresters**	**8.12 / 10.8.12**
13	**Weather ageing test on polymer arresters**	**10.8.17**
14.	**Tests for arrestor disconnectors**	**Clause 4.1.5 of technical specifications**

8.2.2 It shall be the option of the owner to accept the surge arresters based on type test reports submitted by the manufacturer. The owner shall be free to repeat the type tests & may witness the same.
For the purpose of facilitating the type test.

8.2.3 All the type tests given in Clause No:8.2 in addition to routine and acceptance test shall be carried out on surge arresters along with hard ware fittings wherever required.

8.3 Acceptance (Sample) Tests

8.3.1 For Surge Arrester

a)	Measurement of Power Frequency voltage at Reference Current	Clause 9.2.1 As per IEC:60099-4 IEC:2014
b)	Lightning impulse residual on the complete arrester	
C)	Internal partial discharge test	
d)	Repetitive charge transfer rate with minimum Qrs = 0.4 C	

8.4 Routine Tests

A)	Measurement of reference voltage (Uref) (See 3.35 and 6.2)	Clause 9.1 As per IEC:60099-4 IEC:2014
b)	Residual voltage test	
c)	Internal partial discharge test	
d)	Current distribution test for multi-column arrester	
e)	For arrester units with sealed housing, a leakage check shall be made on each unit by any sensitive method adopted by the manufacture.	

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8.5 Tests During Manufacture

a)	Chemical analysis of zinc used for galvanizing
b)	Chemical analysis, mechanical, metallographic test and magnetic particle inspection for malleable castings.
c)	Chemical analysis, hardness tests and magnetic particle inspection for forgings

Following tests shall also be carried out on all components if applicable.

8.6 Sample batch for Type Testing

8.6.1 The bidder shall offer material for sample selection for type testing only after getting Quality Assurance Programme approved by the Owner. The bidder shall offer at least three times the quantity of materials required for conducting all the type tests for sample selection. The sample for type testing will be manufactured strictly in accordance with the Quality Assurance Programme approved by the Owner.

8.7 Additional Tests

8.7.1 The Owner reserves the right at his own expenses, for carrying out any other test(s) of reasonable nature carried out at supplies premises, at site, or in any other place in addition to the aforesaid type, acceptance, and routine tests to satisfy himself that the material complies with the specifications.

8.7.2 The Owner also reserves the right to conduct all the tests mentioned in this specification on the samples drawn from the site at supplies premises or at any other test center. In case of evidence of noncompliance, it shall be binding on the part of the supplier to prove the compliance of the items to the technical specifications by repeat tests or correction of deficiencies or replacement of defective items, all without any extra cost to the owner.

8.8 co-ordination For Testing

8.8.1 The suppliers shall have to co-ordinate testing of surge arresters with hard ware fittings to be supplied by other suppliers and shall have to guarantee overall satisfactory performance of the surge arresters with the hardware fittings.

8.8.2

8.8.3 The bidder shall intimate the owner about carrying out of the type tests along with detailed testing programme at least 3 weeks in advance of the scheduled date of testing which the owner will arrange to depute his representative to be present at the time of carrying out the tests.

8.9 Quality Assurance Plan

8.9.1 The successful bidder shall submit following information to the owner:

8.9.1.1 Test certificates of the raw materials and brought out accessories.

8.9.1.2 Statement giving list of important raw materials, their grades along with manes of sub – supplies for raw materials, list of standards according to which the raw materials are tested. List of tests normally carried out on raw materials in presence of bidder's representative.

8.9.1.3 List of manufacturing facilities available along with Routine test facilities.

8.9.1.4 Level of automation achieved and lists of areas where manual processing exists.

8.9.1.5 Lists of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections.

8.9.1.6 List of testing equipment's available with the bidder for final testing of equipment's along with valid calibration reports.

8.9.1.7 The manufacture shall submit manufacturing quality plan (MPQ) for approval & the same shall be followed during manufacture and testing,

8.9.2 The successful bidder shall submit the routine test certificates of brought out raw material/accessories and central excise passes for raw material at the time of inspection.

8.10 Guarantee

The Supplier of surge arresters shall guarantee overall satisfactory performance of the surge arresters.

8.11.1 At least three copies of type test reports shall be furnished. One copy shall be returned duly certified by the owner. Only after that supply of the item can be made.

8.11.2 Copies of acceptance test reports shall be furnished in at least three (3) copies. One copy shall be returned duly

certified by the owner, only after which the materials shall be dispatched.

811.3 Record of the acceptance test reports shall be maintained by the supplier. These shall be produced for verification as and when desired by the owner.

811.4 Test certificates of test during manufacture shall be maintained by the supplier. These shall be produced for verification as and when desired by the owner.

9.0 Inspection

9.1 The Owner's representative shall at all times be entitled to have access to the works and all places of manufacture, where surge arresters and its component parts shall be manufactured and the representatives shall have full facilities for unrestricted inspection of the supplier's and sub- supplier's works, raw materials, manufacture of the material and for conducting necessary test as detailed herein.

9.2 The material for final inspection shall be offered by the supplier only under packed condition. The Owner shall select samples at random from the packed lot for carrying out acceptance tests. The lot offered for inspection shall be homogenous and shall contain surge arresters manufactured in 3-4 consecutive weeks.

9.3 The supplier shall keep the owner informed in advance of the time of starting and the progress of manufacture of material in their various stages so that arrangements could be made for inspection.

9.4 No material shall be dispatched from its point manufacture before it has been satisfactory inspected and tested unless the inspection is waived off by the owner in writing. In the latter case also, material shall be dispatched only after satisfactory testing specified here in has been completed.

9.5 The acceptance of any quantity of material shall in a way relieve the supplier of his responsibility for meeting all the requirements of the specification and shall not prevent subsequent rejection, if such materials are later found to be defective.

10.0 Packing

10.1 All surge arresters shall be packed in strong corrugated box of min.7 ply duly palette or wooden crates. The gross weight of the crates along with the material shall not normally exceed 100kg to avoid handling problem. The crates shall be suitable for outdoor storage under wet climate during rainy season.

10.2 The packing shall be of sufficient strength to withstand rough handling during transit, storage at site and subsequent handling in the field.

10.3 Suitable cushioning protective padding or dunnage or spacers shall be provided to prevent damage or deformation during transit and handling.

10.4 All Packing cases shall be marked legibly and correctly so as ensure safe arrival at their destination and to avoid the possibility of goods being lost or wrongly dispatched on account of faulty or illegible markings. Each wooden case/crate/corrugated box shall have all markings stenciled on it in indelible ink.

10.5 The bidders shall provide instructions regarding handling and storage precautions to be taken at site.

Tests on surge arresters' units

1. **RIV Test (Dry)**
   The surge arresters string along with complete hardware fittings have a radio interference voltage level below 100 microvolts at one MHZ when subjected to 50 Hz AC voltage of 10kv class surge arresters under dry condition. The test procedure shall be in accordance with IS:8263/IEC:437/CISPR 18-2. This test is applicable for surge arresters > 72.5kV
2. **Brittle Fracture Resistance Test**
   A brittle fracture test shall be carried out on naked rod along with end fittings by applying " IN HNO3 acid" (63 g conc. HNO3 added to 937 g water) to the rod. The rod should be held at 80% of SML for the duration of the test. The rod should not fail within the 96-hour test duration. Test arrangement should ensure continuous wetting of the rod with Nitric acid.
3. **Recovery of Hydrophobicity & Corona test.**
   The test shall be carried out on 4mm thick samples of 5cm x 7cm.
   i) The surface of selected samples shall be cleaned with isopropyl alcohol. Allow the surface to dry and spray with water. Record the Hydrophobicity classification in line with STRI guide for Hydrophobicity classification. Dry the sample surface.

ii) The samples shall be subjected to mechanical stress by bending the sample over a ground electrode. Corona is continuously generated by applying 12kv to a needle like electrode place 1mm above the sample surface. The test shall be done for 100 hrs.

iii) Immediately after the corona treatment, spray the surface with water and record the HC classification. Dry the surface and repeat the corona treatment as at clause 2 above. Note HC classification. Repeat the cycle for 1000 hrs or unit HC of 6 or7 obtained. Dry the sample surface.

iv) Allow the sample to recover and repeat hydrophobicity measurement at several time intervals. Silicone rubber should recover to HC1 – HC 2 within 24 hours, depending on the material and the intensity of the corona treatment.

4. Chemical composition test for Silicon content.

The content of silicon in the composite polymer shall be evaluated by EDX (energy Dispersion X-ray) Analysis or Thermogravimetric analysis. The test may be carried out at CPRI or any other NABL accredited laboratory.

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Annexure – B

Guaranteed technical Particulars of surge arresters Name of the manufacture:

Address of works:

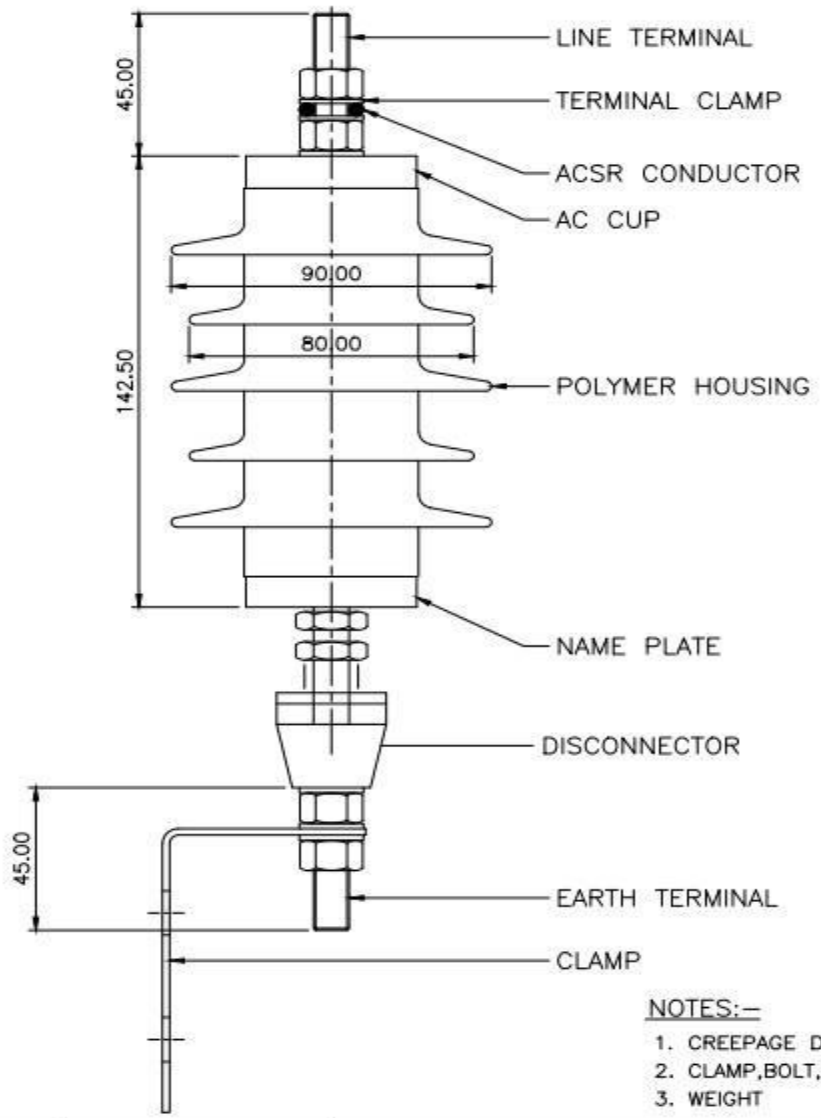
Sl.no	Description	Unit	
1.	Arrester Type or Designation	Kvrms	
2.	Arrester continuous operating voltage Uc	Kvrms	
3.	Arrester rated voltage Ur	KA	
4.	Nominal discharge current in	KA	
5.	Arrester Class	DH/DM/DL	
6.	High current discharge current 4/10us	KA	
7.	Repetitive Charge Transfer rate	C	
8.	Repetitive Charge Transfer rate duration	µs	
9	Temporary overvoltage capability (kV rms)	0.1 sec 1.0 sec 10 sec 100 sec	
10.	Rated short circuit current Isc		
	a. pressure relief class		
	b. High current	kA	
	c. Low current	A	
11.	Pull strength	N	
12.	Cantilever strength	Nm	
13.	Torque strength	Nm	
14.	Total height of arrester	mm	
15.	Creepage length	mm	
16.	Flashover distance	mm	
17.	Housing Lightning impulse 1,2/50 Us withstand level	kVp	
18.	Housing Wet power frequency withstand level	kVrms	
19.	Housing type		
20.	Housing material		
21.	Colour of Housing		
22.	Void – free Design (state)	Yes/No	
23.	Bonding/Interfacial sealing (State)	Yes/No	
24.	Reference current	mA	

K-RIDE

25.	Reference Voltage range (Min/Max)	kV	
26.	Max. partial discharge level	pC.	

27.	TOV curve enclosed?	Yes/No	
28.	Arresters will be able to operate under the system. parameters mentioned is S3	Yes/No	
29.	Maximum residual voltage of arrester for: Lightning current impulse 8/20us at 5kA 10kA 20kA Step lightning current impulse 1/10 us at nominal discharge current In	kV	
30.	Minimum recommended centre to centre distance between arresters	mm	
31.	Minimum recommended distance from centre of arrester to nearest grounded object.	mm	
32	Each ZnO block Dimension		
32	Date of last Type test		

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NOTES:–

1. CREEPAGE DISTANCE :310mm
2. CLAMP,BOLT,NUT & WASHERS :HDG
3. WEIGHT :860Gms

	Signatures	All dimensions are in mm unless otherwise stated.	BESCOM
Chd	AGM (QS&S)	10KV 5KA POLYMER LIGHTNING ARRESTER WITH GROUND DISCONNECTOR	Approved: General Manager,(Elec.) QS&S
Sub	DGM (QS&S)		DRG.NO.BESCOM/GM/QS&S/60 REV–002 DATED:24–11–2018
SCALE: N.T.S			

SECTION - 12
11K.V PIN INSULATOR

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TECHNICAL SPECIFICATION FOR 11 KV COMPOSITE PIN INSULATORS

1. SCOPE:

This specification covers the design, manufacture, testing and supply of 11KV Composite Insulators. The composite insulators shall be pin insulators for straight line locations.

2. SYSTEM PARTICULARS:

- Nominal System Voltage 11 kV
- Corresponding highest system Voltage 12 kV
- Frequency 50 Hz with 3% tolerance
- Number of phases 3
- Neutral earthing: effectively grounded.

3. STANDARDS:

Unless otherwise specified elsewhere in the specification's insulators shall confirm to the latest revisions of all relevant standards available at the time of placement of the order. The standards are listed in Annexure 'A'.

4. GENERAL REQUIREMENTS

4.1 The composite insulators shall generally conform to latest Standards as listed in Annexure 'A'

4.2 The Composite Insulators will be used on lines on which the conductors will be ACSR of any size up to Coyote. The insulators should withstand the conductor tension, the reversible wind load as well as the high frequency vibrations due to wind.

4.3 Insulators shall have sheds with good self-cleaning properties. Insulator shed profile, spacing, projection etc. and selection in respect of polluted conditions shall be generally in accordance with the recommendation of IEC-60815/IS: 13134.

4.4 The size of Composite insulator, minimum creepage distance and mechanical strength along with hardware fittings shall be as follows:

Type of Composite insulator	Nominal System Voltage kV(rms)	Highest System Voltage kV(rms)	Visible discharge test voltage kV(rms)	Wet power frequency withstand voltage kV (rms)	Impulse withstands voltage kV(peak)	Minimum creepage distance in mm	Min. failing load kN
Pin Insulator	11	12	9	35	75	320	5

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4.5 Dimensional Tolerance of Composite Insulators

The tolerances on all dimensions e.g., diameter, length and creepage distance shall be allowed as follows in line with-IEC 61109:

± (0.04d+1.5) mm when d≤300mm
± (0.025d+6) mm when d>300 mm.
Where, d being the dimensions in millimeters for diameter, length or creepage distance as the case may be.

However no negative tolerance shall be applicable to creepage distance.

4.6 Corona and RI Performance

All surfaces shall be clean, smooth, without cuts, abrasions, or projections. No part shall be subjected to excessive localized pressure. The insulator and metal parts shall be so designed and manufactured that it shall avoid local corona formation and not generate any radio interference beyond specified limit under the operating conditions.

5. TECHNICAL DESCRIPTION OF COMPOSITE INSULATORS

Polymeric Insulators shall be designed to meet the high quality, safety and reliability and should be capable of withstanding a wide range of environmental conditions: Polymeric Insulators shall consist of THREE parts, at least two of which are insulating Parts: - (a) Core- the internal insulating part (b) Housing- the external insulating part (c) Metal end fittings.

5.1 CORE

It shall be a glass-fiber reinforced epoxy resin rod of high strength (FRP rod). Glass fibers and resin shall be optimized in the FRP rod. Glass fibers shall be Boron free electrically corrosion resistant (ECR) glass fiber or Boron free E-Glass and shall exhibit both high electrical integrity and high resistance to acid corrosion. The matrix of the FRP rod shall be Hydrolysis resistant. The FRP rod shall be manufactured through Pultrusion process. The FRP rod shall be void free as proven through die penetration test. The FRP rod must pass electric leakage current test of 175V/mm. The leakage current shall not exceed 0.05mA.

5.2 HOUSING:

The FRP rod shall be covered by a seamless sheath of a silicone elastomeric compound or silicone alloy or EVA compound of a thickness of 3mm minimum. It shall be one-piece housing using Injection Molding Principle to extrude directly onto the core and cover the core. The elastomer housing shall be designed to provide the necessary creepage distance and protection against environmental influences. Housing shall conform to the requirements of IEC 61109/92- 93 with latest amendments. The bonding of the elastomeric compound to the fiber glass rod shall be perfect and shall be proved by a peel off test as described elsewhere in this specification.

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5.3 WEATHERSHEDS

The composite polymer weather sheds made of a silicone elastomeric compound or silicone alloy, or EVA compound shall be firmly bonded to the sheath, vulcanized to the sheath or molded as part of the sheath and shall be free from imperfections. It should protect the FRP rod against environmental influences, external pollution, and humidity. The weather sheds should either be of EVA or have silicon content of minimum 30% by weight. The strength of the weather shed to sheath interface shall be greater than the tearing strength of the polymer. The interface, if any, between sheds and sheath (housing) shall be free from voids. Housing and weather shed materials shall have tensile strength of 10MPa with 300% elongation minimum and tear strength of 20N/mm.

5.4 METAL END FITTINGS (Pins):

End fitting transmit the mechanical load to the core. They shall be made of spheroidal graphite cast iron, malleable cast iron or forged steel or aluminum alloy. They shall be connected to the rod by means of a controlled compression technique. Metal end fittings shall be hot dip galvanized after all fittings have been completed. The material used in fittings shall be corrosion resistant. As the main duty of the end fittings is the transfer of mechanical loads to the core the fittings should be properly attached to the core by a coaxial or hexagonal compression process & should not damage the individual fibers or crack the core. The gap between fitting and sheath shall be sealed by a flexible EVA or silicone elastomeric compound or silicone alloy compound sealant. System of attachment of end fitting to the rod shall provide superior sealing performance between housing, i.e., seamless sheath and metal connection. The sealing must be moisture proof. The dimensions of end fittings of Insulators shall be in accordance with the standard dimensions stated in IEC: 60120/ IS: 2486 - Part-II /1989.

6. WORKMANSHIP

6.1 All the materials shall be of latest design and conform to the best engineering Practices adopted in the high voltage field. Bidders shall offer only such insulators as are guaranteed by them to be satisfactory and suitable for continued good service in power transmission/distribution lines.

6.2 The design, manufacturing process and material control at various stages shall be such as to give maximum working load, highest mobility, best resistance to corrosion, good finish and elimination of sharp edges and corners.

6.3 The design of the insulators shall be such that stresses due to expansion and contraction in any part of the insulator shall not lead to deterioration.

6.4 The core shall be sound and free of cracks and voids that may adversely affect the insulators.

6.5 Weather sheds shall be uniform in quality. They shall be clean, sound, smooth and shall be free from defects and excessive flashing at parting lines

6.6 End fittings shall be free from cracks, seams, shrinks, air holes and rough edges. End fittings should be effectively sealed to prevent moisture ingress; effectiveness of sealing system must be supported by test documents. All surfaces of the metal parts shall be perfectly smooth without projecting points or irregularities, which may cause corona. All load bearing surfaces shall be sooth and uniform so as to distribute the loading stresses uniformly.

6.7 All ferrous parts shall be hot dip galvanized to give a minimum average coating of zinc equivalent to 610 gm/sq.m. or 87-micron thickness and shall be in accordance with the requirement of IS:4759. the zinc used for galvanizing shall be of purity 99.5% as per IS:4699. The zinc coating shall be uniform, adherent, smooth, reasonably bright continuous and

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free from imperfections such as flux, ash rust stains, bulky white deposits, and blisters. The galvanized metal parts shall be guaranteed to withstand at least four successive dips each lasting for one (1) minute duration under the standard preece test. The galvanizing shall be carried out only after any machining.

7. TESTS AND STANDARDS

Insulators offered shall be manufactured with the same configuration & raw materials as used in the insulators for which design & type test reports are submitted. The manufacturer shall submit a certificate for the same. **The design & type test reports submitted should have been carried out within five years prior** to the date of opening of this tender.

7.1 DESIGN TESTS:

For polymeric insulators it is essential to carry out design test as per clause 4.1 of IEC 61109/92- 93 with latest amendments. The design tests are intended to verify the suitability of the design, materials, and method of manufacture (technology). When a composite insulator is submitted to the design tests, the result shall be considered valid for the whole class of insulators, which are represented by the one tested and having the following characteristics:

- Same materials for the core, and sheds and same manufacturing method.
- Same material of the fittings, the same design, the same method of attachment.
- Same or greater layer thickness of the shed material over the core (including a sheath where used);
- Same or smaller ratio of the highest system voltage to insulation length.
- Same or smaller ratio of all mechanical loads to the smallest core diameter between fittings
- Same or greater diameter of the core.

The tested composite insulators shall be identified by a drawing giving all the dimensions with the manufacturing tolerances.

Manufacturer should submit test reports for Design Tests as per IEC – 61109 (clause – 5) prior to supply. Additionally following tests shall be carried out or reports for the tests shall be submitted after award of contract:

UV test: the test shall be carried out in line with clause 7.2 of ANSI C29.13.

7.2 TYPE TESTS:

The type tests are intended to verify the main characteristics of a composite insulator. The type tests shall be applied to composite insulators, the class of which has passed the design tests.

7.2.1 Following Type test shall be conducted on a suitable number of individual insulator units, components, materials:

Sl. No	Description of type test	Test procedure/standard
1	Dry lightning impulse withstand voltage test	As per IEC 61109 (clause 6.1)
2	Wet power frequency test	As per IEC 611 09 (clause 6.2)
3	Mechanical load-time test	As per IEC 611 09 (clause 6.4)
4	Radio interference test	As per IEC 61109 (clause 6.5) revised
5	Recovery of Hydrophobicity test	Annexure - B This test may be repeated every 3yrs by the manufacturer
6	Chemical composition test for silicon content	Annexure - B Or any other test method acceptable to the owner.
7	Brittle fracture resistance test	Annexure – B

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The bidder shall submit type test reports as per IEC 61109 along with the bid. Additional type tests required if any shall be carried out by the manufacturer, after award of contract for which no additional charges shall be payable. In case, the tests have already been carried out, the manufacturer shall submit reports for the same.

7.2.2 **UV Resistance as per ASTMG 53:** 5000 Hours- UV Light for 8 hours and condensation for 4 hours in a continuous cycle. Elongation to be limited to 20% (% of elongation to break before and after the test)

7.2.3 Salt Fog Test: On Insulator for 1000hours as per IEC.

7.3 Acceptance (sample) Tests

7.4 The test samples after having withstood the routine test shall be subject to the following acceptance tests in order indicated below:

(a)	Verification of dimensions	Clause 7.2 IEC: 61109,
(b)	Verification of the locking system: (if applicable)	Clause 7.3 IEC : 61109,
©	Galvanizing test	IS:2633/15: 6745
(d)	Verification of the specified mechanical load	Clause 7.4IEC: 61109,
(e)	Verification of tightness of the interface between end fitting & insulator housing	Clause 7.4IEC: 61109, amendment 1 of 1995

7.5 Routine Tests

Sl No	Description	Standard
1	Identification of marking	As per IEC: 61109
2	Visual Inspection	As per IEC:61109
3	Mechanical Routine test	As per IEC:61106

Every Polymeric Insulator shall withstand Mechanical Routine test at ambient temperature, Tensile Load at RTL corresponding to at least 50% of the SML for at least 10 seconds.

7.6 Tests during manufacture:

The following tests shall also be carried out on all components as applicable.

a)	Chemical analysis of zinc used for galvanizing
b)	Chemical analysis, mechanical, metallographic test and magnetic particle inspection for malleable castings.
c)	Chemical analysis, hardness tests and magnetic particle inspection for forgings.
d)	Peel off test to confirm adhesion of EVA/ Silicon /Silicon alloy to the core of the insulator.

7.7 Tests on the material used in manufacture of the insulator:

The bidder shall furnish following test reports conducted on the raw materials (i.e., silicon rubber or EVA) for confirming following properties prior to supply.

Sl. No	Property	Standard
1	Tensile Strength (MPa)	ISO37/ASTM D 638

2	Elongation (%)	ISO37/ASTM D 638
3	Tear Strength (N/mm)	ASTM D624B
4	TERT (4.5KV 360min)	ASTM D2303/IEC507
5	Volume Resistivity (Ohm –cm)	ASTM D257/IEC93
6	Dielectric constant	IEC 250/ ASTM D150
7	Dielectric Strength (kV/mm)	ASTM D149/IEC93
8	Density	ISO 1183A
9	Hardness (shore A)	ISO868
10	Accelerated aging	ISO188/ ASTM G53
11	Flammability test	UL-94 V0/IEC60707
12	Arc Resistance	IEC61621

7.8 The following characteristics shall be met by FRP rods used in manufacture of the insulator:

1 Tensile strength: 760 N/mm² Min
2 Glass content (%) : 75% min
3 Tg by DSC – 110 Deg C min
4 Dye penetration – No dye rise on 10 sample of 10 mm thick> 15 mins
5 Water diffusion & Voltage tests – 100 hours – 12kv for 1 min, no puncture or flashover on the FRP & current shall not exceed 1 Ma
6 Hardness> 51 Barcol No
7 ECR glass – Boron/alkali content not more than 0.8%.

7.8 Additional Tests

7.8.1 The Owner reserves the right at his own expenses, for carrying out any other test(s) of reasonable nature carried out at Supplier's premises, at site, or in any other place in addition to the aforesaid type, acceptance, and routine tests to satisfy himself that the material complies with the Specifications.

7.8.2 The Owner also reserves the right to conduct all the tests mentioned in this specification on the samples drawn from the site at Supplier's premises or at any other test center. In case of evidence of noncompliance, it shall be binding on the part of the Supplier to prove the compliance of the items to the technical specifications by repeat tests or correction of deficiencies or replacement of defective items, all without any extra cost to the Owner.

7.9 Co-ordination for Testing

7.9.1 The bidder shall intimate the Owner about carrying out of the type tests along with detailed testing programme at least 3 weeks in advance of the scheduled date of testing during which the Owner will arrange to depute his representative to be present *at* the time of carrying out the tests.

8. QUALITY ASSURANCE PLAN:

8.1 The successful bidder shall submit the following information before procuring:

8.1.1 Test certificates of the raw materials and bought out accessories.

8.1.2 Statement giving list of important raw material, their grades along with names of Sub suppliers for raw materials, list of standards according to which the raw materials are tested. List of tests normally carried out on raw materials in the presence of bidder's representative.

8.1.3 List of manufacturing facilities available.

8.1.4 Level of automation achieved and lists of areas where manual processing exists.

8.1.5 List of areas in manufacturing process, where stage inspections are normally carried out for quality

control and details of such tests and inspections.

8.1.6 List of testing equipment's available with the bidder for final testing of equipment along with valid calibration reports.

8.1.7 The manufacturer shall submit Manufacturing Quality Assurance Plan (QAP) followed during manufacture and testing.

8.2 The successful bidder shall submit the routine test certificates of bought out raw materials/accessories and central excise passes for raw material at the time of inspection.

8.3 The Purchaser representative shall at all times be entitled to have access to the works and all places of manufacture, where insulator, and its component parts shall be manufactured and the representatives shall have full facilities for unrestricted inspection of the Supplier's and sub-Supplier's works, raw materials, manufacture of the material and for conducting necessary test as detailed herein.

8.4 The material for final inspection shall be offered by the Supplier only under packed condition. The owner shall select samples at random from the packed lot for c a r r y i n g out acceptance tests. The lot offered for inspection shall be homogeneous and shall contain insulators manufactured in 3-4 consecutive weeks.

8.5 The Supplier shall keep the Owner informed in advance of the time of starting and the progress of manufacture of material in their various stages so that arrangements could be made for inspection.

8.6 No material shall be dispatched from its point of manufacture before it has been satisfactorily inspected and tested unless the owner in writing waives off the inspection. In the later case also, the material shall be dispatched only after satisfactory testing specified herein has been completed.

8.7 The acceptance of any quantity of material shall in no way relieve the Supplier of his responsibility for meeting all the requirements of the specification and shall not prevent subsequent rejection if such materials are later found to be defective.

9. TEST CERTIFICATE:

The tenderer shall furnish detailed type test reports of the offered composite Insulators as per clause 8.2 of the Technical Specifications at the NABL approved laboratories to prove that the composite Insulators offered meet the requirements of the specification. These Type Tests should have been carried out within five years prior to the date of opening of this tender.

10. TESTING FACILITIES:

The tenderer must clearly indicate what testing facilities are available in the works of the manufacturer and whether facilities are adequate to carry out all Routine & acceptance Tests. These facilities should be available to Purchasers Engineers if deputed to carry out or witness the tests in the manufacturer works. If any test cannot be carried out at the manufacturer's work, the reasons should be clearly stated in the tender. The insulators shall be tested in accordance with the procedure detailed in IEC 61109 / 92-93 with latest amendments.

11. DRAWINGS:

The insulator shall be as per the Drawing enclosed.

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12. RETEST AND REJECTION:

12.1 Sample Procedure for testing of insulators shall be as per clause 7.1 to 7.6 of IEC 61109 for Acceptance & Routine Tests. For the sampling tests, two samples are used, E1and E2. The sizes of these samples are indicated in the table below.

Lot Size(N)	Sample size	
	E1	E2
N<300	Subject to agreement	
300<N<2000	4	3
2000<N<5000	8	4
5000<N<10000	12	6

If more than 10000 insulators are concerned, they shall be divided into an optimum number of lots comprising between 2000 and 10000 insulators. The results of the tests shall be evaluated.

separately for each lot. The insulators shall be selected by the purchaser's representative from the lot at random. The samples shall be subjected to the applicable sampling tests.

The sampling tests are:

Verification of dimensions - (E1 + E2)
Verification of the locking system - (E2)
Verification of tightness of the interface between end fittings & Insulator housing - (E2)
Verification of the specified mechanical load SML - (E1)
Galvanizing test - (E2)

In the event of a failure of the sample to satisfy a test, the retesting procedure shall be as follows:

- If only one insulator or metal part fails to comply with the sampling tests, a new sample equal to twice the quantity originally submitted to the tests shall be subjected to retesting. The retesting shall comprise the test in which failure occurs.
- If two or more insulator or metal parts fail to comply with any of the sampling tests or if any failure occurs during the retesting, the complete lot is considered as not complying with this standard and shall be withdrawn by the manufacturer.
- Provided the cause of the failure can be clearly identified, the manufacturer may sort the lot to eliminate all the insulators with these defects. The sorted lot then be resubmitted for testing. The number then selected shall be three times the first chosen quantity for tests. If any insulators fail during this retesting, the complete lot is considered as not complying with this standard and shall be withdrawn by the manufacturer.

12.2 Verification of dimensions (E1 + E2)

The dimensions given in the drawings shall be verified. The tolerances given in the drawing are valid. If no tolerances are given in the drawings the values mentioned in this specification shall hold good.

12.3 Verification of the locking system (E2)

This test applies only to the insulators equipped with socket coupling as specified by IEC 120 and is performed according to IEC 383.

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12.4 Verification of tightness of the interface between end fittings & Insulator housing (E2)

One insulator selected randomly from the sample E2, shall be subjected to crack indication by dye penetration, in accordance with ISO 3452, on the housing in the zone embracing the complete length of the interface between the housing and metal fitting and including an additional area, sufficiently extended beyond the end of the metal part. The indication shall be performed in the following way.

- The surface shall be properly pre-cleaned with the cleaner.
- The penetrant, which shall act during 20 minutes, shall be applied on the cleaned surface;
- Within 5 minutes after the application of the penetrant, the insulator shall be subjected, at the ambient temperature, to a tensile load of 70 % of the SML, applied between the metal fittings; the tensile load shall be increased rapidly but smoothly from zero up to 70 % of the SML, and then maintained at this value for 1 minute
- The surface shall be cleaned with the excess penetrant removed, and dried.
- The developer shall be applied if necessary.
- The surface shall be inspected.

Some housing materials may be penetrated by the penetrant. In such cases evidence shall be provided to validate the interpretation of the results. After the 1 min. test at 70 % of the SML, if any cracks occur, the housing and, if necessary, the metal fittings and the core shall be cut, perpendicularly to the crack in the middle of the widest of the indicated cracks, into two halves. The surface of the two halves shall then be investigated for the depth of the cracks.

12.5 Verification of the specified mechanical load SML

The insulators of the sample E1 shall be subjected at ambient temperature to a tensile load, applied between the couplings. The tensile load shall be increased rapidly but smoothly from zero to approximately 75 % of the SML, and then be gradually increased to the SML in a time between 30 sec. to 90 sec. If 100 % of the SML is reached in less than 90 s, the load (100 % of the SML) shall be maintained for the remainder of the 90 s. (This test is considered to be equivalent to a 1 min withstand test at the SML). The insulators have passed the test at 13.4 &

13.5 above if:

- No failure (breakage or complete pull out of the core, or fracture of the metal fitting) occurs either during the 1 min. 70 % withstand test (a) or during the 1 min.100 % withstand test (b).
- No cracks are indicated after the dye penetration method described in 13.4 above.
- The investigation of the halves described in 13.4 above shows clearly that the cracks do not reach the core.

12.6 Galvanizing test

This test shall be performed according to IS: 2633/IS: 6745 on galvanized parts.

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13. MARKINGS:

Each insulator shall be legibly and indelibly marked with the following details as per IEC- 61109:

a) Name or trademark of the manufacturer.
b) Voltage & Type
c) Month and year of manufacturing.
d) Min. failing load/guaranteed mechanical strength in kilo Newton followed by the word 'KN' to facilitate easy identification.
e) Country of Manufacturer.

14. PACKING:

14.1 All insulators shall be packed in strong corrugated box of min. 7 ply duly paletted or wooden crates. The gross weight of the crates along with the material shall not normally exceed 100 Kg to avoid hackling problem. The crates shall be suitable for outdoor storage under wet climate during rainy season.

14.2 The packing shall be of sufficient strength to withstand rough handling during transit, storage at site and subsequent handling in the field.

14.3 Suitable cushioning, protective padding, or Dunn age or spacers shall be provided to prevent damage or deformation during transit and handling.

14.4 All packing cases shall be marked legibly and correctly so as to ensure safe arrival at their destination and to avoid the possibility of goods being lost or wrongly dispatched on account of faulty packing and faulty or illegible markings. Each wooden case /crate /corrugated box shall have all the markings stenciled on it in indelible ink.

14.5 The bidder shall provide instructions regarding handling and storage precautions to be taken at site.

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Annexure-A

STANDARDS TO BE ADOPTED FOR COMPLETE INSULATORS

Sl No	IS Standard	Title	International Standard
1		Definition. test methods and acceptance criteria for composite insulators for a.c. overhead lines above 1000 V	IEC: 61109
2	IS: 731	Porcelain insulators for overhead Power lines with a nominal voltage greater than 1000 V	IEC: 60383
3	IS: 2071	Methods of High Voltage Testing	IEC: 60060-1
4	IS: 2486	Specification for Insulator fittings for Overhead Power Lines with a nominal Voltage greater than 1000V General Requirements and Tests Dimensional Requirements Locking Devices	IEC: 60120 IEC: 60372
5		Thermal Mechanical Performance test and mechanical performance test on string insulator units	IEC: 60575
6	IS: 13134	Guide for the selection *of* insulators in respect *of* polluted Conditions	IEC: 60815
7		Characteristics *of* string insulator units *of* the long rod type	IEC: 60433
8		Hydrophobicity Classification Guide	STRI Guide 1.92/1
9		Radio interference characteristics *of* overhead power lines and high-voltage equipment.	CISPR:18-2 Part-2
10	IS: 8263	Methods *of* RI *Test of* HV insulators	IEC: 60437
11		Standard for Insulators Composite-Distribution Dead-end Type	ANSI C29. 13-2000
12	IS: 4759	Hot dip zinc coatings on structural steel & other allied products	ISO:1459 ISO:1461
13	IS:2629	Recommended Practice for Hot. Dip . Galvanisation *for* iron and steel	ISO:1461(E)
14	IS: 6745	Determination *of* Weight *of* Zinc Coating on Zinc coated iron and steel articles	ISO:1460
15	IS:3203	Methods *of* testing of local thickness *of* electroplated coatings	ISO:2173
16	IS:2633	Testing *of* Uniformity *of* Coating *of* zinc coated articles	
17		Standard specification *for* glass fiber strands	ASTM D 578-05
18		Standard test method *for* compositional analysis by Thermogravimetry	ASTM E 1131-03
19	IS: 4699	Specification for refined secondary Zinc	

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Annexure-B
Tests on Insulator units

1. RIV Test (Dry)

The insulator string along with complete hardware fittings shall have a radio interference voltage level below 100 micro volts at one MHz when subjected to 50 Hz AC voltage of 10 kV & 30 kV for 11 kV insulators under dry condition. The test procedure shall be in accordance with 15:8263 IEC: 437/CISPR 18-2.

2. Brittle Fracture Resistance Test

Brittle fracture test shall be carried out on naked rod along with end fittings by applying "l n HN03 acid" (63 gm conc. HN03 added to 937 gm water) to the rod. The rod should be held at 80% of SML for the duration of the test. The rod should not fail within the 96-hour test duration. Test arrangement should ensure continuous wetting of the rod with Nitric acid.

3. Recovery of Hydrophobicity & Corona test

The test shall be carried out on 4mm thick samples of 5cm x 7cm.

I. The surface of selected samples shall be cleaned with isopropyl alcohol. Allow the surface to dry and spray with water. Record the Hydrophobicity classification in line with STRJ guide for Hydrophobicity classification (Extract enclosed at Annexure - D). Dry the sample surface.

II. The sample shall be subjected to mechanical stress by bending the sample over a ground electrode. Corona is continuously generated by applying 12 kV to a needle like electrode placed 1 mm above the sample surface. The test shall be done for 100 hrs.

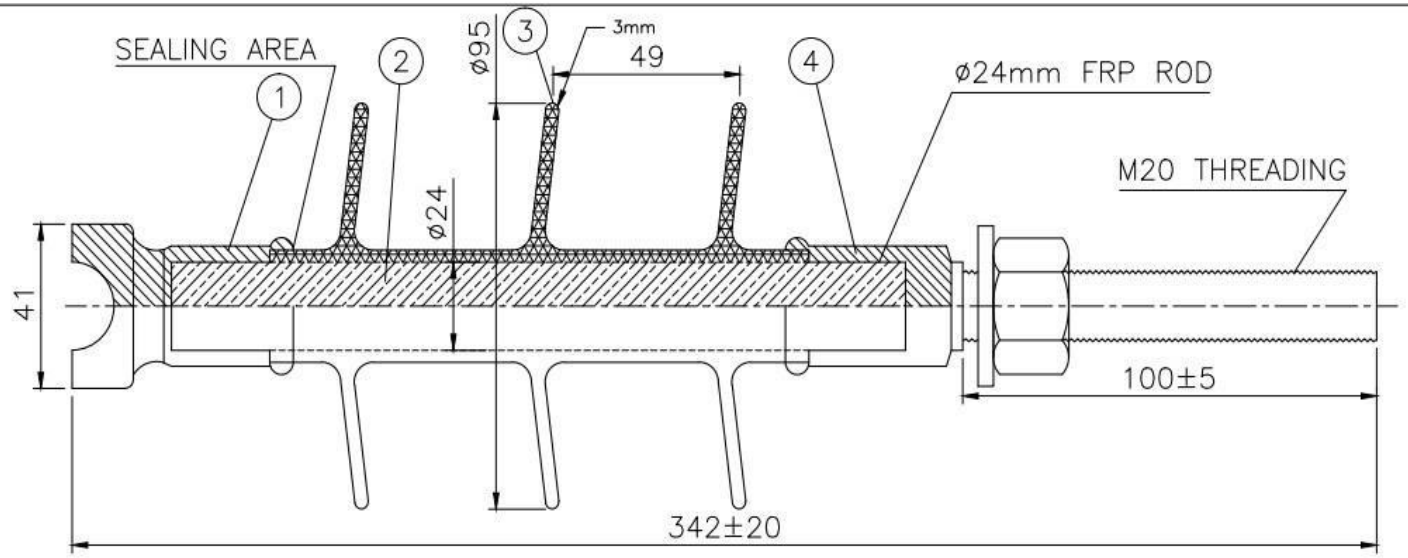
III. Immediately after the corona treatment, spray the surface with water and record the HC classification. Dry the surface and repeat the corona treatment as at clause 2 above. Note HC classification. Repeat the cycle for 1000 hrs. or until an HC of 6 or 7 is obtained. Dry the sample surface.

IV. Allow the sample to recover and repeat hydrophobicity measurement at several time intervals. Silicone rubber should recover to HC 1 - HC 2 within 24 to 48 hours, depending on the material and the intensity of the corona treatment.

5. Chemical composition test for Silicon content

The content of silicon in the composite polymer shall be evaluated by EDX (Energy Dispersion X-ray) Analysis or Thermo-gravimetric analysis. The test may be carried out at CPRI/ERDA or any other NABL accredited govt laboratory.

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ITEM	DESCRIPTION	MATERIAL	QTY	REMARKS
1	TOP METAL FITTING	SGCI/FORGED	1 NO	HDG
2	CORE ROD	FIBERGLASS	1 NO	24mmø
3	POLYMER HOUSING	SILICONE RUBBER	–	
4	BOTTOM METAL FITTING	SGCI/FORGED	1 NO	HDG

TECHNICAL CHARACTERISTICS:

DIMENSIONS:	
1. CREEPAGE DISTANCE(MINIMUM)	320mm
2. ARCING(MINIMUM)	167mm
3. No OF ø95mm SHEDS	3

MECHANICAL CHARACTERISTICS:	
1. MIN FAILING LOAD	5kN

ELECTRICAL CHARACTERISTICS:	
1. NOMINAL SYSTEM VOLTAGE	11KV
2. HIGHEST SYSTEM VOLTAGE	12KV
3. SYSTEM FREQUENCY	50HZ
4. WET 1 MINUTE POWER FREQUENCY WITHSTAND VOLTAGE	35kV(rms)
5. DRY 1 MINUTE POWER FREQUENCY WITHSTAND VOLTAGE	40kV(rms)
6. DRY LIGHTNING IMPULSE WITHSTAND VOLTAGE	75kVp
7. VISIBLE DISCHARGE TEST VOLTAGE	9kV(rms)

NOTES:
1. INSULATOR CONFORMS TO IEC: 61109–2008
   IS: 2488–1974
2. GALVANISATION CONFORMS TO IS: 2679–1985

	Signatures
Chd	AGM (QS&S)
Sub	DGM (QS&S)

SCALE: N.T.S

All dimensions are in mm unless otherwise stated.

11kV 5KN COMPOSITE PIN INSULATOR

BESCOM

Approved:

General Manager,(Elec.)
QS&S

DRG.NO.BESCOM/GM/QS&S/28
REV–002 DATED:24–11–2018

SECTION - 13
L.T PROTECTION KIT

Bi-RIDE

TECHNICAL SPECIFICATION FOR LT PROTECTION KIT FOR DISTRIBUTION TRANSFORMERS UP TO AND INCLUSIVE OF 100 KVA.

1.0 **SCOPE:**

This Specification covers design, manufacture, and supply of LT protection kit for distribution Transformers. The LT protection kit offered shall be suitable for outdoor installation and mounting on RCC Poles. They shall serve for protection on LV side of distribution transformers ranging from capacity 25 KVA up to and inclusive of 100 KVA, distribution transformers.

2.0 **CLIMATIC CONDITIONS:**

The LT Protection kit along with its mounting shall suit outdoor installations.

3.0 **STANDARDS:**

The L.T Protection kit along with its components/Mounting arrangement shall conform to the latest edition of relevant standards.

4.0 **(A) COMPLETENESS OF SUPPLY:**

The component offered shall be complete and operative on all aspects and shall conform to high standard of Engineering design and workmanship.

(B) Deviation from technical specifications: Tenderer shall furnish the details of deviations/modification proposed by him if any towards improvement of the said offer.

5.0 **TECHNICAL PARTICULARS:**

The brief technical particulars of various components to be offered are as hereunder.

5.01 A typical sketch detailing the L.T protection kit to be supplied is annexed. It is mentioned that the dimensions regarding mounting and conductor sizes are binding.

5.02 **1.1 KV PIN INSULATORS:**

a) The insulators shall conform to IS-1445/1977 with latest amendments if any and baked in temperature-controlled kiln only. They should be brown glazed.
The pin Insulator shall be in conformity with Fig.1 of IS-1445/1977, and with threaded forged G.I Pins. The profile of threads being as given on Fig. 5 of IS- 1445/1977.

b) The Insulators shall have the following electrical and mechanical characteristics.

1	Dry power frequency with stand voltage	:	23 KV (RMS)
2	Wet power frequency with stand voltage	:	10 KV (RMS)
3	Power frequency puncture With stand voltage	:	1.3 x the actual dry flash over voltage
4	Minimum failing load	:	366.902 Kgf. (3.5 KN)

c) **One sample 1.1 KV insulators used in LT Protection kit shall be submitted as per QR and sample will be verified by BESCOM/ KRIDE officials. The make of the insulators shall be mentioned in the Guaranteed Technical Particulars.**

d) The type tests, acceptance tests and routine tests for 1.1 kV Pin Insulators shall be as per IS: 1445/1977. **The type test certificates in respect of the insulators used shall be furnished prior to supply.**

e) Mounting frame assembled with insulators, terminal connectors shall be packed in suitable crates, loose items such as Fish Plates, Bolts and nuts etc., to be packed in suitable polythene bags.

5.03 **TERMINAL CONNECTOR (For receiving LT leads from Transformer and tap off to line):**

a) The fasteners used shall be galvanized.
b) The materials used shall be Aluminum alloy.
c) All Ferrous components shall be galvanized.
d) 6 numbers of pad connector shall be provided as shown in the drawing.
e) 6 numbers of Aluminum plates of size 120x60x10mm shall be provided as shown in the drawing fixed

to (d) above with 4nos of GI bolts & nuts to each plate.

f) 12 Nos of 95 sq mm heavy duty long barrel Aluminum lugs shall be supplied and fixed to the Aluminum plate with 16mm dia 40mm GI bolts & nuts with spring & flat washers.

5.04 **BILL OF MATERIALS:**

The bill of materials is as indicated in the drawing.

5.05 **G.I. PINS:**

The 1.1 KV G.I pins used shall conform to IS-2633/1972 and IS-6745/1972. The dimensions shall conform to Fig-2 of IS-7935/1975 with shank length of 40 mm as indicated in the drawing.

6.0 **PACKING:**

Each LT protection kit i.e mounting frame assembled with insulators, terminal connectors shall (with fittings) shall be packed in wooden crates suitable for easy and rough handling and acceptable for transport. Wooden separators shall be fixed between each kit to keep individual insulators in position without movement within the crate. The package containing the insulators shall have a mark BESCOM and P.O No. & Date.

7.0 **Name Plate**: Each LT Protection kit Unit shall be provided with a Name plate of minimum size 100X40mm shall be fixed with the following details which are legibly and indelibly marked.

1) Name of the material
2) Name of Manufacturer
3) BESCOM
4) Purchase Order No. and Date
5) Sl.No.

Bi-RIDE

8.0 INSPECTION:

8.01 All tests and inspection shall be generally made at the place of manufacturer. Purchaser (BESCOM) shall be provided with all reasonable facilities, without charge, to satisfy him that the material is being furnished in accordance with this specification. Purchaser and its representative shall at times be entitled to have access to the works and to all places of manufacture where insulators are manufactured and the supplier shall afford all facilities to them for unrestricted inspection of the works, inspection of materials and inspection of manufacturing process of insulators for conducting necessary tests and specified herein.

8.02 The supplier shall keep the Purchaser informed in advance of the time of Starting and progress of manufacture of insulators in various stages so that arrangements could be made for inspection.

8.03 No material shall be dispatched from its point of manufacture unless the material has been satisfactorily inspected and tested.

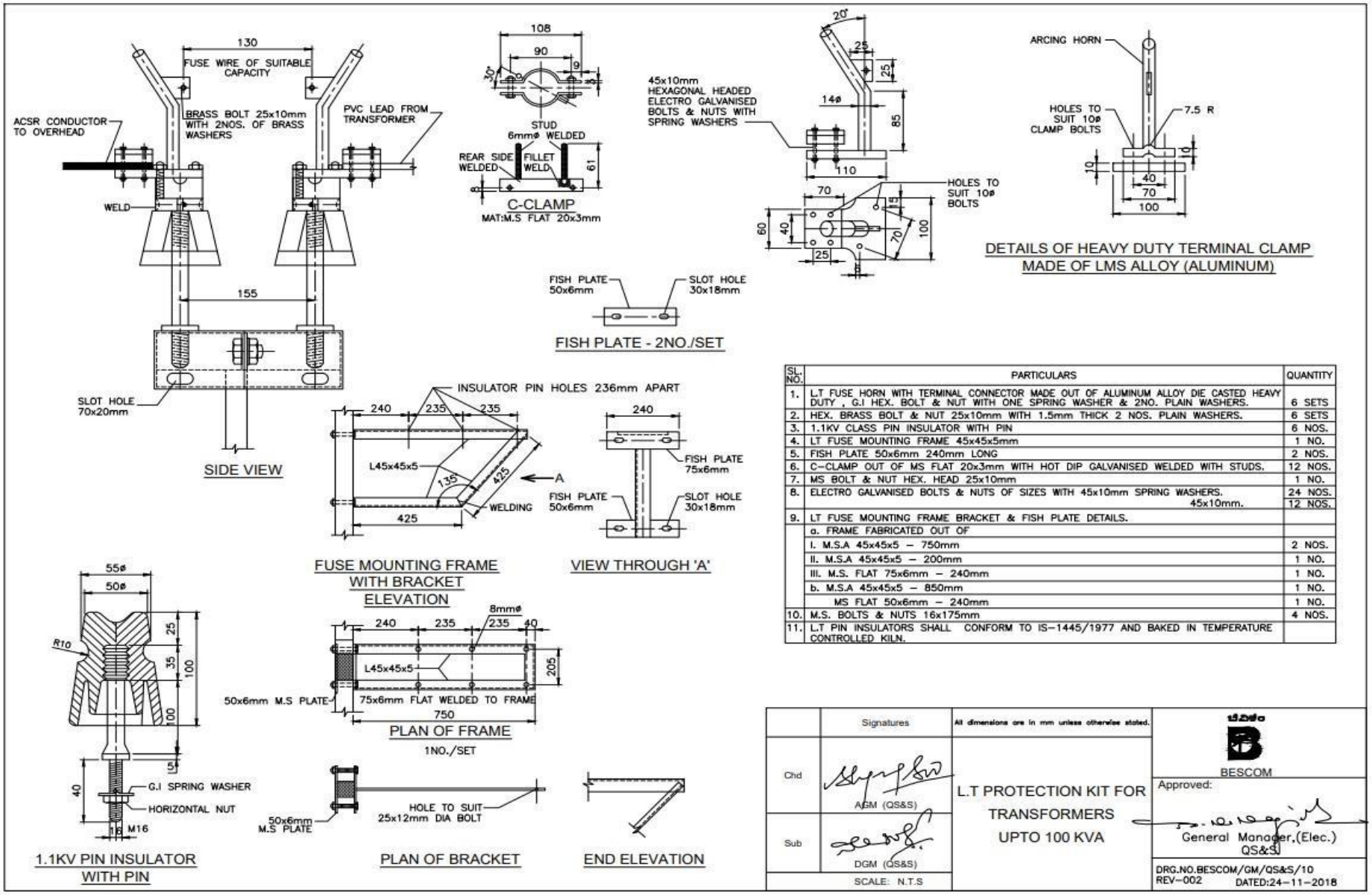
8.04 The BESCOM/ KRIDE has the right to have the tests carried out by an independent agency, when considered necessary.

9.0 SAMPLE

The Contractor shall submit two samples and get them approved by the competent authority before taking up the manufacture. The approved samples will be kept as under

ii) One approved sample will be with the manufacturer at the manufacturing premises so that so that the inspecting officer can inspect the materials offered for inspection with reference to the approved sample.

Bi-RIDE



SL. NO.	PARTICULARS	QUANTITY
1.	L.T FUSE HORN WITH TERMINAL CONNECTOR MADE OUT OF ALUMINUM ALLOY DIE CASTED HEAVY DUTY , G.I HEX. BOLT & NUT WITH ONE SPRING WASHER & 2NO. PLAIN WASHERS.	6 SETS
2.	HEX. BRASS BOLT & NUT 25x10mm WITH 1.5mm THICK 2 NOS. PLAIN WASHERS.	6 SETS
3.	1.1KV CLASS PIN INSULATOR WITH PIN	6 NOS.
4.	LT FUSE MOUNTING FRAME 45x45x5mm	1 NO.
5.	FISH PLATE 50x6mm 240mm LONG	2 NOS.
6.	C-CLAMP OUT OF MS FLAT 20x3mm WITH HOT DIP GALVANISED WELDED WITH STUDS.	12 NOS.
7.	MS BOLT & NUT HEX. HEAD 25x10mm	1 NO.
8.	ELECTRO GALVANISED BOLTS & NUTS OF SIZES WITH 45x10mm SPRING WASHERS.	24 NOS.
	45x10mm.	12 NOS.
9.	LT FUSE MOUNTING FRAME BRACKET & FISH PLATE DETAILS.	
	a. FRAME FABRICATED OUT OF	
	I. M.S.A 45x45x5 – 750mm	2 NOS.
	II. M.S.A 45x45x5 – 200mm	1 NO.
	III. M.S. FLAT 75x6mm – 240mm	1 NO.
	b. M.S.A 45x45x5 – 850mm	1 NO.
	MS FLAT 50x6mm – 240mm	1 NO.
10.	M.S. BOLTS & NUTS 16x175mm	4 NOS.
11.	L.T PIN INSULATORS SHALL CONFORM TO IS–1445/1977 AND BAKED IN TEMPERATURE CONTROLLED KILN.	

	Signatures	All dimensions are in mm unless otherwise stated.	BESCOM
Chd	AGM (QS&S)	L.T PROTECTION KIT FOR TRANSFORMERS UPTO 100 KVA	Approved: General Manager,(Elec.) QS&S
Sub	DGM (QS&S)		DRG.NO.BESCOM/GM/QS&S/10 REV–002 DATED:24–11–2018
SCALE: N.T.S			

SECTION – 14

L.T. FEEDER PILLAR BOXES

Bi-RIDE

TECHNICAL SPECIFICATION FOR LT FEEDER PILLAR BOXES

1.0 SCOPE:

1.1 This Technical Specification covers design, manufacture, assembly, inspection, testing and supply of
a) 08-way LT Feeder Pillar Box.
b) 12-way LT Feeder Pillar Box.
Complete with accessories and other miscellaneous equipment's specified in this specification.

2.0 STANDARDS:

2.1 The equipment should conform in all respects to the relevant latest editions of the Bureau of Indian Standards or other equivalent National or International Standards.

2.2 If the specifications other than those mentioned below are applicable, the fact should be made clear in the bid and one copy of such standard specifications in the English language shall be furnished.

2.3 The equipment shall also comply with the latest revision of the Indian Electricity Rules and any other applicable statutory provision, rules, and regulations applicable in the location where these are to be installed.

2.4 **The applicable standards are listed here below**:

IS: 5-1994:Color of ready mixed paints and enamels.
IS: 6875/1973 : Control switches, push buttons and related Part I & II control switches.
IS: 13607/1992 : Ready mixed paint, Finishing, General purpose, Synthetic. IS:
13947/1993 : Specification for Low-voltage Switchgear and Control gear.

3.0 CLIMATIC CONDITION:

3.1 The Feeder Pillar Boxes offered shall be suitable for being used in the following weather conditions.

a)	Minimum temperature of air in shade	- 5^0C
b)	Maximum temperature of air in shade	- 50^0C
c)	Relative Humidity	- 85% - 100%
d)	Average No. of rainy days per annum	- 60 days
e)	Rain falls	- 750-3000mm
f)	Altitude above means sea level maximum	- 1000 Mtrs.

4.0 PRINCIPAL PARAMETERS:

The Feeder Pillar Box shall confirm to the specific technical requirement specified here under.

1.	Rated Voltage	- 400 V $\pm$ 10%
2.	Rated Frequency	- 50 HZ
3.	Continuous Current Rating	- 400A & 600A
4.	Type	- Out door
5.	Mounting	- On concrete foundation.

K-RIDE

6. Suitable for - 3 ph 4 wire with Neutral Earthing
7. Maximum system Voltage - 1.1KV
8. Rated short Circuit Level - 50KA @ 400V.

4.1 FEEDER PILLAR BOX DESCRIPTION:

4.1.01 Feeder Pillar Box shall be suitable for the purpose for which they are intended to be used.

4.1.02 Each box shall be complete with accessories such as load break switches, bus bars, fuses, lock & key etc.

4.1.03 Feeder Pillar Box shall have access for sufficient ventilation and head description.

4.1.04 The cable entry and exit shall be from the sides through the extended box at the top on the sides. The design of the box must be such as to facilitate easy removal of the cable during erection and repair by suitable bolting the box cover and sliding the bottom plates. The entry of the cable at the extended box shall be through 100 mm PVC pipe and projecting 50 mm inside the box through suitable glands. The extended box shall be provided with suitable gland and clamps for fixing the cable rigidly. The feeder pillar box shall be suitable for 1.1kV 240 Sq.mm armoured UG cable through 100 mm PVC pipe and clearance inside the box must be such as to offer fair working facilities during erection and maintenance.

4.1.05 The box shall be vermin proof and dust proof.

4.1.06 Louvers of suitable size shall be provided in the front for ventilation and wire nets shall be provided on the back of the louvers to prevent the entry of dust and insect.

4.1.07 The box shall have double door (self-closing type) fitted with internal type door lock with common key for all the boxes and shall give maximum protection to the interior of the box.
The hinged design shall permit doors being completely removed when necessary.

4.1.08 The Feeder Pillar Box shall be suitable to mount on brick concrete foundation. Necessary provision for foundation bolt in the pillar shall be made for GI foundation bolts of size 12mm. Nuts, Bolts and 2 Nos. of Washers

4.1.09 The box shall be provided with suitable rain shed and all bolt and washers used shall be galvanized mild steel.

4.1.10 A danger board shall be provided in the front of the box.

4.2 EARTHING:

The box shall be provided with two Nos. of earthing points internally connected with accessible position on the sides. The earthing point shall be provided by 25 mm M8 bolts and nuts and marked with ⏚ symbol.

4.3 NAME PLATE AND CIRCUIT BOARD:

43.1 The Feeder Pillar Box shall be provided with transparent label or card of removable type and the following information are to be recorded.

(1)Title
(2)Cable Size
(3)Current Rating of I/C Cable
(4)Current Rating of O/G Cable
(5)Current Rating of Fuse Links.
(6)No. of Outgoing Lines.

43.2 The label or card shall be fitted on the side of the door and circuit numbering means shall be indicated by symbol or diagram relating to the fuse ways.

43.3 The Circuit plate with the following engraved information's has to be rivetted to the inside of the door of the feeder pillar box in an accessible position for easy reading.

Incoming Line from :
Incoming Line to :
Outgoing Line _____Amps to : (1-12)/ (1-8)

5.0 FABRICATION:

5.01 The feeder Pillar-Box shall be in conformity with the typical drawing in all respects.

5.02 The feeder pillar-Box shall comprise of the following accessories.

(1)Feeder Pillar box Metal Body.
(2)Copper / Aluminum bus bar.
(3)Removable links.
(4)Load break Switch.
(5)Porcelain Re-wirable cut-outs.

(6)Links.

5.1 FEEDER PILLAR BOX METAL BODY:

5.1.01 Feeder pillar box metal body shall be made out of high-grade MS sheet confirming to IS1079, with 3.00 mm thick for the body and 2.00 mm thick for the doors. The metal body shall be robust and painted complete with 2 coats of red-oxides on both sides as primary and LIGHT Grey paint with shade 631 of IS-5 for final finish.

5.2 BUS BARS:

5.2.01 Feeder pillar box shall be provided with insulated sleeved bus bar. The bus bar sizes as follows:

Load Break Switch Rating	8 WAY	12 WAY
630A	30 X 10 mm (300 Sq. mm) Copper	30 X 10 mm (300 Sq. mm) Copper
400 A	40 X 6 mm (240 Sq. mm) Copper	40 X 6mm (240 Sq. mm) Copper
400 A	40 X 10 mm (400 Sq. mm) Aluminum	40 X 10mm (400 Sq. mm) Aluminum

The insulated sleeves shall be of high grade with red, yellow and blue color for three phases and black for neutral.

5.2.02 The bus bar shall be made out of E.C. Grade Copper/ Aluminum flats. The bus bar shall be suitably supported on an insulating base rigidly fitted to the metal box.

5.2.03 The connection to the neutral bus bar is by means of socket. Necessary holes may be drilled on the bus bar for mounting the bus bar and extension.

5.3 FUSE LINK:

5.3.01 The feeder pillar box shall be provided with re-wirable porcelain cut out of reputed make and of the following rating:

Fuse Rating	8 WAY	12 WAY
32 A	4 Nos. Per Phase	-
63 A	3 Nos. Per Phase	10 Nos. Per Phase
100 A	1 No. Per Phase	2 Nos. Per Phase

5.3.02 The fuse carrier shall be non-inflammable and non- hygroscopic and the same shall have a hard glossy surface and shall conform to IS-2086/1993. The extended portion of the fuse carriers should be provided with galvanized M.S. Bolts and nuts. The design of the box shall be suitable for adding a minimum of 3 cut-outs on each side. The fuse cutouts should be with extended terminal as shown in the drawing and be of rewireable type. Adequate contact pressure shall be provided in the cut-outs for carrying rated current without overheating. The fuse cut-outs shall be connected to the bus bar rigidly with aluminum strips of suitable size.

5.4 LOAD BREAK SWITCH:

Load break switch shall be suitable to work on 440 V, 400/630A, four pole 50HZ, heavy duty, front operated type, with replaceable silver plate contacts conforming to IS 4064/1978, superior type arc chambers with necessary insulating barriers and enclosed in a compact insulating cover. The switch shall be designed break the current of 400/630A and able to withstand breaking stresses with quick and reliable spring-loaded operating handle.

The location of the operating handle shall be so as to facilitate convenient operation. The position of ON & OFF must be clearly indicated. The utilization category of the switch shall be Ac-23.

6.0 TEST & TEST CERTIFICATES AND INSPECTION:

6.1 The following routine tests shall be carried out on the panels at the factory:

K-RIDE

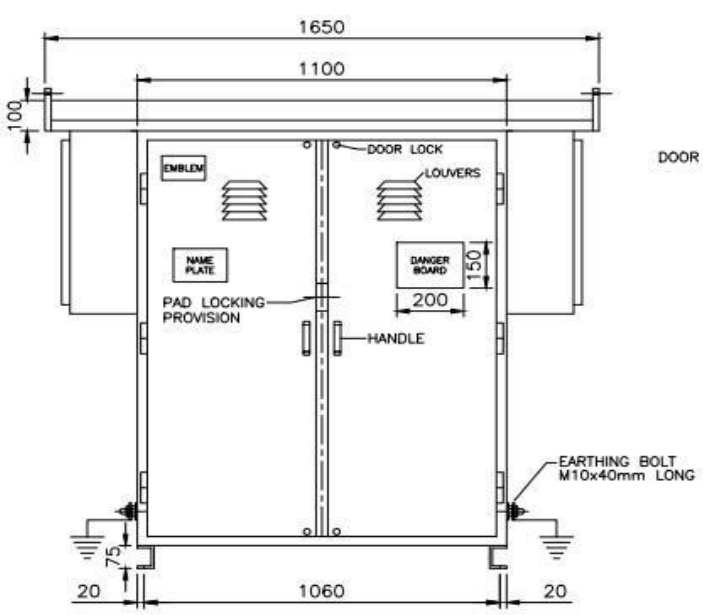
a) Checking of overall dimension, thickness of box sheet and paint film.
b) Checking correctness of continuity of circuits.
c) One-minute HV withstand test – All equipment's on panel and internal wiring shall be tested to withstand a test voltage of 2KV to earth for one minute.
d) Insulation resistance of the complete circuit by circuit with all equipment's mounted on the panel using insulation Tester/Megger.
e) Verification of degree of protection as per IS: 13947 (part-I).

6.2 The feeder pillar box shall be subjected to type test and acceptable test accessories with the standard to which it conforms.

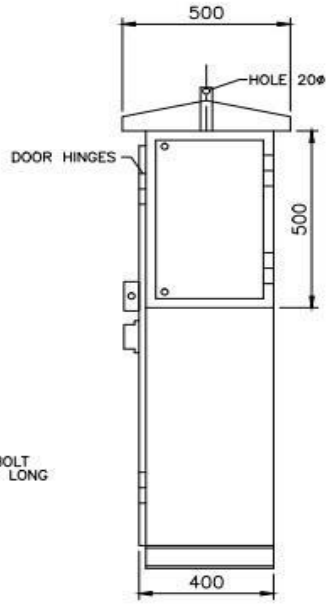
6.3 All routine and acceptance tests shall be conducted in presence of the owner's representative. No material shall be dispatched unless the owner communicated his written approval to these test certificates.

6.4 Copies of the type and routine test certificates for all the components used in the manufacture of the box from a recognized test house (to prove the conformity of the components to the relevant standards)

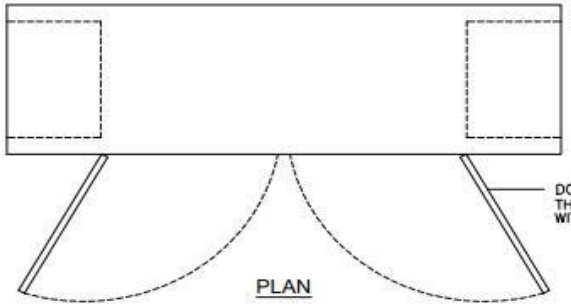
Bi-RIDE



FRONT VIEW



SIDE VIEW



PLAN

REFERENCE STANDARDS:- (Latest Editions)

1.	M.S SHEET	IS–1079
2.	REWIRABLE TYPE PORCELAIN CUTOUTS.	IS–2086
3.	DANGER BOARD.	IS–2551
4.	PAINT – SHADE 631	IS–5
5.	LOAD BREAK SWITCH	IS–4064

NOTES:-

1. THE BOX SHALL BE MADE OUT OF 3.0D(10SWG) SHEET EXCEPT DOOR SHALL BE OF 2.00 (14SWG) WITH CENTER STIFFNER PROVIDED.
2. THE BOX SHALL HAVE DOUBLE DOORS AND FITTED WITH INTERNAL TYPE DOOR LOCK WITH COMMON KEY FOR ALL THE BOXES.
3. THE BOX SHALL BE SUPPLIED WITH CHANNEL IN THE BOTTOM FIXED TO THE BOX HOLES FOR FOUNDATION BOLTS TO BE PROVIDED.
4. THE CUTOUTS SHALL BE OF RE–WIRABLE TYPE WITH EXTENDED TERMINAL.
5. THE EXPOSED PORTION OF THE BUS BARS SHOULD BE PROVIDED WITH INSULATING SLEEVES OF THE BEARING COLOURS OF R. Y. B AND BLACK FOR RESPECTIVE PHASES AND NEUTRAL.
6. TERMINAL STRIPS OF THE CUTOUTS OF 100A AND 63A MUST BE SUITABLY BENT TO THE SHAPE IF REQUIRED FOR PROPER FIXING.
7. THE BOX SHALL BE SUPPLIED WITH ENAMEL DANGER BOARD CONFORMING TO IS–2551.
8. THE BOX SHALL BE RUST PROOF. VERMIN PROOF AND WEATHER PROOF.
9. THE BOX SHALL BE PROVIDED WITH EARTHING WITH G.I BOLTS AND NUTS ON SLOTTED ANGLE IRON. (2 NOS. WITH SIGNS)
10. CABLE SHOULD BE PROVIDED BY SUITABLE SADDLE OF ANGLE IRON SUPPORTS.
11. CABLE ENTRY SHOULD BE AT SIDES OF THE BOX.
12. SWITCH TERMINAL SHOULD BE BENT EXTENDED AND STAGGERED SO THAT CABLE LEADS CAN BE FIXED DIRECT BY BOLT AND NUT WITHOUT BENDING.
13. ALL LIVE PARTS SHOULD BE SUFFICIENTLY INSULATED BY PVC INSULATING SLEEVES.
14. ARRANGEMENT OF FIXING HINGES TO THE DOORS MUST BE SUCH THAT DOOR CAN BE OPENED FULLY (160° MIN.) WITHOUT ANY DIFFICULTY. (AS SHOWN IN DRAWING).
15. THE BOX INCLUSIVE OF
    (A) 1 NO. 400A/630A 3 PHASE, 4 POLE LOAD BREAK SWITCH L&T, SIEMENS, ENGLISH ELECTRIC & CROMPTON GREAVES MAKE.
    (B) LINKS ON OTHER SIDE (PULLER TYPE LINK)

FUSE RATING	8 WAY	12 WAY
32A	4 Nos. Per Phase	–
63A	3 Nos. Per Phase	10 Nos. Per Phase
100A	1 No. Per Phase	2 Nos. Per Phase

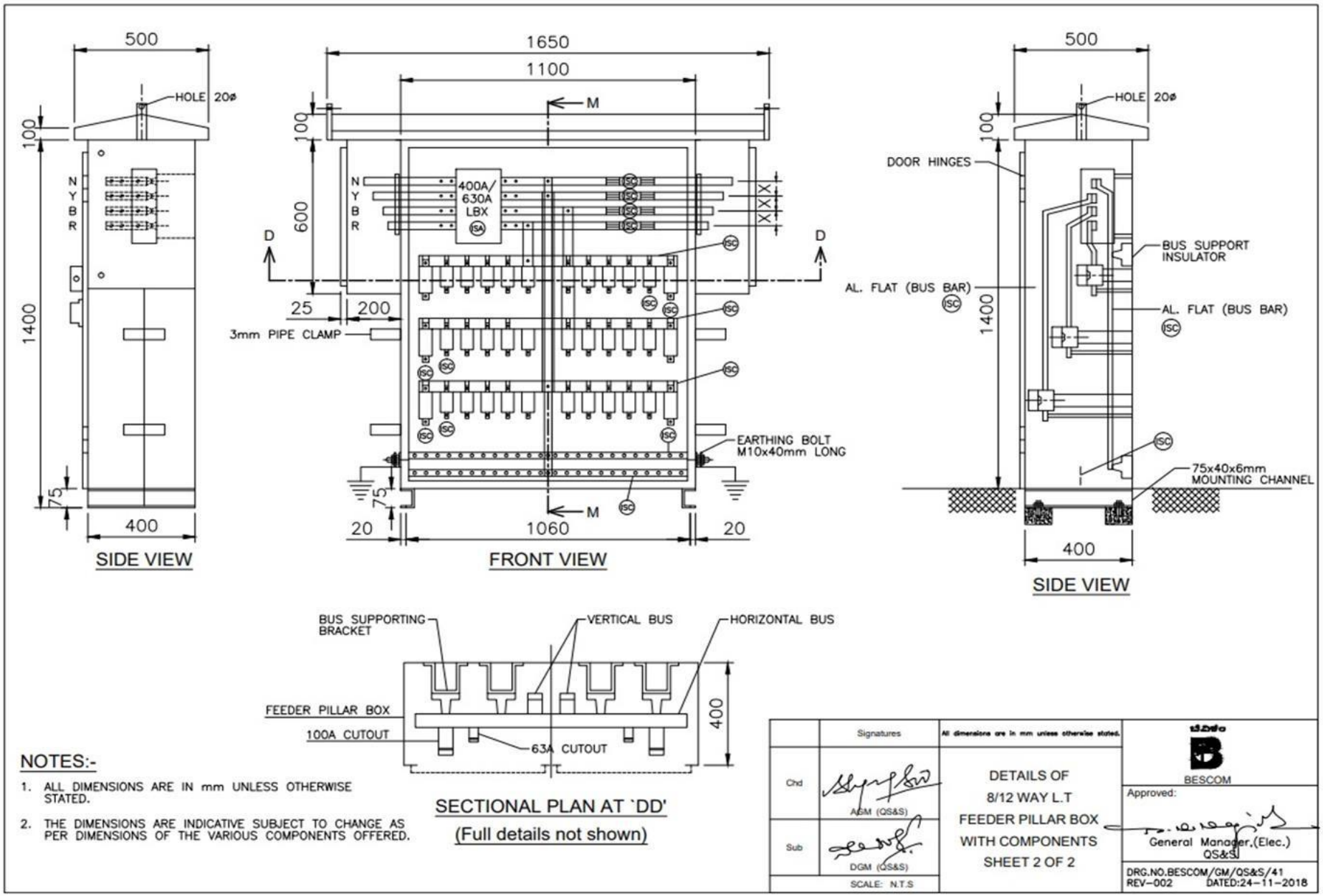
16. SIZE OF BUS BARS (COPPER/ALUMINIUM FOR 400A/630A CIRCUIT BREAKER)
    A. 30x3mm G.I PLATED M.S EARTH BUS.

8WAY & 12WAY BUSBAR DETAILS

LBS RATING	8 WAY	12 WAY
630A	30x10mm (300sqmm) Copper	30x10mm (300sqmm) Copper
400A	40x10mm (240sqmm) Copper	40x6mm (240sqmm) Copper
400A	30x10mm (400sqmm) Alu	40x10mm (400sqmm) Alu

17. DIMENSIONS SHOWN ARE INDICATIVE, SUBJECT TO CHANGE AS PER DIMENSIONS OF THE VARIOUS COMPONENTS OFFERED.
18. PROVISION FOR CLAMP TO FIX 100mm DIA, PVC PIPE IS TO PROVIDED FOR CABLES.

	Signatures	All dimensions are in mm unless otherwise stated.	
Chd	AGM (QS&S)	DETAILS OF 8/12 WAY L.T FEEDER PILLAR BOX SHEET 1 OF 2	BESCOM Approved: General Manager,(Elec.) QS&S
Sub	DGM (QS&S)		
	SCALE: N.T.S		DRG.NO.BESCOM/GM/QS&S/41 REV–002 DATED:24–11–2018


500
HOLE 20ø
100
1400
75
400
N Y B R
SIDE VIEW
1650
1100
M
100
600
400A/ 630A LBX
D
D
25
200
3mm PIPE CLAMP
EARTHING BOLT M10x40mm LONG
75
20
1060
20
M
FRONT VIEW
500
HOLE 20ø
100
DOOR HINGES
BUS SUPPORT INSULATOR
AL. FLAT (BUS BAR)
1400
AL. FLAT (BUS BAR)
75x40x6mm MOUNTING CHANNEL
400
SIDE VIEW
BUS SUPPORTING BRACKET
VERTICAL BUS
HORIZONTAL BUS
FEEDER PILLAR BOX
100A CUTOUT
63A CUTOUT
400
SECTIONAL PLAN AT `DD'
(Full details not shown)
NOTES:-
1. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE STATED.
2. THE DIMENSIONS ARE INDICATIVE SUBJECT TO CHANGE AS PER DIMENSIONS OF THE VARIOUS COMPONENTS OFFERED.
Signatures
All dimensions are in mm unless otherwise stated.
Chd
AGM (QS&S)
Sub
DGM (QS&S)
SCALE: N.T.S
DETAILS OF 8/12 WAY L.T FEEDER PILLAR BOX WITH COMPONENTS SHEET 2 OF 2
BESCOM
Approved:
General Manager,(Elec.) QS&S
DRG.NO.BESCOM/GM/QS&S/41
REV–002 DATED:24–11–2018

SECTION – 15

HEAT SHRINKABLE TYPE, TAPE X TYPE, PRE-MOULDED TYPE AND COLD SHRINKABLE TYPE JOINTING KITS AND TERMINATIONS

Bi-RDE

TECHNICAL SPECIFICATION FOR HEAT SHRINKABLE TYPE, TAPE X TYPE, PRE-MOULDED TYPE AND COLD SHRINKABLE TYPE JOINTING KITS AND TERMINATIONS

1.0 This specification covers the design, manufacture, testing and supply and Heat Shrinkable type, Pre molded type, Cold shrinkable type, Tapex type, Jointing, and termination kits suitable for XLPE and PILC Cables manufactured in general conformity to the standards published by Bureau of Indian Standards, New Delhi.

1.1 The purchaser reserves the right to place orders for any type of terminations/joints.

2.0 The tenderers shall furnish the type and complete technical details of joints/terminations offered with dimensional drawings, materials, literature, type test certifications from recognized test houses/institutions prior to supply of item.

3.0 The cable jointing kits/terminations are required for use on PILC/XLPE Cables, the details of which are as noted below:

1.	Type	:	PILC/XLPE insulated conductor and insulation screened.
2.	Voltage	:	11KV
3.	Conductor	:	Circular Compacted Aluminum
4.	No. of Cores & Cross-Sectional area of conductor	:	Three Core – 95, 240 and 400 Sq.mm. Single Core – 1000 Sq.mm.
5.	Armor	:	G.I. Round/Formed, Wire/Hard drawn, Aluminum wire.
6.	Sheath	:	a)Lead alloy E. Sheathed in Case of PILC Cable. b) PVC Compound type ST-2 in case of XLPE Cable.
7.	Installations	:	Directly buried in ground.

4.0 **HEAT SHRINKABLE TYPE**:

4.1 The term 'Heat Shrinkable' refers to extruded or molded – polymeric material which are cross linked to develop elastic memory and supplied in an expanded or otherwise deformed size and shape. Subsequent heating in an unconstrained state to a temperature above the shrink temperature results in the materials recovering or shrinking to its original shape.

4.2 Stress control and stress grading wherever necessary in the termination and joint shall be by means of semi conducting heat shrinkable tubing.

Bi-RIDE

4.3 Environmental sealing between the heat shrinkable materials and cable surfaces shall be achieved by using hot melted sealants or adhesives. Where such sealants or adhesives are exposed to high electrical stress, they must be track resistant. The adhesive or sealant used in the joint/terminations should not permit any entry of moisture into the joint/termination.

4.4 The external covering of insulated cores for terminations shall be by means of modified silicon heat shrinkable tubing's, which have non tracking and erosion resistant properties. The purchaser reserves the right to insist on checking the tracking resistance property of the non tracking materials.

5.0 **PREMOULDED TYPE (XLPE CABLE)**:

5.1 The term permoulded refers to of premanufactured work-tested parts of a termination or joint of moulded Ethylene Propylene Diane Monomer (i.e. EPDM) rubber or silicone Rubber components with non-tracking and erosion resistant properties.

5.2 The stress control and stress grading components/material wherever necessary in the terminations and joints shall be highly track resistant insulating section vulcanized to a semi conducting section.

5.3 Interface between the premoulded stress control/grading – component screen material and cable surface shall be achieved by semi conducting material which has cold flow properties. The design should climinate voids/air packets at the interface and discharge at the cable screen edges.

5.4 The stress cone must be of proven design for stress control. The semi conducting portion of ht stress cone should be vulcanized with insulation so that both semi conducting and insulation portion becomes an integrated part.

5.5 Environment sealing and to prevent ingress of moisture – between pre molded components and cable surface/end shall be provided with compatible component/device.

6.0 **TRANSITION JOINTS**:

In this specification the transition joint is defined as a straight through cable joint between two cables of different designs. The construction of the two cables to be joined, differ in insulation material, water barriers and configuration of cores, and stress distribution.

The transition joint is intended to be used between two cable 11 KV Grade, 3 core of following description.

1. Paper insulated, Mind, Lead Covered, Double steel tape/round wire armored of either belted or screened design. The conductor is Aluminum with stranded sector shape or stranded circular shape.
2. Cross linked polyethylene insulated cables of screened type with formed wire or round wire Armor, with PVC jacket. The conductor is Aluminum circular, compacted, generally the sizes of the conductor are 95, 240 and 400 Sq.mm.

7.1 **Design Requirements**:

The joint must be capable of meeting the performance requirements of both the PILC and XLPE cables. The design must ensure that any interaction between the joining – materials.and the cable materials are not detrimental to either the performance of the transition joint or the cables to be joined.

i) STRESS CONTROL

The design of transition joint must control and limit high electrical stress and prevent discharges which occur at.

a) The termination (cut) of the lead sheath or earth envelop in a three-core belated cable.
b) At the screen cut back in a screened cable.
c) In the area of conductor connection (Ferrule/connector).

ii) CONTENT OF PAPER IMPREGNANT

The design should ensure that there will be no contact between impregnant of the paper cable and the insulating and screening materials on the XLPE side of the joint. The transition joint must be capable of totally eliminating any migration of the impregnant from the MI/MIND cable to XLPE cable.

iii) The transition joint must provide for continuation of armor/ earth continuity. The fault current carrying capacity of the earth/armor continuity must not be less than that provided on the cables being joined.

iv) The transition joint must be provided with a strong over-all cover for protection to prevent ingress of moisture into the joint.

8.0 **TAPEX TYPE SYSTEM**:

8.1 The term Tapex refers to the kits using self-amalgamation/self-vulcanizing insulation tape made of EPDM Rubber/EPR Tapes and Nonlinear stress grading material for stress control.

8.2 Stress control shall be by means of non-liner resistance material.

8.3 The joints and terminations shall meet the requirement of class 1 accuracy of IEEE-48.

8.4 The stress grading material shall be wrapped around the cable core, overlapping the edge of the outer conducting layer. The top layers shall fuse together to form a compact rubber body around the stress grading material and

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cable core thereby exert on active pressure on cable.

8.5 DESIGN REQUIREMENTS:

The joints and terminations shall provide the following performance function:

a) Electric Stress Control between the semi conducting screens and over the ferrule.
b) Reinstatement of cable insulation.
c) Environmental and moisture sealing.
d) Mechanical strength and protection.
e) The tapes shall be self-amalgamating/self-vulcanizing having Antitracking, Corona, Ozone and UV light resistant.
f) The joints and terminations shall not require penciling of insulation and preparation of semi conducting screen at right angles or evenly.

9.0 **REQUIREMENTS**:

The Heat Shrinkable Type/Premoulded Type/Tapex Type/Straight Through Joints, Transition Joints, Indoor and Outdoor Terminations shall be suitable for 11KV, XLPE and PILC Underground Cable of sizes.

a) 3 Core x 95 Sq.mm.
b) 3 Core x 240 Sq.mm.
c) 3 Core x 400 Sq.mm.
d) 1 Core x 1000 Sq.mm.

9.1 The approximate total requirement of jointing kits and terminations of various sizes are as per Annexure.

9.2 The quantity shown is only approximate and is subject to increase or decrease depending on the actual requirement.

10.0 **SERVICE CONDITIONS**:

10.1 The straight through joint transition joints shall be suitable for use with cables which are directly buried in ground.

10.2 The indoor terminations shall be suitable for use in switchgear designed for both Indoor and Outdoor installation.

10.3 The outdoor terminations shall be suitable for use in directly exposed atmospheric conditions.

11.0 **POWER SYSTEM PARTICULARS**:

1. System voltage	:	11 KV
2. Highest voltage	:	12 KV
3. Neutral	:	Effectively earthed
4. Frequency	:	50 HZ + OR – 3%
5. CSA of conductor	:	3 core 95 to 400 Sq.mm. Aluminium 1 core 1000 Sq.mm. Aluminium
6. Rated Current at 90^0C	:	3 Core 195 to 410 Amps 1 Core 740 Amps.

12.0 **CLIMATIC CONDITIONS**:

a. Site locations	:	Various sites in Karnataka State.
b. Altitude	:	Not exceeding 1000M above sea level.
c. Ambient Temp.	:	50^0C Max. 5^0C Min.
d. Relative Humidity	:	100% Max. 10% Min.
e. Rainfall	:	As per Indian Monsoon.

13.0 **STANDARDS**:

13.1 The testing of the completed system of joints and terminations shall be in accordance with the following standards, with latest amendments.

a) IS 13573: Joints and terminations of polymeric cables for working voltages from 6.6 KV up to & including 33 KV performance requirements and type tests.
b) VDE 0278 Power Cables accessories with rated voltage up to 30KV.

The other applicable standards for testing of accessories and material properties of document shall be:

i) IS 7098 Part (2) – 1985: Cross linked polyethylene insulated PVC sheathed cables.
ii) IEC 60502 – Extruded solid dielectric power cables for rated voltages from 1 KV up to 30 KV.
iii) ISI 0913 – Electricity supply industry (Electricity Technical Association) performance specification for high voltage heat shrinkable components for use with high voltage solid type cables Up to and including

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33KV.

iv) IEEE 48 – Test procedures and requirements for high voltage alternating current cable terminations.
v) ISO-R 37 – determination of tensile stress strain properties of vulcanized rubbers.
vi) ASTM – D – 2303 liquid contaminant inclined plane tracking and erosion test.
vii) IEC 60243 recommended method of test for electric strength of solid insulating materials at power frequencies.

14.0 **DESIGN REQUIREMENTS**:

a) **Joints**: The joint shall provide for the following performance functions.
   i) Electric stress control between the cable semi-conducting screens and over the ferrule.
   ii) Reinstatement of cable insulation.
   iii) Environmental protection and moisture sealing.
   iv) Mechanical strength and protection.

b) **Terminations**: The terminations shall be designed to provide.
   i) Electric stress control for the cable insulation shield terminus.
   ii) Complete external leakage insulation between the cable conductor/conductors and earth.
   iii) Seal to the end of the cable against the entrance of external environment.

c) The joints and terminations in the form of completed system shall meet the type test requirements as per the standards:
   i) IS 13573 with the latest amendments.
   ii) VDE 0278

15.0 **TESTS**:

15.1 Routine Tests:
a) Visual inspection.
b) Dimensional check.
c) Physical verification of kit contents as per bill of material.

15.2 Acceptance Tests:
a) Tensile strength for tubings.
b) Ultimate elongation test for tubings.
c) Longitudinal shrinkage.

The above tests shall be conducted on samples selected at random from each lot of supply, at suppliers works or a reputed test house at suppliers' costs.

15.3 **Type Test:**

The successful bidder shall arrange at his own cost for conducting of type test on a completed system, at a reputed test house. The samples for such tests will be selected at random by the purchaser out of supplies offered. The tests will be witnessed by the representative of the purchaser. The type tests to be conducted shall be as prescribed in IS 13573 – or equivalent standards.

16.0 **TEST CERTIFICATE**:

16.1 The material offered shall be fully type tested as per relevant standards and the tenderer shall furnish type test reports from CPRI, Bangalore or VDE test certificates from any National/International test house.

16.2 For any change in the design/type already type tested and the design/ type offered against this specification, the purchaser will draw a sample from the supplies and the type test on these will be carried out by the supplier at his cost. In case the material/system fails in the type test the entire lot will be rejected.

16.3 The purchaser reserves the right to demand repetition of some or all the type tests in the presence of purchaser's representative.

17.0 **DRAWINGS**:

The tenderer shall furnish the dimensional drawing of the joints and terminations offered.

18.0 **GUARANTEED TECHNICAL PARTICULARS**:

The guaranteed technical particulars of the joints/terminations offered shall be furnished by the tenderer prior to supply of item.

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19.0 **TESTING FACILITY**:

The bidder shall furnish the details of manufacturing and testing facilities available with him and the address of their test houses where manufacturing and testing will be carried out.

20.0 **INSPECT AND TESTING**:

20.1 In respect of components like tubing, moldings and sealants the bidder shall furnish the proof of source of supply, manufacture test reports and quality assurance reports along with the bid, against past supplies similar documents shall be made available in respect of this order during inspection and testing.

20.2 The supplier shall tender necessary assistance in inspection and for witnessing of testing at his work/test house.

21.0 **QUALITY ASSURANCE**:

The bidder shall invariably furnish the following information along with the offer. The information shall be separately given for individual components of the system offered, failing which the offer will be rejected.

i) Statement giving list of important components, auxiliaries, source of supply of raw materials, list of standards according to which the materials are tested, list of tests carried out on materials, test reports under type approval and quality assurance.

ii) List of areas in manufacturing process where stage inspections are normally carried out from quality control and details of such tests and inspections.

iii) The quality assurance plan with hold points for owners' inspection. The quality assurance plan and owners hold points shall be discussed between the owner and contractor before the QAP is finalized.

iv) The supplier shall furnish the routine test certificates of bought out accessories and central excise gate pass for imported items during inspection.

22.0 **DEVIATION**:

Any deviation from the specifications shall be set out clause by clause by the tenderer in a separate sheet titled "Technical Deviations".

23.0 **BILL OF MATERIALS/KIT CONTENTS**:

23.1 Each jointing/termination kit supplied as a single kit shall be self-sufficient and contain all necessary electrical/mechanical components for making a complete joint/termination. There shall be absolutely no necessity of any additional material/component, except the contents supplied in the kit for making the joint/termination. Terminal lugs shall be of copper only.

23.2 The bid shall accompany with detailed list of kit contents/bill of materials, describing the component, quantity, material of component, dimensions size, weights lengths of tubing etc.

23.3 All the kit contents shall have unlimited life for storage in Indian conditions.

23.4 Any components which have a specific shelf life, the component should be stamped with date of manufacturing and the expiry date.

24.0 **PACKING AND MARKING**:

24.1 All components pertaining to a joint or termination shall be packed in a strong separate cardboard carton with each component sealed and labeled.

24.2 The package shall be marked with the name of the manufacturer, supplier, type designation, and relevant technical information along with address of consignee the details of consignment batch No., bill of materials for each package.

25.0 **LIST OF DOCUMENTS TO BE FURNISHED WITH THE BID**:

25.1 (i) Technical Brochure
(ii) Drawings
(iii) Installation Instructions
(iv) Type test reports on complete (joint and termination) system and the components
(v) Quality assurance plan
(vi) Supply record, clearly indicating the address of the purchaser, order reference, material supplied, voltage class, quantity and date of supply.
(vii) Test report literature, brochure of bought out items.
(viii) Performance reports/certifications from customers.

26.0 **GUARANTEE**:

26.1 The jointing kits and terminations shall be guaranteed for satisfactory and trouble-free operation for a period of five years from the date of supply against defects in the materials or design.

26.2 In case of failure within the guaranteed period due to faulty design and defective materials, and on such information to the supplier the jointing/termination kit will be replaced free of cost by the supplier within a period of 3 months from the date of intimation by the purchaser.

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Heat Shrink Straight Through joint on 6.6kV (UE)/11kV(E) XLPE

Type: SHR

Sl. No.	Particulars	Unit	Guaranteed Values
1	MANUFACTURER		
2	APPLICABLE STANDARDS		
3	GAURANTEED PARTICULARS		
3.1	For the nominal (phase to phase)		
	System Voltages	KV	
	Maximum system voltage	KV	
3.2	A.C. withstand voltage Dry (ph/ground)	KV	
	time duration	Mins	
3.3	Partial Discharge at 1.73 Uo	pC	
3.4	Impulse Withstand, 1.2/50/Us	kV	
3.5	Load Cycle Test		
	a) Each Cycle-Heating Duration	Hrs	
	Temperature	o C	
	Cooling Duration	Hrs	
	b) Number of Cycles		
	c) Continuous phase to ground		
	Voltage withstands	kV	
3.6	Thermal Withstand Short circuit current. 1Sec	ka	
3.7	Dynamic short circuit withstand	ka Peak	
4	KIT PARTICULARS		
4..1	Material of the tubing/moulded parts		
4.2	Method of stress control		
4.3	Method of environmental seal		
4.4	Allowable Kit storage Temperature	o C	
4.5	Shelf life of H.S. components	Years	
5	Cable Termination Instruction Manuals	Yes/No	

Heat Shrink Outdoor Termination on 6.6kV (UE)/11kV(E) XLPE cable.

Type: OHR

Sl. No.	Particulars	Unit	Guaranteed Values
1	MANUFACTURER		
2	APPLICABLE STANDARDS		

TENDER

3	GAURANTEED PARTICULARS		
3.1	For the nominal (phase to phase)		
	System Voltages	KV	
	Maximum system coltage	KV	
3.2	A.C. withstand voltage Dry (ph/ground)	KV	
	Time duration	Mins	
	A.C. withstand voltage Wet (ph/ground)	KV	
	Time duration	Mins	
3.3	Partial Discharge at 1.73 Uo	pC	
3.4	Impluse Withstand, 1.2/50/Us	kV	
3.5	Load Cycle Test		
	a) Each Cycle-Heating Duration	Hrs	
	Temperature	o C	
	Cooling Duration	Hrs	
	b) Number of Cycles		
	c) Continuous phase to ground		
	Voltage withstands	kV	
3.6	Thermal Withstand Short circuit current 1Sec	ka	
3.7	Dynamic short circuit withstand	ka Peak	
4	KIT PARTICULARS		
4..1	Material of the tubing/moulded parts		
4.2	Method of stress control		
4.3	Method of environmental seal		
4.4	Allowable Kit storage Temperature	o C	
4.5	Shelf life of H.S. components	Years	
5	Cable Termination Instruction Manuals	Yes/No	

Heat Shrinkable Indoor Termination on 6.6kV (UE)/11kV(E) XLPE cable

Type: IHR

Sl. No.	**Particulars**	**Unit**	Guaranteed Values
1	MANUFACTURER		
2	APPLICABLE STANDARDS		
3	GAURANTEED PARTICULARS		
3.1	For the nominal (phase to phase)		
	System Voltages	KV	
	Maximum system coltage	KV	
3.2	A.C. withstand voltage Dry (ph/ground)	KV	
	Time duration	Mins	
3.3	Partial Discharge at 1.73 Uo	pC	

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3.4	Impluse Withstand, 1.2/50/Us	kV	
3.5	Load Cycle Test		
	a) Each Cycle-Heating Duration	Hrs	
	Temperature	o C	
	Cooling Duration	Hrs	
	b) Number of Cycles		
	c) Continuous phase to ground		
	Voltage withstands	kV	
3.6	Thermal Withstand Short circuit current 1Sec	ka	
3.7	Dynamic short circuit withstand	ka Peak	
4	KIT PARTICULARS		
4..1	Material of the tubing/moulded parts		
4.2	Method of stress control		
4.3	Method of environmental seal		
4.4	Allowable Kit storage Temperature	o C	
4.5	Shelf life of H.S. components	Years	
5	Cable Termination Instruction Manuals	Yes/No	

GUARANTEED TECHNICAL PARTICULARS FOR STRAIGHT OUGHJOINTING, TRANSITION JOINTING & TERMINATION KI ABLE FOR 11KV (E) SYSTEM

Sl. No.	Particulars		As per BESCOM
1	Name of manufacturer		Shall be spcified by Bidder
2	Applicable standards		IS -13573, IS-13705 etc.
3	Rated Voltage of Cable accessories		11LV
4	AC voltage withstand (Dry)		35KV
5	AC voltage withstand (Wet) for outdoor termination)		28KV
6	DC voltage withstand		48KV
7	Partial Discharge test		Pd magnitude shall not exceed 20Pc for elastomeric & XLPE cables and 40Pc for PVC cables
8	Impulse voltage withstand test		75KV
9	Load cycle test		
	a. Each cycle Heating duration		5Hrs
	Temperature		
	Cooling duration		3Hrs
	b. Number of cycles		60
	c. Continious Phase to earth voltage withstand		

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10	Humidity test		7KV
11	Salt Fog test (only for outdoor terminations)		7KV
12	Thermal withstand short circuit test		
13	Dynamic short circuit withstand test		2.55 x Isc
14	tubing material		
15	method of stress control		
	method of environmental seal		
16	Non tubing Material		
17	Di electric insulating Material		
18	conductor resistance test		
19	Impact test		
20	Water tightness test		
21	Dielectric power factor test (Applicable for screened cables)		
22	Allowable kit storage temperature		
23	Shelf life of H.S components		
24	Cable termination Instruction manuals		

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SECTION – 16

SPUN POLE

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TECHNICAL SPECIFICATION FOR SPUN CONCRETE POLES

1) SCOPE:

This specification covers design manufacture testing and supply of prestressed concrete circular spun poles/designed for a working load of 500 Kgs.

2) Applicable Standards:

The poles shall comply with the relevant provisions made in the following Indian Standards Specifications or the latest versions thereof, except when they conflict with the specific requirements in this specific requirement in this specification.

a. IS 1678-1978 – Specification for the stressed concrete poles for overhead power, traction, and telecommunication lines.
b. IS 2905-1966 – Methods of test for concrete poles for overhead power and telecommunication lines.
c. IS 7321-1974 – Code of practice for selection, handling, and erection of concrete poles for overhead power and telecommunication lines.
d. IS **13158**-1991 – Prestressed concrete circular spun poles for overhead power.

Materials meeting any other authoritative standards which ensure an equal or better quality than the standards mentioned above will also be acceptable. In such cases, English version of the standard adopted should be furnished prior to supply.

3) Terminology:

For the purpose of this specification, the definitions of Average Permanent Load, Load Factor and Transverse Load at first crack, Ultimate Failure, Ultimate Transverse Load and Working Load shall be as per IS 1678 or any other equivalent International Standards.

4) Dimensions and Shape:

The poles shall be of hollow circular section with an outside taper of 1:65. The diameter and thickness shall be as per design requirements. The tolerances shall be as follows:

Outer diameter	+4,	(-) 2mm
Length	+50,	(-) 10mm

5) Cement:

5.1. High strength ordinary Portland cement conforming to IS:8112 or ordinary Portland Cement conforming to IS: 269-1976 or rapid hardening cement conforming to IS-804 1 E-1978 or any other equivalent International Standards shall be used, which shall have the following additional requirements:

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a)	Initial Setting Time	:	Not less than 30 minutes.
b)	Final Setting Time	:	Not more than 600 minutes.

5.2 The minimum compressive strength of standard mortar cube with standard sand as per IS:650 at 7 days shall be 375 Kgs/cm square.
A minimum of 3 trial cubes shall be made with aggregate grading to be used for the approved design mix and the average compressive strength results at 7 days, shall be determined to assess the suitability of the cement for every batch of cement.

6) Aggregates:

Coarse and fine aggregates used for the casting of poles shall conform to IS:383 or any other equivalent international Standards. The nominal max size of aggregates shall in no case exceed 20 mm or 1/4th the minimum thickness of the pole, whichever is less., provided further that the size of aggregates shall be at least 5mm less than the spacing between the pre-stressing wires.
Each size of graded aggregate shall be stocked in different storage bins or stockpiles and shall be mixed only after the quantity required for each size has been separately weighed. The storage bins or stockpiles shall be under cover to protect from the weather.

7) Water:

Water should be free from chlorides, sulphates, other salts, and organic matter. Potable water will be generally suitable.

8) Admixtures:

Admixtures should not contain calcium chloride or other chlorides and salts which are likely to promote corrosion of pre-stressing steel.

9) Reinforcement:

9.1 Reinforcing bars and wires used for the manufacture of prestressed concrete poles shall conform to the following Indian Standards or any other equivalent International Standards.

a. IS:1785(Part-I) Specification for plain hard drawn steel wire for prestressed concrete: Part-I cold-drawn stress relieved wire (second revision).
b. IS:1785(Part-II) – 1983 Specification for plain hard drawn steel wire for prestressed concrete: Part-II as drawn wire (First revision).
c. IS:2090-1983 – Specification for high tensile steel bars used in prestressed concrete (first revision).
d. IS:6003-1983 Specification for indented wire for prestressed concrete (first revision)
e. IS:6006-1983 specification for uncoated stress relieved strand prestressed concrete (first revision).

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9.2 The surface of all reinforcement shall be free from loose scale, oil, grease, clay or other material that may have deteriorated effect on the bond between the reinforcement and the concrete.

10) Concrete:

The concrete mix shall be designed to the requirement laid down for controlled concrete (also called design mix concrete) in IS-1343 (code of practice for prestressed concrete) and 1S-456 (code of practice for plain and reinforced concrete) or any other equivalent international standards subject to the following special conditions.

a. Minimum works cube strength at 28 days should be at least 50N/mm square.
b. The concrete strength at transfer should be at least half the 28 days strength ensured in the design.

11) Design Requirements:

The pole shall be designed for the following requirements:

a. Factor of safety for the poles shall not be less than 2.0
b. The average permanent load shall be taken as 50% of the working load.
c. The F.O.S. against first crack load shall be 1.0
d. At average permanent load, permissible tensile stress in concrete shall be 3.0 N/mm square.
e. At the design value of first crack load, the hypothetical flexural tensile stress of M 50 concrete grade shall not exceed 6.3 N/mm square.
f. The maximum compressive stress in concrete at the time of transfer of prestress shall not exceed 0.8 times the cube strength.

12) Molds:

Molds shall be of steel and or rigid construction to prevent distortion and so arranged as to provide smooth surfaces. The molds shall not allow any leakage of cement grout during casting. The holes in the end plates for the HT wires shall be accurately drilled by jigs to ensure inter-changeability. The end plates shall be designed to withstand the forces arising out of the change in direction of pre-stressing wires during tensioning.

13) Tensioning of Wires:

13.1 The HT wires shall be placed axially at regular spacing along the circumference. The spacing shall be as per IS 1678 or any other equivalent to International Standards. While cutting in of HT wires will be by automatic machines, button heading and forming reinforcement cages shall be done manually.

13.2 Helical steel shall be 2.7mm dia MS wires and the pitch shall be 150mm.

13.3 The clear cover shall be 20mm.

13.4 Pre-stressing shall be by automatic machines. Force shall be applied on the entire group of HT wires to ensure all wires are equally stressed.

13.5 The pre-stressing wires shall be stretched by an approved method. The anchoring of the stretched wires shall be such that during manufacture and until the wires are released, no slipping occurs. The force at the time of initial stretching shall in addition to imparting of designed prestress also be sufficient to overcome the friction on account of any change in the inclination of wires and slippage that might occur during the anchoring process which will have to be suitably compensated.

13.6 The tensioning of pre-stressing steel shall be carried out in a manner that will induce a smooth and even rate of increase of stress in the wires.

13.7 The force induced in the pre-stressing wires shall be determined by means of gauges attached to the tensioning apparatus and cross checked by extension to be achieved shall be determined in advance, based on trials conducted on representative samples of the wires as used in the poles. The accuracy of the devices for measuring of the tensioning force shall be within plus or minus 5%.

14) Mixing and Consolidation of Concrete.

14.1 Provision shall be made to measure the quantities of cement and of fine and coarse aggregates by weight only. The accuracy of the measuring equipment shall be plus or minus 3%. All the measuring equipment's shall be maintained in clean, serviceable condition and its accuracy checked regularly. Modern high-speed mixers, preferably pan or turbine type shall be used for mixing the concrete.

14.2 The manufacture of poles shall be done under suitable cover and not in the open.

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14.3 The concrete shall be thoroughly mixed and consolidated.

14.4 The freshly cast poles shall be protected during the first stage of hardening form the harmful effects of sunshine, dry winds, cold and rains.

15) De tensioning of Wires:

15.1 The anchoring system shall provide a device for gradual de tensioning of the wires. No back pulling of the wires shall be permitted in the gradual de tensioning device for the purpose of release of any wedge or other parts of the de tensioning device. Flame cutting of the wires before release of the full tension shall be strictly prohibited.

15.2 The transfer of prestress shall not be affected until the concrete in the poles has attained the specified as established of cube tests.

16) Curing:

16.1 The curing shall be done on a saturated steam at 65 degrees centigrade to ensure that 80% ultimate strength is reached in 6 hours. Thereafter the HT wires will be cut, poles demoulded and transferred to water for 14 days curing.

16.2 During manufacture, periodical tests on concrete cubes of preferably spun hollow cylindrical specimen measuring 200mm in dia and 300mm in height shall be carried out till the concrete achieves the required strength at transfer. Thereafter the test on concrete shall be carried out as detailed in IS:1343 or any other equivalent international standards. The manufacturer shall supply when required by the purchaser results of compressive test conducted in accordance with IS:456 or any other equivalent International Standards on concrete cubes made from the concrete used for the poles. If the purchaser so desires the manufacturer shall supply cubes for test purpose and such cubes shall be tested in accordance with IS:456 or nay other equivalent International Standards.

17) Earthing:

17.1 Earthing shall be provided by 6mmΦ MS Earth Rod embedded in Concrete with M16 MS Nut as shown in Drawing.

17.2 Earth wire shall not be allowed to come in contact with the prestressing wires.

18) Finish:

18.1 Poles shall be free from surface defects including hair cracks. The surface of the poles in contact with the steel mould shall be smooth and regular in shape and shall as far as possible, be free from pores. Water retaining pockets or honey- combing formation shall not be admissible. 25mm thick 1:2 cement mortar cover shall be provided on the full area of the top of pole.

18.2 The ends of the prestressing wire shall be cut as close to the surface of the pole as possible and in any case shall not project more than 3mm.

18.3 The ends of the prestressing wire shall be given two coats of suitable anti- coorrosive paints approved by the purchaser.

18.4 No touching up or finishing by cement grout, etc., shall be done on the poles after it is removed from the moulds.

18.5 A metallic base plate shall be provided at the bottom of pole.

19) Welding and Lapping of Steel:

The high tensile steel wire shall be continuous over the entire length of the tendon. Welding shall not be allowed in any case. However, joining or coupling may be permitted provided the strength of the joint of coupling is not less than the strength of each individual wire.

20) Provision of Holes & Hooks:

20.1 Through holes shall be provided for fixing cross arms and top clamp as specified by purchaser.

20.2 PVC inserts shall be provided at intervals of 600mm on alternate sides for fixing up of step bolts along the length of pole.

20.3 A set of step-up bolts shall be supplied along with each lot of 100 poles.

21) Tests:

21.1 During manufacture, tests on concrete shall be carried out as detailed in the clause.

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16.2 of this specification.

21.2 Transverse strength test.

21.2.1 Poles made of ordinary Portland cement shall be tested on the completion of 28 days and poles made from rapid hardening cement only on the completion of 14 days after the day of manufacture.

21.2.2 The pole may be tested in either horizontal or vertical position. If tested in horizontal position, provision shall be made to compensate for the overhanging weight of the pole. For this purpose, the overhanging portion of the pole may be supported on a movable trolley or similar device.

21.2.3 The pole shall be rigidly supported at the butt end for a distance equal to the agreed depth of planting i.e. 1.8 mtr.

21.2.4 Load shall be applied at a point 600mm from the top of the pole and shall be steadily and gradually increased to the design value of the transverse load at first crack. The deflection at this load shall be measured.

21.2.5 A pre-stressed concrete pole shall be deemed not to have passed the test if visible cracks appear at a stage prior to the application of the design transverse load for the first crack.

21.2.6 The load shall then be reduced to zero and increased gradually to a load equal to the first crack load plus 10% of the minimum ultimate transverse load and held up for 2 minutes. This procedure shall be repeated until the load reaches the value of 80% of the minimum ultimate transverse load and thereafter increased by 5% of the minimum ultimate transverse load until failure occurs. Each time the load is applied, it shall be held for 2 minutes. The load applied to pre-stressed concrete pole at the point of failure and shall be measured to the nearest five kilograms.

21.2.7 The pole shall be deemed not to have passed the test if the observed ultimate transverse load is less than the designed ultimate transverse load.

22) Sampling and Testing:

22.1 scale of sampling:

22.1.1 Lot-In a consignment, 500 poles or part there of the same mounting height, same dimensions and belonging to the same batch of manufacture, shall be grouped together to constitute a lot.

22.1.1.1 Sub-Lot: If the number of poles in a lot exceeds 500, the lot shall be divided into a suitable number of sub-lots such that the number of poles if any, sub-lot shall not exceed 500. The acceptance or otherwise of a sub lot shall be determined on the basis of the performance of samples selected from it.

22.1.2 The number of poles to be selected from a lot or a sub lot shall depend upon its size and shall be in accordance with col. 1 and 2 of the following table:

Size of lot	Dimensional Requirement		
	Sample Size	Permissible No. of Defective Samples	No. of poles for transverse strength test
(1)	(2)	(3)	(4)
Upto 100	10	1	(*)
101 to 200	15	1	3
201 to 300	20	2	4
301 to 500	30	3	5

(*) The No. of Poles to be tested shall be subject to confirmation by inspecting staff.

22.1.3 These poles shall be selected at random, in order to ensure randomness, all the poles in the lot or the sub-lot may be arranged in a serial order and starting from any random pole, every 'r'th pole may be included in the sample, 'r' being the integral part of N/n where N is the size of the lot or the sub-lot and 'n' is the sample size.

22.2 Number of Tests:

22.2.1 All the poles as selected in 22.1.2 shall be tested for overall length, cross-section, and uprightness. The permissible tolerances shall be +/- 15 mm on overall length,
+/- 3mm on cross sectional dimensions and 0.5% on uprightness.

22.2.2 The number of poles to be tested for transverse strength test shall be in accordance with col. 4 of the table in 22.1.2. These poles may be selected from those already tested in 22.2.1.

22.3 Criteria for Conformity:

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22.3.1 A lot or sub-lot shall be considered as conforming to this specification if the conditions under 22.3.2 and 22.3.3 are satisfied.

22.3.2 The number of poles which do not satisfy the requirements of overall length, cross- section and uprightness shall not exceed the corresponding number given in col.3 of the Table under clause 22.1.02. If the number of such poles exceeds the corresponding number, all poles in the lot or sub-lot shall be tested for these requirements., and those not satisfying the requirements shall be rejected.

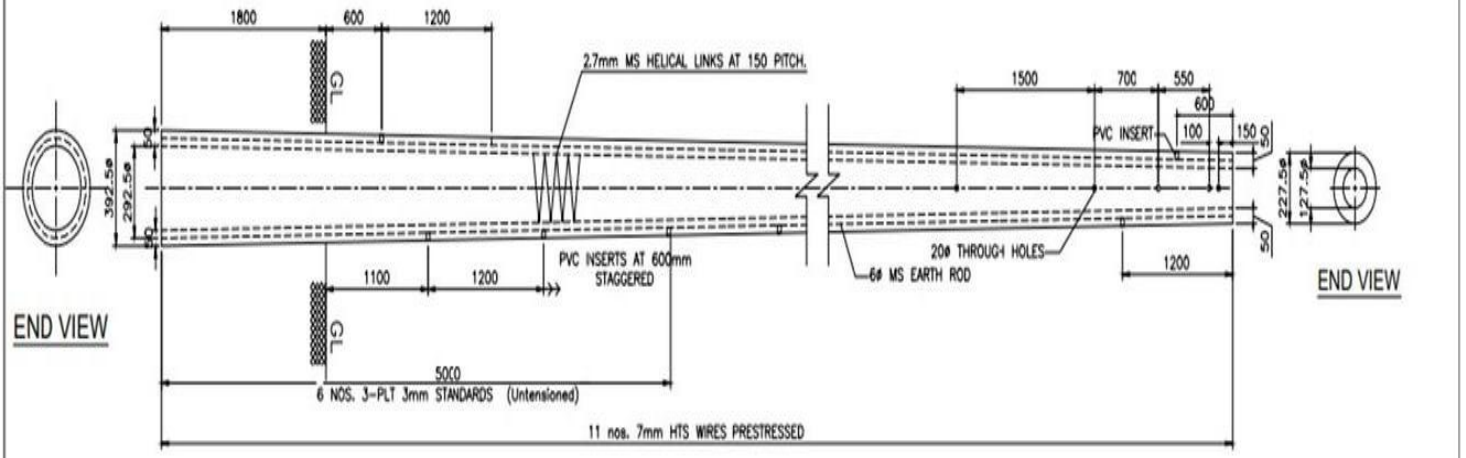
22.3.3 All the poles tested for transverse strength test shall satisfy the requirements of the test, if one or more poles fail, twice the number of poles originally tested, shall be selected form those already selected and subjected to the test. If there is no failure among these poles, the lot or the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

23) Marking:

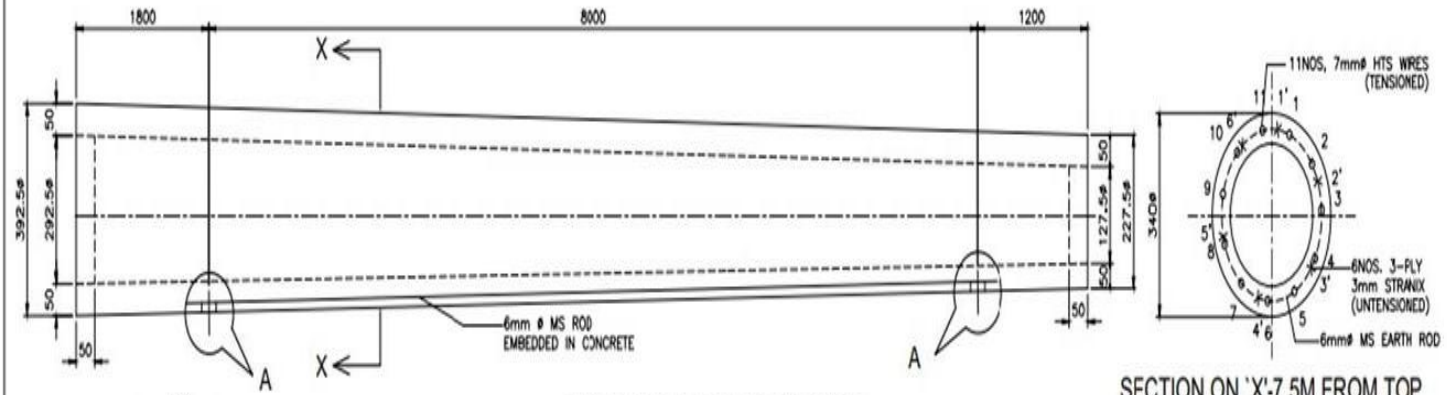
The poles shall be clearly engraved and indelibly marked with the following particulars either during or after manufacture but before testing at a position so as to easily read after erection in position:

a. Month and year of manufacture.
b. Transverse strength of pole in kg.
c. Serial number of the pole.
d. Position of center of Gravity of the pole with the word C.G.
e. Line indicating depth of planting.
f. BESCOM

Bi-RIDE

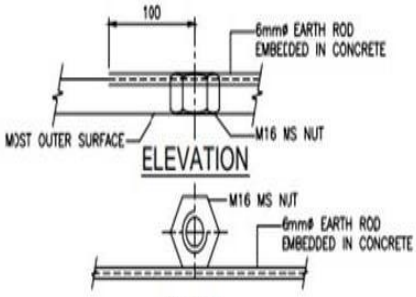


ELEVATION



ENLARGED SECTION SHOWING EARTHING ROD ARRANGEMENTS

SECTION ON 'X'-7.5M FROM TOP



ELEVATION

PLAN

DETAILS AT 'A'

INDEX OF MATERIALS

SL. NO.	DESCRIPTION	WEIGHT(Kg)
1.	CONCRETE 0.4416 - 2500Kg/m	1104.0
2.	3x3 PLY. HTS WIRES TO IS:6006-1983	5.0
3.	7mm HTS WIRES TO IS:6003-2010	36.8
4.	2.7mm HELICAL	2.8
5.	6mm EARTHING ROD TO IS:2062 GRADE 'A'	1.8

NOTES:-

1. 7mm HTS WIRES ARE INDENTED PC WIRES TO IS:6003-2010.
2. MS REINFORCEMENTS ARE TO IS:432 PL1-1982
3. GRADE OF CONCRETE F=52 Kg/Sq.Cm (CONTROLLED CONCRETE)
4. TRANSFER STRENGTH OF CONCRETE TO BE MINIMUM 306 Kg/Sq.Cm.
5. MINIMUM CLEAR COVER FOR TENSIONED & UNTENSIONED WIRE IS 20mm.
6. 6mm MS EARTH WIRE TO BE WELDED TO M16 NUT AT 2 LOCATIONS AS SHOWN.
7. PVC INSERTS AT 600 CRS STANDARD ON OPPOSITE SIDES SHOWN.
8. CG. OF POLE IS 6M FROM BOTTOM.

	Signatures	All dimensions are in mm unless otherwise stated.	
Chd	AGM (QS&S)	11.0M LENGTH PRESTRESSED CONCRETE SPUN POLE	BESCOM Approved: General Manager,(Elec.) QS&S
Sub	DGM (QS&S)		
SCALE: N.T.S			DRG.NO.BESCOM/GM/QS&S/45 REV-003 DATED:09-02-2022

SECTION - 17
PSCC POLE

Bi-RIDE

TECHNICAL SPECIFICATIONS FOR PRESTRESSED CEMENT CONCRETE POLES (9Mtr PSCC Pole with working Load of 300Kg) SCOPE:

1.1 This Specification covers the manufacture as per designs, testing and supply of 9Mtr Long Pre-stressed Cement Concrete Poles (PSCC) - 300 Kg Working Load.

The poles shall be manufactured according to REC Standard with Working Load of 300Kg. (designed, tested, and approved by the cement Research Institute of India) the details of which are furnished in the drawings enclosed.

2.0 APPLICABLE STANDARDS

2.1 Except when they conflict with specific requirement in this specification, the poles shall comply with the relevant provisions made in the latest version of the following Indian Standards specifications:

a) IS 1678/1998 Specification for pre-stressed concrete poles for overhead power, traction, and telecommunication lines.

b) IS 2905/1989 Methods of tests for concrete poles for overhead power and telecommunication lines.

c) IS 7321/1974 Code of practice for selection, handling, and erection of concrete poles for overhead power and telecommunication lines.

3.0 MATERIALS

3.1 Cement: The cement used in the manufacture of pre-stressed concrete poles shall be any one of the following 53-grade ordinary Portland cement conforming to IS 12269.

a) Portland slag cement conforming to IS 455 but with not more than 50 percent slag content.

b) Rapid hardening Portland cement conforming to IS 8041.

c) 43 grade ordinary Portland cement conforming to IS 8112, and

d) 53 grade ordinary Portland cement conforming to IS 12269.

3.2 **Aggregates:** Aggregates used for manufacture of pre-stressed concrete poles shall conform to IS: 383 (Specification for coarse and fine aggregates from natural sources for concrete). The nominal maximum size of aggregates shall in no case exceed 12 mm.

3.3 **Water:** Water shall be free from chlorides, Sulphate, other salts and organic matter. Potable water will be generally suitable.

3.4 **Admixtures:** Admixtures should not contain chlorides in any form are likely to promote corrosion of pre-stressing steel. Admixtures shall conform to IS: 9103 (Specification for admixtures for concrete).

3.5 **Pre-stressing steel:** The pre-stressing steel wires, including those used as intentioned wires, should conform to any one of the following:

1. IS 1785 (Part-I) Specification for plain hard-drawn steel wire for pre-stressed concrete. Part-I-Cold drawn stress relieved wire,
2. IS: 1785 (Part-II) Specification for plain hard drawn steel wire for pre-stressed concrete, Part-II. As drawn wire, or
3. IS 6003 Specification for indented wire for pre-stressed concrete,
4. Uncoated stress relieved strand conforming to IS 6006 or IS 14268
5. High tensile steel bar conforming to IS 2090

The type designs given are for plain wires of 4 mm. dia. with guaranteed ultimate strength of 175 Kg / mm². All

BIRD

pre-stressing steel shall be free from splits, harmful stretches, surface flaws, rough, aged and imperfect edges and other defects likely to impair its use in pre-stressed concrete.

4.0 CONCRETE MIX:

4.1 The concrete mix shall be designed to the requirement laid down for controlled concrete (also called design mix concrete) in IS:1343 Code of practice for pre- stressed concrete and IS:456 Code of practice for plain and reinforced concrete, Subject to the following special conditions:

a) Minimum works cube strength at 28 days should be at least 420 Kg./Cm².
b) The concrete strength at transfer shall not be less than half the 28 days strength ensured in the design, i.e., 420x0.5 = 210 Kg/Cm².
d) The mix should contain at least 360 Kgs. of cement per cubic meter of concrete.
e) The mix should contain low water content as is consistent with adequate workability. If it becomes necessary to add water to increase the workability the cement content also should be raised in such a way that the original value of water cement ratio is maintained.

5.0 DESIGN REQUIREMENTS:

5.1 The poles shall be designed for the following requirements:

a) The poles shall be planted directly in the ground with a planting depth as indicated in drawing i.e., 1.7 M. for 9 M. poles.
b) The poles should be suitable to take up a load of 300 Kg. applied at 0.6 M. from top.
c) The factor of safety for all these poles shall not be less than 2.0.
d) The average permanent load shall be 40% of the working load.
e) The FOS against first crack load shall be 1.0.
f) In the design value of first crack load the modulus of rupture shall not exceed 55.2 Kg sq.cm for M-40 concrete.
g) At average permanent load, permissible tensile stress in concrete shall be 30 Kg/Cm².
h) The ultimate moment capacity in the longitudinal direction should be at least one fourth of that in the transverse direction.
i) The maximum compressive stress in concrete at the time of transfer of pre- stress should not exceed 0.8 times the cube strength.
j) The concrete strength at transfer shall not be less than half the 28 days strength ensured in the design, i.e., 420x0.5 = 210 Kg/Cm².
k) The Poles shall be manufactured as per the enclosed drawings.

6.0 DIMENSIONS AND REINFORCEMENTS:

6.1 The cross-sectional dimensions and the details of pre-stressing wire should conform to the particulars as per drawings.

6.2 The provisions of holes for fixing cross arms and other fixtures should conform to the construction practice adopted by BESCOM.

7.0 MANUFACTURE:

7.1 All pre-stressing wires and reinforcements shall be accurately fixed as shown in the drawings and maintained in position during manufacture. The un-tensioned reinforcement, as indicated in the drawings, should be held in position by the use of stirrups, which should go round all the wires.

7.2 All wires shall be accurately stretched with uniform pre-stress in each wire. Each wire or group of wires shall

BI-RIDE

be anchored positively during casting. Care shall be taken to see that the anchorage does not yield before the concrete attains the necessary strength.

7.3 Cover: The cover of concrete measured from the outside of the pre-stressing tendon shall be normally 20 mm.

7.4 Welding & lapping of steel: The high tensile steel wire shall be continuous over the entire length of the tendon. Welding shall not be allowed in any case. However, jointing or coupling may be permitted provided the strength of the joint or coupling is not less than the strength of each individual wire.

7.5 Compacting: Concrete shall be compacted by spinning, vibrating shocking or other suitable mechanical means. Hand compaction shall not be permitted.

7.6 Curing: The concrete shall be covered with a layer of sacking, canvas, hessian, or similar absorbent material and kept constantly wet up to the time when the strength of concrete is at least equal to the minimum strength of concrete at transfer of pre- stress. Thereafter, the pole may be removed from the mould and watered at intervals to prevent surface cracking of the unit, the interval should depend on the atmospheric humidity and temperature.

7.7 The pre-stressing wires shall be de-tensioned only after the concrete has attained the specified strength at transfer (i.e., 210 Kg/Cm²). The cubes cast for the purpose of determining the strength at transfer should be

7.8 cured, as far as possible under conditions similar to those under which the poles are cured. The transfer stage shall be determined based on the daily tests carried out on concrete cubes till the specified strength indicated above is reached. Thereafter the test on concrete shall be carried out as detailed in IS 1343 Code of practice for pre-stressed concrete. The manufacturer shall supply when required by the Engineer or his representative, results of compressive test conducted in accordance with IS: 456 Code of practice for plain and reinforced concrete on concrete cubes made from the concrete used for the poles. If the Engineer so desires, the manufacturer shall supply cubes for test purposes and such cubes shall be tested in accordance with IS: 456 Code of practice for plain and reinforced concrete. The de-tensioning shall be done by slowly releasing the wires, without imparting shock or sudden load to the poles. The rate of de-tensioning may be controlled by any suitable means either mechanical (Screw type) or hydraulic. The poles shall not be de-tensioned or released by cutting the pre-stressing wires using flames or bar croppers while the wires are still under tension.

7.9 Stacking should be done in such a manner that the broad side of the pole is vertical. Each tier in the stack should be supported on timber sleepers located at 0.15 times the overall length, measured from the end. The timber supports in the stack should be aligned in a vertical line.

7.10 Poles should be transported with their broad faces placed vertically and, in such a,manner that shocks are avoided. The supports should be so arranged that they are located approximately at a distance equal to 0.15 times the overall length, from the ends. The erection of the pole should be carried out in such a way that the erection loads are applied so as to cause moment with respect to the major axis, i.e., the rope used for hoisting the pole should be parallel to the broader face of the pole.

8.0 EARTHING:

8.1 Earthing shall be provided by having a separate length of 4 mm dia GI Wire embedded in concrete during manufacture and the ends of wire left projecting from the burrow end of the pole to a length of 100 mm at 215 mm from top of the pole and 150 mm below ground level. The arrangement for termination of the earth wire and fixing of the bolt and nut shall be as indicated in the enclosed drawings. The Wire used for embedding shall comply with the requirement of IS-2141/2000.

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9.0 TESTS:

9.1 Transverse Strength Tests: Poles made from ordinary Portland cement shall be tested only on the completion of 28 days and poles made from rapid hardening cement, only on the completion of 14 days, after the day of manufacture.

9.2 The pole may be tested in either horizontal or vertical position. If tested in horizontal position, provisions shall be made to compensate for the overhanging weight of the pole. For this purpose, the overhanging portion of the pole may be supported on a movable trolley or similar device.

9.3 The pole shall be rigidly supported at the butt end for a distance equal to the depth of planting i.e., 1.7 meter for 9-meter poles.

9.4 Load shall be applied to at a point 600 mm from the top of the pole and shall be steadily and gradually increased to the design value of the transverse load for the first crack.

9.5 A Prestressed concrete pole shall be deemed not to have passed the test if visible cracks appear at a stage prior to the application of the design transverse load for the first crack.

9.6 The load shall then be reduced to a zero and increased gradually to a load equal to the first crack load plus 10% of the minimum ultimate transverse load and held up for 2 minutes. This procedure shall be repeated until the load reaches a value of 80% of the minimum ultimate transverse load and thereafter increased by 5% of the minimum ultimate transverse load until failure occurs. Each time the load is applied, it shall be held for 2 minutes. The load applied to Prestressed concrete pole at the point of failure shall be measured to the nearest five kilograms.

9.7 The pole shall be deemed not to have passed the test if the observed ultimate transverse load is less than the design ultimate transverse load.

9.8 Destruction Test: One pole out of a lot of 500 or less shall be subjected to destruction test to verify the steel and other aggregates used. No payment shall be made for the pole / poles which are subject to Destruction test.

10.0 MEASUREMENT OF COVER:

10.1 After completion of the transverse strength test, the sample pole shall be taken and checked for cover. The cover of the pole shall be measured at 3 points, one within

1.8 meters from the butt end of the pole, the second within 0.6 mtr. From the top and the third at an intermediate point and the mean value compared with the specified value.

10.2 The mean value of the measured cover should not differ by more than +/- 1 mm. from the specified cover. The individual values should not differ by more than +/- 3

mm. from the specified value. If these requirements are not met, the workmanship with reference to aligning of the end plates and per-stressing wires and assembly of moulds should be improved and inspection at production stage tightened suitably.

11.0 SCALE OF SAMPLING:

11.1 **Lot:** In any batch, all poles of the same class and same dimensions shall be grouped together to constitute a lot.

11.2 **Sub-Lot:** If the number of poles in a lot exceeds 500, the lot shall be divided into a suitable number of sub-lots such that the number of poles in any sub-lot shall not exceed 500. The acceptance or otherwise of a sub-lot shall be determined on the basis of the performance of samples selected from it.

3.1 The number of poles to be selected from a lot or a sub-lot shall depend upon its size and shall be in accordance with Col. 1 and 2 of the following table.

BERIDE

No. of poles in the Lot 1	Sample Size 2	Dimensional Requirement Acceptance Number 3	Transverse Strength Test 4	Transverse Strength Ultimate 5
Up to 100	10	1	2	1
101 to 200	15	1	3	1
201 to 300	20	2	4	1
301 to 500	30	3	5	2

The poles shall be selected at random. In order to ensure randomness, all the poles in the lot of the sub-lot may be arranged in a serial order and starting from any random pole, every 7th pole may be included in the sample `r' being the integral part of N/n where `N' is the size of the sub-lot and `n' is the sample size.

4.0 NUMBER OF TESTS:

4.1 All the poles as selected in accordance with Clause 11.3 shall be checked for overall length, cross section, and uprightness. The tolerance shall be +/- 15 mm. on overall length, +/- 3 mm. on cross sectional dimensions and 0.5 % on uprightness.

4.2 The number of poles to be tested for transverse strength test shall be in accordance with column-4 of the above Table. These poles may be selected from those already tested.

5.0 CRITERIA FOR CONFORMITY:

5.1 A lot or sub-lot shall be considered as conforming to this specification if the conditions under 11.1 and 11.2 are satisfied.

5.2 The number of poles, which do not satisfy the requirements of overall length, cross section, and uprightness, shall not exceed the corresponding number given in column 3 of Table. If the number of such poles exceeds the corresponding number, all poles in the lot or Sub-lot shall be tested for these requirements, and those not satisfying the requirements shall be rejected.

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

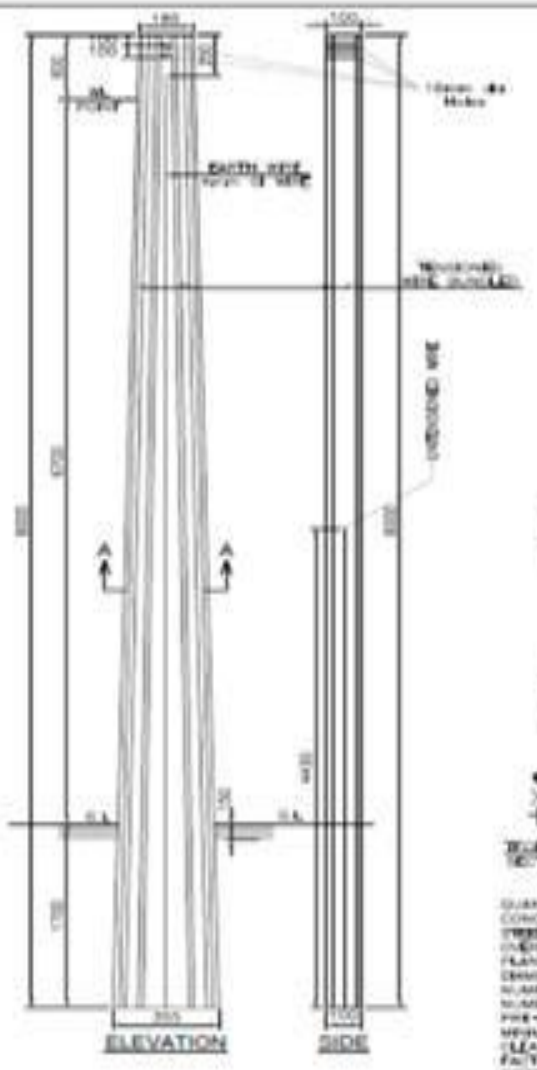
NOTE: No payment will be made for the tested pole, which fails or poles, which are tested to destruction.

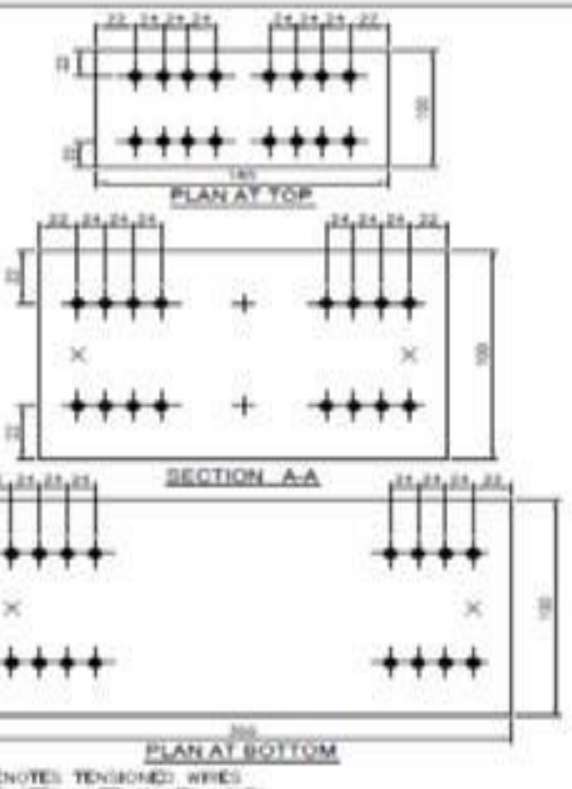
6.0 MARKING:

6.1 The pole shall be clearly engraved and indelibly marked with the following particulars during manufacture but before testing at a position so as to be easily read after erection in position.

a. Month and year of manufacture
b. Transverse strength of pole in Kg
c. Makers Sl. No. And mark
d. Line indicating depth of planting at 1.7 mtr.
e. Engraved letters indicating BESCOM.
f. P.O. No. / Date
g. Any other details as specified.

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● DENOTES TENSIONED WIRES
× DENOTES UNTENSIONED WIRES
+ POSSIBLE POSITION OF EARTH WIRE

	Signatures	All dimensions are in mm unless otherwise stated.	BESCOM
Chd	AGM (QS&S)	REINFORCEMENT DETAILS OF 9.0 M 300 Kg. PRESTRESSED CEMENT CONCRETE POLE (FACTOR OF SAFETY=2.0)	Approved. General Manager,(Elec.) QS&S
Sub	DGM (QS&S)		
SCALE: N.T.S			DRG.NO.BESCOM/GM/QS&S/55 REV=003 DATED:23-12-2019

SECTION - 18
EARTHING ARRANGEMENT

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1. EARTHING ARRANGEMENTS:

Perforated steel galvanized pipe of 'C' class of 40mm dia, 2.9mm thick and 2500 mm long shall be erected in an earth pit as shown in drawing below. The earth wire used shall be of GI strip of size 25mm x 3mm/ 8 SWG GI Wire whichever is required with suitable clamping of size not less than 25 x 3mm on to the terminal structure and embedded in concrete for raising to the top of terminal structure. Both ends of the GI strip/GI Wire should be fixed with GI bolts, nuts, and spring washer. The funnel shall be enclosed in a CC chamber of size 400x400x400mm with a cast iron cover. Earth box shall be painted above the ground level to facilitate painting of earth values. The earth electrode shall have staggered holes of 12mm dia and the pit shall be filled with alternate layers of charcoal and salt of thickness 150 mm surrounding the pipe. The earth value when measured individually and combined should be less than 10 ohms. Earth resistance value in ohms, earth pit No. and date of testing to be painted in the plinth by white paint. Supply of GI pipe and all accessories for earthing (excluding GI wire/ flat) is included in the scope of work for earthing arrangements.

44.1 Scope:

This section of the specification covers the supply, erection, testing and commissioning of Galvanized Iron Earthing Strips for the Distribution Network equipment's.

44.2 Applicable Standards:

The galvanizing and testing of materials shall confirm to the latest edition of the following standards except otherwise specified in the specification. Recommended practice for hot dip galvanized of Iron Earthing Strips	IS: 2629(1966)
Methods of testing weight, thickness & uniformity of coating on hot dip galvanized articles	IS: 2633(1972)
Specification for hot dip galvanized coating on fastness	IS: 5358(1969)
Specification for Electroplating	IS:3203
Specification for hot dip Zinc coating on structural & other allied products	IS: 4759(1968)

44.3 General Technical Requirements:

MATERIAL

Supplier has to purchase raw materials (MS Flat) as per relevant IS at his own cost. The zinc required for galvanizing shall be quality Zn-98 & shall confirm to IS: 209 - 1966 and its latest amendments. The Supplier shall make his own arrangement for procurement before the commissioning of work, sufficient quantity of electrolytic zinc of proper quality for galvanizing. The Supplier shall, however, not link the delivery period with the supply of zinc. The KRIDE is at liberty to have sample of zinc used and to test in any laboratory at his own cost and reject the particular supply, is found below standard. All raw materials required for galvanizing etc. and for complete execution of work shall be stocked in adequate quantities by the Supplier to ensure that the progress of work is not hampered.

GALVANISING

Fully galvanized Iron strips shall be used. Galvanized Iron strips shall confirm to IS: 2629 (1966). The zinc deposition should not be less than 610 grams/meter square of the galvanized surface area of the MS Earthing strips. All galvanized materials shall withstand test as per IS: 2633 (1972). The weight of zinc coating shall determine as per the method stipulated in IS: 2633(1964). The standard length of Galvanized Iron Earthing Strip shall be minimum 7 Mtrs and not exceeding 10 Mtrs.

1. **Precautions:**

The earthing system shall be mechanically robust and the joints shall be capable of retaining low resistance even after subjections to fault currents.

Joints shall be tinned, soldered and/or double riveted. All the joints shall be mechanically and electrically continuous and effective. Joints shall be protected against corrosion.

2. **Testing:**

On the completion of the entire installation, the following tests shall be conducted:

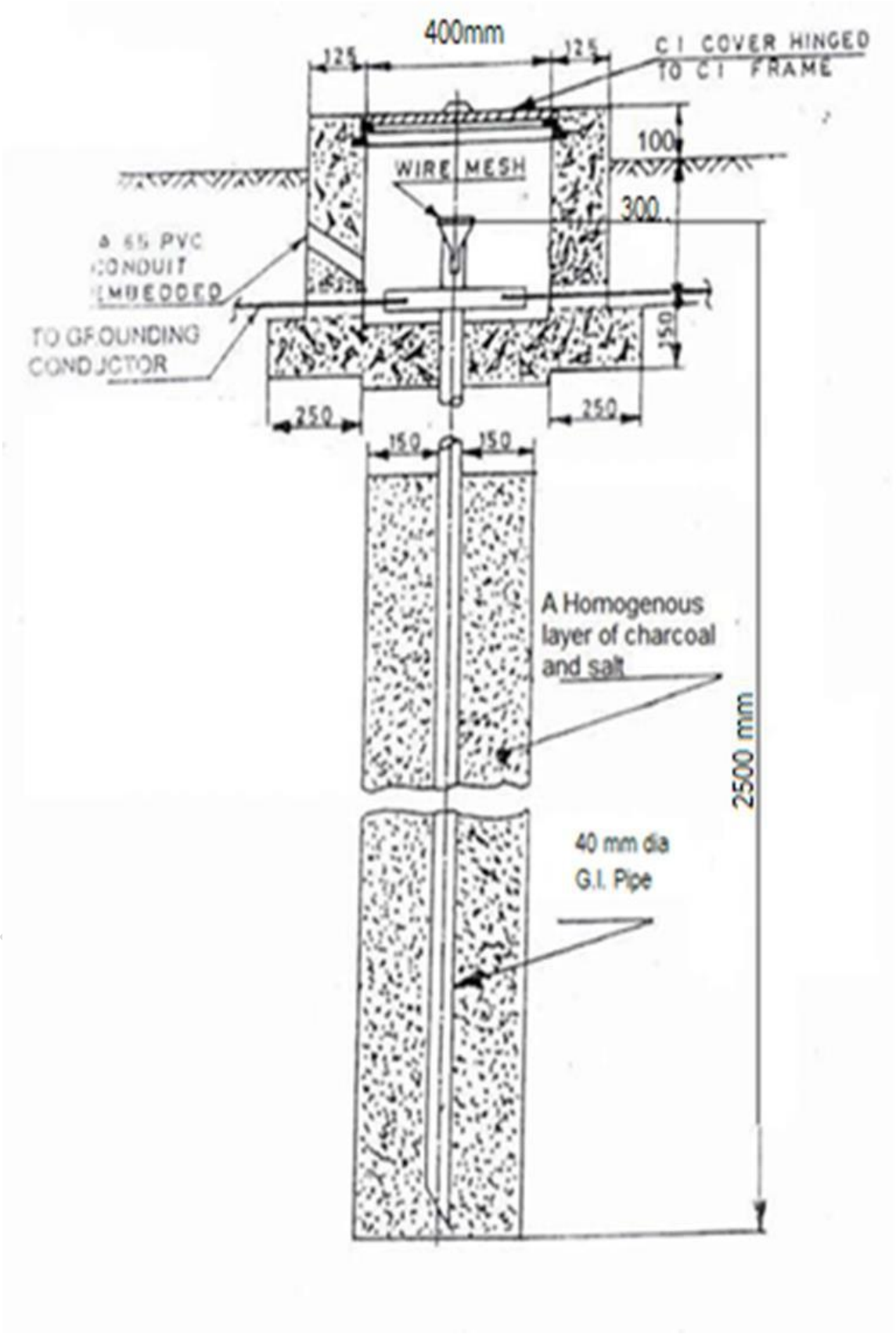
i) Earth resistance of electrodes

ii) Impedance of earth continuity conductors as per BIS.

iii) Effectiveness of earthing as per BIS.

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All meters, instruments and labour required for the tests shall be provided by the contractor. The tests results shall be submitted in the prescribed tabulated form in triplicate to the consultants.



SECTION - 19
L.T DISTRIBUTION BOXES & H.T METERING CUBICLE.

BI-PIDE

TECHNICAL SPECIFICATION FOR L.T. AC DISTRIBUTION BOXES MADE OUT OF SMC MATERIAL SUITABLE FOR 250KVA DISTRIBUTION TRANSFORMER

1. SCOPE:

The scope of this specification is for design, manufacture, testing and supply of outdoor type
L.T. distribution boxes made out of SMC Materials as per IS 13410 suitable for operation on 433 volts, 3 phase, four wires AC, 50Hz system and required to be installed at the secondary side of the distribution Transformer centres of 250kVA.

2. COMPONENTS:

The L.T. Distribution boxes shall comprise of the following components:

1. Sheet Moulding Compound Box
2. Bus Bars
3. Moulded case circuit breakers.

3. APPLICABLE STANDARDS:

The L.T. Distribution Boxes with its components shall conform to the following standards of Bureau of Indian Standard (IS) and International Electro Technical Commission (IEC).

1.	IS-13410 1992	Grade of Sheet Moulding Compound Material - Thermosetting Plastic i.e., Glass Reinforced Polyester Sheet Moulding Compound.
2.	IS-13947	Parts I & II Circuit breakers.
3.	IS-6639	Hexagonal bolts for steel structures.
4.	IS-8828 1996	MCCB's for voltages not exceeding 1000V.

4. NORMAL SERVICE CONDITIONS:

Generally, as per IS-13947- Part 1 & II with latest amendments thereon.

5. DEFINITION & TERMINOLOGY - As per

i) IEC-56 Clause (3) and sub clause thereof for circuit breakers.
ii) As per 1S-13947 Part I & II thereof for circuit breakers.

6. DESIGN & CONSTRUCTION:

a. The distribution box shall comprise of a moulded base and moulded door.
b. Thickness of SMC Door/base shall be minimum 2mm.
c. The Box and cover should be fixed by concealed hinges with hardware from inside in such a manner that it cannot be manipulated from outside.

BTRIDE

d. The door/cover shall rest on the base of box in such a way that any access from outside is not possible. The door in closed position should be overlapped on collar of base such that direct entry of screwdriver or tool is not possible.
e. Suitable Mounting Arrangement should be made for mounting Bus Bars and MCCBs.
f. For cable entry & exit holes with PVC Glands with check nuts of suitable dia, shall be provided at the Bottom and sides.
g. The hole for entry and exit provided with glands shall be large enough to permit entry of 240 sq.mm lugs and at the same time shall be provided with suitable rubber / epoxy glands to prevent entry of foreign materials into the box.
h. Earthing bolts with 2 nuts and washers shall be provided.
i. The doors shall be of self-closing type with springs or any arrangement so that the doors automatically close when released.
j. All the corners of the meter box should be round and not pointed ones.

7. BUS BARS:

7.1. The main Bus bars shall be of EC grade Aluminium flat and provided with PVC/heat shrink insulation with red, yellow and blue colour code to identify each of the phases.
7.2. The recommended sizes of the main bus bars and vertical riser links suitable for 250kVA Transformer shall be as follows:

Current rating in Amps	Size of Main Aluminium bus bars in mm (Width X Thickness)	Copper vertical riser links in mm (Width X Thickness)	Number of Circuits (Outgoing)
500 A	50mm x 10mm	25mm x 6mm	2

The bus bars shall be arranged in a staggered vertical formation and shall be supported by porcelain insulators.
NOTE: All the connections made in the bus bar with vertical risers etc., shall be made with suitable size of zinc bolts electro plated to avoid any loose contact.

8. MOULDED CASE CIRCUIT BREAKERS (MCCB):

The MCCBS shall generally comply with IS-13947 Part-I & II. The MCCB shall be a compact unit comprising of all the protective circuits. The MCCBs suitable for 250kVA Transformer.

9. Rating & Characteristics of MCCB:

Continuous current rating of MCCB	Rated short circuit breaking capacity at 0.25 PF kA (rms)	Rated peak making capacity kA (rms)
250 Amps	50kA	105kA

a) Category of Utilization : A
b) Rated operating Voltage Ue : 433V Phase to Phase.
250V Phase to Neutral.
c) Rated insulation voltage Ui : 660V Minimum.

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d) Rated Impulse Voltage Uimp: 8kV.

e) **Current Limiting: -** The moulded case circuit breakers directly feeding the loads shall be preferably of current limiting type such that under short circuit conditions very low cut off current and are let through for better protection of loads, cables etc.,

f) **Rated Ultimate Short Circuit Breaking Capacity (Icu):** The short circuit current breaking rating of a MCCB is the highest value of the current that the MCCB is capable of breaking without being damaged. Icu shall be 50kA at 0.25 Power factor as per IS 13947.

g) **Rated Service Short Circuit Breaking Capacity (Ics):** The rated service breaking capacity is the maximum fault current a MCCB can successfully interrupt without being damaged. It has been expressed as a percentage of Icu. The Ics =100% Icu i.e., **Ics shall be equal to Icu.**

h) **Protective Release:** The MCCB's shall be fitted with suitable protective release to give overload short circuit protection. The protective release and the tripping mechanism shall be such that all three poles of the MCCB shall open in case of fault on anyone/two or all three poles.

i) **Current Setting:** The Current of the MCCB shall be for 100% of the MCCB thermal rating. The setting shall be fixed at 100% setting suitable for momentary rating and compatible with the full load current of the Transformers.

9.1 AMBIENT COMPENSATION:

The current setting or the tripping time shall not be affected by change in ambient conditions. The ambient compensation shall be effective over 0°C to 55° C.

9.2 TIME CURRENT CHARACTERISTICS:

The protective release shall have inverse time current tripping for overl o a d and instantaneous for short circuit.

9.3 MECHANISM:

The MCCB shall have manual closing mechanism, which shall be quick make, quick brake, and trip free. The position of the knob shall give indication of 'ON', 'OFF & TRIP'.

Facility for manual tripping shall be provided.

9.4 EXTENDED COPPER SPREADERS:

The MCCB Terminals shall be provided with suitable Copper spreaders for both incoming and outgoing terminals of the MCCB for connecting to the Main and Load side.

10. TERMINATION:

The terminals shall have adequate capacity for termination of Aluminum cables of size up to 3 x 240 Sq. mm.

11. EARTHING:

The Earthing shall be as per clause 4.5 and sub clause there of 8828 - 1996 with latest revisions etc.,

12. TESTS:

Type and Routine Tests on the circuit breaker shall be as per IS-13947 Part I & II and as per IS-8828- 1996.

1. Type tests: As per clause of IS-13947 Part I & II.
2. Routine tests: As per IS-13947 part I & II with latest revision thereon.

13. INSPECTION:

In respect of bought out items the contractor shall use equipment's/items supplied by standard/reputed manufacturers and furnish manufacturers Test certificate for information of the KRIDE.

The fabrication and assembly of equipment shall be strictly in accordance with the approved drawings and prior approval of drawing is to be taken before supply. No deviations shall be permitted without the written approval of KRIDE. All the manufacturing and fabrication work in connection with the equipment prior to approval of drawing shall be at contractor's risk.

The supplier shall give to KRIDE sufficient advance intimation to arrange for inspection of the LT Distribution Boxes.

The Supplier shall also arrange for testing of the MCCB's at the manufacturer's premises at his cost.

14. MARKING & NAME PLATE:

Each outgoing and incoming circuit near the MCCB and the exit shall be clearly marked. A Caution board of 433V

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rating shall be affixed on the front of the box.
A name plate incorporating the following shall be provided:

1. Manufacturer name and address
2. Purchase order reference
3. Rating of the Distribution Box
4. Rating of MCCB used with make and other ratings.

15. DESPATCH:

The manual containing operation, maintenance of the equipment/components shall be supplied along with each distribution box.

16. PACKING & FORWARDING:

The equipment shall be packed suitably. The contractor is responsible for any damage to the equipment due to improper and inadequate packing. The contractor without any extra cost shall supply any material found short without any extra cost.

L.T AC DISTRIBUTION BOXES MADE OUT OF SMC MATERIAL SUITABLE FOR 250KVA TRANSFORMER.
ANNEXURE-A

Sl.No	Particulars	Particulars
1.	Name of Manufacturers	
2.	Material	
3.	Grade of Material	
4.	**Properties of Material of Construction of Meter Box**	
	(a) Heat Deflection Temperature (ref.Std.IS:13360:P- IV/Sec.III)	
	(b) Exposure to flame (ref.Std.IS:1171 (Part-II)	
	(c) Burning Property (ref.Std.IS:1171 (Part-II)	
5.	Clear inside dimensions of meter Box	
	(a) Height	
	(b) Width	
	(c) Depth	
6.	Earthing arrangement	
	(a) No. of earth bolts	
	(b) Material of earthing bolt	

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	(c) Dia. & Length of bolts	
	(d) Double nuts provided	
	(e) Plain Washer Provided	
	(f) Treatment of earth bolt and hardware	

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GUARANTEED TECHNICAL PARTICULARS

MOULDED CASE CIRCUIT BREAKER SUITABLE FOR 250KVA DISTRIBUTION TRANSFORMER

ANNEXURE-B

Sl. No	Particulars	Technical Particulars
1.	Name of the manufacturer	
2.	Address of Office & Works	
3.	Make	
4.	Type and Model of MCCB	
5.	Number of Poles	
6.	Utilization Category	
7.	Rated Frequency, Hz	
8.	Rated Current Rating	
9.	Rated Operational Voltage (Volts)	
10.	Rated Insulation Voltage (Ui)	
11.	Rated Impulse Voltage (Uimp)	
12.	Rated Ultimate Short Circuit Breaking Capacity, Icu (kA rms)	
13.	Rated Service Short Circuit Breaking Capacity, Ics (kA rms)	
14.	Type of Operating Mechanism	
15.	Operation Principle	
16.	Type of Release	
17.	Overload Release	
18.	Short Circuit Release	
19.	Application Standard	
20.	Time Current Characteristics	

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Description for Drawing

Sl.No	Particulars	Details	Qty	Dimensions	Remarks Conforming to
1.	Housing Box with Doors. (Off colour)	Made out of (Thermo setting plastic) sheet moulding compound by the process of hot press compressing moulding confirming. to IS-13410	1 No.	H-1000mm x W-690mm x Depth- 250mm	IS-13410 of 1992 Dimensions are indicative
2.	Horizontal Aluminium Bus Bar	Horizontal bus bar shall be provided with Heat Shrinkable PVC insulation of red, yellow and blue colour to indicate phases	3 Nos.	50x10mm	
3.	Busbar support insulators	Porcelain			
4.	Vertical risers	To connect from main bus bar to MCCB extended spreaders (main side) made of EC grade copper	6 Nos.	25x6mm	
5.	Vertical droppers	To connect from MCCB extended spreaders to cable (load side) made of EC grade copper	6 Nos.	25x6mm	
6.	Extended Copper Spreaders	To connect vertical risers & droppers to MCCB main & load side terminals to prevent damage to the MCCB terminals.	12 Nos.	Suitable for MCCB terminals	
7.	MCCB	Triple pole, 50 cycles - 250 Amps, Ics=Icu (kA rms) - 50kA	2 Nos.		IS-8828 of 1996
8.	Cable Supporter	Cable supporting frame with Hylam/ SMC material insulation and cable fixing clamps	6 Nos.		
	Hexagonal Bolts and nuts	MS Hot Dip Galvanized of suitable size			IS-6639

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Note:

1.	The doors shall be of self-closing type with spring arrangement so that the doors automatically closed when released.
2.	The doors shall have internal locking arrangement with spring loaded latch operated by a common key for all the boxes.
3.	All the MS bolts & Nuts, plain and spring washers shall be hot dip galvanized.
4.	Zinc Bolts and nuts shall be electro plated.

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H.T METERING CUBICLE

TECHNICAL SPECIFICATION FOR HT METERING CUBICLE OF CABLE ENTRY TYPE ON BOTH OUTGOING AND INCOMER SIDES SUITABLE FOR 3 PHASE, 50 CYCLES 11KV SUPPLY

1. Scope:

This specification covers the design, fabrication, painting and supply of HT Metering cubicles (Metal cabinet), supply of components consisting of instrument transformers, meters, etc., housed in suitable cubicle for indoor / outdoor use including the wiring, testing at works, packing and for Departmental supply and Self-Execution Works as per requirement and the approved drawings enclosed.

2. Service Conditions:

The metering equipment shall be suitable for the following site conditions.

a) Min. Ambient Temperature : 5°C
b) Max. Ambient Temperature : 50°C
c) Max. Humidity : 10 to 100%
d) Altitude : Not exceeding 1000 Mtrs.
e) Rainfall : 1450mm
f) Max. wind pressure (kg/sqmm) 150
g) Seismic level (Horz. acceleration) : 0.3g
h) Protected from limited dust ingress : IP55

3. Standards:

Unless otherwise specified elsewhere in this specification, the rating, performance and testing of the metering cubicle and accessories shall conform to the latest amendments to the relevant standards and specific requirement of ESCOMs.

4. General Arrangements:

The HT Metering Cubicle shall be installed electrically in between the incoming supply point and the step-down transformer of consumer's installation. The general arrangement of the cabinet shall be as per the enclosed drawing and final drawing approval has to be obtained after approval of prototype sample, as mentioned, and shown in the general arrangement drawing, the meter cubicle shall be provided with the following components duly wire up ready for installation and complete in all respects:

a) 3 Nos. single phase Potential Transformers
b) 3 Nos. single phase Current Transformers of appropriate ratio as the case may be.
c) 6 Nos of epoxy resin cast bus-bar embedded wall entrance bushings of adequate rating with necessary hardware and connector pads.
d) HT Tri-vector meter 3 phase, 4 wires (Electronic Meter) – 0.2S class conforming to IS 14697, and as per New GOK HT Meter Specification & BESCOM approved make with appropriate category and No.s/Quantities as the case may be.
e) HT aluminum / copper bus bar of appropriate size with standard colour coding as the case may be and Transparent Test Terminal Block (TTB).

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f) The secondary wires from the terminals of CTs and PTS (having with standard colour coding as per annexure) in the CT/PT. compartments shall be covered by suitable PVC conduits and the secondary wires shall be brought in the metering compartment through rubber bush and shall be left open duly crimped with suitable flat pin type copper lugs.

g) Incoming and outgoing bus-bar arrangements to receive Raychem or equivalent type of cable terminations for incoming and outgoing supply points.

5. Metering Cubicle Construction features:

a) The HT Metering Cubicle shall have only Metering System as said in 4.0. Metering cubicle is independent from the Load Break Switch (LBS) or any Circuit Breaker.

b) The cubicle shall be fabricated out of mild steel sheets of thickness not less than 3mm. Cubicles shall be Protected from limited dust ingress as per IP55 of IS 12063 if the air vents are closed. Adequate clearance between HT bus bars and ground shall be provided.

c) The Overall dimension of the HT Metering Cubicle be width 1000mm (CTPT Side) x height 1800mm (Excluding Canopy) x breadth (Meter Chamber Side) 900mm as per diagram enclosed. The angle iron framework using angles of minimum sizes 75 x 40 x 6mm and provided with eyebolts for hoisting purposes.

d) Both Main Cable & Load Side Cable entry shall be at the height of 600mm.

e) All live points should be at a clearance of 200mm from the earth and 300mm between phases to phase.

f) Meter visibility should be made such that it is clear for the meter reader to read the meter standing in front of the meter chamber. The cubicle shall be mounted on a concrete plinth of suitable height. A bottom frame of MS angle as shown in the diagram shall be provided, duly welded for mounting the HT metering cubicle on the plinth. The meter window shall be such that it is at the normal eye level. The suitable concrete steps shall be constructed front and sides for easy access of CT PT chamber & Meter reading.

g) The design of HT Metering Cubicle shall be such that the water should not enter inside the cubicle. Extended canopy shall be provided to avoid rainwater entry and protected from limited dust ingress as per IP55 as per IS 12063 if the air vents are closed.

h) Necessary lifting hooks shall be provided for easy lifting and transportation.

6. Compartments of HT Metering Cubicle:

The HT Metering cubicle shall consist of four metal enclosed compartments as follows:

a. CT & PT Compartment : 01 No
b. Incoming cable termination Compartment : 01 No
c. Outgoing cable termination Compartment : 01 No
d. Meter Compartment : 01 No

Note: Each chamber has to be in welded form only (no screw and bolt system allowed)

a. CT & PT Compartment:

- The CTs to be mounted on the horizontal surface of the CTPT Compartment, with CTs Secondary terminal facing towards the chamber door only.
- The PTs should be mounted on the opposite side wall of the CTPT Compartment only. The PT Secondary terminals should face the downward direction. Suitable clearance shall be maintained for future maintenance work.

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- For fixing the CT PT, angular arrangement shall be made with slotted holes to fix the bolt and nuts firmly to the Cubicle Horizontal and vertical surfaces.

b. Incoming and Outgoing cable termination Compartment:

- Separate Incoming (Main) side and Outgoing (Load) side cable termination compartment shall be provided on both sides and each chamber shall be marked to identify the chamber for Incoming and outgoing.
- The connections are proposed to be given by underground cable end terminations which will be fixed on the HT metering cubicles.
- The leads from the termination will be taken inside through 6 Nos of epoxy resin cast bus-bar embedded wall entrance bushings noted above. Detachable gland-plates shall be provided at the bottom side of this compartment for accommodating 11kV XLPE, 3 core cables (120 sqmm to 300 sqmm).
- At the time of work execution, Incoming and outgoing cable shall be suitable marked to identify incomer and load side cable.

c. Meter Compartment:

- The Meter compartment with front door shall be provided on front side of the Cubicle.
- The Meter compartment should be mandatorily able to house 2 Nos of meters (namely Main Meter and Check Meter) along with transparent TTBs and Modem mounted on a Hylam sheet of minimum 6mm thickness. The Hylam sheet shall be mounted on the wall of the meter compartment leaving not more than half an inch width and depth to avoid easy access to the Secondary wires.
- The Secondary Wires from the CTPT Compartment shall enter the Meter Compartment in a PVC Conduit inside Cubicle beneath the Hylam sheet to the Test Terminal Block. The secondary wires will further run from TTB to the Meter beneath the Hylam sheet. The Secondary wires shall not be exposed.
- On the front door there shall be another door opening (window), with a glass front covered, which shall be used for access to the meter only for purpose of reading.

- This auxiliary door (window) shall be of sufficient size to have access for reading and for downloading the meter data to MRI purpose. The glass used on this auxiliary door shall be toughened glass or laminated salty glass 6mm thick. It shall be possible to replace the glass from inside only and after breaking the seal and opening the door.
- Separate and independent sealing arrangements shall be provided for the Front door of the metering compartment and the auxiliary (window) door needed for downloading the meter data to MRI purposes. The purpose of having a main door and an auxiliary door is to ensure that the staff meant for taking periodical readings have limited access to the meter and do not have access to the metering compartment as a whole.

d. General feature of the compartments:

i. Detachable 1-inch square 14SWG weld mesh using 25 x 25 x 25 x 3mm angle iron frame Cover shall be provided with 6mm dia sealing bolt to prevent inadvertent access to the Compartment. The roof shall be sloping 5 to 10 degrees towards the ends with canopy. The guards for the CTs and PTs are to be provided with sealing arrangements for bolt and nuts at the top of the mesh by making holes for the bolts to pass through.

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This cover shall be provided for CTPT compartment and Incoming / outgoing compartments.

ii. A Body Grounding copper / aluminum busbar shall be run through for connecting the CT PT secondary wire star connections for CTPT compartment and Incoming / outgoing compartments.

iii. A Separate Grounding Copper / aluminum Busbar **with insulation** and bushing (isolation) shall be provisioned for connecting the PT primary Neutral star connection.

iv. For all the compartment suitable door shall be provide using the same mild steel sheets to make it tamper proof. Heavy duty concealed type hinges (hinges shall not be accessible from outside) shall be used for the door.

v. All the doors and removable covers shall be fixed all around with neoprene gaskets and the metering cubicle shall meet the requirements of IP55 protection as per IS12063 if the air vents are closed.

vi. Separate and independent sealing arrangements shall be provided for all the doors.

vii. Suitable metal handles shall be provided for opening and closing the doors with heavy duty metallic locks to hold the doors firmly.

7. Metering cubicle finished with powder coating:

The metering cubicle will be powder coated with pure polyester-based powder after 7 tank process. The **color** of the powder coating shall be **"DA Grey 632 of IS:5"**

The thickness of the powder coating film shall be minimum 50 to 60 microns.

8. Bushings:

8.1 The bushings shall be of reputed make.

8.2 The insulators shall be guaranteed for long and satisfactory performance, generally conforming to technical particulars covered in the relevant IS with latest amendments.

8.3 The bushings used shall be bus bar embedded epoxy resin cast type wall entrance type. The bushing shall withstand all routine tests.

9. Current Transformers:

9.1 The HT metering equipment shall be provided with current transformers of reputed makes approved by ESCOMs. The CTs shall be of indoor, single core wound primary, drying resin cast type and shall be of ratio as per the schedule of requirement. They shall be suitable for 3 phase, 50 hz system as required. The terminals of the CTs shall be clearly marked by distinctive signs or letter.

9.2 The characteristics of CTs shall conform to the IS: 2705 / part – I and II of 1992 with latest amendment. The CTs shall conform to the following technical particulars.

i) Accuracy Class : 0.2S

ii) Burden : 2.5VA for all ratios.

iii) Rated thermal short current rating : 150 times the highest rated thermal current rating.

iv) Dynamic short time current rating : 2.5 times the rated short time thermal current rating.

v) Insulation level for CTs : 15 KV

vi) Power frequency withstand voltage: 38 KV vii) Impulse voltage withstand test for 1.2 / 50 micro second impulse : 95 KV

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9.3 **Marking:** Each Current Transformer shall be marked with all relevant detailing on the nameplate in accordance with IS:2705 (with latest amendments).

9.4 General features:

i. The Height between the CT base plate to the bottom of primary terminal stud of CT should be 300mm as per diagram enclosed.

ii. The Secondary terminals should be provided at P2 side of the CT, and it should be easily accessible from outside when mounted in the Meter Cubicle.

iii. The Primary and Secondary terminals should be of **STUD TYPE** only. The material used should be copper or bimetallic. The primary terminal should be of (12mm dia) M12 type & the distance between the primary terminals should be 90 mm apart. The primary terminal should be projected out from the surface 50 mm length threaded and provided with suitable nut & washers. The Secondary terminal should be of (4mm dia) M5 type & the distance between the secondary terminals should be 40mm apart. The Secondary terminal should be projected out from the surface 20 mm length, threaded, and provided with suitable nut & washers.

iv. The serial nos. of CTs should be superscribed on top and P2 side surface.

v. The terminal markings of CTs shall be made on both top and side surface. Both engrave/emboss, and sticker marking should be provided.

vi. The overall dimensions of the CTs should be as per the diagram enclosed.

vii. The CT Ratios to be used for various Contract Demand shall be strictly as per the table enclosed, unless otherwise there is specific approval from corporate office on case-to-case basis.

10. Potential Transformers:

10.1 The PTs shall be of reputed make approved by ESCOMs and shall be for indoor use and without fuses and be of epoxy dry resin cast type single phase having voltage ratio 11kV /√3/ 110√3V. They shall be suitable for operation on 3 phase, 11kV / 50 cycles, solidly grounded system.

10.2 The characteristics of PTs shall conform to the IS: 3156 / part – I and II of 1992 with latest amendment. The PTs shall conform to the following technical particulars.

i) Accuracy Class	: 0.2S
ii) Burden	: 25VA for all ratios.
iii) Insulation level for PTs	: 15 kV
iv) One minute Power frequency withstand voltage	: 38 kV
v) Impulse voltage withstand test for 1.2 / 50 micro second impulse	: 95 kV
vi) Ratio	: 11000/110V

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10.3 Marking: Each Potential Transformer shall be marked with all relevant detailing on the nameplate in accordance with IS:3156/1965 (with latest amendments).

10.4 General features:

i. The Secondary terminals should be provided such that it is easily accessible from outside when mounted in the Meter Cubicle.

ii. The Primary and Secondary terminals should be of stud type only. The material used should be copper or bimetallic. The primary terminal should be of 50sqmm M12 type. The Secondary terminal should be of M5 type & the distance between the secondary terminals should be 40mm apart. The Secondary terminal shouldn't be engraved inside, it should be able to connect 2-3 wires using copper lugs.

iii. The primary Neutral terminal should also be min 40mm apart from secondary terminal. All the three phases Neutral should be star connected using a rigid copper bus-bar and grounded running the bus bar using insulators and shouldn't be connected to Meter Cubicle body grounding.

iv. The serial nos. of PTs should be superscribed on top and sideways.

v. The terminal markings of PTs shall be made on two sides. Both engrave/emboss and sticker marking should be provided.

vi. The overall dimensions should be as per the diagram enclosed.

11. Bus Bar:

The Bus bar size shall be as follows depending on the CT ratio used:

Sl. No	CT Ratio	Bus Bar size	Material
1	1.25/1 to 75/1A	20 x 6 mm	Aluminium
2	100/1 to 200/1A	30 x 5 mm	Copper
3	225/1 to 400/1A	30 x 8 mm	Copper

The bus bars should be covered with 11kV Heat Shrinkable sleeves, other than the contact surfaces.

12. HT Meters:

HT Tri-vector Meter 3 phase, 4 wires (Electronic Meter) – 0.2S class conforming to IS 14697, as per New GOK specification and BESCOM approved make with following type of meter specific to nature of customer.

Sl. No	Type of Consumer	Category of Meter	No of Meters required
1	Open access consumer without genera ting facility at the premises	Category C: DLMS, Unidirectional meter having ABT & TOD features	2 Nos (Main and Check)
2	Open access consumer having generating facility at the premises with net meter	Category B: DLMS, Bidirectional meter having ABT & TOD features	2 Nos (Main and Check)

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3	Consumer having generating facility at the premises with net meter	Category B: DLMS, Bidirectional meter having ABT & TOD features	2 Nos (Main and Check)
4	Consumer without generating facility at the premises	Category C: DLMS, Unidirectional meter having ABT & TOD features	1 No.

13. Secondary Wiring:

Colour coded Wire shall be 4sqmm copper sheathed insulated copper wires for CT & 2.5sqmm for PT connections besides providing a sealable cover for the terminals shall be also painted in Red, Yellow, Blue & Black to indicate phase and neutral wiring, besides clear indications on the cubicles to identify the main and load sides for proper registration of KVAH, KWH, etc.,

The Wire Ferrule and nomenclature to be used are as shown in the wiring diagram for single meter wiring and dual meter (Main & Check Meter) wiring

14. Test Terminal Block (TTB):

A reputed make Test Terminal Block (TTB) shall be used for each meter connected. The TTB shall be of Bakelite of reputed make with transparent cover. The TTB shall be positioned at the front so that the wiring work during the testing can be easily carried out. The terminals connecting material shall be bimetallic. The size of the terminal shall be of minimum 5.5sqmm and the terminal connection screws size shall be of 3.5sqmm.

15. Other General features:

a) The secondaries of the instrument transformers shall be laid in a PVC conduit from the instrument transformers chamber into the Tri-vector / TTB through the cable chamber. The wire connections from the conduit shall enter the TTB from the rear side through hole of requisite diameter made on the partition sheet metal between meter and cable chamber. The load side wiring connections from the TTB shall again be run in a conduit up to meter terminal and the wire connections shall enter the meter terminal blocks from the rear side of the meter mounted on sheet metal, through holes at the ends of the conduits. The TTB shall be of Bakelite of reputed make with **transparent cover**. The TTB shall be positioned at the front so that the wiring work during the testing can be easily carried out.

b) The cable terminations on the load side / main side are not covered in the scope of supply. Arrangement is shown in the drawings for purpose of providing the necessary facilities in the cubicle. Care shall be taken to maintain the required clearances for use in 11kV system. However, the cubicles shall be provided with a suitable fixing bracket on which the cable termination box can rest, and the leads connected on to the outgoing terminals through the floor entry bushings.

c) Grounding: 25 x 3 mm copper strip shall run from cable entry chamber to CTs and PTs. The core / body of CTs and PTs shall be connected to this copper strip. The other end of the 25 x 3 mm copper strip shall be connected to 12 mm bolts and nuts provided for grounding at cable entry chamber. Similar 12 mm bolts and nuts

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shall be provided at the load side also. The armour of XLPE cable shall have provision for grounding in the HT Metering cubicle.

16. Marking:

Each HT Metering Cubicle shall be punched or embossed as "Property of BESCOM" at the front side of the Meter Cubicle such that it is clearly visible. Also, the nameplate shall carry all the details in accordance with relevant IS as follows:

i) Make:
ii) Sl. No.:
iii) Type:
iv) Voltage Class:
v) Year of Manufacturer:
vi) P.O details., etc.,

17. Prototype and drawing:

The manufacturer will have to offer a sample for inspection before supply of item. The sample will be inspected by a team of purchaser's representatives / agency (CPRI). On approval, the contractor will have to submit the drawings accordingly and get it approved from the purchaser before supply.

18. TESTS:

The Cubicle manufacturer should use the instrument CT & PTs approved by ESCOMs and should confirm to dimensions and features mentioned in this specification.

18.1 MT lab Testing of CTs, PTs and HT Meters:

All the CTs, PTs and HT Meters purchased from the original manufacturer (approved vendor), shall be sent to the MT lab along with manufacturer test report for testing. The components will be tested as per relevant IS. The testing fee shall be borne by the manufacturer. The successfully tested CTs, PTs & HT Meters shall be sealed for having passed by MT lab.

Only the successfully tested & sealed CTs, PTs and HT Meters shall be assembled to the HT Metering cubicle and kept ready for complete Unit testing at manufacturer works.

18.2 Minimum Testing facilities:

The manufacturer must clearly indicate the details of testing facilities available at the works of manufacturer and that the facilities are adequate to carry out all routine and acceptance tests. These facilities should be available to purchaser Engineers, if deputed to carry out or witness the tests at the manufacturers works.

For HT Metering Cubicle:

- Power frequency withstand test generator set with control panel.
- Current source for temperature rises test with digital ammeter, volt meter, temperature indicators and tong tester.
- Power operated shearing machine.

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- Power operated press brake.
- Power operated press.

The tenderer shall furnish details of powder coating process employed.

18.3 Acceptance and Routine Test:

Following tests shall be carried out as acceptance and routine tests for Complete assembled HT Meter Cubicle:

a. Temperature rise test on complete unit at rated current of cubicle.
b. Power frequency withstand test at 28kV.
c. Overall dimension check.

19. Inspection:

The inspection may be carried out by the purchaser at any stage of manufacture. The manufacturer shall grant free access to the purchaser's representative at a reasonable time when the work is in progress. Inspection and acceptance of any equipment under this specification by the purchaser shall not relieve the manufacturer of his obligation of furnishing equipment in accordance with the specification and shall not prevent subsequent rejection if the equipment is found to be defective.

20. Documentation:

a. The manufacturer shall furnish two sets of following drawings and documents:
   i. Complete assembly drawings of the metering cubicle showing plan, elevation and typical sectional views and locations of cable boxes, busbars, metering compartments and meter.
   ii. Foundation plan showing location of foundation channels, anchor bolts of anchors, floor plan and openings for cables etc.,
   iii. Type test certificates for the type testing bought out items, if already carried out.
   iv. Descriptive pamphlets and literature of bought out items including CT characteristic curves, etc.,
b. All drawings and data shall be annotated in English.
c. The manufacturer shall be required to furnish four sets of final versions of all the above said drawings and documents within 15days after the prototype inspection for purchasers' approval.
d. Approval of drawings / work by manufacturer shall not relieve manufacturer of his responsibilities and liability for ensuring correctness and correct interpretation of the drawings for meeting the requirement of the latest revision of applicable standards, rules, and codes of practices. The equipment shall conform in all respects to high standards of engineering, design, workmanship, and latest revisions of relevant standards at the time of ordering and purchaser shall have power to reject any work or materials which, in his judgment, is not in full accordance therewith.

21. Packing and forwarding:

The equipment shall be packed in crates suitable for vertical / horizontal transport, as the case may be, and suitable to withstand handling during transport and outdoor

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storage during transit. The supplier shall be responsible for any damage to the equipment during transit, due to improper and inadequate packing. The easily damageable materials shall be carefully packed and market with appropriate caution symbols. Wherever necessary, proper arrangement for lifting, such as lifting hooks etc., shall be provided.

Any material found short inside the packing cases shall be supplied by supplier without any extra cost.

22. Technical Compliance for Instrumental Transformer & HT Meters:

The following Technical Compliance required with respect to the Instrumental Transformer (CTs & PTs) and HT Meters to provide reliable Power Supply and avoid interruption to consumers.

22.1 Type test:

For the CTs, PTs and HT Meters the type tests shall be carried out for each rating of short time withstand current with lowest CT ratio.

a. For Current Transformers:

All Testes (Except High Voltage power frequency wet withstand test) as per clause No. 9.1.1 of IS 2705 (Part – I) 1992. Amended up to date, considering outdoor application of CTs

- Short time current tests.
- Temperature rise test.
- Lightning impulse test for CT for service in electrically exposed installation.
- Determination of errors or other characteristics accordingly to the requirements of the appropriate designation or accuracy class.

b. For Potential Transformers:

All Testes (Except High Voltage power frequency wet withstand test) as per clause No. 9.1.1 of IS 3156 (Part – I) 1992. Amended up to date, considering outdoor application of PTs

- Short time current tests.
- Temperature rise test.
- Lightning impulse test for CT for service in electrically exposed installation.
- Determination of errors or other characteristics accordingly to the requirements of the appropriate designation or accuracy class.

c. For HT Meters:

All tests as per clauses of New GoK HT meter specification.

d. For Complete Unit:

- Temperature rise test on complete unit at the rated current of cubicle of each voltage class with highest CT ratio (IS 3427 -1997)
- Power frequency withstand test at 28kV.
- Impulse wave withstand test at 75kV considering that the cubicle are meant for outdoor use as per IS 2071.
- Type test for IP55 protection as per category '1' as mentioned as per clause no 7.5 of IS 12063.
- Short time withstand current test, shall be performed on the cubicle by

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passing a current of 13.1kA for 1 Sec for 11kV, with CT/PT bypassed. (IS 3427 – 1997)

The HT Metering cubicles, CTs, PTs and HT Meters shall be fully type tested as per relevant IS and this specification. The manufacturer shall furnish detailed type test reports of all the type tests for offered CTs, PTs, HT Meters and HT Metering cubicles. For these CTs & PTs, the type tests shall be for each rating of short time current. These tests should have been carried within 5 years prior to the date of submission of type test reports. The purchaser reserves the right to demand repetition of some or all TTRs in presence of purchaser's representative. In case the unit fails in any one type test, the complete supply shall be rejected.

All the above type tests shall be carried out at NABL laboratories to prove that the complete HT Metering cubicle, CTs, PTs and HT Meters offered meet the requirements of specification. The successful tenderer shall take approval / waive of type tests from the purchaser prior to commencement of supply.

22.2 Minimum Facilities required:

The manufacturer must clearly indicate the details of testing facilities available at the works of manufacturer and that the facilities are adequate to carry out all routine and acceptance tests. These facilities should be available to purchaser Engineers, if deputed to carry out or witness the tests at the manufacturers works.

a. <u>For CT/PT at original manufacturers works:</u>

- Class of accuracy test panel for CTs with phase angle and ratio error measuring unit with Current source, burden box and standard CT
- Class of accuracy test panel for PTs with phase angle and ratio error measuring unit with Voltage source, burden box and standard PT
- Partial discharge test setup.
- Resistance voltage divider
- High frequency generator set with control panel.
- Milli ohms meter.
- Over voltage inter turn test equipment.

b. <u>HT Meter:</u>

As per new GoK HT meter specification.

22.3 Acceptance and Routine Test:

Following tests shall be carried out as acceptance and routine tests.

i. For Current Transformers:

All tests as per clause No 9.1.2 of IS-2705 (Part-I) 1992.

ii. For Potential Transformers:

All tests as per clause No 9.1.2 of IS-3156 (Part-I) 1992.

iii. For HT Meter:

All tests as per clause of New GoK HT meter specification.

For CTs, PTs and HT Meters required tests shall be carried out at the original manufacturer's works in the presence of purchaser's representative.

23. Guarantee/ Warranty:

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The manufacturer shall stand guarantee for the materials supplied, especially CT, PT, Meter, Modem, etc., for a period of 18 months from the date of Supply of Meter Cubicle or from the date commissioning of HT Metering Cubicle whichever is earlier, for manufacturing defects.

24. Annexures:

The following annexures are herewith enclosed for adhering to the above specification.

1. Table showing CT ratios to be used for various HT consumer Contract Demand
2. HT Meter Cubicle Dimension diagram
3. 11kV Current Transformer Dimension diagram
4. 11kV Potential Transformer Dimension diagram
5. Single Meter wiring diagram
6. Dual Meter (Main & Check Meter) wiring diagram

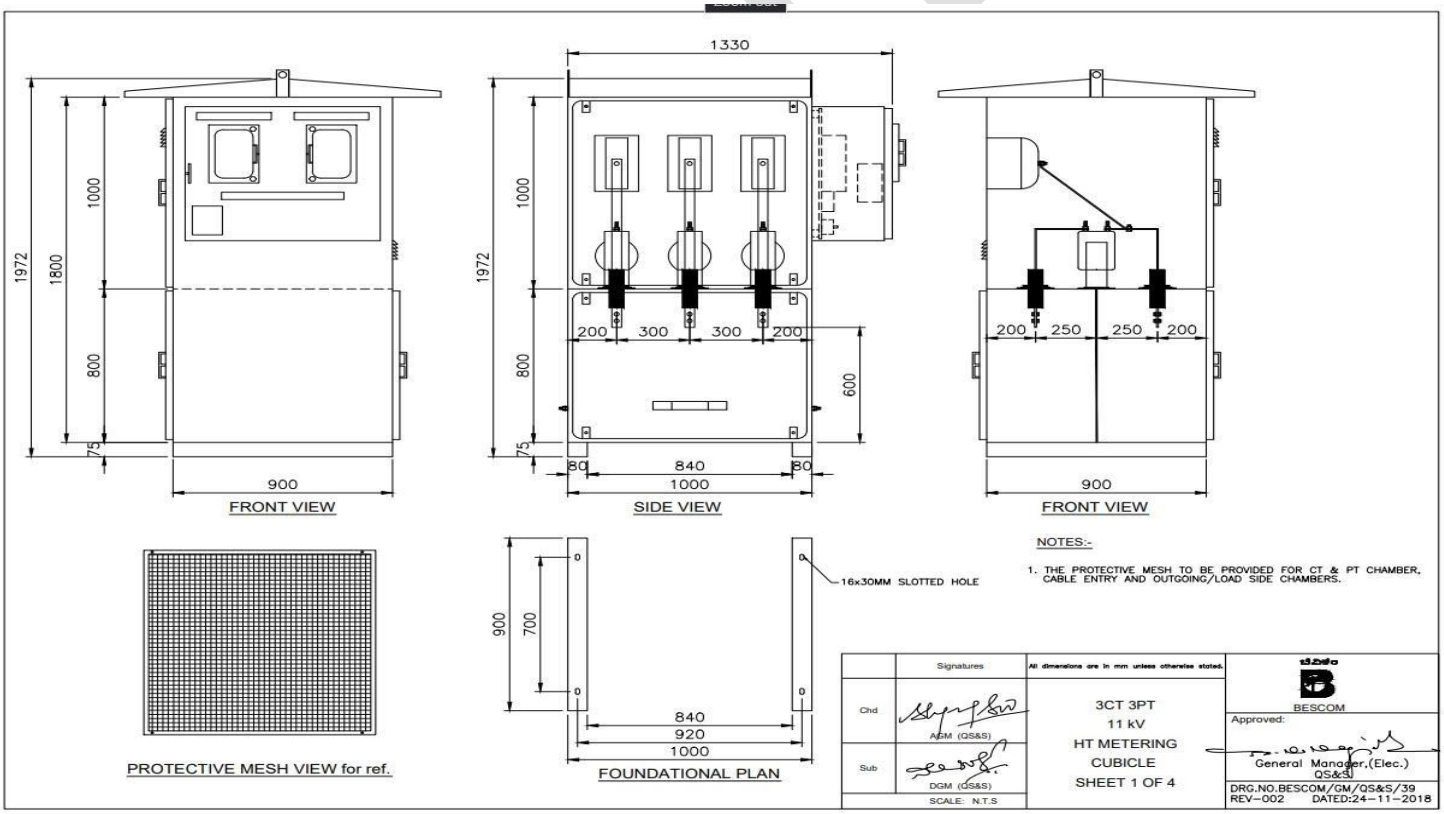
Table showing 11kV CT Ratios for different Contract Demands

Sl. No.	Contract Demand (kVA)	Required CT ratio
1	25	1.25/1
2	26-50	2.5/1
3	51-100	5/1
4	101-150	7.5/1
5	151-200	10/1
6	201-250	12.5/1
7	251-300	15/1
8	301-400	20/1
9	401-500	25/1
10	501-600	30/1
11	601-800	40/1
12	801-1000	50/1
13	1001-1200	60/1
14	1201-1500	75/1
15	1501-2000	100/1
16	2001-2500	125/1
17	2501-3000	150/1

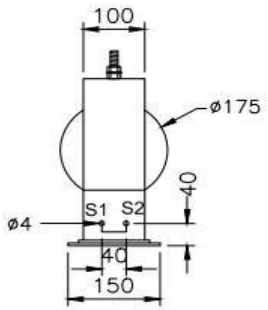
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18	3001-3500	175/1
19	3501-4000	200/1
20	4001-4500	225/1
21	4501-5000	250/1
22	5001-6000	300/1
23	6001-8000	400/1

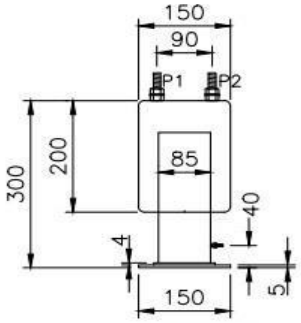
Note: These are all general 11 kV CT ratios for different contract Demands. Any deviations in the CT ratios shall be approved from corporate office on case-to-case basis.



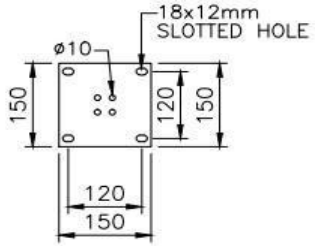
DRAWING FOR INDOOR 11kV CURRENT TRANSFORMER (CT)



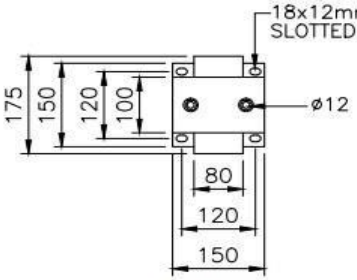
FRONT VIEW



SIDE VIEW

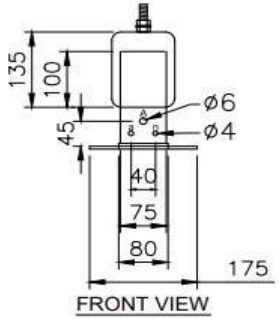


BASE PLATE DIMENSION

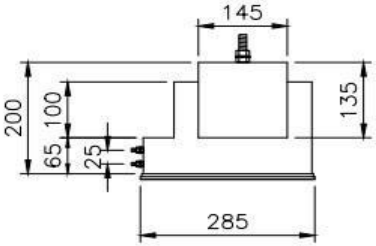


TOP VIEW

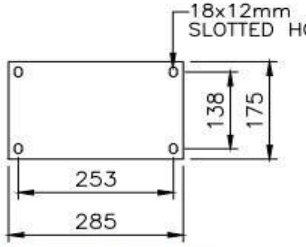
DRAWING FOR INDOOR 11kV POTENTIAL TRANSFORMER (PT)



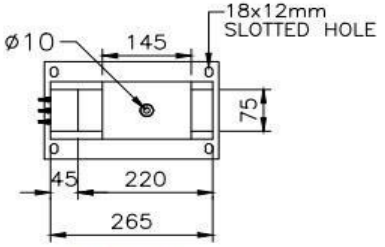
FRONT VIEW



SIDE VIEW



BASE PLATE DIMENSION

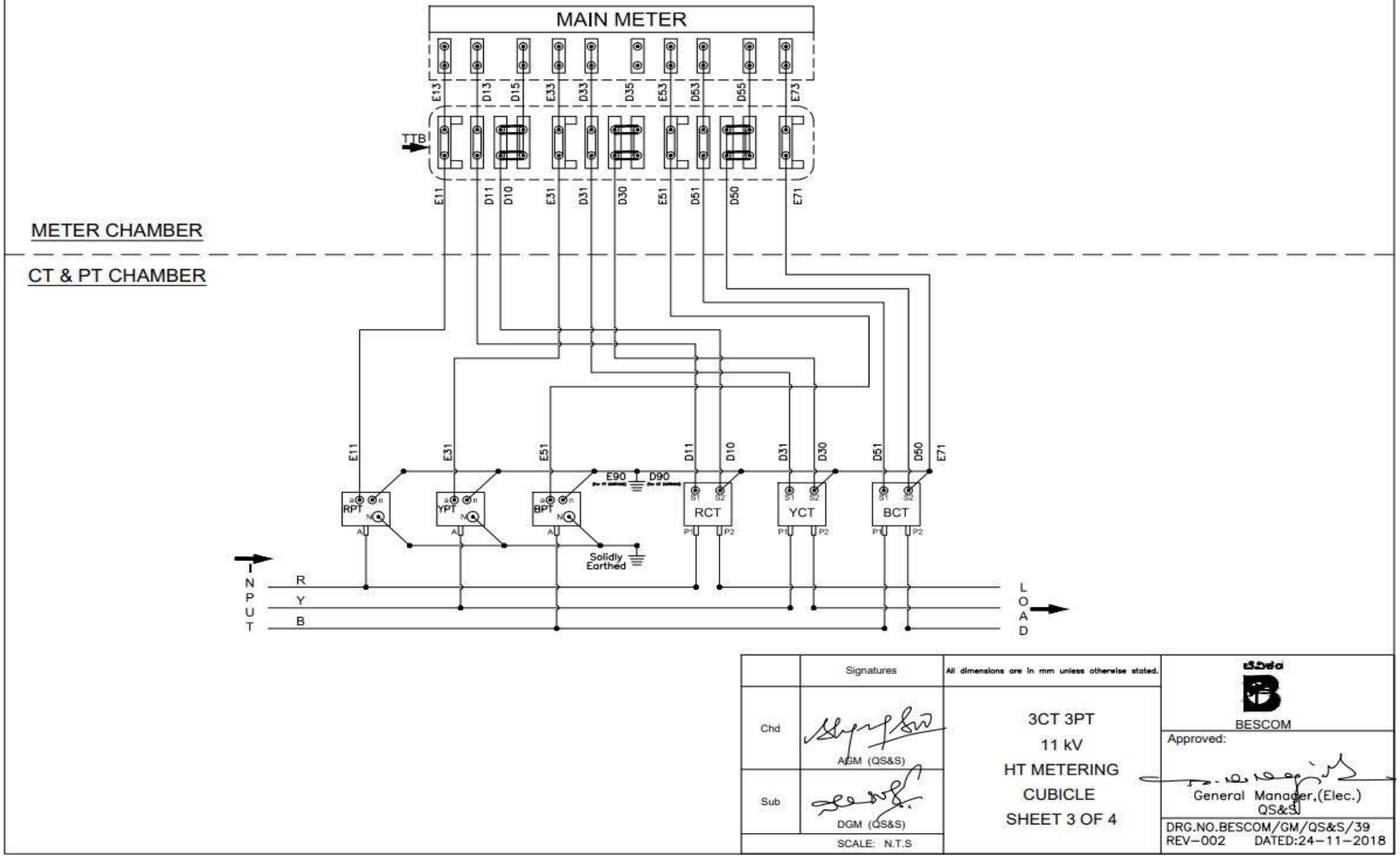


TOP VIEW

	Signatures	All dimensions are in mm unless otherwise stated.	BESCOM
Chd	AGM (QS&S)	3CT 3PT 11 kV HT METERING CUBICLE SHEET 2 OF 4	Approved: General Manager,(Elec.) QS&S
Sub	DGM (QS&S)		DRG.NO.BESCOM/GM/QS&S/39 REV–002 DATED:24–11–2018
SCALE: N.T.S			

WIRING DIAGRAM FOR 11kV HT METERING (for Regular Consumer)

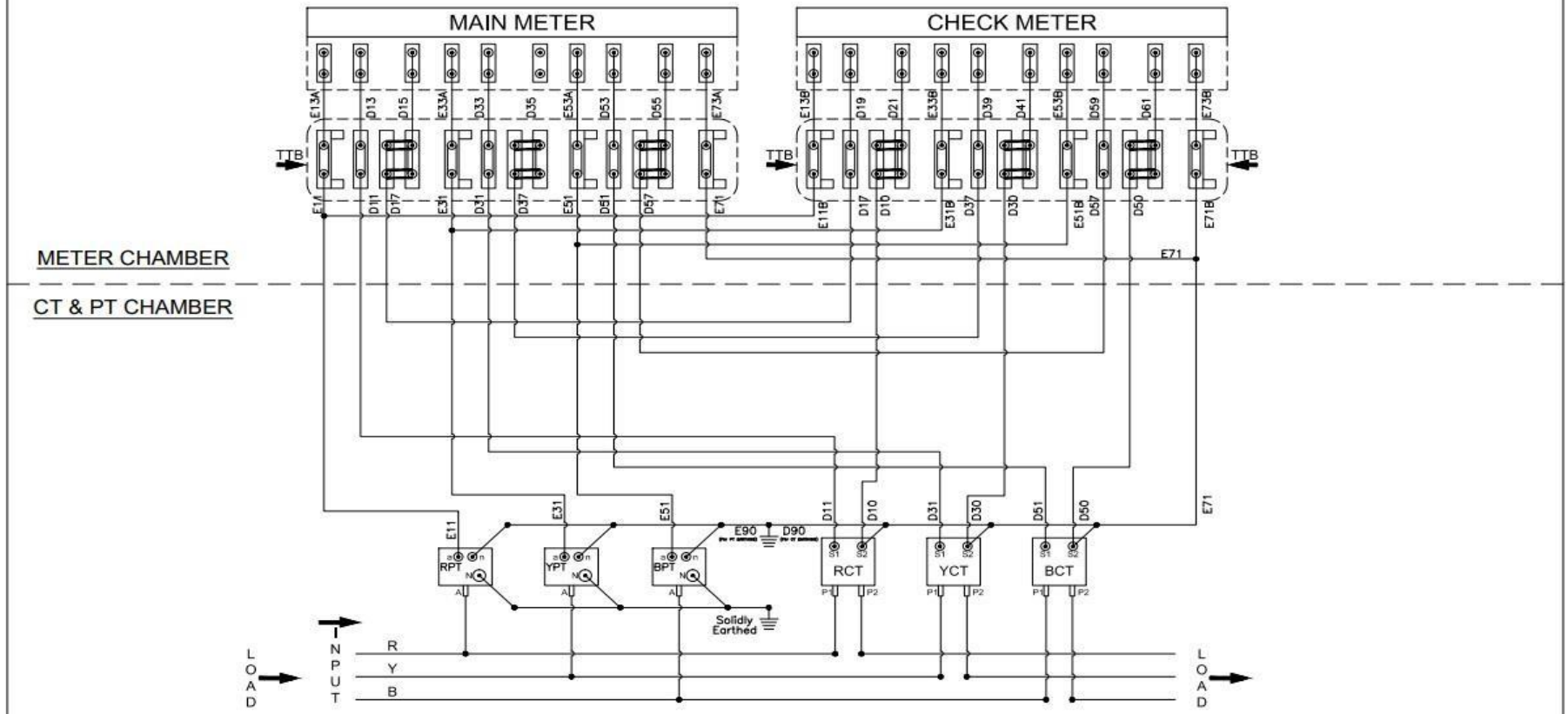
ANNEXURE-4



	Signatures	All dimensions are in mm unless otherwise stated.	BESCOM
Chd	AGM (QS&S)	3CT 3PT 11 kV HT METERING CUBICLE SHEET 3 OF 4	Approved: General Manager,(Elec.) QS&S
Sub	DGM (QS&S)		DRG.NO.BESCOM/GM/QS&S/39 REV–002 DATED:24–11–2018
	SCALE: N.T.S		

ANNEXURE-5

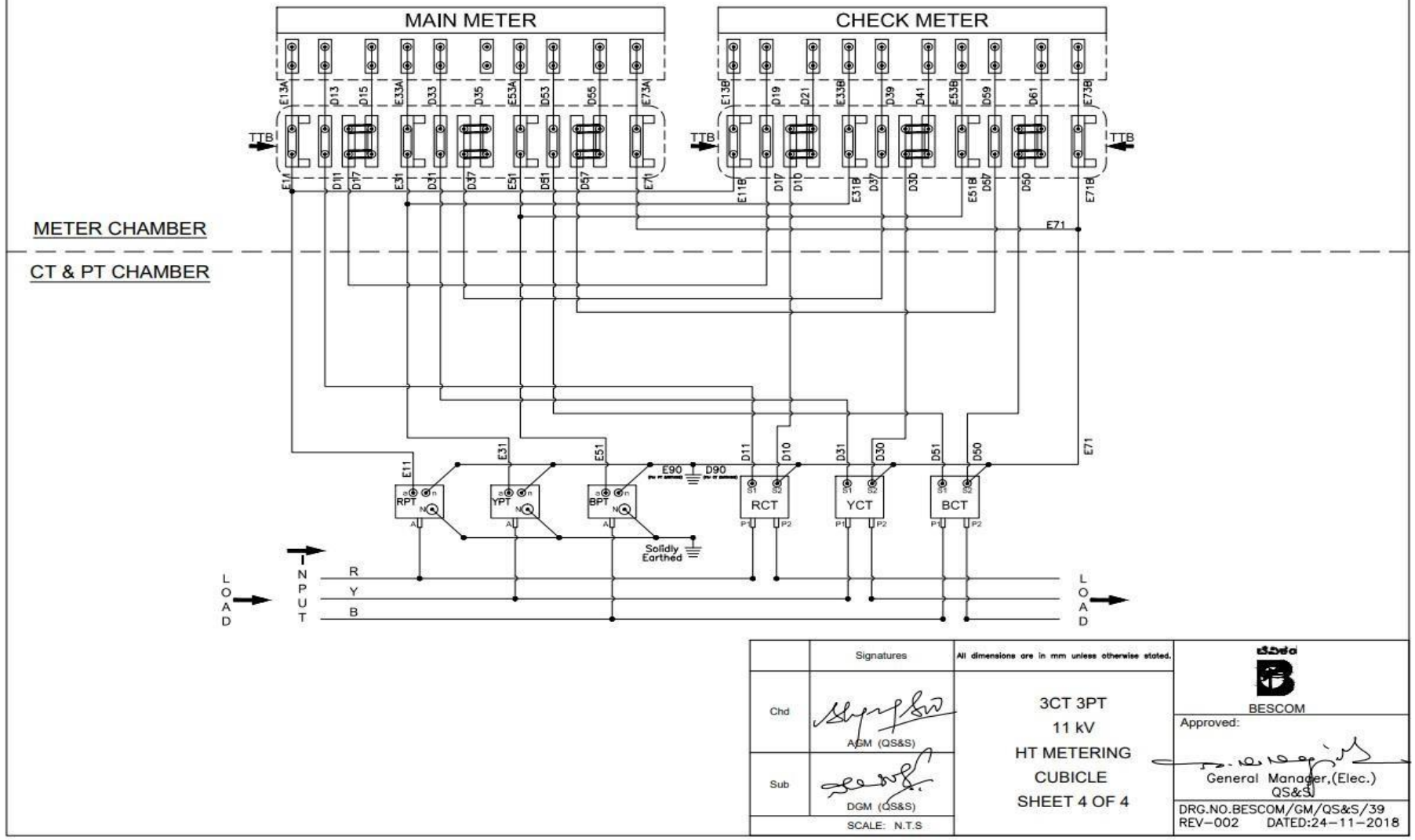
WIRING DIAGRAM FOR EHT/HT MAIN & CHECK METER IN SERIES



	Signatures	All dimensions are in mm unless otherwise stated.	BESCOM
Chd	AGM (QS&S)	3CT 3PT 11 kV HT METERING CUBICLE SHEET 4 OF 4	Approved: General Manager,(Elec.) QS&S
Sub	DGM (QS&S)		
SCALE: N.T.S			DRG.NO.BESCOM/GM/QS&S/39 REV–002 DATED:24–11–2018

ANNEXURE-5

WIRING DIAGRAM FOR EHT/HT MAIN & CHECK METER IN SERIES



	Signatures	All dimensions are in mm unless otherwise stated.	BESCOM
Chd	AGM (QS&S)	3CT 3PT 11 kV HT METERING CUBICLE SHEET 4 OF 4	Approved: General Manager,(Elec.) QS&S
Sub	DGM (QS&S)		DRG.NO.BESCOM/GM/QS&S/39 REV–002 DATED:24–11–2018
	SCALE: N.T.S		

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SECTION – 20
LED LIGHTNING, SWITCH & METERING BOX

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LED LIGHT FITTINGS AND STREET LIGHT FITTINGS

General requirements of LED Type (INDOOR/OUTDOOR) light fitting.

CEE/SWR specification No: SWR/LED LIGHT FITTING (Indoor/Outdoor) /001-2016

1	LED Make	NICHIA / OSRAM / SEQULCREE / / PHILIPS LUMILEDS / LEDNIUM / AVAGO
2	Type of LED	High Power, SMD (Surface Mounting Device) LED
3	Lumen Output/Efficiency	> 100 Lumens / Watt
4	Lumen at fitting level/ Output Efficiency	> 75 Lumens / Watt
5	LED Life	> 50,000 burning hours
6	Depreciation	30% max, after 50,000 burning hours
7	Colour Rendering Index (CRI)	> 75
8	Nominal Voltage	220 V AC
9	Input Operating Voltage	105-295 V AC
10	Power Factor	> 0.9
11	Protections	
	i. Surge protection	1.5 KV for 50 microseconds
	ii. Over voltage protection	300 V AC for 2 minutes
	iii. High voltage protection	1.72 KV AC for 1 minute
	iv. Insulation Resistance	Minimum 2 mega ohms with 500 V megger
12	Driver Type	Constant Current driver with short circuit protection
13	Driver Components	Industrial grade only
14	THD	< 20%
15	Efficiency of Driver Electronic	Efficiency of driver > 85%
16	Construction of Housing	Pressure die cast aluminium or CRCA or Extruded aluminium
17	Finishing	Power coated / anodized
18	Lamp Cover	Toughened glass of min. 0.8 mm thickness of sufficient strength of high transmittance efficiency (min.90%) Acrylic diffuser as per need of fitting
19	Secondary optics	Polycarbonate reflector / polycarbonate lence
20	Mounting	Indoor: Suitable for Surface / Recessed / Hung Type Outdoor: Suitable for Existing pole etc.,
21	Ingress Protection	IP 20 – Indoor IP 65 – Outdoor.

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NOTE:

- Supplied LED Luminaires shall conform to BIS:16107 or IEC 62722 and LEDs to BIS:16103 or IEC: 62717
- LED Luminaires shall also conform to LM- 79 (For quoted fitting) and LM- 80 for LEDs used.
- Firms have to submit LM80& LM79 test certificate from National/International accredited Laboratory and OEM certificate for compliance of BIS/IEC along with offer.
- Firms have to submit a warranty certificate for 5 (five) years along with supply.
- The make of whole LED Luminaire shall be as per approved make enclosed as annexure.

Following information's are to be mentioned by consignee in indent description.

- Type of luminaire: Like Street light, Flood light, focus light, retrofit (for retrofit type luminaire, this specification may be referred wherever applicable)
- Total wattage of LED luminaire
- Arrangement of LED: Single LED/ Multi LED
- Dimensions if required.
- Indoor/ Outdoor
- Mounting type: ie., Indoor: Suitable for Surface / Recessed /Hung Type
- Outdoor: Suitable for Existing Pole etc.

❖ **Sheet Metal/Deep drawn street lighting metering box with Automatic control switch, contactors with single phase 5-30 Amps meter & 50/5A CT**

The Sheet metal street light metering Box should be fabricated with 26 SWG Sheet metal with knock out block for cable entry and exit with metal glands. The box should have sufficient space and Din rail to house the protective equipment (ELCB/MCB), Auto changeover contactor with timer relay along with 3 phase 440 V 5-30 Amps High accuracy Energy meter. The Box door should have waterproofing rubber gasket along with viewing window for taking meter readings. The box should have necessary clamping arrangements for clamping on to the marked Street light pole.

❖ **Automatic Switches for streetlights**

The system should consist of an RTC (Real Time Clock) based electronic timer with an operating voltage of 220 v AC 50 Hz, having necessary NO/NC contacts

- Compact 17.5 mm Wide
- Multi-Function: (8 or 18) Non-Signal & Signal based functions
- Multi-Voltage: 24 – 240 VAC/DC
- Wide Timing Range: 0.1s to 999 Hr
- 3 Digit LCD for Preset time and Runtime
- Option to select Up/Down counting.
- Tamper-proof with key lock feature
- Panel mounting only.

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Made of environmentally friendly materials
AC or DC coil control (conventional or electronic) Side-mount auxiliary contacts

- Surge suppressors
- IP20 terminal blocks
- Terminal shields
- Terminal covers
- Connecting components
- Terminal lugs
- Mechanical/electrical interlocks

SMC: (Sheet Moulding Compund)
SMC is a hot press molded advanced plastic composites used by EPP engineers to produce SMC meter box, SMC electric junction box and other variety of electrical products. These ranges of products are free from all the issues of rusting, denting, splitting, maintenance, etc. There are certain points for design and construction of SMC meter boxes that EPP experts want you to remember-

- Minimum inside dimensions of the meter box should be suitable for installing distinct meters that users get from the market.

- The meter box is crafted with anti-corrosive, rust proof, dust proof, waterproof, UV protected and flame-retardant high-grade material that should have great dielectric and mechanical strength properties.

- The base of the meter box and cover should have at least two similar wire sealing holes for sealing purposes

EPP experts test the meter box as per the IS standards. Each test is performed in the laboratory that is accredited by the standard government bodies to ensure that the meter box meets all the requirements and safety standards.

Various types of testing include-

- Flammability
- Self-extinguishing
- Glow wire test
- Ball pressure test
- Heat deflection temperature
- Water absorption
- Mechanical strength
- Marking, dimension, and built
- UV ageing
- test Light transmission.

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EPP composites Pvt. Ltd. experts among leading suppliers of SMC electrical products like electric boxes. They have a team of experienced skilled workers that offers reasonable competitively priced products to stand ahead of the competitors.

Having more than thousands of satisfied customers with our workmanship, we ensure good quality products that meet all required standards and the customer's specifications.

You can put requests in a mail and send us at our email address directly. To inquire about SMC meter box, navigate to our inquiry page.

SALIENT FEATURES

- Single piece molded without any joints.
- Concealed metal hinges
- Mounting screws fitted from inside.
- Metal hardware for wire seal
- Adequate space for meter and cutouts
- Wide range for different applications
- Lightweight, yet strong
- Weatherproof
- Prices matching conventional meter boxes.
- Shockproof
- Free from pilferage
- Maintenance-free
- Lower thermal conductivity and good adaptability dimensional stability with UV resistance and Flexibility in design

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SECTION - 21

MISCALLANEOUS

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Heavy-duty long barrel copper terminal

The cost includes supply of heavy-duty long barrel copper terminals of different sizes bearing technical specification as mentioned.

i. The terminals should be made of High Purity Copper Tube and should be annealed.
ii. It should feature a Double Length Barrel for enhanced Electrical and Mechanical performance in Heavy Duty applications.
iii. There should be no cracks or gaps (Including inspection hole) to prevent the entry of water or moisture into the crimped joint making these terminals suitable for outdoor applications.
iv. The terminals should be electrically Tin Plated to prevent atmospheric corrosion.
v. The make of copper terminal shall be as per list of approved make.

1. 7/10 SWG Guy Wire:

The GI stay wire used for guy set shall confirm to the specification indicated and the strain insulator for LT line is No 8 and for HT line No 15 as per detailed specification and drawing furnished shall be used.

2. Mild Steel Black Grade 'B' Bolts & Nuts:

The specification covers manufacture and supply of mild steel hexagonal black grade 'B' bolts and nuts, manufactured from 4.6 / 4.8 grade material as per ISS 1363 and its latest revisions thereof.

The bolts and nuts shall be free from dirt, dust, and burns, cleanly finished, so that it shall be possible to turn the nuts freely with hand, but the ply shall be minimum. The bolts length less than 65mm shall be fully threaded & above 65mm must be threaded to the extent specified in IS:1363 and its latest revisions thereof. Tests shall be carried out in accordance with the relevant clauses of IS 1363 and test certificates thereon shall be submitted to this office and dispatches shall not be made till these test certificates are approved. The bolts and nuts shall be supplied duly packed in heavy new gunny bags and the weight of the individual bag shall not exceed 50 Kgs.

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SECTION - 22
CONCRETE

Bi-RIDE

Technical Specification for Concrete:

The detailed cement concrete specification gives information about quality and the quantity of the materials, proportion of mortar, workmanship, method of preparation and execution of work etc. The cement concrete specification is properly prepared which makes it easy on site for execution of cement concrete work.

Coarse Aggregates:

Coarse aggregate shall be of broken stones of granite or similar stones. They shall be free from dust, dirt and other foreign matters. Size of the stones should be 20 mm and down all should be retained on 5 mm square mesh and well graded such that it should not have voids more than 42
%.

Fine Aggregates:

Fine aggregates shall be of coarse sand and should have hard, sharp, and angular grains. The grains should pass the screen of 5 mm square mesh. The sand should be of standard specification and should be free from dust, silt and it should not be obtained from sea.

Cement:

Cement used from the construction should be fresh and it should not be too old. It should be of good quality and should meet all the standard specifications. The minimum compressive strength of cement should be 175 kg/ m².

Water:

Water should be clean and free from alkaline and other acidic matter. It should be suitable for drinking purpose.

Proportion:

M7.5:

The proportion of the cement concrete should be **1:4:8** or as prescribed. For the proportion of 1:4:8 the quantity of materials goes as one part of cement, four parts of sand and eight parts of aggregates.

M10:

The proportion of the cement concrete should be **1:3:6** or as prescribed. For the proportion of 1:3:6 the quantity of materials goes as one part of cement, three parts of sand and six parts of aggregates.

M15:

The proportion of the cement concrete should be **1:2:4** or as prescribed. For the proportion of 1:2:4 the quantity of materials goes as one part of cement, two parts of sand and four parts of aggregates.

M20:

The proportion of the cement concrete should be **1:1.5:3** or as prescribed. For the proportion of 1:1.5:3 the quantity of materials goes as one part of cement, one and half parts of sand and three parts of aggregates.

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Grade of Concrete	Mix of (Cement:Sand:Aggregate)	Size of Coarse Aggregates
M20	1:1.5:3	20 mm
M15	1:2:4	12.5 mm, 20 mm, 40 mm
M10	1:3:6	20 mm, 40 mm, 60 mm
M7.5	1:4:8	40 mm, 63 mm
M5	1:5:10	40 mm, 63 mm
Low Grade	1:6:12	40 mm, 63 mm

Mixing:

Hand Mixing:
Hand mixing is done on masonry platform or iron sheet tray. For the proportion of 1:2:4 first of all 2 boxes of sand and one bag of cement shall be properly and thoroughly mixed. Then 4 boxes of aggregates are added into the mix and then it is again properly mixed. The mixture should be dry mixed till all the materials are mixed together. Water is then added gradually along with turnings of the mixture. Generally, 25-30 liters of water per bag of cement is used to obtain plastic mix of required workability and water cement ratio.

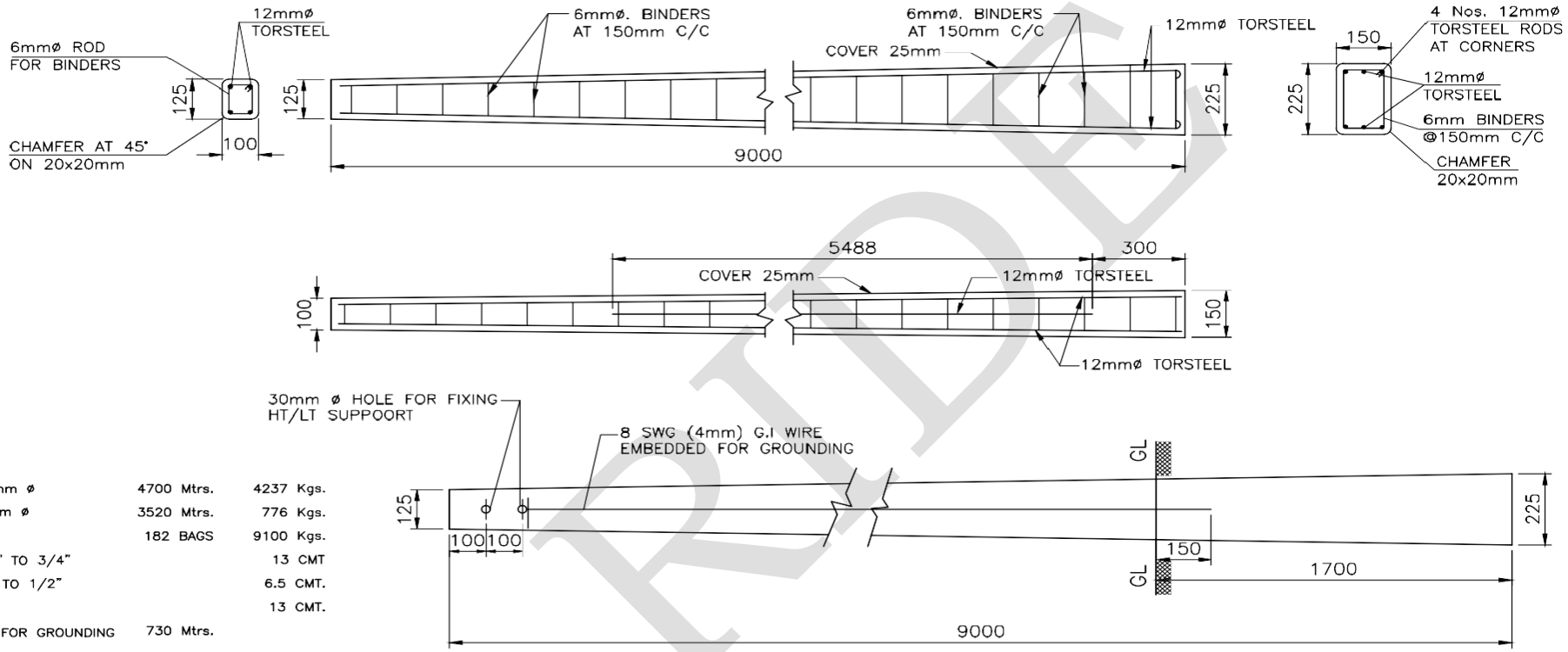
Machine Mixing:
In machine mixing for the proportion of 1:2:4 first of all 2 boxes of sand are dumped into the cement concrete mixer then one bag of cement and four boxes of aggregates are gradually added and rotated for dry mix to obtain required colour and then required quantity of water is added by water can. While being mixed, generally 25-30 lit of water per bag of cement is used to obtain required workability and water cement ratio.

Curing:
When the concrete gets hardened (generally after 3-5 hours of laying) wet gunny bags are placed on the concrete surface to keep the surface damp till 24 hours. The next day onward the concrete surface is flooded with water for 15 days for proper curing.

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SECTION - 23
DRAWINGS

Bi-RIDE



1	TOR–STEEL 12 mm ø	4700 Mtrs.	4237 Kgs.
2	M.S ROUND 6 mm ø	3520 Mtrs.	776 Kgs.
3	CEMENT	182 BAGS	9100 Kgs.
4	BABY JELLY 1/2" TO 3/4"		13 CMT
5	PEA JELLY 3/8" TO 1/2"		6.5 CMT.
6	SAND		13 CMT.
7	G.I WIRE 8 SWG FOR GROUNDING	730 Mtrs.	

1. THE CEMENT CONCRETE FOR THE POLE WILL BE OF PROPORTION 1:2:3 WITH GRADED HARD BROKEN STONE OF 10mm TO 20mm SIZE AND SHALL BE PROPERLY CONTROLLED WITH MINIMUM WATER CONTENT AND WELL CONSOLIDATED BY VIBRATION OR OTHER MEANS.
2. A CLEAR COVER OF 25mm TO BE PROVIDED FOR MAIN REINFORCEMENT.
3. SL NO. OF THE POLE NAME OF FIRM TURN KEY CONTRACTOR. AND THE WORK AWARD NO. SHALL BE ENGRAVED ON EACH POLE. (APPLICABLE ONLY FOR TURN KEY WORKS)
4. WORKING LOAD OF THE POLE IN KGS. AND DATE OF MANUFACTURING SHOULD BE ETCHED ON THE POLE.
5. FOR MORE DETAILS REFER I.S.785.

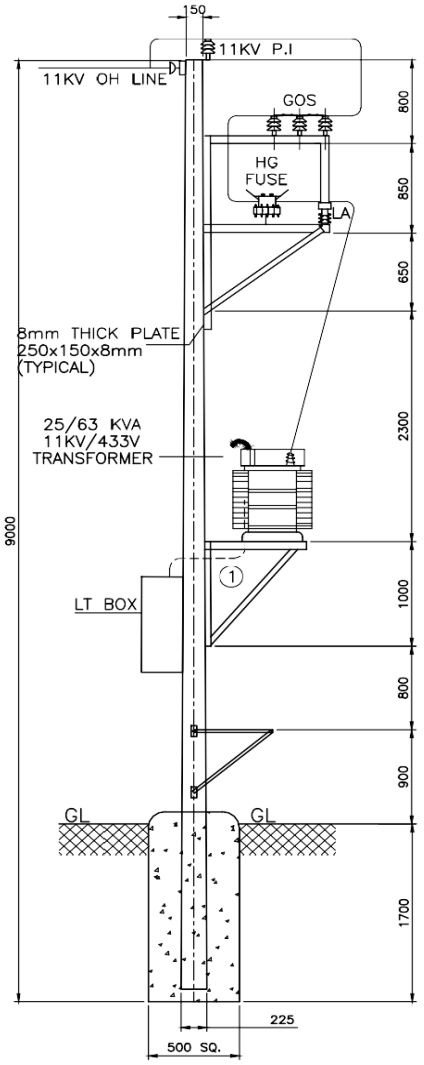
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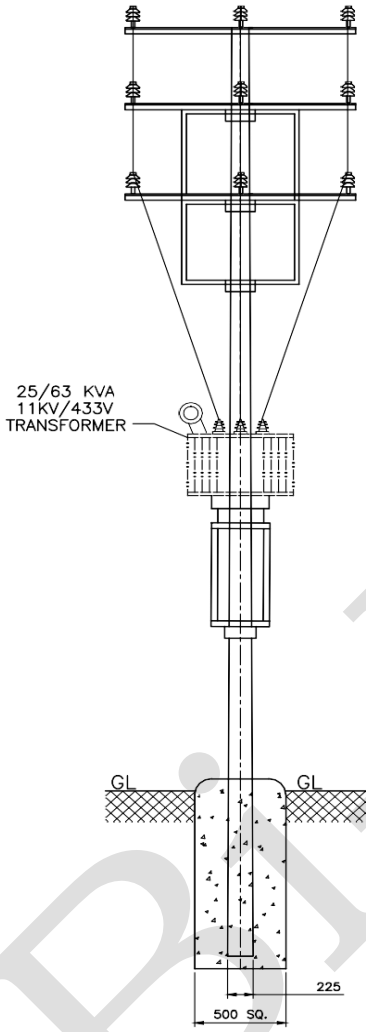
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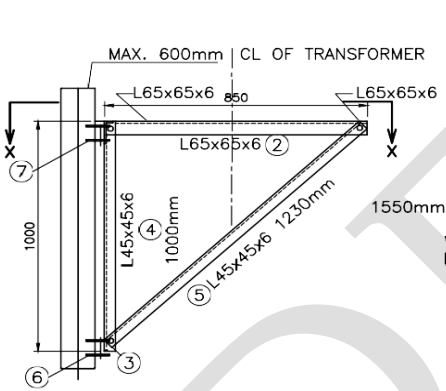
General Manager,(Elec.)
QS&S

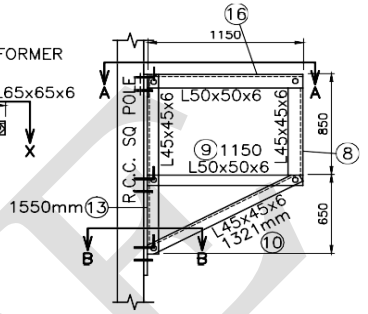
DRG.NO.BESCOM/GM/QS&S/02
REV–002 DATED:24–11–2018

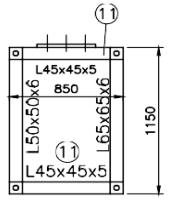
Bi-RIDE

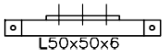


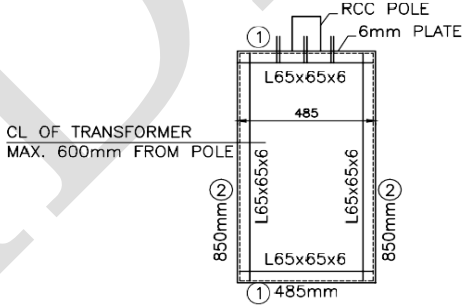


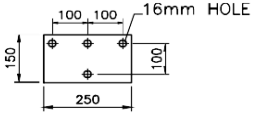












1. ALL HOLES ARE 18mm DIA. FOR 16mm DIA. BOLTS.

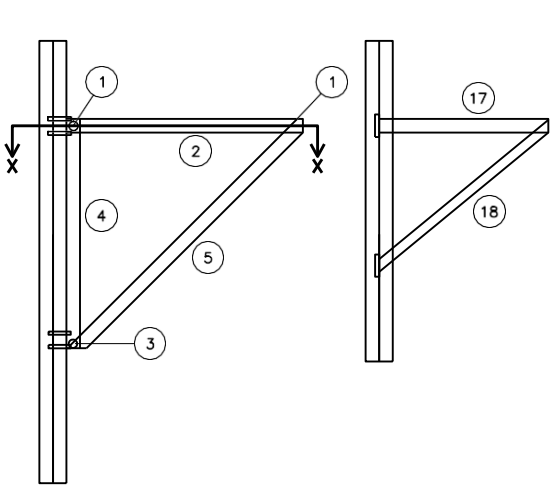
All dimensions are in mm unless otherwise stated.

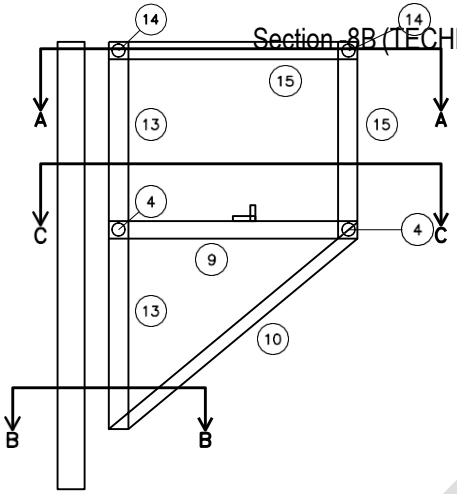
POLE STRUCTURE SET ON
9MTR. 150 KG WL RCC SQ
POLE FOR 25/63 KVA 4/5 STAR

General Manager,(Elec.)
QS&S

DRG.NO.BESCOM/GM/QS&S/37
REV–002 DATED:24–11–2018

K-RIDE

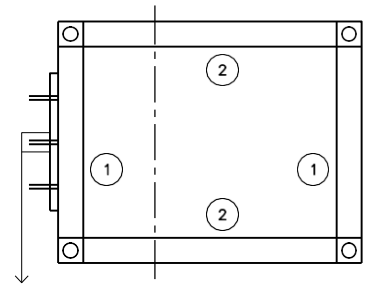


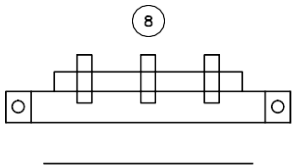


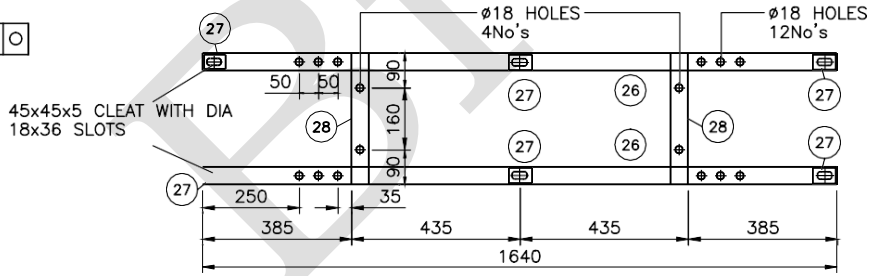
BILL OF MATERIALS - 7 A

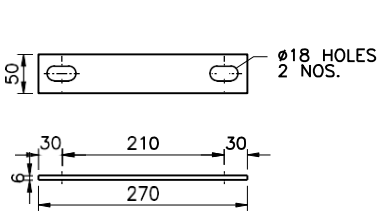
SPMT Structure materials suitable for mounting 25/63KVA Star Rated Transformers by using RCC Sq Section Pole 9Mtrs Long, 150kG WL With H Frame

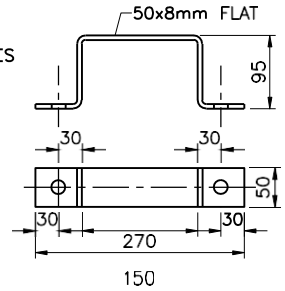
Sl. No.	Part No.	Qty in Nos	MS Angle Flat in mm	Length/ Piece in mm x Nos	Wt/Mtr in Kgs	Approx wt in Kg
	Transformer Seating Kit					
1	Transformer Seating Channel	2	65x65x6	485	5.8	5.63
2	Transformer Seating Channel	2	65x65x6	850	5.8	9.86
3	Tranformer Belting Angle with 65mm Cleat Welded	1	65x65x6	485	6.5	3.15
4	Tranformer Seating Supporting Verticle Side Angle	2	45x45x5	1000	3.4	6.80
5	Brace for Transformer Seating Angle	2	45x45x5	1230	3.4	8.36
6	Back Clamp for Transformer Seating Angle	1	50x8	560	3.1	1.74
7	Back Clamp for Transformer Belting Angle	1	50x8	560	3.1	1.74
	LA, HG Fuse Unit and Supporting Materials					
8	Horizontal Supporting Side Angle for H Frame set	1	50x50x6	850	4.5	3.83
9	Horizontal Supporting Side angle for HG Fuse Unit	2	50x50x6	1150	4.5	10.35
10	Brace for GOS & HG Fuse Unit	2	45x45x5	1321	3.4	8.98
11	Horizontal Supporting Side Angle for HG Fuse Unit	2	50x50x6	850	4.5	7.65
12	Horizontal Angle for HG Fuse Fixing	1	50x50x6	835	4.5	3.76
13	Vertical Supporting angle for fixing GOS & HG Fuse Unit	2	45x45x5	1550	3.4	10.54
14	Horizontal Supporting Side angle for fixing GOS	2	50x50x6	850	4.5	7.65
15	Vertical Supporting angle for fixing GOS	2	45x45x5	850	3.4	5.78
16	Horizontal Supporting angle for fixing GOS	2	50x50x6	1150	4.5	10.35
17	GOS Operating Pipe Supporting Angle	1	65x65x6	1150	5.8	6.67
18	GOS Operating Pipe Brace Angle	1	45x45x5	1000	3.4	3.40
19	Back Clamp For GOS Operating Pipe Supporting Angle (ON/OFF)	1	50x8	480	3.1	1.49
20	Back Clamp For GOS Operating Pipe Brace Angle (ON/OFF)	1	50x8	480	3.1	1.49
21	Back Clamp For GOS Mounting	1	50x8	480	3.1	1.49
22	Back Clamp For GOS Brace	1	50x8	480	3.1	1.49
23	Back Clamp For HG Fuse Unit	1	50x8	480	3.1	1.49
24	Back Clamp For LT Kit	1	50x8	480	3.1	1.49
		1	50x8	480	3.1	1.49
25	Fish Plate	1	50x6	270	2.4	0.65
	11kV H Frame Ladder Set details					
26	Angle Type A1& A2	2	45x45x5	1640	3.4	11.15
27	Welded Angle	6	45x45x5	60	3.4	1.22
28	Angle Type A3	2	45x45x5	345	3.4	2.35
	TOTAL a) Structure Steel					**142.02**
	MS Bolts & Nuts Full Thread Including H Frame					
	MS Bolt & Nuts For Transformer, Structure Kit & H Frame	47	**16x40mm to 16x125mm**	-	-	10.00
	TOTAL b) Bolt and Nut Full Thread					**10.00**











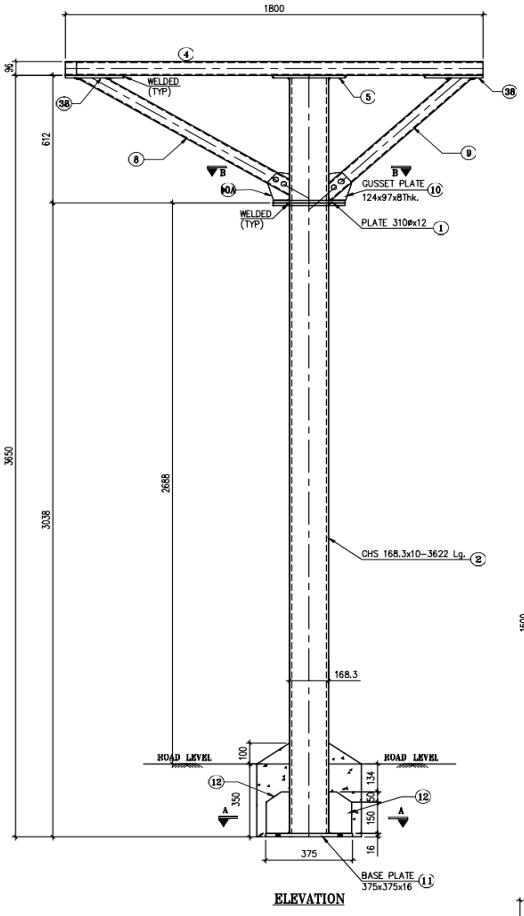
All dimensions are in mm unless otherwise stated.

POLE STRUCTURE SET ON
9MTR. 150 KG WL RCC SQ
POLE FOR 25/63 KVA 4/5 STAR

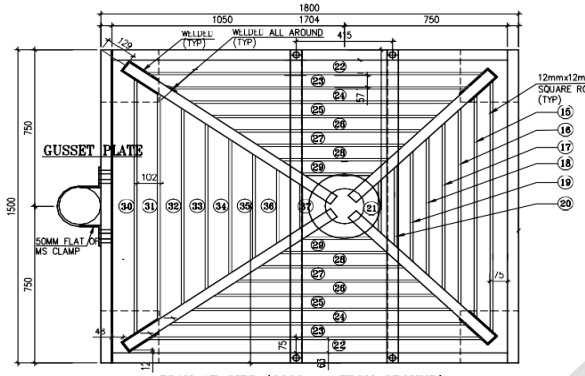
General Manager,(Elec.)
QS&S

DRG.NO.BESCOM/GM/QS&S/37
REV-002 DATED:24-11-2018

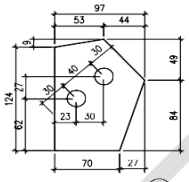
Bi-RIDE



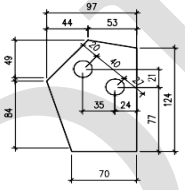
ELEVATION



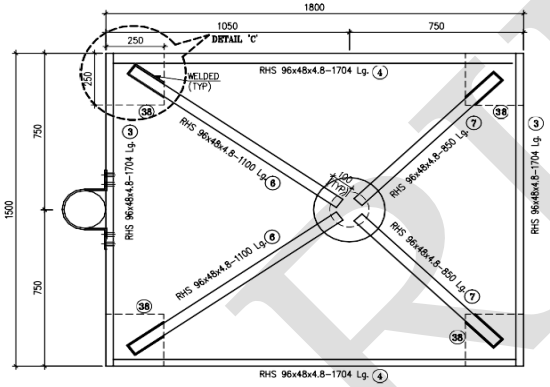
PLAN AT GIRD (3300mm FROM GROUND)



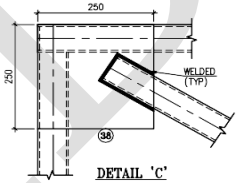
GUSSET PLATE (10)
(SCALE 1:3.75)



10A
(SCALE 1:3.75)



PLAN AT PLATFORM LEVEL(3300mm ABOVE GROUND)



DETAIL 'C'
(SCALE : 1:7.5)

BOLTS & NUTS (GRADE 5.6) PER STRUCTURE

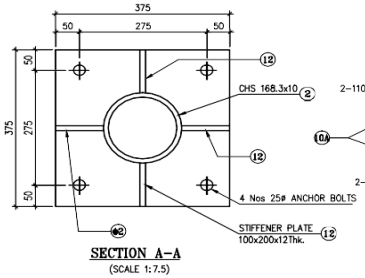
DESCRIPTION	WT./PCS.	QTY	TOTAL WEIGHT
	Kg	Nos	Kg
M16X75MM LG	0.142	8	1.136
M16X50MM LG	0.180	4	0.72
M16X3.15MM THK PLAIN WASHER	0.011	12	0.018
M16X3.5MM THK SPRING WASHER	0.009	12	0.072
	TOTAL WEIGHT		1.95 kg

SUMMARY OF WEIGHTS:–

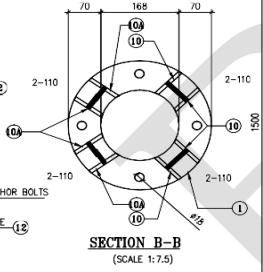
WEIGHT OF STRUCTURE	402.24 kg
WEIGHT OF BOLTS & NUTS	1.95 kg
TOTAL WEIGHT	404.19 kg

BILL OF QUANTITY PER STRUCTURE

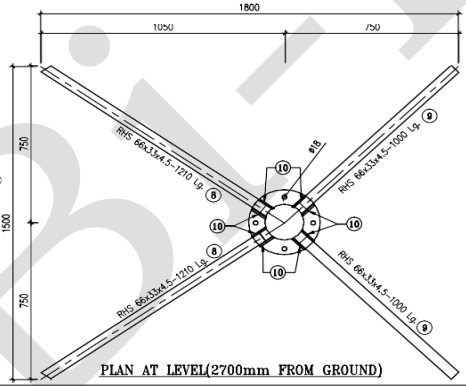
ERECTION MARK	SIZE/ DESCRIPTION	LENGTH (MM)	No.of	SECTION Wt(Kg)/M	WEIGHT/ PIECE (Kg)	TOTAL WEIGHT (Kg)
1	PLATE 310ø x12Thk.	310ø	2	94.20	7.11	14.22
2	CHS 168.3x10	3010	1	32.45	118.20	118.2
2A	CHS 168.3x10	588	1	6.34	23.2	23.2
3	RHS 96x48x4.8	1500	2	9.66	14.49	28.98
4	RHS 96x48x4.8	1734	2	9.66	16.75	33.5
5	PLATE 310ø x12Thk.	310ø	1	94.20	7.11	7.11
6	RHS 96x48x4.8	1100	2	9.66	10.63	21.26
7	RHS 96x48x4.8	850	2	9.66	8.21	16.42
8	RHS 66x33x4.5	1210	2	5.95	7.20	14.40
9	RHS 66x33x4.5	1000	2	5.95	5.95	11.90
10	GUSSET PLATE 97x8Thk.	133	4	62.8	0.81	3.24
10A	GUSSET PLATE 97x8Thk.	133	4	62.8	0.81	3.24
11	PLATE 375x16Thk.	375	1	125.60	17.66	17.66
12	STIFFENER PLATE 100x12Thk.	200	4	94.20	1.88	7.52
13	ISMC 100x50	1500	2	9.56	14.34	28.68
14	12mmx12mm SQUARE ROD	1218	1	1.13	1.38	1.38
15	12mmx12mm SQUARE ROD	1080	1	1.13	1.22	1.22
16	12mmx12mm SQUARE ROD	943	1	1.13	1.07	1.07
17	12mmx12mm SQUARE ROD	806	1	1.13	0.91	0.91
18	12mmx12mm SQUARE ROD	668	1	1.13	0.75	0.75
19	12mmx12mm SQUARE ROD	531	1	1.13	0.60	0.60
20	12mmx12mm SQUARE ROD	394	1	1.13	0.45	0.45
21	12mmx12mm SQUARE ROD	256	1	1.13	0.29	0.29
22	12mmx12mm SQUARE ROD	1458	2	1.13	1.65	3.30
23	12mmx12mm SQUARE ROD	1293	2	1.13	1.46	2.92
24	12mmx12mm SQUARE ROD	1129	2	1.13	1.28	2.56
25	12mmx12mm SQUARE ROD	964	2	1.13	1.09	2.18
26	12mmx12mm SQUARE ROD	799	2	1.13	0.90	1.80
27	12mmx12mm SQUARE ROD	635	2	1.13	0.72	1.44
28	12mmx12mm SQUARE ROD	470	2	1.13	0.53	1.06
29	12mmx12mm SQUARE ROD	1233	1	1.13	1.39	1.39
30	12mmx12mm SQUARE ROD	306	2	1.13	0.35	0.70
31	12mmx12mm SQUARE ROD	1087	1	1.13	1.23	1.23
32	12mmx12mm SQUARE ROD	941	1	1.13	1.06	1.06
33	12mmx12mm SQUARE ROD	795	1	1.13	0.90	0.90
34	12mmx12mm SQUARE ROD	649	1	1.13	0.73	0.73
35	12mmx12mm SQUARE ROD	503	1	1.13	0.57	0.57
36	12mmx12mm SQUARE ROD	357	1	1.13	0.40	0.40
37	12mmx12mm SQUARE ROD	211	1	1.13	0.24	0.24
38	PLATE 250x12Thk.	250	4	94.20	5.89	23.56
				TOTAL WEIGHT OF STRUCTURAL STEEL		402.24 Kg.



SECTION A–A
(SCALE 1:7.5)



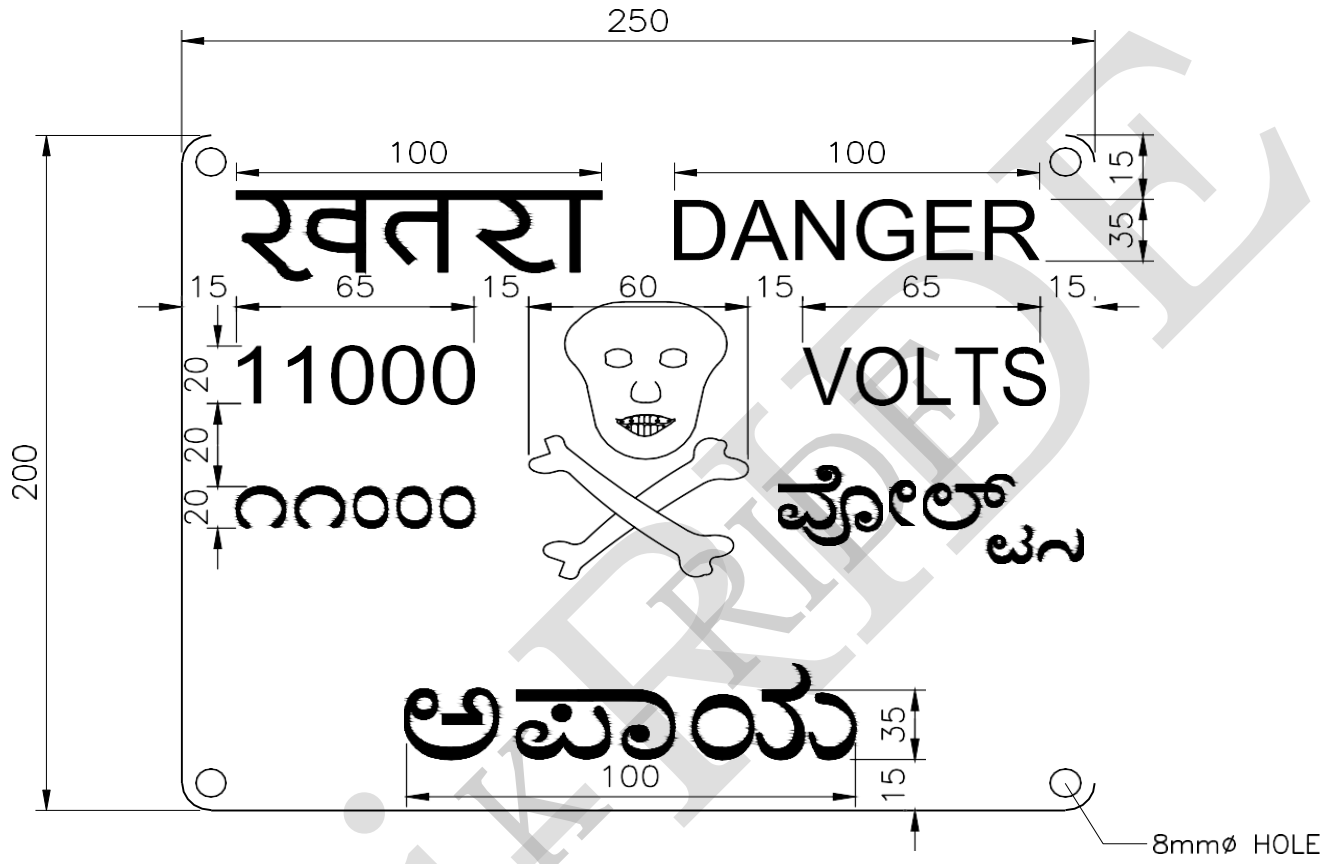
SECTION B–B
(SCALE 1:7.5)



PLAN AT LEVEL(2700mm FROM GROUND)

	Signatures		
Chd	AGM (QS&S)	GA DRAWING OF TRANSFORMER SUPPORT STRUCTURE	BESCOM
Sub	DGM (QS&S)		Approved
	SCALE: N.T.S		General Manager,(Elec.) QS&S
			DRG.NO.BESCOM/GM/QS&S/70 REV–002 DATED: 24–11–2018

K-RIDE



1. THE PLATE SHALL BE MADE FROM MILD STEEL OF MINIMUM THICKNESS 1.6mm.
2. THE PLATE SHALL BE VITREOUS ENAMELLED WHITE WITH LETTERS, FIGURES AND THE CONVENTIONAL SKULL AND BONES IN SIGNAL RED COLOUR.
3. ALL LETTERING SHOULD BE CENTRALLY SPACED.

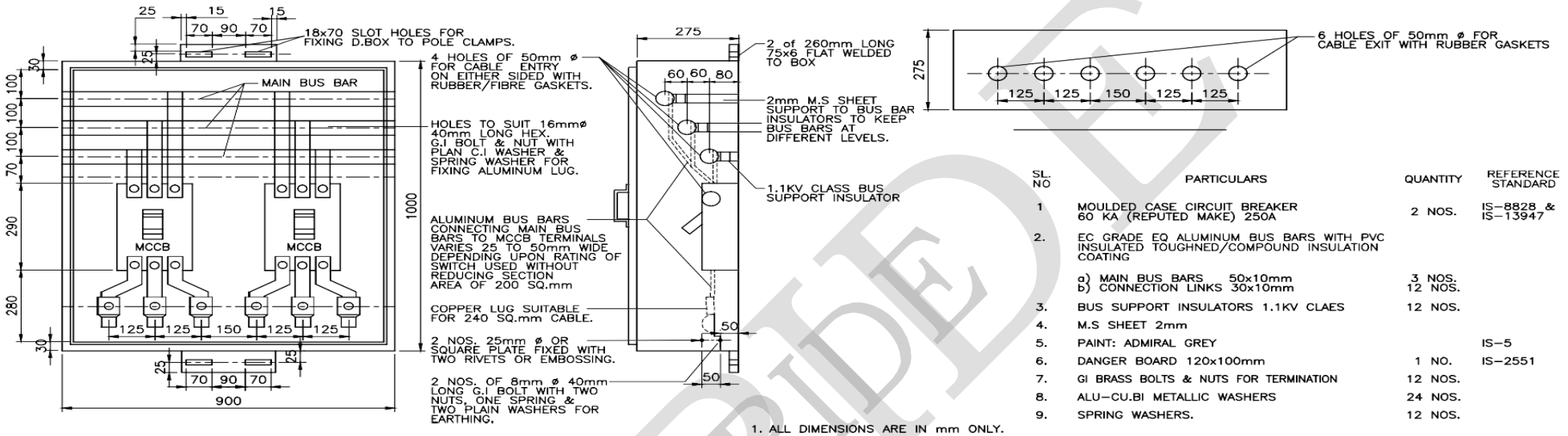
BIRDED

4. THE CORNERS OF THE PLATE SHOULD BE ROUNDED OFF.

5. THE REAR SIDE OF THE BOARD SHALL ALSO BE ENAMELLED.

	Signatures	All dimensions are in mm unless otherwise stated.	ಬಿ.ಐ.ಆರ್.ಟಿ.ಇ
Chd	AGM (QS&S)	DETAILS OF DANGER BOARDFOR 11KV INSTALLATIONS	Approved: General
Sub	DGM (QS&S)		
	SCALE: N.T.S		

Bi-RIDE



SL NO	PARTICULARS	QUANTITY	REFERENCE STANDARD
1	MOULDED CASE CIRCUIT BREAKER 60 KA (REPUTED MAKE) 250A	2 NOS.	IS-8828 & IS-13947
2.	EC GRADE EQ ALUMINUM BUS BARS WITH PVC INSULATED TOUGHNED/COMPOUND INSULATION COATING		
	a) MAIN BUS BARS 50x10mm b) CONNECTION LINKS 30x10mm	3 NOS. 12 NOS.	
3.	BUS SUPPORT INSULATORS 1.1KV CLAES	12 NOS.	
4.	M.S SHEET 2mm		
5.	PAINT: ADMIRAL GREY		IS-5
6.	DANGER BOARD 120x100mm	1 NO.	IS-2551
7.	GI BRASS BOLTS & NUTS FOR TERMINATION	12 NOS.	
8.	ALU-CU.BI METALLIC WASHERS	24 NOS.	
9.	SPRING WASHERS.	12 NOS.	

1. ALL DIMENSIONS ARE IN mm ONLY.
2. BOX SHALL BE MADE OUT OF 2mm SHEET, DEGREE OF PROTECTION AS PER IP-53.
3. THE DOOR SHALL HAVE INTER LOCKING ARRANGEMENT WITH SPRING LOADED LATCH OPERATED BY A COMMON KEY FOR ALL THE BOXES.
4. ALL M.S. BOLTS & NUTS PLAIN & SPRING WASHERS SHALL BE GALVANISED BY HOT DIP OR ELECTRO PLATED PROCESS.
5. EARTHING MUST BE DISTINCTLY INDICATED BY METALLIC LABEL OR EMBOSSED.
6. CABLE ENTRIES AND OUTLETS ARE OF 50mm ø HOLES COVERED WITH 2mm THICK M.S. SHEET SQUARE PLATES.
7. RIGOROUS RUST PROOFING PROCESS (3 IN 1 TREATMENT), DEGREASING, DERUSTING AND PHOSPHATING SHALL BE CARRIED OUT ON THE METAL BEFORE AND AFTER FABRICATION OF THE BOX AND BEFORE SPRAY PAINTING.
8. THE DOORS SHALL BE OF SELF CLOSING TYPE WITH SPRING ARRANGEMENT.

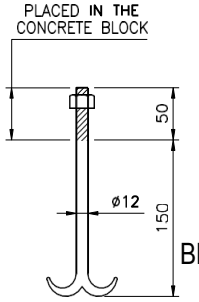
MANUFACTURES'S NAME & ADDRESS	
KVA	TYPE
VOLTS	P.ONO.
AMPS.	S.NO.

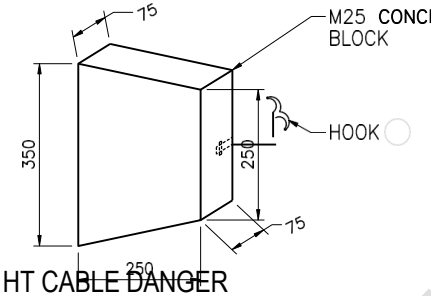
All dimensions are in mm unless otherwise stated.

General Manager,(Elec.)
QS&S

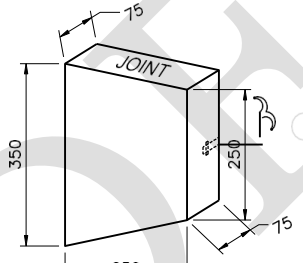
DRG.NO.BESCOM/GM/QS&S/08
REV-002 DATED:24-11-2018

Bik RIDE

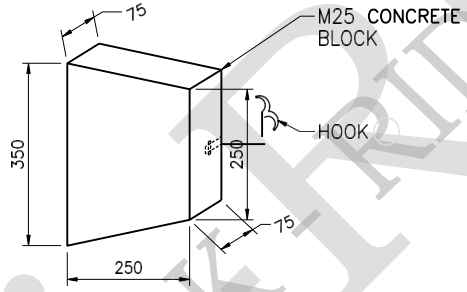




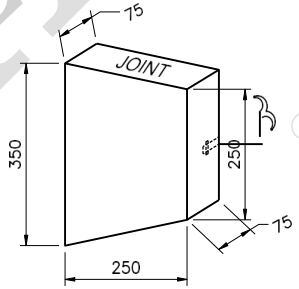
BESCOM HT CABLE DANGER



JOINT MARKER (LT)



BESCOM LT CABLE DANGER



All dimensions are in mm unless otherwise stated.

ROUTE MARKER (HT & LT)
JOINT MARKER (HT & LT),

General Manager,(Elec.)
QS&S

DRG.NO.BESCOM/GM/QS&S/80
REV-002 DATED:24-11-2018

BIKRIDE

SECTION – 24

OUTDOOR TYPE PACKAGED SUBSTATION
(COMPACT SUBSTATION)

TECHNICAL SPECIFICATION FOR 11 / 0.433KV HIGH VOLTAGE /LOW VOLTAGE COMPACT PREFABRICATED PACKAGED SUBSTATION

1 SCOPE

The specification covers design, manufacture, Testing, Inspection, Packing, Transportation and supply of 11/0.433 kV Packaged Substation with all safety accessories, tools and tackles. The substation shall be designed, manufactured, and tested as per IEC 62271.The substation shall be tested for internal arc test.

Test methods of prefabricated sub-station which are cable connected to be operated from inside or outside for alternating current of primary rated voltage 10KV to 13KV and for a transformer of maximum power 1000KVA for service frequencies. The pre-fabricated sub- station can be situated at ground level are partially or completely below ground level.

2 SYSTEM DETAILS

KPTCL Power is fed to Grid Substations at 66 / 11 KV from the 220 / 66 and where it is stepped down to the primary distribution voltage of 11kV.BESCOM distribute the power at 11 KV to consumers.

3 A. BILL OF QUANTITY

Each offer of Packaged Substations shall consist of

a. 11 KV 3-way RMU Unit (SF6/VCB type)	---	1 no.
b. 11 / 0.433 KV, Distribution transformer	---	1 no
c. Bus bar connection between LT terminal of transformer to ACB and to MCCB	---	1 set
d. Enclosure for entire sub station		
e. Exhaust fan for Transformer Compartment		
f. Provision for ETV Meter with CT & wiring		
g. MCCB/ACB details:		

B-RIDE

Sl. No	Transformer	No. of MCCB	Capacity of MCCB 4 pole 50KA, TM Based	Incomer for LT
1	100kVA Al. Winding	2	100A	250A MCCB, 50kA, 4 pole Fixed Type Micro Processor based
2	250kVA Al. Winding	3	250A	400A MCCB, 50kA, 4 pole Fixed Type Micro Processor based
3	500kVA Al. Winding	7	250A	800A ACB, 50kA, 4 pole Fixed Type Micro Processor based
4	800kVA Cu winding	6	250A	1250A ACB, 50kA Fixed Type 4 pole Micro Processor based
5	1000kVA Cu winding	7	3 x 400A 4 x 250A	1600A ACB, 50kA Fixed Type 4 pole Micro Processor based

A. SPARE

The bidder has to specify the list of recommended spare per packaged substation for a period of 2 years.

4 SITE CONDITION

The equipment covered under this specification is for **outdoor installation** and should be suitable for use at the sites in BESCOM jurisdiction for the prevailing climatic conditions.

a) TEMPERATURE: The reference ambient temperature is to be taken as 43.3ºC as per IS 9676.
   i) Maximum ambient air temp---------- 50ºC
   ii) Maximum daily average ambient temp----------40ºC
b) RELATIVE HUMIDITY
   i) Maximum ---------- 100%
   ii) Minimum ---------- 10%
c) Average Annual rainfall ---------- 750mm
d) Average no of rainy days/annum ---------- 50
e) Average no of thunderstorm days/annum----------40
f) Altitude ----------Not exceeding 300 m
g) Rainy months----------June to Oct
h) Wind pressure---------- 195kg/m^2 up to 30m elevation as per IS 875/75.

The atmosphere is heavily polluted, laden with mild acid and dust in suspension during the dry months and is subjected to fog in cold months. Heavy lightening occurs in the area during rainy months.

All equipment's shall be designed to withstand seismic forces, corresponding to an acceleration of 0.1g.

5 DRAWINGS AND DOCUMENTS

Vendor shall furnish with the detail, as per "VENDOR DATA REQUIREMENT", attached with the specification.

6 INSTRUCTIONS TO BIDDERS

6.1 All equipment and material shall be designed manufactured and tested in accordance with the latest applicable Indian Standard, IEC standard and CBIP manuals.

6.2 The electrical installation shall meet the requirement of Indian Electricity Rules as amended up to date relevant IS code of practice and Indian electricity act. In addition, other rules of regulations applicable to the work shall be followed.

6.3 The high-tension Switchgear, distribution transformer, LT Switchgear & its accessories offered shall in general comply to the following specification attached.

A. Specification for 11kV Non extensible compact RMU

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B. Specification for Distribution Transformer
C. Specification for LT system
D. Specification for enclosure for package substation.

A. SPECIFICATION FOR 11 kV Non-Extensible Compact RMU

1 CODES AND STANDARDS

1.1 The equipment shall comply with the requirements of latest revision of following standards issued by BIS (Bureau of Indian Standards), unless otherwise specified.

IS 694:	PVC insulated cables for working voltages up to and including 1100V.
IS 722:	Integrating meters.
IS 1248:	Electrical indicating instruments.
IS 2071:	Methods of high voltage testing.
IS 2544:	Porcelain post insulators for systems with nominal voltage greater than 1000V.
IS 2705:	Current Transformer.
IS 3156:	Voltage Transformer.
IS 3231:	Electrical relays for power system protection.
IS 3427:	Metal enclosed Switchgear and Control gear for voltages above 1000V but not exceeding 11000V.
IS 3618:	Phosphate treatment of iron and steel for protection against corrosion.
IS 5082:	Material for data for aluminum bus bars.
IS 5578:	Guide for marking of insulated conductors.
IS 6005:	Code of practice of phosphating of iron and steel.
IS 9046:	AC conductors of voltage above 1000V up to and including 11000V.
IS 9920:	Switches and Switch isolators for voltages above
1000V.	
IEC: 1330:	Specification for High Voltage Pre-
1995 IS: 14786/2000	Fabricated Sub-Station.
IEC:50 (441):1984	International Electro Technical
IS:1885 (Part 17)	Vocabulary (IEU) chapter 441 Switch gear, Control gear & fuses.
IEC: 298:1990:IS: 3427	AC metal enclosed Switch gear and Control gear for rated voltages above 1 KV and up to and including 52KV.
IEC: 364-4-441: 1992	Electrical installation of building.
Part 4	protection for safety, chapter 41 protection against electrical shock.
IEC:439-1:1992:IS:8623	Low voltage Switch gear and Control gear
(Part I)	assemblies Part-I, type tested and partially type tested assemblies.
IEC: 466:1987:	AC Insulator-enclosed Switch gear and
IS:14659	Control gear for rated voltages above 1 KV and up to and including 38KV.
IEC: 529:1989:	Degree of protection provided by
IS:12063	enclosures (IP code).
IEC:664-1,1992:	Insulators co-ordination for equipment's with low voltage system Part-I, principles, and tests.
IEC:694,1980:	Common clauses for high voltage Switch gear and Control gear standards.
IEC:947-1,1988	Low voltage Switch gear and Control gear
IS:13947 (Part I)	Part-I, general rules.

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IEC:1180-1,1992	High voltage test Techniques for low voltage equipment Part – I, definition test and procedure requirement.
ISO: 1052:1982	Steels for general engineering purposes.
ISO: 1210:1992	Plastics determination of the burning behavior of horizontal and electrical Specimen in contact with small flame or ignition source.
IEC:694:IS:12729	Common clauses for high voltage Switch gear and Control gear standards.
IEC:298:IS:3427	AC metal enclosed Switch gear and Control gear for rated voltage above 1 KV and up to and including 52KV.
IEC:129	AC Switches and Earthing Switches.
IEC:265:IS:9920	Switches and dis-connectors (All parts)
IEC:801	Monitoring and Control.
IS:13118	High voltage AC circuit breakers.
IS/BS:5463	High voltage Switches.
IS/BS:5227	Metal enclosed AC Switch gear.
IEC:376	For SF6 Gas used for the filling of RMU.
IS 9921:	AC dis-connectors (isolators) and earthing Switches for voltage above 1000V.
IS 11353:	Guide for uniform system of marking and identification of conductors and apparatus terminals.
IS 12661:	HV motor starters.
IS 12729:	General requirements for Switchgear and Control gear for voltages exceeding 1000V.
IS 13118:	General requirements for circuit breakers for voltages above 1000V.
IS 13703:	Low voltage fuses.

1.2 In case of imported equipment standards of the country of origin shall be applicable if these standards are equivalent or stringent than the applicable Indian standards.

1.3 The equipment shall also conform to the provisions of Indian electricity rules and other statutory regulations currently in force in the country.

2 Design Criteria

2.1 The 11KV Non-Extensible, Non-metering Switchgear shall be installed at Outdoor substation location along the ring main 11KV feeder system in BESCOM supply area. 11KV wing isolator Controls incoming/Outgoing feeder cables of the 11KV distribution system. Tee-off Vacuum/ SF6 Circuit Breaker shall be used to Control and isolate the 11KV/433V distribution transformer / HT Consumers connected through 11KV grade underground cable at distribution center.

2.2 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.

2.3 For continuous 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.

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2.4 The equipment offered shall be suitable for continuous satisfactory operation as per site condition specified elsewhere.

3 Specific Requirement

3.1 The requirement of 11KV, 20 KA SF6/VCB insulated non-extensible SF6 insulated Ring Main Unit is as under.

a) Non-Extensible compact ring main unit suitable for Indoor/Outdoor installation shall consist of the following.

i. Two numbers of 11KV, **630 Amps**, continuously rated fault making, load breaking Switches. These units shall be triple pole, SF6 Insulated, quick break type with spring charge stored energy mechanism for operation. It shall have arrangement for terminating up to 400sq.mm incoming and outgoing 11KV, 3C XLPE HT UG cables.

ii. One Tee-Off unit with 11kV, **200 Amps** Vacuum / SF6 Circuit Beaker (for Controlling transformer), load breaking and fault breaking type fitted with three 200 Amps continuously rated SF6 insulated busbar along with CT with combination for protection of transformer. It shall have arrangement for terminating up to 240sqmm 11KV, 3C XLPE HT UG cables.

iii. Providing **Right angled reusable boot** for terminations (3x3 nos.)

3.2 System:

3.2.1 The system network is 11000 Volts, 3 phase 3 wires 50 cycles with neutral solidly grounded. The voltage and frequency are subject to variation as per statutory limits governed by Indian Electricity Rules 1956 with latest amendments in force.

a. GENERAL FINISH:

The equipment should be totally enclosed, metal clad, vermin and dust proof suitable for tropical climate use as detailed above. The body of the RMU Unit should be of **metalized cast resin tank /stainless steel** and should be **rust free**.

b. PAINTING:

The surface of all metallic parts shall be thoroughly cleaned, scrapped and degreased preferably by shot blasting or any other treatment. The exterior surface shall be given two coats of rust resisting red oxide primer conforming to IS 2074:1992 and final two coats of weather resisting battleship grey enamel paint. The paint shall withstand the operating conditions described above and equipment shall not show any sign of the rust formation.

c. RATING:

The busbar shall have continuous rating of **630 Amps**. The isolator should have continuous rating of 630 Amps and Vacuum / SF6 circuit breaker shall have a continuous rating of 200 Amps.

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All connection including band joints for busbars etc., shall be of ample cross section to cater the rated load current continuously and shall be suitable for short time rating of **20 KA for 3 seconds**.

4 Breaking and Making CAPACITY:

i. The Vacuum / SF6 circuit breaker shall be capable of having rupturing capacity of **350 MVA** symmetrical at 11000 Volts three phase. Symmetrical breaking capacity shall be **20 KA** and the making capacity of **50 KA** at 11000 Volts. The isolators shall be capable for breaking rated full load current and shall have fault making capacity of **50 KA peak.**

4.1 Type of EQUIPMENT:

4.1.1 The equipment shall be compact, totally enclosed in as self-contained self-supporting, gas tight compartment, mounted on base frame or channels. The assembly shall be equipped with common power busbars, load break Switches and SF6/vacuum circuit breaker as specified in specific requirement as above. All medium voltage parts should be totally enclosed in an SF6 environment.

4.1.2 **BUSBARS:** The busbar shall be SF6 insulated type. The cross-sectional area of the copper busbar and jointing accessories shall be furnished prior to supply of item.

(a) Isolator:

The isolators offered shall conform to IEC-265 IS-9920 (all parts) as amended to date. The isolator shall be SF6 insulated, triple pole, spring assisted hand operated type with quick break contacts. The isolator shall be contained in sealed SF6 enclosure made of stainless steel. SF6 gas pressure gauge shall be provided for pressure indication purpose.

a) The operating handle shall have the three positions “ON”, “OFF”, and “EARTH” which shall be clearly marked with suitable arrangement to padlock in any position. A safety arrangement for locking shall be provided by which the isolator operation shall be prevented from “ON” position to “EARTH” position or vice versa in a single operation.

b) Integral cable test terminals for test plug with clear identification mark and with interlocked cover shall be provided. The interlocks shall be so arranged that, the cable test terminals. will be accessible only in the “EARTH” position of the isolator.

c) To facilitate testing of cables, it shall be possible to bring the isolator to OFF position while the test plugs are kept inserted, but operation to ON position shall be prevented so long the cable testing is in progress.

d) The isolator shall be capable of breaking full load current and a fault making of 50 KA peak.

e) Isolators: Isolators are to be operated manually.

(b) Vacuum / SF6 Circuit Breaker

- The tee-off unit shall consist of 11KV, **200 Amps** VCB/ SF6 (for Controlling transformer), load breaking and fault breaking type fitted with three 200 Amps continuously rated SF6 gas insulated busbars and arrangement for cable to the primary side of the transformer.

- The Tee-off circuit breaker shall be suitable for manual closing and opening.

- The operating mechanism shall be direct hand operated trip free with a mechanically operated indicator, positively coupled to the operating mechanism to indicate whether the breaker is in the closed or in the open position.

- Off load isolator shall have three positions i.e., ON, OFF & EARTH.

- Voltage Indication: There should be arrangement to check whether the cable connecting to the isolator is live or not.

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- The tee-off unit shall be provided with accessories for tripping such as CT operated series trip coils for over current and earth fault protection.

- Breaker shall be provided with a **shunt trip** coil suitable for **230VAC** supply.
- Current Transformer: The Ratio of the CTs shall be suitable for Controlling transformer. The VA burden of the CTs shall be sufficient to supply the energy required by the relay for normal operation and tripping of the circuit breaker.
- Protection System: The protection system should be provided with the provision of suitable self-powered relays having scheme for both over current & earth fault. It must provide immediate protection and can detect faults instructing the circuit breaker to trip in less than 40 ms.
    i. The protection system is a **self-powered relay which requires no external power source or batteries**.
    ii. It must have improved operation and Control with the Relay settings clearly displayed on the front of the panel.
    iii. It should have the provision for the trip test on circuit breaker. The 'trip inhibit' facility allows the Relay to be tested without tripping the circuit breaker. Secondary injection can also be carried out using conventional test equipment's.

The free-standing metal housing shall be designed to withstand internal pressure and external mechanical loads without distortion. Where required the SF6 gas insulated Switchgear housing shall have an over pressure relief device vented to the rear side of the equipment. An operating mimic diagram shall be provided on the front side of RMU. Each unit shall be provided with lifting facility of proven design for easy handling.
Isolator / Breaker ON-OFF, Earth, (230VAC space heater, thermostat Controlled) with heater ON/OFF indication & 'SF6 gas pressure low' indication etc. shall be provided.

Handle operated 'spring charged' mechanical operation shall be provided. Local Control of

Switch / isolator shall be possible.

Local operation selector Switch shall be provided.

SF6 Insulation: Switchgear housing shall be completely gas tight. In the power compartment, provision shall be made for filling up the gas at site.

A manometer should be provided to indicate the healthy state of SF6 gas pressure inside the tank. SF6 gas pressure inside the tank shall not be more than 1 bar at 20 Deg Centigrade.

5 Operation and interlocking:

5.1 All operations shall be from front of the equipment via spring assisted mechanism. The Ring Main Unit and SF6/VCB for Tee-off should be provided with a series trip coil for tripping. It shall be possible to operate the Switches and circuit breaker manually and spring assisted mechanism shall ensure speed of operation of Switches.

5.2 Operation handle shall be considered as part of the unit and should be provided with each RMU.

5.3 Load break Switches and earthing Switches shall be fully interlocked to ensure that operation is carried out in correct sequence. Movement of operating handle against interlock shall not by any means originate, store or activate the energy mechanisms. Padlocking facility shall be provided for operation of load Switch and earthing Switch. Safety of operation shall be ensured by interlocks.

5.4 Simultaneously closing of the main Switch and earth Switch. This interlock shall be integral part of the operating mechanism. Also separate operating shafts shall be provided for operation of earthing Switch and main Switch for the same purpose.

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5.5 The fully interlocked integral test facilities are to be provided underneath the units, so that access to the test terminals is achieved only by removal of a cover.

5.6 The SF6 insulated isolators and SF6/VCB breaker operating mechanisms shall be totally enclosed and self-lubricating type. The manually operated handle shall be mounted in front of the isolators and so designed that the operation is complete by one movement without any undue stain on the operator.

5.7 All mechanical interlock shall be robust so as not to give any way during normal operation.

5.8 The tripping of breaker unit should be provided with push button.

6 Secondary wiring:

6.1 The secondary wiring supplied for the equipment shall consist of non-deteriorating fire proof superior grade stranded copper PVC wires suitably colored and fitted with numbered ferrules at both ends. The cross section of the wires shall be 4 mm² for CT and 2.5 mm² for others. Following color codes shall be used for wiring.

C.T.: Red, Yellow, Blue, Black,
D.C. Circuit: Grey, Earth: Green,
A.C. Circuit: Black.

6.2 Wiring shall be terminated with ring type ferrules with ferrule numbers marked at both ends of wiring. CT wiring shall be marked with additional distinct red tags on both ends. All secondary wiring shall be terminated by using reputed make terminal blocks.

7 Earthing arrangement:

a) It shall be easily possible to test the cables including the Tee-off (in case of RMU) by a simple earthing arrangement. In case of breaker, the earthing shall be preferably.
accomplished through the circuit breaker and the tripping arrangements made inoperative if required.

b) Equipment earthing of copper strips of adequate size shall be provided.

c) A set of earthing and a set of three phase test bushings shall form an integral part of RMU and shall be all enclosed within an interlocked cover to prevent incorrect operation. The
access of the test bushing shall be fully interlocked.

7.1 A mechanical 'ON/OFF' indicator shall be provided on SF6 insulated isolators and SF6/ VCB breaker to indicate whether Switch is ON or OFF.

7.2 SF6 insulated Switches shall be fitted with correct sequence device having "ON/OFF' and re-set and test position and shall have provision for padlocking **operating handle.**

8 Cable Boxes

8.1 The isolators and SF6/VCB shall be provided with suitable and identical cable boxes for connection 3 core, 11KV XLPE cables of size up to 400 Sqmm approaching vertical from below. The cable boxes shall be so located at convenient height to facilitate easy cable jointing work.

8.2 The access for the isolator cable box shall be from side and the access for the Tee-Off SF6 / VCB cable box shall be from rear side and distanced of bottom level of wiping gland from ground shall be maintained at 310 mm (minimum).

8.3 The cable boxes shall be with detachable front cover for ease of termination & shall be interlocked with Switch position (i.e., when isolator is in Earth / OFF position).

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8.4 The design of the cable box shall be such that any type of jointing methods such as heat shrinkable/push on type/cold shrinkable type terminations can be adopted.

8.5 Earthing: All ring main units shall have a special earth bar with a sectional area of not less than 100 sq.mm run along the whole of metal enclosed Switch structure, each end being connected to the main earthing system where metal cases are used on instruments these shall be connected to this bar by conductors of not less than 16 mm² section.

8.6 All foundation bolts, nuts and washers necessary for installation shall be supplied by the manufacturer.

8.7 Removable eye bolts shall be provided to facilitate the handling of the RMU/tee-off unit/ SF6 isolators.

8.8 Labels: All RMUs shall be clearly labeled as required indicating where necessary their purpose and "ON" and "OFF" lettered on brass, ivory, enamel iron or other suitable materials.

8.9 Name plate.

Each RMU and its associated equipment's shall be provided with a nameplate legible and indelibly marked with at least the following information.

(a) Name of manufacturer
(b) Type, design, and serial number
(c) Rated voltage and current.
(d) Rated frequency.
(e) Rated symmetrical breaking capacity.
(f) Rated making capacity.
(g) Rated short time current and its duration.
(h) Purchase Order number and date
(i) Month and Year of supply
(j) Rated lighting impulse withstand voltage.
(k) D.C. component of current.
(l) DTs Structure name,11000Volts Dangers etc.

NOTE:

i) The word rated need not appear on the name plate. Recognized abbreviations may be used to express the above particulars.
ii) Whether the circuit breaker is fitted with closing/tripping devices necessitating an auxiliary supply shall be stated either on the circuit breaker name plate or any other acceptable position.

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9 Corona Discharge:

The equipment shall be so designed that corona discharge would occur under conditions mentioned earlier in this specification.

10 Ratings and Requirement

		Non-Metering SF6 Insulated Ring Main Unit with SF6/VCB Breaker
10.01	Switchgear Data	
a)	Service	Indoor
b)	Type	Metal clads
c)	Number of phases	3
d)	Voltage	11000V
e)	Rated Frequency	50 Hz
f)	Rated Current	630 Amps
g)	Short Circuit rating	
	Breaking Short time 3S	20 KA rms
h)	Insulation Level	75 KV peak
i)	System earthing	Solidly earthed at substation
10.02	Vacuum / SF6 Circuit Breaker	
a)	Type	SF6 / VCB encapsulated in SF6 Environment
b)	Rated Voltage	11kV
c)	Breaking Current	**20 KA**
d)	Making Current	**50 KA peak**
e)	Rupturing Capacity	**350 MVA**
f)	Rated Current	**200 Amps**
g)	No. of Poles	3
h)	Operating mechanism	Trip free & free handle type with mechanically operated indicator
10.03	Isolators	
a)	Type	SF6 insulated load breaking and fault making
b)	Duty cycle	-
c)	Rated current	**630 Amps**.
d)	Rated breaking capacity	630 Amps.
e)	Fault making capacity	50 kA peak
f)	Rupturing Capacity	350 MVA
g)	No. of poles	3
h)	Operating mechanism	Operating handle with ON, OFF, Earth positions with arrangement for padlocking in each position.
i)	SF6 tank	Tank with substantial stainless-steel construction with SF6 pressure Gauge for indicator and filling arrangement.

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j)	Interlocks	Suitable interlocks for: 1. Cable test terminals on the orifices will be accessible only in "Earth" position. 2. Test plugs can be inserted and withdrawn only in the "Earth" position. 3. To prevent operation from "ON" position to "Earth" position or vice versa in a Single operation. 4. To bring isolator to "OFF" position with test plugs inserted but to prevent operation to "ON" position with test plugs inserted or test terminals kept open.
k)	Operation safety	Safety against explosion and fire hazards etc.
10.04	Busbars:	
a)	Material	Copper
b)	Type	SF6 insulated
c)	Rated Current	**630 Amps**
d)	Short time rating for 3 Sec.	20 kA
10.05	Cable Boxes	Vacuum / SF6 circuit breaker shall be provided with identical cable boxes for connecting 1 No. 11kV 3C, 70 to 300 mm^2 XLPE/PILC cable
10.06	**Current Transformer**	
a)	**C.T. Ratio**	As per BESCOM's requirement
b)	**Over current factor**	To correspond to rupturing capacity of Switchgear.
c)	**Class of Accuracy**	5 P 20
d)	**Rated Burden**	2.5 VA
10.07	**Configuration**	3 function RMU loop in /loop out and tee off CB
10.08	**Protection**	
	a) Three phase over current and earth fault relays.	Self-Powered Relay

11 TESTS

11.1 Each type of H.V. Switchgear shall be completely assembled, wired, adjusted, and tested at the factory as per the relevant standards and during manufacture and on completion.

11.2 ROUTINE TEST

The tests shall be carried out in accordance with IEC 60298 include but not necessarily limited to the following:

i. Withstand voltage at Power Frequency for all current carrying parts including wiring.
ii. Measurement of resistance of the main circuit
iii. Gas Leakage test
iv. Withstand voltage on auxiliary circuits.
v. Operation of functional locks, interlocks, signaling devices and auxiliary devices
vi. Suitability and correct operation of protections, Control instruments and electrical connections of the circuit breaker operating mechanism (PRIMARY & SECONDARY INJECTION)
vii. Verification of wiring
viii. Visual Inspection

Routine test shall be carried out on all equipment such as circuit breakers, current transformers, relays, meter etc. as per relevant standards.

11.3 TYPE TEST

The following tests shall be performed on a typical section of the bus assembly of each type of Switchgear.

Units shall be type tested in accordance with IEC Standards 60056, 60129, 60265, 60298, 60529 and 60694.

a) Impulse test with breaker inside the cubicle
b) Temperature rise test with breaker inside the cubicle.
c) Short Circuit test with breaker inside the breaker
d) Dielectric Tests
e) Test of apparatus i.e., circuit breaker and earthing Switch
f) Arc Fault test

TEST WITNESS

All tests shall be performed in presence of owner's representatives, if so desired by the Owner. The Contractor shall give at least ten (10) days advance notice of the date when tests are to be carried out.

12 Test Certificates

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

12.2 The equipment shall be dispatched from works only after receipt of Owner's written approval of the test reports.

12.3 Type test certificates on any equipment, if so desired by the Owner, shall be furnished; otherwise the equipment shall have to be type tested, free of charge, to prove the design.

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13 DRAWING APPROVAL

The bidder has to get approval for the various drawings of the RMU unit including the protection scheme. The bidder has to provide us all relay characteristics.

14 MANUAL

The bidder has to provide the complete manual for the operation of the breaker.

B. SPECIFICATION FOR DISTRIBUTION TRANSFORMER

The bidder has to quote for the following types of distribution transformers. The transformer should be of

I. **Star 2 Rated, oil cooled, 11/0.433kV, 3Phase, 50Cycle, Distribution Transformer of rating 25/63/100/250/500 Aluminum Wound & 800/1000kVA copper wound.**

C. SPECIFICATION FOR LT SYSTEM

LT compartment shall be suitable to house following equipment, Bus bar connection from transformer to LT ACB & MCCB

Sl.No	Transformer	No. of MCCB	Capacity of MCCB 4 pole 50KA, TM Based	Incomer for LT
1	100kVA Al. Winding	2	100A	250A MCCB, 50kA, 4 pole Fixed Type Micro Processor based
2	250kVA Al. Winding	3	250A	400A MCCB, 50kA, 4 pole Fixed Type Micro Processor based
3	500kVA Al. Winding	7	250A	800A ACB, 50kA, 4 pole Fixed Type Micro Processor based
4	800kVA Cu winding	6	250A	1250A ACB, 50kA Fixed Type 4 pole Micro Processor based
5	1000kVA Cu winding	7	3 x 400A 4 x 250A	1600A ACB, 50kA Fixed Type 4 pole Micro Processor based

Trivector meter (Provision- meter to be fixed by BESCOM) CT for metering wiring for Trivector meter.
CT for measuring the Current and voltage connection MFM Cable glands for outgoing feeders.

The design should comply for the following standards.

1. IEC-439-1, 1992 Low voltage Switch gear and Control gear assemblies Part-I, type tested and partially type tested assemblies.
2. IEC-947-1, 1998 Low voltage Switch gear and Control gear Part-I general rules.
3. IEC-1180-1, 1992 High voltage test techniques for low voltage equipment Part – I definition test and Procedure requirement
4. IEC-529, 1989 Degree of protection provided by enclosures (IP code)

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EQUIPMENT SPECIFICATION

1. Air circuit breaker (ACB)

These shall be fixed type with manually operated mechanism microprocessor based. The short circuit mechanism and breaking capacity as shall be supported by test certificate. The test certificates should be from CPRI / ERDA/any Govt. approved recognized test house / laboratory.

The circuit breaker shall be fitted with CT operated thermal overload and short circuit releases devices for current rating 800/1250/1600Amps.

a) Overload releases should be settable from 50% to 100% of the rated current In.

b) Ambient temperature compensated type and there should not be de-rating of ACB current carrying capacity at 40□C. The testing of ACB for the temperature rise shall be carried out by the manufacturer as per the prevailing, IS / IEC or any other international standards.

c) ACB shall be provided with overload and short circuit release. Short circuit release should have settable value of 15kA to 25kA with a adjustable times having setting range of 40 – 460 m seconds, to have a proper co-ordination with short circuit release of outgoing MCCBs.

1) 3 phases, 4 wire, neutral earthed having link arrangement.
2) Rated current thermal current- 250/400/800/1250/1600Amps.
3) Service voltage - 415 volts
4) No. of break / pole - one
5) Frequency - 50 c / s
6) Rated insulation voltage - 1000 volts
7) Rated short circuit breaking capacity.
   Rated services S/C breaking capacity Ics (rms) – 50kA Rated ultimate S/C breaking capacity Icu (rms) – 50kA
8) Break Time - less than 40ms
9) S/C making capacity 1cm (peak) - 143kA
10) Rated short time withstand current: Icw 50kA for 1 sec.
11) Suitable for outdoor installation.
12) It shall conform to IS 13947 / pt.2 / 1993, IEC 60947-2&3 with latest amendment, if any.
13) Performance category: Utilization category – B with operation cycle O – t – Co – t – Co.
14) The status of open and close shall be clearly visible.
15) The trip indication separated for overload and individual phase wise trip indication for short circuit to be provided.
16) The ACB shall have the provision to lock the operating mechanism in off position.
17) The operating mechanism should be from front and the compartment should have the degree of protection IP – 54.
18) Separator shall be provided between all phases inside. ACB enclosed to prevent travel of arc during short circuit.
19) The CTs mounted for thermal overload release shall have secondary winding inaccessible including tripping mechanism of O/L and magnetic releases to avoid tampering CTs should also have provision of separators.
20) Two nos. earthing bolts for propose of earthing of ACB may also be provided & suitable for G.I stay wire of size 7 / 10 SWG.
21) The bus bar size shall be confirming to relevant IS and the neutral bus bar shall be of same wire of size as phase bus bar and should be suitable for connecting neutral.
22) The ACB shall be tested in accordance with the provision of IS 13947 – Part I or relevant IEC.

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2. Moulded case circuit breaker (MCCB)

L.T. section with one MCCB/ACB as incoming and following outgoing MCCB feeders and with enclosure made of electronically Galvanized sheet (min 2 mm Thickness) with powder coated finish, Cu bus bar with LT Metering facility. IEC 60947-2.

Sl. No	Transformer	No. of MCCB	Capacity of MCCB 4 pole 50KA, TM Based	Incomer for LT
1	100kVA Al. Winding	2	100A	250A MCCB, 50kA, 4 pole Fixed Type Micro Processor based
2	250kVA Al. Winding	3	250A	400A MCCB, 50kA, 4 pole Fixed Type Micro Processor based
3	500kVA Al. Winding	7	250A	800A ACB, 50kA, 4 pole Fixed Type Micro Processor based
4	800kVA Cu winding	6	250A	1250A ACB, 50kA Fixed Type 4 pole Micro Processor based
5	1000kVA Cu winding	7	3 x 400A 4 x 250A	1600A ACB, 50kA Fixed Type 4 pole Micro Processor based

The MCCB should be suitable for connecting LT 3 ½ C x 400sqmm XLPE cable. Connection between transformer LT terminal to ACB and MCCB shall be through copper bus bars.

3. Interconnecting bus bar

Bus bar shall be of high conductivity copper supported on insulators made of non- hygroscopic, non-inflammable material with tracking index equal to or more than that defined in BIS. The main bus bars shall have uniform current ratings throughout their length as specified in data sheet / job specification. The current rating of the neutral shall be half that of the phase busbars. Removable neutral links shall be provided on feeders to permit isolation of the neutral bus bar.

Both horizontal and vertical bus bars, bus joints and supports shall be capable of withstanding dynamic and thermal stresses of the specified short circuit currents for 1 second. Only zinc passivated or cadmium plated high tensile strength steel bolts, nuts and washers shall be used for all bus bar, joints and supports. The short circuit capacity of the neutral bus bars shall be in line with IS: 13947.
The hot spot temperature of bus bars including joints at design ambient temperature shall not exceed 95□C for normal operating conditions.

The current rating of the bus bars shall be 250/400/800/1250/1600A for design ambient temperature at site conditions and for being inside the cubicle at fully loaded condition. The vendor shall suitably de-rate the nominal rating to suit the above condition.

All bus bars shall be insulated with heat shrink PVC sleeves of 1100V grade, red, yellow and blue color shall be used for phase bus bars and black color shall be used for neutral bus bars. Removable type shrouds shall be provided for joints.

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Minimum clearance between live parts, between live parts / neutral to earth shall be 19mm. However, clearances between terminals at components shall be as per applicable individual standard for components.

Interconnections between the main bus bars and individual units shall be made using vertical / horizontal copper bus bars of adequate rating shall be used.

4. Tri-vector meter and CTs

Suitable cutout shall be provided on LT compartment for installation.
Tri-Vector meter (Tri-Vector meter and its details shall be provided by BESCOM). CT's 04 Nos. & potential connection for metering shall be provided in the LT compartment. The details are as under.
CT's with accessories: CT's of rating as specified below are to be provided, mounted on the Transformer L.T bus bar.

Sl. No	Particulars	Requirement
1	100/250/500/800/1000kVA	250/5A,400/5A,800/5A,1250/5 1600/5Amps
2	Class of Accuracy	0.5
3	Burden	15 VA
4	Type	Resin Cast, Suitable for Outdoor use

The Secondary Terminals of the CT's shall be individually wired, using 2.5 sq mm flexible copper wires (with color coding, and ferrules at both ends) up to a Terminal block. Terminal Block shall be located, at a suitable height. The three phase voltages also are to be tapped from the L.T busbar and wired up to the terminal block. The C.T secondary shall be covered with sealable covers.

5. Auxiliary supply

3phase with neutral, 440V AC supply shall be tapped from main bus bar after the ACB for supply to exhaust fan, lighting of the substation and Control supply for RMU etc. Necessary protection in incomer and outgoing shall be provided.

D. SPECIFICATION FOR ENCLOSURE FOR PACKAGE SUBSTATION

The package substation shall have the following features.

1. Enclosure for the package substation shall be made of electronically galvanized sheets and MS sheets are not accepted.
2. Separate compartment for 11 kV Compact RMU, Distribution Transformer & LT Switchgear
3. Door of the HT and LT compartment shall be designed such as complete door is divided into minimum two-fold / parts vertically for minimum space requirement while opening.
4. Painting shall be tested for radiation test.
5. The painting specification and color shade of the enclosure shall be approved by the BESCOM.
6. There should be proper earthing arrangement for the entire substation i.e., 11 kV Compact RMU, Distribution Transformer & LT Switchgears along with the enclosures.

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7. Design of Transformer Compartment shall be such to accommodate oil type 100/250/500/800/1000KVA transformers, and it shall be possible to interchange any of these transformers.
8. Barrier shall be provided between MCCB.
9. Non-metallic phase separator shall be provided between the three phases connected to MCCB.
10. Layout of package substation shall have approval of Chief Electrical Inspector. It is the responsibility of bidders to make changes as per the requirement of Chief Electrical Inspector, without any time and cost implication to the purchaser.
11. Suitable cut out shall be provided on LT compartment for installing Tri-Vector meter (Tri-Vector meter and its details shall be provided by purchaser).
12. CT's & potential connection for metering shall be provided in the LT compartment.
13. The Packaged Substation should have adequate arrangements of ventilation and should be inclusive of all safety accessories like voltage detection rod, fire extinguishers, gloves etc. Adequate illumination is to be provided for Packaged Substation. There should be provision for providing enclosure around the entire Packaged Substation. There should be barrier for RMU section, Transformer section and LT Switchgear section for safety purpose. There should be easy access to all these three compartments independently.
14. The Packaged Substation should have ample arrangement to meet the requirements of protection of all electrical equipment's. The clearances between live parts and minimum clearances to earth have to be maintained to the respective standards. The size of the substation should be compact to meet the traffic and road requirements.
15. The bidder has to specify the total weight of the Packaged Substation.

RELAY CO-ORDINATION

Bidder shall ensure proper relay co-ordination between 11 kV RMU & LT ACB & LT MCCB and shall provide calculation in support of the same.

DIMENSION

The approximate base dimension for packaged substation shall be around **2 Mtr x 3 Mtr.** However, depending upon the design of the bidder, the same may be reviewed.

GUARANTEED TECHNICAL PARTICULARS FOR 11KV Non-Extensible Compact RMU

The bidder should fill up technical particulars of 11 kV panel in the following format) Name of the Bidder:

Sr. No.	Description	RMU
1.0	**SWITCHGEAR ASSEMBLY**	
1.1	Make	
1.2	Type	
1.3	Reference Standard	
1.4	Voltage (Normal/Max.) kV	
1.5	Phase (Nos.)	
1.6	Frequency (Hz)	
1.7	Short Circuit Rating	
	a) Breaking Symmetrical (kA)	
	b) Breaking Asymmetrical (kA)	

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	c) Short time for 1 Sec. d) Short time for 3 sec.	
1.8	Insulation Level	
	a) Impulse Withstand (kVpeak)	
	b) 1 minute 50 Hz. Voltage Withstand (kVrms)	
1.9	Metal Clad Construction	Yes/ No
1.10	Degree of protection:	
1.11	Switchgear completely wire and tested at factory:	Yes/ No
2.0	**CONSTRUCTION**	
2.1	Overall Dimensions	
a.	Breaker	
	i) Length (mm)	
	ii) Breadth (mm)	
	iii) Height (mm)	
b.	Isolator	
	a) Length (mm)	
	2) breadth (mm)	
	3) Height (mm)	
c.	Total non-extensible 3 Panel RMU	
	1) Length (mm)	
	2) Breadth (mm)	
	3) Height (mm)	
2.2	Weight	
	a) Breaker (kg)	
	b) Isolator (kg)	
	c) Non-Extensible 3 panel RMU (kg)	
3.0	**Bus Bar**	
3.1	Make	
3.2	Material & Grade	
3.3	Reference Standard	
3.4	a) Cross Sectional area (m m^2)	
	b) Size (m m^2)	
3.5	Continuous Current	
	a) Standard	
	b) At site conditions and within cubicle	
3.6	Maximum temperature rise over ambient (c)	
3.7.	Short time current for 3 Sec. (KArms)	
3.8	Minimum clearance from bare bus bar connection	
	a) Phase to phase (mm)	
	b) Phase to earth (mm)	
3.9	Bus Bar provided with	
	a) Insulation Sleeve	
	b) Phase barriers	
	c) Cast Resin shrouds for joints	
3.10	Bus bar connection	
	a) Silver Plated	
	b) Made with anti-oxide grease	
3.11	Bus bar support spacing (mm)	
3.12	Bus support insulators	
	a) Make	
	b) Type	

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	c) Reference Standard	
	d) Voltage Class (kV)	
	e) Minimum creepage distance (mm)	
	f) Cantilever strength Kg/mm^2	
	g) Net Weight (kG)	
4.0	**SF6 / VCB CIRCUIT BREAKER**	
4.1.	Make	
4.2.	Type	
4.3.	Reference Standard	
4.4.	Rated Voltage	
4.5	Rated Frequency	
4.6	No. of Poles	
4.7	Rated Current	
	a) Normal (Standard) Amps	
	b) Derated (Site) Amps	
4.8	Maximum temperature rise over ambient °C	
4.9	Rated operating Duty	
4.10	Rupturing capacity at rated voltage (MVA)	
4.11	Breaking capacity at rated voltage & operating duty	
	a) Symmetrical (kArms)	
	b) Asymmetrical (kArms)	
4.12	Rated making Current (kApeak)	
4.13	a) short time current for 1 sec. (kArms)	
	b) Short time current for 3 Sec. (kArms)	
4.14	Transient Recovery Voltage	
	a) Rate of rise (kV/ms)	
	b) Peak Voltage (kV)	
4.15	Insulation Level	
	a) Impulse voltage withstands on 1/50 full wave	
	b) 1 minute 50 Hz. Voltage withstands	
4.16	Maximum over voltage factor when switching off	
	a) Un loaded transformer	
	b) Loaded transformer	
	c) Un loaded cables	
	d) Capacitors	
4.17	Opening time maximum No load condition (ms)	
4.18	Opening and closing time under SF6 gas loss or vacuum loss condition (ms)	
4.19	At 100% Breaking capacity	
	a) Opening time-Max. (ms)	
	b) Arcing time-Max (ms)	
	c) Total break time (ms)	
4.20	At 60% breaking capacity	
	a) Opening time-Max. (ms)	
	b) Arcing time-Max. (ms)	
	c) Total break time (ms)	
4.21	At 30% breaking capacity (ms)	
	a) Opening time-Max. (ms)	
	b) Arcing time-Max. (ms)	
	c) Total break time (ms)	
4.22	At 10% breaking capacity (ms)	
	a) Opening time-Max. (ms)	

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	b) Arcing time-Max. (ms)	
	c) Total break time	
4.23	a) Make time (Max) (ms)	
	b) Total closing time (ms)	
4.24	Number of breaks per pole	
4.25	Total length of breaks per pole (mm)	
4.26	Total length of contact travel (mm)	
4.27	Speed of break (100% short circuit current)	
4.28	Rate of contact travel	
	a) At tripping M/sec.	
	b) At closing M/sec.	
4.29	No. of breaker operations permissible without requiring inspection, replacement of contacts and other main parts.	
	a) At 100% rated current	
	b) At 100% rated breaking current	
4.30	Type of contacts	
	a) Main	
	b) Arcing	
4.31	Material of contact	
	a) Main	
	b) Arcing	
	c) Whether contacts silver plated	
	d) Thickness of silver plating	
4.32	Contact pressure at No load (Kg)	
4.33	Type of arc Control device provided	
4.34	Operating mechanism-closing	
	a) Type	
	b) No. of breaker operations stored	
	c) Trip free or fixed trip	
	d) Anti pumping features provided	
	e) Earthing for operating mechanism and metal parts furnished	
	f) Earth terminal size and material	
4.35	Operating mechanism-tripping	
	a) Type	
	b) No. of breaker operations stored	
	c) Trip free or fixed trip (V)	
	d) Anti pumping features provided (%)	
	e) Earthing for operating mechanism and metal parts furnished	
	f) Earth terminal size and material	
4.36	1Spring Charging mechanism 2Make 3Type 4Size 5rating	
4.37	Breaker suitable for capacity Switching Operating duty 4Max. rating of capacitor bank that can be safely Controlled	
4.38	Tripping Coil	
	a) Voltage	
	b) Permissible voltage variation (%)	
	c) Tripping Current at rated Voltage (A)	
	d) Power at rated voltage (W)	

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	e) 2-Over current trip with 1- earth fault furnished as specified.	
4.39	Breaker/Accessories Accessories such as Control Switch indication lamps etc. furnished as specified: (Please attach separate sheet giving details of all accessories, interlocks and safety shutters)	
	a) Mechanical Safety Interlock	
	b) Automatic Safety Interlock	
	c) Operational Interlock	
	d) Emergency manual trip	
	e) Operation counter	
	f) Charge/discharge indicator	
	g) Manual spring charging facility	
4.40	Impact load foundation design (to include dead load plus impact value on opening at maximum interrupting rating) (Kg)	
5.0	Isolators	
5.1	Make	
5.2	Type	
5.3	Reference Standard	
5.4	Rated Voltage (KV)	
5.5	Rated Frequency Hz	
5.6	No. of Poles (No)	
5.7	Rated Current Normal (Standard) Derated (Site) Amp	
5.8	Maximum temperature rise over ambient °C	
5.9	Rated Operation duty	
5.10	Rupturing Capacity at rated voltage MVA	
5.11	Rated making current KA Peak	
5.12	Short time current a) for 1 Sec KA RMS b) for 3 Sec KA RMS	
5.13	Impulse voltage withstands on 1/50 full wave b) 1 minute 50 Hz voltage withstand	
5.14	Maximum over voltage factor when Switching off a) Loaded feeder cable	
5.15	Minimum SF6 Gas pressure required	
5.16	No. of isolator operation permissible without requiring inspection, replacement of contacts and other main parts At 100% rated current At 100% rated breaking current	
5.17	Isolator provided with the following Mechanical safety. Mechanical ON, OFF, CABLE EARTH indicators Operation counter Manual spring charging facility	
5.18	Impact load for foundation design (To include dead load plus impact values on opening at maximum interrupting rating) Kg	
6.0	CURRENT TRANSFORMER	

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6.1	Make	
6.2	Type & voltage level	
6.3	Reference standard	
6.4	C.T. ratio as specified	
6.5	Rated frequency	
6.6	Short circuit withstands. Short time current for 3 Sec. KA RMS ii)Short time current for 5 Sec. KA RMS iii. Dynamic current kA peak	
6.7	Class of insulation	
6.8	Temperature rise over ambient ° C	
6.9	Basic insulation level	
6.10	For tripping CT Ratio Class of accuracy Rated burden VA Knee point voltage V Excitation current at Vk/2 Amps Rated saturating current Amp Over current rating. Continuous % overload (%)	
7.0	Secondary Wiring	
7.1	Type and insulation	
7.2	Voltage grade	
7.3	Conductor material	
7.4	Conductor size (minimum) and insulation wiring	
7.5	Wires identified at both ends with markers	
7.6	Wiring and other accessories provided as per specification.	
8.0	CABLE TERMINATIONS	
8.1	Circuit Breaker Type Material Dimensions Size Height of cable box from ground level Arrangement for supplying bus end cable box furnished for extensible ring main unit Arrangement for mounting an extra cable box on each equipment furnished	
8.2	Isolator Type Material Dimensions Size Height of cable box from ground level	
9.0	Name Plate	
9.1	Material	
9.2	Thickness	
9.3	Size for	
	a) Breaker cubicle	
	b) Instruments/devices	

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10.0	Painting	
10.1	Finish of Breaker Inside outside	
10.2	Finish of Isolator Inside outside	
11.0	No. of Accessories Furnished	
	a) Earthing Equipment	
	b) Test Plug	
12.0	TESTS	
12.1	Reference Standard	
12.2	Routine tests to be performed on Switchgear	
12.3	Type Tests quoted	
13.0	Drawing/Data	
13.1	General arrangement for Panel Board	
13.2	Foundation plan	
13.3	SF6/VCB tripping & material schematic	
13.4	Bill of material	
13.5	SF6/VCB LT Panel Wiring Diagram	

GUARANTEED TECHNICAL PARTICULARS FOR DISTRIBUTION TRANSFORMERS
SCHEDULE 'A' (To be furnished by the manufacturer)

Sl.No.	**Description**	
1.	Make	
2.	Name of Manufacture	
3.	Place of Manufacture	
4.	Voltage Ratio.	
5.	Rating in kVA.	
6.	Core Material used and Grade.	
	a). Flux density.	
	b). Over fluxing without saturation (Curve to be furnished by the manufacture in support of his claim).	
7.	Maximum temperature rise of:	
	a. windings by resistance method	
	b. Oil by thermometer	
8.	Magnetizing (no-load) current at:	
	a. 90%	
	b. 100%	
	c.110%	
9.	Core loss in watts	
	a. Normal voltage	
	b. Maximum voltage.	
10.	Resistance of windings at 20°C (with 5% tolerance)	
	a. HV Windings (ohms).	

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	b. LV Windings (ohms).	
11.	Full load losses (watt) at 75°C	
12.	Total Losses at 100% load at 75°C	
13.	Total Losses at 50% load at 75°C	
14.	Current density used for : (Amper/sqmm)	
	a. HV Winding	
	b. LV Winding	
15.	Clearances: mm	
	a. Core and LV	
	b. LV&HV	
	c. HV Phase to Phase	
	d. End insulation clearance to earth	
	e. Any point of winding to tank	
16.	Efficiency at 75°C	
	a. Unity P.F. and	
	b. 0.8 P.F.	
	1.125% load	
	2.100% load	
	3. 75% load	
	4. 50% load	
	5. 25% load	
17.	Regulation at:	
	a. Unity P.F. and	
	b. 0.8 P.F. at 75°C	
18.	% Impedance at 75°C	
19.	Flash Test:	
	(i) HV 28kV/50HZ for 1 minute	
	(ii) LV 3kV/50Hz for 1 minute	
20.	Over potential test (Double voltage and Double frequency for 1 minute)	
21.	Impulse test in peak kVA.	
22.	Mass of : (kg)	
	a. Core lamination (minimum)	
	b. Windings (minimum)	
	c. Tank and fittings	
	d. Oil	
	e. Oil quantity (minimum) (litre)	
	f. Total weight	
23.	Oil Data:	
	1. Qunatity for first filling (minimum) (litre)	
	2. Grade of oil used	
	3. Maker's name	
	4. BDV at the time of filling (kV)	
24.	Transformer:	
	1. Overall length x breadth x height (mm x mm x mm)	
	2. Tank length x breadth x height	
	3. Thickness of plates for	
	a. Side plate (min)	
	b. Top and bottom plate (min)	
	4. Conservator dimensions	
25.	Radiation:	
	1. Heat dissipation by tank walls excluding top and bottom	

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	2. Heat dissipation by cooling tube	
	3. Diameter and thickness of cooling tube	
	4. whether calculation sheet for selecting cooling area to ensure that the transformer is capable of giving continuous rated output without exceeding temperature rise is enclosed	
26.	Inter layer insulation provided in design for:	
	1. top and bottom layer	
	2. In between all layer	
	3. Details of end insulation	
	4. Whether wedges are provided at 50% turns of the HV coil	
27.	Insulation materials provided	
	a. For conductors	
	1. HV	
	2. LV	
	b. For core	
28.	Material and size of the wire used	
	1. HV Dia (mm) SWG	
	2. LV a) Strip size	
	b) No. of conductors in parallel	
	c) Total area of cross section (sq.mm)	
29.	Whether the name plate gives all particulars as required in tender	
30.	Particulars of bushings HV/LV	
	1. Maker's name	
	2. Type IS:	
	3. Rating as per IS	
	4. Dry power frequency voltage withstand test	
	5. Wet power frequency voltage withstand test	
31.	Type of insulation used in	
	a. HV windings	
	b. LV windings	
32.	Type of insulation used on	
	a. Core bolts	
	b. core bolt washers	
	c. Core laminations	
33.	whether conservator is provided	
34.	whether breather is provided	
35.	Approximate overall dimensions	
	a. height	
	b. Breadth	
	c. Length	
36.	Weight of insulated conductor	
	a. HV	
	b. LV	
37.	a. Weight of core	
	b. Tolerance	
38.	a. weight of complete Transformer for transport	
39.	Period for which this design of transformer has been in commercial use	
40.	Reactance of windings at 75 ° C/ph a.HV b. LV	

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41.	Resistance of rated current and frequency. a. HV b.LV	
42.	Bushing charcteristics Normal power frequency with voltage stands voltage (kV) Dry(kV) Wet (kV) 11kV 28 28 0.433kV 3 3	
43.	Material of bushing rod and nuts	
44.	Date of commencement of production of distribution transformer at the factory of the supplier	

SCHEDULE 'A1'

Sl.No.	Particulars	
1.	Tank	
	a. Wall thickness mm	
	b. Top/bottom plate thickness mm	
	c. Welding of plates	
	d. Side wall joints	
	e. General	
	i. Reinforcement for walls	
	ii. Limits for permanent deflection	
	iii. channel (bore) m m	
2.	Core (Magnetic circuit)	
	a. Top yoke (single sheet) Thickness mm	
	b. Channel liner	
	c. Core wrapper	
	d. Core clamping	
	e. Core dimensions	
	i. height (window)	
	ii. Core diameter	
	iii. Limp centre	
	f. No load current (% of FL current)	
	g. No load loss in watts	
	h. Core material	
	i. Core fixing bolt Ø mm	
	j. Tie rod insulation mm paper	
3.	Winding (Electrical circuit)	
	a. Conductor material	
	b. Conductor insulation	
	i. HV winding	
	ii. LV winding	
	c. Conductor size	
	i. HV winding mm2	
	ii. LV winding mm2	
4.	Phase barrier board (press board)	
	a. Spacer between HV & LV coils	
	b. Coil end insulation m m	
	c. coil packing screw	
	d. HV jumper & delta formation	

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	e. LV jumper mm	
	f. HV termination (bushing)	
	g. LV termination (bushing)	
	h. Spacers	
	i. Load loss at 50% and 100% load in watts	
	j. Percentage of impedance 75º C	
	k. Neutral current at full load in %	
5.	a. Coil packing	
	b. Tapping lead Cu mm	
	c. Neutral current	
	d. Breather (Silica gel)	

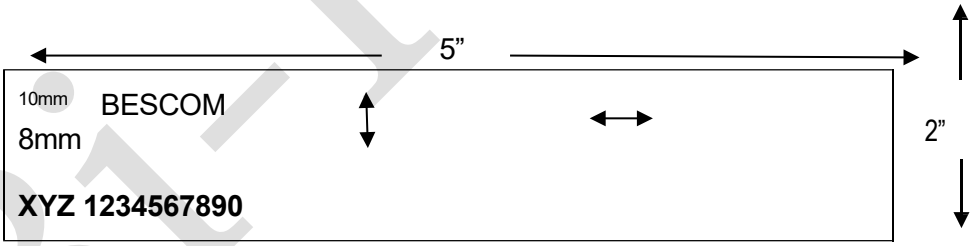
Note:
The following shall be specifically confirmed:

16. Whether the offer conforms to the limits of impedance mentioned in the specification
17. Whether the offer conforms to the limits of temperature rise mentioned in the specification
18. Whether the losses of the transformers offered are within the limits specified
19. Whether the transformers offered is already type tested for the design and test reports enclosed.

Annexure-A

Welding of Unique ID Number plate (Stainless Steel) on the Distribution Transformer Tank for Distribution Transformer Tracking System (DTTS).

The Design for SS plates to be welded as given below.



Transformer Name Plate Dimensions

- Length = 5"
- Width = 2"
- Thickness= 1mm
- Material = Stainless Steel (SS)
- Unique ID code= a) First three letters (initials of Manufacturer as approved/to be approved by BESCOM) followed by 10-digit serial no.
- Unique ID code with BESCOM shall be punched on stainless steel plate and the same shall be welded on transformer tank. The unique ID code with initials of manufacturer & 10-digit code shall be punched on the top cover, on the transformer tank and also shall be embossed /engraved on the rating plate.
- The punched Unique ID code& BESCOM initials on stainless plate shall be painted with Black color & shall be visible from the ground.

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NOTE:

TERMINAL MARKING PLATE AND RATING PLATES SHALL BE PROVIDED IN ACCORDANCE WITH IS 1180 IN ADDITION TO UNIQUE ID STAINLESS STEEL PLATE MENTIONED ABOVE:

The transformer shall be provided with an anodized aluminum/stainless steel plate securely fixed on the outer body showing the relative physical position of the terminal and their markings. This shall be in accordance with IS: 1180(Part1):2014. The transformers shall be provided with rating plate furnishing the information as specified in 1180(Part1):2014**.** The month and year of delivery shall be indicated on the rating plate. The rating plate shall be embossed / engraved type but not painted. The serial No. of transformer shall follow the code Nos. as detailed in annexure B. These shall be punch marked on the transformer tank and also on the top cover.

Annexure B

Procedure for assigning Unique ID code to Distribution Transformers:

Alpha Numeric code	**Numeric** 1	**Numeric** 2	**Numeric** 3&4	**Numeric** 5&6	**Numeric** 7,8,9&10
3-digit code assigned to manufacturer by BESCOM	Star Rating	capacity	Year of manufacture	Month of manufacture	Sl. No. of the Transformer as assigned by the manufacturer
Example: Sl. No: XYZ 1315063456					
XYZ	1	3	15	06	3456

Unique ID code: XYZ 1315063456. XYZ denotes First three letters (initials of Manufacturer as approved/to be approved by BESCOM) 3 star rated 63kVA distribution Transformer manufactured in the month of June during the year 2015 with Sl.No.3456.

a) Alphanumeric codes (3 Digits)

Alphanumeric code (3 digit)	**Name of the Company**	**Remarks**
XYZ	---	3-digit alpha numeric code assigned to manufacturer by BESCOM

b) Details of the 10 Digit code.

Digit	**Digit codes**	**Description of the Digit Code**
1st Digit	0,1, 2 or 3	0- Conventional (Un starred)
		1 – BEE-3 Star
		2- BEE-4 Star
		3- BEE-5 Star
2nd Digit	1 to 9	1- 15 KVA Capacity
		2-25 KVA Capacity

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		3- 63 KVA Capacity
		4- 100 KVA Capacity
		5- 250 KVA Capacity
		6- 300 KVA Capacity
		7 - 500 KVA Capacity
		8- 750 KVA Capacity
		9 -990/1000 KVA Capacity
3rd & 4th Digit	15 or 16 etc.,	Year of Manufacture that is 2015 or 2016 etc.
5th & 6th Digit	01 to 12	Month of Manufacturing
		01-Jan, 02-Feb,03-March etc., up to 12- Dec
7th to 10th Digit	0001 to 9999	Sl. No. of the transformer

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EXPLANATORY NOTES

Bi-RIDE

Explanatory notes of Schedule A & B for the work of "SHIFTING OF ELECTRICAL UTILITIES INFRINGING PROPOSED CORRIDOR-1 OF BENGALURU SUBURBAN RAIL PROJECT BETWEEN KRANTIVEERA SANGOLLI RAYANNA-YELAHANKA ON ALIGNMENT OF KRANTIVEERA SANGOLLI RAYANNA – DEVANAHALLI SECTION."

Supply, Testing & laying of **11 kV, 3 Core, HTUG Cable**, for insulations High quality clean XLPE compound shall be used (Free from micro voids, Moisture content, ambers and contaminations) with pressure extruded, inner sheath round wire armored as per IS-7098 (Part-2) Armoring wires dia in average ± 2.5% and Resistivity 14 Ohms/KM (Max) as per IS- 3975. As per the scope of work the size of the cable shall be 3x400, 3x240 & 3x95 sq.mm sq.mm cables shall be supplied and laid. The detailed specification of cable has been discussed in section 8-B under technical specification. The scope of work also includes manual digging of cable trench or by drilling 5'/6"/8" bore by HDD method and laying of cable along 50/42/40/33 mm HDPE/PLB pipe as per site requirement, supply and laying of 2000mm length, 150 mm Dia RCC pipe, RCC collar, supply of cable route and cable joint indicating stones, drawing of cable in the trench, reconsolidation of trench and making good the road up to the satisfaction of BBMP or other civic bodies/agencies, if any. In case of normal cable trench is required to be Dugged, excavation of cable trench of 450mm wide and 1000mm deep in all kinds of soil and refilling the cable trench with 150mm beddings of river sand above and below the cable including protection by laying country bricks across the trench, excavated soil free from unwanted materials, ramming, consolidating, and bringing to its original finish.

In case trench is excavated on either side of track, the LT UG cable has to be laid in all kinds of soil in a trench of 1.0 mtr. depth with river sand cushioning for laying of cable throughout the length of trench. Stock Bricks should be laid breadthwise without any gap on the top of the cable in the trench to ensure protection. The excavated soil to be filled back. All other items which are required for satisfactory completion of work are to be borne by the contractor. After laying of cable in the trench, the filled up soil has to be rammed and the trench has to be brought back to shape in conjunction with the surroundings.

In case cable is to be laid underneath the track/road, the cables shall be drawn be drawn through HDPE/RCC hume pipes. Trench to accommodate pipe shall be of suitable width and excavated at 1.0 mtr. below the formation level. No sand cushioning and spreading of bricks are required. But once the pipes are laid in the trench, it should be made to its original formation level by filling it up with excavated earth by watering and ramming process and resetting the ballast of track to its original level. Similarly, when road has been dug for laying of the cable the same should be re-filled, rammed, and asphalted and brought to original condition. The cable rising above ground shall be taken through GI pipe neatly clamped and open end of GI pipe must be sealed with bitumen compound. The cable must be laid along the route as per instruction of Engineer. The laying of cables includes uncoiling of cable from cable drum, laying of the cable in the trench free from twists, bends, peeling of insulation, dressing at terminal ends, provision of cable glands, crimping with suitable shoe, connection at both ends & earthing of amour at both ends.

The cost of work includes depositing earth on bank up to a lead of 50 mtr., supplying and fixing of necessary danger boards/cable route indicators at every 100 mtrs. Etc. The cost of work includes the associated works involved in satisfactory completion of HT UG cable laying work.

The cable laying method shall comply with IS:1255 (1983). The cost of work also includes the associated works involved in satisfactory completion of cable supply and laying.

Compact RMU:

Supply, installation, testing & commissioning of **Compact RMU** (VCB/SF6 Type) with Copper Busbar, 350 MVA, 630 Amps as per IEC-62271/IS-3427, 3-way RMU **(2 OD+1 VL)** ,4 way RMU **(2OD+2VL)** & 1 OD consisting of one in comer, one breaker, one outgoing with Al. Busbar. The scope of work involves Earth excavation for RMU foundation, depositing of earth bank up to a lead of 50mtr and with a lift up to 1.5mtr, Bed concreting with CC 1:2:4, foundation with reinforcement CC 1:2:4, providing plinth with CC 1:2:4 on the stone masonry (if required), Construction of stone masonry (if required). The scope also includes supply of MS Channel (100x50mm) & MS Angle (40x40x5mm) with welding etc. complete, providing of Rod type earthing with 40mm dia, 2.5 mtr long MS rod as per specification & drawing enclosed. The scope of work also includes aligning the RMU on foundation bed, assembling of units, connecting bus bars from panel to panel, initial filling of oil, lettering the RMU with enamel paint and also writing single line diagram of each panel, caution board, danger board etc., and commissioning of RMU. The cost of work includes the Labour and other associated items required for satisfactory supply, testing and commissioning of above work.

Supply, installation, testing & commissioning of **DAS compact RMU (VCB/SF6 Type**) as per IEC-62271. The DAS RMUs shall have the following in addition to the Standards:

- DC motors, Numerical Relays, Multi-functional meters, fault passage indicator (FPI), Metering CTs, Protection CTs, Auxiliary

transformers, Potential transformer, Batteries, Battery chargers (12 V & 24 V), AC power socket and light for illumination of Control panel.

- Control cable from each panel shall be wired and terminated to suitable 24 pin connector in the control panel.
- Suitable space for fixing the Remote Terminal Unit (RTU) and Radio Modem in Control panel.
- Suitable Clamps for fixing Antenna Pipe.

Termination Kit's

1. Supply and making cable end termination by **Heat Shrinkable Indoor & Outdoor type** cable termination kit for 11 kV XLPE cables. The size of cable end termination shall be 3X400, 3x240 & 3x95 Sq.mm. The specification of end termination kit has been discussed in section8-B under technical specification. The cable termination method shall comply with IS:1255 (1983). The cost of work also includes cost cable lugs and other associated works etc. for satisfactory completion of cable end termination.
2. Supply and making straight through joints of **heat shrinkable straight through jointing kit** for 11 kV XLPE Cable with Copper Lug of the following sizes. 3X400, 3x240 & 3x95 Sq.mm for 11 KV HT UG XLPE cable. The specification of straight through joint kit has been discussed in section 8-B under technical specification. The cable termination method shall comply with IS:1255 (1983). The cost of work also includes cost cable lugs and other associated works etc. for satisfactory completion of cable end termination.
3. Supply, Installation, Testing & Commissioning of 1.1 kV, XLPE or heat resistant PVC insulated, PVC extruded inner sheath armored **LT UG Cable** as per IS-1554 (Part-1) or IS-7098 Part-1, armoring strip thickness as per IS-3975. The size of the cable shall be 240 sq.mm 3.5 core, 50 sq.mm 4 core, 16 sq.mm 4core. The detailed specification of LT cables has been discussed in section 8-B under technical specification. The scope of work also includes manual digging of cable trench or by drilling 5'/6"/8" bore by HDD method and laying of cable along 50/42/40/33 mm HDPE/PLB pipe as per site requirement, laying of cable trench/GI pipe/stone ware/RCC Hume pipe using wooden/ Aluminum rollers as directed by site Engineer. In case of normal cable trench is required to be Dugged, excavation of cable trench of 450mm wide and 1000mm deep in all kinds of soil and refilling the cable trench with 150mm beddings of river sand above and below the cable including protection by laying country bricks across the trench, excavated soil free from unwanted materials, ramming, consolidating, and bringing to its original finish.
   In case trench is excavated on either side of track, the LT UG cable has to be laid in all kinds of soil in a trench of 1.0 mtr. depth with river sand cushioning for laying of cable throughout the length of trench. Stock Bricks should be laid breadthwise without any gap on the top of the cable in the trench to ensure protection. The excavated soil to be filled back. All other items which are required for satisfactory completion of work is to be borne by the contractor. After laying of cable in the trench, the filled-up soil has to be rammed and the trench has to be brought back to shape in conjunction with the surroundings.
   In case cable is to be laid underneath the track/road, the cables shall be drawn be drawn through HDPE/RCC Hume pipes. Trench to accommodate pipe shall be of suitable width and excavated at 1.0 mtr. below the formation level. No sand cushioning and spreading of bricks are required. But once the pipes are laid in the trench, it should be made to its original formation level by filling it up with excavated earth by watering and ramming process and resetting the ballast of track to its original level. Similarly, when road has been dug for laying of the cable the same should be re-filled, rammed, and asphalted and brought to original condition. The cable rising above ground shall be taken through GI pipe neatly clamped and open end of GI pipe must be sealed with bitumen compound. The cable must be laid along the route as per instruction of Engineer. The laying of cables includes uncoiling of cable from cable drum, laying of the cable in the trench free from twists, bends, peeling of insulation, dressing at terminal ends, provision of cable glands, crimping with suitable shoe, connection at both ends & earthing of amour at both ends.
   The cost of work includes depositing earth on bank up to a lead of 50 mtr., supplying and fixing of necessary danger boards/cable route indicators at every 100 mtrs. Etc. The cost of work includes the associated works involved in satisfactory completion of LT UG cable laying work.

4. Supply and stringing of 1.1 kV, 3*95+1*70+1*16 sq.mm, **LT Aerial Bunched Cable**, confirming to IS-14255: 1995 XLPE insulation. The scope of work includes supply and fixing of accessories for AB Cables as per NF-33, as per IS-13573 for joints & terminations such as suspension clamp for insulated messenger wire of size 25 to 95 sq.mm, dead end clamp/anchor clamp assembly 70 to 210 sq.mm bare messenger, dead end clamp/anchor clamp assembly 25 to 95 sq.mm bare messenger, piercing connector suitable for 16 sq.mm to 95 sq.mm AB Cable – Service connection, piercing connector suitable for 16 sq.mm to 95 sq.mm AB Cable – main to main connection, pre-insulated lugs CPTAU for 95 sq.mm, piercing connector suitable for 16 sq.mm to 95 sq.mm AB Cable – Street light connection, three phase distribution box for 6 connections, end cap for 50/70 sq.mm, universal hook, bolts & nuts etc., The cost of work includes labor & items required for satisfactory completion of work.
5. Supply & making of earthing arrangements. The scope of work includes digging of pit for providing pipe type earthing, installation of G.I grounding pipe of class-B, 40mm dia, 2.5 mtr long, 3.2mm thick with bolts, nuts, G.I strips & washer. The pit should be filled with equal proportion of salt & charcoal 150 mm all-round the pipe to complete depth. The scope of work also includes

construction of earth chamber as per IS:3043, supply and fixing earth chamber door, measuring earth value, and inscribing the same on earth chamber. The specification of earthing has been discussed in section-8-B under technical specification.

6. **Providing and laying in position plain cement concrete of mix M-7.5 (1:4:8):** Providing of M-7.5 cement concrete with OPC cement @ 180 Kgs, with 40mm and downsize graded granite metal coarse aggregates @ 0.85 cum and fine aggregates @ 0.57 cum, machine mixed, concrete laid in layers not exceeding 15 cms. thick well compacted in foundation and plinth, including cost of all materials, labour, cost of HOM of machinery, curing etc. required for satisfactory completion of work. The specification of M-7.5 concrete has been discussed in section-8-B under technical specification.
7. **Providing and laying in position plain cement concrete of mix M15 (1:2:4):** Providing M-15 cement concrete with cement @ 240 Kgs, with 20 mm and downsize graded granite metal coarse aggregates 0.878 cum and fine aggregates 0.459 cum, machine mixed concrete laid in layers not exceeding 15 cms. thick well compacted, in foundation and plinth and cills, including cost of all materials, Labor, HOM of machinery, curing complete as per specification as given in section8-B of Technical specification. The cost of work includes the Labor and other items required for satisfactory completion of above work.

   Providing and constructing of granite/trap/ballast size stone masonry in foundation cement mortar 1:8 stones hammered and dressed in courses not less than 20 Cms. Height, bond stones at 2 mtr. apart in each course. The cost of the work includes cost of materials and Labor required for satisfactory completion of work.

   Plastering concrete surface in cement mortar 1:4 and 20mm thick inclusive of smooth rendering of curing etc. complete above ground level. The cost of work includes the cost of labor and other items required for satisfactory completion of work.
8. Supply, Installation, Testing & Commissioning of **L.T. Feeder pillar box** with porcelain rewireable cutout and 1 No. of 630A load break switch with copper bus bar as per IS- 13947 Part-1&2,

   12-way/8-way

   The scope also includes Mounting of LT feeder pillar box including necessary civil works like soil excavation, supply and constructing of burnt brick masonry with approved non-modular bricks of standard size of class designation of 5.0 newton/ sq.mm (table moulded) with cement mortar 1:8 for basement and super structure including cost of material, scaffolding, curing, plastering concrete surface in cement mortar 1:4 and 20mm thick inclusive of smooth rendering of curing etc. complete above ground level. The cost of work includes the Labor and other items required for satisfactory completion of supply and installation of LT feeder pillar. The detailed specification of LT feeder pillar has been discussed under section8-B under technical specification.
9. Supply and laying of 2000mm long, 150mm dia **RCC Hume pipe** for crossing the cable in the existing road. The scope also includes digging of earth for required depth to provide RCC Hume pipe and cable collar, re-consolidation of the soil. The location of the work will be as indicated by site Engineer. The re-consolidation work shall be done up to the satisfaction of BBMP/any civic body. The cost of the work includes satisfactory completion of the work in all respect.
10. Supply and laying/erection of **GI pipe of class B**, 150mm dia for raising of cable at transformer centers/DP structures/Drainages etc. The cost of work includes digging of soil to suitable length to raise the UG cables and reconsolidation of earth. The cost of work includes supply and fixing of clamps, bolts, nuts & washers for fixing GI pipe on RCC/PSCC poles, RCC clamp etc. for satisfactory completion of supply and erection GI pipe.
11. Supply and erection of Pre-stressed **Tubular spun pole** of 11mtr long, 500kg Working load (drawing No. BESCOM/GM/QS&S/45 dtd 09/02/2022) as per IS-13158:1991. The scope of work involves earth excavation for Spun pole foundation, Base concreting with CC 1:4:8 of dimensions (1000x1000x150mm), Pole concreting with CC 1:2:4 of dimensions (1000x1000x2500mm), Coping with CC 1:2:4 (as per actuals) 390mm all around the pole for a height of 300mm, installation of single pole transformer structure kit with three H frames without transformer seating and seating angle support cross arm for 63/100/250/500 KVA (UG Cable)-GI, installation of HT Single top support with bolts, nuts & washers, supply and installation of 11 KV, 5KN Polymeric pin insulator (24mm dia FRP rod), supply and fixing of Rabbit conductor for jumps, GI wire 10SWG, Guy wire 7/10 SWG, fixing of G.I pipe 100 mm dia, installation of Distribution transformer BEE-5 star rated of appropriate capacity with oil, fixing of 11KV solid core type H.G fuse unit, fixing of 11 KV 200A single break / 400A Double break G.O.S, providing earthing materials, Installation of LT Distribution box for suitable rating with MCCB including wiring with all necessary works related to wiring, installation of Lightning arrestor, cross arm supports with necessary fish plates, bolts & nuts, installation of anticlimbing device, caution / danger board etc., complete. The cost of work involves for satisfactory completion of supply and erection of above work. The specification of spun pole has been discussed in section-8-B under technical specification. Supply and fixing different types of SPMT is explained below:

i. The scope of work involves earth excavation for Spun pole foundation, Base concreting with CC 1:4:8 of dimensions (1000x1000x150mm), Pole concreting with CC 1:2:4 of dimensions (1000x1000x2500mm), Coping with CC 1:2:4 (as per actuals) 390mm all around the pole for a height of 300mm, Installation of Three H frame with transformer seating and seating angle support cross arm for 11mtr spun pole for 25KVA (UG cable)-MS, Installation of HT Single top support with bolts, nuts & washers, Installation of 11 KV, 5KN Polymeric pin insulator (24mm dia FRP rod), Rabbit conductor for jumps, GI wire 10SWG, Guy wire 7/10 SWG, G.I pipe 100 mm dia, installation of Distribution transformer BEE-5 star rated of appropriate capacity with oil, 11KV solid core type H.G fuse unit, 11 KV 200A single break / 400A Double break G.O.S, providing earthing materials, Installation of LT Distribution box for suitable rating with MCCB including wiring with all necessary works related to wiring, Installation of

Lightning arrestor, cross arm supports with necessary fish plates, bolts & nuts, installation of anticlimbing device, caution / danger board etc., complete. The cost of work involves for satisfactory completion of supply and erection of above work.

ii. The scope of work involves earth excavation for Spun pole foundation, Base concreting with CC 1:4:8 of dimensions (1000x1000x150mm), Pole concreting with CC 1:2:4 of dimensions (1000x1000x2500mm), Coping with CC 1:2:4 (as per actuals) 390mm all around the pole for a height of 300mm, installation of single pole transformer structure kit with three H frames without transformer seating and seating angle support cross arm for 63/100/250/500 KVA (UG Cable)-MS,

Installation of HT Single top support with bolts, nuts & washers, Installation of 11 KV, 5KN Polymeric pin insulator (24mm dia FRP rod), Rabbit conductor for jumps, GI wire 10SWG, Guy wire 7/10 SWG, G.I pipe 100 mm dia, installation of Distribution transformer BEE-5 star rated of appropriate capacity with oil, 11KV solid core type H.G fuse unit, 11 KV 200A single break / 400A Double break G.O.S, providing earthing materials, Installation of LT Distribution box for suitable rating with MCCB including wiring with all necessary works related to wiring, Installation of Lightning arrestor, cross arm supports with necessary fish plates, bolts & nuts, Installation of anticlimbing device, caution / danger board etc., complete. The cost of work involves for satisfactory completion of supply and erection of above work.

12. Supply and erection of 9mtr long RCC/PSCC pole, square section

Supply, erection of 9 mtr. long 150 kg working load RCC/PSCC pole (as per drawing No.(BESCOM/GM/QS&S/51 dtd 24/11/2018) as IS-785: The scope of work involves supply, erection and installation of RCC square section of 9mtr long, 150 Kg working load, Installation of 11 KV Horizontal cross arm with clamps, HTST supports, bolts, nuts & washers for RCC/PSCC poles, RCC clamp, Guy set complete with 8/15 strain insulator and associated concrete, 11kv,5KN polymeric insulator (where ever necessary), 11kv,5KN polymeric insulator (24 mm dia FRP rod), PG clamps for rabbit conductor. The scope of work also involves earth excavation for RCC/PSCC pole foundation, Base concreting with CC 1:4:8 of dimensions (650x650x150mm), Pole concreting with CC 1:2:4 of dimensions (650x650x1700), coping with CC 1:2:4 (as per actuals), guy concerting with boulders, mud and sand, Installation of anticlimbing device, Caution/Danger boards etc., complete. The cost of work involves for satisfactory completion of supply and erection of above work. The specification of pole has been discussed in section-8-B under technical specification.

13. Releasing and handing over BESCOM's asset: The following below mentioned items are required to be released during work and as per site requirement and shall be handed over to the concerned BESCOM stores at no extra cost of KRIDE. The scope of the work also includes proper account of released item:

I. Releasing of 2 Pole Structure of RCC/PSCC Pole 9 to 10 Mtr long-3 nos.
II. Releasing of RCC/PSCC Pole of 9 to 10 Mtr long in a pit of 1.8 Mtr depth as per direction of Engineer in charge of work-6 nos.
III. Releasing of 9 Meter RCC Pole with 145 kg WL -12 nos.
IV. Releasing of 11mtr long concrete Spun Pole in a pit of 2.5 mtr depth aligning refilling with soil-2 nos.
V. Releasing of Double Pole Transformer Structure using 9 Mtr Long RCC (145 Kg WL)/PSCC (300 Kg WL) Pole including fixing of Structure Materials, Erection of Poles etc., complete for mounting of Transformer as per approved drawing. For 25/63/100 kVA-2 Nos.
VI. Releasing of 4 Pin cross arm with Insulator and Braces fixing-2 nos.

14. The following items are required to be **released and re-erected** during work. The location will be advised by the site engineer during work.

I. Releasing of PSCC Pole - 9 Meter Long, 200 Kg WL- 1 No.
II. Releasing of RCC/PSCC Pole of 9 to 10 mtr long in a pit of 1.8 mtr depth as per direction of Engineer in charge of work-16 no's
III. Releasing of 9 Meter RCC Pole with 145 kg WL -60no's
IV. Releasing of 11mtr long concrete Spun Pole in a pit of 2.5 mtr depth aligning refilling with soil-4 no's
V. Refixing of H-Frame-18 no's
VI. Releasing of 250 kVA Transformer structure kit on the existing 11 Mtr Spun Pole (excluding erection of Pole)-7 no's
VII. Releasing of 4 Pin cross arm with Insulator and Braces fixing-2 nos.
VIII. Releasing of V-Shape/Horizontal cross arm including Single Top Support Brace and Insulator fixing-27 nos.
IX. Re- Stringing of Rabbit Conductor-0.9KM
X. Reconductoring of coyote conductor 4.5KM
XI. Releasing of 200-250 KVA Transformer-5 nos.
XII. Releasing of LT Distribution box for 100/250/500 kVA DTC (Excluding wiring)-1 no.
XIII. Releasing of 250KVA TC-1 no.
XIV. Releasing of 1 Circuit of LT Wiring for 25/63/100 kVA DTC to the existing LT protection Kit/Distribution Box via metering box. (Includes fixing of necessary supports like 2 Pin cross arm, Spacer etc.)-2 nos.
XV. Releasing of DOLO Cutout/Horn Gap Fuse including fixing of cross arm and wiring- 5 nos.
XVI. Releasing of GOS including wiring (11 kV Single Break 200 Amps) including wiring-

XVII. 8 nos.
XVIII. Releasing of GOS including wiring (11KV Double Break 400 Amps)-1 no.
XIX. Releasing of non-DAS RMU (2OD+4VL) as per direction of Engineer in charge of Work-3 nos.
XX. Releasing of Lightning Arrestor-5 nos.
XXI. Releasing of 1.1 kV grade Aerial Bunched 3 Core cable of XLPE insulation of size (3x95) (Phase Conductor) + (1x70) (Insulated Messenger Neutral) + (1x16) (Street Light Control)-0.09 KM.
XXII. Releasing of 1.1 kV grade Aerial Bunched 3 Core cable of XLPE insulation of size (3x95) (Phase Conductor) + (1x70) (Insulated Messenger Neutral) + (1x35) (Street Light Control)-2.5 KM's
XXIII. Note:

RESPONSIBILITIES OF CONTRACTOR

1 The Contractor shall liaison with ESCOM/ KPTCL/ PGCL, State/Central Government and local bodies till completion of works in all respect. It is the responsibility of the contractor to ensure proper liaison and co-ordination with State Authorities for availing line clearance, joint inspection, testing & commissioning energization of into the full satisfaction of State Authorities and handing over, and KRIDE intervention should not be sought for any of the above.

2 **ROW issues if any shall be sorted out by the contractor.**

2.1 It is the responsibility of the Successful contractor to liaison with EB authorities for arranging joint inspections along with KRIDE supervisor as and when required and to ensure for early preparation of estimations, obtaining approvals at various stages, getting sanctioning of estimations and supervision charges intimations (Modification work of HT/LT power line crossings, Additional load/ Availing new power supply for railway installations)

2.2 In connection with the work Contractors has to liaison with EB authorities / statuary authorities in getting the intimations towards the payment of the following and submit the same to this office in time to facilitate for processing the payment by Railway.

a. Availing of new supply/service connection charges/deposit.
b. Supervision charges (10% of estimate or latest as per EB guidelines) based on sanctioned estimate of ESCOM / KPTCL / PGCL authorities along with copy of sanctioned estimate.
c. The contractor shall coordinate for payment of "Supervision Charges" to electricity authority and other charges payable to individual Govt. agencies as per the prevailing government rules, such payment shall be paid by KRIDE.

2.3 KRIDE will pay the necessary statutory Charges, related ROW charges, Electrical inspectorate, and inspection charges payable to ESCOM. Charges of stamp duties /Agreements, TAQC/ MR charges as applicable and any other incidental charges payable to ESCOM / KPTCL/ PGCL / BBMP, GAIL, BWSSB, BDA, to be borne by contractor.

2.4 Execution of agreement with KRIDE / Railways and SEB authorities/ DISCOM submitting Relevant documents for EIG approval as per the requirement. It is the responsibility of the contractor for the proper handing over of released materials to State Authorities. For this purpose, it is suggested that a joint inspection with the State Authorities officials concerned shall be carried out, the items and quantities of materials to be released are assessed properly before the work is started.

BI-RIDE