

Technical Specifications

(Validity 07 Years at the time of Approval) from your OEM. Bidders shall have to submit for minimum 03 OEM to 05 OEM. Approval will be issued to awarded bidders within commencement period if found as per technical specifications. However, PGVCL may do changes if required at the time of prototype inspection. This is mandatory. This is without any commitment from PGVCL.

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TECHNICAL SPECIFICATION FOR 11 KV MOTORISED RING MAIN UNIT OUTDOOR TYPE**1. Scope**

- 1.1 This specification covers Design, Engineering, Manufacture, Assembly, testing, Inspection, packing of Motorized Ring Main Units with inbuilt FPI (Fully factory integrated & demonstrable at the time of inspection) with all accessories for trouble free and efficient performance and capable of being monitored.
- 1.2 Manufacturer of the RMU must use vacuum interrupter with which type tests have been carried out on the offered switchgear. The type test reports shall mention the make of the VI used for type testing. Manufacturers not meeting these criteria shall be technically rejected.
- 1.3 The RMU to be supplied against this specification are required for vital installations where continuity of service is very important. The design, materials and manufacture of the equipment shall, therefore, be of the highest order to ensure continuous and trouble free service over the years.
- 1.4 The insulation/dielectric media inside the stainless steel welded tank (Grade SS304 – Non ferrite, Non Magnetic) should be SF6 gas. The RMU should be Modular, extensible type on single sides with provision of attaching / connecting with bus through plug-in type busbar links. The busbar links shall be protected with silicon insulation to avoid any ageing effect & also to provide the protection from harsh climatic conditions. However, RMU left side is occupied by metering panel and right side is free for extension on vice versa is also possible depending on site condition. RMU shall be front access or access from sides.
- 1.5 Ring Main Units shall be SCADA compatible for future use.
- 1.6 Each new RMU shall be equipped with main-line load break switches and a fault passage indicator (FPI). Furthermore, to protect each of its lateral / transformer feeders, it shall be equipped with a corresponding set of circuit breakers and relay with self-power supply shall be provided for communication purpose. The RMU shall provision for include potential-free contacts and control contacts so as to connect to SCADA/DMS via FRTUs, so as to:
 - Monitor and control the open/closed status of the RMU circuit breakers and load break switches.
 - Monitor the local/remote position of RMU motorized (in case if failure of motor) manually-operated switches that can be used to enable and disable remote monitoring.
 - 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 in case of Hinge doors.
 - Monitor for low SF6 gas pressure indication.
 - Monitor for circuit breaker relay operations.
 - Monitor for indication of main-circuit fault detected by the RMU's FPI.
- 1.7 The RMU offered shall be compact, maintenance free, easy to install reliable, safe and easy to operate and complete with all parts necessary for their effective and trouble-free operation. Such parts will be deemed to be within the scope of the supply irrespective of whether they are specifically indicated in the commercial order or not.

- 1.8 It is not the intent to specify herein complete details of design and construction. The offered equipment shall conform to the relevant standards and be of high quality, sturdy, robust and of good design and workmanship complete in all respects and capable to perform continuous and satisfactory operations in the actual service conditions at site and shall have sufficiently long life in service as per statutory requirements. In actual practice, notwithstanding any anomalies, discrepancies, omissions, in-completeness, etc. in these specifications, the design and constructional aspects, including materials and dimensions, will be subject to good engineering practice in conformity with the required quality of the product, and to such tolerances, allowances and requirements for clearances etc. as are necessary by virtue of various stipulations in that respect in the relevant Indian Standards, IEC standards, I.E. Rules, I.E. Act and other statutory provisions.
- 1.9 It shall also encompass all necessary project management, data engineering, acceptance testing, training, documentation, warranty services as efficiently as possible with minimum interruptions of power to Employer / customers.
- 1.10 Tolerances on all the dimensions shall be in accordance with provisions made in the relevant Indian /IEC standards amended up-to date and in this specification. Otherwise the same will be governed by good engineering practice in conformity with required quality of the product.
- 1.11 Battery shall be sealed lead acid VRLA or DRY type and shall have minimum life of 5 years at 25° C.
- 1.12 The successful bidder shall give rigorous on field and inhouse training with supplier of RMUs to the engineers and staff for 1 week (7 working days) (in attending trouble shooting and maintenance.
- 1.13 Anodized aluminum operating instructions in GUJARATI shall be fixed inside the door. The letter should be cleared legible and readable. The letters of the instructions should be of sufficient size to read with normal eye

2. Service Conditions

Equipment to be supplied against this specification shall be suitable for satisfactory continuous operation under the following tropical conditions.

- Maximum ambient temperature of air: 50°C
- Maximum temperature of air in shade: 4°C
- Maximum daily average ambient temperature: 40°C
- Maximum yearly average ambient temperature: 30°C
- Relative Humidity: up to 95%
- Average number of thunder storm days per annum: 15
- Maximum annual Rainfall: 150cm
- Maximum Altitude above mean sea level: 1000Meter
- Maximum Wind Pressure: 150 Kg/cm² (As per IS 802 latest code)
- Maximum soil temperature at cable depth: 30°C
- Maximum soil thermal resistivity: 150°C cm/watt
- Design ambient temperature : 40°C

3. TECHNICAL PARAMETERS

| Sr No | Description | 11kV RMU |
|-------|-------------|--------------------------|
| 1 | Application | Three phase - Three wire |

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| 2 | Rated Voltage | 12 kV |
| 3 | Service Voltage | 11 kV |
| 4 | System Frequency | 50 Hz |
| 5 | SF6 gas at a relative pressure | As per IEC 62271-200 & IEC 60694 |
| 6 | Internal Arc test | 21kA for 1 Sec for tank IAC A FLR 21kA for 1sec as per IEC 62271 for Gas vessel along with cable compartment |
| 7 | Lightning Impulse withstand Voltage | 75 kV Peak |
| 8 | Power Frequency withstand voltage | 28 kV rms |
| 9 | Rated current of Circuit-breaker | 630A |
| 10 | Rated Short time current withstand | 21 KA for 3 sec |
| 11 | Rated Short circuit making current | 50 kA |
| 12 | Number of operations at rated short circuit current on line switches, earthing switches and CB | 5 close for line & earth switches and 20 nos for 11 kV VCB. |
| 13 | Opening time of breaker (max.) | 2.5 cycle |
| 14 | Closing time of breaker (max.) | 3 cycle |
| 15 | Breaker Duty Cycle | 0-3min-C0-3min-C0 |
| 16 | Fault Clearing time | 70 millisecond |
| 17 | Rated cable charging interrupting current of incomer- Load Break Switch | 10A |
| 18 | Rated cable charging breaking current of breaker | 25A |
| 19 | Insulating medium | SF6 |
| 20 | Interrupting medium | Vacuum |
| 21 | Temperature Rise | Maximum permissible temperature rise as per table 3 of IEC 60694. |

4. Applicable Standards

The RMU Switchgear shall comply with the requirements stated in the following standards and specifications amended up to date:

| Standard | Description |
|---------------------|--|
| IEC 60529 | Classification of degrees of protection provided by enclosures of electrical equipment |
| IEC 62271-200: 2003 | A.C metal-enclosed switchgear and control gear for rated voltages above 1KV and up to and including 72KV |
| IEC 1330 | High voltage/Low voltage prefabricated substations |
| IEC 62271-1:2007 | Common specification for HV switchgear standards |
| IEC 60265 | High-voltage switches-Part 1: Switches for rated voltages above 1kV and less than 52kV |
| IEC 60801 | Monitoring and control |
| IEC 60185 | Current Transformers |

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| IEC 60186 | Voltage transformers |
| BS 159 | Bus-bar |
| IEC 60137 | Bushings |
| BS 7430 | Earthing |
| IEC 60255 | Specification for Static Protective Relays |
| BS 6231 | Wires and wiring |
| IEC 61000 | Electromagnetic compatibility |
| IEC 60129 | Alternating current Dis-connector (isolators) and earthing switches |
| IEC 62271-200 | Metal enclosed BS 5311 switchgear |
| IEC 62271-100 | MV AC circuit breaker |
| IEC 60060-1 / BS 923 | High Voltage test technique |
| IEC 60947-4-1 | Control Gears |
| IEC 60623 | Open Ni-Cd prismatic rechargeable cell |
| IEC 60376 | Filling of SF6 gas in RMU |

5. General Technical Requirement

5.1 Configuration:

- 2-Way (CV):11KV Gas (SF6) Insulated RMU with One 630A load break switches and One 630A SF6 Insulated VCB
- 3-Way (CCC), 11KV Gas (SF6) Insulated RMU with 3 Nos 630A load break switch
- 3-Way (CVV), 11KV ,Gas (SF6) Insulated RMU with 1 Nos 630A load break switch and 2 Nos. 630 A SF6 Insulated VCB
- 3-Way (CCV), 11KV, Gas (SF6) Insulated RMU with 2 Nos 630A load break switch and 1No. 630 A SF6 Insulated VCB
- 4-Way (CCVV), 11 KV Gas (SF6) Insulated RMU with 2 Nos 630A Load break switches and 2 Nos, 630 A SF6 Insulated VCB
- 4-Way (CCCV), 22 KV Gas (SF6) Insulated RMU with 3 Nos 630A Load break switches and 1 Nos, 630 A SF6 Insulated VCB
- 4-Way (CCCC), 22 KV Gas (SF6) Insulated RMU with 4 Nos 630A Load break switches
- 5-Way (CCCVV), 11KV , Gas (SF6) Insulated RMU with 3 Nos 630A load break switch and 2 Nos. 630 A SF6 Insulated VCB
- 6-Way (CCCVV+V), 11KV Gas (SF6) Insulated RMU with 3 Nos 630A Load break switches and 3 Nos 630 A SF6 Insulated VCB

5.2 RMU Design Features:

The RMU are to be designed, manufactured, factory integrated with fault passage indicator, tested and delivered at site. The RMU shall be locally monitorable and/or operable for/to:

- The open/close the status of the RMU circuit breakers and load break switches.
- The health of the power supply, which will include battery failure and low voltage indications.
- The open/closed status of RMU earthing switches.
- For low SF6 gas pressure indication.
- For circuit breaker relay operations.

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- For indication of main-circuit fault detected by the RMU's FPI.
- Busbars and switching equipments in a 5-way RMU shall be in a common single gas vessel so as to ensure the least gas monitoring points
- Main Door Limit Switch and indication thereof at SCADA Center

5.3 Outdoor Enclosure Features:

The RMUs shall be designed specifically for outdoor installation with ingress protection degree of IP54. They shall also be suitable for conditions in which they will be exposed to heavy industrial pollution, and high levels of airborne dust.

The outer enclosure shall be made of CRCA, 2 mm thick with thick glands plates of 3 mm. The sheet steel and the fabricated parts shall be pretreated using 7 tank process and then coated by layer of zinc phosphate. A finish coat with high scratch resistance epoxy powder finish paint shall be applied over the primer. The coat thickness shall be minimum 100 microns +/- 25 micron.

The equipment in the proposed outdoor RMU shall be 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 IEC60721, which covers the classification of such conditions. All live parts, high voltage components, excluding the HV cable termination of the switchgear shall be insulated/ protected in SF6 to provide complete proofing against dangers of flashover between phase and earth and between phases. In particular, the equipment shall be climate free in that no high voltage connection will be exposed to the environment.

The complete RMU unit shall be powder coating of RAL 7032 Grey to DIN Standard 43656.

5.4 Indoor Enclosure Features:

The tank shall be corrosion resistant stainless steel sheet (Grade SS 304 – Non ferrite, Non Magnetic) of minimum 2.5 mm (as per relevant IS/ IEC) thickness with internal Arc Type tested and meet the 'sealed pressure system' criteria in accordance with the IEC 62271-200. This is a system for which no handling/ refilling of gas shall be required throughout the expected operating life, i.e. 30 years. Sealed pressure systems are completely assembled, filled and tested in the factory. The maximum leakage rate of SF6 gas shall be lower than 0.1% of the total initial mass of SF6 gas per annum. The filling pressure for the switchgear shall be just above the atmospheric pressure so as to reduce the tendency to leak. SF6 gas used for the filling of the RMU shall be in accordance with IEC376. It is preferable to fit an absorption material in the tank to absorb the moisture from the SF6 gas and to regenerate the SF6 gas following arc interruption. There shall be no requirement to 'top up' the SF6 gas. The degree of protection for RMU tank, high voltage live parts, SF6 and VCB shall be IP 67. The Front cover mechanism and cable cover shall have IP2X degree of protection.

After the calculation of rate of leakage of SF6 gas pressure, minimum SF6 gas inside the tank should be for 30 years of life cycle.

5.5 The RMU shall be mounted on base channels with anchor bolt holes for installation in a concrete plinth. The RMU shall be suitable for mounting for cabling through gland plate in the base and trench below. The RMU shall be designed so that the position of the different devices is visible to the operator on the front and operations are also visible. The RMU shall

- be identified by an appropriately sized label which clearly indicates the functional units and their electrical characteristics. The RMU shall be designed to be tamper proof so as to prevent access to all live parts during operation without the use of tools.
- 5.6 The RMU shall be completed with all connection and copper bus bar within SF6 enclosure bus bar for air exposed parts with continuous current carrying capacity of 630A as per relevant IEC/IS. The bus bar shall be fully encapsulated by SF6 gas inside the steel tank. There shall be continuity between the metallic parts of the RMU and cables so that there is no electric field pattern in the surrounding air, thereby ensuring the safety of people. The earth bus bar shall be preferably enclosed in an enclosure to prevent theft/tampering.
- 5.7 All parts of main circuit to which access is required or provided shall be capable of being earthed prior to becoming accessible. This does not apply to removable parts which become accessible after being separated from the switchgear and control gear. The cables shall be earthed by an earth switch through circuit breaker. The interlocking between circuit breaker and earth switch shall be provided in such a manner to avoid accidental earthing of live bus bar. The earth switch shall be fitted with its own operating mechanism and manual closing shall be driven by a fast-acting mechanism, independent of operator action. Mechanical interlocking systems shall prevent access to the operating shaft to avoid all operator errors such as closing the earth switch when cable is charged.
- 5.8 Clear empty space shall be mandatory provided in RMU panel for mounting FRTU Panel. Dimension details of required space for FRTU are about 900 mm H X 600 mm W X 300 mm D.
- 5.9 RMU itself will supply 230 V AC 200 VA for FRTU. Each RMU Shall Include its own power supply unit including (auxiliary power transformer, maintenance free batteries, and battery charger) which shall provide a stable power source for the RMU. The RMU shall be supplied with battery charger for charging of 24V DC, 48 AH battery set for FRTU and for charging battery for motorized operation of RMU.

Separate auxiliary transformer for charging of battery to feed the auxiliary load of RMU and FRTU and its circuit shall be provided with 500 VA burden.

- Monitor the health of the power supply, which will include battery failure and low voltage indications.
- Battery and battery charger, to provide stable as per motor rating, 24 V DC, power for the RMU's Motor.
- The batteries shall have minimum life of Five (5) Years.
- The 24 V DC Batteries shall have sufficient capacity to supply power to the following devices with a normal backup of 4 hours.
 - (1) RMU's motors for a minimum of five (5) operations
 - (2) RMU's trip coil, close coil, FPI
- 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 pre set 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 value with set values (e.g, internal resistance, voltage, etc.)

- The battery charger shall be fully temperature compensated. 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.

- (1) Low battery voltage
- (2) High battery voltage
- (3) Battery failed
- (4) Battery charger overvoltage
- (5) Grounded battery / battery –charger
- (6) Others according to manufacturer's design.

5.10 Interconnecting cables, wiring, connectors and terminal blocks:

The interconnecting wires, cables, connectors, terminations and other wiring accessories such as terminal blocks shall be in the scope of the manufacturer. Plug-type/screw type connectors shall be used for all interconnections. Suitable Disconnect type terminal blocks shall be provided for CT circuits. 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

5.11 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 Circuit Breaker/Isolator is in its "closed" position.

The unit shall be internal arc proof and tested and totally safe for human beings. The enclosure for switchgear and metallic RMU housing shall have a design such that in the event of an internal arc fault, the operator shall be safe. This should be in accordance with IEC 62271-200. The outdoor RMU must be tested for internal arc fault for IAC A FLR 21KA/1sec for the vessel as well as the cable compartment. The release of gas to be from the bottom of the unit, so that, even if the person is operating the unit, opening the cover, the release will be at the bottom. The release in no case should be from any side or top of the unit, as the same is unsafe for the operating personnel/pedestrian or general public. All manual operations shall be carried out on the front of the RMU.

5.12 Isolators/Load Break Switch:

The RMUs shall be equipped with 630Amp fault making/load breaking spring assisted ring switches, each with integral fault making earth switches. The switch shall be naturally interlocked to prevent the main and earth switch being switched "ON" at the same time. The selection of the main and earth switch is made by a lever on the front which is allowed to

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move only if the main or earth switch is in OFF" position. The Ring switches shall be capable for local manual operation. The load break switch and earthing switch operating mechanism shall have mechanical endurance of at least 1000 operations.

Each INCOMING load break switch will have the following

1. Motor operated 630A Load Break switch and manually operated Earthing Switch with making capacity
2. Cable switch 11 kV, 630 A, 20 kA.
2. Mechanism for manual operation with integrated earthing switch
3. Cable bushing 630 A, standard C bushings.
4. Capacitive voltage indication fixed type- LED display.
5. Fault passage indicator with LED display and reset facility
6. Operation counters for each load break switch
7. ON,OFF, EARTH indication on the front mimic of the panel.
8. Cable box for termination of XLPE cable up to 3CX 300 sq. mm.
9. Cable entry bottom.
10. 2NO + 2 NC contacts for load break switch
11. 1NO+1NC contact for Earth switch
12. Local remote control switch for each load break switch
13. Set of Right Angled Cable Boots.
14. It should be feasible to retrofit the motor required for LBS & circuit breaker operating mechanisms at site

5.13 Vacuum Circuit Breakers

The motorized circuit breakers shall be maintenance free and the position of the power and earthing contacts shall be clearly visible on the front of the RMU through mimic. 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.

The circuit breakers shall have 2 positions (open / closed) along with earthing switch and shall be constructed in such a way that natural interlocks prevent all unauthorized operations. They shall be fully assembled, tested and inspected in the factory. Breaker operation counter should be provided. An operating mechanism shall be used to manually close the circuit breaker and charge the mechanism in a single movement in manual mode or electrically motor operated. In manual mode the operating mechanism of breaker shall be such that spring charging shall be through the handle and on/ off operation through push button. It shall be fitted with a local system for manual tripping by an integrated push button. There shall be no automatic re-closing. 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.

The circuit breaker shall be associated with an integrated protection unit that will operate without any auxiliary power supply and shall include three toroid current transformers incorporated in the cable chamber as per manufacturer standard type test design. An

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electronic self-powered relay, a low energy release, and a "fast-on" test receptacle for protection testing (with or without CB tripping). The protection system shall ensure circuit breaker tripping as of a minimum operating current which is the rated current of the underground network to be protected. The CT settings shall be adjustable between 80-40/1A for distribution transformer i.e. VCB Compartment, as per the requirement at site. Protection core CT complete details should be furnished (Burden, class, ALF).

In case cables are to be tested with front door open, doors shall have interlocks such that doors can be opened only with earth switch in closed position & a cable test rod shall be provided which can be fixed on the terminations to facilitate testing. Termination boots as approved by the Purchaser's should have a proper opening to facilitate the testing. The opening shall be covered by means of removable protection cap.

In case of front door opened, it shall not be possible to operate the breaker. All panel covers shall be provided with anti-vandal screw bolts so that opening of panel covers is only possible with special tools, which shall be provided by the Bidder. This is required to prevent pilferage. The cable cover door shall be pad lockable and shall be Tamper and Arc proof. Double door arrangement for Outdoor breakers to be provided for additional safety or RMU shall be IP 54 for outdoor and type tested for weather proof. Also cable compartment shall be independently IP54. The Outdoor RMU shall be with dedicated outdoor design. Indoor RMU installed inside the separate outdoor enclosure shall not be acceptable. There shall be no ventilation louvres on any portion of the RMU to prevent dust entry and ensure long service life. There shall be provision of hinged doors or bolted type door as per manufacturer standards type tested design. The circuit breaker and earth switch shall be lockable in the open or closed positions by 1 to 3 padlocks. Circuit Breaker shall have mechanical endurance of at least 2000 operations

Each OUTGOING Circuit Breaker will have the following

1. Motor operated 630A SF6 insulated Vacuum circuit breaker and Earthling Switch
2. Mechanism for manual operation.
3. Self-Powered protection relay providing over-current & earth fault protection.
4. Ring core current transformers for protection depending upon the transformer ratings 2.5VA, 5P10 for protection
5. Operation counters
6. 4NO+4NC Auxiliary contacts for breaker
7. 2NO+2NC Auxiliary contact for Disconnecter
8. 1No+1NC contact for Earth switch
9. Local remote control switch for each breaker
10. Capacitive voltage indication fixed type
11. ON, OFF, Earth indication on mimic and trip indication on relay.
12. Cable box for termination of XLPE cable up to 1RX1CX300 sq. mm.
13. Emergency Trip Push Button.
14. Set of Cable boots.

15. It should be feasible to retrofit the motor required for LBS & circuit breaker operating mechanisms at site

5.14 Busbars

The three nos of continuous busbars made up of copper within SF6 enclosure bus bar for air exposed parts of rating current 630 A shall be provided. The short time current withstand rating shall be 21 kA for 3 second.

5.15 Current Transformers and potential transformers

3 nos ring type, single core CTs shall be provided in each circuit breaker for protection purpose. 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. The protection CTs shall be Epoxy resin cast with **burden 2.5 VA** for transformer and **Accuracy class 5P10**.

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

Appropriate capacity CTs and PTs shall be provided in the RMU for the metering purpose. The meter shall not be in the scope of supplier but the provision and space for installation of the same in future shall be available in the separate enclosure for housing the Battery/Charger etc.

RMUs having configuration of 4 Isolators (4-Way), metering CT and PT is not required.

5.16 Protection Relays

The relay shall be provided with Phase protection of Definite time/ IDMT element for over current and earth fault with minimum PSM-0.2 for Overcurrent & PSM-0.1 for Earth fault, Tsm-0.01 having standard characteristics of Standard Inverse, Very inverse, Extremely Inverse as per IEC 60255-3 standard. The Earth Fault Protection shall be provided of Definite time/ IDMT element having standard characteristics of Standard Inverse, Very inverse, Extremely Inverse as per IEC 60255-3 standard. The "Time Multiplier" with minimum set point of 0.05 TMS shall be available. The breaker shall have the provision of LED indication of Trip on Fault High set (DT) for over current and earth fault-min current setting-0.5 In, minimum Time Delay - 20 milliseconds. The relays shall be suitable numerical relay with necessary elements as per the Purchaser's approval.

On this basis, the relay as a minimum shall provide:

- a) Phase over Current Protection: (50/51)
- b) Earth Fault Protection: (50N/51N)

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:

- a) It shall be housed in a flush mounting case and Dual power supply with AC/DC power supply and battery.
- b) Phase and Earth sensors shall be connected to FPI by fibre optic cable
- c) It shall have 3- phase over-current elements and one earth fault element.
- d) IDMT trip current settings shall be 20-200% in steps of 1% for phase over- current and 10-80% in steps of 1% for earth fault.
- e) Instantaneous trip current settings shall be 100-2000% in steps of 100% for phase over-current and 100- 1200% in steps of 100% for earth fault.
- f) Selectable IDMT curves shall be provided to include, for example, Normal Inverse, Very Inverse, Extreme Inverse, Long Time Inverse, and Definite Time. Separate curve settings for phase over-current and earth fault shall be supported.
- g) For IDMT delay multiplication, the Time Multiplier Setting (TMS) shall be adjustable from 0.01 to 0.1 in 0.01 steps.

The relay shall also be provided with:

- Alphanumeric Liquid Crystal Display (LCD)
- Parameter change capability that is password protected
- Capability to record up to 10 of the latest fault records duly time stamped and 100 events records stored in non-volatile memory for subsequent reading via the above referenced RS485/RS 232 port
- Relay shall have Thermal overload protection
- Relay shall have 2 settings group. Change of settings group can be achieved both locally at the relay fascia and remotely over the data communications channel(s) or via a binary input
- Relay shall have Switch on to Fault and operating time shall be <100mSec for fault current > 2xIset
- Relay shall have at least 2 Binary inputs, 2 Binary outputs, 4 Programmable LED's and 5 Fixed LED
- Relay shall have RS485 supporting site selectable IEC60870-5-103 and Mod-bus RTU.
- Relay shall optional provision to have IP54 from front with extra transparent cover
- 10% for 3-phase fault and 20% for 1-Phase fault
- Relay shall be Type tested as protection product standard IEC60255-1, Safety IEC60255-27, EMI/EMC IEC60255-26, Climatic: IEC60068

5.17 Bushings and cable terminations:

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Each cable compartment shall, be provided with three bushings of adequate sizes to terminate the incoming and outgoing cables along with a terminal block (TB) located at convenient accessible location so as to wire all inputs & outputs (IOs) up to the terminal block (TB). The bushings shall be conveniently located for proper bend so as to allow easy working and termination of cables. The cable termination shall be done with Heat shrinkable /Push ON termination method so that adequate clearances are maintained between phases & cable shall be held by HDPE (fire retardant) cleat. The clearance between phase to phase and phase to earth shall be as per IEC 61243- 5 amended up to dates. 1 run of up to 3CX300 Sq. mm shall be used for cable termination. All the cable secondary wiring should be routed through marshaling box separately for relay, CT etc. Bimetallic washer for tightening of cable to be provided. RMU bushing shall be female or bus-bar type for cable termination and provision for replacement of bushing should be available. Cable entry should be from front bottom only; Side cable entry shall not be allowed.

5.18 Earthing

The RMU outdoor metal enclosed shall be equipped with an earth bus securely fixed along the base of the RMU. Earthing shall be carried out as per attached drawing for maintenance free earthing. The earth bus bar shall be of GI strip (50sqmmX6) or copper strip (inside the RMU) having equivalent current rating and short circuit rating as per IEC/IS. Provision shall be made on end of RMU for connecting the earth bus to the earth grid by erecting suitable 2 earth pipes of 50mm dia. M.S. rod of 3 meter in Pits. Both the earth pipes are also to be connected in a grid formation.

5.19 Voltage indicator lamps and phase comparators

Each function shall be equipped with a fixed type voltage indicator box on the front to indicate whether or not there is voltage in the cables. The capacitive dividers will supply low voltage power to the lamps. Three inlets can be used to check the synchronization of phases. These devices shall be in compliance with IEC 61958 standard. Voltage indicator lamp shall be operating individually per phase. VDI shall be visible from outside without opening the doors.

5.20 Front cover

The front cover shall provide a clear mimic diagram that indicates the different functions. The position indicators shall give a true reflection of the position of the main contacts. They shall be clearly visible to the operator. The lever operating direction shall be clearly indicated in the mimic diagram. The bidder shall provide a marking plate showing RMU's main electrical characteristics.

5.21 Fault Passage Indicator .

Fault Passage Indicators shall be installed on the Ring Main Unit. This shall facilitate quick detection of faulty cable. The FPI shall be in integral part of one isolator and shall be capable of displaying fault. The fault indication may be on the basis of monitoring fault current through the device. These devices shall be electronic devices with their own energy source and connected to Single 3 phase Split Core CTs (CBCT). These shall be provided with bright

LEDs / flag Indicators, which shall be clearly visible in the day time. These shall have the following resetting facilities:

- Manual reset
- Resetting after a set time duration
- Electrically reset from remote with at least 2-spare potential free contacts.
- Resetting on restoration of LV
- Accuracy of phase and earth measurement shall be $\leq 10\%$
- Response time starting from 40ms (40 to 500ms)
- FPI shall have at least 2000 hours of flashing hours
- FPI shall support on site test functions such as device test, battery test and cable test
- FPI shall be Type tested as per provided specifications
- FPI shall have
 1. Transient or momentary fault reset mechanism
 2. Permanent fault confirmation by passively sensing of Auto reclosure activity

The unit shall have Short Circuit and Earth fault adjustable to different settings with separate Current transformer. They shall be fully field-programmable and shall have o/c setting 200-1200 A and E/F setting 10-100 A. To restrain operation of fault passage indicators due to inrush / switching current, settings of time delay of 1s-5s shall be available or device shall have facility to distinguish between momentary & permanent fault. It shall be possible to Test these indicators at site thru "Test" push button.

The conventional practice is to have (N-1) FPI where N is nos. of LBS in a particular configuration of RMU. FPI shall be visible from outside without opening the doors.

5.22 Paint

All paint shall be applied on dean dry surfaces under suitable atmospheric conditions by seven tank process and powder coating. The overall paint thickness shall not be less than 100 microns ± 25 micron as standard. The paint shall not scale off or crinkle or be removed by abrasion during normal handling. The enclosure of the RMU shall be painted with shade Dark Gray i.e. RAL 7032. Sufficient quantity oftouch-up paint shall be furnished for application at site. Paint shall be capable to withstand in saline conditions. Paint shall be capable to withstand in saline conditions.

5.23 Name Plate & Marking

All the components and operating devices of the RMU shall be provided with durable and legible nameplates containing all technical parameters. Name plates shall be suitably embossed with the following information. A Danger plate of appropriate size shall also be provided on the enclosure.

- Manufacturer's Name
- Month and year of supply
- PO Number
- Rated Voltage

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- System Frequency
- RMU Configuration
- Rated Short Time Withstand current for 3 sec
- Rated Impulse withstand Voltage
- Degree of Protection
- Type Designation or Serialno.
- Year of manufacture
- Applicable Rated values
- Mass of unit
- SF6 gas filling pressure
- Property of PGVCL

6. Testing & Inspection

6.1 General:

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 in the specification. The type test produced by supplier shall be only from reputed NABL accredited / international / national government approved testing laboratories such as CPRI, ERDA from India and PEHLA, KEMA, Volta, KERI, CESI, ERDA etc. from remaining part of the globe. Report from any other testing lab mentioned above shall not be accepted. In such a case manufacture has to perform the repeat type test for the RMU from these labs at his own cost. The type test report shall have been conducted during the period not exceeding seven (07) years from the date of opening of the bid. In the event of any discrepancy in the test reports i.e. any test report not acceptable or any/ all type tests (including additional type tests, if any) not carried out, same shall be carried out without any cost implication.

Prior to acceptance testing, the supplier shall prepare and submit a detailed Manufacturing Quality Plan (MQP) and routine/ inspection test plan for review and approval.

Successful bidder has to get approval of drawings. The supplier shall have to offer proto inspection for RMU. The supplier shall have in house testing facility for carrying out proto inspection, lot inspection by the utility at works of supplier. All the equipment used must be up to date and calibrated by reputed agency.

It shall be possible to test the cable without disconnecting them from the cable bushing. The access to the cable must be available only after earthing the respective feeder to ensure complete safety of the operators. To fulfill this feature the cable compartment covers shall be logically interlocked with the feeder earth switch. The cable boots to be supplied along with the RMU should be used during the type test as well. The necessary report for the same should be provided. Cable boots not tested along with the RMU and supplied shall not be accepted.

6.2 Type tests:

Following shall constitute the type tests: -

- a) Short time current withstand test and peak current withstand test.
- b) Lightning Impulse voltage with-stand test
- c) Temperature rise test.
- d) Short Circuit current making and breaking tests.
- e) Power frequency voltage withstand test (dry).

- f) Capacitive current switching test confirming to IEC.
g) Mechanical operation test.
h) Measurement of the resistance of the main circuit.
i) Checking of degree of protection of main tank and outer enclosure
j) Switch, circuit breaker, earthing switch making capacity.
k) Switch, circuit breaker breaking capacity.
l) Internal arc withstands.
m) Checking of partial discharge on complete unit.
n) In-house helium leak test facility shall be used by manufacturer to test the welded stainless steel gas vessel for gas leakage.

IN ADDITION, FOR SWITCHES, TEST REPORTS ON RATED BREAKING AND MAKING CAPACITY SHALL BE SUPPLIED.

FOR EARTHING SWITCHES, TEST REPORTS ON MAKING CAPACITY, SHORT-TIME WITHSTAND CURRENT AND PEAK SHORT-CIRCUIT CURRENT SHALL BE SUPPLIED.

6.3 Routine tests:

The following routine tests shall be conducted by the manufacturer and the same shall be backed by the factory's quality control department test reports.

- a) Conformity with drawings and diagrams,
b) Measurement of closing and opening speeds,
c) Measurement of operating torque,
d) Checking of filling pressure,
e) Checking of gas-tightness,
f) Dielectric testing and main circuit resistance measurement.
g) Power frequency voltage
h) Resistance test for the circuit
i) Mechanical operation tests.

BIDDERS SHALL CONFIRM THE FOLLOWING ROUTINE TESTS ON EACH RMU SUPPLIED.

- a) Micro ohm test (contact Resistance test) for the assembly inside the tank
b) Circuit breaker analyzer test so as to ensure the simultaneous closing of all Poles for VCB.
c) SF6 gas leak test
d) Partial Discharge test on the complete gas tank so as to be assure of the proper insulation level and high service life.
e) High voltage withstand.
f) Secondary test to ensure the proper functioning of the live line indicators, fault passage indicators and relays.

6.4 Acceptance tests:

All the tests specified under Routine Test Clause above shall be carried out as acceptance test on random samples as per sampling plan under IEC/15 for each lot.

6.5 DOCUMENTATION and DRAWINGS

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All drawings shall conform to relevant International Standards Organization (ISO) Specification. All drawings shall be in ink and suitable for microfilming.

The tenderer shall submit along with his tender dimensional general arrangement drawings of the equipment's, illustrative and descriptive literature in triplicate for various items in the RMUs which are all essentially required for future automation.

- I. Schematic diagram of the RMU panel
- II. Instruction manuals
- III. Catalogues of spares recommended with drawing to indicate each items of spares
- IV. List of spares and special tools recommended by the supplier.
- V. Copies of Type Test Certificates as per latest IS/IEC.
- VI. Drawings of equipment's, relays, control wiring circuit, etc.
- VII. Foundation drawings of RMU so that Utility will planned and carry out civil works etc.
- VIII. Dimensional drawings of each material used for item VII.
- IX. Actual single line diagram of RMU/RMUs with or without Extra combinations shall be made displayed on the front portion of the RMU so as to carry out the operations easily.

The following should be supplied to each consignee circle/town along with the initial supply of the equipment's ordered.

Copies of printed and bound volumes of operation, maintenance and erection manuals in English along with the copies of approved drawings and type test reports etc.

Sets of the manuals as above shall be supplied to the Chief Engineer/Distribution. A soft copy of the all Technical and Drawing furnished in a CD.

7. GTP

| Sr. No. | Description | PGVCL Requirement |
|------------|--|--|
| 1.0 | SWITCHGEAR ASSEMBLY | |
| 1.1 | Make | |
| 1.2 | Type | Outdoor, 2/3/4/5/6 WAY |
| 1.3 | Reference Standard | IEC 56, IEC 129, IEC 298, IEC 694, IEC 265 |
| 1.4 | Voltage (Normal/Max.) kV | 11kV/12 kV |
| 1.5 | Phase (Nos.) | 3 nos |
| 1.6 | Frequency (HZ) | 50 ± 3 Hz |
| 1.7 | Short Circuit Rating for 3 Sec. (KA) | 20 kA |
| 1.8 | Insulation Level | |
| | a) Impulse withstand (KV peak) | 75 kVp |
| | b) 1 Minute 50 Hz. Voltage withstand (KV rms) | 28 kV |
| 1.9 | Metal Clad Construction | Yes |
| 1.10 | a) Degree of protection for outer enclosure: b) Degree of protection for main tank: | IP 54 IP 67 |

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| | | |
|------------|---|---|
| 1.11 | Switchgear completely wire and tested at factory (yes/No) | Yes |
| 2.0 | CONSTRUCTION | |
| 2.1 | Overall Dimensions | |
| A | Extensible 2/3/4/5/6 Way RMU | |
| | i) Width (W) (mm) | To be filled by Bidders |
| | ii) Depth (D) (mm) | |
| | iii) Height (mm) | |
| 2.2 | Overall Weight of Extensible 2/3/4/5/6 Way RMU | To be filled by Bidders |
| 3.0 | Bus bar | |
| 3.1 | Make | |
| 3.2 | Material & Grade | Copper |
| 3.3 | Reference Standard | IEC 129 |
| 3.4 | a) Cross sectional area (mm ²) | To be filled by Bidders |
| 3.5 | Continuous Current | |
| | a) Standard | 630 A |
| | b) At site conditions and within cubicle | 630A |
| 3.6 | Maximum temperature rise over ambient (c) | As per IEC Standard (above ambient of 40 Deg.C) |
| 3.7 | Minimum clearance from bare bus bar Connection | To be filled by Bidder |
| | a) Phase to phase (mm) | |
| | b) Phase to Earth (mm) | |
| 3.9 | Bus Bar support spacing (mm) | To be filled by Bidder |
| 3.10 | Bus support insulators | |
| | a) Make | |
| | b) Type | |
| | c) Reference Standard | |
| | d) Voltage Class (KV) | |
| | e) Minimum creep age distance (mm) | |
| | f) Cantilever strength Kg/mm ² | |
| | g) Net Weight (Kg) | |
| 3.11 | SF6 gas pressure (filing pressure at 20 deg. C) | 1.5 Bar |
| 4.0 | SF6/VCB CIRCUIT BREAKER | |
| 4.1 | Make | |
| 4.2 | Type (Vacuum/ SF6) | Vacuum |
| 4.3 | Reference Standard | IEC 62271 – 1/ IEC 60694 |
| 4.4 | Rated Voltage | 11 kV |
| 4.5 | Rated Frequency | 50 Hz |
| 4.6 | No. of Poles | 3 |
| 4.7 | Rated Current | |

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| | | |
|------|---|--|
| | a) Normal (Standard) Amps | 630 A |
| | b) Rated (Site) Amps | 630 A |
| 4.8 | Maximum temperatures rise over ambient.(deg. C) | As per IEC Standard (above ambient of 40 Deg.C) |
| 4.9 | Rated operating Duty | 0- 3min- CO-3min-CO |
| 4.11 | Breaking Capacity at rated voltage & operating duty | 20 |
| 4.12 | Rated making current (KA peak) | 52.5 |
| | b) Short time current for 3 Sec. (KA rms) | 20 |
| 4.14 | Transient Recovery Voltage | |
| | a) Rate of rise (KV/ms) | 0.34 KV/micro sec (as per IEC) |
| | b) Peak Voltage (KV) | 23 (35 % DC component) |
| 4.15 | Insulation Level | |
| | a) Impulse Voltage with stand on 1/50 full wave | 75 |
| | b) 1 minute 50Hz voltage withstand | 28 |
| 4.17 | Opening time Maximum, No load condition (ms) | 40-60 |
| 4.18 | Opening and closing time under SF6 gas loss or vacuum loss condition (ms) | 40-60 |
| 4.19 | At 100% Breaking capacity | |
| | a) Opening time - max (ms) | 40-60 |
| | b) Arcing time - max (ms) | 6-9 |
| | c) Total break time (ms) | 40-60 |
| 4.20 | At 60% Breaking capacity | |
| | a) Opening time - max (ms) | 40-60 |
| | b) Arcing time - max (ms) | 6-9 |
| | c) Total break time (ms) | 40-60 |
| 4.21 | At 30% Breaking capacity | |
| | a) Opening time - max (ms) | 40-60 |
| | b) Arcing time - max (ms) | 6-9 |
| | c) Total break time (ms) | 40-60 |
| 4.22 | At 10% Breaking capacity | |
| | a) Opening time - max (ms) | 40-60 |
| | b) Arcing time - max (ms) | 6-9 |
| | c) Total break time (ms) | 40-60 |
| 4.23 | Number of breaks per pole | Single |
| 4.24 | No of breaker operations permissible without requiring inspection replacement of contacts and other main parts. | |
| | a) At 100% rated current | 2000 & 40 Nos at 20 kA |
| 4.25 | Type of contacts | |
| | a) Main | Copper chromium, Butt type |
| | b) Arcing | Copper chromium |

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| | | |
|------|--|--------------------------------|
| 4.26 | Material of contacts | |
| | a) Main | Copper chromium |
| | b) Arching | |
| | c) Whether contacts silver plated | NA |
| | d) Thickness of silver plating | NA |
| 4.27 | Operating mechanism- closing | |
| | a) Type | STORED ENERGY |
| | b) No of breaker operations stored | One Tripp free |
| | C) Trip free or fixed trip | |
| | d) Anti pumping features provided | NA (Anti reflex on Earthing) |
| | e) Earthing for operating mechanism and metal parts furnished | |
| | f) Earth terminal size and material | |
| 4.28 | 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 | To be filled by bidder |
| | f) Earth terminal size and material | |
| 4.29 | Spring charging mechanism | |
| | 2) Make | |
| | 3) Type | |
| | 4) Size | |
| | 5) Rating | To be filled by bidder |
| 4.30 | Breaker suitable for capacity switching 4 operating duty 5Max.rating of capacitor bank that can be safely controlled | Yes |
| 4.31 | Tripping coil | |
| | a) Voltage | |
| | b) Permissible voltage variation (%) | |
| | c) Tripping current at rated voltage (A) | |
| | d) Power at rated voltage (W) | |
| | e) 2-Over current trip with TLF (5A) and 1-earth fault furnished as specified | |
| 4.32 | Breaker /Accessories such as control switch indication Lamps etc. furnished as specified : (please attach separate sheet giving details of all accessories, inter locks and safety shutters) | |
| | a) Mechanical safety Interlock | Yes |
| | b) Automatic Safety Interlock | No |
| | C) Operational Interlock | Yes |

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PASCHIM GUJARAT VIJ COMPANY LIMITED

Regd. & Corporate Office : Nana Mava Main Road, Laxminanagar : Rajkot : 360004

CIN U40102GJ2003SGC042908

Phone No: (0281) 2380425

Fax : (0281) 2380428

Website: www.pgvcl.com

| | | |
|------------|---|---|
| | d) Emergency manual trip | Yes |
| | e) Operation counter | Yes |
| | f) Charge /discharge indicator | Yes |
| | g) Manual spring charging facility | Yes |
| 4.33 | Impact load foundation design (to include dead load plus impact value On opening at maximum interrupting rating) (KG) | |
| 5.0 | Isolators/Load Break Switch | |
| 5.1 | Make | |
| 5.2 | Type | |
| 5.3 | Reference standard | IEC129 |
| 5.4 | Rated voltage (KV) | 12 |
| 5.5 | Rated Frequency HZ | 50 |
| 5.6 | No. Of poles (No) | 3 |
| 5.7 | Rated current | |
| |) Normal (Standard) Amps | 630 |
| | j) Derated (site) Amp | 630 |
| 5.8 | Maximum temperature rise over ambient Deg. C | As per IEC Standard (above ambient of 40 Deg.C) |
| 5.9 | Rated operation duty | 0 – 3min-CO-3min-CO |
| 5.10 | Rupturing Capacity at rated voltage MVA | |
| 5.11 | Rated making current KA peak | |
| 5.12 | Short time current | |
| | b) For 3 sec KA rms | 20 |
| 5.13 | Impulse voltage withstands on 1/50 full wave | 75 |
| 5.14 | Maximum over voltage factor when switching Off a) Loaded feeder cable | |
| 5.15 | Operating SF6 Gas pressure | |
| 5.16 | No of isolator operation permissible without requiring inspection, replacement of contacts and other | Yes |
| | 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 | Yes |
| 5.18 | Impact load for foundation design (To include | |

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| | | |
|------------|---|------------------------|
| | dead load plus impact Values on opening at maximum interrupting rating) Kg | |
| 6.0 | CURRENT TRANSFORMER | |
| 6.1 | Make | |
| 6.2 | Type & voltage level | Tap wound/11kV |
| 6.3 | Reference standard | IEC 298 |
| 6.4 | C.T. ratio as specified | To be filled by bidder |
| 6.5 | Rated frequency | 50 |
| 6.7 | Class of insulation | Class A |
| 6.8 | Temperature rises over ambient. Deg. C | To be filled by bidder |
| 6.9 | Basic insulation level | |
| 6.10 | For tripping CT RATIO | |
| | Class of accuracy | |
| | Rated Burden VA | |
| | Knee Point Voltage V | |
| | Excitation Current at $V_k/2$ Amps | |
| | Rated Saturating Current Amps | To be filled by bidder |
| | Over Current Rating | |
| | Continuous % Over Load % | |
| 7.0 | Cable terminations | |
| 7.1 | Circuit Breaker | |
| | Type | To be filled by bidder |
| | Materials | |
| | Dimensions | |
| | Size | |
| | Height of Cable box from ground Level | |
| | Arrangement for supplying bus end cable box furnished for extensible ring main Unit | To be filled by bidder |
| | Arrangement for mounting an extra cable box on each equipment furnished | |
| 7.2 | Isolator | |
| | Type | To be filled by bidder |
| | Materials | |
| | Dimensions | |
| | Size | |
| | Height of Cable box from ground Level | |
| | Arrangement for supplying bus end cable box furnished for extensible ring main Unit | To be filled by bidder |
| | Arrangement for mounting an extra cable box on each equipment furnished | |
| 8.0 | Name Plate | |

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| | | |
|-------------|--|--|
| 8.1 | Material | To be filled by bidder |
| 8.2 | Thickness | |
| 8.3 | Size for Breaker Cubicle Instruments / Devices | |
| 9.0 | Painting | Refer detail technical specification, To be filled by bidder |
| 9.1 | Finish of Breaker | |
| | Inside | |
| | Outside | |
| 9.2 | Finish of Isolator | |
| | Inside | |
| | Outside | |
| 10.0 | Drawing / Data | To be filled by bidder |
| 10.1 | General arrangement for Panel Board | |
| 10.2 | Foundation plan | |
| 10.3 | SF6/VCB tripping and material Schematic | |
| 10.4 | Bill of Material | |
| 10.5 | SF6/VCB LT panel wiring diagram | |

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TECHNICAL SPECIFICATION FOR 11 KV NON-MOTORISED RING MAIN UNIT OUTDOOR TYPE**1.1 SCOPE**

- 1.1.1** This specification covers Design, Engineering, Manufacture, Assembly, testing, Inspection, packing of Non-Motorized Ring Main Units with inbuilt FPI (Fully factory integrated & demonstrable at the time of inspection) with all accessories for trouble free and efficient performance and capable of being monitored.
- 1.1.2** In the Non-Motorized RMU shall be provision for add the motor for motorized mechanism/SCADA operation in future.
- 1.1.3** The RMU to be supplied against this specification are required for vital installations where continuity of service is very important. The design, materials and manufacture of the equipment shall, therefore, be of the highest order to ensure continuous and trouble free service over the years.
- 1.1.4** The insulation/dielectric media inside the stainless steel welded tank (Grade SS304 – Non ferrite, Non Magnetic) should be SF6 gas. The RMU should be Modular, extensible type on single sides with provision of attaching / connecting with bus through plug-in type busbar links. The busbar links shall be protected with silicon insulation to avoid any ageing effect & also to provide the protection from harsh climatic conditions. However, RMU left side is occupied by metering panel and right side is free for extension on vice versa is also possible depending on site condition. RMU shall be front access or access from sides.
- 1.1.5** Manufacturer of the RMU must use vacuum interrupter with which type tests have been carried out on the offered switchgear. The type test reports shall mention the make of the VI used for type testing. Manufacturers not meeting these criteria shall be technically rejected.
- 1.1.6** The RMU offered shall be compact, maintenance free, easy to install reliable, safe and easy to operate and complete with all parts necessary for their effective and trouble-free operation. Such parts will be deemed to be within the scope of the supply irrespective of whether they are specifically indicated in the commercial order or not.
- 1.1.7** It is not the intent to specify herein complete details of design and construction. The offered equipment shall conform to the relevant standards and be of high quality, sturdy, robust and of good design and workmanship complete in all respects and capable to perform continuous and satisfactory operations in the actual service conditions at site and shall have sufficiently long life in service as per statutory requirements. In actual practice, notwithstanding any anomalies,

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discrepancies, omissions, in-completeness, etc. in these specifications, the design and constructional aspects, including materials and dimensions, will be subject to good engineering practice in conformity with the required quality of the product, and to such tolerances, allowances and requirements for clearances etc. as are necessary by virtue of various stipulations in that respect in the relevant Indian Standards, IEC standards, I.E. Rules, I.E. Act and other statutory provisions.

- 1.1.8** It shall also encompass all necessary project management, data engineering, acceptance testing, training, documentation, warranty services as efficiently as possible with minimum interruptions of power to Employer / customers.
- 1.1.9** Tolerances on all the dimensions shall be in accordance with provisions made in the relevant Indian /IEC standards amended up-to date and in this specification. Otherwise the same will be governed by good engineering practice in conformity with required quality of the product.
- 1.1.10** Anodized aluminum operating instructions in GUJARATI shall be fixed inside the door. The letter should be cleared legible and readable. The letters of the instructions should be of sufficient size to read with normal eye

1.2 SERVICE CONDITIONS

Equipment to be supplied against this specification shall be suitable for satisfactory continuous operation under the following tropical conditions.

- a) Maximum ambient temperature of air: 50°C
- b) Maximum temperature of air in shade: 4°C
- c) Maximum daily average ambient temperature: 40°C
- d) Maximum yearly average ambient temperature: 30°C
- e) Relative Humidity: up to 95%
- f) Average number of thunder storm days per annum: 15
- g) Maximum annual Rainfall: 150cm
- h) Maximum Altitude above mean sea level: 1000Meter
- i) Maximum Wind Pressure: 150 Kg/cm² (As per IS 802 latest code)
- j) Maximum soil temperature at cable depth: 30°C
- k) Maximum soil thermal resistivity: 150°C cm/watt
- l) Design ambient temperature : 40°C

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1.3 TECHNICAL PARAMETERS

| Sr No | Description | 11kV RMU |
|-------|--|---|
| 1 | Application | Three phase - Three wire |
| 2 | Rated Voltage | 12 kV |
| 3 | Service Voltage | 11 kV |
| 4 | System Frequency | 50 Hz |
| 5 | SF6 gas at a relative pressure | As per IEC 62271-200 & IEC |
| 6 | Internal Arc test | 21 kA for 1 Sec for tank AC A FLR 21kA for 1sec as per IEC 62271 for Gas vessel along with cable compartment |
| 7 | Lightning Impulse withstand Voltage | 75 kV Peak |
| 8 | Power Frequency withstand voltage | 28 kVrms |
| 9 | Rated current of Circuit-breaker | 630A |
| 10 | Rated Short time current withstand | 21 KA for 3 sec |
| 11 | Rated Short circuit making current | 50 kA |
| 12 | Number of operations at rated short circuit current on line switches, earthing switches and CB | 5 close for line & earth switches and 20 nos for 11 kV VCB. |
| 13 | Opening time of breaker (max.) | 2.5 cycle |
| 14 | Closing time of breaker (max.) | 3 cycle |
| 15 | Breaker Duty Cycle | 0-3min-C0-3min-C0 |
| 16 | Fault Clearing time | 70 millisecond |
| 17 | Rated cable charging interrupting current of incomer- Load Break Switch | 10A |
| 18 | Rated cable charging breaking current of breaker | 25A |
| 19 | Insulating medium | SF6 |
| 20 | Interrupting medium | Vacuum |
| 21 | Temperature Rise | Maximum permissible temperature rise as per table 3 of IEC 60694. |

1.4 APPLICABLE STANDARDS

The RMU Switchgear shall comply with the requirements stated in the following standards and specifications amended up to date:

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| Standard | Description |
|----------------------|--|
| IEC 60529 | Classification of degrees of protection provided by enclosures of electrical equipment |
| IEC 62271-200: 2003 | A.C metal-enclosed switchgear and control gear for rated voltages above 1KV and up to and including 72KV |
| IEC 1330 | High voltage/Low voltage prefabricated substations |
| IEC 62271-1:2007 | Common specification for HV switchgear standards |
| IEC 60265 | High-voltage switches-Part 1: Switches for rated voltages above 1kV and less than 52kV |
| IEC 60801 | Monitoring and control |
| IEC 60185 | Current Transformers |
| IEC 60186 | Voltage transformers |
| BS 159 | Busbar |
| IEC 60137 | Bushings |
| BS 7430 | Earthing |
| IEC 60255 | Specification for Static Protective Relays |
| BS 6231 | Wires and wiring |
| IEC 61000 | Electromagnetic compatibility |
| IEC 60129 | Alternating current Disconnecter (isolators) and earthing switches |
| IEC 62271-200 | Metal enclosed BS 5311 switchgear |
| IEC 62271-100 | MV AC circuit breaker |
| IEC 60060-1 / BS 923 | High Voltage test technique |
| IEC 60947-4-1 | Control Gears |
| IEC 60623 | Open Ni-Cd prismatic rechargeable cell |
| IEC 60376 | Filling of SF6 gas in RMU |

1.5 GENERAL TECHNICAL REQUIREMENT

1.5.1 Configuration:

- 2-Way (CV): 11KV Gas (SF6) Insulated RMU with One 630A load break switches and One 630A SF6 Insulated VCB
- 3-Way (CCC), 11KV Gas (SF6) Insulated RMU with 3 Nos 630A load break switch
- 3-Way (CVV), 11KV ,Gas (SF6) Insulated RMU with 1 Nos 630A load break switch and 2 Nos. 630 A SF6 Insulated VCB
- 3-Way (CCV) , 11KV ,Gas (SF6) Insulated RMU with 2 Nos 630A load break switch

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and 1No. 630 A SF6 Insulated VCB

- 4-Way (CCVV), 11 KV Gas (SF6) Insulated RMU with 2 Nos 630A Load break switches and 2 Nos, 630 A SF6 Insulated VCB
- 4-Way (CCCV), 22 KV Gas (SF6) Insulated RMU with 3 Nos 630A Load break switches and 1 Nos, 630 A SF6 Insulated VCB
- 4-Way (CCCC), 22 KV Gas (SF6) Insulated RMU with 4 Nos 630A Load break switches
- 5-Way (CCCVV), 11KV, Gas (SF6) Insulated RMU with 3 Nos 630A load break switch and 2 Nos. 630 A SF6 Insulated VCB
- 6-Way (CCCVV+V), 11KV Gas (SF6) Insulated RMU with 3 Nos 630A Load break switches and 3 Nos 630 A SF6 Insulated VCB

Note: RMU configuration as above shall be non-motorized mechanism, and there shall be provision for add the motor in future for motorized mechanism/SCADA operation.

1.5.2 RMU Design Features:

The RMU are to be designed, manufactured, factory integrated with fault passage indicator, tested and delivered at site. The RMU shall be locally monitorable and/or operable for/to:

- the open/close the status of the RMU circuit breakers and load break switches.
- The health of the power supply, which will include battery failure and low voltage indications.
- the open/closed status of RMU earthing switches.
- For low SF6 gas pressure indication.
- for circuit breaker relay operations.
- for indication of main-circuit fault detected by the RMU's FPI.

1.5.3 Outdoor Enclosure Features:

The RMUs shall be designed specifically for outdoor installation with ingress protection degree of IP54. They shall also be suitable for conditions in which they will be exposed to heavy industrial pollution, and high levels of airborne dust.

The outer enclosure shall be made of CRCA, 2 mm thick with thick glands plates of 3 mm. The sheet steel and the fabricated parts shall be pretreated using 7 tank process and then coated by layer of zinc phosphate. A finish coat with high scratch resistance epoxy powder

finish paint shall be applied over the primer. The coat thickness shall be minimum 100 microns +/- 25 micron.

The equipment in the proposed outdoor RMU shall be 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. All live parts, high voltage components, excluding the HV cable termination of the switchgear shall be insulated/ protected in SF6 to provide complete proofing against dangers of flashover between phase and earth and between phases. In particular, the equipment shall be climate free in that no high voltage connection will be exposed to the environment.

The complete RMU unit shall be powder coating of RAL 7032 Grey to DIN Standard 43656.

1.5.4 Indoor Enclosure Features:

The tank shall be corrosion resistant stainless steel sheet (Grade SS 304 – Non ferrite, Non Magnetic) of minimum 2.5 mm (as per relevant IS/ IEC) thickness with internal Arc Type tested and meet the 'sealed pressure system' criteria in accordance with the IEC 62271-200. This is a system for which no handling/ refilling of gas shall be required throughout the expected operating life, i.e. 30 years. Sealed pressure systems are completely assembled, filled and tested in the factory. The maximum leakage rate of SF6 gas shall be lower than 0.1% of the total initial mass of SF6 gas per annum. The filling pressure for the switchgear shall be just above the atmospheric pressure so as to reduce the tendency to leak. SF6 gas used for the filling of the RMU shall be in accordance with IEC376. It is preferable to fit an absorption material in the tank to absorb the moisture from the SF6 gas and to regenerate the SF6 gas following arc interruption. There shall be no requirement to 'top up' the SF6 gas. The degree of protection for RMU tank, high voltage live parts, SF6 and VCB shall be IP 67. The Front cover mechanism and cable cover shall have IP2X degree of protection.

After the calculation of rate of leakage of SF6 gas pressure, minimum SF6 gas inside the tank should be for 30years of life cycle.

- 1.5.5** The RMU shall be mounted on base channels with anchor bolt holes for installation in a concrete plinth. The RMU shall be suitable for mounting for cabling through gland plate in the base and trench below. The RMU shall be designed so that the position of the different

devices is visible to the operator on the front and operations are also visible. The RMU shall be identified by an appropriately sized label which clearly indicates the functional units and their electrical characteristics. The RMU shall be designed to be tamper proof so as to prevent access to all live parts during operation without the use of tools.

1.5.6 The RMU shall be completed with all connection and copper bus bar within SF6 enclosure bus bar for air exposed parts with continuous current carrying capacity of 630A as per relevant IEC/IS. The bus bar shall be fully encapsulated by SF6 gas inside the steel tank. There shall be continuity between the metallic parts of the RMU and cables so that there is no electric field pattern in the surrounding air, thereby ensuring the safety of people. The earth bus bar shall be preferably enclosed in an enclosure to prevent theft/tampering.

1.5.7 All parts of main circuit to which access is required or provided shall be capable of being earthed prior to becoming accessible. This does not apply to removable parts which become accessible after being separated from the switchgear and control gear. The cables shall be earthed by an earth switch through circuit breaker. The interlocking between circuit breaker and earth switch shall be provided in such a manner to avoid accidental earthing of live bus bar. The earth switch shall be fitted with its own operating mechanism and manual closing shall be driven by a fast-acting mechanism, independent of operator action. Mechanical interlocking systems shall prevent access to the operating shaft to avoid all operator errors such as closing the earth switch when cable is charged

1.5.8 Interconnecting cables, wiring, connectors and terminal blocks:

The interconnecting wires, cables, connectors, terminations and other wiring accessories such as terminal blocks shall be in the scope of the manufacturer. Plug-type/screw type connectors shall be used for all interconnections. Suitable Disconnect type terminal blocks shall be provided for CT circuits. 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

- 1.5.9** 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 Circuit Breaker/Isolator is in its "closed" position.

The unit shall be internal arc proof and tested and totally safe for human beings. The enclosure for switchgear and metallic RMU housing shall have a design such that in the event of an internal arc fault, the operator shall be safe. This should be in accordance with IEC 62271-200. The outdoor RMU must be tested for internal arc fault for IAC A FLR 21KA/1sec for the vessel as well as the cable compartment. The release of gas to be from the bottom of the unit, so that, even if the person is operating the unit, opening the cover, the release will be at the bottom. The release in no case should be from any side or top of the unit, as the same is unsafe for the operating personnel/pedestrian or general public. All manual operations shall be carried out on the front of the RMU.

1.5.10 Isolators/Load Break Switch:

The RMUs shall be equipped with 630Amp fault making/load breaking spring assisted ring switches, each with integral fault making earth switches. The switch shall be naturally interlocked to prevent the main and earth switch being switched "ON" at the same time. The selection of the main and earth switch is made by a lever on the front which is allowed to move only if the main or earth switch is in OFF" position. The Ring switches shall be capable for local manual operation. The load break switch and earthing switch operating mechanism shall have mechanical endurance of at least 1000 operations.

Each INCOMING load break switch will have the following

1. Manually operated 630A Load Break switch and manually operated Earthing Switch with making capacity
2. Cable switch 11 kV, 630 A, 21 kA.
2. Mechanism for manual operation with integrated earthing switch
3. Cable bushing 630 A, standard C bushings.
4. Capacitive voltage indication fixed type- LED display.

5. Fault passage indicator with LED display and reset facility
6. Operation counters for each load break switch
7. ON, OFF, EARTH indication on the front mimic of the panel.
8. Cable box for termination of XLPE cable up to 3CX 300 sq. mm.
9. Cable entry bottom.
10. 2NO + 2 NC contacts for load break switch
11. 1NO+1NC contact for Earth switch
12. Local remote control switch for each load break switch
13. Set of Right Angled Cable Boots.
14. It should be feasible to retrofit the motor required for LBS & circuit breaker operating mechanisms at site

1.5.11 Vacuum Circuit Breakers

The non-motorized/manually operated circuit breakers shall be maintenance free and the position of the power and earthing contacts shall be clearly visible on the front of the RMU through mimic. 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.

The circuit breakers shall have 2 positions (open / closed) along with earthing switch and shall be constructed in such a way that natural interlocks prevent all unauthorized operations. They shall be fully assembled, tested and inspected in the factory. Breaker operation counter should be provided. An operating mechanism shall be used to manually close the circuit breaker and charge the mechanism in a single movement in manual mode or electrically motor operated. In manual mode the operating mechanism of breaker shall be such that spring charging shall be through the handle and on/ off operation through push button. It shall be fitted with a local system for manual tripping by an integrated push button. There shall be no automatic re-closing. 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.

The circuit breaker shall be associated with an integrated protection unit that will operate without any auxiliary power supply and shall include three toroid current transformers incorporated in the cable chamber as per manufacturer standard type test design. An electronic self-powered relay, a low energy release, and a "fast-on" test receptacle for protection testing (with or without CB tripping). The protection system shall ensure circuit breaker tripping as of a minimum operating current which is the rated current of the underground network to be protected. The CT settings shall be adjustable between 80-40/1A for distribution transformer i.e. VCB Compartment, as per the requirement at site. Protection core CT complete details should be furnished (Burden, class, ALF).

In case cables are to be tested with front door open, doors shall have interlocks such that doors can be opened only with earth switch in closed position & a cable test rod shall be provided which can be fixed on the terminations to facilitate testing. Termination boots as approved by the Purchaser's should have a proper opening to facilitate the testing. The opening shall be covered by means of removable protection cap.

In case of front door opened, it shall not be possible to operate the breaker. All panel covers shall be provided with anti-vandal screw bolts so that opening of panel covers is only possible with special tools, which shall be provided by the Bidder. This is required to prevent pilferage. The cable cover door shall be pad lockable and shall be Tamper and Arc proof. Double door arrangement for Outdoor breakers to be provided for additional safety or RMU shall be IP 54 for outdoor and type tested for weather proof. Also cable compartment shall be independently IP54. The Outdoor RMU shall be with dedicated outdoor design. Indoor RMU installed inside the separate outdoor enclosure shall not be acceptable. There shall be no ventilation louvres on any portion of the RMU to prevent dust entry and ensure long service life. There shall be provision of hinged doors or bolted type door as per manufacturer standards type tested design. The circuit breaker and earth switch shall be lockable in the open or closed positions by 1 to 3 padlocks. Circuit Breaker shall have mechanical endurance of at least 2000 operations

Each OUTGOING Circuit Breaker will have the following

1. Non-Motor/manually operated 630A SF6 insulated Vacuum circuit breaker and Earthling Switch

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2. Mechanism for manual operation.
3. Self-Powered protection relay providing over-current & earth fault protection.
4. Ring core current transformers for protection depending upon the transformer ratings
2.5VA, 5P10 for protection
5. Operation counters
6. 4NO+4NC Auxiliary contacts for breaker
7. 2NO+2NC Auxiliary contact for Disconnecter
8. 1No+1NC contact for Earth switch
9. Local remote control switch for each breaker
10. Capacitive voltage indication fixed type
11. ON, OFF, Earth indication on mimic and trip indication on relay.
12. Cable box for termination of XLPE cable up to 1RX1CX300 sq. mm.
13. Emergency Trip Push Button.
14. Set of Cable boots.
15. It should be feasible to retrofit the motor required for LBS & circuit breaker operating mechanisms at site

1.5.12 Busbars

The three nos of continuous busbars made up of copper within SF6 enclosure bus bar for air exposed parts of rating current 630 A shall be provided. The short time current withstand rating shall be 21 kA for 3 second. Busbars and switching equipments in a 5-way RMU shall be in a common single gas vessel so as to ensure the least gas monitoring points

1.5.13 Current Transformers and potential transformers

3 nos ring type, single core CTs shall be provided in each circuit breaker for protection purpose. 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. The protection CTs shall be Epoxy resin cast with burden 2.5 VA for transformer and Accuracy class 5P10.

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

Appropriate capacity CTs and PTs shall be provided in the RMU for the metering purpose. The meter shall not be in the scope of supplier but the provision and space for installation of the same in future shall be available in the separate enclosure for housing the Battery/Charger etc.

1.5.14 Protection Relays

The relay shall be provided with Phase protection of Definite time/ IDMT element for overcurrent and earth fault with minimum PSM-0.2 for Overcurrent & PSM-0.1 for Earth fault, Tsm-0.01 having standard characteristics of Standard Inverse, Very inverse, Extremely Inverse as per IEC 60255-3 standard. The Earth Fault Protection shall be provided of Definite time/ IDMT element having standard characteristics of Standard Inverse, Very inverse, Extremely Inverse as per IEC 60255-3 standard. The "Time Multiplier" with minimum set point of 0.05 TMS shall be available. The breaker shall have the provision of LED indication of Trip on Fault High set (DT) for overcurrent and earth fault-min current setting-0.5 In, minimum Time Delay- 20 milliseconds. The relays shall be suitable numerical relay with necessary elements as per the Purchaser's approval.

On this basis, the relay as a minimum shall provide:

- a) Phase Over Current Protection: (50/51)
- b) Earth Fault Protection: (50N/51N)

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:

- a) It shall be housed in a flush mounting case and Dual power supply with AC/DC power supply and battery.
- b) It shall have 3- phase over-current elements and One earth fault element.

- c) IDMT trip current settings shall be 20-200% in steps of 1% for phase over- current and 10-80% in steps of 1% for earth fault.
- d) Instantaneous trip current settings shall be 100-2000% in steps of 100% for phase over-current and 100- 1200% in steps of 100% for earth fault.
- e) Selectable IDMT curves shall be provided to include, for example, Normal Inverse, Very Inverse, Extreme Inverse, Long Time Inverse, and Definite Time. Separate curve settings for phase over-current and earth fault shall be supported.
- f) For IDMT delay multiplication, the Time Multiplier Setting (TMS) shall be adjustable from 0.01 to 0.1 in 0.01 steps.

The relay shall also be provided with:

- Alphanumeric Liquid Crystal Display (LCD)
- Parameter change capability that is password protected
- Capability to record up to 10 of the latest fault records duly time stamped and 100 events records stored in non-volatile memory for subsequent reading via the above referenced RS485/RS 232 port
- Relay shall have Thermal overload protection
- Relay shall have 2 settings group. Change of settings group can be achieved both locally at the relay fascia and remotely over the data communications channel(s) or via a binary input.
- Relay shall have Switch on to Fault and operating time shall be <100mSec for fault current > 2xIset
- Relay shall have at least 2 Binary inputs, 2 Binary outputs, 4 Programmable LED's and 5 Fixed LED
- Relay shall have RS485 supporting site selectable IEC60870-5-103 and Mod-bus RTU.
- Relay shall optional provision to have IP54 from front with extra transparent cover
- 10% for 3-phase fault and 20% for 1-Phase fault
- Relay shall be Type tested as protection product standard IEC60255-1, Safety IEC60255-27, EMI/EMC IEC60255-26 , Climatic: IEC60068

1.5.15 Bushings and cable terminations:

Each cable compartment shall, be provided with three bushings of adequate sizes to terminate the incoming and outgoing cables along with a terminal block (TB) located at convenient accessible location so as to wire all inputs & outputs (IOs) up to the terminal block (TB). The bushings shall be conveniently located for proper bend so as to allow easy working and termination of cables. The cable termination shall be done with Heat shrinkable /Push ON termination method so that adequate clearances are maintained between phases & cable shall be held by HDPE (fire retardant) cleat. The clearance between phase to phase and phase to earth shall be as per IEC 61243- 5 amended upto dates. 1 run of up to 3CX300 Sq. mm shall be used for cable termination. All the cable secondary wiring should be routed through marshaling box separately for relay, CT etc. Bimetallic washer for tightening of cable to be provided. RMU bushing shall be female or bus-bar type for cable termination and provision for onsite replacement of bushing should be available. Cable entry should be from front bottom only; Side cable entry shall not be allowed.

1.5.16 Earthing

The RMU outdoor metal enclosed, switchgear, Distribution Transformer, R.S. Joists, M.S Channels/M.S. angles etc., shall be equipped with an earth bus securely fixed along the base of the RMU. The earth bus bar shall be of GI strip (50sqmmX6) or copper strip (inside the RMU) having equivalent current rating and short circuit rating as per IEC/IS. Provision shall be made on end of RMU for connecting the earth bus to the earth grid by erecting suitable 2 earth pipes of 50mm dia. M.S. rod of 3 meter in Pits. Both the earth pipes are also to be connected in a grid formation.

1.5.17 Voltage indicator lamps and phase comparators

Each function shall be equipped with a fixed type voltage indicator box on the front to indicate whether or not there is voltage in the cables. The capacitive dividers will supply low voltage power to the lamps. Three inlets can be used to check the synchronization of phases. These devices shall be in compliance with IEC 61958 standard. Voltage indicator lamp shall be operating individually per phase. VDI shall be visible from outside without opening the doors.

1.5.18 Front cover

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The front cover shall provide a clear mimic diagram that indicates the different functions. The position indicators shall give a true reflection of the position of the main contacts. They shall be clearly visible to the operator. The lever operating direction shall be clearly indicated in the mimic diagram. The bidder shall provide a marking plate showing RMU's main electrical characteristics.

1.5.19 Fault Passage Indicator .

Fault Passage Indicators shall be installed on the Ring Main Unit. This shall facilitate quick detection of faulty cable. The FPI shall be in integral part of one isolator and shall be capable of displaying fault. The fault indication may be on the basis of monitoring fault current through the device. These devices shall be electronic devices with their own energy source and connected to Single 3 phase Split Core CTs (CBCT). These shall be provided with bright LEDs / flag Indicators, which shall be clearly visible in the day time. Phase and Earth sensors shall be connected to FPI by fiber optic cable. These shall have the following resetting facilities:

- Manual reset
- Resetting after a set time duration
- Electrically reset from remote with at least 2-spare potential free contacts.
- Resetting on restoration of LV

The unit shall have Short Circuit and Earth fault adjustable to different settings with separate Current transformer. They shall be fully field-programmable and shall have o/c setting 200-1200 A and E/F setting 10-100 A. To restrain operation of fault passage indicators due to inrush / switching current, settings of time delay of 1s-5s shall be available or device shall have facility to distinguish between momentary & permanent fault. It shall be possible to Test these indicators at site thru "Test" push button.

The conventional practice is to have (N-1) FPI where N is nos. of LBS in a particular configuration of RMU. FPI shall be visible from outside without opening the doors. Accuracy of phase and earth measurement shall be $\leq 10\%$. Response time starting from 40ms (40 to 500ms). FPI shall have at least 2000 hours of flashing hours. FPI shall support on site test functions such as device test, battery test and cable test. FPI shall have 1. Transient or

momentary fault reset mechanism. 2. Permanent fault confirmation by passively sensing of Auto re-closure activity. FPI shall be Type tested as per provided specifications.

1.5.20 Paint

All paint shall be applied on dean dry surfaces under suitable atmospheric conditions by seven tank process and powder coating. The overall paint thickness shall not be less than 100 microns ± 25 micron as standard. The paint shall not scale off or crinkle or be removed by abrasion during normal handling. The enclosure of the RMU shall be painted with shade Dark Gray i.e. RAL 7032. Sufficient quantity of touch-up paint shall be furnished for application at site. Paint shall be capable to withstand in saline conditions.

1.5.21 Name Plate & Marking

All the components and operating devices of the RMU shall be provided with durable and legible nameplates containing all technical parameters. Name plates shall be suitably embossed with the following information. A Danger plate of appropriate size shall also be provided on the enclosure.

- Manufacturer's Name
- Month and year of supply
- PO Number
- Rated Voltage
- System Frequency
- RMU Configuration
- Rated Short Time Withstand current for 3 sec
- Rated Impulse withstand Voltage
- Degree of Protection
- Type Designation or Serial no.
- Year of manufacture
- Applicable Rated values
- Mass of unit
- SF6 gas filling pressure

1.6 TESTING & INSPECTION**1.6.1 General:**

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 in the specification. The type test produced by supplier shall be only from reputed NABL accredited / international / national government approved testing laboratories such as CPRI, ERDA from India and PEHLA, KEMA, Volta, KERI, CESI, ERDA etc. from remaining part of the globe. Report from any other testing lab mentioned above shall not be accepted. In such a case manufacture has to perform the repeat type test for the RMU form these labs at his own cost. The type test report shall have been conducted during the period not exceeding seven (07) years from the date of opening of the bid. In the event of any discrepancy in the test reports i.e. any test report not acceptable or any/ all type tests (including additional type tests, if any) not carried out, same shall be carried out without any cost implication.

Prior to acceptance testing, the supplier shall prepare and submit a detailed Manufacturing Quality Plan (MQP) and routine/ inspection test plan for review and approval.

The manufacture may have in house testing lab for carrying out internal inspection and testing inside the factory witness by the utility. All the equipment used must be up to date and calibrated by reputed agency.

In-house helium leak test facility shall be used by manufacturer to test the welded stainless steel gas vessel for gas leakage.

1.6.2 Type tests:

Following shall constitute the type tests: -

- o) Short time current withstand test and peak current withstand test.
- p) Lightning Impulse voltage with-stand test
- q) Temperature rise test.
- r) Short Circuit current making and breaking tests.
- s) Power frequency voltage withstand test (dry).
- t) Capacitive current switching test confirming to IEC.
- u) Mechanical operation test.
- v) Measurement of the resistance of the main circuit.

- w) Checking of degree of protection of main tank and outer enclosure
- x) Switch, circuit breaker, earthing switch making capacity.
- y) Switch, circuit breaker breaking capacity.
- z) Internal arc withstands.
- aa) Checking of partial discharge on complete unit.

In addition, for switches, test reports on rated breaking and making capacity shall be supplied.

For earthing switches, test reports on making capacity, short-time withstand current and peak short-circuit current shall be supplied.

It shall be possible to test the cable without disconnecting them from the cable bushing. The access to the cable must be available only after earthing the respective feeder to ensure complete safety of the operators. To fulfill this feature the cable compartment covers shall be logically interlocked with the feeder earth switch. The cable boots to be supplied along with the RMU should be used during the type test as well. The necessary report for the same should be provided. Cable boots not tested along with the RMU and supplied shall not be accepted.

1.6.3 Routine tests:

The following routine tests shall be conducted by the manufacturer and the same shall be backed by the factory's quality control department test reports.

- j) Conformity with drawings and diagrams,
- k) Measurement of closing and opening speeds,
- l) Measurement of operating torque,
- m) Checking of filling pressure,
- n) Checking of gas-tightness,
- o) Dielectric testing and main circuit resistance measurement.
- p) Power frequency voltage
- q) Resistance test for the circuit
- r) Mechanical operation tests.

BIDDERS SHALL CONFIRM THE FOLLOWING ROUTINE TESTS ON EACH RMU SUPPLIED.

- g) Micro ohm test (contact Resistance test) for the assembly inside the tank

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- h) Circuit breaker analyzer test so as to ensure the simultaneous closing of all Poles for VCB.
- i) SF6 gas leak test
- j) Partial Discharge test on the complete gas tank so as to be assure of the proper insulation level and high service life.
- k) High voltage withstand.
- l) Secondary test to ensure the proper functioning of the live line indicators, fault passage indicators and relays.

1.6.4 Acceptance tests:

All the tests specified under Routine Test Clause above shall be carried out as acceptance test on random samples as per sampling plan under IEC/15 for each lot.

Heat Run Test shall be carried out on one random sample/configuration/tender quantity as acceptance test.

1.6.5 DOCUMENTATION and DRAWINGS

All drawings shall conform to relevant International Standards Organization (ISO) Specification. All drawings shall be in ink and suitable for microfilming.

The tenderer shall submit along with his tender dimensional general arrangement drawings of the equipment's, illustrative and descriptive literature in triplicate for various items in the RMUs which are all essentially required for future automation.

- I. Schematic diagram of the RMU panel
- II. Instruction manuals
- III. Catalogues of spares recommended with drawing to indicate each items of spares
- IV. List of spares and special tools recommended by the supplier.
- V. Copies of Type Test Certificates as per latest IS/IEC.
- VI. Drawings of equipment's, relays, control wiring circuit, etc.
- VII. Foundation drawings of RMU so that Utility will have planned and carry out civil works etc.
- VIII. Dimensional drawings of each material used for item VII.
- IX. Actual single line diagram of RMU/RMUs with or without Extra combinations shall be made displayed on the front portion of the RMU so as to carry out the operations easily.

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The following should be supplied to each consignee circle/town along with the initial supply of the equipment's ordered.

Copies of printed and bound volumes of operation, maintenance and erection manuals in English along with the copies of approved drawings and type test reports etc.

Sets of the manuals as above shall be supplied to the Chief Engineer/Distribution. A soft copy of the all Technical and Drawing furnished in a CD.

1.7 GTP

| Sr. No. | Description | GUVNL Requirement |
|------------|---|--|
| 1.0 | SWITCHGEAR ASSEMBLY | |
| 1.1 | Make | |
| 1.2 | Type | Outdoor, 2/3/4/5/6 WAY |
| 1.3 | Reference Standard | IEC 56, IEC 129, IEC 298, IEC 694, IEC 265 |
| 1.4 | Voltage (Normal/Max.) kV | 11kV/12 kV |
| 1.5 | Phase (Nos.) | 3 nos |
| 1.6 | Frequency (HZ) | 50 \pm 3 Hz |
| 1.7 | Short Circuit Rating for 3 Sec. (KA) | 21 kA |
| 1.8 | Insulation Level | |
| | a) Impulse withstand (KV peak) | 75 kVp |
| | b) 1 Minute 50 Hz. Voltage withstand (KV rms) | 28 kV |
| 1.9 | Metal Clad Construction | Yes |
| 1.10 | c) Degree of protection for outer enclosure: | IP 54 |
| | d) Degree of protection for main tank | IP 67 |
| 1.11 | Switchgear completely wire and tested at factory (yes/No) | Yes |
| 2.0 | CONSTRUCTION | |
| 2.1 | Overall Dimensions | |
| a | Extensible 2/3/4/5/6 Way RMU | |
| | i) Width (W) (mm) | To be filled by Bidders |
| | ii) Depth (D) (mm) | |
| | iii) Height (mm) | |
| 2.2 | Overall Weight of Extensible 2/3/4/5/6 Way RMU | To be filled by Bidders |
| 3.0 | Bus bar | |
| 3.1 | Make | |
| 3.2 | Material & Grade | Copper |
| 3.3 | Reference Standard | IEC 129 |

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| | | |
|------------|---|---|
| 3.4 | a) Cross sectional area (mm ²) | To be filled by Bidders |
| 3.5 | Continuous Current | |
| | a) Standard | 630 A |
| | b) At site conditions and within cubicle | 630A |
| 3.6 | Maximum temperature rise over ambient (c) | As per IEC Standard (above ambient of 40 Deg. C) |
| 3.7 | Minimum clearance from bare bus bar connection | To be filled by Bidder |
| | a) Phase to phase (mm) | |
| | b) Phase to Earth (mm) | |
| 3.8 | Bus Bar support spacing (mm) | |
| 3.9 | Bus support insulators | |
| | a) Make | |
| | b) Type | |
| | c) Reference Standard | |
| | d) Voltage Class (KV) | |
| | e) Minimum creep age distance (mm) | |
| | f) Cantilever strength Kg/mm ² | |
| | g) Net Weight (Kg) | |
| 3.10 | SF6 gas pressure (filing pressure at 20 deg. C) | 1.5 Bar |
| 4.0 | SF6/VCB CIRCUIT BREAKER | |
| 4.1 | Make | |
| 4.2 | Type (Vacuum/ SF6) | Vacuum |
| 4.3 | Reference Standard | IEC 62271 – 1/ IEC 60694 |
| 4.4 | Rated Voltage | 11 kV |
| 4.5 | Rated Frequency | 50 Hz |
| 4.6 | No. of Poles | 3 |
| 4.7 | Rated Current | |
| | a) Normal (Standard) Amps | 630 A |
| | b) Rated (Site) Amps | 630 A |
| 4.8 | Maximum temperatures rise over ambient.(deg. C) | As per IEC Standard (above ambient of 40 Deg. C) |
| 4.9 | Rated operating Duty | O- 3min- CO-3min-CO |
| 4.11 | Breaking Capacity at rated voltage & operating duty | 20 |
| 4.12 | Rated making current (KA peak) | 52.5 |
| | b) Short time current for 3 Sec. (KA rms) | 20 |
| 4.14 | Transient Recovery Voltage | |
| | a) Rate of rise (KV/ms) | 0.34 KV/micro sec (as per IEC) |
| | b) Peak Voltage (KV) | 23 (35 % DC component) |
| 4.15 | Insulation Level | |
| | a) Impulse Voltage with stand on 1/50 | 75 |

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| | | |
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| | full wave | |
| | b) 1 minute 50Hz voltage withstand | 28 |
| 4.17 | Opening time Maximum, No load condition (ms) | 40-60 |
| 4.18 | Opening and closing time under SF6 gas loss or vacuum loss condition (ms) | 40-60 |
| 4.19 | At 100% Breaking capacity | |
| | a) Opening time – max (ms) | 40-60 |
| | b) Arcing time – max (ms) | 6-9 |
| | c) Total break time (ms) | 40-60 |
| 4.20 | At 60% Breaking capacity | |
| | a) Opening time – max (ms) | 40-60 |
| | b) Arcing time – max (ms) | 6-9 |
| | c) Total break time (ms) | 40-60 |
| 4.21 | At 30% Breaking capacity | |
| | a) Opening time – max (ms) | 40-60 |
| | b) Arcing time – max (ms) | 6-9 |
| | c) Total break time (ms) | 40-60 |
| 4.22 | At 10% Breaking capacity | |
| | a) Opening time – max (ms) | 40-60 |
| | b) Arcing time – max (ms) | 6-9 |
| | c) Total break time (ms) | 40-60 |
| 4.23 | Number of breaks per pole | Single |
| 4.24 | No of breaker operations permissible without requiring inspection replacement of contacts and other main parts. | |
| | a) At 100% rated current | 2000 & 40 Nos at 20 kA |
| 4.25 | Type of contacts | |
| | a) Main | Copper chromium, Butt type |
| | b) Arcing | Copper chromium |
| 4.26 | Material of contacts | |
| | a) Main | Copper chromium |
| | b) Arching | |
| | c) Whether contacts silver plated | NA |
| | d) Thickness of silver plating | NA |
| 4.27 | Operating mechanism- closing | |
| | a) Type | STORED ENERGY |
| | b) No of breaker operations stored | One Tripp free |
| | C) Trip free or fixed trip | |
| | d) Anti pumping features provided | NA (Anti reflex on Earthing) |
| | e) Earthing for operating mechanism and metal parts furnished | |
| | f) Earth terminal size and material | |
| 4.28 | Operating mechanism- tripping | |

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| | | |
|------------|---|------------------------|
| | a) Type | To be filled by bidder |
| | 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 | |
| 4.29 | Spring charging mechanism | |
| | 2) Make | To be filled by bidder |
| | 3) Type | |
| | 4) Size | |
| | 5) Rating | |
| 4.30 | Breaker suitable for capacity switching 4 operating duty 5Max.rating of capacitor bank that can be safely controlled | Yes |
| 4.31 | Tripping coil | |
| | a) Voltage | |
| | b) Permissible voltage variation (%) | |
| | c) Tripping current at rated voltage (A) | |
| | d) Power at rated voltage (W) | |
| | e) 2-Over current trip with TLF (5A) and 1-earth fault furnished as specified | |
| 4.32 | Breaker /Accessories such as control switch indication Lamps etc. furnished as specified :(please attach separate sheet giving details of all accessories, inter locks and safety shutters) | |
| | a) Mechanical safety Interlock | Yes |
| | b) Automatic Safety Interlock | No |
| | C) Operational Interlock | Yes |
| | d) Emergency manual trip | Yes |
| | e) Operation counter | Yes |
| | f) Charge /discharge indicator | Yes |
| | g) Manual spring charging facility | Yes |
| 4.33 | Impact load foundation design (to include dead load plus impact value On opening at maximum interrupting rating) (KG) | |
| 5.0 | Isolators/Load Break Switch | |
| 5.1 | Make | |
| 5.2 | Type | |
| 5.3 | Reference standard | IEC129 |
| 5.4 | Rated voltage (KV) | 12 |

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| | | |
|------------|--|---|
| 5.5 | Rated Frequency HZ | 50 |
| 5.6 | No. Of poles (No) | 3 |
| 5.7 | Rated current | |
| |) Normal (Standard) Amps | 630 |
| | j) Derated (site) Amp | 630 |
| 5.8 | Maximum temperature rise over ambient Deg. C | As per IEC Standard (above ambient of 40 Deg. C) |
| 5.9 | Rated operation duty | 0 – 3min-CO-3min-CO |
| 5.10 | Rupturing Capacity at rated voltage MVA | |
| 5.11 | Rated making current KA peak | |
| 5.12 | Short time current | |
| | b) For 3 sec KA rms | 20 |
| 5.13 | Impulse voltage withstands on 1/50 full wave | 75 |
| 5.14 | Maximum over voltage factor when switching off a) Loaded feeder cable | |
| 5.15 | Operating SF6 Gas pressure | |
| 5.16 | No of isolator operation permissible without equiring inspection, replacement of contacts and other | Yes |
| | 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 | Yes |
| 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 | |
| 6.1 | Make | |
| 6.2 | Type & voltage level | Tap wound/11kV |
| 6.3 | Reference standard | IEC 298 |
| 6.4 | C.T. ratio as specified | To be filled by bidder |
| 6.5 | Rated frequency | 50 |
| 6.7 | Class of insulation | Class A |
| 6.8 | Temperature rises over ambient. Deg. C | |
| 6.9 | Basic insulation level | |
| 6.10 | For tripping CT RATIO Class of accuracy | |

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| | | |
|-------------|---|--|
| | Rated Burden VA | To be filled by bidder |
| | Knee Point Voltage V | |
| | Excitation Current at $V_k/2$ Amps | |
| | Rated Saturating Current Amps | |
| | Over Current Rating | |
| | Continuous % Over Load % | |
| 7.0 | Cable terminations | |
| 7.1 | Circuit Breaker | |
| | Type | To be filled by bidder |
| | Materials | |
| | Dimensions | |
| | Size | |
| | Height of Cable box from ground Level | |
| | Arrangement for supplying bus end cable box furnished for extensible ring main Unit | To be filled by bidder |
| | Arrangement for mounting an extra cable box on each equipment furnished | |
| 7.2 | Isolator | |
| | Type | To be filled by bidder |
| | Materials | |
| | Dimensions | |
| | Size | |
| | Height of Cable box from ground Level | |
| | Arrangement for supplying bus end cable box furnished for extensible ring main Unit | To be filled by bidder |
| | Arrangement for mounting an extra cable box on each equipment furnished | To be filled by bidder |
| 8.0 | Name Plate | |
| 8.1 | Material | To be filled by bidder |
| 8.2 | Thickness | |
| 8.3 | Size for Breaker Cubicle Instruments / Devices | |
| 9.0 | Painting | Refer detail technical specification, To be filled by bidder |
| 9.1 | Finish of Breaker | |
| | Inside | |
| | Outside | |
| 9.2 | Finish of Isolator | |
| | Inside | |
| | Outside | |
| 10.0 | Drawing / Data | |
| 10.1 | General arrangement for Panel Board | |

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| | | |
|------|---|------------------------|
| 10.2 | Foundation plan | To be filled by bidder |
| 10.3 | SF6/VCB tripping and material Schematic | |
| 10.4 | Bill of Material | |
| 10.5 | SF6/VCB LT panel wiring diagram | |
| | | |

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TECHNICAL SPECIFICATION FOR 11kV XLPE THREE CORE POWER CABLE**1 Scope**

- 1.1. The specification covers design, manufacture, shop testing, packing and delivery of 11kV voltage grade, three core power cable, Aluminum Conductor, Dry gas cured, Flame Retardant, Low Smoke (FRLS) type, XLPE insulated, PVC sheathed, Armoured, screened Power Cables of different sizes generally conforming to latest Standards of IS / IEC / BS or equivalent. These cables shall primarily be designed for effectively earthed neutral system.
- 1.2. The equipment offered shall be complete with all parts necessary for their effective and trouble-free operation. Such parts will be deemed to be within the scope of the supply irrespective of whether they are specifically indicated in the commercial order or not.
- 1.3. It is not the intent to specify herein complete details of design and construction. The equipment offered shall conform to the relevant standards and be of high quality, sturdy, robust and of good design and workmanship complete in all respects and capable to perform continuous and satisfactory operations in the actual service conditions at site and shall have sufficiently long life in service as per statutory requirements.
- 1.4. In these specifications, the design and constructional aspects, including materials and dimensions, will be subject to good engineering practice in conformity with the required quality of the product, and to such tolerances, allowances and requirements for clearances etc. as are necessary by virtue of various stipulations in that respect in the relevant IEC, IS standards and other statutory provisions.
- 1.5. Tolerances:
Tolerances on all the dimensions shall be in accordance with provisions made in the relevant standards. Otherwise the same will be governed by good engineering practice in conformity with required quality of the product.

2 Service Conditions

Equipment to be supplied against this specification shall be suitable for satisfactory continuous operation under the following tropical conditions.

- a) Maximum ambient temperature of air: 50°C
- b) Maximum temperature of air in shade: 4°C
- c) Maximum daily average ambient temperature: 40°C
- d) Maximum yearly average ambient temperature: 30°C
- e) Relative Humidity: up to 95%
- f) Average number of thunder storm days per annum: 15
- g) Maximum annual Rainfall: 150cm
- h) Maximum Altitude above mean sea level: 1000Meter
- i) Maximum Wind Pressure: 150 Kg/cm² (As per IS 802 latest code)
- j) Maximum soil temperature at cable depth: 30°C
- k) Maximum soil thermal resistivity: 150°C cm/watt

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3 Technical Parameters

System details:

| S.No | Description | 11kV |
|------|--------------------------------------|---|
| i | Voltage grade (kV) of Cable | 6.35 / 11 kV |
| ii | Core (Nos.) | 3 |
| iii | System Voltage | 11kV |
| iv | Highest Voltage | 12kV |
| v | Earthing system | Effectively earthed |
| vi | Frequency | 50Hz |
| vii | Variation in supply voltage | " +6% to -9% |
| viii | Variation in supply frequency | ± 3% |
| ix | Max. Conductor temp | 90°C at max. Continuous current |
| x | Max. Permissible short circuit temp. | 250°C for 1 sec |
| xi | Short circuit current | Shall be ≥28.3KA for 1 sec for 11kV 300sq.mm. |
| | | Shall be ≥22.6KA for 1 sec for 11kV 240sq.mm. |
| | | Shall be ≥17.5KA for 1 sec for 11kV 185sq.mm. |
| | | Shall be ≥9.0KA for 1 sec for 11kV 95sq.mm. |
| | | Shall be ≥6.6KA for 1 sec for 11kV 70sq.mm. |
| xii | Impulse Test Voltage | 75kV and as per relevant IS or equivalent Standards |
| xiii | Max. D.C. resistance Ω /KM | As per relevant IS or equivalent Standards |
| xiv | End sealing | The cable ends of cable in the wooden drum for delivery shall be sealed with heat shrinkable caps |

Continuous A.C. Current Capacity:

Continuous a.c. current capacity shall be as per Table given below.

| Conductor sizes in sq.mm. | Continuous A.C. current capacity in Amps. at maximum conductor temp. of 90°C. | |
|---------------------------|---|------------------|
| | 11kV(E) HT XLPE three core cable | |
| | When laid direct in the ground | When laid in air |
| 300 sq. mm | 354 | 441 |
| 240 sq. mm | 315 | 387 |
| 185 sq. mm | 273 | 330 |

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| | | |
|-----------|-----|-----|
| 95 sq. mm | 190 | 222 |
| 70 sq. mm | 161 | 184 |

4 Applicable Standards

| Title | IS Standard | IEC / BS |
|--|---------------------------|-------------|
| XLPE PVC sheathed cable for working voltages from 3.3 kV up to and including 33kV. | IS 7098 (Part-II) | IEC 60502 |
| Conductors for insulated electric cables and flexible cords. | IS: 8130 – 1984 | IEC 60228 - |
| PVC insulation and sheath of electric cables. | IS: 5831 – 1984 | IEC 60502 |
| Mild steel wires, Formed wires and Tapes for armouring of cables. | IS: 3975 – 1988 | |
| Fictitious calculation method for determination of dimensions of protective coverings of cables. | IS :10462 (Part I) –1983 | |
| Code of practice for installation & maintenance of power cables up to & including 33kV rating. | IS : 1255-1983 | |
| Method of test for cables | IS : 10810 | |
| Electro Technical Vocabulary for Electric Cables | IS:1885, Part-32 | |

5 General Technical Requirements

5.1 General:

Three core power cables shall normally be high conductivity, stranded compacted H2/H4 grade aluminium circular shaped conductor as per IS: 8130 - 1984, provided with conductor screening (of extruded semi-conducting cross link material) and shall be insulated with XLPE of natural color. At rated continuous current and under standard conditions of installations the conductor temperature rise shall not exceed 45°C with an ambient temperature of maximum 45°C. Outer sheath shall be designed to afford high degree of mechanical protection and shall also be heat, oil, chemical and weather resistant, Common acid, alkalis, FRLS Properties and sealing solution shall not have adverse effect on material of PVC sheath. Cable shall be suitable for lying in covered trenches and / or buried under-ground in outdoor.

5.2 Cable Design & Construction:

Conductor:

Electrolytic grade aluminum conductor shall be of H2/H4 grade as per clause 3.1 of IS 8130/1984 and shall have flexibility class-2 in accordance with clause 5.3 of IS 8130-1984. The shape of conductor shall be geometric, compacted, stranded, and circular.

Conductor screen/Shield:

The conductor screen shall be as per IS 8130, an extruded layer of black, semi-conducting compound. The allowable operating temperatures of the conductor shield shall be equal to or

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greater than those of the insulation. The conductor screen shall be extruded in the same operation as the insulation. The semi-conducting screens should be effectively cross linked to achieve 90°C cable rating. The interface between the extruded conductor screen and insulation shall be free of any voids. The volume resistivity of the screen material shall not exceed 1000 Ω m at 90°C.

The conductor having semi-conducting screen shall ensure perfectly smooth profile & avoid concentration of stress. The conductor screen shall be extruded in the same operation as the insulation. The semi-conducting polymer shall be cross linked.

Insulation:

The insulating material shall be XLPE cured by dry curing process and applied by true triple extrusion process as per IS-7098 and its latest amendments. The insulation shall be an extrusion of dry/sioplas (chemical curing only) cured thermosetting cross linked poly ethylene material rated for 90°C continuous operation.

The insulating material shall have excellent electrical properties with regard to resistivity, dielectric constant and loss factor and shall have high tensile strength and resistance to abrasion. This shall not deteriorate at elevated temperatures or when immersed in water.

The insulation properties shall be stable under thermal conditions arising out of continuous operation at conductor temperature of 90°C rising momentarily to 250°C under short circuit conditions. It shall be free from any foreign material or Porosity visible to the unaided eye. The insulation shall be so applied that it fits closely on the conductor and it shall be possible to remove it without damaging the conductor.

The extruded XLPE insulation shall be of very high degree of purity. The manufacturer should provide the certification that the XLPE compound used has proven track record. The insulation compound shall be clean with low levels of contamination. The quality of insulation should be good and insulation should not be deteriorated when exposed to the climatic conditions.

The thickness of insulation, tolerance on thickness of insulation shall be high standard quality generally confirming to IS: 7098 (Part II) and with any latest amendments.

Insulation Screen/ Shield:

Extruded Semi-conducting screening and metallic screening of copper tape shall be generally as per IS: 7098 (Part-II) with latest amendments. The semi conducting compound shall be suitable for the operating temperature of the cable and compatible with the insulating material.

The insulation screen shall be an extruded layer of black semi-conducting compound and continuously covers the whole area of the insulation. The semiconducting screens should be effectively cross linked to achieve 90°C cable rating. The contact surface between insulation and insulation screen shall be smooth and free from protrusion and irregularities.

The interface between the insulation and insulation screen shall be free of any voids. Insulation screen shall be strippable type.

The metallic screen shall consist of a layer of copper tape applied in helical form. Copper Screen withstand capacity shall be capable 1kA per second and its minimum area shall be 2.6sqmm.

Filler and Inner-Sheath:

The sheath shall be suitable to withstand the site conditions and the desired temperature. It shall be of adequate thickness, consistent quality and free from all defects. The Solid PVC / Solid Polypropylene sheath shall be extruded. The material of fillers and inner-sheath shall be compatible with the temperature ratings of the cable and shall have no deteriorious effect on any other component of the cable. Central PVC filler shall also, be provided. Fillers and inner sheath should be confirming to IS: 7098 (Part-II) 1985. PVC filler shall be solid type Vulcanized or Unvulacanized rubber or thermoplastic material used for inner sheath shall not harder than compound used for insulation and outer sheath. Thickness of inner sheath shall be follow latest IS edition 7098-II.

Binder Tape:

Binder tape shall be continuing without break and minimum size of binder tape shall be 50micron. When more layers of binder tapes are applied over the laid up core, the thickness of the tapes shall be constructed as a part of inner sheath. Water soluble tape also be provided between inner sheath and armour for coastal areas.

Armoring:

Armouring shall be following:

- (i) Galvanized steel strip
- (ii) Galvanized Bar

The dimensions of steel strips shall be as per latest edition of IS: 3975 – 1979.

Armouring shall be applied over the insulation or protective barrier or non-metallic part of insulation screening. Armour wire/formed wire shall be applied as closely as predictable. A binder tape may be applied over the armour. As per IS minimum 90% area of inner sheath covers through armour. Joint in the armour / formed wires shall be made by brazing or welding and the surface irregularities shall be removed. A joint in any wires/formed wire shall be at least 300mm from the nearest formed wires in armour by required nos. of tinned copper wire / formed wire is permissible.

Outer sheath:

The outer sheath shall consist of extruded tough outer sheath of PVC compound insulation over the armouring. Inner conductor shielding, XLPE insulation and outer shielding shall be extruded in one operation by special process to ensure that the insulation is free from contaminations and voids and perfect bonding of inner & outer shielding with insulation is achieved. The PVC compound for the outer sheath shall conform to type ST-2 of IS: 5831 - 1984 (amended up to date), Outer sheath shall be Flame Retardant, Low smoke (FRLS) type. The color of the outer sheath shall be different according to the different size as Dark Blue for 300sqmm, Dark Green

for 240sqmm, Black for 185sqmm and Dark red for 95sqmm & 70sqmm Cable. The cable must meet all the requirements of the IS: 7098 (Part 2) - 1985 amended up to date.

Discharge Free Construction:

The inner conductor shield, XLPE insulation, and outer insulation shield shall be extruded with a true triple extruder head using a dry cure process and sioplas (chemical curing) process for saline areas. The conductor screen, Insulation and Insulation screen shall all be extruded in single point at one-time process to ensure homogeneity and reduction of voids, in the insulation and the screening system of the cable.

Length:

The cable shall be supplied in standard drum length of 500 mtrs. +/- 5% tolerance for all the sizes of cable.

Over all tolerance in total quantity of ordered cables shall be +/- 2%.

Identification Mark:

- i. The cable drum shall be printed with information as per cl. 21; 2 of IS and ISI Certification mark. Bidder shall submit Xerox copy of valid ISI Licenses with technical bid.
- ii. For identification of cores, colored strip of Red, Yellow and Blue colors shall be used for identification of phases. Following details of identification shall be embossed at intervals of length of one meter of cable outer sheath.
 - (a) Name of manufacturer
 - (b) Year of manufacture
 - (c) ISI Mark
 - (d) Logo
 - (e) Applicable Standards
 - (f) License No.
 - (g) Voltage grade
 - (h) Name of purchaser "DISCOM".
 - (i) AT NO.
 - (j) Batch NO.

Storage & Handling of Cables

- The cable storage and Handling shall be carried out in accordance with IS 1255.
- All cables shall be inspected upon receipt at site and checked for any damage during transit. Cable drums shall be stored on a well-drained, hard surface, preferably of concrete, so that the drums do not sink in the ground causing rot and damage to the cable drums.
- It should be ensured that both ends of the cable are properly sealed to prevent ingress/absorption of moisture by the insulation.
- Protection from rain and sun shall be ensured. Sufficient ventilation between cable drums should be ensured during storage.
- The drums shall always be rested on the flanges and not on the flat sides.
- Damaged battens of drums etc. should be replaced, if necessary.
- When cable drums have to be moved over short distances, they should be rolled in the direction of the arrow, marked on the drum.

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- For transportation over long distances, the drum should be mounted on cable drum wheels strong enough to carry the weight of the drum and pulled by means of ropes. Alternatively, they may be mounted on a trailer or on a suitable mechanical transport.
- When unloading cable drums from vehicles, a crane shall preferably be used. Otherwise the drum shall be rolled down carefully on a suitable ramp or rails, where necessary.
- While transferring cable from one drum to another, the barrel of the new drum shall have a diameter not less than that of the original drum.
- Cable with kinks and straightened kinks or with similar apparent defects like defective armouring etc. Shall be rejected.

5.3 Installation of Cable:

- **General:**

The cable laying including necessary termination shall be carried out in accordance with IS 1255. Cables shall be so laid that the maximum bending radius is 20 times the overall diameter for cables above 11kV Voltage level.

Trenching:

The detail technical specification of Trench shall be a part of civil works.

- (i) Width of Trench: - As per Drawing
- (ii) Depth of Trench: - As per Drawing

- **Laying of Cable**

- i. At the time of issue of cable for laying, the core shall be tested for continuity and insulation resistance.
- ii. Conduct Cable partial discharge test
- iii. The inter-axial spacing between the cables shall be maintained as per IS to maximize the cable capacity.
- iv. The cable drum shall be properly mounted on jacks or on a cable wheel, at a suitable location, making sure that the spindle, jack etc. shall be strong enough to carry the weight of the drum without failure and that the spindle is horizontal in the bearings so as to prevent the drum creeping to one side while rotating.
- v. The cable shall be pulled over rollers in the trench steadily and uniformly without jerks and strains. The entire cable length shall as far as possible be pulled off in one stretch. However, where this is not possible the remainder of the cable may be removed by 'Flaking' i.e. by making one long loop in the reverse direction.
- vi. After the cable has been uncoiled and laid into the trench over the rollers, the cable shall be lifted slightly over the rollers beginning from one end by helpers standing about 10 m apart and drawn straight. The cable should then be taken off the rollers by additional helpers lifting the cable and then laid in a reasonably straight line.
- vii. When the cable has been properly straightened, the cores shall be tested for continuity and insulation resistance. In case of PVC XLPE cables, suitable moisture seal tape shall be used for this purpose.

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- viii. At the time of original installation, approximately 3 m of surplus cable shall be left on each end of the cable and on each side of underground joints (Straight through/Tee/Termination) and at entries and places as may be decided by the Engineer-in-Charge. The surplus cable shall be left in the form of a loop. Where there are long runs of cable length 3mtrs. Loose cable to be left at intervals of 100mtrs. Lengths in addition to lose at each bend of cable; if not specified otherwise.

• **Laying in HDPE pipes by HDD/closed ducts:**

- i. In location such as road crossing, crossing other utilities etc. cables shall be laid in HDPE pipes.
- ii. HDPE Pipes shall be used for such purposes. Pipes as required shall be laid along with the civil works and jointed according to the instructions of the Engineer-in-Charge as the case may be. The size of pipe shall be as indicated in the Road Crossing Drawing for Electrical Services.
- iii. The pipes on road crossing shall preferably be on the skew to reduce the angle of bends as the cable enters and leaves the crossings. This is particularly important for high voltage cables.
- iv. Manholes of adequate size as specified or decided by the Engineer-in-Charge shall be provided to facilitate feeding/drawing in of cables and to provide working space for persons. They shall be covered by suitable manhole covers with frame of proper design.
- v. Pipes shall be continuous and clear of debris or concrete before cable is drawn. Sharp edges at ends shall be smoothened to prevent injury to cable insulation or sheathing.
- vi. Cable grips/draw wires and winches etc. may be employed for drawing cables through pipes.

6 Tests & Testing Facilities

Type Tests:

All the cable sizes i.e. items offered should have been fully type tested as per the relevant standards at any Govt. recognized Laboratory. The bidder shall furnish three sets of type test reports along with the offer. The Type test reports shall not be older than SEVEN years and shall be valid up to the expiry of validity of offer.

For any change in design/type, already type tested and the design / type offered against this specification, the purchaser reserves the right to demand reputation of type tests without any extra cost.

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

The following type test reports shall be furnished with the offer:

(a) Tests on conductor:

- (i) Tensile test (stranded Conductor)
- (ii) Resistance test

(b) Tests for armoring strips / wires:

- (i) Dimensions
- (ii) Tensile strength and elongation at break

- (iii) Wrapping test
(iv) Resistivity test
(c) Tests for thickness of insulation and sheath.:
(d) Physical tests for insulation.:
(i) Tensile strength and elongation at break.
(ii) Ageing in air oven
(iii) Hot set
(iv) Shrinkage test
(v) Water absorption
(vi) Void and contaminants
(vii) Physical Dimension and thickness of insulation
(e) Physical tests on outer sheath:
(i) Tensile strength and elongation at break.
(ii) Ageing in air oven
(iii) Shrinkage test
(iv) Hot deformation
(v) Bleeding and blooming test
(vi) Thermal stability
(vii) Loss of Mass
(viii) Heat shock test
(ix) UV test
(f) Partial discharge test
(g) Bending test
(h) Dielectric power factor test
i) As a function of voltage
ii) As a function of temperature
(i) Insulation resistance test (volume resistivity)
(j) Heating cycle test
(k) Impulse withstand test
(l) High voltage test
(m) Flammability test
(n) Water tightness test
(o) Testing for bonding of conductor screen, insulation and insulation screen

Routine Tests:

All the Routine tests as per IS: 7098 (Part 2) - 1985 amended up to date shall be carried out on each and every delivery length of cable. The result should be given in test report. Partial discharge test must be carried out in a fully screened test cell. It is, therefore, absolutely essential that the manufacturer should have the appropriate type of facility to conduct this test which is routine test.

Acceptance Tests:

- i. All Acceptance tests as per IS:7098 (Part 2) - 1985 as modified up to date including the optional test as per clause no 18.4 and Flammability Test shall be carried out on sample taken from the delivery lot.
- ii. The following acceptance tests shall be carried out on the selected samples as per IS: 7098 (Part-II) - 1985.
- (a) Annealing test (for copper)
 - (b) Tensile test (for aluminum)
 - (c) Wrapping test (for aluminum)
 - (d) Conductor resistance test.
 - (e) Test for thickness of insulation and sheath
 - (f) Hot set test for insulation
 - (g) Tensile strength and elongation at break test for insulation and sheath.
 - (h) Partial discharge test (for screened cables only)
 - (i) High voltage test for 4 hours
 - (j) Insulation resistance (volume resistivity) test.
 - (k) Copper foil resistivity test
 - (l) Identification of cores, colored strip of Red, Yellow and Blue colors
 - (m) Test for Dimension of insulation
 - (n) Void and contaminants test
 - (o) Measurement of Capacitance
- iii. All the acceptance tests shall be carried out by the firm, in the presence of purchaser's representative at their works. The firm shall give at least 15 days' advance notice to the purchaser to enable him to depute the engineer for witnessing the tests. The test certificates for acceptance tests witnessed by inspecting officer/ engineer shall be submitted for approval before dispatch of material.

Test:

The bidder shall have to submit, well in advance, the test certificates for the following routine test for approval prior to inspection of the materials for the complete lot offered for inspection at a time.

- a) Partial Discharge Test
- b) Conductor Resistance Test.
- c) High Voltage Test.

Stage Inspection:

- i. The inspection may be carried out by the purchaser at any stage of manufacture. The successful bidder shall grant free access to the purchaser's representative at reasonable time, when the work is in progress. Inspection and acceptance, of any cables under this specification by the purchaser, shall not relieve the supplier of his obligation of supplying cable in accordance with the specification and shall not prevent subsequent rejection, if the cables are found defective.
- ii. The supplier shall keep the purchaser informed in advance about the program of manufacturing of cables so that arrangement can be made for inspection.

- iii. The purchaser reserves the right to insist for witnessing the acceptance / routing tests of the bought out items.

Packing and Forwarding:

- a) The cable shall be wound on wooden drums as per IS: 10418 – 1972 and packed in drums suitable for vertical / horizontal transport, as the case may be and shall be suitable to withstand rough handling during transport and outer storage. The outer surface of the drum shall be painted with white aluminum paint. Similarly, the inside surface of drum shall have the protective layer of varnish / paint to protect it from white ants.
- b) The wooden drums shall be reinforced with steel bends and strips for better protection.
- c) The ends of the cable shall be sealed by means of non-hygroscopic sealing materials.
- d) The following information may be stenciled on the drum with either water proof ink or oil paint:
- Reference of IS / IEC standard.
 - Manufacturer's name or trademark.
 - Type of cable and voltage grade.
 - No. of cores.
 - Nominal cross-sectional area of conductor.
 - Cable code.
 - Length of cable on the drum
 - No. of lengths on the drum (if more than one)
 - Direction of rotation of drum (by means of an arrow)
 - Position of outer end of cable
 - Gross weight
 - Country of manufacture
 - Year of manufacture
 - Reference of A/T No. & date
 - Property of PGVCL
 - Name of consignee and the destination.

The drum may also be marked with ISI Certification Mark.

Over and above, name plate of aluminum of suitable size and thickness, containing all the above information, shall be fixed on the drum in addition to the painting.

- e) The firm shall be responsible for any damage to the cables during transit due to improper and inadequate packing. Wherever necessary, proper arrangement for lifting, such as lifting hooks, shall be provided. Any cable found short inside the packing cases shall be supplied by the supplier, without any extra cost.
- f) Each consignment shall be accompanied by a detailed packing list, containing the following information:
- Name of consignee
 - Details of consignment
 - Destination
 - Total weight of consignment
 - Handling and unpacking instruction
 - Bill of materials, indicating contents of each package.

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Site Testing:

a) Testing before laying:

All cables, before laying, shall be tested with a 2500 / 5000V megger. The cable core shall be tested for continuity, absence of cross phasing, and insulation resistance from conductors to earth / armour and between conductors.

b) Testing after laying:

After laying and jointing, the cable shall be subjected to a 15 minutes pressure test. The test pressure shall be as per applicable IS. DC pressure testing may normally prefer to AC pressure testing or as per latest IS code.

Drawing & Literature:

Contractor shall provide an illustrated literature on the cable, giving technical information, on current ratings, cable constants, short circuit ratings, de-rating factors, for different types of installation, packing date, weights and other relevant information.

Completion plan and completion certificate

After completion of the work the Contractor shall draw completion plans to a suitable scale in duplicate and frame for installation in switching-stations shall submit to the Construction - Manager. The completion plans shall, inter-alia, give the following details:

- i. Layout of cable work
- ii. Length, size, type and grade of cables.
- iii. Method of laying i.e. direct in the Trench or in pipes etc.
- iv. Location of each joint with jointing method followed.

7 GTP

| S.No | DESCRIPTION | DETAILS | | | | |
|------|----------------------|----------------|----------------|-----------------|-----------------|-----------------|
| | | 3C X 70 ²MM | 3C X 95 ²MM | 3C X 185 ²MM | 3C X 240 ²MM | 3C X 300 ²MM |
| 1 | GENERAL | | | | | |
| | Name of Manufacturer | | | | | |
| | Voltage Grade | 6.35/11kV | 6.35/11kV | 6.35/11kV | 6.35/11kV | 6.35/11kV |
| | Standards Applicable | IS: 7098 (P-2) | IS: 7098 (P-2) | IS: 7098 (P-2) | IS: 7098 (P-2) | IS: 7098 (P-2) |
| 2 | CONDUCTOR | | | | | |

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| | Material | Aluminium as per class- 2 of IS: 8130 | Aluminium as per class- 2 of IS: 8130 | Aluminium as per class- 2 of IS: 8130 | Aluminium as per class- 2 of IS: 8130 | Aluminium as per class- 2 of IS: 8130 |
|---|---|---|---|---|---|---|
| | Nominal Cross Sectional Area | 70 SQMM | 95 SQMM | 185 SQMM | 240 SQMM | 300 SQMM |
| | Shape of conductor | Stranded compacted circular | Stranded compacted circular | Stranded compacted circular | Stranded compacted circular | Stranded compacted circular |
| | Nominal Diameter | As per IS- 8130 | As per IS- 8130 | As per IS- 8130 | As per IS- 8130 | As per IS- 8130 |
| | Max. DC Resistance at 20 Deg.C | 0.44 Ohms/km | 0.32 Ohms/km | 0.164 Ohms/km | 0.125 Ohms/km | 0.1 Ohms/km |
| | Approx. AC Resistance at 90 Deg.C | 0.56 Ohms/km | 0.41 Ohms/km | 0.21 Ohms/km | 0.16 Ohms/km | 0.13 Ohms/km |
| | Short Circuit Current for 1 sec | 6.6 kA/sec | 9 kA/sec | 17.5 kA/sec | 22.6 kA/sec | 28.3 kA/sec |
| | Approx. Reactance at 50 Hz | 0.10 Ohms/km | 0.095 Ohms/km | 0.087 Ohms/km | 0.085 Ohms/km | 0.082 Ohms/km |
| | Approx. Capacitance at 50 Hz | 0.25 uF/km | 0.29 uF/km | 0.36 uF/km | 0.41 uF/km | 0.46 uF/km |
| 3 | Max CONDUCTOR TEMPERATURE | | | | | |
| | Rated | 90 Degree C | 90 Degree C | 90 Degree C | 90 Degree C | 90 Degree C |
| | During short circuit | 250 Degree C | 250 Degree C | 250 Degree C | 250 Degree C | 250 Degree C |
| 4 | CONDUCTOR SCREEN | | | | | |
| | Material | Extruded semi conducting compound | Extruded semi conducting compound | Extruded semi conducting compound | Extruded semi conducting compound | Extruded semi conducting compound |
| | Thickness (Minimum) | As per IS- 8130 | As per IS- 8130 | As per IS- 8130 | As per IS- 8130 | As per IS- 8130 |
| 5 | INSULATION | | | | | |
| | Material | XLPE, Confirming to IS: 7098 (P-2) | XLPE, Confirming to IS: 7098 (P-2) | XLPE, Confirming to IS: 7098 (P-2) | XLPE, Confirming to IS: 7098 (P-2) | XLPE, Confirming to IS: 7098 (P-2) |
| | Thickness (Nominal) | To be filled by Bidders | | | | |
| 6 | INSULATION SCREEN | | | | | |

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| | | | | | | |
|----|------------------------|--|--|--|--|--|
| | Material | Extruded semi conducting compound | Extruded semi conducting compound | Extruded semi conducting compound | Extruded semi conducting compound | Extruded semi conducting compound |
| | Thickness (Minimum) | 0.3mm | 0.3mm | 0.3mm | 0.3mm | 0.3mm |
| 7 | CORE COLOUR | For 3 Cores- Coloured strips of Red, Yellow & Blue | For 3 Cores- Coloured strips of Red, Yellow & Blue | For 3 Cores- Coloured strips of Red, Yellow & Blue | For 3 Cores- Coloured strips of Red, Yellow & Blue | For 3 Cores- Coloured strips of Red, Yellow & Blue |
| 8 | INNER SHEATH | | | | | |
| | Material | Extruded PVC "Type ST-2" as per IS: 5831 | Extruded PVC "Type ST-2" as per IS: 5831 | Extruded PVC "Type ST-2" as per IS: 5831 | Extruded PVC "Type ST-2" as per IS: 5831 | Extruded PVC "Type ST-2" as per IS: 5831 |
| | Thickness (minimum) | 0.5mm | 0.6 mm | 0.7 mm | 0.7 mm | 0.7 mm |
| | Colour | Black | Black | Black | Black | Black |
| 9 | ARMOUR | | | | | |
| | Material | Galvanized steel Round Wire/strip as per IS: 3975 | Galvanized steel Round Wire/strip as per IS: 3975 | Galvanized steel Round Wire/strip as per IS: 3975 | Galvanized steel Round Wire/strip as per IS: 3975 | Galvanized steel Round Wire/strip as per IS: 3975 |
| | Nominal Dia. of armour | 2.50 mm/4.0(L) * 0.8(T) (Wire-dia/Strip-thickness) | 2.50 mm/4.0(L) * 0.8(T) (Wire-dia/Strip-thickness) | 3.15 mm/4.0(L) * 0.8(T) (Wire-dia/Strip-thickness) | 3.15 mm/4.0(L) * 0.8(T) (Wire-dia/Strip-thickness) | 3.15 mm/4.0(L) * 0.8(T) (Wire-dia/Strip-thickness) |
| 10 | OUTER SHEATH | | | | | |
| | Material | Extruded PVC "Type ST-2" as per IS: 5831 | Extruded PVC "Type ST-2" as per IS: 5831 | Extruded PVC "Type ST-2" as per IS: 5831 | Extruded PVC "Type ST-2" as per IS: 5831 | Extruded PVC "Type ST-2" as per IS: 5831 |
| | Thickness (minimum) | 2.04 mm / 1.88 (Wire/Strip) or as per IS | 2.20 mm / 2.04 (Wire/Strip) or as per IS | 2.52 mm / 2.36 (Wire/Strip) or as per IS | 2.68 mm / 2.52 (Wire/Strip) or as per IS | 2.84 mm / 2.68 (Wire/Strip) or as per IS |
| | Colour | Black or any other color as per required | Black or any other color as per required | Black or any other color as per required | Black or any other color as per required | Black or any other color as per required |

Tender's Technical Specification

Signature of Tenderer
Place:

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Signature of Tenderer

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CIN U40102GJ2003SGC042908

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| | | | | | | |
|----|--|--|-----------|-----------|-----------|-----------|
| 11 | CABLE DATA | | | | | |
| | Approximate overall Dia of cable | as per IS | as per IS | as per IS | as per IS | as per IS |
| | Tolerance on overall Dia | as per IS | as per IS | as per IS | as per IS | as per IS |
| 12 | Continuous current rating for cables when laid up | | | | | |
| | In Buried direct in Ground | 161 A | 190 A | 273 A | 315 A | 354 A |
| | In Air | 184 A | 222 A | 330 A | 387 A | 441 A |
| 13 | Drum Details | In Non-Returnable Wooden Drum as per IS: 10418 | | | | |
| | Standard Drum Length* | 500 mtrs | 500 mtrs | 500 mtrs | 500 mtrs | 500 mtrs |
| | Individual drum tolerance | ± 5 % | ± 5 % | ± 5 % | ± 5 % | ± 5 % |
| | Overall Quantity tolerance | ± 2%. | ± 2%. | ± 2%. | ± 2%. | ± 2%. |
| 14 | Sequential length marking | Shall be provided on outer sheath @ every one mtr | | | | |
| 15 | Embossing/Printing | Manufacturer Name-Cable Electric 11kV (E), Cable Size, Year of Mfr. | | | | |

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HEAT SHRINKABLE TYPE INDOOR & OUTDOOR TERMINATIONS KIT FOR 11kV CABLE

1. Scope

- 1.1 This Section of the Specification covers design, manufacturing, testing, packing, supply & commissioning of heat shrinkable type indoor and outdoor termination kit suitable for 11 kV XLPE cable.
- 1.2 The equipment offered shall be complete with all parts necessary for their effective and trouble-free operation. Such parts will be deemed to be within the scope of the supply irrespective of whether they are specifically indicated in the commercial order or not.
- 1.3 It is not the intent to specify herein complete details of design and construction. The equipment offered shall conform to the relevant standards and be of high quality, sturdy, robust and of good design and workmanship complete in all respects and capable to perform continuous and satisfactory operations in the actual service conditions at site and shall have sufficiently long life in service as per statutory requirements.
- 1.4 In these specifications, the design and constructional aspects, including materials and dimensions, will be subject to good engineering practice in conformity with the required quality of the product, and to such tolerances, allowances and requirements for clearances etc. as are necessary by virtue of various stipulations in that respect in the relevant IEC, IS standards and other statutory provisions.
- 1.5 Tolerances on all the dimensions shall be in accordance with provisions made in the relevant standards. Otherwise the same will be governed by good engineering practice in conformity with required quality of the product.

2. Service Conditions

Equipment to be supplied against this specification shall be suitable for satisfactory continuous operation under the following tropical conditions.

- a) Maximum ambient temperature of air: 50°C
- b) Maximum temperature of air in shade: 4°C
- c) Maximum daily average ambient temperature: 40°C
- d) Maximum yearly average ambient temperature: 30°C
- e) Relative Humidity: up to 95%
- f) Average number of thunder storm days per annum: 15
- g) Maximum annual Rainfall: 150cm
- h) Maximum Altitude above mean sea level: 1000Meter
- i) Maximum Wind Pressure: 150 Kg/cm² (As per IS 802 latest code)
- j) Maximum soil temperature at cable depth: 30°C
- k) Maximum soil thermal resistivity: 150°C cm/watt

3. Technical Parameters

System details:

| S.No | Description | 11kV |
|------|---|----------------------------|
| i | Voltage grade (kV) of Cable | 6.35 / 11 kV |
| ii | Core (Nos.) | 3 |
| iii | System Voltage | 11kV |
| iv | Highest Voltage | 12kV |
| v | Earthing system | Effectively earthed |
| vi | Frequency | 50Hz |
| vii | Variation in supply voltage | " +6% to -9% |
| viii | Variation in supply frequency | ± 3% |
| ix | A.C. Withstand Voltage (ph/ground) with time duration | 35kV, 1min |
| x | Partial discharge at 2Vo | < 5pc |
| xi | Impulse Withstand, 1.2/50/Us | 75kV |
| xii | Thermal Withstand Short Circuit current 1Sec | As per IS 13573 |
| xiii | Dynamic short circuit withstand | 2.55 x As per IS 13573 |
| xiv | DC Voltage | 48kV for 30mins. |
| xv | Materials of the tubing / molded part | Polyolefin |
| xvi | Method of Stress Control | High permittivity material |

4. Application Standards

| Title | IS Standard | IEC Standard |
|---|------------------------------------|--------------|
| Applicable IS Standard | IS 13573 | |
| Power cables with extruded insulation and their accessories for rated voltages from 1 kV ($U_m = 1,2$ kV) up to 30 kV ($U_m = 36$ kV) - ALL PARTS | IS 7098 (Part-II) IS 13573,1992 | IEC 60502 |
| Heat shrinkable moulded shapes - Part 1: Definitions and general requirements | - | IEC 62329-1 |
| Heat-shrinkable moulded shapes - Part 2: Methods of test | - | IEC 62329-2 |

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5. General Technical Parameters

The purpose of this specification is to specify the performance requirements of termination kits for the use on 50C/S phase system with earthed neutral for working voltage of 11kV. Earthing arrangement shall be as per relevant standard and details of earthing arrangement offered shall be submitted along with the tender.

- 5.1 The cable termination kit shall be suitable for termination of the cable on indoor switchgear or outdoor installation as per requirement. The type of cable will be XLPE insulated. The cable termination jointing kits shall be as per defined in IEC 62329-1.
- 5.2 Proper stress control, stress grading and non-tracking arrangement in the termination shall be offered by means of proven methods, details of which shall be elaborated in the offer. Detailed sectional views of the assemblies shall be submitted along with the offer. In case of heat shrinkable cable accessories, stress control tubing, shall have volume resistivity of minimum 1, 00, 00,000 Ohms- meter for termination. Also relative permittivity shall be minimum 15.
- 5.3 Impedance of stress control tubing shall not change over a range of temperature from 0° C to 125°C. The impedance also remains constant in spite of the difference in stress, which will exist within the sleeve due to hearting effect within the conductors and the temperature of the environment. Bidder must submit graph-showing effect on the impedance value of stress control humbling due to temperature variations and thermal ageing with his offer.
- 5.4 In all type of kits offered, the external leakage insulation between high voltage conductor and ground as specified in I.E.E.E. -48, 1975 amended up to date, shall be of non-tracking erosion resistant and weather resistant flexible sleeve.
- 5.5 The kit offered shall provide for total environmental sealing of the cable crutch and at the lug end.
- 5.6 Termination system shall be suitable for use with standard aluminum conductor fittings [cable lugs and ferrules] of compressed crimping type.
- 5.7 The termination kit of heat shrinkable type kit, the joint shall include heat shrinkable duel wall tubing, which shall be insulating from inside and semiconductor from outside.
- 5.8 Material used for construction of a joint/termination shall perfectly match with the dielectric, chemical and physical characteristics of the associated cable. The material and design concepts shall incorporate a high degree of operating compatibility between the cable and the joints.
- 5.9 The tenderer shall indicate the required net dimensions of the indoor cable, joints for various cable sizes, in the form of Length X Breadth X Depth in mm.

6. Test & Inspection

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- 6.1 The termination kits offered shall be fully type tested as per the relevant standards and the test certificates are to be provided.
- 6.2 The supplier shall carry out all routine tests as stipulated in the relevant standards.
- 6.3 The termination kits offered shall be fully type tested at CPRI as per the relevant standards. The vendor shall furnish four sets of the type test reports along with the MQP for getting approval on material before placing purchase order to the manufacturer.
- 6.4 Type tests shall be carried out as per the test sequence given in I.S.:13573 or VDE-0278 at C.P.R.I. Laboratory as amended from time to time. The test report will have to be submitted for the test carried out.
- 6.5 Test details for Termination Kit should be as follow:

| Indoor as per VDE 0278 | |
|------------------------|---|
| 1. | Partial Discharge Test |
| 2. | Partial Discharge Test |
| 3. | Conductor Resistance Test |
| 4. | Partial Discharge Test |
| 5. | AC High Voltage Test (Dry) |
| 6. | Tan Delta as a Function of Voltage & Capacitance. |
| 7. | Tan Delta as a Function of temperature |
| 8. | Impulse with stand test |
| 9. | AC Voltage life test with cyclic current loading |
| 10. | Partial Discharge Test |
| 11. | Tan Delta as a Function of Voltage & capacitance. |
| 12. | AC Voltage life test with cyclic current loading |
| 13. | Thermal Short circuit test |
| 14. | AC Voltage life test with cyclic current loading |
| 15. | Partial Discharge Test |
| 16. | Conductor Resistance Test |
| 17. | Impulse with stand test |
| 18. | D.C. High Voltage test |

| Outdoor Termination VDE 0278 | |
|------------------------------|---|
| 1. | Partial Discharge Test |
| 2. | Partial Discharge Test |
| 3. | Conductor Resistance Test |
| 4. | Impact Test |
| 5. | Wet power frequency AC High Voltage Test |
| 6. | Partial Discharge Test |
| 7. | Tan Delta as a Function of Voltage & Capacitance. |
| 8. | Tan Delta as a Function of temperature |
| 9. | Impulse with stand test |
| 10. | AC Voltage life test with cyclic current loading |

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| | |
|-----|---|
| 11. | Partial Discharge Test |
| 12. | Tan Delta as a Function of Voltage & Capacitance. |
| 13. | AC Voltage life test with cyclic current loading |
| 14. | Short circuit test |
| 15. | AC Voltage life test with cyclic current loading |
| 16. | Conductor Resistance Test |
| 17. | Impulse with stand test |
| 18. | D.C. High Voltage test |
| 19. | Dynamic short circuit |
| 20. | Impulse with stand test |
| 21. | D.C. High Voltage test |

7. GTP

| Sr. No | Particulars | Unit | Guaranteed values. |
|--------|--|--|---|
| 1 | MANUFACTURER | | |
| 2 | APPLICABLE STANDARDS | | Asper IS:13573 |
| 3 | GUARANTEED PARTICULARS | | |
| 3.1 | For the nominal (phase to phase) System voltages Maximum system voltage | KV KV | 11KV 12KV |
| 3.2 | A.C. withstand voltage Dry (ph./ground) Time duration | KV Mins | 35KV 1Min |
| | A.C. withstand voltage Wet(ph./ground) Time duration | KV Mins | 28KV 1Min |
| 3.3 | Partial Discharge at 2Vo | pC | <5pC |
| 3.4 | Impulse withstand, 1.2/50/Us | kV | 75KV |
| 3.5 | Load cycle Test a) Each Cycle-Heating Duration Temperature Cooling Duration Number of Cycles b) Continuous phase to ground Voltage Withstand | Hrs. OC Hrs. kV | 5 100 3 117 2.5Uo |

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| | | | |
|-----|--|---------|-----------------------------|
| 3.6 | Leak Tightness | | 9 Cycles. |
| 3.7 | Thermal Withstand Short circuit current | ka | As per IS:13573 |
| 3.8 | Dynamic short circuit Withstand | Ka peak | 2.55 x Is As per IS:13573 |
| 3.9 | DC Voltage | kV | 48kV for 30Mins. |
| 4 | KIT PARTICULARS | | |
| 4.1 | Material of the tubing/molded parts | | Polyolefin |
| 4.2 | Method of stress control | | High permittivity Material. |
| 4.3 | Method of environmental seal | | H.S. Anti-tracking Tubes. |
| 4.4 | Allowable Kit storage Temperature | 0C | Normal Ambient Temperature. |
| 4.5 | Shelf life of H.S components | Years | More than 5 Years. |
| 5 | Cable Termination Instruction Manuals | Yes/No | Yes |

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HEAT SHRINKABLE STRAIGHT THROUGH JOINT KIT FOR 11kV CABLE

1. Scope

- 1.1 This Section of the Specification covers design, manufacturing, testing, packing, supply & commissioning of heat shrinkable type straight through joint kit suitable for 11 kV XLPE cable.
- 1.2 The equipment offered shall be complete with all parts necessary for their effective and trouble-free operation. Such parts will be deemed to be within the scope of the supply irrespective of whether they are specifically indicated in the commercial order or not.
- 1.3 It is not the intent to specify herein complete details of design and construction. The equipment offered shall conform to the relevant standards and be of high quality, sturdy, robust and of good design and workmanship complete in all respects and capable to perform continuous and satisfactory operations in the actual service conditions at site and shall have sufficiently long life in service as per statutory requirements.
- 1.4 In these specifications, the design and constructional aspects, including materials and dimensions, will be subject to good engineering practice in conformity with the required quality of the product, and to such tolerances, allowances and requirements for clearances etc. as are necessary by virtue of various stipulations in that respect in the relevant IEC, IS standards and other statutory provisions.
- 1.5 Tolerances on all the dimensions shall be in accordance with provisions made in the relevant standards. Otherwise the same will be governed by good engineering practice in conformity with required quality of the product.

2. Service Conditions

Equipment to be supplied against this specification shall be suitable for satisfactory continuous operation under the following tropical conditions.

- a) Maximum ambient temperature of air: 50°C
- b) Maximum temperature of air in shade: 4°C
- c) Maximum daily average ambient temperature: 40°C
- d) Maximum yearly average ambient temperature: 30°C
- e) Relative Humidity: up to 95%
- f) Average number of thunder storm days per annum: 15
- g) Maximum annual Rainfall: 150cm
- h) Maximum Altitude above mean sea level: 1000Meter
- i) Maximum Wind Pressure: 150 Kg/cm² (As per IS 802 latest code)
- j) Maximum soil temperature at cable depth: 30°C
- k) Maximum soil thermal resistivity: 150°C cm/watt

3. Technical Parameters

System details:

| S.No | Description | 11kV |
|------|---|-----------------------------|
| i | Voltage grade (kV) of Cable | 6.35 / 11 kV |
| ii | Core (Nos.) | 3 |
| iii | System Voltage | 11kV |
| iv | Highest Voltage | 12kV |
| v | Earthing system | Effectively earthed |
| vi | Frequency | 50Hz |
| vii | Variation in supply voltage | " +6% to -9% |
| viii | Variation in supply frequency | ± 3% |
| ix | A.C. Withstand Voltage (ph/ground) with time duration | 35kV, 1min |
| x | Partial discharge at 2Vo | < 5pc |
| xi | Impulse Withstand, 1.2/50/Us | 75kV |
| xii | Thermal Withstand Short Circuit current 1Sec | As per IS 13573 |
| xiii | Dynamic short circuit withstand | 2.55 x As per IS 13573 |
| xiv | DC Voltage | 48kV for 30mins. |
| xv | Materials of the tubing / molded part | Polyolefin |
| xvi | Method of Stress Control | High permittivity materials |

4. Application Standards

| Title | IS Standard | IEC Standard |
|---|------------------------------------|--------------|
| Applicable IS Standard | IS 13573 | |
| Power cables with extruded insulation and their accessories for rated voltages from 1 kV ($U_m = 1,2$ kV) up to 30 kV ($U_m = 36$ kV) - ALL PARTS | IS 7098 (Part-II) IS 13573,1992 | IEC 60502 |
| Heat shrinkable moulded shapes - Part 1: Definitions and general requirements | - | IEC 62329-1 |
| Heat-shrinkable moulded shapes - Part 2: Methods of test | - | IEC 62329-2 |

5. General Technical Parameters

The purpose of this specification is to specify the performance requirements of cable jointing kits for the use on 50C/S phase system with earthed neutral for working voltage of 11kV.

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Earthing arrangement shall be as per relevant standard and details of earthing arrangement offered shall be submitted along with the tender.

- 5.1 Proper stress control, stress grading and non-tracking arrangement in the joint shall be offered by means of proven methods, details of which shall be elaborated in the offer. Detailed sectional views of the assemblies shall be submitted along with the offer. In case of heat shrinkable cable accessories, stress control tubing, shall have volume resistivity of minimum 1, 00, 00,000 Ohms- meter for straight through joints. Also relative permittivity shall be minimum 15.
- 5.2 Impedance of stress control tubing shall not change over a range of temperature from 0° C to 125°C. The impedance also remains constant in spite of the difference in stress, which will exist within the sleeve due to hearting effect within the conductors and the temperature of the environment. Bidder must submit graph-showing effect on the impedance value of stress control humbling due to temperature variations and thermal ageing with his offer.
- 5.3 The jointing kit shall be with aluminum crimping type ferrules, semi-conductor self-bonding tape, the self-amalgamating tape [or EPR or equivalent] stress grading pad etc. The straight through joints should be absolutely impervious to the entry or water. The manufacturer shall use the proven technologies and design to ensure a construction, which will prevent entry of water or any other liquid inside the straight through joint and cable. Proven technologies such as resin injection, hydrophobic sealants etc. shall be deployed in the critical areas.
- 5.4 In all type of jointing kits offered, the external leakage insulation between high voltage conductor and ground as specified in I.E.E.E. -48, 1975 amended up to date, shall be of non-tracking erosion resistant and weather resistant flexible sleeve.
- 5.5 The kit offered shall provide for total environmental sealing of the cable crutch and at the lug end.
- 5.6 Jointing system shall be suitable for use with standard aluminum conductor fittings [cable lugs and ferrules] of compressed crimping type.
- 5.7 For straight through joint the kit shall also include tubular sleeve in line connectors for solder less crimping of cable connector. The connector shall be of aluminum alloy A 6 drop forged type or other equivalent or better material.
- 5.8 Material used for construction of a joint shall perfectly match with the dielectric, chemical and physical characteristics of the associated cable. The material and design concepts shall incorporate a high degree of operating compatibility between the cable and the joints. The tenderer shall indicate the required net dimensions of the indoor cable, joints for various cable sizes, in the form of Length X Breadth X Depth in mm.
- 5.9 The kit which requires lesser skill for the cable jointing which can be done in shorter time and guarantee a reliable and long operating life and reduced or no waiting time for erection shall be given preference.

6. TEST & INSPECTION

- 6.1 The jointing kits offered, shall be fully type tested as per the relevant standards and the test certificates are to be provided.
- 6.2 The supplier shall carry out all routine tests as stipulated in the relevant standards.
- 6.3 The jointing kits offered, shall be fully type tested at CPRI as per the relevant standards. The vendor shall furnish four sets of the type test reports along with the MQP for getting approval on material before placing purchase order to the manufacturer.

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6.4 Type tests shall be carried out as per the test sequence given in I.S.:13573 or VDE-0278 at C.P.R.I. Laboratory as amended from time to time. The test report will have to be submitted for the test carried out.

6.5 Test details for Termination Kit should be as follow:

| Joint Kit as per IS 13573 | |
|---------------------------|--|
| 1. | Conductor Resistance Test |
| 2. | Impact Test |
| 3. | AC High Voltage Test (Dry) |
| 4. | Partial Discharge Test |
| 5. | Impulse with stand test |
| 6. | AC Voltage life test with cyclic current loading |
| 7. | Thermal Short circuit test |
| 8. | D.C. High Voltage test |

7. GTP

| Sr. No | Particulars | Unit | Guaranteed values. |
|--------|--|-----------------------------|--|
| 1. | MANUFACTURER | | |
| 2. | APPLICABLE STANDARDS | | As per IS:13573 |
| 3. | GUARANTEED PARTICULARS For the nominal (phase to phase) System voltages Maximum system voltage | KV KV | 11KV 12KV |
| 3.1 | A.C. withstand voltage Dry (ph./ground) Time duration | KV Mins | 35KV 1Min. |
| | A.C. withstand voltage Wet(ph./ground) Time duration | KV Mins | 28KV 1Min. |
| 3.2 | Partial Discharge at $2U_0$ | pC | <5pC |
| 3.3 | Impulse withstand, $1.2/50/\mu s$ | kV | 75KV |
| 3.4 | Load cycle Test a) Each Cycle-Heating Duration Temperature Cooling Duration a) Number of Cycles c) Continuous phase to ground Voltage Withstand | Hrs °C Hrs. kV | 5 100 3 63 2.5 U_0 |
| | Water tightness test | KV | 60Nos. at 2.5 U_0 . as per above cycles. |
| 3.5 | Thermal Withstand Short circuit current 1Sec. | ka | As per IS:13573 |

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| | | | |
|----------|---|-----------------------|--|
| 3.6 | Dynamic short circuit Withstand | Ka peak | 2.55 x Is As per IS:13573 |
| 3.7 | DC Voltage | kV | 48kV for 30Mins |
| 4 | KIT PARTICULARS | | |
| 4.1 | Material of the tubing/molded parts | | Polyolefin. |
| 4.2 | Method of stress control | | High permittivity Material. |
| 4.3 | Method of environmental seal | | H.S. Black Insulating Tubes. |
| 4.4 | List of items included in the Kit a) For Terminations b) Allowable kit storage temperature c) Kit shelf life | Yes/No 0C Years | Yes Normal Ambient Temperature More than 5 Years |
| 5 | Cable Termination Instruction Manuals | Yes/No | Yes |

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**TECHNICAL SPECIFICATION FOR MAINTENANCE FREE EARTH FOR ELECTRICAL
INSTALLATION**

1. SCOPE

This specification covers supply, installation, connecting, testing & commissioning of Maintenance Free Earthing suitable for Package Substations, distribution transformers, RMU & Feeder Pillars etc.

Earthing is essential in any electrical installation to provide safety. The conventional GI pipe earthing system employing charcoal & salts are provided for various applications as per IS:3043. Corrosion of metallic parts is comparatively fast besides maintenance by way of watering of earth pits and chiseling of corrosion prone parts & their replacement requires monitoring which may not always be feasible in certain crowded and inaccessible areas.

This specification covers components, enhancing material & jointing used and procedure for constructing the earth pit for maintenance free earthing system to ensure that the resistance to earth is near zero consistent throughout the year.

2. SERVICE CONDITIONS

Equipment to be supplied against this specification shall be suitable for satisfactory continuous operation under the following tropical conditions.

- a) Maximum ambient temperature of air: 50°C
- b) Maximum temperature of air in shade: 4°C
- c) Maximum daily average ambient temperature: 40°C
- d) Maximum yearly average ambient temperature: 30°C
- e) Relative Humidity: up to 95%
- f) Average number of thunder storm days per annum: 15
- g) Maximum annual Rainfall: 150cm
- h) Maximum Altitude above mean sea level: 1000Meter
- i) Maximum Wind Pressure: 150 Kg/cm² (As per IS 802 latest code)
- j) Maximum soil temperature at cable depth: 30°C
- k) Maximum soil thermal resistivity: 150°C cm/watt

3. APPLICABLE CODES & STANDARDS

- a) IEEE 80 :IEEE guide for safety in AC sub-station grounding
- b) IS : 3043 :Indian standard code of practice for earthing
- c) IEEE 837 :Standard for qualifying permanent connections used in substation grounding

4. APPLICATION

Earthing systems covered in this document shall be for providing effective grounds for

- i. Sub-Stations
- ii. RTUs, supply control posts

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- iii. RMU, Transformer and Generator neutral earths
- iv. Lightning arrester earths
- v. Equipment earths including panels
- vi. In applications for PRS, UTS, FOIS, COIS, ATMs and data processing centre etc.

5. GENERAL TECHNICAL REQUIREMENTS

(I) SELECTION OF EARTHING SYSTEM

| Sl. No | Installations/ Current Capacity | IR Value Required | Soil Type/ Resistivity | Earth System |
|----------|--|-------------------|--|---------------------|
| <u>1</u> | House hold earthing/ 3kA | 8 ohm | Normal Soil/ upto 50 ohm-mtr | Single Electrode |
| | | | Sandy Soil/ between 50 to 2000 ohm-mtr | Single Electrode |
| | | | Rocky Soil/ More than 2000 ohm-mtr | Multiple Electrodes |
| <u>2</u> | Commercial premises Office buildings/ 5kA | 2 ohm | Normal Soil/ upto 50 ohm-mtr | Single Electrode |
| | | | Sandy Soil/ between 50 to 2000 ohm-mtr | Single Electrode |
| | | | Rocky Soil/ More than 2000 ohm-mtr | Multiple Electrodes |
| <u>3</u> | Transformers, substation earthing, LT line equipment/ 15kA | 1 - 2 ohm | Normal Soil/ upto 50 ohm-mtr | Single Electrode |
| | | | Sandy Soil/ between 50 to 2000 ohm-mtr | Single Electrode |
| | | | Rocky Soil/ More than 2000 ohm-mtr | Multiple Electrodes |
| <u>4</u> | Transformers, substation earthing, HT line equipment/ 40kA | less than 1 ohm | Normal Soil/ upto 50 ohm-mtr | Single Electrode |
| | | | Sandy Soil/ between 50 to 2000 ohm-mtr | Single Electrode |
| | | | Rocky Soil/ More than 2000 ohm-mtr | Multiple Electrodes |
| <u>5</u> | Lightning arresters, extra high current applications etc./ 50kA | less than 1 ohm | Normal Soil/ upto 50 ohm-mtr | Single Electrode |
| | | | Sandy Soil/ between 50 to 2000 ohm-mtr | Single Electrode |
| | | | Rocky Soil/ More than 2000 ohm-mtr | Multiple Electrodes |
| <u>6</u> | PRS, UTS, RTUs, FOIS, COIS, ATMs and data processing centre etc./5KA | less than 0.5 ohm | Normal Soil/ upto 50 ohm-mtr | Single Electrode |
| | | | Sandy Soil/ between 50 to 2000 ohm-mtr | Single Electrode |

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| | | | | |
|--|--|--|---------------------------------------|------------------------|
| | | | Rocky Soil/ More than 2000 ohm-mtr | Multiple Electrodes |
|--|--|--|---------------------------------------|------------------------|

(II) TYPE OF SOILS

Soil can be classified in to various types, though based on the size of the particles it contains:

Normal soil

Black cotton soil, vegetable soil, garden soil, loamy garden, soil shallow black, soil medium black soil, deep black soil and marshy soil etc. having low soil resistivity value (up to 50 ohm-meter)

Sandy soil

This type has the big particles and the size of the particles does determine the degree of aeration and drainage that the soil allows. It is granular and consists of rock and mineral particles that are very small. Therefore, the texture is gritty and sandy soil is formed by the disintegration and weathering of rocks such as limestone, granite, quartz and shale, thus resulting in over-drainage. It warms very fast in the spring season. Coastal area, silt soil, red sandy soil, sandy clay and coastal alluvium etc having soil resistivity up to 2000 ohm-meter are considered as sandy soil.

Rocky soil

The area containing rocks, pebbles, uneven hard surface laterite soil, lime stone, sand stone, gravel, granite and chalk etc having soil resistivity more than 2000 ohm-meter is considered as rocky soil. This type of soil does not absorb moisture and are extremely poor conductor.

(III) LOCATION OF EARTH ELECTRODE

Where there is option, site should be chosen in one of the following types of soil in the order of preference given: -

- Wet marshy ground;
- Clay, loamy soil, arable land.
- Clay and loam mixed with varying proportions of sand, gravel and stones;
- Damp and wet sand, peat.

Dry sand, gravel chalk, limestone, granite, very stony ground and all locations where virgin rock is very close to the surface should be avoided,

(IV) MEASUREMENT OF EARTH ELECTRODE RESISTANCE

The earth resistance shall be measured using fall of potential method as per para 37 of IS:3043.

(V) EARTHING SYSTEM

The earthing system includes earth electrode, installation of earth electrode in suitable pit size, construction of earth pit with cover for the installation, connection of earth electrode with equipotential earth bus and connection of equipment to equipotential earth bus.

Earth electrode

The earth electrode is the main component of the earthing system which is in direct contact with the ground and thus provides a means of releasing or collecting any earth leakage currents. The material should have good electrical conductivity and should not corrode in a wide range of soil conditions. For an effective earthing system, two types of earth electrodes can be used as described here:

Rod earth electrode

- High tensile-low carbon steel rod having diameter not less than 17mm complying with requirements of BS 4360 Grade 43A or EN10025:2-004 S275JR, molecularly bonded by 99.99% pure high conductivity copper on outer surface with copper coating thickness 250 micron or more, Length 3000 mm (minimum). Length of the electrode may be increased in multiple of 1 meter to reduce earth resistance if required. To increase the length, pieces of similar rod shall be either exothermally welded to basic 3-meter electrode or connected using socket of suitable size. These sockets shall also be molecularly bonded by 99.99% pure high conductivity copper on inner & outer surface with copper coating thickness 250 micron or more.
- Copper bus bar of size 250 mm x 50mm x 6 mm having electrical conductivity of 101% IACS, minimum 99.9% copper content shall be exothermally welded to rod with 4 holes of 12 mm dia. (2 on each side) for connecting earthing conductor.
- Current carrying capacity: The design of the electrode should be such as to have more than 15kA current carrying capacity for 1 second.

Concentric pipe earth electrode:

- Primary conductor
MS pipe with 25 - 50 mm diameter, class B, ISI mark as per IS-1239, Length 2000 or 3000 mm as per table below current carrying capacity.
- Secondary conductor
MS pipe with 40-100 mm diameter, class B, ISI mark as per IS-1239, Length 2000 or 3000 mm as per table below current carrying capacity.
- Conductive mixture
For hermetically filling inside the cavity i.e. between secondary conductor & primary conductor, crystalline compound is to be injected in the electrode assembly. It is a combination of high conductivity metal alloys, copper & aluminum powder, conductive carbon/cement and bonding material etc. mixed in different proportion. The mixture is forced (pressurized) filled inside the earth electrode in the paste form and after solidification of the same, the end caps are welded. The metal alloys shall help in conducting the current and conductive carbon gives anti corrosive property. Bonding material should provide strength to the mixture. Resistivity of the mixture shall be less than 0.2 ohm-meter. Resistivity shall be tested by making a 20cm cube of the material and checking resistance across the opposite face of the cube.

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- Complete electrode shall be molecularly bonded by 99.99% pure, high conductivity copper on outer surface with copper coating thickness 300 micron or more.
- Its surface shall be clean and free from any visible oxide layer or foreign material.
- Copper bus bar of size 250 mm x 50mm x 6 mm having electrical conductivity of 101% IACS, minimum 99.9% copper content shall preferably be exothermically welded to earth electrode or connected with the help of two number stainless steel nut bolts of appropriate size having 4 holes of 12 mm dia. (2 on each side) for connecting earthing conductor.
- Current carrying capacity:
The design of the electrode should be such as to have more than following current carrying capacity in kA (for 1 second):

| <u>Sl. No</u> | <u>Current Capacity</u> | <u>Primary Conductor diameter</u> | <u>Electrode dimensions (dia. x length)</u> |
|---------------|-------------------------|-----------------------------------|---|
| <u>1</u> | 3 kA | 25 mm | 40 mm x 2000 mm |
| <u>2</u> | 5kA | 25 mm | 40 mm x 3000 mm |
| <u>3</u> | 15kA | 25 mm | 50 mm x 3000 mm |
| <u>4</u> | 40kA | 40 mm | 80 mm x 3000 mm |
| <u>5</u> | 50kA | 50 mm | 100 mm x 3000 mm |

Note: - For more than 50KA applications, multiple electrodes of 50KA capacity shall be installed and connected.

Earth enhancement material:

Earth enhancement material is a superior conductive material that improves earthing effectiveness, especially in areas of poor conductivity (rocky ground, areas of moisture variation, sandy soils etc.). It may contain conductive cement, graphite, hydrous aluminium silicate, sodium montmorillonite etc and shall not contain bentonite. It improves conductivity of the earth electrode and ground contact area. It shall have following characteristics

- i. It should have low resistivity preferably bellow 0.2 Ohm-meters. Resistivity shall be tested by making a 20cm. cube of the material and checking resistance across the opposite face of the cube.
- ii. It shall not depend on the continuous presence of water to maintain its conductivity.
- iii. It should be a little alkaline in nature with pH value >7 but test certificate from NABL approved laboratory to be provided for the composition so designed.
- iv. It should have better hygroscopic properties to absorb moisture. It should absorb and release the moisture in dry weather condition and help in maintaining the moisture around the earth electrode.
- v. It should have capacity to retain >10% moisture at 105°C. Test certificate from NABL approved lab to be submitted for the composition so designed.
- vi. It should have water solubility < 5%. Test certificate from NABL approved lab be submitted for the composition so designed.
- vii. It should be granular with granule size 0.1 mm to 3 mm.

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- viii. It should be nontoxic, non-reactive, non-explosive & non-corrosive.
- ix. It shall be thermally stable between -10 degrees centigrade to +60-degree centigrade ambient temperature.
- x. It shall not decompose or leach out with time.
- xi. It shall not pollute the soil or local water table and meets environmental friendly requirement for landfill.
- xii. It should expand & swell considerably and removes entrapped air to create strong connection between earth electrode and soil.
- xiii. It should be diffusing into soil pores and creates conductive roots enlarging conductive zone of earth pit.
- xiv. It shall be permanent & maintenance free and in its "set form", maintains constant earth resistance with time.
- xv. It shall not require periodic charging treatment or replacement.
- xvi. It shall be suitable for any kind of electrode and all kinds of soils of different resistivity.
- xvii. It shall not cause burns, irritation to eye, skin etc.
- xviii. Minimum quantity of earth enhancement material to be supplied: For 5' x 5' x 10' earth pit – Min. 75 kgs per pit for 300mm bore type earth pit – Min 50 kgs per pit
- xix. The Earth enhancement material shall be supplied in sealed, moisture proof bags. These bags shall be marked with Manufacturer's name or trade name, quantity, batch no & date of manufacture.

Backfill material

Normally the excavated soil shall be used if it is free from sand, gravel and stones. In case the excavated soil contains sand, gravel and stones these shall be removed by appropriate methods such as hand picking, sieving etc. Small proportion of sand in the soil may be permissible. Material like sand, salt, coke breeze, cinders and ash shall not be used because of its acidic and corrosive nature. If the excavated soil contains sand, gravel and stone in large proportion and it is not feasible to remove these economically, good quality soil from other place may be used for backfilling. While backfilling the soil shall be thoroughly compacted with at least 5 kg compactor. In case the soil is dry, small quantity of water may be sprinkled only to make it moist enough suitable for compacting. Large quantity of water may make the soil muddy which is not suitable for compacting and after drying the soil may contain voids which may permanently increase earth resistance.

Equipotential bus & Earthing Conductor

- A copper bus bar of size 300mm x 25mm x 6mm to be installed in the equipment room as equipotential bus and must be connected with preferably copper strip of 25mm x 3mm (suitable length) from instrument to the bus bar. The connecting terminal of the earth electrode to the bus bar must be connected by copper strip of 25mm x 3mm (suitable length) buried inside a trench of 300mm width x 600mm depth (from the earth pit to the nearest wall). It shall be duplicated. However, it shall be ensured that only minimum required length is used and any extra length is cut away to keep the earth impedance minimum.

- It shall be high conductivity copper having electrical conductivity of 101% IACS i.e. minimum 99.9% copper content The maximum specific resistance of the copper strip earthing conductor shall be 17.241×10^{-7} -ohm cm at 20°C.
- At a temperature of 20°C, its density shall be 8.89 gm/cm³
- Its surface shall be clean and free from any visible oxide layer or foreign materials.
- It shall preferably be connected to earth electrode and earth bus bar with the help of exothermic welding or at least two number stainless steel nut bolts of appropriate size.
- Normally a single length of copper strip shall be used for each duplicate copper strip earthing conductor and no joint should be used. However, in situation requiring greater length one joint in each copper strip shall be permitted. The joints shall be made by exothermic welding of at least 10mm overlapping portion of the strips.

Construction of ring earth by providing multiple earth pits

- Wherever it is not possible to achieve required earth resistance with one earth electrode/pit due to difficult/rocky soil conditions, provision of ring earth consisting of more than one earth pit shall be done. The number of pits required shall be decided based on the resistance achieved for the earth pits already installed. The procedure mentioned above for one earth pit shall be repeated for other earth pits.
- The distance between two successive earth electrodes shall be min. 3mtrs / length of electrode whichever is higher. and max. up to twice the length of the earth electrode.
- These earth pits shall then be inter linked using 25X3 mm copper strip to form a loop preferably using exothermic welding or with the help of at least two number of stainless steel nut bolts of appropriate size.
- The interconnecting strip shall be buried no less than 600mm (0.6m) below the ground level. This interconnecting strip shall also be covered with earth enhancing compound.

(VI) MARKING:

The marking shall be clear, distinct and visible to the naked eye from a distance of about 1 meter; the size of marking shall be of minimum 25 mm. Following information shall be legibly and indelibly marked on the packed sets:

- a. Specification no.
- b. Name of the manufacturer
- c. Batch no. & Date of manufacturer
- d. Current carrying capacity

6. TESTING & COMMISSIONING

Following tests shall be done on one sample-

- Testing of copper coating shall be done as described below: -
 - i. The copper coating mentioned in clause 14.5.5.1 shall not be less than the prescribed thickness at any point and shall comply with the adherence requirement in para (ii) & (iii) below.

- ii. Length of the electrode with one end cut to a 45-degree point shall be driven between two steel clamping plates or the jaws of a vise set 0.04 in (1.02 mm) less than the diameter of the electrode, so as to shear off sufficient metal to expose the bond between the copper coating and electrode. Peeling of the coating by the steel plates or the jaws of the vise is acceptable, but there shall be no other evidence of separation of the coating from the metal core.
- iii. At room temperature, a length of the electrode is rigidly held in a clamp or vise and the free end is bent by applying a force normal to the electrode at a distance from the clamping device equal to 40 times the diameter. The magnitude of the force and the direction of application of force shall be such that the electrode is permanently bent through a 30-degree angle. While bending of the electrode there shall be no evidence of cracking of the copper coating.
- Material composition of rod shall be tested as per standards mentioned in clause no. 14.5.5.1 (Rod Earth Electrode)
 - MS pipes shall be tested as per IS:1239.
 - Copper bus bars shall be tested for percentage of copper as per IS:14644.
 - Current carrying capacity test on rod electrode shall be done as per clause above.
 - Corrosion Test: As per IS:2119, salt spray test for analysis of effect of corrosion for the specific electrode shall be done through NABL approved testing lab, preferably for 500 hrs. or more.
 - Exothermic weld material shall be tested as per provisions of IEEE 837.
 - Electrical properties test on conductive mixture as per clause above.
 - Physical, chemical & electrical properties test on earth enhancement material as per clause no. 14.5.5.2.
 - Toxic content tests for cadmium, lead, mercury, hexavalent chromium, polybrominated biphenyls (PBBs) & polybrominated diphenyl ethers (PBDEs) on conductive mixture & earth enhancement material.
- Certificates from NABL approved laboratories shall be submitted with test results of above tests. Test certificates shall not be more than three years old.
- For dimension, weight and specific resistance average of 3 readings shall be taken. Average value shall be within specified limits and individual values shall not go beyond double of tolerances.

ACCEPTANCE TESTS

Following shall constitute acceptance tests and shall be done on 100% sample basis for all the tests mentioned below except where otherwise indicated–

- a. Physical check for earth electrode as per clause above for rod type electrode and as per clause above for concentric pipe type electrode.
- b. Physical check for copper bus bar as per clause above for rod type electrode and as per clause above for concentric pipe type electrode.
- c. Dimensional and construction feature tests of inspection chamber
- d. Earth enhancement material as per clause no. 14.5.5.2
- e. Earth resistance measurements as per clause no. 14.5.4.

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In case the any component tested and inspected in accordance with this specification, fail to pass the tests or comply with the requirement of the specification, another two components from the same lot shall be inspected in accordance with the specification and if one of them also fail to pass the test, the whole lot of that component shall be rejected subject to the discretion of the purchaser or his nominee.

INSPECTION:

All the gauges/ test & measuring instruments shall be under calibration control at the time of inspection and proof to this office shall be produced. Inspection and testing shall be carried out by the inspecting authority nominated by the purchaser to ensure that all the requirements of this specification are complied with for the acceptance of the materials offered by the supplier for inspection. The purchaser or his nominee shall have right of free access to the works of the manufacturer and to be present at all reasonable times and shall be given facilities by the manufacturer to inspect the manufacturing process at any stage of manufacture. He shall have the right to reject whole or part of any work or material that does not conform to the terms of this specification or any other specification or requirement applicable and may order the same to be removed / replaced or altered at the expense of the manufacturer. All reasonable/complete facilities considered necessary by the inspecting authorities for the inspection shall be supplied by the manufacturer free of cost. The manufacturer shall at his own cost prepare and furnish the necessary test pieces and appliances for such testing as may be carried out at his own premises in accordance with the specification. Failing the existence of facilities at his own premises for the prescribed tests, the manufacturer shall bear the cost of carrying out the tests in an approved laboratory, workshop or test house.

COMPLETION REPORT & CERTIFICATION:

The last documents for the completion of the procedure will be submission of the work completion report to the engineer in charge. After testing the earth values of the pits and proper recording in presence of engineer in charge, certified grounding self-adhesive certificate shall be provided for all installations and the same will be displayed / pasted at the place of installation.

The complete layout with dimensions of the earthing & bonding system shall be submitted by the supplier in appropriate size (in three copies) after commissioning showing commissioning date, earth resistance, specification no. and manufacturer's name.

7. GTP

| Sl. No. | Parameter Name | Details |
|---------|---|---------|
| 1 | Name of Manufacturer | |
| 2 | Type of earth electrode | |
| 3 | Whether Inner & Outer pipes of the earth electrodes are marked with ISI mark as per IS:1239 | |
| 4 | Dimensions of the Outer Pipe (Dia x Length x Thickness in mm) | ----- |
| 5 | Dimensions of the inner Pipe (Dia x Length x Thickness in mm) | ----- |

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| | | |
|----|---|--|
| 6 | Whether M. S. Pipes are hot dip galvanized as per this specification & the level of hot dip galvanizing in microns | 250-300 microns |
| 7 | Whether the conductive material in the pipe electrodes is machine pressed to have homogenous solid mixture | |
| 8 | Contents of the Conductive materials (in Percentage) filled in between the two pipes & in the inner side pipe | 70% Carbon powder & 30% metal powder preferably pure copper or aluminum material along with the required quantity of bonding materials |
| 9 | Whether the material is tested for resistivity as per this specification. | <0.2 ohm-meter |
| 10 | Size of bus bar connecting M. S. Plate (Hot dip Galvanized) welded to the electrode for earth connection. | 350mmx50mmx6mm |
| 11 | Hardness of the Conductive material after setting | |
| 12 | Earth Resistivity of the earth electrode assembly after setting | |
| 13 | Total weight of the earth electrode assembly | |
| 14 | Brand name of the earth enhancement material (if any) | |
| 15 | Contents of the earth enhancement material (Percentage of various components in the mixture & their Chemical Composition etc.) | |
| 16 | Resistivity of the earth enhancement material | Below 0.2 Ohm-meter |
| 17 | pH value of the earth enhancement material | >7 & <9 |
| 18 | Moisture retaining capacity at 105°C | >10% |
| 19 | Granular size of the material | 0.1mm to 3mm |
| 20 | Water solubility (in Percentage) | 51% |
| 21 | Thermal stability of the material (Temperature Range) | -10°C to 60°C |
| 22 | Weight of material per bag | |
| 23 | Whether the Material is nontoxic, nonreactive, nonexplosive & noncorrosive as per the specification | |
| 24 | Whether the material is packed in proper bags & bags marked with details such as Brand name, Batch no., Year & month of manufacture & tender reference etc. | |
| 25 | Whether type tests as applicable for the materials offered are submitted if so Give details | |

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TECHNICAL SPECIFICATION OF GI EARTHING STRIPS

1. Scope

This section of the specification covers the supply, erection, testing and commissioning of Galvanizes Iron Earthing Strips for the Distribution Network equipment's.

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 I | IS: 5358(1969) |
| Specification for Electroplating | IS:3203 |
| Specification for hot dip Zinc coating on structural & other allied products | IS: 4759(1968) |

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 DISCOM 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.

4. Inspection

The Purchaser reserves the right to inspect the material at the time of tests. All tests shall then be performed in the presence of Inspecting Authority appointed by the Purchaser and the Supplier. The Bidder shall have to give intimation of place and date and time of each test to enable the later to be present to witness the test. All the test results must be recorded in presence of the inspecting authority and no materials shall be dispatched, without having been passed by Purchaser's duly appointed Inspector and specific dispatch instructions in writing from Chief Engineer / Addl. Chief Engineer (Project).

5. TESTS

The following tests shall be carried out in accordance with IS:280-1978 or the latest version thereof as per sampling criteria stipulated therein:

- i) Dimensional check (dia.).
- ii) Visual inspection regarding freedom from defects.
- iii) Tensile test
- iv) Galvanizing/Electroplating test

6. QUALITY ASSURANCE PLAN

The bidder shall invariably furnish following information along with his offer, failing which his offer shall be rejected.

- I. Statement giving list of raw materials, proposed to be used against this Specification, names of sub suppliers for the 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 as routine and / or acceptance during processing and on finished goods, copies of test certificates of processing and testing facilities available.
- II. List of areas where stage inspections are normally carried out for quality control and details of such tests and inspections.
- III. List of testing equipment available with the Bidder for testing. In the case if the Bidder does not possess all the Routine and Acceptance testing facilities the tender will be rejected.
- IV. The Purchaser reserves the right for factory inspection to verify the facts quoted in the offer. If any of the facts are found to be misleading or incorrect the offer of that Bidder will be out rightly rejected and he may be black listed.

TECHNICAL SPECIFICATION FOR 1.1kV XLPE INSULATED POWER CABLES

1. Scope

This specification covers the design, manufacture, shop testing, supply and delivery in proper packed condition of 1.1kV voltage grade Aluminum Conductor, XLPE insulated, PVC sheathed, Armoured, screened Power Cables generally conforming to the latest standards of IS / IEC / BS or equivalent.

2. Service Conditions

Equipment to be supplied against this specification shall be suitable for satisfactory continuous operation under the following tropical conditions.

- a) Maximum ambient temperature of air: 50°C
- b) Maximum temperature of air in shade: 4°C
- c) Maximum daily average ambient temperature: 40°C
- d) Maximum yearly average ambient temperature: 30°C
- e) Relative Humidity: up to 95%
- f) Average number of thunder storm days per annum: 15

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- g) Maximum annual Rainfall: 150cm
- h) Maximum Altitude above mean sea level: 1000Meter
- i) Maximum Wind Pressure: 150 Kg/cm² (As per IS 802 latest code)
- j) Maximum soil temperature at cable depth: 30°C
- k) Maximum soil thermal resistivity: 150°C cm/watt

3. Code & Standards

All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those (IS: Codes, standards, etc.) referred to herein, the former shall prevail.

Nothing in this specification shall be construed to relieve the contractor of his responsibility. Where no standards are available, the supply items shall be good quality, workmanship and backed by test results.

The power cable shall conform to the latest applicable standards and codes of practice as mentioned in this specification.

Other National Standard are acceptable if they are established to be equivalent to or superior to the listed standards subject to approval by the purchaser and the contractor shall provide English version of standards and codes applicable.

The 1.1kV XLPE power cable shall confirm to the currently applicable standards and codes of practice and reports as mention below table:

| S. No. | Title | IS Standard | IEC / BS Standard |
|--------|--|----------------------------|-------------------|
| 1 | Conductors for insulated electric cables and flexible cords. | IS: 8130 – 1984 | IEC 60228-1978 |
| 2 | PVC insulation and sheath of electric cables. | IS: 5831 – 1984 | IEC 60502 |
| 3 | Mild steel wires, Formed wires and Tapes for armouring of cables. | IS: 3975 – 1988 | |
| 4 | Fictitious calculation method for determination of dimensions of protective coverings of cables. | IS :10462 (Part I) – 1983 | IEC 60502:1978 |
| 5 | 1.1 KV Grade XLPE insulated cables. | IS : 7098 (Part-I) | |

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| 6 | Method of test for cables | IS : 10810 | |
| 7 | Code of practice for installation & maintenance of power cables up to & including 11 KV rating. | IS : 1255 | |
| 8 | Drums for electric cables. | IS : 10418 | |
| 9 | Electro Technical Vocabulary for Electric Cables | IS:1885, Part-32 | |

4. General Technical Requirements

(II) Armoured cables: -

1100 Volts Grade L.T. cable with stranded H2/H4 grade aluminum conductor, XLPE insulated, colour coded, laid up, with fillers and/or binder tape where necessary provided with extruded PVC inner sheath, single galvanized round steel wire / strip armoured and provided with PVC outer sheath. All LT cable shall be conforming to IS : 5831& IS : 8130 (amended up to date) and bearing ISI mark .

(III) Insulation, Inner sheath and Outer sheath: -

Insulation, inner sheath and outer sheath shall be applied by separate extrusion. Inner sheath shall be applied by extrusion only. Bedding of PVC tape for inner sheath is not acceptable. The color of the outer sheath shall be different according to the different size of cables and color of outer sheath shall be approved before manufacturing. The quality of insulation should be good and insulation should not be deteriorated when exposed to the climatic conditions.

The core insulation shall be with cross linked polyethylene insulating compound applied by extrusion & should be manufactured with Dry/Gas curing process. It shall be free from voids and shall withstand all mechanical and thermal stresses under steady state and transient operating condition. It shall conform to the properties given in Table-1 of IS: 7098(Part-2).

The conductor screen, XLPE insulation and insulation screen shall be extruded in one operation by "Triple Extrusion Dry. Cured" process to ensure perfect bonding between the layers. The core identifications shall be colored strips or by printed numerals.

The outer sheath of the cables shall be of PVC compound conforming to the armouring and shall be of PVC compound conforming to the requirements of Type ST2 compound of IS:5831 with suitable additives shall be provided (To prevent attack by rodent & termite). The thickness of outer sheath shall be as per amendment No. 1 to Table 5 of IS: 7098- part-2.

The dimension of the insulation, inner sheath and armour materials shall be governed by values given in latest IS: 7098(pt.2)1958.

(IV) Sequential marking of length on cable: -

Non erasable Sequential Marking of length shall be provided by embossing on outer sheath of the cable for each meter length.

(V) Continuous A C current capacity: -

Continuous A.C. current capacity shall be as per Table given below.

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| Conductor sizes insq.mm. | Continuous A.C. current capacity in Amps. | |
|-----------------------------|---|--------------|
| | In ground(Amps) | In air(Amps) |
| 4C X 10 sq.mm | 78 | 70 |
| 4C X 25 sq.mm | 95 | 99 |
| 3.5C X 35 sq.mm | 116 | 117 |
| 3.5C X 50 sq.mm | 140 | 140 |
| 3.5C X 70 sq.mm | 176 | 176 |
| 3.5C X 95 sq mm | 200 | 221 |
| 3.5C X 120 sq mm | 225 | 258 |
| 3.5C X 185 sq mm | 285 | 339 |
| 3.5C X 240 sq mm | 325 | 402 |
| 1C X 300 sq mm | 390 | 519 |

(VI) Common Conductor Resistance and Short circuit current carrying capacity: -

| Nominal Area of Conductor (Sq.MM) | Maximum DC resistance at 20 deg C (Ohms / kM) | Short Circuit Current for Conductor (KA / Sec) |
|-----------------------------------|---|--|
| 25 | 1.20 | 2.35 |
| 35 | 0.868 | 3.29 |
| 50 | 0.641 | 4.70 |
| 70 | 0.443 | 6.58 |
| 95 | 0.320 | 8.93 |
| 120 | 0.253 | 11.28 |
| 150 | 0.203 | 14.10 |
| 185 | 0.164 | 17.39 |
| 240 | 0.125 | 22.56 |
| 300 | 0.100 | 28.20 |

(VII) Dimensional Details of Cable: -

| Type of Cable | Nominal Thickness of Insulation (mm) | Minimum thickness of Inner sheath (mm) | Minimum thickness of Outer Sheath (mm) |
|---------------|--------------------------------------|--|--|
| 4C X 10 sq.mm | 0.70 | 0.30 | 1.40 |
| 4C X 25 sq.mm | 0.90 | 0.30 | 1.40 |

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| | | | |
|------------------|------|------|------|
| 3.5C X 35 sq.mm | 0.90 | 0.30 | 1.40 |
| 3.5C X 50 sq.mm | 1.00 | 0.30 | 1.40 |
| 3.5C X 70 sq.mm | 1.00 | 0.30 | 1.40 |
| 3.5C X 95 sq mm | 1.10 | 0.40 | 1.56 |
| 3.5C X 120 sq mm | 1.20 | 0.40 | 1.72 |
| 3.5C X 185 sq mm | 1.60 | 0.50 | 1.88 |
| 3.5C X 240 sq mm | 1.70 | 0.60 | 2.20 |
| 1C X 300 sq mm | 2.2 | - | 1.56 |

(VIII) Storage and handling of cables: -

- a. All cables shall be inspected upon receipt at site and checked for any damage during transit. Cable drums shall be stored on a well-drained, hard surface, preferably of concrete, so that the drums do not sink in the ground causing rot and damage to the cable drums.
- b. During storage periodical rolling of drums once in 3 months done. Rolling shall be done in the direction of the arrow marked on the drum.
- c. It should be ensured that both ends of the cable are properly sealed to prevent ingress/absorption of moisture by the insulation.
- d. Protection from rain and sun shall be ensured. Sufficient ventilation between cable drums, should be ensured during storage.
- e. The drums shall always be rested on the flanges and not on the flat sides.
- f. Damaged battens of drums etc. should be replaced, if necessary.
- g. When cable drums have to be moved over short distances, they should be rolled in the direction of the arrow, marked on the drum.
- h. For transportation over long distances, the drum should be mounted on cable drum wheels strong enough to carry the weight of the drum and pulled by means of ropes. Alternatively, they may be mounted on a trailer or on a suitable mechanical transport.
- i. When unloading cable drums from vehicles, a crane shall preferably be used. Otherwise the drum shall be rolled down carefully on a suitable ramp or rails, where necessary.
- j. While transferring cable from one drum to another, the barrel of the new drum shall have a diameter not less than that of the original drum.
- k. The cables shall not be bent sharp to a small radius. The minimum safe bending radius for all types of XLPE cables shall be taken as 12 times the overall diameter of the cable. Wherever practicable, larger radius should be adopted. At joints and terminations, the bending radius of individual cores of a multi core cable shall not be less than 15 times its overall diameter.
- l. Cable with kinks and straightened kinks or with similar apparent defects like defective armouring etc. shall be rejected.
- m. Cables from the stores shall be supplied by the contractor as per the site requirement in pieces cut in the stores, and further both ends are to be sealed as per Para 'c' above.

(IX) Drums

Cables shall be supplied in the drums made from eco-friendly material in the specified length. The Drums shall be strong, weatherproof and non-returnable. The ends of the cable shall be

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sealed by means of non-hygroscopic sealing material. Applicable Length of Cable/ drum should be as per IS.

The cable shall be supplied in standard drum length of 500 mtrs. +/- 5% tolerance for all the sizes of cable except 10 mm² & 16mm² size cable. The drum length for 10 mm² and 16mm² cable shall be 1000 mtrs. +/- 5%.

Over all tolerance in total quantity of ordered cables shall be +/- 2%.

General

- All cables shall be suitable for installation in air, conduits, ducts, and open concrete trenches or for direct burial in either wet or dry locations for normal operating conditions.
- All cables shall be flexible and easy to bend, pull, handle and install

(X) Installation (Laying in trench):-

General:

The cable installation including necessary termination shall be carried out in accordance with the specifications given herein and IS 1255.

Trenching:

The detail technical specification of Trench shall be a part of civil works.

- (i) Width of Trench: - 300/450/600mm
- (ii) Depth of Trench: - 1200mm.

Laying of Cable in Trench

- i. At the time of issue of cable for laying, the cores shall be tested for continuity and insulation resistance.
- ii. The inter-axial spacing between the cables shall be maintained as per IS to maximize the cable capacity.
- iii. The cable drum shall be properly mounted on jacks or on a cable wheel, at a suitable location, making sure that the spindle, jack etc. shall be strong enough to carry the weight of the drum without failure and that the spindle is horizontal in the bearings so as to prevent the drum creeping to one side while rotating.
- iv. The cable shall be pulled over rollers in the trench steadily and uniformly without jerks and strains. The entire cable length shall as far as possible be pulled of in one stretch. However, where this is not possible the remainder of the cable may be removed by 'Flaking' i.e. by making one long loop in the reverse direction.
- v. After the cable has been uncoiled and laid into the trench over the rollers, the cable shall be lifted slightly over the rollers beginning from one end by helpers standing about 10 m apart and drawn straight. The cable should then be taken off the rollers by additional helpers lifting the cable and then laid in a reasonably straight line.
- vi. When the cable has been properly straightened, the cores shall be tested for continuity and insulation resistance. In case of PVC XLPE cables, suitable moisture seal tape shall be used for this purpose.

Laying in HDPE pipes by HDD/closed ducts:

- i. In location such as road crossing, crossing other utilities etc. cables shall be laid in pipes.

- =====
- ii. HDPE Pipes shall be used for such purposes. Pipes as required shall be laid along with the civil works and jointed according to the instructions of the Engineer-in-Charge as the case may be. The size of pipe shall be as indicated in the Road Crossing Drawing for Electrical Services.
 - iii. The pipes on road crossing shall preferably be on the skew to reduce the angle of bends as the cable enters and leaves the crossings. This is particularly important for high voltage cables.
 - iv. Manholes of adequate size as specified or decided by the Engineer-in-Charge shall be provided to facilitate feeding/drawing in of cables and to provide working space for persons. They shall be covered by suitable manhole covers with frame of proper design.
 - v. Pipes shall be continuous and clear of debris or concrete before cable is drawn. Sharp edges at ends shall be smoothened to prevent injury to cable insulation or sheathing.

5. TEST & INSPECTION

Cables shall be subjected to routine & acceptance tests in accordance with the IS 1554 (Part – I, in addition to physical, ageing and electrical tests at the Manufacturer’s plant in accordance with applicable standards and will be approved by 3rd party agency.

5.1 Type Test:-

The successful bidder shall submit the following type test reports conducted on similar equipment’s for approval of owner.

- a) Annealing test (for copper)
- b) Tensile Test (for aluminum)
- c) Conductor resistance test
- d) Test for Armour wires
- e) Test for thickness of insulation check
- f) Physical test for insulation
- g) Physical test for PVC sheath
 - i. Fire resistance.
 - ii. Cold-impact
 - iii. Bleeding and blooming
- h) Partial discharge test
- i) Bending Test
- j) Dielectric power factor tests
- k) Heating cycle test
- l) Impulse withstand test
- m) High voltage test (water immersion test)

All the following routine / acceptance tests specified in relevant standards shall be witnessed by the owner / consultant.

5.2 Acceptance Test:-

- a) Conductor resistance test
- b) Test for thickness of insulation and sheath
- c) Partial discharge test (for screened cables only)
- d) High voltage test (water immersion test)
- e) Annealing test (for copper)
- f) Tensile test (for aluminum)
- g) Wrapping test (for aluminum)
- h) Insulation resistance test

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5.3 Routine Test: -

- a) Conductor resistance Test
- b) Partial discharge test (for screened cable only)
- c) High voltage test.

5.4 Test Certificate: -

Three (3) copies of routine / acceptance test certificates shall be produced with the endorsement of the inspecting authority to the purchaser before effecting dispatch.

5.5 PACKING AND MAKING

Cables shall be dispatched in non-returnable wooden drums of suitable barrel diameter. Securely battened, with the take-off end fully protected against mechanical damage. The wood used for construction of the drum shall be properly seasoned, sound and free from defects. Wood preservatives shall be applied to the entire drum. Ferrous parts used shall be treated with a suitable rust preventive finish or coating to avoid rusting during transit or storage.

On the flange of the drum, necessary information such as project title, manufacturer's name, type, size, voltage grade of cable, length of cable in meters drum no, cable code, BIS certification mark, gross weight etc. shall be printed. An arrow shall be printed on the drum with suitable instructions to Show the direction of the drum.

6. GTP

| S No | Description | To be submitted by Bidder | | | | | |
|------|--|---|--|--|--|--|--|
| | NAME OF MANUFACTURER | | | | | | |
| 1 | Size of the cable | | | | | | |
| 2 | Rated Voltage | 1.1 kV | | | | | |
| 3 | Standard Referred | | | | | | |
| 4 | Conductor | Aluminium as per Class-2 of IS: 8130 | | | | | |
| 5 | Nominal Cross Section Area | | | | | | |
| 6 | No of wires/DIA | | | | | | |
| 7 | Shape of Conductor | | | | | | |
| 8 | Insulation | | | | | | |
| | Material | XLPE | | | | | |
| | Nominal Thickness | | | | | | |
| | App. Dielectric strength | | | | | | |
| | Suitability with regard to temperature, moisture, acid, oil and alkaline surrounding | YES | | | | | |
| 9 | Inner Sheath | | | | | | |
| | Material | PVC Type ST-2 as per IS: 5831; Options: FR Type/FRLS Type | | | | | |
| | Minimum thickness of sheath (mm) | | | | | | |
| 10 | Armouring | | | | | | |

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| | | | | | | | | |
|----|---|---|--|--|--|--|--|--|
| | Material & Type | Single Layer of Galvanized Steel Round Wire / Flat Strip | | | | | | |
| | Nom.dia/dimen of armour wires/Strips in mm | | | | | | | |
| 11 | Outer sheath | | | | | | | |
| | Material | PVC Type ST-2 as per IS: 5831; Options: FR Type/FRLS Type | | | | | | |
| | Minimum thickness of sheath (mm) | | | | | | | |
| 12 | Approx. overall dia of Cable (in mm) | | | | | | | |
| 13 | Method of core identification | | By colour coding (Red, Yellow, Blue & Black) | | | | | |
| 14 | Electrical Properties: - | | | | | | | |
| | Maximum d.c. resistance of conductor at 20 ⁰ C Ohm/Km) | | | | | | | |
| | Maxmimum permissible conductor temperature(°C) under full load | 90°C for XLPE insulation | | | | | | |
| | Rated voltage | 1.1 kV | | | | | | |
| | Maximum operating voltage | 1.1 kV | | | | | | |
| | Permissible voltage variation | ±10% | | | | | | |
| | Rated frequency | 50HZ | | | | | | |
| | Permitted frequency variation | ±5% | | | | | | |
| | Approx. Conductor A.C.Resistance at 90 °C | | | | | | | |
| | Reactance of Cable at 50 Hz (Approx.) | | | | | | | |
| | Normal Current Rating | | | | | | | |
| | Short Circuit Current Rating for 1 Second Duration in K amps | | | | | | | |

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**TECHNICAL SPECIFICATION OF JOINTS FOR 1.1kV XLPE ALUMINIUM / COPPER
POWER CABLES**

1 Scope

This specification covers design and manufacturing, supply and jointing of cable joints suitable for 1.1kV Armored PVC/XLPE Al/Cu Conductor Cables.

2 Service Conditions

Equipment to be supplied against this specification shall be suitable for satisfactory continuous operation under the following tropical conditions.

- a) Maximum ambient temperature of air: 50°C
- b) Maximum temperature of air in shade: 4°C
- c) Maximum daily average ambient temperature: 40°C
- d) Maximum yearly average ambient temperature: 30°C
- e) Relative Humidity: up to 95%
- f) Average number of thunder storm days per annum: 15
- g) Maximum annual Rainfall: 150cm
- h) Maximum Altitude above mean sea level: 1000Meter
- i) Maximum Wind Pressure: 150 Kg/cm² (As per IS 802 latest code)
- j) Maximum soil temperature at cable depth: 30°C
- k) Maximum soil thermal resistivity: 150°C cm/watt

3 General Technical Requirements

- i. The accessories shall be supplied in kit form. Each component of the kit shall carry the manufacturer's mark of origin.
- ii. The supplied joint shall have a range taking feature.
- iii. The kits must have unlimited shelf life.
- iv. The insulating tubing over the connector should be Dual Wall design sleeve with entrapped lubricant.
- v. Type tests should have been carried out to prove the general qualities and design of a given type of jointing system. The sleeve shall be tested for ANSI C1191.1-1986 or equivalent standard. Type Test Report for the same shall be submitted along with offer.
- vi. The installation of joint shall be done without use of special tools like crimping tool.
- vii. Conductor connection shall be achieved by use of connectors with pre-defined shear off bolt head design. The connector should be range taking which can be used for both copper & Aluminium cables.
- viii. Armour Connectivity shall be maintained by using Tinned copper braid.
- ix. Armour Wrap to be provided for mechanical protection of joint body.
- x. The design of joint shall be such that on completion of joint the cable can be charged immediately.

4 Marking & Labeling

As per the IS 13573 (Part-I&II):2011 all kits shall be marked and labeled suitably for identification.

- a. Manufacturer's name or logo and the name of components wherever feasible;

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- b. Type of jointing materials, the application;
- c. Batch number(s), where relevant;
- d. Product reference;
- e. Defined storage conditions and expiry date, if any;
- f. If relevant, the manufacturing date;
- g. Health and safety marking and handling instructions, where relevant; and
- h. Reference to compliance with this standard.

5 Tests

5.1. TYPE TESTS

The Jointing Kit offered, shall be fully type tested at NABL Lab as per the relevant standards. The tenderer shall furnish the type test reports along with the offer. Offer without Type test reports will not be considered. For any change in the design/type, already type tested and the design/type offered against this specification the purchaser reserved the right to demand repetition of type tests without any extra cost in presence of purchaser's representative.

TYPE TEST SEQUENCE

The type test shall be carried out as per the test sequence given in IS 13573/2011(Part -I, II & III)

5.2. ACCEPTANCE & ROUTINE TESTS:

All acceptance and routine tests as stipulated in the relevant standards shall be carried out by the supplier in presence of purchaser's representative. The purchaser reserves the right to insist for witnessing the acceptance/routine testing of the bought-out items.

5.3. ADDITIONAL TESTS:

Additional test to be carried out in GUVNL'S Lab are Volume Resistivity, B.D.V., Tensile & Elongation etc. Supplier may depute his representative for witnessing the test conforming the date from relevant GUVNL'S Lab.

5.4. PRE-DESPATCH INSPECTION

All acceptance tests and inspection shall be carried out at the place of manufacturer unless otherwise specially agreed upon the manufacturer and purchase at the time purchase. Manufacturer shall offer to the inspector representing the purchaser, all the reasonable facilities, free of charge, for inspection and testing to satisfy him that the material is being supplied in accordance with this specification. The GUVNL representative/Engineer attending the above test will carried out testing for suitable number of cable joints/terminations as per sampling procedure laid down in IS:13573(Part-I, II, III):2011 (amended up to date) and issue test certificate approval to the manufacturer and give clearance for dispatch. The cable jointing/termination kit shall be sealed after the inspection.

5.5. INSPECTION AFTER RECEIPT AT STORES

For Random sample testing (RST) the sample Cable Termination/jointing kit will be drawn from any one of the store.

5.6. DEMONSTRATION & TRAINING:

The purchaser reserves the right to ask for demonstration of the equipment offered at the purchaser's place. The Tenderer shall arrange for demonstration of installation of jointing/termination kits free of cost for giving training to purchaser's representative to get acquainted with the jointing method. The jointing/termination kit along with required length of the kits to be used for demonstration purpose shall be specified the cable will be provided by the Purchaser.

5.7. GUARANTEE

The Kits shall be suitable for storage without deteriorating at a temperature up to 50degree Celsius under normal conditions of storage and shall have unlimited shelf storage life. The tenderer shall guarantee the installed cable accessories for a minimum period of not less than 5 years from the date of installation. The stores/materials found defective within the above guarantee period, shall be replaced by the supplier free of cost within one month of receipt of intimation.

5.8. QUALITY CONTROL

The purchaser has a right to send team of experienced Engineers for assessing the capability of the firm for manufacturing and testing of Cable jointing kit as per this specification. The purchaser representative should be given all assistances and cooperation for inspection and testing at the bidder's work.

5.9. QUALITY ASSURANCE PLAN

The tendered shall invariably furnish QAP along with his offer, The QAP adopted by him in the process of manufacturing shall be consist of List of Plant and Machinery available at the manufacturers premises. List of Testing equipment's available at the manufacturers premises with their calibration schedule.

5.10. PACKING

The Cable jointing kits shall be suitably packed to avoid damage or disturbance during transit or handling. Each Cable jointing kits may be suitably packed in the first instance to prevent ingress of moisture and dust and then placed in a cushioned carton of a suitable material to prevent damage due to shocks during transit. The lid of the cartoon may be suitably sealed. A suitable number of sealed cartons may be packed in a case of adequate strength with extra cushioning if considered necessary. The cases may then be properly sealed against accidental opening in transit.

The following information shall be furnished with the consignment:

- Name of consignee
- Details of consignment
- Destination
- Total Weight of consignment.
- Sign showing upper / lower side of the crate
- Sign showing fragility of the material.
- Handling and unpacking instructions.
- Bill of Materials indicating contents of each component and spare materials.
- Installation instructions including drawing or other information specific to the accessories.

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6 GTP FOR LT CABLE ACCESSORIES i.e. JOINTS & TERMINATIONS (Heat Shrinkable)

| Sr. No. | Particulars | GUVNL Requirement | Bidder Offer. |
|---------|---|--|---------------|
| 1 | Manufacturer' Name& Address | | |
| 2 | Brand Name &Country of Origin | | |
| 3 | Kit Storage Temperature | 50°C max | |
| 4 | Voltage Grade | 1.1kv | |
| 5 | Applicable Standards | Indicated in Cl.No.4 of Technical Spec. | |
| 6 | Material to be used | Polymeric Heat shrink tubes. | |
| 7 | Type of Kit Offered | 1)Straight through Joint. 2)Transition joint. 3)Termination joint. | |
| 8 | Shelf life of components in the kit | Unlimited. | |
| 9 | Time Required for energization after completion of termination/joint. | Immediate. | |
| 10 | Impulse withstand on Low voltage kits. | As per IS 13573 joints classification for cable size less than 50sqmm.it will be 8kv & for cable size more than 50sqmm.it will be 20kv | |
| 11 | Heating cycle in Air | As per IS-13573 part-I See 8.3 | |
| 12 | Heat Cycle in Water(Over sheath damage) | As per IS-13573 part-I See 8.3 | |
| 13 | Insulation resistance(Immersed) | As per IS-13573 part-I See 8.4 | |
| 14 | Insulation resistance(Air) | As per IS-13573 part-I See 8.4 | |
| 15 | Impact at ambient temp. | As per IS-13573 part-I See 8.5 | |
| 16 | AC High voltage withstand(In Air) | As per IS-13573 part-I See 8.6 | |
| 17 | AC High voltage withstand(immersed) | As per IS-13573 part-I See 8.6 | |
| 18 | Examination of joint. | As per IS-13573 part-I See 8.8 | |
| 19 | Dielectric Strength for insulating Tube. | 12kv/mm | |
| 20 | Dielectric constant for insulating tube | 3.5(min) | |

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| | | | |
|----|--|---|--|
| 21 | Tensile strength for insulating tube | 8N/mm ² | |
| 22 | Ultimate Elongation for insulating tube | 200 to 500% | |
| 23 | Water Absorption for Insulating Tube | 0.3% | |
| 24 | Longitudinal Change for insulating tube | +10% | |
| 25 | Heat Shock for insulating tube | 30min@2000c, | |
| 26 | Flammability for insulating tube | pass | |
| 27 | Heat Shrink Outer insulating tubes | As per specification (clause no.5.01& 5.02) | |
| 28 | G.I. Wire mesh / Canister | As per cable size | |
| 29 | Red mastic | As per cable size | |
| 30 | G.I. Solid Collet | As per cable size | |
| 31 | Earthing Conductor | As per requirement | |
| 32 | Ferrule | As per specification (clause no.5.01&5.02) | |
| 33 | PVC NA Tape | As per requirement | |
| 34 | PVC Adhesive Tape | As per requirement | |
| 35 | Cleaning Liquid | As per requirement | |
| 36 | Aluminum Oxide cloth | As per requirement | |
| 37 | Heat shrink break boot(Termination) | boot(Termination) As per specification (clause no.5.02) | |
| 38 | List Of Contents Of Kit (To Be Furnished Separately) | Detailed component list with Quantity etc. | |

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TECHNICAL SPECIFICATION FOR FUSE SECTION PILLAR (FSP)**1.1 SCOPE**

This specification covers the design, manufacturing and testing of FSP with anti-corrosive, dust proof, rust proof, shock proof, self-extinguishing property, resistant to heat, vermin & water proof, Ultra Violet Stabilized and pilfer resistant made from Thermosetting Plastic i.e. Glass Reinforced Polyester Sheet Moulding Compound (SMC) Confirming to IS: 13410 -1992 and attached technical specification, and IS: 14772-2000 with TPN switch Disconnecter fuse & SMC HRC fuse base confirming to IS:13703/1993 (Pt.I & II amended up to date) and other relevant IS.

The equipment offered shall be complete with all parts necessary for their effective and trouble-free outdoor operation. Such parts will be deemed to be within the scope of the supply irrespective of whether they are specifically indicated in the commercial order or not.

It is not the intent to specify herein complete details of design and construction. The equipment offered shall conform to the relevant standards and be of high quality, sturdy, robust and of good design and workmanship complete in all respects and capable to perform continuous and satisfactory operations in the actual service conditions at site and shall have sufficiently long life in service as per statutory requirements.

In these specifications, the design and constructional aspects, including materials and dimensions, will be subject to good engineering practice in conformity with the required quality of the product, and to such tolerances, allowances and requirements for clearances etc. as are necessary by virtue of various stipulations in that respect in the relevant ISO, IEC, BS, IS standards and other statutory provisions.

1.2 SERVICE CONDITIONS

Equipment to be supplied against this specification shall be suitable for satisfactory continuous operation under the following tropical conditions.

- a) Maximum ambient temperature of air: 50°C
- b) Maximum temperature of air in shade: 4°C
- c) Maximum daily average ambient temperature: 40°C
- d) Maximum yearly average ambient temperature: 30°C
- e) Relative Humidity: up to 95%
- f) Average number of thunder storm days per annum: 15

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- g) Maximum annual Rainfall: 150cm
- h) Maximum Altitude above mean sea level: 1000Meter
- i) Maximum Wind Pressure: 150 Kg/cm² (As per IS 802 latest code)
- j) Maximum soil temperature at cable depth: 30°C
- k) Maximum soil thermal resistivity: 150°C cm/watt

1.3 TECHNICAL PARAMETERS

FSP should be designed to have maximum utilization of transformer capacity and shall be well equipped with adequate protection to transformer against overload and short circuit and minimum interruption in power supply.

| Sl. No | Parameter | Value |
|--------|------------------------------|---|
| 1 | Rated Supply Voltage | 433 volts +/-10% |
| 2 | Number of Phases & Frequency | 3 phase 4W 50 Hz |
| 3 | Rated Current | 250A, 630A (as per Single line diagram/BOQ). |
| 4 | Neutral | Solidly Grounded |
| 5 | MODE OF INSTALLATION | mounted either on plinth near transformer or on M.S. Channels fixed between two Poles |
| 6 | Thickness of wall mm | 4 |
| 7 | Bus bar material | Tinned Cu / Al bus bar |

1.4 APPLICABLE STANDARDS

All equipment and material shall be designed manufactured and tested in accordance with the latest applicable IEC standard or IS standard except where modified and / or supplemented this specification.

| Title | IEC Standard | IS /Other Standard |
|---|---------------------------|--------------------|
| Low-voltage switchgear and control gear | IEC:60947 (Part-1,2,3) | IS: 13947 |

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PASCHIM GUJARAT VIJ COMPANY LIMITED

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| | | |
|--|--------------------|----------|
| Low-voltage switchgear and control gear assemblies | IEC:60439 (Part-2) | -do- |
| General Requirements for Enclosures for Accessories for Household and Similar Fixed Electrical Installations | | IS 14772 |
| Glass reinforced polyester sheet moulding compounds (SMC) | | IS 13410 |
| LV Fuses for voltages not exceeding 1000 V ac or 1500 V dc, | | IS 13703 |
| MCBs | IEC 60898 | IS: 8828 |

1.5 GENERAL TECHNICAL REQUIREMENTS

- The minimum size of box from inside shall be 1200(H)x 1000(W)x400(D) mm. and thickness of wall minimum 4 mm.
- FSP shall be of Grade S-3 SMC material. FSP shall be moulded in a single piece forming the body of the FSP with a cover fitted with base by minimum three nos. concealed stainless steel hinges. The lid/cover shall rest on the collar of the FSP base in such a way that any access from outside is not possible. The stainless steel hinges shall be fitted with the FSP body base and covers rigidly, thereby making the FSP pilfer resistant.
- The door in closed position should be overlapped in such a manner that no direct entry or access is possible. The FSP shall be closed by SS 'U' Clamp for holding and locking of the door with body base. The "U" Clamp shall have minimum diameter holes through which it is possible to lock the FSP.
- The door shall open at 90 degrees (Min.). The top surface of box shall have little tapering shape towards both sides of the distribution box for easy flow of rainwater.
- Earth bolt of 6 mm diameter X 20 mm. length with 2 nos. nuts, 2 nos. washers and 1 no. spring washer shall be provided. The earthing arrangement shall be of M.S. with Zinc passivation. All corners of the FSP should be round & not pointed ones. All metal parts shall be zinc passivated.
- The FSP should have a three pole AC-23 – 1250 / 800 / 630 AMP TPN switch Disconnector fuse with bolted HRC Fuses which can provide Isolation and Protection. 1250 / 800 / 630 AMP Protection Switch should be as per IS: 13947-3/ IEC-947-, having test reports either from NABL or COFRAC accredited lab for AC-23 A utilization test, short circuit test for 80KA rms.

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- g) The FSP should have 5 nos. of 3 phase & neutral outgoing circuit with HRC SMC fuse base and appropriate size of lugs fitted with busbar.
- h) Anodized aluminum operating instructions in GUJARATI shall be fixed inside the door. The letter should be cleared legible and readable. The letters of the instructions should be of sufficient size to read with normal eye.
- i) The FSP should have Bus bar of EC grade tinned copper bus bar 50x8 mm / Aluminum bus bar 15x60 mm duly insulated of for all phase and neutral.

1.6 TESTS

- a) The bidder shall submit type test report for complete FSP as per BS 214/1959 or IS 8623/93 and for box as per IS-14772-2000 & IS: 13410- 1992 from CIPET, Ahmedabad/ERDA, Baroda or NABL accredited lab. for the box as well as TPN switch disconnecter fuse & SMC fuse base along with the offer. Type Test Certificate should not be older than 5 years as on the date of tender opening.

- b) **ROUTINE TEST:** Manufacturer has to carryout routine test during production to check the essential requirements that are likely to vary during production. Manufacturer has to keep records of the same and to be produced for verification of inspector when asked at the time of inspection of lot.

c) **TYPE TEST (For SMC box):**

From the offered lot sample may be picked up at discretion of purchaser for type test at CIPET, Ahmedabad/ERDA, Baroda or NABL accredited lab for each lot offer. The charges for the type test shall be borne by bidder. On passing the type test successfully, the lot shall be accepted. In case, the boxes are not confirmed to type test, another sample from the lot shall be selected and the tested again. On receipt of unsatisfactory results, the lot shall be rejected and new lot shall be offered for inspection keeping aside old lot offered and rejected earlier by the Company. However, Company reserves the right to accept the boxes by levying penalty as per description of the company.

d) **TYPE TEST (For Isolator/box):**

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Type test reports not more than 5 years old from the date of tender from Government approved and NABL accredited lab.

- 1) Type Test for complete FSP as per BS214/1959 or IS8623/93.
- 2) Type test report for Switch Disconnecter as per IS 13947/1993 (all parts) or its latest amendment.

e) ACCEPTANCE TESTS:

The bidder should have all the testing facilities at their works & shall offer testing as under. Following acceptance tests shall be carried out, on 2% of the offered quantity on sample boxes selected at random, while inspecting the lot of materials offered.

- Visual examination
- Verification of dimensions as per approved drawings.
- Verification of fittings
- HV test at 5.2 (3.5*1.5) KV for Bus bar, 11KV for SMC material of Box.
- Insulation resistance test with 2.5KV DC megger of each box.
- Temperature rise test in accordance with relevant IS for the rated capacity of Switch disconnecter fuse.
- Earth continuity checking test.
- Operations test on Switch disconnecter or fuse as well as SMC HRC fuse base & fuse link.

Note: PGVCL reserve the right to select one sample from whole tender quantity and will send Govt. approved/ NABL accredited lab. For complete acceptance test of all material. Cost of the same is to be paid by contractor.

1.7 DRAWING & CALIBRATION OF INSTRUMENT

The tenderer shall submit detailed constructional and dimensional drawing of complete FSP details of Units and TPN switch Disconnecter fuse, incoming and outgoing circuit, Louvers details, clearance details along with the offer.

- (a) The firm has to submit list of testing equipment's instruments, stating Sr. No., Make, Capacity, date of last calibration along with test certificate of each instrument along with the offer, same is also required to be provided to inspecting officer at the time of prototype inspection as well as regular lots. The calibration shall be either from original manufacturer of the equipment's / instruments or from Government approved laboratory.

1.8 PROTO TYPE

The successful tenderer shall have to offer 1 No. Prototype FSP for carrying out tests mentioned at specification clause No. e (acceptance test) at their works or at Government approved Laboratory, where no adequate testing facility is available at firm's work in presence of PGVCL's representative. In case of brought out items like SMC **HRC** Fuse Units, Disconnecter switch the same have to be either tested at firm's work or at the works of original manufacturer or at Government approved / recognized laboratory in case of non-availability of adequate testing facility either at firm's works of original manufacturer. However, all the testing expenditures of prototype sample testing. Acceptance tests for routine inspection of lots will be borne by the firm

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only after successful passing of the prototype unit in all the tests and after obtaining the written approved from the competent authority of PGVCL for prototype box and drawing approval, the firm can commence bulk manufacturing of the ordered boxes. The expenses towards prototype test including visit of our Engineers (2 Nos.) other than your works shall be borne by the bidder.

1.9 RAW MATERIALS

Test certificate for the material used in the lot offered and document for purchase of raw material should be maintained by manufacturer and produced to inspector as and when required.

1.10 FACILITY

The bidder shall have facility to test the box for routine tests and acceptance as per IS – 14772: 2000 and IS – 13410 & PGVCL's specifications at their works. The bidder has to submit list of Machinery & Equipment / Testing instruments etc. along with the offer.

1.11 INSPECTION AND TESTING

During the inspection manufacturer will offer all facilities to inspector without any charge.

1.12 DISPATCH

The FSP shall be dispatched duly packed so as to ensure that no damage occurs during transport.

1.13 GUARANTEE

If the goods, stores and equipments found defective due to bad design or workmanship the same should be repaired or replaced free of charge if reported within **24** months from the date of commissioning of equipments. Supplier will be responsible for the proper performance of the equipments materials for the respective guarantee period.

1.14 GTP

The vendor shall furnish all necessary guaranteed technical particulars in the prescribed Performa enclosed hereinafter.

| SR. NO. | PARTICULARS | DETAILED PARTICULARS | TO BE OFFERED BY BIDDER |
|----------------|--|--|--------------------------------|
| 1 | Maker's name | To be intimated by the supplier | |
| 2 | Material | Glass reinforced polyester sheet moulding compound | |
| 3 | Grade of Material | SMC confirming to IS: 13410:1992 Grade S 1 | |
| 4 | Properties of Material of Construction of Distribution Box | | |
| | Heat Deflection Temperature (Ref.Std. IS: 13411) | 180°C (Minimum) | |
| | Exposure to flame (Ref. Std. IS: 4249) | Self-extinguishing | |
| | Melting Point (Ref. Std. IS: 13360) | Does not melt | |
| | Glow wire test at 650 C | As per IS 11000 Part-2/sec-1 | |
| | Degree of protection | IP-43 as per IS-12063 / 87 | |

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| | | | |
|------|---|---|--|
| | Dielectric Strength at 90 C in oil | 9 KV/mm (Min) as per IS: 6262-1971 | |
| 5 | Inside dimension of Box | To be mentioned by the supplier | |
| | a. Height | 1200 mm (min) | |
| | b. Width | 1000 mm (min) | |
| | c. Depth | 400 mm (min) | |
| | d. Thick ness of sheet | 4.0 mm (Min) | |
| 6 | Earthing Arrangement | | |
| | Earthing bolt | Two no. Zinc Passivated MS bolt with 2 nuts and 2 washers & 1 no. spring washer with each bolt. | |
| | Dia. & Length of earthing bolts | Dia. 6 mm Length 25 mm | |
| 7 | Door Locking | For holding of door with base 'U' shaped SS clamp to be provided | |
| 8 | Manufacturer's short name & short name of Purchaser | To be provided on the front side of the box | |
| 9 | Locking arrangement | | |
| 10 | Colour of Meter Box | Off White / Grey | |
| 11 | 1200 / 800 / 630 AMP TPN switch Disconnecter fuse. | Having 3 Phase & 1 Neutral with 1200 / 800 / 630 AMP Current Carrying capacity with pad locking arrangement | |
| 12 | For Box: | | |
| 12.1 | Name or Trademark of manufacturer | | |
| 12.2 | Rated Voltage | | |
| 12.3 | KVA Rating | | |
| 12.4 | Thickness of Enclosure | | |
| 12.5 | Hinges Inside / Outside specify | | |
| 13 | For TPN switch Disconnecter fuse unit | | |
| 13.1 | Name or Trademark of manufacturer | | |
| 13.2 | Type designation | | |
| 13.3 | Rated Current | | |
| 13.4 | Rated Duty | | |
| 13.5 | Utilization Category | | |
| 13.6 | Rated short time withstand current for 2 second | | |
| 14 | HRC SMC Fuse Base | | |
| 14.1 | Name of Trade Mark of Manufacturer | | |
| 14.2 | Rated Current | | |
| 14.3 | Rated Voltage | | |

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| | | | |
|------|---|--|--|
| 14.4 | Breaking Capacity | | |
| 14.5 | HRC SMC Fuse Base Material &size | | |
| 14.6 | Contact Material | | |
| 15 | HRC Fuse Link | | |
| 16.1 | Name or Trade Mark of Manufacturer | | |
| 16.2 | Rated Current | | |
| 16.3 | Rated Voltage | | |
| 17 | One no. of Box Spanner is to provide with 10 nos. quantity supply | | |
| 18 | The Contact area of Lug & Busbar should not be lesser than each other | | |

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TECHNICAL SPECIFICATION FOR MINI SECTION PILLAR (MSP)**1.1 SCOPE**

This specification covers the design, manufacturing and testing of MSP with anti-corrosive, dust proof, rust proof, shock proof, self-extinguishing property, resistant to heat, vermin & water proof, Ultra Violet Stabilized and pilfer resistant made from Thermosetting Plastic i.e. Glass Reinforced Polyester Sheet Moulding Compound (SMC) Confirming to IS: 13410 -1992 and attached technical specification, and IS: 14772-2000 with SMC HRC fuse base confirming to IS:13703/1993 (Pt.I & II amended up to date) and other relevant IS.

The equipment offered shall be complete with all parts necessary for their effective and trouble-free outdoor operation. Such parts will be deemed to be within the scope of the supply irrespective of whether they are specifically indicated in the commercial order or not.

It is not the intent to specify herein complete details of design and construction. The equipment offered shall conform to the relevant standards and be of high quality, sturdy, robust and of good design and workmanship complete in all respects and capable to perform continuous and satisfactory operations in the actual service conditions at site and shall have sufficiently long life in service as per statutory requirements.

In these specifications, the design and constructional aspects, including materials and dimensions, will be subject to good engineering practice in conformity with the required quality of the product, and to such tolerances, allowances and requirements for clearances etc. as are necessary by virtue of various stipulations in that respect in the relevant ISO, IEC, BS, IS standards and other statutory provisions.

1.2 SERVICE CONDITIONS

Equipment to be supplied against this specification shall be suitable for satisfactory continuous operation under the following tropical conditions.

- a) Maximum ambient temperature of air: 50°C
- b) Maximum temperature of air in shade: 4°C
- c) Maximum daily average ambient temperature: 40°C
- d) Maximum yearly average ambient temperature: 30°C
- e) Relative Humidity: up to 95%
- f) Average number of thunder storm days per annum: 15
- g) Maximum annual Rainfall: 150cm

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- h) Maximum Altitude above mean sea level: 1000Meter
- i) Maximum Wind Pressure: 150 Kg/cm² (As per IS 802 latest code)
- j) Maximum soil temperature at cable depth: 30°C
- k) Maximum soil thermal resistivity: 150°C cm/watt

1.3 TECHNICAL PARAMETERS

The L.T Feeder Pillar panel shall be designed as following: -

| Sl. No | Parameter | Value |
|--------|---------------------------------------|---|
| 1 | Rated Supply Voltage | 433 volts +/-10% |
| 2 | Number of Phases & Frequency | 3 phase 4W 50 Hz |
| 3 | Rated Current | as per Single line diagram/BOQ |
| 4 | Neutral | Solidly Grounded |
| 5 | Location of panel | Outdoor on M.S Channels fixed on RCC Plinth |
| 6 | Thickness of SMC Sheet for cabinet mm | 3.15MM |
| 7 | Bus bar material | Tinned Cu / Al bus bar |

1.4 APPLICABLE STANDARDS

All equipment and material shall be designed manufactured and tested in accordance with the latest applicable IEC standard or IS standard except where modified and / or supplemented this specification.

| Title | IEC Standard | IS /Other Standard |
|--|------------------------|--------------------|
| Low-voltage switchgear and control gear | IEC:60947 (Part-1,2,3) | IS: 13947 |
| Low-voltage switchgear and control gear assemblies | IEC:60439 (Part-2) | -do- |
| General Requirements for Enclosures for Accessories for Household and Similar Fixed Electrical Installations | | IS 14772 |
| Glass reinforced polyester sheet moulding compounds (SMC) | | IS 13410 |

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|--|-----------|----------|
| | | |
| LV Fuses for voltages not exceeding 1000 V ac or 1500 V dc | | IS 13703 |
| MCBs | IEC 60898 | IS: 8828 |

1.5 GENERAL TECHNICAL REQUIREMENTS

- The minimum size of box without rain hood shall be 820(H)x 525(W)x400(D) mm. and with rain hood shall be 1370(H) x 735 (W) x 516 (D)mm. The thickness of SMC sheet for enclosure and door is minimum 3.15 mm.
- MSP shall be of Grade S-3 SMC material MSP shall be moulded in a single piece forming the body of the MSP with a cover fitted with base by minimum three nos. concealed stainless steel hinges. The lid/cover shall rest on the collar of the MSP base in such a way that any access from outside is not possible. The stainless steel hinges shall be fitted with the MSP body base and covers rigidly, thereby making the MSP pilfer resistant.
- The door in closed position should be overlapped in such a manner that no direct entry or access is possible. The MSP shall be closed by minimum two nos hinges per door. Minimum 50 mm length of strip having thickness not less than 1.2 mm for holding and locking of the door with body base.
- The door shall open at 90 degrees (Min.). The top surface of box shall have little tapering shape towards both sides of the distribution box for easy flow of rainwater.
- Earth bolt of 12 mm diameter X 20 mm. length with 2 nos. nuts, 2 nos. washers and 1 no. spring washer shall be provided. The earthing arrangement shall be of M.S. with Zinc passivation. All corners of the MSP should be round & not pointed ones. All metal parts shall be zinc passivated.
- The MSP should have one no of 400 / 250 Amp three phase and neutral incoming circuit HRC SMC fuse base and appropriate size of lugs filled with 50X6 mm copper or 50x10 mm Aluminum bus bar and six (6) nos of outgoing circuit.
- Anodized aluminum operating instructions in GUJARATI shall be fixed inside the door. The letter should be cleared legible and readable. The letters of the instructions should be of sufficient size to read with normal eye.
- The MSP should have Bus bar of EC grade tinned copper / aluminum bus bar duly insulated for all phase and neutral.

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1.6 TESTS

a) The bidder shall submit type test report for complete FSP as per BS 214/1959 or IS 8623/93 and for box as per IS-14772-2000 & IS: 13410- 1992 from CIPET, Ahmedabad/ERDA, Baroda or NABL accredited lab. for the box as well as TPN switch disconnecter fuse & SMC fuse base along with the offer. Type Test Certificate should not be older than 7 years as on the date of tender opening.

b) **ROUTINE TEST:** Manufacturer has to carryout routine test during production to check the essential requirements that are likely to vary during production. Manufacturer has to keep records of the same and to be produced for verification of inspector when asked at the time of inspection of lot.

c) **TYPE TEST (For SMC box):**

From the offered lot sample may be picked up at discretion of purchaser for type test at CIPET, Ahmedabad/ERDA, Baroda or NABL accredited lab for each lot offer. The charges for the type test shall be borne by bidder. On passing the type test successfully, the lot shall be accepted. In case, the boxes are not confirmed to type test, another sample form the lot shall be selected and the tested again. On receipt of unsatisfactory results, the lot shall be rejected and new lot shall be offered for inspection keeping aside old lot offered and rejected earlier by the Company. However, Company reserves the right to accept the boxes by levying penalty as per description of the company.

d) **TYPE TEST (For Isolator/box):**

Type test reports not more than 7 years old from the date of tender from Government approved and NABL accredited lab.

1) Type Test for complete FSP as per BS214/1959 or IS8623/93.

e) **ACCEPTANCE TESTS:**

The bidder should have all the testing facilities at their works & shall offer testing as under. Following acceptance tests shall be carried out, on 2% of the offered quantity on sample boxes selected at random, while inspecting the lot of materials offered.

- Visual examination
- Verification of dimensions as per approved drawings.
- Verification of fittings
- HV test at 5.2 (3.5*1.5) KV for Bus bar, 11KV for SMC material of Box.
- Insulation resistance test with 2.5KV DC megger of each box.

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- Temperature rise test in accordance with relevant IS for the rated capacity of Switch disconnector fuse.
- Earth continuity checking test.
- 10 Operations test on SMC HRC fuse base & fuse link.

Note: PGVCL reserve the right to select one sample from whole tender quantity and will send Govt. approved/ NABL accredited lab. For complete acceptance test of all material. Cost of the same is to be paid by contractor.

1.7 DRAWING & CALIBRATION OF INSTRUMENT

The tenderer shall submit detailed constructional and dimensional drawing of complete FSP details of Units and TPN switch Disconnector fuse, incoming and outgoing circuit, Louvers details, clearance details along with the offer.

- (a) The firm has to submit list of testing equipment's instruments, stating Sr. No., Make, Capacity, date of last calibration along with test certificate of each instrument along with the offer, same is also required to be provided to inspecting officer at the time of prototype inspection as well as regular lots. The calibration shall be either from original manufacturer of the equipment's / instruments or from Government approved laboratory.

1.8 PROTO TYPE

The successful tenderer shall have to offer 1 No. Prototype FSP for carrying out tests mentioned at specification clause No. e (acceptance test) at their works or at Government approved Laboratory, where no adequate testing facility is available at firm's work in presence of PGVCL's representative. In case of brought out items like SMC **HRC** Fuse Units, Disconnector switch the same have to be either tested at firm's work or at the works of original manufacturer or at Government approved / recognized laboratory in case of non-availability of adequate testing facility either at firm's works of original manufacturer. However, all the testing expenditures of prototype sample testing. Acceptance tests for routine inspection of lots will be borne by the firm only after successful passing of the prototype unit in all the tests and after obtaining the written approved from the competent authority of PGVCL for prototype box and drawing approval, the firm can commence bulk manufacturing of the ordered boxes. The expenses towards prototype test including visit of our Engineers (2 Nos.) other than your works shall be borne by the bidder.

1.9 RAW MATERIALS

Test certificate for the material used in the lot offered and document for purchase of raw material should be maintained by manufacturer and produced to inspector as and when required.

1.10 FACILITY

The bidder shall have facility to test the box for routine tests and acceptance as per IS – 14772: 2000 and IS – 13410 & PGVCL's specifications at their works. The bidder has to submit list of Machinery & Equipment / Testing instruments etc. along with the offer.

1.11 INSPECTION AND TESTING

During the inspection manufacturer will offer all facilities to inspector without any charge.

1.12 DISPATCH

The FSP shall be dispatched duly packed so as to ensure that no damage occurs during transport.

1.13 GUARANTEE

If the goods, stores and equipments found defective due to bad design or workmanship the same should be repaired or replaced free of charge if reported within **24** months from the date of commissioning of equipments. Supplier will be responsible for the proper performance of the equipments materials for the respective guarantee period.

1.14 GTP

The vendor shall furnish all necessary guaranteed technical particulars in the prescribed Performa enclosed hereinafter.

| Sr. No | Particulars | Particulars to be offered by Bidders |
|--------|--|---|
| 1 | Name of Trade mark of Manufacturer | |
| 2 | Type of L.T. pillar | |
| 3 | Rated normal Voltage | 3 phase, 440 Volt, 50Hz |
| 4 | Material of construction of L.T. Pillar enclosure and doors | Grade S-3 SMC material |
| 5 | Thickness of SMC sheet for enclosure | 3.15 mm |
| 6 | Thickness of SMC sheet for door | 3.15 mm |
| 7 | Colour of L.T. Pillar of enclosure | |
| 8 | Dimension of cubical without rain hood-width x depth x height mm. | 820(H)x 525(W)x400(D) mm minimum |
| 9 | Dimension of cubical with Rain hood-width x depth x height of (in mm). | 1370(H) x 735 (W) x 516 (D)mm. |
| 10 | Fibre glass reinforce Plastic sheet moulding compound | |
| a | Material | Grade S-3 SMC material (Thermostatic Plastic) |
| b | Grade of Material | SMC as per IS -13410-1992 |
| c | Grade of material for frame | FRP pultruded section as per IS 6746 |
| d | Heat deflection temperature | (as per IS 13411) min 150o C |
| e | Exposure to flame | (ref. std. IS 4249) Self-extinguishing |
| f | Melting point | (ref std IS 13360) Does not melt |
| g | Fibre glass reinforcement | (Min 20%) |
| h | Density of fibre glass material | (450 gm/sq mtr) |
| i | Maximum permissible temperature | (≥ 90°C) |
| j | Door material (UV resistance and salty and humid atmosphere) | Grade S-3 SMC material |
| k | Insulation Resistance | (As per ASTM D257) |
| l | Specific Gravity | as per IS:10192 of SMC material (1:8) |
| m | Dielectric Strength | |
| n | Tensile Strength | 70MPa |
| o | Cross Breaking Strength | as per ASTM D790 (1723 Kg/sq.cm) |

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| | | |
|----|---|---|
| p | Shear strength | as per ASTM D732 (879 Kg/sq.cm) |
| q | Ball pressure Test | as per IS:335 |
| r | Water Absorption | as per IS:14772 |
| s | Mechanical strength | as per IS:14772 |
| 11 | Hinges | |
| a | Hinges: Type | stainless steel hinges |
| b | Hinges: Length | 50mm |
| c | Hinges: Thickness of material | not less than 1.2 mm |
| d | Hinges: Pin diameter | Min 4mm |
| e | Number of hinges per door | two |
| 12 | Type of locking arrangements | "Godrej" type triple position locking arrangement and shall be operational with a common handle from outside the door |
| 13 | Number of padlocking arrangements | 2 Nos. |
| 14 | Size of ventilating louvers with wire mesh | Four Louvers (two on each side) |
| 15 | Details of painting | anti-corrosive high-quality paint |
| 16 | Dimension and details of asbestoses sheets | Asbestos sheet of at least 6mm thick shall be provided for separation between front and rear compartments |
| 17 | Dimension and details of Bakelite sheets | at least 50 x 12mm shall be provided to support and take care of weight of cables, jointing etc. |
| 18 | Dimension and details of gland plates | Suitable no. of detachable gland plates made up of 10 SWG MS sheets/SMC material shall be provided in the cubicle at the bottom |
| 19 | Bus Bar, Fuse Base & fuse Link | |
| a | Size of bus bar Size of neutral bus bar | |
| b | Grade and specification of material of Bus bars | IS: 5082/1998 |
| c | Rated normal current of bus bars | |
| d | Rated safe temperature of bus bars | |
| e | Make and Type of Fuse base assembly | |
| f | Grade and specification of material of Fuse base contacts | IS: 13703/1993 |
| g | Thickness and dimensions of contacts of fuse base | |
| h | Rated normal current of Fuse base | |
| i | Rated safe temperature of Fuse base | |
| j | Grade and specification of material of Fuse links | IS/IEC 127-2: 1989 |

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| | | |
|----|---|--|
| k | Make and Type of Fuse link | |
| l | Rated normal current of Fuse link | |
| m | Rated safe temperature of Fuse link | |
| n | Grade and specification of material of spring steel round | IS: 6005/1998 |
| o | Dimension of steel spring round | spring ring shall be made out of at least 6 mm dia |
| 20 | Make & Type of bimetallic lugs | |
| 21 | One Minute P.F Withstand voltage | |
| 22 | Rated short time current | |
| 23 | Rated temperature rise | |
| 24 | Size Thickness of Bakelite sheets provided | |
| 25 | List of tests conducted on similar equipment | |
| 26 | List of copies of test certificate enclosed | |

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TECHNICAL SPECIFICATION M.S. CHANNEL, ANGLE AND FLAT ETC**1 Scope:**

This specification covers manufacture, transport to site, insurance, storage, erection and commissioning of different type MS structures required to installation of the RMU & Distribution transformer structure suitable for Underground Distribution System.

2 Applicable Standards:

The mild steel shall conform to IS: 2062 grade 'a' modified up-to date or equivalent international standard for steel materials, documents for which shall be made available at the time of inspection to the owner's representative.

3 General Requirements:

Material shall be supplied as per the following sizes:

Channel ISA Angles and flats confirming (Not re-rolled) of grade "A" E250 (Fe-410WA) should be supplied confirming to IS 2062 / 2011 with latest amendment if any.

4 Galvanization:

All above steel members shall be fabricated as per approved drawing having smooth edge, drilled circular/elliptical holes of suitable measurements.

All structural steel members and bolts shall be galvanized as per IS:4759 and zinc coating shall not be less than 610gm/sq. meter for all structural steel members. All welds shall be 6mm filled weld unless specified otherwise. All nuts and bolt shall be of property class 5.6 of IS 1367. Plain washers shall be as per IS 2016 and spring washers shall be IS:3063.

5 Tests:

All tests will be carried out by representative of owner.

All tests and inspection shall be made at the place of manufacturer unless otherwise specially agreed upon by the manufacturer and the owner. The manufacturer shall provide all reasonable facilities, without charge to satisfy him that the material is being supplied in accordance with the specification.

TECHNICAL SPECIFICATION FOR FRP FENCING**1 Scope**

This specification covers the basic requirement for the complete design, manufacture, fabrication, testing and inspection at manufacturer's works, packing, supply and Installation of Insulating type FRP Fencing for safety with necessary hardware, accessories, fittings, etc. for Distribution Transformer Stations/RMU/Package Substations.

2 Service Conditions

The equipment to be supplied against this specification shall be suitable for satisfactory continuous operation under the following tropical conditions.

- a) Maximum ambient temperature of air: 50°C
- b) Maximum temperature of air in shade: 4°C
- c) Minimum ambient temperature of air: 3.5°C
- d) Maximum daily average ambient temperature: 40°C
- e) Maximum yearly average ambient temperature: 30°C
- f) Relative Humidity: up to 95%
- g) Average number of thunder storm days per annum: 15
- h) Maximum annual Rainfall: 150cm
- i) Maximum Altitude above mean sea level: 100Meter
- j) Maximum Wind Pressure: 150 Kg/cm² (As per IS 802 latest code)
- k) Maximum soil temperature at cable depth: 30°C
- l) Maximum soil thermal resistivity: 150°C cm/watt
- m) Iso-ceramic level (days/year) 50
- n) Climate Moderately hot and humid tropical climate, conducive to rust and Fungus growth.

3 Applicable Standards

All components used in the manufacture of the FRP Fencing shall confirm to the Relevant Indian standard specification and IS-6746 i.e. Unsaturated Polyester Resin System and IS 13410 Glass reinforced Sheet Moulding Compounds (SMC)

4 General Technical Requirements**(I) General: -**

- a. The Fencing shall be antistatic and ultra violet resistant. Fencing shall be manufactured using components made in accordance with IS-6746 and IS 13410.
- b. FRP Fencing shall be made utilizing FRP Pultruded sections & SMC Pickets. FRP sections shall be made from an advanced formulation of Thermosetting Polyester Resin with Glass Fiber Reinforcement on state of art electronically controlled pultrusion technology. Manufacturing process shall be pultrusion using automated pultrusion machines. SMC Pickets from hot press compression moulded SMC confirming to IS 13410
- c. FRP Fencing shall be made of FRP and shall be corrosion resistant and fire retardant (Low flammability) in accordance with the latest IS-6746. An additive material shall be mixed

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PASCHIM GUJARAT VIJ COMPANY LIMITED

Regd. & Corporate Office : Nana Mava Main Road, Laxminanagar : Rajkot : 360004
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- with the FRP to make them resistant to ultraviolet light. FRP/SMC Flats may be used as preferred by bidder. Colour shade shall be as approved by PGVCL.
- The oxygen index shall be minimum 24 as per IS 6746.
 - The minimum glass content in the FRP and SMC material shall be 45% and 20% respectively
 - The FRP Fencing shall be free from sharp edges and corners, burns and unevenness.
 - FRP fencing shall be supplied in completely knocked down condition and shall be of ready to use type. The fencing system shall be suitable for onsite fabrication using standard hardware and tools. The fencing shall be supplied as per BOQ agreed between supplier and purchaser.
 - The fencing is constructed utilizing vertical post duly grouted / fitted in ground/on floor. Horizontal rails fitted to sub frame to suite onsite mounting the vertical posts, pickets fitted to rails and gate to facilitate entry and exit restriction within the covered area.
 - FRP Pultruded Sections and SMC pickets shall have following mechanical properties

| Sr. No. | Parameter | Value for Pultruded Section | Value for SMC Pickets |
|---------|---------------------------------------|--|-----------------------|
| a) | Ultimate tensile strength: | 2000-4000Kg/cm ² | 50 MPa |
| b) | Flexural strength | 2000-10000 Kg/ cm ² | 155 MPa |
| c) | Flexural modulus: | 1.5-5x100000 Kg/ cm ² | N.A. |
| d) | Izod impact: | 130Kg/cm/cm of notch | 45 KJ/m2 |
| e) | Compressive strength: | 1500-5000 kg/ cm ² | N.A. |
| f) | Compressive modulus: | 2.5-4.5 kg/ cm ² | N. A. |
| g) | Bar col thickness: | 50- 65 | 50- 65 |
| h) | Water absorption: | <=0.6% | <=0.25% |
| i) | Glass Content | Min. 45% | Min. 20% |
| j) | Flammability | Low flammability as per IS 6746 | |
| k) | Flame Spread (Fire propagation Index) | Less Than 15 as per BS 476 (Part 5, 6 & 7) | |

- FRP Pultruded Sections and SMC pickets shall have following Electrical Properties.

| Sr. No. | Parameter | Value for Pultruded Section | Value for SMC Pickets |
|---------|----------------------------|-----------------------------|-----------------------|
| a) | Dielectric Strength Axial | 30 – 45 kV / 25 mm | 9 kV |
| b) | Dielectric Strength Radial | 10-15 kV / 25mm | N. A. |
| c) | Arc Resistance | > 120 sec | > 120 sec |

- FRP Pultruded Sections fencing – Routine & Acceptance Testing Parameter shall include but not be limited to following:

Test for FRP sections

| Sr. No. | Parameter | Value specified |
|---------|-----------|-----------------|
|---------|-----------|-----------------|

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| | | |
|---|---------------|---------------------------------|
| 1 | Visual | As per approved drawing |
| 2 | Dimensions | As per approved drawing |
| 3 | Glass Content | Min. 45% |
| 4 | Flammability | Low flammability as per IS 6746 |

Test for SMC Pickets

| Sr. No. | Parameter | Value specified |
|---------|---------------|---------------------------------|
| 1 | Visual | As per approved drawing |
| 2 | Dimensions | As per approved drawing |
| 3 | Glass Content | Min. 20% |
| 4 | Flammability | Low flammability as per IS 6746 |

Construction of FRP

- Vertical Posts:**

The vertical post shall be made out of FRP Pultruded square hollow section of size 50x50x5 mm. Such posts shall be kept at a distance not exceeding 1000mm c/c except gate opening and shall be grouted in the ground with c.c. of ratio 1:2:4 in the pit of size 300x300x450 mm. The work must be done under Supervision of concerned SDO OR Authorized staff appointed by SDO. The vertical posts shall be supplied with pre-drilled holes so as to accept Sub frame provided using hollow FRP box sections 50x25x5 mm and other accessories for fixing of gates etc. The length of vertical post shall be sufficient to take care of grouting, depth i.e. underground and height of fencing above the ground. Post should be buried in foundation at least 450mm from ground level. Posts at corners and gate openings may be of different size/shape so as to take care of the fencing requirements.

- Rails**

Rails shall be made out of FRP notch bars of 12 mm dia. provided at equal spacing not exceeding 200 mm Centre to Centre as shown in drawing. The rails are placed horizontally and height of the 1st rail from the ground as well as gap between the rails shall be maintained as detailed in the approved drawing.

- Pickets:**

Pickets shall be made of flats of size 35x5 mm SMC or FRP provided at equal spacing not exceeding 100 mm Centre to Centre mechanically locked between vertical post as well as top and bottom member of sub frame as shown in the drawing. Pickets shall be pre-drilled to facilitate fixing on the rails. Dimensions of the sections utilized (vertical post, rail, picket), length of those sections (height of fencing), gate openings, corner posts and the perimeter as well as shape of area to be covered by fence shall be as per the drawing and shall be as mutually agreed between the supplier and purchaser by way of issue of approved drawing. The fencing Material of Construction (MOC) shall conform to the IS: 6746 and/ IS 13410 as applicable and the fabricated, installed fencing shall confirm to the approved drawing.

- Fencing Gate:**

Fencing gate should have door with two shutters with one Heavy duty S.S. aldrap of size not less than 16 mm Dia and 350 mm length. Gate is to be provided as per site conditions. General arrangement and layout of fencing is shown in schematic drawing.

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- **Danger Board:**

Danger Board of size 300X300 mm (1.6 mm thick M.S. Plate) is to be provided on left hand side of fencing with standard drawing as attached herewith. Danger Board should have letter writing pattern and size as per drawing.

Other Conditions

- At top the whole fencing shall be tied with FRP Angle section 50x50x5 to provide suitable stiffness. Angle section should be openable across gate.
- Hardware for fixing / assembling shall be of stainless steel.
- Gate should be suitably stiffened to prevent sagging. 3nos. of Hinges of 100 mm size on each door and shall be of heavy duty S.S. and facilitate of outward 180 degree movement of the gate flaps.
- Left door of gate should be provided with stopper of 300 mm and Dia. Of 10 mm at upper and lower part of fencing with proper locking arrangement.
- Transformer fencing erection should be done according to site situation and as per instruction of engineer in charge of sub division office.
- Supporting bracing flat size SMC molded / FRP Flat 35 x 5mm and length 300 mm are to be provided in each corner on top and bottom frames of fencing and on each shutter of door.
- Grouting Roads of M. S. With Dia. of 12mm and 250 mm long at each Vertical Post are to be provided as shown in Drawing.
- Payment of bill will be based on running meter measured during joint measurement with engineer in charge.

DRAWINGS AND DOCUMENTATION

- The successful bidder shall submit sketches for each location of the FRP Fencing and get the same approved at concerned Division office before commencement of supply. The indicative schematic drawing is enclosed herewith.
- The tenderer shall furnish all details and clarifications required if any for scrutiny and evaluation of the offer.
- Manufacturing of material to be supplied shall be done strictly as per approved drawing.
- Approval of drawing shall not absolve the supplier of his liability for ensuring correctness according to applicable standards & regulations.

5 Tests

All the Type Tests shall be carried out from reputed Laboratories which are accredited by the National Board of Testing and Calibration Laboratories (NABL) of Govt. of India or accepted by PGVCL. Test Reports submitted by Labs such as CPRI, ERDA, ERTL, CIPET, Fire Research Laboratory (FRL) of CBRI Roorkee shall be accepted to prove that the FRP Pultruded Sections meet the requirements of specification. Type Test Reports conducted in manufacturers own laboratory and certified by testing institute shall not be acceptable. The FRP Pultruded Sections used in FRP Fencing shall be fully type tested for Mechanical and Electrical Properties. Attested copies of Type Test Reports are to be submitted.

6 Testing & Manufacturing Facilities

- The Bidder/manufacturer shall have necessary machinery for production of FRP Pultruded Sections using Automated Pultrusion Machines as well as SMC material and SMC hot press compression molding Machines if SMC is intended to be used for FRP Fencing.
- Manufacturer should have in house testing facilities for carrying out the routine and acceptance tests. Each Lot dispatched should be tested in house and test report should be submitted to PGVCL.
- Supplier shall be responsible for packing, transporting and delivery to the consignee.

7 GTP

| Sr. No. | Description | Requirement | Supplier Remark |
|---------|------------------------------------|--|-----------------|
| 1 | Vertical Post (Pultruded FRP) | Box section of 50 x 50 x 5mm @ max 1000 mm c/c & corners | YES/NO |
| 2 | Sub frame section | FRP Box section of 50 x 25 x 5mm | YES/NO |
| 3 | Rail | FRP Rod Dia. 12mm @ 200mm c/c with notch and keys to lock pickets. | YES/NO |
| 4 | Pickets | SMC molded / FRP Flat 35 x 5mm Thick @ 100 mm c/c | YES/NO |
| 5 | Bracing Flat | SMC molded / FRP Flat 35 x 5mm and length 300 mm | YES/NO |
| 6 | Heavy Duty S.S. Aldrop | Not less than 16 mm Dia. And 350 mm Long | YES/NO |
| 7 | Grade of Material for Fencing | Pultruded FRP - UV and Fire Resistant conforming to IS 6746 | YES/NO |
| 8 | Type Test Certificate For Material | Refer Respective Clause of Technical Specifications | YES/NO |
| 9 | Size of the fencing | HEIGHT: 1600 MM (1500+100 mm) above ground and 450 mm in ground; minimum Width and Length as per site conditions and as decided by EIC (Engineer In-charge). | YES/NO |

PGVCL will take random samples from the material supplied and subject them to tests in Government approved laboratories. The material should stand these tests and if the materials do not stand these tests, they will summarily be rejected and the supplier should make immediate arrangement to replace them with standard material only after getting them duly inspected.

PGVCL also reserves the right to accept the whole or part of such supplies or of the utilized material and recommend reduced prices taking into account the defects noticed. Such reduction for the whole lot will be maximum up to 30% (Thirty) of the end cost price, provided PGVCL accepts the material. In this respect, the decision of the PGVCL will be final and will be binding on the supplier.

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TECHNICAL SPECIFICATION FOR CIVIL WORKS

1 Cable Trench:

Construction of cable trench (Three tier/ Four Tier) as per approved design & Drawing as per directives of Engineer-in-charge with required excavation as per site condition, Base concreting, Providing & laying of reinforcement as per design, concreting of M-20 grade for Pardi & Raft, Pre-cast RCC cover of 75mm thick, fabrication of cable tray as per design with one coat of red oxide and two coats of oil painting to structural steel, two coats of Waterproof cement paint to all inside, outside surfaces of cable trench with top cover. Work to be done as per drawing and PWD specifications. Detail description of major civil work activities involved are as under.

- i. Excavation for foundation in Dense or Hard soil up to 1.5 M Depth including sorting out and stacking of useful materials and disposing of the excavated stuff up to 50 meter lead and filling excavated stuff in trenches & besides cable trench in layers not exceeding 20 cm in depth with consolidating/ watering etc. complete.
- ii. Providing and laying cement concrete 1:4:8 (1 Cement : 4 coarse sand : 8 Machine crush metal aggregates 40 mm nominal size) and curing complete including cost of form work in Foundation etc. complete.
- iii. Providing and laying control cement concrete M200 and curing complete including cost of form work and reinforcement for reinforced cement concrete work in.(A) Raft Foundations, Vertical pardi/wall etc. (Form work of steel sheets to be utilized)
- iv. Providing & placing 75mm thick Precast RCC cover of size 1500 X 300mm, made in M-200 cement concrete with necessary reinforcement of 3 Nos. of 10mm TMT bars as main bar and 8mm TMT Distribution bars at 200mm c/c including providing 8mm TMT bars hook for lifting arrangement & curing, finishing all the surfaces etc complete incl. placing in position at site.
- v. Providing & fabrication of structural Steel for cable tray incl. cutting, erecting, fixing in position and applying one coat of red oxide & two coats of oil painting in angles, flat and like section etc. complete.
- vi. Expansion Joint: Providing & placing 12mm thick pre-moulded asphalt or bitumen cork board filler joint at every 50 Mtr length.
- vii. Painting the inside, outside of Cable trench wall including precast cover with two coats of water proofing cement paint.

2 Precast RCC Cable Guard Block

Providing & placing precast RCC cable guard blocks for underground cable laying work as per approved drawing made in M-200 concrete for UG cable laying. 1.0 Rmt of cable guard consist of 3 nos. of RCC blocks, having size as stated below (A-type, B-Type, C-Type), including providing & laying of reinforcement steel as per drawing in all the three blocks including necessary form works of steel sheets, curing, finishing of all the surfaces & placing in the position at site as per drawing & as directed by engineer-in-charge.

| | |
|---------------|--|
| A-Type | L x W x T = 1000 x 300 x 75 mm (For 01 no. of horizontal RCC block) L x W x T = 1000 x 300 x 75 mm (For 02 no. of vertical RCC block) |
|---------------|--|

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| | |
|---------------|---|
| B-Type | L x W x T = 1000 x 450 x 75 mm (For 01 no. of horizontal RCC block) |
| | L x W x T = 1000 x 300 x 75 mm (For 02 no. of vertical RCC block) |
| C-Type | L x W x T = 1000 x 600 x 75 mm (For 01 no. of horizontal RCC block) |
| | L x W x T = 1000 x 300 x 75 mm (For 02 no. of vertical RCC block) |

3 Cable Route Marker

Providing & fixing of route marker of pre-cast RCC block made in M-200 concrete of size 220 x 75 x 800 mm having top width round shape as per drawing, including providing & laying reinforcement steel of 1 no. of 10 mm dia tor steel main bar & 6 no of 8 mm dia tor steel distribution bars as per the drawing including necessary excavation, form works of steel sheets, curing, finishing of all surfaces & placing in position at site including fixing block by providing & laying 75 mm thick PCC (1:4:8) on all vertical sites & bottom of pre-cast RCC blocks as per drawings etc complete.

4 Detail Specification for Civil Work Items

Item No. 1: Excavation for foundation in trenches in ordinary, dense, hard soil, sand, clay, soft murrum up to 1.50 Mt. depth including strutting, shoring wherever necessary and throwing away the extra stuff with in the lead of 500 Mt. radius and its dressing etc. complete as directed by E. I. C.

a) General

Any soil which generally require close application of picks or jumpers or scarifies to loosen it, stiff clay, gravel and stone, etc. or organic soil, gravel silt, sand, turf, loam, clay, peat, etc. fall under this category.

b) Clearing the site

- The site on which the structure is to be built shall be cleared, and all obstructions loose stone, materials, and rubbish of all kind, bush wood and trees shall be removal as directed. The materials so obtained shall be property of the Government and shall be conveyed and stacked as directed within 50 m. lead. The roots of the trees coming in the sides shall be cut and coated with a hot asphalt.
- The rate of side clearance is deemed to be included in the rate of earth work for which no extra will be paid.

c) Setting out

After clearing the site, the centre lines will be given, by the Engineer-in-Charge. The contractor shall assume full responsibility for alignment, elevation and dimension of each and all parts of the work. Contractor shall supply labours materials, etc., required for setting out the reference marks and bench marks and shall maintain them as long as required and directed.

d) Excavation

The excavation in foundation shall be carried out in true line and level and shall have the width and depth as shown in the drawings or as directed. The contractor shall do the necessary shoring and shutting or providing necessary slopes to a safe angle, at his own cost. The payment for such precautionary measures shall be paid separately if not specified. The bottom of the excavated area shall be leveled both longitudinally and transferal as directed by

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removing and watering as required. No earth filling will be allowed for bringing it to level. If by mistake or any excavation is made deeper or wider than that shown on the plan or directed. The extra depth or width shall be made up with concrete of same proportion as specified for the foundation concrete at the cost of the contractor. The excavation up to 1.5 m depth shall be measured under this item.

e) Disposal of the excavated stuff

- i. The excavated stuff of the selected type shall be used in filling the trenches and plinth or leveling the ground in layers including ramming and watering etc.
- ii. The balance of the excavated quantity shall be removed by the contractor from the site of work to a place as directed with lead up to 500 M. and all lift.

Item No. 2: Filling available excavated earth (Excluding rock) in trenches, plinth sides of foundation etc. in layers not exceeding 20 CM in depth, consolidating each deposited layers by ramming and watering.

a) Workmanship

- i. The earth to be used for filling shall be free from salts, organic or other foreign matter. All clots of earth shall be broken.
- ii. As soon as the work in foundation has been completed and measured the site of foundation shall cleared of all debris, brick bats, mortar dropping etc., and filled with earth in layers not exceeding 20 cms. Each layer shall be adequately watered, rammed and consolidated before the succeeding layer is laid. The earth shall be rammed with iron rammers where feasible and with the butt ends of crow bars, where rammer cannot be used.
- iii. The plinth shall be similarly filled with earth in layers not exceeding 20 cms. adequately watered and consolidated by ramming with iron or wooden rammers. When filling reaches finished level the surface shall be flooded with water for at least 24 hours and allowed to dry and then rammed and consolidated.
- iv. The finished level of filling shall be kept to shape intended to be given to floor.
- v. In case of large heavy duty flooring like factory flooring, the consolidation may be done by power rollers, where so specified. The extent of consolidation required shall also be as specified.
- vi. The excavated stuff of the selected type shall be allowed to be used in filling the trenches and plinth. Under no circumstances black cotton soil be used for filling in the plinth.

Item No. 3: Filling in foundation and plinth with murrum or selected soil in layers of 20 CM thickness including watering, ramming and consolidation etc. complete (Yellow earth should be brought by contractor from outside)

a) Materials

Murrum shall be clean, of good binding quality, and of approved quality obtained from approved pots / quarries of disintegrated rocks which contain silicon materials and natural mixture of clay of calcareous origin. The size of murrum shall not be more than 20mm.

b) Workmanship

The relevant specifications of item No. 2 shall be followed except that murrum or selected soil shall be filled in foundation and plinth in 20 cms. Layers including consolidating, ramming, watering, dressing, etc complete.

Item No. 4: Filling in plinth with sand under floors including watering, ramming consolidating and dressing etc. complete.

a) Materials

Sand shall conform to M-3.

b) Workmanship

The relevant specifications of item No. 2 shall be followed except that sand shall be filled in under floors, including watering, ramming, consolidating and dressing etc. complete.

Item No. 5: Brick work using common fly ash / concrete blocks / building bricks having crushing strength not less 35 kg. / sq. cm. in foundation and plinth in cement mortar 1:6 (1 Cement: 6 - Fine sand)

a) Materials

Water shall conform to M-1. Cement shall conform to M-2. Sand shall conform to M-3. Cement mortar shall conform to M-5. Brick shall conform to M-8.

b) Workmanship

- **Proportion:** The proportion of the cement mortar shall be 1:6 (1 Cement: 6 fine sand) by volume.
- **Wetting of bricks:** The bricks required for masonry shall be thoroughly wetted with clean water for about two hours before use or as directed. The cessation of bubbles, when the bricks are wetted with water is an indication of thorough wetting of bricks.
- **Laying:**
 - i. Bricks shall be laid in English bond unless directed otherwise. Half or cut bricks shall not be used except when necessary to complete to bond, closers in such case shall be cut to the required size and used near the ends of walls.
 - ii. A layer of mortar shall be spread on full width for suitable length of the lower course. Each brick shall first be properly bedded and set home by gently tapping with the handle of trowel or wooden mallet. Its side face shall be flushed with mortar before the next brick is laid and pressed against it. On completion of course, the vertical joint shall be fully filled from the top with mortar.
 - iii. The wall shall be taken up truly in plumb. All courses shall be laid truly horizontal and all vertical joints shall be truly vertical. Vertical joints in alternate course shall generally be directly one over the other. The thickness of the brick course shall be kept uniform.
 - iv. The bricks shall be laid with frog upwards. A set of tools comprising of wooden straight edges, mason's spirit level, square half meter rub, and pins, string and plumb shall be kept on the site of the work for frequent checking during the progress of work.
 - v. Both the faces of the walls of thickness greater than 23 cms shall be kept in proper place. All the connected brickwork shall be kept not more than one meter over the rest of the work. Where this is not possible the work shall be raked back according to bond (and not left toothed) at an angle not steeper than 45 degrees.
 - vi. All fixtures, pipes, outlets of water, holdfasts of doors and windows, etc. which are required to be built in wall shall be embedded in the cement mortar.
- **Joints**
 - i. Bricks shall be so laid that all joints are quite flush with mortar. Thickness of the joint shall not exceed 12mm. The face joints shall be raked out as directed by raking tool daily during

the progress of work, when the mortar is still green so as to provide key for plaster or pointing to be done.

- ii. The face of the brick shall be cleaned the very day on which the brick work is laid and all mortar dropping removed.

• **Curing**

Green work shall be protected from the rain suitable. Masonry work shall be kept moist on all the faces for a period of seven days. The top of the masonry work shall be kept well wetted at the close of the day.

• **Preparation of the foundation bed**

If the foundation is to be laid directly on the excavated bed, the bed shall be leveled, cleaned of all the loose materials, cleaned and wetted before starting masonry. If masonry is to be laid on concrete footing, the top of the concrete shall be cleaned and moistened. The contractor shall obtain the engineer's approval for the foundation bed, before foundation masonry is started. When pucca flooring is to be provided flush with the top to plinth, the inside plinth offset shall be kept lower than the outside plinth top by the thickness of the flooring.

c) Mode of measurement

- i. The measurements of this item shall be taken for the brick masonry fully completed in foundation up to plinth. The limiting dimensions not exceeding those shown on the plans or as directed shall be final. Battered, tapered and curved portion shall be measured net.
- ii. No deduction shall be made from the quantity of brick work, nor any extra payment made for embedding in masonry or making holes in respect of following items.
- End of joints, beams, posts, girders, rafters, purlins, trusses, corbel, steps, etc. where cross section area does not exceed 500 sq cm.
 - Opening not exceeding 1000 sq cm.
 - Wall plates and bed plates, bearing of slabs, and the like whose thickness does not exceed 10 cm and the bearing does not extended to the full thickness of the wall.
 - Drainage holes and recesses for cement concrete blocks to embed hold fasts for doors, windows etc.
 - Iron fixtures, pipes up to 300mm dia, hold fasts and doors and windows built into masonry and pipes, etc. for concealed wiring.
 - Forming chases of section not exceeding 350 sq. cm. in masonry.
- iii. Apertures for fire places shall not be deducted nor shall extra labour required to make splaying of jambs, throttling and making arches over the apertures be paid for separately.
- iv. The rate shall be for a unit of one cubic meter.

Item No. 6: Providing & laying controlled cement concrete M-200 curing complete for reinforced concrete work in

a) Foundation, footings, Bases of columns etc. and Mass concrete,

b) Slabs, Landings, shelves, Balconies, Lintels, Beams, Girders, wall and cantilever up to floor two level.

a) Materials

Water shall conform to M-1. Cement shall conform to M-3. Sand shall conform to M-6. Grit shall conform to M-8. Graded stone aggregate 20mm nominal size shall conform to M-12.

b) General

- i. The concrete mix shall be designed by preliminary tests, the proportioning of cement and aggregates shall be done by weight and necessary precautions shall be taken in the production to ensure that the required work cube strength is attained and maintained. The controlled concrete shall be in grade of M-200 with prefix controlled added to it. The letter 'M' refers to mix and numbers specify 28 days works cube compressive strength of 150mm cubes of the mix expressed in Kg/ Cm²
- ii. The proportion of cement, sand and coarse aggregates shall be determined by weight. The weigh batching machine shall be used for maintaining proper control over the proportion of aggregates as per mix design.

The strength requirements of different grades of concrete shall be as under:

| Grade of concrete | Compressive strength of 15 cms. cubes in Kg / Cm ² at 28 days, conducted in accordance with IS 516 – 1959. | |
|-------------------|---|-----------------|
| | Preliminary test (min) | Work test (min) |
| M-150 | 200 | 150 |
| M-200 | 260 | 200 |
| M-250 | 320 | 250 |
| M-300 | 380 | 300 |
| M-350 | 440 | 350 |
| M-400 | 500 | 400 |

In all cases, the 28 days compressive strength specified in above table be the criteria for acceptance or rejection of the concrete. Where the strength of a concrete mix as indicated by tests, lies in between the strength of any two grades specified in the above table, such concrete shall be classified in for all purposes as concrete belonging to the lower of the two grades between which its strength lies.

- iii. Admixture may be used in concrete only with approval of Engineer – in – Charge based upon the evidence that with the passage of time neither the compressive strength of concrete is reduced nor are other requisite qualities of concrete and steel impaired by the use of such admixture.

c) Workmanship

- i. The proportions for ingredients chosen shall be such that concrete has adequate workability for conditions prevailing on the work in question and can be properly compacted with means available except where it can be shown to the satisfaction of the Engineer – in – Charge, that the supply of properly graded aggregate of uniform quality can be maintained till the completion of work. Grading of aggregate shall be controlled by obtaining the coarse aggregates, in different sizes and being in them in the right proportions as required. Aggregate of different sizes shall be stocked in separate stock piles. The required quantity of material shall be stock piled several hours, preferably a day before use. The grading of coarse and fine aggregate shall be checked as frequently as possible, the frequency for a given job being determined by the Engineer – in – Charge to ensure that the suppliers are maintaining the uniform grading as approved for samples used in the preliminary tests.
- ii. In proportioning concrete, the quantity of both cement and aggregate shall be determined by weight. Where the weight of cement is determined by accepting the maker's weight per bag a reasonable number of bags shall be weighed separately to check the net weight. Where the cement is weighed from bulk stocks at site and not by bags, it shall be weighed separately from

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the aggregates. Water shall either be measured by volume in calibrated tanks or weighed. All measuring equipments shall be maintained in clean, and serviceable condition. Their accuracy shall be periodically checked.

iii. It is most important to keep the specified water cement ratio constant and at its correct value. To this end, moisture content in both fine and coarse aggregates shall be determined by the Engineer – in – Charge, according to the weather conditions. The amount of mixing water shall then be adjusted to compensate for variations in the moisture content. For the determination of moisture content in the aggregates, IS 2389 (Part III) shall be referred to. Suitable adjustments shall also be made in the weights of coarse aggregates due to variation in the moisture content. Minimum quantity of cement to be used in concrete shall not be less than 320 Kg / Cmt.

iv. Mixing

- For all work, concrete shall be mixed in a mechanical mixer which along with other accessories shall be kept in first class working condition and so maintained throughout the construction. Measured quantity of aggregate, sand, cement required for each batch shall be poured into the drum of the mechanical mixer while it is continuously running. After about half a minute of dry mixing measured quantity of water required for each batch of concrete mix shall be added gradually and mixing continued for another one and half a minute. Mixing shall be continued till materials are uniformly distributed and uniform colour of the entire mass is obtained and each individual particle of the coarse aggregate shows complete coating of mortar containing its proportionate amount of cement. In no case shall the mixing be done for less than two minutes after all ingredients have been put into the mixer.
- Mixers which have been out of use for more than 30 minutes shall be thoroughly cleaned before putting in a new batch. Unless otherwise agreed to by the Engineer – in – Charge the first batch of concrete from the mixture shall contain only two thirds of normal quantity of coarse aggregate. Mixing plant shall be thoroughly cleaned before changing from one type of cement to another.

v. Consistency

The degree of consistency which shall depend upon the nature of the work and methods of vibration of concrete shall be determined by regular slump tests in accordance with IS 1199 – 1959. The slump of 10 mm to 25 mm shall be adopted when vibrators are used and 80 mm when vibrators are not used.

vi. Inspection

- Contractor shall give the Engineer – in – Charge due notice before placing any concrete in the forms to permit him to inspect and accept the false work and forms as to their strength, alignment and general fitness but such inspection shall not relieve the contractor of his responsibility for the safety of men, machinery, materials and for results obtained. Immediately before concreting, all forms shall be thoroughly cleaned.
- Centering design and its erection shall be got approved from the Engineer – in – Charge. One carpenter with helper shall invariably be kept present throughout the period of concreting. Movement of labour and other persons shall be totally prohibited for reinforcement laid in position. For access to different parts, suitable mobile platforms shall be provided so that steel reinforcement in position is not disturbed. For ensuring proper

cover, mortar blocks of suitable size shall be cast and tied to the reinforcement. Timber, kapachi or metal pieces shall not be used for this purpose.

vii. Transporting and laying

- The method of transporting and placing concrete shall be as approved. Concrete shall be so transported and placed that no contamination, segregation or loss of its constituent material takes place. All form work shall be cleaned and made free from standing water, dust, snow or ice immediately before placing of concrete. No concrete shall be placed in any part of the structure until the approval of Engineer – in – Charge has been obtained.
- Concreting shall proceed continuously over the area between construction joints. Fresh concrete shall not be placed against concrete which has been in position for more than 30 minutes unless a proper construction joint is formed. Concrete shall be compacted in its final position within 30 minutes of its discharge from the mixer. Except where otherwise agreed to by the Engineer – in – Charge concrete shall be deposited in horizontal layers to a compacted depth of not more than 0.45 metre when internal vibrators are used and not exceeding 0.30 meter in all other cases.
- Unless otherwise agreed to by the Engineer – in – Charge, concrete shall not be dropped into place from a height exceeding 2 meters. When trucking or chutes are used they shall be kept close and used in such a way as to avoid segregation. When concreting has to be resumed on a surface which has hardened, it shall be roughened, swept clean, thoroughly wetted and covered with a 13mm thick layer of mortar composed of cement and sand in same ratio as in the concrete mix itself. This 13 mm layer of mortar shall be freshly mixed and placed immediately before placing of new concrete. When concrete has not fully hardened, all laitance shall be removed by scrubbing the wet surface with wire or bristle brushes, care being taken to avoid dislodgement of any particles of coarse aggregate. The surface shall then be thoroughly wetted, all free water removed and then coated with neat cement grout. The first layer of concrete to be placed on this surface shall not exceed 150mm in thickness and shall be well rammed against old work, particular attention being given to corners and close spots.
- All concrete shall be compacted to produce a dense homogeneous mass with the assistance of vibrators, unless, otherwise permitted by the Engineer – in – Charge for exceptional cases, such as concreting under water, where vibrators cannot be used. Sufficient vibrators in serviceable condition shall be kept at site so that spare equipment is always available in the event of breakdowns.

Concrete shall be judged to be compacted when the mortar fills the spaces between the coarse aggregate and begins to cream up to form an even surface. Compaction shall be completed before the initial setting starts i.e. within 30 minutes of addition of water to dry mixture. During compaction, it shall be observed that needle vibrators are not applied on reinforcement which is likely to destroy the bond between concrete and reinforcement.

viii. Curing

Immediately after compaction, concrete shall be protected from weather, including rain, running water, shocks, vibration, traffic, rapid temperature changes, frost and drying out process. It shall be covered with wet sacking, Hessian or other similar absorbent material approved, soon after the initial set and shall be kept continuously wet for a period of not less than 14 days from the date of placement. Masonry work over foundation concrete may be

started after 48 hours of its laying but curing of concrete shall be continued for a minimum period of 14 days.

ix. Sampling and testing of concrete

- Samples from fresh concrete shall be taken as per IS 1199 – 1959 and cubes shall be made, cured and tested at 7 days or 28 days as per requirements in accordance with IS 516 – 1959. A random sampling procedure shall be adopted to ensure that each concrete batch shall have a reasonable chance of being tested i.e. the sampling should be spread over the entire period of concreting and cover all mixing units. The minimum frequency of sampling of concrete of each grade shall be in accordance with following:

| Quantity of concrete in the work | No. of samples | Quantity of concrete in the work | No. of samples |
|----------------------------------|----------------|----------------------------------|---|
| 1 – 5 Cmt. | 1 | 31 - 50 Cmt. | 4 |
| 6 – 15 Cmt. | 2 | 51 and above | 4 + one additional for each additional 50 m. or part thereof. |
| 16–30 Cmt. | 3 | | |

NOTE: At least one sample shall be taken from each shift. Ten test specimens shall be made from each sample, five for testing at 7 days and the remaining five at 28 days. The samples of concrete shall be taken on each day of concreting as per above frequency. The number of specimens may be suitably increased as deemed necessary by the Engineer – in – Charge when procedure of tests given above reveals a poor quality of concrete and in other special cases.

- The average strength of the group of cubes cast for each day shall not be less than the specified cube strength of respective concrete grade at 28 days. 20 % of the cubes cast for each day may have value less than the specified strength provided the lowest value is not less than 85% of the specified strength. If the concrete made in accordance with the proportions given for a particular grade, does not yield the specified strength, such concrete shall be classified as belonging to the appropriate lower grade. Concrete made in accordance with the proportions given for a particular grade shall not, however, be placed in a higher grade on the ground that the test strength are higher than the minimum specified.

d) Stripping

- x. The Engineer – in – Charge shall be informed in advance by the contractor of his intention to strike the form work. While fixing the time for removal of form work, due consideration shall be given to local conditions, character of the structure, the weather and other condition that influence the setting of concrete and of the materials used in the mix. In normal circumstances (generally where temperatures are above 20° C and where ordinary concrete is used, forms may be struck after expiry of periods specified in item for respective item of form work.
- xi. All form work shall be removed without causing any shock or vibration as would damage the concrete. Before the soffit and struts are removed, the concrete surface shall be exposed, where necessary in order to ascertain that the concrete has sufficiently hardened. Centering

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shall be gradually and uniformly lowered in such a manner as to permit the concrete to take stress due to its own weight uniformly and gradually. Where internal metal ties are permitted, they or their removable parts shall be extracted without causing any damage to the concrete and remaining holes filled with mortar. No permanently embedded metal part shall have less than 25 mm cover to the finished concrete surface. Where it is intended to re-use the form work, it shall be cleaned and made good to the satisfaction of the Engineer – in – Charge. After removal of form work and shuttering, the Executive Engineer shall inspect the work and satisfy by random checks that concrete produced is of good quality.

- xii. Immediately after the removal of forms, all exposed bolts etc., passing through the cement concrete member and used for shuttering or any other purpose shall be cut inside the cement concrete member to a depth of at least 25 mm below the surface of the concrete and the resulting holes be filled by cement mortar. All line caused by form joint, all cavities produced by the removal of form ties and all other holes and depressions, honeycomb spots, broken edges or corners and other defects shall be thoroughly cleaned, saturated with water and carefully pointed and rendered true with mortar of cement and fine aggregate mixed in proportions used in the grade of concrete that is being finished and of as dry consistency as is possible to use. Considerable pressure shall be applied in filling and pointing to ensure thorough filling in all voids. Surfaces which are pointed shall be kept moist for a period of 24 hours.

If rock pockets / honeycombs in the opinion of the Engineer – in – Charge are of such and extent or character as to effect the strength of the structure materially or to endanger the life of the steel reinforcement, he may declare the concrete defective and require the removal and replacement of the portions of the structure effected.

Item No. 7: Providing and laying Thermo Mechanically Treated (TMT bars) steel reinforcement conforming to grade Fe 415 IS : 1786 for RCC work including cutting, bending, hooking and binding the reinforcement with approved quality of binding wire etc., completed as per design.

All reinforcement TMT bar specified in item shall confirm to relevant IS standard 1786 for thermo mechanical Tested bars, wherever tested brands to be used, certificate for the same from manufacture shall be submitted.

Bars shall be bent as per bar bending schedule supplied with drawing. If bar bending schedule is not supplied contractor shall prepare it and get it approved at the site before cutting for fabrication. Bars shall be clean, free from rust, dust, mud etc. if coils are there, they shall be first straightened. Bars shall be cut according to the cutting length specified/approved by department. Bars shall be bent gradually. Bars having crack or spits shall be rejected. Bars shall be bent cold, unless otherwise specified in case of higher diameter bars. If bar is bent wrongly, it should be straightened and re-cut such that it does not injure the materials.

Laps and splices shall be got approved. They shall be staggered and shall be at location shown / approved. Lapping shall be avoided when full length bars are available. All laps, hooks, bends etc. shall be provided as per IS standards. Reinforcement bars shall be placed in position as per drawing or details given. It shall be tied with annealed black wire/G.I. wire of 18 gauge. Blocks, spacers, chairs etc., shall be provided as per IS. 2502 at places instructed.

Bars shall be provided with clear cover as shown in drawing or as instructed on site. Cover shall be provided with cement mortar cover block prepared of specified thickness with binding

wire embedded to fix cover in position and tie with the reinforcement so that it may not get disturbed. Minimum clear cover shall be less than 13 mm or diameter of bars for slabs. For beam and columns depending on size it shall be 20mm to 25mm. Cover shall be provided depending on structure, weather condition, location of structure etc., as per ISI.

After the reinforcement is tied and checked by contractor himself it shall be got checked by client authorized representative and okayed for pouring of concrete. Quantity of reinforcement bars in M.T. embedded in concrete shall be paid. Weight shall be computed on cutting length approved or given multiplied by standard weight of particular diameter of bars as per IS standards. Work shall to be carried out at all levels. "Rate quoted shall inclusive of wastages, cost of binding wire etc., No separate payment will be made for binding wire. However, laps, dowels etc shall be paid as per drawing or as approved.

For the purpose of payment, the bar shall be measured correct up to 100 mm length and weight payable worked out at the rate specified below:

| | | | |
|---|------------------------|----|-----------------------|
| 1 | 6 mm x 0.22 Kg / Rmt. | 8 | 20mm x 2.47 Kg / Rmt. |
| 2 | 8 mm x 0.39 Kg / Rmt. | 9 | 22mm x 2.98 Kg / Rmt. |
| 3 | 10 mm x 0.62 Kg / Rmt. | 10 | 25mm x 3.85 Kg / Rmt. |
| 4 | 12 mm x 0.89 Kg / Rmt. | 11 | 28mm x 4.83 Kg / Rmt. |
| 5 | 14mm x 1.21 Kg / Rmt. | 12 | 32mm x 6.31 Kg / Rmt. |
| 6 | 16 mm x 1.58 Kg / Rmt. | 13 | 36mm x 7.99 Kg / Rmt. |
| 7 | 18 mm x 2.00 Kg / Rmt. | 14 | 40mm x 9.86 Kg / Rmt. |

Item No. 8: Providing 15 mm. thick cement plaster in single coat in C. M. (1:3) on fair side brick / concrete wall for interior plastering of floor two level including finishing the surfaces with smooth cement finishing, necessary drip moulding, scaffolding, curing with three coats of the white wash or colour wash as directed by E. I. C.

a) Materials

Water shall confirm to M-1. The cement mortar of proportion 1:3 shall conform to M-5.

b) Workmanship

- i. Scaffolding: Wooden ballies, bamboos, planks, trestles and other scaffolding shall be sound. These shall be properly examined before erection and use. Stage scaffolding shall be provided for ceiling plaster which shall be independent of the walls.
- ii. Preparation of back ground:
 - The surface shall be cleaned of all dust, loose mortar droppings, traces, of algae, efflorescence and other foreign matter by water or by brushing. Smooth surface shall be roughened by wire brushing if it is not hard and by racking if it is hard. In case of concrete surface, if a chemical retardant has been applied to the hard and by racking if it is hard. In case of concrete surface, if a chemical retardant has been applied to the form work, the surface shall be roughened by wire brushing and all the resulting dust and loose particles cleaned off and care shall be taken that none of the retardant is left on the surface. Trimming of projections on brick / concrete surface where necessary shall be carried out to get an even surface.
 - Raking of joints in case of masonry where necessary shall be allowed to dry out for sufficient period before carrying out the plaster work.
 - The work shall not be soaked but only damped evenly before applying the plaster. If the surface becomes dry such area shall be moistened again.

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- For external plaster, the plastering operation shall be started from top floor and carried downwards. For internal plaster, the plastering operations may be started wherever the building frame and cladding work are ready and the temporary supporting ceiling resting on the wall of the floor have been removed. Ceiling plaster shall be completed before starting plaster to walls.

c) Applications of plaster:

- The plaster about 15 x 15 cms shall be first applied horizontally and vertically at not more than 2 metre intervals over the entire surface to serve as gauge. The surfaces of these gauges shall be truly in plane of the finished plastered surface. The mortar shall then be applied in uniform surface slightly more than the specified thickness, then brought to a true surface by working a wooden straight edge reaching across the gauges with small upward and sideways movement at a time. Finally, the surface shall be finished off true with a trowel or wooden float according as a smooth or a sandy granular texture is required. Excessive trowelling or overworking the float according as a smooth or a sandy granular texture is required. Excessive trowelling or overworking the float shall be avoided. All corners, arises, angles and junctions be truly vertical or horizontal as the case may be and shall be carefully finished. Rounding or chamfering corners, arises, junctions etc. shall be carried out with proper templates to the size required.
- Cement plaster shall be used within half an hour after addition of water. Any mortar or plaster which is partially set shall be rejected and removed forthwith from the site.
- In suspending the work at the end of the day, the plaster shall be left out clean to the line both horizontally and vertically. When recommencing the plaster, the edges of the old work shall be scraped clean and wetted with cement putty before plaster is applied to the adjacent areas to enable the two to properly join together. Plastering work shall be closed at the end of the day on the body of the wall and nearer than 15cms to any corners or arises. Horizontal joints in plaster work shall not also occur on parapet tops and copings as these invariably lead to leakage. No portion of the surface shall be left out initially to be packed up later on.
- Each coat shall be kept damp continuously till the next coat is applied or for a minimum period of 7 days. Moistening shall commence as soon as plaster is hardened sufficiently. Soaking of walls shall be avoided and only as much water as can be readily absorbed shall be used, excessive evaporation on the sunny or windward side of building in hot air or dry weather shall be prevented by hanging matting or gunny bags on the outside of the plaster and keeping them wet.

Item No. 9: Providing fabricating & erecting in position M. S. Angle, channels girders etc., for purlins rafters, columns etc., including welding the section as per instruction & drawing making holes & 3 coats of oil painting of approved shade & make etc. complete.

General specification of fabrication shall be applicable. Cutting schedule of the various members shall be prepared as per drawing and got approved.

The rate quoted shall be for supplying steel, confirming I. S. Standards, fabricating erecting and painting the structure.

Item No. 10: Expansion Joints – Premoulded filter

The item provides for expansion joints in RCC frame structures for internal joints as well as exposed joints, with the use of premoulded bituminous joint filler. Premoulded bituminous

joint filler, i.e. performed strip of expansion joint filler shall not get deformed or broken by twisting, bending or other handling when exposed to atmospheric condition. Pieces of joint filler that have been damaged shall be rejected. Thickness of Premoulded joint filler shall be 25mm unless otherwise specified. Premoulded Bituminous joint filler shall confirm to IS 1838-1961.

Item No. 11: Providing form work of sheeting of steel sheets so as to give fair finish including centering, shuttering strutting and propping etc., height of propping and centering below supporting floor to ceiling not exceeding 4 M. and removal of the same for in situ reinforced concrete and plain concrete work in

a) Materials

The shuttering to be provided shall be using sheathing of steel sheets and plates of steel or Plywood as approved by E-I-C.

b) Workmanship

i. The form work shall conform to the shape, lines and dimension as shown on the plans and be so constructed as to remain sufficiently rigid during the placing and compacting of the concrete. Adequate arrangements shall be made by the contractor to safe-guard against any settlement of the form work during the course of concreting and after concreting. The form work of shuttering, centering, scaffolding, bracing, etc. shall be as per design.

ii. Cleaning and Treatment of forms

All rubbish, particularly chippings, shaving and saw dust shall be removed from the interior of the form before the concrete is placed and the form work in contact with concrete shall be cleaned and thoroughly wetted or treated. The surface shall be then coated with soap solution applied before concreting is done. Soap solution for the purpose shall be prepared by dissolving yellow soap in water to get consistency of paint. Alternatively, a coat of raw linseed oil or form oil of approved manufacture may be applied in case steel shuttering is used. Soap solution or raw linseed oil shall be applied after thoroughly cleaning the surface. Care shall be taken that the coating does not get on construction joint surface and reinforcement bars.

iii. Stripping time

In normal circumstances and where ordinary cement is used, forms may be struck after expiry of following periods.

| | | |
|-----|---|-----------------|
| (a) | Sides of walls, columns, and vertical faces of beam | 24 to 48 hours. |
| (b) | Beam soffits. (Props left under) | 7 days. |
| (c) | Removal of props slabs | |
| | (i) Slabs spanning upto 4.5 m | 7 days. |
| | (ii) Spanning over 4.5 m | 14 days. |
| (d) | Removal of props to beams and Arches | |
| | (i) Spanning up to 6 m | 14 days |
| | (ii) Spanning over 6 m | 21 days |

iv. Procedure when removing the form work

All form work shall be removed without such shock or vibrations as would damage the reinforced concrete surface. Before the soffit form work and struts are removed, the soffits and the concrete surface shall be exposed where necessary in order to ascertain that the concrete has sufficiently hardened.

v. Centering

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- The centering to be provided shall be got approved. It shall be sufficiently strong to ensure absolute safety of the form work and concrete work before, during and after pouring concrete. Watch should be kept to see that behaviour of centering and form work is satisfactory during concreting. Erection should also be such that it would allow removal of forms in proper sequence without damaging either the concrete or the forms to be removed.
- The props of centering shall be provided on firm foundation or base of sufficient strength to carry the loads without any settlement.
- The centering and form work shall be inspected and approved by the Engineer - in - Charge before concreting. But this will not relieve the contractor of his responsibility for strength, adequacy and safety of form work and centering. If there is a failure of form work or centering, contractor shall be responsible for the damages to the work, injury to life and damage to property.

vi. Scaffolding

- All scaffolding, hoisting arrangement and ladders, etc. required for the facilitating of concreting shall be provided and removed on completion of work by contractor at his own expense. The scaffolding, hoisting arrangements and ladders etc. shall be strong enough to withstand all live, dead and impact loads expected to act and shall be subject to the approval of the Engineer - in - Charge. However, contractor shall be solely responsible for the safety of the scaffolding, hoisting arrangement, ladders, work and workman etc.
- The scaffolding, hoisting arrangements and ladders shall allow easy approach to the work spot and afford easy inspection.
- The rate is applicable to all conditions of working and any height. The rate shall include the cost of materials and labour for various operations involved such as:
 - (a) Splayed edges, notching allowance for over laps and passing at angles, battens centering, shuttering, strutting, propping, bolting, nailing, wedging, easing, striking and removal.
 - (b) Filleting to form stop chamfered edges or splayed external angles not exceeding 20mm width to beams, columns and the like.
 - (c) Temporary openings in the forms for pouring concrete, if required, removing rubbish etc.
 - (d) Dressing with oil to prevent adhesion of concrete with shuttering, and
 - (e) Raking or circular cutting.

vii. Re-use

Before re-use, all forms shall be inspected by the Engineer - in - Charge and their suitability ascertained. The forms shall be scarred, cleaned, and joints gone over, repaired where required. Inside surface shall be retreated adhesion of concrete.

Item No. 12: Providing & applying 2 coats of water proof cement paint of approved brand & manufacture on wall & cable trench cover surfaces after thoroughly brushing the surface to remove all dirt and remains of loose materials. The work should be carried out strictly as per manufacturer's specifications and requirement etc. complete as directed by E. I. C.

a) Materials

The water shall confirm to M-1. Cement water proofing shall confirm to IS 5410-1969.

b) Workmanship

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i. Scaffolding

Where scaffolding is required, it shall be erected in such a way that as far as possible no part of scaffolding shall rest against the surface to be distempered. A properly secured and well tied suspended platform (Joola) may be used for distempering. Where ladders are used, pieces of old gunny bags" shall be tied at top and bottom to prevent scratches to the walls and floors. For distempering to ceiling, proper stage scaffolding shall be erected where necessary.

ii. Preparation of surface:

The undecorated surface to be water proofing cement painted shall be thoroughly brushed from dust, dirt, grease, mortar dropping and other foreign matter and sand papered smooth. The surface shall be thoroughly wetted with clean water before cement water proofing paint is applied.

iii. Preparation of paint:

Portland cement shall be prepared by adding paint powder to water and stirring to obtain a thick paste, which shall then be diluted to a brushable consistency. Generally equal volumes of paint powder and water make a satisfactory paint. In all cases manufacturer's instructions shall be followed. The paint shall be mixed in such quantities as can be used up within an hour of mixing as otherwise the mixture will set and thicken, affecting flowing and finish. The lids of cement paint drums shall be kept tightly when not in use.

iv. Application of Paint:

- No painting shall be done when the paint is likely to be exposed to a temperature of below 7° C within 48 hours after application.
- When weather conditions are such as to cause damage the work shall be carried out "in the shadow" as far as possible. This helps the proper hardening of the paint film by keeping the surface moist for a longer period.
- To maintain the uniform mixture and to prevent segregation, the paint shall be stirred frequently in the bucket.
- For undercoated surfaces, the surfaces shall be treated with minimum two coats of water proof cement paint. Not less than 24 hours shall be allowed between two coats. Next coat shall not be started until the preceding coat shall be allowed between two coats. Next coat shall not be started until the preceding coat has become sufficiently hard to resist marking by the brush being used. In not dry weather, the preceding coat shall be allowed between two coats. Next coat shall not be started until the preceding coat has become sufficiently hard to resist marking by the brush being used. In hot dry weather, the preceding coat shall be slightly moistened before applying the subsequent coat.
- The finished surface shall be even and uniform in shade, without patches, brush marks, paint drops etc.
- The cement paint shall be applied with a brush with relatively short stiff hog or fiber bristles. The paint shall be brushed in uniform thickness and shall be free from excessive heavy brush marks. The lamps shall be well brushed out.
- Water proof cement paint shall not be applied on surfaces already treated with white wash color wash, distemper dry or oil bound varnishes, paint etc. It shall not be applied on gypsum, wood and metal surfaces.

v. Curing:

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Painted surfaces shall be sprinkled with water two or three times a day. This shall be done between coats and for at least two days following the final coat. The curing shall be started as soon as the paint has hardened so as not to be damaged by the sprinkling of water say about 12 hours after the application.

Item No. 13: Methods for Laying of Cable

The cables shall be laid direct in ground, pipe, closed or open ducts, on cable trays or on surface of wall etc. The method(s) of laying required shall be specified in the Bill of Quantity.

i. Laying direct in ground**• General**

This method shall be adopted where the cable route is through open ground, along roads/lanes, etc. and where no frequent excavations are likely to be encountered and where re-excavation is easily possible without affecting other services.

• Trenching**a) Width of trench**

The width of the trench shall first be determined on the following basis

- The minimum width of the trench for laying a single cable shall be 35cm
- Where more than one cable is to be laid in the same trench in horizontal formation, the width of the trench shall be increased such that the inter-axial spacing between the cables, except where otherwise specified, shall be at least 20cm.
- There shall be a clearance of at least 15cm between axis of the end cables and the sides of the trench.

b) Depth of trench

The depth of the trench shall be determined on the following basis: -

- Where the cables are laid in a single tier formation, the total depth of trench shall not be less than 75cm for cables upto 1.1KV and 1.2m for cables above 1.1KV.
- When more than one tier of cables is unavoidable and vertical formation of laying is adopted, the depth of the trench in (b) as above shall be increased by 30cm for each additional tier to be formed.

c) Excavation of trenches

- The trenches shall be excavated in reasonably straight lines. Wherever there is a change in the direction, a suitable curvature shall be adopted.
- Where gradients and changes in depth are unavoidable, these shall be gradual.
- The bottom of the trench shall be level and free from stones, brick bats etc.
- The excavation should be done by suitable means-manual or mechanical. The excavated soil shall be stacked firmly by the side of the trench such that it may not fall back into the trench.
- Adequate precautions should be taken not to damage any existing cable(s), pipes or any other such installations in the route during excavation. Wherever brick, tiles or protective covers or bare cables are encountered, further excavation shall not be carried out without the approval of the Engineer-in-Charge.
- Existing property, if any, exposed during trenching shall be temporarily supported adequately as directed by the Engineer-in-Charge. The trenching in such cases shall be done in short lengths, necessary pipes laid for passing cables therein.

- It there is any danger of a trench collapsing or endangering adjacent structures, the sides may be left in place when back filling the trench.
- Excavation through lawns shall be done in consultation with the Department concerned.

ii. Laying of cable in trench**• Sand cushioning**

- a) The trench shall then be provided with a layer of clean, dry sand cushion of not less than 8cm in depth, before laying the cables therein.
- b) However, sand cushioning as per (a) above need not be provided for MV cables, where there is no possibility of any mechanical damage to the cables due to heavy or shock loading on the soil above.
- c) Sand cushioning as per (a) above shall however be invariably provided in the case of HV cables.

• Testing before laying

All the time of issue of cables for laying, the cables shall be tested for continuity and insulation resistance test.

• Testing before covering

The cables shall be tested for continuity of cores and insulation resistance and the cable length shall be measured, before closing the trench. The cable end shall be sealed /covered.

• Sand covering

Cables laid in trenches in a single tier formation shall have a covering of dry sand of not less than 17cm above the base cushion of sand before the protective cover is laid.

In the case of vertical multi-tier formation, after the first cable has been laid, a sand cushion of 30cm shall be provided over the base cushion before the second tier is laid. If additional tiers are formed, each of the subsequent tiers also shall have a sand cushion of 30cm as stated above. Cables in the top most tiers shall have final sand covering not less than 17cm before the protective cover is laid.

• Extra loop cable

- a) At the time of original installation, approximately 3m of surplus cable shall be left on each terminal end of the cable and on each side of the underground joints. The surplus cable shall be left in the form of a loop. Where there are long runs of cables such loose cable may be left at suitable intervals as specified by the Engineer-in-Charge.
- b) Where it may not be practically possible to provide separation between cables when forming loops of a number of cables as in the case of cables emanating from a substation, measurement shall be made only to the extent of actual volume of excavation, sand filling etc. and paid for accordingly.

• Mechanical protection over the covering

- a) Mechanical protection to cables shall be laid over the covering in accordance with (b) and (c) below to provide warning to future excavators of the presence of the cable and also to protect the cable against accidental mechanical damage by pick-axe blows etc.
- b) Unless otherwise specified, the cables shall be protected by second class brick of nominal size 22cmX11.4cmX7 cm or locally available size, placed on top of the sand (or, soil as the case may be). The bricks shall be placed breadth-wise for the full length of the cable. Where more than one cable is to be laid in the same trench, this protective covering shall cover all the cables and project at least 5cm over the sides of the end cables.

- c) Where bricks are not easily available, or are comparatively costly, there is no objection to use locally available material such as tiles or slates or stone/cement concrete slabs.

• **Back filling**

- a) The trenches shall be then back-filled with excavated earth, free from stones or other sharp ended debris and shall be rammed and watered, if necessary in successive layers not exceeding 30cm depth.
- b) Unless otherwise specified, a crown of earth not less than 50mm and not exceeding 100mm in the center and tapering towards the sides of the trench shall be left to allow for subsidence. The crown of the earth however, should not exceed 10 Cms so as not to be a hazard to vehicular traffic.
- c) The temporary re-statements of roadways should be inspected at regular intervals, particularly during wet weather and settlements should be made good by further filling as may be required.
- d) After the subsidence has ceased, trenches cut through roadways or other paved areas shall be restored to the same density and materials as the surrounding area and re-paved in accordance with the relevant building specifications to the satisfaction of the Engineer-in-Charge.
- e) Where road beams or lawns have been cut out of necessity, or kerb stones displaced, the same shall be repaired and made good, except for turfing /asphalting, to the satisfaction of the Engineer-in-Charge and all the surplus earth or rock shall be removed to places as specified.

iii. Laying in pipes / closed ducts

- a) In locations such as road crossing, entry in to buildings, paved areas etc. cables shall be laid in pipes or closed ducts. Metallic pipe shall be used as protection pipe for cables fixed on poles of overhead lines.
- b) Stone ware pipes, GI, CI or spun reinforced concrete pipes shall be used for cables in general; however only GI pipe shall be used as protection pipe on poles.
- c) The size of the pipe shall not be less than 10cm in diameter for a single cable and not less than 15cm for more than one cable.
- d) In the case of new construction, pipes as required (including for anticipated future requirements) shall be laid along with the civil works and jointed according to the CPWD Building Specifications.
- e) Pipes shall be continuous and clear of debris or concrete before cables are drawn. Sharp edges if any, at ends shall be smoothened to prevent damage to cable sheathing.
- f) These pipes shall be laid directly in ground without any special bed except for SW pipe which shall be laid over 10cm thick cement concrete 1:5:10 (1 cement:5 coarse sand:10 graded stone aggregate of 40mm nominal size) bed. No sand cushioning or tiles need be used in such situations.

iv. Road crossings

- a) The top surface of pipes shall be at a minimum depth of 1m from the pavement level when laid under roads, pavements etc.
- b) The pipes shall be laid preferably askew to reduce the angle of bend as the cable enters and leaves the crossing. This is particularly important for HV cables.
- c) When pipes are laid cutting an existing road, care shall be taken so that the soil filled up after laying the pipes is rammed well in layers with watering as required to ensure proper compaction. A crown of earth not exceeding 10cm should be left at the top.

- d) The temporary re-instatements of roadways should be inspected at regular intervals, particularly after a rain, and any settlement should be made good by further filling as may be required.
- e) After the subsidence has ceases, the top of the filled up trenches in roadways or other paved areas shall be restored to the same density and material as the surrounding area in accordance with the relevant CPWD Building Specifications to the satisfaction of the Engineer-in-Charge.
- f) Manholes shall be provided to facilitate feeding/drawing in of cables with sufficient working space for the purpose. They shall be covered by suitable manhole covers. Sizes and other details shall be indicated in the Schedule of work.

v. Cable entry into the building

- a) Pipes for cable entries to the building shall slope downwards from the building. The pipe at the building end shall be suitably sealed to avoid entry of water, after the cables are laid.
- b) Cable-grip / draw-wires, winches etc. may be employed for drawing cables through pipes / closed ducts.
- c) Measurement for drawing/ laying cables in pipes/ closed duct shall be on the basis of the actual length of the pipe / duct for each run of the cable, irrespective of the length of cable drawn through.

All other specification which are not mention here under are as per PWD specifications.

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PSC Poles of 10 meter long and 270 Kgs. TECHNICAL TERMS AND CONDITIONS

1 SCOPE OF WORK:
 The scope of the work covers fabrication and supply PSC Poles of 10 meter long and 270 Kgs. working (transverse) load in accordance with the technical terms and drawing of this specification. Alternate design / specifications shall not be considered which may be noted.

2 DIMENSIONS AND TOLERANCES:

| SR NO | DESCRIPTION | STANDARD IN MM | MAXIMUM IN MM | MINIMUM IN MM |
|-------|----------------------------|------------------|------------------|------------------|
| 1 | LENGTH | 10000 | 10015 | 9985 |
| 2 | WIDTH - TOP - BOTTOM | 127.00 406.00 | 132.00 411.00 | 122.00 401.00 |
| 3 | THICKNESS | 165.00 | 168.00 | 162.00 |
| 4 | PLANTING DEPTH | 1675 | - | - |

NOTE: All dimensions are in mm.

3 WORKMANSHIP:
 The contractor will be responsible for the general soundness as well as good finish of each pole. The workmanship should be of high degree and poles having flaws and defects will be rejected.

4 STANDARDS:
 The poles shall comply with the relevant provisions made in the following Indian standard specifications with latest amendment.
 IS: 1678/1998: Specification for Prestressed concrete poles for overhead Power traction and telecommunication lines.
 IS: 2905/1989: Method of test for concrete poles for Overhead Power and Telecommunication lines.
 IS: 1343 & IS: 456: Code of practice for Prestressed and plain/reinforced concrete.

5 MATERIALS:
 The materials shall conform to this specification and be in accordance with the guaranteed particulars given. The quality of materials to be used for manufacturing of PSC poles shall be as under.

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| | <p>[A] CEMENT: The Ordinary Portland Cement used in manufacture of Prestressed concrete poles shall be relevant to IS: 8112/1989 of 43-Grade / 53- Grade to get 28 days strength of 450 Kg/ cm².</p> <p>[B] STEEL: The 4mm H.T. Steel wire used in manufacture of Prestressed concrete poles shall be conforming to IS 6003/1983 of latest amendment thereof respectively.</p> <p>[C] AGGREGATE: Aggregate used for the manufacturing of Prestressed concrete poles shall conform to IS: 383-1963. Aggregate shall consist of naturally occurring crushed black metal. They shall be hard, strong, dense, durable, clear and free from veins and adherent coating, and free from injurious amount of disintegrated pieces, alkali, vegetable material, and other deterious substances. As far as possible flaky and Elongated pieces should be avoided. It should not contain organic or other admixture that may cause corrosion of the reinforcement or impair the strength or durability of the concrete.</p> <p>The coarse aggregate shall consist of trap (preferably black) metal and in no case exceed 20 mm size. The fine aggregate shall be sharp, free from impurities and required fineness modules as specified. The sand shall be washed before use by installing a sand washing machine in the factory and the same shall not contain silt and deterious materials. The grading of fine aggregate shall be in accordance with IS: 2386 - 1963 with latest amendment.</p> <p>[D] WATER: Water to be used for process of manufacturing PSC poles like concrete mix and curing should be free from chlorides, other salts and organic materials and it should be got tested in Govt. Laboratory at test once in a year by the party. Potable water is preferable.</p> |
| 5 | <p>STORAGE OF MATERIALS</p> <p>The cement shall be stored at the work side in such a manner as to prevent deterioration due to moisture or intrusion of foreign matter.</p> <p>Steel reinforcement shall ordinary be staggered in such a way so as to avoid distortion and to prevent deterioration and corrosion, it is good practice to coat reinforcement with cement wash before stacking to prevent scale and rust.</p> <p>The aggregates shall be stored in such a way as to prevent mixing of foreign materials. The heaps of fine and coarse aggregates shall be kept separately. When different sizes of fine or coarse aggregate are procured separately, they shall be stored in separate stockpiles, to prevent the material at the edges of the piles from getting intermixed.</p> |

| | |
|----------|---|
| | Any material, which has deteriorated or has been damaged or is otherwise considered defective, shall not be used for the concrete. |
| 6 | TESTING OF MATERIALS: The Supplier shall arrange for the necessary testing of the material like Metal, Sand, Water etc. and see that the materials to be used in the manufacturing confirm to relevant IS. |
| 7 | METHOD OF MANUFACTURING OF PSC POLES: The Prestressed concrete poles are generally manufactured by long line multiple bed method for mass production. (A) BED AND MOULD: The length and number of rows of concrete casting bed shall be according to the production capacity of pole factory. Preferably one pole bed separately should be provided to minimise wastage of H.T.Steel wire. The Prestressed poles are to be cast in a steel mould having accurately machined bottom bed and side faces. The steel mould should be strong enough to resist distortion. The bed should be absolutely horizontally levelled and free from any undulation. The mould should be capable of being opened in such a way that edges of the poles are not damaged. At both the ends of row of concrete casting bed, the anchor blocks are provided for fixing and stretching of H.T.Steel Wire. (B) STIRRUPS: The stirrups shall be prepared as per the design / drawing of the PGVCL from 4 MM dia H.T. Steel. The stirrups shall be placed in position as per approved drawing. Stirrups shall have standard lap lengths and be welded to ensure maintaining proper shape and position. (C) PREPARATION OF REINFORCEMENT: All the reinforcement and window boxes shall be accurately placed and maintained in position during the fabrication. As per the Design / Drawing all the stirrups made out of H.T.steel, H.T.Steel wire shall be placed in respective position of the mould and thereafter continuous H.T.Steel wires are arranged through holes and plates of the mould. The welded joints in H.T. Steel wire will not be permitted. The H.T.Steel wires are stretched up to the required tension 10% of UTS as specified in relevant I.S. code with the help of Jacks and anchor blocks. All the wires shall be accurately stretched with uniform prestressing in each wire. Each wire shall be anchored positively during the casting. The tension applied shall be checked with the help of suitable Gauge/Meter. (D) CONCRETE MIX: The concrete mix to be used for manufacturing of PSC Poles shall be prepared by weight batching only in such a manner and proportion so as to achieve the |

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compressive strength of the concrete mix as per IS: 456 and none of the test specimen shall have strength less than 225 and 450 KG/CM² after 3 and 28 days respectively. The cement concrete shall be mixed only in electrically / mechanically operated concrete mixer machine. Gradation of the aggregate used in concrete mix shall adhere to the appropriate Mix Design and proportions be checked in regular interval. Water in concrete shall be added with proper measurement to maintain required water cement ratio. The hand broken metal shall not be permitted.

(E) PLACING OF CONCRETE MIX:

The mould should be free from Dust, Dirt and other organic materials and oil is to be applied before placing the concrete mix. The machine mixed concrete is, thereafter poured in the mould and shall be compacted by spinning, vibrating, shocking or other suitable mechanical means. Over-vibration or under-vibration or vibration of very wet mix is harmful and should be avoided. The Hand compaction shall not be permitted.

On application of vibrator the concrete Mix will compact & get to 2 to 3 mm below form/mould level. This gap shall also be filled up with prepared concrete Mix only & re vibrated. The mixture of cement & sand for filling up the gap as well as finishing work will not be permitted. Finishing work shall be done only with cement slurry.

Care should be taken to see that anchorages do not yield before concrete attains necessary strength. Proper cover for concrete should be maintained throughout process of pouring, compacting etc. of concrete mix.

On achieving setting time, the side faces of the mould shall be removed from the bed and watered at intervals to prevent the surface cracking of the pole. The concrete shall be covered with a layer of sacking, canvas, Hessian or similar absorbent materials and kept constantly wet up to the time when the strength of the concrete reaches to the minimum strength of the concrete at transfer of prestress i.e. for about 72 hours.

The Steam curing may be permitted in exigency or emergency cases with the approval of the competent authority only.

(F) DETENSIONING, CUTTING OF WIRE AND REMOVING OF POLES FROM THE BED:

After ascertaining that concrete has attained required strength of min. 225 KG/CM² by checking the cube strength stretched wires are released from the anchor blocks and cut with the help of welding machine. The cutting shall be started only from the centre of the bed length. The pole is then removed from the bed by lifting at 2 points using gantry and moved to the Curing Pond.

(G) CURING:

The curing of the pole shall commence after setting of the concrete. Continuous curing on bed should be done till it is shifted to curing pond, The

| | | | | | | | | | | | | | |
|-----|--|------------------------|------------------------------------|-----------------|-----|----------------------------|-----------------|-----|-------------------------------|------------------|-----|------------------|------------------------|
| | <p>curing pond shall be full of water and each pole must be immersed in the water for a period of at least 28 days. If required, water sprinkling shall be done at intervals to keep the poles constantly wet as per I.S.No.1678-1998.</p> <p>(H) STORING OF POLES READY FOR INSPECTION: The poles prepared vide method stated above shall be stacked in chronological method and indication of the date of manufacturing and number of poles be put before with particular lot so as to identify the lot by inspecting officer.</p> | | | | | | | | | | | | |
| 8 | <p>MARKING: The poles shall be clearly and indelibly marked with the following particulars during manufacture, at a position between 5th (W5) and 6th (W6) window indicated in the drawing so as to easily read after erection in position. The mark shall be done by pressing embossed figures / letters of 50 mm height and 20 mm width with gap of 5 mm between two figures. The sample drawing No. - C 583 - A is attached with the tender.</p> <table><tr><td>(a)</td><td>Date, month & year of manufacture,</td><td>(On front face)</td></tr><tr><td>(b)</td><td>Serial number of pole, and</td><td>(On front face)</td></tr><tr><td>(c)</td><td>Maker's serial number or mark</td><td>(On front faces)</td></tr><tr><td>(d)</td><td>PGVCL (in words)</td><td>(above planting depth)</td></tr></table> <p>The pole shall also be suitably marked for the planting depth i.e. 1675 mm from bottom. On both the end of pole the anti-corrosive paint i.e. epoxy based bituminous paints two coats are to be applied. One before putting in curing pond and second after removing from the pond.</p> | (a) | Date, month & year of manufacture, | (On front face) | (b) | Serial number of pole, and | (On front face) | (c) | Maker's serial number or mark | (On front faces) | (d) | PGVCL (in words) | (above planting depth) |
| (a) | Date, month & year of manufacture, | (On front face) | | | | | | | | | | | |
| (b) | Serial number of pole, and | (On front face) | | | | | | | | | | | |
| (c) | Maker's serial number or mark | (On front faces) | | | | | | | | | | | |
| (d) | PGVCL (in words) | (above planting depth) | | | | | | | | | | | |
| 9 | <p>CUBE TESTING: Total 6 Nos. Cubes of 100mm X 100mm X 100mm size concrete shall be cast daily and tested at release, i.e. after approx. 72 Hours of cast as well as after 28 days, in accordance with Indian Standard specification at Supplier's own expense. The mix for concrete adopted shall be such as to give cube strength not less than 225Kg/cm2 at release (after 3 days) and 450 Kg/cm2 after 28 days.</p> <p>Cube testing machine shall always be kept in the working condition and regular cube tests shall be taken and results be recorded in the registers duly signed by engineer-in -charge and representative of the Supplier.</p> | | | | | | | | | | | | |
| 10 | <p>SAMPLING AND CONFORMITY</p> <p>1] LOT:</p> <p>A. In any batch, all poles of the same class and same dimensions shall be grouped together to constitute a LOT.</p> <p>B. If the number of poles in a lot exceeds 500 then the lot shall be divided into suitable number of SUB-LOTS such that the number of poles i.e. any</p> | | | | | | | | | | | | |

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- sub-lot shall not exceed 500. The acceptance or otherwise of a sub lot shall be determined on the basis of the performance of sample selected from it.
- 2] Scale of Sampling: 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&2 of the table given below.

**SAMPLE SIZE AND CRITERIA OF CONFORMITY
 DIMENSIONAL REQUIREMENTS.**

| Size of lot Or Sub-Lot | Sample size | Permissible No. of Defective samples. | NO. Of sample Poles (Out of Col.2) for Transverse Strength test |
|---------------------------|----------------|---|--|
| (1) | (2) | (3) | (4) |
| Up to 100 | 10 | 1 | 2 |
| 101 to 200 | 15 | 1 | 3 |
| 201 to 300 | 20 | 2 | 4 |
| 301 to 500 | 30 | 3 | 5 |

- 3] Number of Tests: All the poles as selected as above shall be tested for overall length, cross-section and uprightness. The number of poles to be tested for transverse strength test shall be in accordance with col 4 of table. These poles may be selected from those already tested.
- 4] Criteria of conformity: A lot or sub-lot shall be considered as conforming to the specification if the conditions under are satisfied.
 The numbers 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 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. 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. If one or more poles of the second samples fail, the lot or the sub-lot represented by the corresponding samples shall be considered not to have passed the test.

11 METHOD OF INSPECTION AND TESTING GENERAL:

The tests on poles shall not be carried out earlier than 28 days from date of manufactured for poles manufactured from ordinary Portland cement or blast furnace slag cement. If a chloride free ad mixture is used or rapid hardening Cement of Grade 43 / 53 is used than pole can be tested at 14 days of age. The specimens shall be inspected and any specimen with visible flaws shall be discarded. If any test specimen fails because of mechanical reasons, such as failure of testing equipment of improper specimen preparation, it shall be discarded and another specimen shall be taken.

INSPECTION:

The Tenderer shall offer Ready Made PSC Poles lot for inspection and relevant tests.

(01) DIMENSIONS:

All the Poles shall be manufactured in accordance with the detailed dimensional drawing.

The tolerance on dimension shall be limited to...

- | | | |
|------------------------|---|----------------------------------|
| (i) For length | - | ± 15 mm. |
| (ii) For Web thickness | - | ± 5 mm. |
| (iii) Upright ness | - | 0.5 % (i.e. 72 to 1.005 / 0.995) |

(02)METHOD OF TESTING:

The pole shall be tested only in the horizontal position or as specified in I.S. 1678 / latest amendment & I.S. 2905 /1989 latest amendment .While testing in the horizontal position, provision shall be made by suitable supports 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. The frictional resistance of the supporting devices should be separately determined and deducted from the total final load applied on the pole.

Theoretically the permanent deflection should be as per IS 2905 / 1966 and latest amendment thereof. The recovery of deformations should not be less than 90%.

A] Testing Arrangement -

The pole shall be fixed in the crib longitudinally from butt to its ground line and then it shall be secured firmly in place. Wooden saddles with concave surfaces and other packing shall be placed around the pole to prevent injury to the butt section as specified in IS: 2905/1966 - latest amendment.

To minimize vertical movement at the point of load application and to reduce the stresses due to dead weight of the pole, a rail support shall be provided near the point of load application, or alternately a number of friction less supports in the form of trolleys may be provided near the end or throughout

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the length of the pole. The rail support or other forms of support shall be such that any friction associated with the deflection of the pole under load shall not be a significant portion of the measured load on the pole.

B] Loading - The load shall be applied at a point 600 mm from the top of the pole by means of a suitable device, such as a wire rope and winch placed in a direction normal to the direction of the length of the pole, so that the minimum length of the straight rope under pull (excluding the curved portion near the transmitting devices) is not less than two times the length of the pole. If the loading device is set sufficiently far away from the pole to make the angle between the initial and final positions of pulling line small, the error in assuming that the pull is always perpendicular to the original direction of the pole axis will be negligible. The pulling line shall be kept level between the winch position and the point where load is applied to the pole. The load shall be applied at a constant rate of 4 percent of the specified test load per minute and in accordance with procedure.

C] Pulling Line: The pulling line shall be secured around the pole at the load point. Load measuring device shall be placed in a way so as to accurately measure in the tension in the pulling line. The other end of which is attached to the loading equipment (winch).

D] Load Measurement: Load Cell with accuracy of 5 Kg. for measurement may be adopted. Load cell shall be calibrated before every test. The load measuring device shall be supported in such a way that the force required to pull it shall not add to the measured load on the pole and that no damage is cause to the instrument if the pole suddenly breaks under test. No pullies or any other device in between load application point and load cell will be allowed.

E] Deflections - The deflection of the pole and the load applied shall be measured simultaneously at different stages of loading to provide at least five sets of readings or as specified in I.S.2905 & latest amendment thereof. The measurement of the deflection of the load point shall be made in a direction perpendicular to the unloaded position of the pole axis. The measurement shall be made correct to the nearest 1 mm by use of datum board. A second datum line shall also be established from which the movement of the ground line if any, shall be measured.

F] PROCEDURE: Load shall be applied at a point 600 mm from the top of the pole and shall be steadily and gradually increased in increments of 67.5Kg. till formation of 1st crack recording deflection at each increment.

| | | | | | | | | | | | | | |
|-----|--|------------|--------------|-----------|-----|------------------|-------|-----|---------------|------------|-----|------------|--|
| | <p>The load shall be then reduced to zero and then increased gradually in 67.5 Kg. increments to 540Kg load. Each load increment be successively increased by 33.75Kg. up to design ultimate transverse load (i.e. 675 Kgs.). The load shall be increased in steps of 33.75 Kgs. to measure ultimate transverse load, until failure occurs. Each time the load is applied same shall be held for 2 minutes. The load applied to Prestressed concrete poles at the point of failure shall be measured to the nearest five kilograms.</p> <p>G] RECORDING OF DATA AND MEASUREMENTS: (i) Any hair cracks appearing at a stage prior to the application of the design transverse load at first crack shall be measured using feeler gauges & shall be recorded. It should also be recorded, whether the hair cracks, if any, produced on application of the 60 percent of the minimum ultimate transverse load close up on the removal or reduction of the test load. (ii) The load applied to the pole at the time of failure shall be measured to the nearest 5Kg. iii) A Prestressed concrete pole shall be deemed not to have passed the test if crack wider than 0.1mm appears at a stage prior to the application of the design transverse load at first crack (270 Kgs.) (iv) The definition of failure of PSC Pole in test will be (i) permanent set more than 3.5 Cm. at load of 675 Kgs. Or (ii) Deflection of more than 35 Cms at load of 675 Kgs.</p> <p>H] ULTIMATE FAILURE: The conditions existing when the pole ceases to sustain a load increment owing to either crushing of concrete or snapping of the Prestressing tension or permanent stretching of the steel in any part of the pole. At least one pole shall be subjected to destruction test in the contract in presence of representative from PGVCL, Rajkot.</p> | | | | | | | | | | | | |
| 12 | <p>TECHNICAL DATA OF PSC POLES</p> <p>The Guaranteed Particulars of PSC Poles 10 Mtr. 270 Kg.</p> <table><tr><td>01.</td><td>Working load</td><td>: 270 Kg.</td></tr><tr><td>02.</td><td>Factor of safety</td><td>: 2.5</td></tr><tr><td>03.</td><td>Ultimate Load</td><td>: 675 Kgs.</td></tr><tr><td>04.</td><td>Dimensions</td><td></td></tr></table> | 01. | Working load | : 270 Kg. | 02. | Factor of safety | : 2.5 | 03. | Ultimate Load | : 675 Kgs. | 04. | Dimensions | |
| 01. | Working load | : 270 Kg. | | | | | | | | | | | |
| 02. | Factor of safety | : 2.5 | | | | | | | | | | | |
| 03. | Ultimate Load | : 675 Kgs. | | | | | | | | | | | |
| 04. | Dimensions | | | | | | | | | | | | |

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- | | | |
|-----|--|--|
| (a) | Bottom Cross-Section | : 406 x 165 mm. |
| (b) | Top Cross-Section | : 127 x 165 mm. |
| (c) | Total height | : 10,050 mm. |
| (d) | Web thickness. | : 63 mm |
| (e) | Planting Depth | : 1675 mm. |
| 05. | No. of Windows | : 10 nos. |
| 06. | No. of 20mm dia. holes. On Front face | : 07 nos. as per drawing |
| 07. | Minimum requirement: | |
| (a) | Cube Test (Each Specimen) | : 450 Kg/Cm ² (28 days). : 225Kg/Cm ² (3 days)- at release of Prestress. |
| (b) | Initial tension in HT Steel Wire/Pole. | : 70% of 175.00 Kg/mm ² as specified in related I.S. Code |

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TECHNICAL SPECIFICATION OF MATERIALS USED FOR CIVIL WORKS

1. M-1. Water

- i. Water shall not be salty brackish and shall be clean, reasonably clear and free objectionable quantities of silt and traces of oil bad injurious alkalis, salts, organic matter and other deleterious material which will either weaken the mortar of concrete or cause efflorescence or attack the steel in R.C.C. Container for transport, storage and handling of water shall be clean. Water shall conform to the standard specified in I.S.456-1978.
- ii. If required by the Engineer-in-Charge it shall be tested by comparison with distilled water. Comparison shall be made by means of standard cement tests for soundness time of setting and mortar strength as specified in I.S. 269-1976 Any indication of unsoundness, change in time of setting by 30 minutes or more or decrease of more than 10 per cent in strength, of mortar prepared with water sample when compared with the results obtained with mortar prepared with distilled water shall be sufficient cause for rejection of water under test.
- iii. Water for curing mortar, concrete or masonry should not be too acidic or too alkaline. It shall be free of elements which significantly affect the hydration reaction or otherwise interfere with the hardening of mortar or concrete during curing or those which produce objectionable stains or other unsightly deposits on concrete or mortar surfaces
- iv. Hard and bitter water shall not be used for curing.
- v. Potable water will generally found suitable for curing mortar or concrete.

2. M-2 Cement

Cement shall be ordinary Portland cement as per I.S. 12269: 2013.

3. M-3 Sand

- i. Sand shall be natural sand, clean, well graded, hard strong, durable and gritty particles free from injurious amounts of dust, clay kankar nodules, soft or flaky particles shale, alkali salts organic matter, loam, mica or other deleterious substances and shall be got approved from the Engineer-in-Charge. The sand shall not contain more than 8 percent of silt as determined by field test. If necessary, the sand shall be washed to make it clean.
- ii. Coarse Sand: The fineness modulus of coarse sand shall not be less than 2.5-and shall not exceed 3.0, The sieve analysis of coarse shall be as under:

| I.S Designation | Sieve Passing sieve | Percentage by weight Designation | I.S. Sieve percentage weight passing sieve |
|-----------------|------------------------|-------------------------------------|---|
| 4.75mm | 100 | 600 Micron | 30-100 |
| 2.36mm | 90 to 100 | 300 Micron | 5-70 |
| 1.18mm | 70-100 | 150 Micron | 0-50 |

- iii. Fine Sand:
The fineness modulus shall not exceed 1.0. The sieve analysis of fine sand shall be as under:

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| I.S Designation | Sieve Passing sieve | Percentage by weight Designation | I.S. Sieve percentage by weight passing sieve |
|-----------------|------------------------|-------------------------------------|---|
| 4.75mm | 100 | 600 Micron | 40-85 |
| 2.36mm | 100 | 300 Micron | 5-50 |
| 1.18mm | 75-100 | 150 Micron | 0-10 |

4. **M-4. Stone Grit**

- i. Grit shall consist of crushed or broken stone and be hard, strong, dense, durable, clean of proper gradation and free from skin or coating likely to prevent proper adhesion of mortar. Grit shall generally be cubical in shape and as far as possible flakey elongated pieces shall be avoided. It shall generally comply with the provisions of I.S. 383-1970. Unless special stone of particular quarries is mentioned grit shall be obtained from the best black trap or equivalent hard stone as approved by the Engineer-in-Charge. The grit shall have no deleterious with cement.
- ii. The grit shall conform to the following gradation as per sieve analysis:

| I.S Designation | Sieve Passing sieve | Percentage by weight Designation | I.S. Sieve percentage by weight passing sieve |
|-----------------|------------------------|-------------------------------------|--|
| 1250mm | 100 % | 4.75mm | 0-20 % |
| 10.00mm | 85-100 % | 2.36mm | 0-25% |

- iii. The crushing strength of grit will be such as to allow the concrete in which it used to build-up the specified strength of concrete
- iv. The necessary tests for grit shall be carried out as per the requirements of I.S.2386- (parts-I of VIII) 1963, as per instructions of the Engineer-in-Charge. The necessity of test will be decided by the. Engineer-in-Charge.

5. **M-5 Cement Mortar**

- i. Water shall conform to specification M-1 Cement: Cement shall conform to specifications M-3 Sand: Sand shall conform to M-6
- ii. **Proportion of Mix**
Cement and sand shall be mixed to specified proportion, sand being measured by measuring boxes, the proportion of cement will be by volume on the basis of 50 Kg/Bag of cement being equal to 0.0342 Cu.m. The mortar may be hand mixed or machine mixed as directed.
- iii. **Proportion of Mortar:**
In hand mixed mortar, cement and sand in the specified proportions shall be thoroughly mixed dry on a clean impervious platform by turning over at least 3 times or more till a homogeneous mixture of uniform colour is obtained. Mixing platform shall be so arranged, that no deleterious extraneous material shall get mixed with mortar or mortar shall flow out. While mixing, the water shall be gradually added and thoroughly mixed to form a stiff plastic mass

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of uniform colour so that each particle of sand shall be completely covered with a film of wet cement. The water cement ratio shall be adopted as directed.
 The mortar so prepared shall be used within 30 minutes of adding water. Only such quantity of mortar shall be prepared as can be used within 30 minutes.

6. M-6 Stone Coarse Aggregate for Nominal Mix Concrete

- i. coarse aggregate shall be of machine crushed stone of black trap or equivalent and be hard, strong, dense, durable, clean and free from skin and coating likely to prevent proper adhesion of mortar.
- ii. The aggregate shall generally be cubical in shape. Unless special stones of particular quarries are mentioned aggregates shall be machine crushed from the best black trap or equivalent hard stone as approved. Aggregate shall Have no deleterious reaction with cement. The size of the coarse aggregate for plain cement and ordinary reinforced cement concrete shall generally be as per the table given below However, in case of reinforced cement concrete the maximum limit may be restricted to 6 mm less than the minimum lateral clear distance between bars or 6 mm. less than the cover whichever is smaller

TABLE

| IS. Sieve | Percentage passing for single | IS. Sieve | Percentage passing for single |
|-------------|--|-------------|--|
| Designation | Sized aggregates of Nominal size 40mm 20mm 16mm | Designation | Sized aggregates of Nominal size 40mm 20mm 16mm |
| 80mm | - | 12.5mm | 0.5 0.20 |
| 63mm | 100 | 10 mm | 0.5 0.5 |
| 40mm | 85-100 100 | 4.75mm | |
| 20mm | 0.2 85-100 100 | 2.35 mm | |
| 16mm | 85-100 | | |

Note: This percentage may be varied somewhat by the Engineer-in-Charge when considered necessary for obtaining better density and strength of concrete.

- iii. The grading test shall be taken in the beginning and at the change of source of materials. The necessary tests Indicated in IS 383-1970 and 456-1978 shall have to be carried out to ensure the acceptability. The aggregates shall be stored separately and handled in such a manner as to prevent the mixing of different aggregates. If she aggregates are covered with dust, they shall be washed with water to make them clean.

7. M-7 Black Trap or Equivalent Hard Stone Coarse

- i. Aggregate for Design Mix Concrete Coarse aggregate shall be of machine crushed stone of black trap or equivalent hard stone and be hard, strong, dense, durable, clean and free from skin and coating likely to prevent proper adhesion of mortar,
- ii. The aggregates shall generally-be cubical in shape. Unless special stones of particular quarries are mentioned, aggregates shall be machine crushed from the best, black trap or equivalent hard stones as approved, Aggregate shall have no deleterious with cement.

- iii. The necessary tests indicated in IS. 383-1970 and IS.456-1978 shall have to be carried out to ensure the acceptability of the material. If aggregate is covered with dust it shall be washed with water to make it clean.

8. M-8 Brick

- i. The brick shall be machine moulded and made from suitable fly ash, cement, lime, gypsum, etc. They shall be free from cracks and nodules of free lime. They shall have smooth rectangular faces with sharp corners and shall be of uniform colour. The bricks shall be moulded with the frog of 100mm x 40 mm and 10mm to 20mm deep on one of its flat sides. The bricks shall not break when thrown on the ground from a height of 600mm.
- ii. The size of the modular bricks shall be 190 x 90 x 90 mm.
- iii. The size of the conventional bricks shall be 225 x 110 x 75mm.
- iv. Only bricks of one standard size shall be used on one work. The following tolerance shall be permitted in the conventional size adopted in a particular work. Length +3.0mm, Width +1.50mm, Height +1.50mm.
- v. The crushing strength of the brick shall not be less than 35.0 Kg / Sq cm. The average water absorption shall not be less than 20 per cent by weight. Necessary test for crushing strength and water absorption shall be carried out as per IS 3495: (Part I to Part IV) 1976.

9. M-9 Mild Steel Binding Wire

- i. The mild steel wire shall be of 1.63 mm. or 1.22 mm. (16 to 18 gauge) diameter and shall conform to I.S. 280-1972.
- ii. The use of black wire will be permitted for binding reinforcement bars. It shall be free from rust, oil paint, grease, loose mill scale or any other undesirable coating which may prevent adhesion of cement mortar.

10. M-10 Structural Steel

All structural Steel shall conform to I.S. 226-1985. The steel shall be free from the defects mentioned in I.S. 226-1975 and shall have a smooth finish. The material shall be free from loose mill scale, rust pits or other defects affecting the strength and durability. River bars shall conform to I.S. 1148-1973. When the steel is supplied by the Contractor test certificate of the manufacturers shall be obtained according to I.S. 226-1975 and other relevant Indian Standards.

11. M-11 Shuttering

- i. The shuttering shall be either of ply wood planking of appropriate thickness with or without steel lining or of steel plates stiffened by steel angles. The shuttering shall be supported on battens and beams and props of vertical ballies properly cross braced together so as to make the centering rigid. In places of bulli props, brick pillar of adequate section built in mud mortar may be used.
- ii. The form work shall be sufficiently strong and shall have camber, so that it assumes correct shape after deposition of the concrete and shall be able to resist forces caused by vibration of live load of men working over it and other incidental loads associated with it. The shuttering shall have smooth and even surface and its joints shall permit leakage of cement grout.

- =====
- iii. If at any stage of work during or after placing concrete in the structure, the form work sags or bulges out beyond the required shape of the structure, the concrete shall be removed and work redone with fresh concrete and adequately rigid form work. The complete formwork shall be got inspected by and got approved from the Engineer-in-Charge, before the reinforcement bars are placed in position
 - iv. The props shall consist to bullies having 100 mm. minimum diameters measured at mid length and 80mm. at thin end shall be placed as per design requirement. These shall rest squarely on wooden sole plates 40 mm. thick and minimum bearing area of 0-10 sq m. laid on sufficiently hard base.
 - v. Double wedges shall further be provided between the sole plate and the wooden props so as to facilitate tightening and easing of shuttering without jerking the concrete.
 - vi. The wood used in shuttering shall not be so dry as to absorb water from concrete and swell or bulge nor so green or wet as to shrink after erection. The timber shall be properly sawn and planed on the sides and the surface coming in contact with concrete, Wooden form work with metal sheet lining or steel plates stiffened by steel angles shall be permitted,
 - vii. As far as practicable, clamps shall be used to hold the forms together and use of nails and spikes avoided.
 - viii. The surface of timber shuttering that would come in contact with concrete shall be well wetted and coated with soap solution before the concreting is done. Alternatively coat of raw linseed oil or oil of approved manufacture may be applied in place of soap solution. In case of steel shuttering either soap solution or raw linseed oil shall be applied after thoroughly cleaning the surface. Under no circumstances black or burnt oil shall be permitted.
 - ix. The shuttering for beams and slabs shall have camber of 4 mm. per meter.
 - x. (1in250) or as directed by the Engineer-in-Charge so as to offset the subsequent deflection. For cantilevers, the camber at free end shall be 1/50 of the projected length or as directed by the Engineer-in-Charge.

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PSC Poles of 8 meter long and 200Kgs TECHNICAL TERMS AND CONDITIONS

1 SCOPE OF WORK:
 The scope of the work covers fabrication and supply PSC Poles of 8 meter long and 200Kgs. working (transverse) load in accordance with the technical terms and drawing of this specification. Alternate design / specifications shall not be considered which may be noted.

2 DIMENSIONS AND TOLERANCES:

| SR NO | DESCRIPTION | STANDARD IN MM | MAXIMUM IN MM | MINIMUM IN MM |
|-------|----------------------------|-----------------|-----------------|-----------------|
| 1 | LENGTH | 8000 | 8015 | 7985 |
| 2 | WIDTH - TOP - BOTTOM | 114.3 336.55 | 117.3 339.55 | 111.3 333.55 |
| 3 | THICKNESS | 139.7 | 142.7 | 136.7 |
| 4 | UP RIGHTNESS | 1 TO 72 | 0.5 % | 0.5 % |
| 5 | PLANTING DEPTH | 1381 | - | - |

NOTE: All dimensions are in mm.

3 WORKMANSHIP:

The contractor will be responsible for the general soundness as well as good finish of each pole. The workmanship should be of high degree and poles having flaws and defects will be rejected.

4 STANDARDS:

The poles shall comply with the relevant provisions made in the following Indian standard specifications with latest amendment.

IS: 1678/1998: Specification for Prestressed concrete poles for overhead Power traction and telecommunication lines.

IS: 2905/1989: Method of test for concrete poles for Overhead Power and Telecommunication lines.

IS:1343 & IS: 456:Code of practice for Prestressed and plain/reinforced concrete.

5 MATERIALS:

The materials shall conform to this specification and be in accordance with the guaranteed particulars given.

The Consumption of materials per PSC Pole with minimum limit indicated below:

1. Cement 53 grade/43 grade 1.45/1.61 Bags. For concrete mix
2. 4mm H.T. Steel wire 12 nos. - For tension wire.

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| | <p>3. 4mm H.T. Steel wire 24 Nos. Rings.</p> <p>The consumption indicated above shall be inclusive of variations inclusive rolling margin. The consumption of cement shall be inclusive of quantity required in finishing work. PSC Pole under destruction test shall be to the Supplier's account.</p> <p>The quality of materials to be used for manufacturing of PSC poles shall be as under.</p> <p>[A] CEMENT: The Ordinary Portland Cement used in manufacture of Prestressed concrete poles shall be relevant to IS: 8112/1989 of 43-Grade / 53- Grade to get 28 days strength of 450 Kg/ cm².</p> <p>[B] STEEL: The 4mm H.T. Steel wire used in manufacture of Prestressed concrete poles shall be conforming to IS 6003/1983 of latest amendment thereof respectively.</p> <p>[C] AGGREGATE: Aggregate used for the manufacturing of Prestressed concrete poles shall conform to IS: 383-1963. Aggregate shall consist of naturally occurring crushed black metal. They shall be hard, strong, dense, durable, clear and free from veins and adherent coating, and free from injurious amount of disintegrated pieces, alkali, vegetable material, and other deterious substances. As far as possible flaky and Elongated pieces should be avoided. It should not contain organic or other admixture that may cause corrosion of the reinforcement or impair the strength or durability of the concrete.</p> <p>The coarse aggregate shall consist of trap (preferably black) metal and in no case exceed 20 mm size. The fine aggregate shall be sharp, free from impurities and required fineness modules as specified. The sand shall be washed before use by installing a sand washing machine in the factory and the same shall not contain silt and deterious materials. The grading of fine aggregate shall be in accordance with IS: 2386 - 1963 with latest amendment.</p> <p>[D] WATER: Water to be used for process of manufacturing PSC poles like concrete mix and curing should be free from chlorides, other salts and organic materials and it should be got tested in Govt. Laboratory at least once in a year by the party. Potable water is preferable.</p> |
| 5 | <p>STORAGE OF MATERIALS</p> <p>The cement shall be stored at the work side in such a manner as to prevent deterioration due to moisture or intrusion of foreign matter.</p> <p>Steel reinforcement shall ordinary be staggered in such a way so as to avoid distortion and to prevent deterioration and corrosion, it is good practice to coat reinforcement with cement wash before stacking to prevent scale and rust.</p> <p>The aggregates shall be stored in such a way as to prevent mixing of foreign materials. The heaps of fine and coarse aggregates shall be kept separately. When different sizes of fine</p> |

| | |
|----------|---|
| | <p>or coarse aggregate are procured separately, they shall be stored in separate stockpiles, to prevent the material at the edges of the piles from getting intermixed.</p> <p>Any material, which has deteriorated or has been damaged or is otherwise considered defective, shall not be used for the concrete.</p> |
| 6 | <p>TESTING OF MATERIALS: The Supplier shall arrange for the necessary testing of the material like Metal, Sand, Water etc. and see that the materials to be used in the manufacturing confirm to relevant IS.</p> |
| 7 | <p>METHOD OF MANUFACTURING OF PSC POLES: The Prestressed concrete poles are generally manufactured by long line multiple bed method for mass production.</p> <p>(A)BED AND MOULD: The length and number of rows of concrete casting bed shall be according to the production capacity of pole factory. Preferably one pole bed separately should be provided to minimise wastage of H.T.Steel wire. The Prestressed poles are to be cast in a steel mould having accurately machined bottom bed and side faces. The steel mould should be strong enough to resist distortion. The bed should be absolutely horizontally levelled and free from any undulation. The mould should be capable of being opened in such a way that edges of the poles are not damaged. At both the ends of row of concrete casting bed, the anchor blocks are provided for fixing and stretching of H.T.Steel Wire.</p> <p>(B)STIRRUPS: The stirrups shall be prepared as per the design / drawing of the PGVCL from 4 MM dia H.T. Steel. The stirrups shall be placed in position as per approved drawing. Stirrups shall have standard lap lengths and be welded to ensure maintaining proper shape and position.</p> <p>(C)PREPARATION OF REINFORCEMENT: All the reinforcement and window boxes shall be accurately placed and maintained in position during the fabrication. As per the Design / Drawing all the stirrups made out of H.T.steel, H.T.Steel wire shall be placed in respective position of the mould and thereafter continuous H.T.Steel wires are arranged through holes and plates of the mould. The welded joints in H.T. Steel wire will not be permitted. The H.T.Steel wires are stretched up to the required tension 10% of UTS as specified in relevant I.S. code with the help of Jacks and anchor blocks. All the wires shall be accurately stretched with uniform prestressing in each wire. Each wire shall be anchored positively during the casting. The tension applied shall be checked with the help of suitable Gauge/Meter.</p> <p>(D)CONCRETE MIX: The concrete mix to be used for manufacturing of PSC Poles shall be prepared by weight batching only in such a manner and proportion so as to achieve the compressive strength of the concrete mix as per IS: 456 and none of the test specimen shall have strength less</p> |

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than 225 and 450 KG/CM2 after 3 and 28 days respectively. The cement concrete shall be mixed only in electrically / mechanically operated concrete mixer machine. Gradation of the aggregate used in concrete mix shall adhere to the appropriate Mix Design and proportions be checked in regular interval. Water in concrete shall be added with proper measurement to maintain required water cement ratio. The hand broken metal shall not be permitted.

(E) PLACING OF CONCRETE MIX:

The mould should be free from Dust, Dirt and other organic materials and oil is to be applied before placing the concrete mix. The machine mixed concrete is, thereafter poured in the mould and shall be compacted by spinning, vibrating, shocking or other suitable mechanical means. Over-vibration or under-vibration or vibration of very wet mix is harmful and should be avoided. The Hand compaction shall not be permitted.

On application of vibrator the concrete Mix will compact & get to 2 to 3 mm below form/mould level. This gap shall also be filled up with prepared concrete Mix only & re vibrated. The mixture of cement & sand for filling up the gap as well as finishing work will not be permitted. Finishing work shall be done only with cement slurry.

Care should be taken to see that anchorages do not yield before concrete attains necessary strength. Proper cover for concrete should be maintained throughout process of pouring, compacting etc. of concrete mix.

On achieving setting time, the side faces of the mould shall be removed from the bed and watered at intervals to prevent the surface cracking of the pole. The concrete shall be covered with a layer of sacking, canvas, Hessian or similar absorbent materials and kept constantly wet up to the time when the strength of the concrete reaches to the minimum strength of the concrete at transfer of prestress i.e. for about 72 hours.

The Steam curing may be permitted in exigency or emergency cases with the approval of the competent authority only.

(F) DETENSIONING, CUTTING OF WIRE AND REMOVING OF POLES FROM THE BED:

After ascertaining that concrete has attained required strength of min. 225 KG/CM2 by checking the cube strength stretched wires are released from the anchor blocks and cut with the help of welding machine. The cutting shall be started only from the centre of the bed length. The pole is then removed from the bed by lifting at 2 points using gantry and moved to the Curing Pond.

(G) CURING:

The curing of the pole shall commence after setting of the concrete. Continuous curing on bed should be done till it is shifted to curing pond, The curing pond shall be full of water and each pole must be immersed in the water for a period of at least 28 days. If required, water sprinkling shall be done at intervals to keep the poles constantly wet as per I.S.No.1678-1998.

(H) STORING OF POLES READY FOR INSPECTION:

The poles prepared vide method stated above shall be stacked in chronological method and indication of the date of manufacturing and number of poles be put before with particular lot so as to identify the lot by inspecting officer.

| 8 | <p>MARKING:</p> <p>The poles shall be clearly and indelibly marked with the following particulars during manufacture, at a position between 5th (W5) and 6th (W6) window indicated in the drawing so as to easily read after erection in position. The mark shall be done by pressing embossed figures / letters of 50 mm height and 20 mm width with gap of 5 mm between two figures. The sample drawing is attached with the tender.</p> <p>(e) Date, month & year of manufacture, (On front face)</p> <p>(f) Serial number of pole, and (On front face)</p> <p>(g) Maker's serial number or mark (On front faces)</p> <p>(h) PGVCL (in words) (above planting depth)</p> <p>The pole shall also be suitably marked for the planting depth i.e. 1381 mm from bottom. On both the end of pole the anti-corrosive paint i.e. epoxy based bituminous paints two coats are to be applied. One before putting in curing pond and second after removing from the pond.</p> | | | | | | | | | | | | |
|---------------------------|--|---|---|--|--|---------------------------|----------------|---|---|-----|-----|-----|-----|
| 9 | <p>CUBE TESTING:</p> <p>Total 6 Nos. Cubes of 100mm X 100mm X 100mm size concrete shall be cast daily and tested at release, i.e. after approx. 72 Hours of cast as well as after 28 days, in accordance with Indian Standard specification at Supplier's own expense. The mix for concrete adopted shall be such as to give cube strength not less than 225Kg/cm2 at release (after 3 days) and 450 Kg/cm2 after 28 days.</p> <p>Cube testing machine shall always be kept in the working condition and regular cube tests shall be taken and results be recorded in the registers duly signed by engineer-in -charge and representative of the Supplier.</p> | | | | | | | | | | | | |
| 10 | <p>SAMPLING AND CONFORMITY</p> <p>1] LOT:</p> <p>A. In any batch, all poles of the same class and same dimensions shall be grouped together to constitute a LOT.</p> <p>B. If the number of poles in a lot exceeds 500 then the lot shall be divided into suitable number of SUB-LOTS such that the number of poles i.e. 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 sample selected from it.</p> <p>2] Scale of Sampling: 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&2 of the table given below.</p> <p>SAMPLE SIZE AND CRITERIA OF CONFORMITY</p> <table><tr><th colspan="4">DIMENSIONAL REQUIREMENTS.</th></tr><tr><th>Size of lot Or Sub-Lot</th><th>Sample size</th><th>Permissible No. of Defective samples.</th><th>NO. Of sample Poles (Out of Col.2) for Transverse Strength test</th></tr><tr><td>(1)</td><td>(2)</td><td>(3)</td><td>(4)</td></tr></table> | DIMENSIONAL REQUIREMENTS. | | | | Size of lot Or Sub-Lot | Sample size | Permissible No. of Defective samples. | NO. Of sample Poles (Out of Col.2) for Transverse Strength test | (1) | (2) | (3) | (4) |
| DIMENSIONAL REQUIREMENTS. | | | | | | | | | | | | | |
| Size of lot Or Sub-Lot | Sample size | Permissible No. of Defective samples. | NO. Of sample Poles (Out of Col.2) for Transverse Strength test | | | | | | | | | | |
| (1) | (2) | (3) | (4) | | | | | | | | | | |

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|----|--|----|---|---|---|
| | Up to 100 | 10 | 1 | 2 | |
| | 101 to 200 | 15 | 1 | | 3 |
| | 201 to 300 | 20 | 2 | | 4 |
| | 301 to 500 | 30 | 3 | | 5 |
| | 3] Number of Tests: All the poles as selected as above shall be tested for overall length, cross-section and uprightness. The number of poles to be tested for transverse strength test shall be in accordance with col 4 of table. These poles may be selected from those already tested. | | | | |
| | 4] Criteria of conformity: A lot or sub-lot shall be considered as conforming to the specification if the conditions under are satisfied. The numbers 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 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. 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. If one or more poles of the second samples fail, the lot or the sub-lot represented by the corresponding samples shall be considered not to have passed the test. | | | | |
| 11 | METHOD OF INSPECTION AND TESTING GENERAL: The tests on poles shall not be carried out earlier than 28 days from date of manufactured for poles manufactured from ordinary Portland cement. If a chloride free ad mixture is used or rapid hardening Cement of Grade 43 / 53 is used than pole can be tested at 14 days of age. The specimens shall be inspected and any specimen with visible flaws shall be discarded. If any test specimen fails because of mechanical reasons, such as failure of testing equipment of improper specimen preparation, it shall be discarded and another specimen shall be taken. INSPECTION: The Tenderer shall offer Ready Made PSC Poles lot for inspection and relevant tests. (01) DIMENSIONS: All the Poles shall be manufactured in accordance with the detailed dimensional drawing. The tolerance on dimension shall be limited to... (i) For length - ± 15 mm. (ii) For Web thickness - ± 5 mm. (iii) Uprightness - 0.5 % (i.e. 72 to 1.005 / 0.995) | | | | |

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(02) METHOD OF TESTING:

The pole shall be tested only in the horizontal position or as specified in I.S. 1678 / latest amendment & I.S. 2905 /1989 latest amendment .While testing in the horizontal position, provision shall be made by suitable supports 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. The frictional resistance of the supporting devices should be separately determined and deducted from the total final load applied on the pole.

Theoretically the permanent deflection should be as per IS 2905 / 1966 and latest amendment thereof. The recovery of deformations should not be less than 90%.

A] Testing Arrangement -

The pole shall be fixed in the crib longitudinally from butt to its ground line and then it shall be secured firmly in place. Wooden saddles with concave surfaces and other packing shall be placed around the pole to prevent injury to the butt section as specified in IS: 2905/1966 – latest amendment.

To minimize vertical movement at the point of load application and to reduce the stresses due to dead weight of the pole, a rail support shall be provided near the point of load application, or alternately a number of frictionless supports in the form of trolleys may be provided near the end or throughout the length of the pole. The rail support or other forms of support shall be such that any friction associated with the deflection of the pole under load shall not be a significant portion of the measured load on the pole.

B] Loading: The load shall be applied at a point 600 mm from the top of the pole by means of a suitable device, such as a wire rope and winch placed in a direction normal to the direction of the length of the pole, so that the minimum length of the straight rope under pull (excluding the curved portion near the transmitting devices) is not less than two times the length of the pole. If the loading device is set sufficiently far away from the pole to make the angle between the initial and final positions of pulling line small, the error in assuming that the pull is always perpendicular to the original direction of the pole axis will be negligible. The pulling line shall be kept level between the winch position and the point where load is applied to the pole. The load shall be applied at a constant rate of 4 percent of the specified test load per minute and in accordance with procedure.

C] Pulling Line: The pulling line shall be secured around the pole at the load point. Load measuring device shall be placed in a way so as to accurately measure in the tension in the pulling line. The other end of which is attached to the loading equipment (winch).

D] Load Measurement: Load Cell with accuracy of 5 Kg. for measurement may be adopted. Load cell shall be calibrated before every test. The load measuring device shall be supported in such a way that the force required to pull it shall not add to the

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measured load on the pole and that no damage is cause to the instrument if the pole suddenly breaks under test. No pullies or any other device in between load application point and load cell will be allowed.

E] Deflections - The deflection of the pole and the load applied shall be measured simultaneously at different stages of loading to provide at least five sets of readings or as specified in I.S.2905 & latest amendment thereof. The measurement of the deflection of the load point shall be made in a direction perpendicular to the unloaded position of the pole axis. The measurement shall be made correct to the nearest 1 mm by use of datum board. A second datum line shall also be established from which the movement of the ground line if any, shall be measured.

F] PROCEDURE: Load shall be applied at a point 600 mm from the top of the pole and shall be steadily and gradually increased to 250 kg. till formation of 1st crack recording deflection at each increment.

The load shall be then reduced to zero and then increased gradually in 50 Kg. increments up to 400Kg load. Then Each load increment be successively increased by 25Kg. up to design ultimate transverse load (i.e. 500 Kgs.). The load shall be increased in steps of 25 Kgs. to measure ultimate transverse load, until failure occurs. Each time the load is applied same shall be held for 2 minutes. The load applied to Prestressed concrete poles at the point of failure shall be measured to the nearest five kilograms.

G] RECORDING OF DATA AND MEASUREMENTS:

(i) Any hair cracks appearing at a stage prior to the application of the design transverse load at first crack shall be measured using feeler gauges & shall be recorded. It should also be recorded, whether the hair cracks, if any, produced on application of the 60 percent of the minimum ultimate transverse load close up on the removal or reduction of the test load.

(ii) The load applied to the pole at the time of failure shall be measured to the nearest 5Kg.

iii) A Prestressed concrete pole shall be deemed not to have passed the test if crack wider than 0.1mm appears at a stage prior to the application of the design transverse load at first crack (200 Kgs.)

(iv) The definition of failure of PSC Pole in test will be (i) permanent set more than 2.5 Cm. at load of 500 Kgs. Or (ii) Deflection of more than 25 Cms at load of 500 Kgs.

H] ULTIMATE FAILURE:

The conditions existing when the pole ceases to sustain a load increment owing to either crushing of concrete or snapping of the Prestressing tension or permanent stretching of the steel in any part of the pole.

In order to access ultimate load carrying capacity of the pole, PGVCL reserves the right to test 1 (One) no. of pole up to destruction test out of total 1000 no. of poles. This one no. of pole shall not form part of quantity to be supplied by the Supplier.

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PASCHIM GUJARAT VIJ COMPANY LIMITED

Regd. & Corporate Office : Nana Mava Main Road, Laxminanagar : Rajkot : 360004
 CIN U40102GJ2003SGC042908 Phone No: (0281) 2380425 Fax : (0281) 2380428 Website: www.pgvcl.com

| | |
|-----------|---|
| | At least one pole shall be subjected to destruction test in the contract in presence of representative from PGVCL, Rajkot. |
| 12 | <p>TECHNICAL DATA OF PSC POLES</p> <p>The Guaranteed Particulars of PSC Poles 8 Mtr. 200 Kg.</p> <p>01. Working load : 200 Kg.</p> <p>02. Factor of safety : 2.5</p> <p>03. Ultimate Load : 500 Kgs.</p> <p>04. Dimensions</p> <p>(a) Bottom Cross-Section : 336.55 x 139.7 mm.</p> <p>(b) Top Cross-Section : 114.3 x 139.7 mm.</p> <p>(c) Total height : 8,000 mm.</p> <p>(d) Web thickness. : 57.15 mm (2.25 inch)</p> <p>(e) Planting Depth : 1381 mm.</p> <p>06. No. of 20mm dia. holes.</p> <p>On Front face : 02 nos. (100 mm apart).</p> <p>On side face : 06 nos. (300 mm apart).</p> <p>07. Minimum requirement:</p> <p>(a) Cube Test (Each Specimen) : 450 Kg/Cm² (28 days). : 225Kg/Cm² (3 days)- at release of Prestress.</p> <p>(b) Initial tension in HT Steel Wire/Pole. : 70% of 175.00 Kg/mm² as specified in related I.S. Code</p> |

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TECHNICAL SPECIFICATION FOR HDPE PIPES

1. Scope

This Specification covers technical requirements of design, Constructional features, inspection, testing, supply and transportation of 110 mm diameter of HDPE Pipe.

2. Application and Standards:

The equipment covered by this specification shall unless otherwise stated, be designed, manufacture and tested in accordance with the latest editions of the following Indian International Standards and shall confirm to the regulations of local statutory authorities.

3. Service Conditions:

Equipment to be supplied against this specification shall be suitable for satisfactory continuous operation under the following tropical conditions.

- Maximum ambient temperature of air: 50°C
- Maximum temperature of air in shade: 4°C
- Maximum daily average ambient temperature: 40°C
- Maximum yearly average ambient temperature: 30°C
- Relative Humidity: up to 95%
- Average number of thunder storm days per annum: 15
- Maximum annual Rainfall: 150cm
- Maximum Altitude above mean sea level: 1000Meter
- Maximum Wind Pressure: 150 Kg/cm² (As per IS 802 latest code)
- Maximum soil temperature at cable depth: 30°C
- Maximum soil thermal resistivity: 150°C cm/watt

4. General Technical Parameters:

| SR. | DESCRIPTION / PARAMETERS | REQUIREMENT |
|-----|--|----------------------|
| 1 | Make | |
| 2 | Applicable Standard | |
| 3 | Grade | PE-100 |
| 4 | Pressure rating (Kg/Sqcm.) | 6 |
| 5 | Outside Diameter (mm) | 110 MM |
| 6 | Inside Diameter (mm) | 99.10 MM |
| 7 | Recommended For (Mention Maximum Armoured cable Type and Size) | 11KV UP TO 300 SQ MM |



TECHNICAL SPECIFICATIONS OF THREE PHASE 11/0.433-0.250KV, STAR 1 (LEVEL-1), 16KVA TO 500KVA, 10 KVA NON STAR RATED AND 5KVA SINGLE PHASE 11/ 0.250KV, NON STAR RATED (LEVEL-1) WITH CRGO/ AMORPHOUS CORE.

1.0 SCOPE:

AS PER THE ELECTRICAL TRANSFORMER (QUALITY CONTROL) ORDER, 2014, IT IS MANDATORY THAT NO ELECTRICAL TRANSFORMERS SHALL BE MANUFACTURE OR STORE FOR SALE, SELL OR DISTRIBUTE WHICH DO NOT CONFIRM TO THE SPECIFIED STANDARD AND DO NOT BEAR STANDARD MARK OF THE BUREAU. MOREOVER, AS PER THE GUIDELINES OF BUREAU OF ENERGY EFFICIENCY (BEE), LABELING OF DISTRIBUTION TRANSFORMER IS MANDATORY & CANNOT BE SOLD IN THE MARKET WITHOUT STAR LABEL. ACCORDINGLY, THE BIDDER SHALL HAVE TO SUBMIT VALID BIS LICENSE OF THE QUOTED ITEM OR HIGHER AS PER APPROVED SCHEME OF BIS AND STAR RATING CERTIFICATE FROM BEE FOR 16 KVA TO 500 KVA TRANSFORMERS.

THIS SPECIFICATION COVERS, ENGINEERING, MANUFACTURE, ASSEMBLY, STAGE TESTING, AND INSPECTION AND TESTING BEFORE SUPPLY AND DELIVERY AT SITE OF MINERAL OIL-IMMERSED, NATURAL AIR-COOLED, OUTDOOR TYPE, DOUBLE-WOUND 3 PHASE 11/0.433 -0.250 KV DISTRIBUTION TRANSFORMERS FOR OUTDOOR USE IN POWER DISTRIBUTION SYSTEMS WITH NOMINAL SYSTEM VOLTAGES OF FOLLOWING TYPES AND RATINGS:

- Three Phase ratings lower than 63 KVA both non-sealed type and sealed type. (REF: IS 1180 PART-1 2014, 3.2&3.3).
- Three phase ratings higher than and including 63 KVA, non-sealed type. (REF: IS 1180 PART-1 2014, 3.2&16).
- Single phase ratings 5 KVA sealed type.

- 1.1 It is not the intent to specify completely herein all the details of the design and construction of equipment. However, the equipment shall conform in all respects to high standards of engineering, design and workmanship and shall be capable of performing in continuous commercial operation up to the Bidder's guarantee, in a manner acceptable to the purchaser, who will interpret the meanings of drawings and specification and shall have the power to reject/accept any work or material which, in his judgment is there or not in accordance therewith. The offered equipment shall be complete with all components necessary for their effective and trouble free operation. Such, components shall be deemed to be within the scope of Bidder's supply irrespective of whether those are specifically brought out in this

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specification and / or the commercial order or not.

1.2 The transformer and accessories shall be designed to facilitate operation, inspection, maintenance and repairs. The design shall incorporate every precaution and provision for the safety of equipment as well as staff engaged in operation and maintenance of equipment.

1.3 All outdoor apparatus, including bushing insulators with their mountings, shall be designed so as to avoid any accumulation of water.

1.4 STANDARD RATINGS:

THE STANDARD RATINGS SHALL BE 5 KVA, 10 KVA, 16 KVA, 25 KVA, 63 KVA, 100 KVA, 200 KVA, 315 KVA AND 500 KVA.

2.0 STANDARDS:

2.1 The materials shall conform in all respects to the relevant Indian / International Standard Specification, with latest amendments thereof, some of them are listed below:

| Indian Standard | Title | International & Internationally recognized standard |
|--|--|---|
| ISS - 1180 / Part-I/ 2014 with latest amendments | Outdoor/Indoor type Oil immersed distribution Transformer up to and including 2500 kVA, 33KV Specifications Mineral Oil Immersed | |
| ISS - 16585:2016 | Magnetic materials - specifications for individual materials - Fe based amorphous strip delivered in the semi processed state | |
| 5484 | Specifications for Aluminum wire rods | ASTM B-233 |
| 649 | Testing of Steel sheet and strips for magnetic circuits | |
| 191: 2007 | Copper | |
| 335 : 2018 | New insulating oils | BS 148, D-1473, D-1533- 1934 IEC Pub 296-1969 |
| 554 : 1999 | Pipe threads where pressure-tight joints are made on the threads – Dimensions, tolerances and designation | |
| 1576 : 1992 | Solid pressboard for electrical purpose | IEC 641 |
| 1608 : 2005 | Mechanical testing of metals – Tensile testing | |

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|-----------------------|--|----------------|
| 1747 : 1972 | Nitrogen | |
| 1885 (Part 38) :1993 | Electro technical vocabulary: Part 38 Power transformers and reactors | |
| 1897 : 2008 | Copper strip for electrical purpose | |
| 2026 | Power transformers : | IEC 76 |
| (Part 1) : 2011 | General | |
| (Part 2) : 2010 | Temperature rise | |
| (Part 3) : 2009 | Insulation levels, dielectric tests and external clearances in air | |
| (Part 5) : 2011 | Ability to withstand short circuit | |
| (Part 8) : 2009 | Application guide | |
| (Part 10) : 2009 | Determination of sound levels | |
| 2099 : 1986 | Bushings for alternative voltages above 1000 volts | |
| 3024 : 2015 | Grain oriented electrical steel sheets and strips | |
| 3347 | Dimensions for porcelain transformer bushings for use in lightly polluted atmospheres | DIN 42531,23,3 |
| (Part 1/Sec 1) : 1979 | Up to and including 1 kV, Section 1 Porcelain parts | |
| (Part 1/Sec 2) : 1979 | Up to and including 1 kV, Section 2 Metal parts | |
| (Part 2/Sec 1) : 1979 | 3.6 kV Bushings, Section 1 Porcelain parts | |
| (Part 2/Sec 2) : 1979 | 3.6 kV Bushings, Section 2 Metal parts | |
| (Part 3/Sec 1) : 1988 | 17.5 kV Bushings, Section 1 Porcelain parts | |
| (Part 3/Sec 2) : 1988 | 17.5 kV Bushings, Section 2 Metal parts | |
| 8603:2008 | Dimensions for porcelain transformer bushings for use in heavily polluted atmospheres,12/17.5 KV,24 KV and 36 KV | |
| ISS 5/1961 | Specification for colors for ready mixed paints. | |
| ISS- 6600/1972 | Guide for loading of oil Immersed Transformers | IEC 76 |
| ISS-10028 | Installation, Maintenance of Transformers | |
| ISS-4257 | Dimension for clamping arrangement for bushings (for porcelain and metal | |

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| | | |
|----------------------|--|---------|
| | parts) | |
| ISS- 6160 | Rectangular conductors for electrical machine | |
| ISS- 3401 | Silica gel | |
| ISS-1866 | Code of practice for maintenance & supervision of Mineral insulating oil in equipment | |
| 3639 : 1966 | Fittings and accessories for power transformers | |
| 4253 (Part 2) : 2008 | Cork composition sheet: Part 2 Cork and rubber | |
| 6162 | Paper-covered aluminum conductors | |
| (Part 1) : 1971 | Round conductors | |
| (Part 2) : 1971 | Rectangular conductors | |
| 7404 (Part1) : 1991 | Paper covered copper conductors: Part 1 Round conductors | |
| 7421 : 1988 | Porcelain bushings for alternating voltages up to and including 1 000 V | |
| 8999 : 2003 | Pipe threads where pressure tight joints are made on the threads – Verification by means of limit gauges | |
| 9335(Part 1) : 1979 | Cellulosic papers for electrical purposes: Definitions and general requirements | IEC 554 |
| (Part 2) : 1998 | Methods of test | |

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| Indian Standard | Title | International & Internationally recognized standard |
|-----------------------------|--|---|
| (Part 3/Sec 1) : 1984 | Specifications for individual materials, Section 1 General purposes electrical paper | |
| (Part 3/ Sec 3) :1984 | Specifications for individual materials, Section 3 Crepe paper | |
| (Part 3/ Sec 5) : 1985 | Specifications for individual materials, Section 5 Special papers | |
| 11149 : 1984 | Specification for rubber gaskets | |
| 12444 : 1988 | Continuously cast and rolled electrolytic copper wire rods for electrical Conductors | ASTM B-49 |
| 13730 | Specification for particular types of winding wires: | |
| (Part 0/ Sec 1) : 2012 | General requirements Section 1, Enamelled round copper wire | |
| (Part 0/ Sec 2) : 2011 | General requirements Section 2, Enamelled rectangular copper wire | |
| (Part 0/ Sec 3) : 2012 | General requirements Section 3, Enamelled round aluminium wire | |
| (Part 17) : 1996 | Polyvinyl acetatenamelled rectangular copper wire, Class 105 | |
| (Part 27) : 1996 | Paper covered rectangular copper wire | |
| IS/IEC 60947-2:2003(Part:2) | Low voltage switchgear and control-gear - Circuit breakers | |
| 16081 : 2013 | Insulating liquids – Specification for unused synthetic organic esters for electrical purposes | |
| IS - 5561 | Electrical power connector | |
| IS - 6103 | Testing of specific resistance of electrical insulating liquids | |
| IS - 6262 | Method of test for power factor and dielectric constant of electrical insulating liquids | |

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| | | |
|-----------|--|--|
| IS - 6792 | Determination of electrical strength of insulating oil | |
|-----------|--|--|

MATERIAL CONFORMING TO OTHER INTERNATIONALLY ACCEPTED STANDARDS, WHICH ENSURE EQUAL OR HIGHER QUALITY THAN THE STANDARDS MENTIONED ABOVE, WOULD ALSO BE ACCEPTABLE. IN CASE THE BIDDERS WHO WISH TO OFFER MATERIAL CONFORMING TO THE OTHER STANDARDS, SALIENT POINTS OF DIFFERENCE BETWEEN THE STANDARDS ADOPTED AND THE SPECIFIC STANDARDS SHALL BE CLEARLY BROUGHT OUT IN RELEVANT SCHEDULE. FOUR COPIES OF SUCH STANDARDS WITH AUTHENTIC ENGLISH TRANSLATIONS SHALL BE FURNISHED ALONG WITH THE OFFER.

3. SYSTEM DETAILS:

THE DISTRIBUTION TRANSFORMERS SHALL BE INSTALLED OUTDOOR LOCATIONS ALONG 11 KV DISTRIBUTION NETWORKS, WHICH CONSIST OF UNDERGROUND/ OVERHEAD NETWORKS. THE HV WINDING SHALL BE CONNECTED WITH HT SFU/OCB/VCB/SF6 CB OF THE RING MAIN UNIT/ DO FUSE THROUGH 11KV (E) XLPE/PILC/AB CABLE/ BARE CONDUCTOR. LV WINDING SHALL BE CONNECTED TO LV DISTRIBUTION BOX/SWITCH TYPE FUSE SECTION PILLAR THROUGH 1.1 KV SINGLE CORE 300 MM2 OR SUITABLE SIZE ALUMINUM CONDUCTOR CABLE.

THE TRANSFORMERS SHALL BE SUITABLE FOR OUTDOOR INSTALLATION WITH 3 PHASE 50 HZ, 11 KV SYSTEMS IN WHICH THE NEUTRAL IS EFFECTIVELY EARTHED AND THEY SHOULD BE SUITABLE FOR SERVICE UNDER FLUCTUATIONS IN SUPPLY VOLTAGE UP TO PLUS 12.5% TO MINUS 12.5%.

4. SERVICE CONDITIONS:

THE DISTRIBUTION TRANSFORMERS TO BE SUPPLIED AGAINST THIS SPECIFICATION SHALL BE SUITABLE FOR SATISFACTORY CONTINUOUS OPERATION UNDER THE FOLLOWING CLIMATIC CONDITIONS AS PER IS 2026 (PART - I) LATEST REVISION.

| Sr. No | Parameters | Values |
|--------|--|----------|
| 1. | Location | In PGVCL |
| 2. | Max ambient air temperature (Degree C) | 50 |
| 3. | Min. ambient air temperature (Degree C) | 0 |
| 4. | Max average daily ambient air temperature (Degree C) | 45 |
| 5. | Max. yearly weighed average ambient temperature (Degree C) | 40 |
| 6. | Max. altitude above mean sea level (meter) | 1000 |

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| | | |
|----|---|-------------|
| 7. | Maximum relative humidity (%age) | 0 to 100% |
| 8. | Average thunder storms (days/ Annum) | 15 |
| 9. | Average rainy days (days/ Annum) | 90 |
| 10 | Average annual rain fall (mili meter) | 800/ 900 mm |
| . | | |
| 11 | Number of months of tropical monsoon (months) | 3 Months |
| . | | |

THE EQUIPMENT SHALL BE FOR USE IN MODERATELY HOT AND HUMID TROPICAL CLIMATE, CONDUCTIVE TO RUST AND FUNGUS GROWTH.



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| Sl. No. | Item | | Specification | | | | | | | |
|---------|---------------------------|-------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|
| 1. | Continuous rated capacity | 5 KVA | 10 KVA | 16 KVA | 25 KVA | 63 KVA | 100 KVA | 200 KVA | 315 KVA | 500 KVA |
| 2. | System voltage (max.) | 12 kV (Line to Line) | 12 kV | 12 kV | 12 kV | 12 kV | 12 kV | 12 kV | 12 kV | 12 kV |
| 3. | Rated voltage HV | 11 kV | 11 kV | 11 kV | 11 kV | 11 kV | 11 kV | 11 kV | 11 kV | 11 kV |
| 4. | Rated voltage LV | 250 V | 433-250 V | 433-250 V | 433-250 V | 433-250 V | 433-250 V | 433-250 V | 433-250 V | 433-250 V |
| 5. | Line current HV | 0.454 A | 0.525 A | 0.84 A | 1.31 A | 3.306 A | 5.25 A | 10.50 A | 16.50 A | 26.25 A |
| 6. | Line current LV | 20.0 A | 13.3 A | 21.33 A | 33.33 A | 84.0 A | 133.0 A | 266.0 A | 419.0 A | 665.0 A |
| 7. | Frequency | 50 c/s +/- 5% | 50 c/s +/- 5% | 50 c/s +/- 5% | 50 c/s +/- 5% | 50 c/s +/- 5% | 50 c/s +/- 5% | 50 c/s +/- 5% | 50 c/s +/- 5% | 50 c/s +/- 5% |
| 8. | No. of Phases | Single | Three | Three | Three | Three | Three | Three | Three | Three |
| 9. | Connection HV | Single | Delta | Delta | Delta | Delta | Delta | Delta | Delta | Delta |

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| | | | | | | | | | | |
|-----|---------------|------------|---|---|---|---|---|---|---|---|
| 10. | Connection LV | Individual | Star (Neutra l brought out) | Star (Neutra l brought out) | Star (Neutra l brought out) | Star (Neutra l brought out) | Star (Neutra l brought out) | Star (Neutra l brought out) | Star (Neutra l brought out) | Star (Neutra l brought out) |
| 11. | Vector group | - - | Dyn-11 | Dyn-11 | Dyn-11 | Dyn-11 | Dyn-11 | Dyn-11 | Dyn-11 | Dyn-11 |
| | | | | | | | | | | |

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| | | | | | | | | | | |
|-----|--|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|---|---|---|
| 12. | Type of cooling | ONAN | ONAN | ONAN | ONAN | ONAN | ONAN | ONAN | ONAN | ONAN |
| 13. | Tap changin garrangement | Not applicabl e | Not applicabl e | Not applicabl e | Not applicabl e | Not applicabl e | Not applicabl e | -7.5 % to +10% in steps of 2.5 % | -7.5 % to +10% in steps of 2.5 % | -7.5 % to +10% in steps of 2.5 % |
| 14. | Noise level at rated voltage and frequency | 48db | 48 db | 48 db | 48 db | 51db | 51db | 55 db | 56 db | 56 db |
| 15. | Permissible temperaturerise over ambient i) Of top oil measured by thermometer ii) Of winding measured by resistance | 30 Deg. C 35 Deg. C | 35 Deg. C 40 Deg. C | 35 Deg. C 40 Deg. C | 35 Deg. C 40 Deg. C | 35 Deg. C 40 Deg. C | 35 Deg. C 40 Deg. C | 35 Deg. C 40 Deg. C | 35 Deg. C 40 Deg. C | 35 Deg. C 40 Deg. C |
| 16 | Minimum clearances in air of bushing terminals with connectors fitted in mm. | | | | | | | | | |
| | HV Phase to Phase | 255 | 255 | 255 | 255 | 255 | 255 | 255 | 255 | 255 |
| | HV Phase to Earth | 205 | 205 | 205 | 205 | 205 | 205 | 205 | 205 | 205 |
| | LV Phase to Phase | -- | 75 | 75 | 75 | 75 | 75 | 75 | 75 | 75 |

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| | | | | | | | | | | |
|--|----------------------------|----|----|----|----|----|----|----|----|----|
| | LV Phase/ Neutral to Earth | 75 | 55 | 55 | 55 | 55 | 55 | 55 | 55 | 55 |
|--|----------------------------|----|----|----|----|----|----|----|----|----|

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**5.0 TECHNICAL REQUIREMENTS:****5.1 CORE:****A. CRGO:**

- i. Transformer core shall be stacked core type, shell type or with wound core construction using new and high quality CRGO core with heat resistant insulating coating. Stampings/ laminations/ cores of transformers (with winding/ without winding) shall be made from BIS Standard marked Grain Oriented Electrical Steel Sheet and strip conforming to IS 3024:2015. The core shall be of NEW/Fresh high grade cold rolled grain oriented annealed lamination core having low loss and good grain properties, coated with hot oil proof insulation, bolted together and to the frames firmly to prevent vibration or noise. The complete design of core must ensure permanency of the core losses with continuous working of the transformers. The core shall be stress relieved by annealing under inert atmosphere if required. The complete design of core must ensure permanency of the core loss with continuous working of the transformers. The value of the maximum flux density allowed in the design and grade of lamination used shall be clearly stated in the offer.

ii. CORE CLAMPING :

1. MS channel shall be used on top and bottom.
2. Core Channel on LV side to be reinforced at equidistance, if holes / cutting is done for LT lead in order to avoid bending of channel.
3. MS Channels shall be painted with hot oil-resistant paint.
4. The transformers core shall be suitable for over fluxing (due to combined effect of voltage and frequency) up to 112.5% without injurious heating at full load conditions and shall not get saturated. The Bidder shall furnish necessary design data in support of this situation.
5. The nominal flux density in any part of the core shall not exceed 1.69 Tesla at 100% rated voltage and frequency and the maximum flux density in any part of the core and yoke at rated voltage and frequency shall be such that the flux density with 112.5 % combined voltage and frequency variation from rated voltage and frequency shall not exceed 1.9 Tesla. (REF IS 1180 PART-1 2014 6.9.1&7.9.1)

NOTE: The design calculations in support of flux density shall be furnished by the manufacturer.

6. No load current shall not exceed the below mentioned percentage of full load current by energizing the transformer on secondary side.

| Particulars | Up to 200KVA | Above 200KVA |
|---|--------------|--------------|
| i. At rated voltage and frequency on the secondary. | 3% | 2% |

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| | | |
|---|----|----|
| ii. At voltage by 112.5% of rated voltage but at rated frequency. | 6% | 5% |
|---|----|----|

- iii. Test for magnetic balance by connecting the LV phase by phase to rated phase voltage and measurement of un, vn, wn voltage will be carried out.
- iv. Clamping and Tie-rods shall be made from HT Bright Bars steel & shall be painted with hot oil resistant paint. (IS 1180 table 12)

5.1 AMORPHOUS :

A. The core shall be high quality Amorphous ribbons having very low loss formed into wound cores of rectangular shape, bolted together to the frames firmly to prevent vibration or noise. Stampings/ laminations/ cores of transformers (with winding/ without winding) shall be made from BIS Standard marked Fe based amorphous strip delivered in the semiprocessed state conforming to IS 16585:2016. The complete design of core must ensure permanency of the core loss with continuous working of the transformers. The value of the flux density allowed in the design shall be clearly stated in the offer. Curve showing the properties of the metal shall be attached with the offer.

B. CORE CLAMPING FOR AMORPHOUS METAL TRANSFORMERS :

- i. Core clamping shall be with top and bottom U-shaped core clamps made of sheet steel clamped HT steel tie rods for efficient clamping.
- ii. MS core clamps and MS rods shall be painted with hot oil-resistant paint.
- iii. HT Steel rods shall be used as tie rods.
- iv. Suitable provision shall be made in the bottom core clamp / bottom plate of the transformer to arrest movement of the active part. The core/coil assembly shall be securely held in position to avoid any movement under short circuit conditions.
- v. The transformers core shall be suitable for over fluxing (due to combined effect of voltage and frequency) up to 112.5% without injurious heating at full load conditions and shall not get saturated. The Bidder shall furnish necessary design data in support of this situation. (REF IS 1180 PART-1 2014 6.9.1&7.9.1)
- vi. No load current shall not exceed 2% of full load current and will be measured by energizing the transformer at rated voltage and frequency on the secondary. Increase of voltage by 12.5% shall not increase the no load current by Max. 5% of full load current.

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- vii. Test for magnetic balance by connecting the LV phase by phase to rated phase voltage and measurement of un, vn, wn voltage will be carried out.
- viii. Clamping and Tie-rods shall be made from HT Bright Bars steel & shall be painted with hot oil resistant paint. (IS 1180 table 12)

5.2 WINDINGS:

COPPER CONDUCTOR SHALL BE USED FOR 11 KV /500 KVA AND 5 KVA TRANSFORMERS, WHILE ALUMINUM CONDUCTOR SHALL BE USED FOR OTHER CAPACITIES OF TRANSFORMERS.

A. MATERIALS:

DOUBLE PAPER COVERED ALUMINUM/ ELECTROLYTIC COPPER CONDUCTOR OR CLASS H SUPER ENAMEL COVER ALUMINUM/ ELECTROLYTIC COPPER CONDUCTOR SHALL BE USED FOR 11 KV CLASS TRANSFORMERS. A MIX OF ELECTROLYTIC COPPER & ALUMINUM CONDUCTORS FOR HV & LV WINDING WILL NOT BE PERMITTED.

B. CURRENT DENSITY (MAXIMUM):

ELECTROLYTIC COPPER CONDUCTOR: SHALL NOT BE MORE THAN 2.5 A/SQ.MM.

ALUMINUM CONDUCTOR: SHALL NOT BE MORE THAN 1.30 A/SQ.MM. (INCLUDING TOLERANCE).

NOTE:

1. LV winding shall be in form of even layers so that the neutral formation will be at top.
2. The winding shall be of one or more rectangular conductors insulated from each other to reduce eddy current losses. The tolerances on the size of the conductor shall be as per IS-6160, specification for rectangular conductors. If the active axial length of the coil is more than 350 mm, an axial duct, of 4 mm is provided between the LV coil layers. The materials used for providing duct shall be non-compressible material such as treated wood permali, etc. Any joints in the HV/LV winding shall not be allowed.
3. Dimensional tolerances for winding coils shall be within limits as specified in GTP.

C. INTERNAL INSULATIONS AND CLEARANCES:

1. Insulating material: Electrical grade insulating craft paper of Triveni/Ballarpur/Cauvery or equivalent make subject to approval of the purchaser shall be used. Similarly Press Board of Senapathy, Whitelay or Raman make or equivalent subject to the approval of



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the purchasers shall be used. Perma wood or Haldi wood blocks shall be used for top and bottom yoke insulation.

2. All spacers, axial wedges / runners used in windings shall be made of pre-compressed Press board solid, conforming to type B 3.1 of IEC 641-3-2. In case of cross-over coil winding of HV all spacers shall be properly sheared and dovetail punched to ensure proper locking. All axial wedges/ runners shall be properly milled to dovetail shape so that they pass through the designed spacers freely. Insulation shearing, cutting, milling and punching operations shall be carried out in such a way, that there should not be any burr and dimensional variations.
3. Transformer rating 200KVA and above, an axial duct of 3 mm is to be provided if the radial thickness of coils is more than 50 mm and/or the axial length of individual coil is more than 80mm. The radial duct shall be adequate for free circulation of oil as well as to withstand voltage between adjacent coils. The inter - layer insulation shall be of Nomex / Epoxy dotted Kraft paper or a minimum 4 layers of 2 mil (0.05mm) paper of approved manufactures.
4. (a) Proper bonding of inter layer insulation with the conductor shall be ensured.

(B) INTER LAYER INSULATION SHALL BE EPOXY DOTTED KRAFT PAPER. TEST FOR BONDING STRENGTH SHALL BE CONDUCTED.

5. Internal Clearances & Number of HV/LV coils : For Both Stack/Wound Core:

| Parameters | 5 KVA | 10 KVA | 16 KVA | 25 KVA | 63 KVA | 100 KVA | 200 KVA | 315 KVA | 500 KVA |
|---|----------|-----------|-----------|-----------|-----------|------------|------------|------------|------------|
| Minimum Radial clearance of LV Coil to Core in mm | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 4 | 4 | 4 | 4 |
| Minimum radial clearance between LV coil to HV coil in mm | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 |
| Phase to phase clearance in mm between HV conductors with a provision of minimum of 2 x 1 mm press board to cover the tie rods. | N.A. | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| Minimum electrical clearance between inside surface of the Tank and outside edge of the winding in mm | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 |

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| | | | | | | | | | |
|---|----|----|----|----|----|----|----|----|----|
| End Insulation, Coil end to Earth in mm | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |
| No. of Coils LV per Phase | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Minimum No. of HV Coils up to 500 KVA (Cross over winding) - for Stack core | 1 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| - Do - for Wound core | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Minimum No. of axial wedges between LV and HV winding equi-spaced around | 6 | 6 | 6 | 6 | 6 | 8 | 8 | 8 | 8 |

**5.2.1 TAPS:**

- No tapping shall be provided for transformers up to 100 KVA rating.
- For ratings above 100 KVA, tapings shall be provided on the higher voltage winding for variation of HV voltage within range of (-) 7.5% to +10% (For 200 KVA, 315 KVA & 500KVA) in steps of 2.5%.
- Tap changing shall be carried out by means of an externally operated self- Position rotary switch (to be mounted on top plate) and when the transformer is in de-energized condition. Switch position No.1 shall correspond to the maximum plus tapping. Each tap change shall result in variation of 2.5% in voltage. Provision shall be made for locking the tapping switch handle in position. Suitable aluminum anodized plate shall be fixed for tap changing switch to know the position number of tap.

5.2.2 OIL :

THE INSULATING OIL SHALL COMPLY WITH THE TYPE-II REQUIREMENTS OF IS 335 WITH LATEST AMENDMENT. USE OF RECYCLED OIL IS NOT ACCEPTABLE. OIL SHALL BE FILTERED AND TESTED FOR BREAK DOWN VOLTAGE (BDV) AND MOISTURE CONTENT BEFORE FILLING.

THE OIL SHALL BE FILLED UNDER VACUUM OF 250 TOR +/- 5 %.

THE DESIGN AND ALL MATERIALS AND PROCESSES USED IN THE MANUFACTURE OF THE TRANSFORMER, SHALL BE SUCH AS TO REDUCE TO A MINIMUM THE RISK OF THE DEVELOPMENT OF ACIDITY IN THE OIL.

5.2.3 LOSSES & LABELLING:

The maximum allowable losses at rated voltage and rated frequency permitted at 75°C and percentage impedance up to 500 KVA, 11/0.433 KV Transformers shall be as per LEVEL-1 OF IS 1180 (PART 1) :2014 AND STAR RATING PLAN AS PER LATEST BEE GUIDELINES, WHICHEVER APPLICABLE. However, rating wise total losses shall be limited to the values as under.

LOSSES OF THE TRANSFORMER SHOULD NOT EXCEED FOLLOWING VALUES AND FOR TRANSFORMERS HAVING TAPINGS SHALL BE GUARANTEED AT MAXIMUM CURRENT TAP AND IT SHOULD NOT EXCEED FOLLOWING VALUES.

LOSSES OF LABELLED TRANSFORMERS IN WATTS

| Item | NON STAR RATED (LEVEL-1) | NON STAR RATED | | BEE rated Star 1 (Level-1 as per IS 1180 (Part 1) :2014) | | | | | |
|-------------------------|-----------------------------------|----------------------|-----|--|-----|-----|-----|------|------|
| | | | | Capacity in KVA | | | | | |
| | | | | 5 | 10 | 16 | 25 | 63 | 100 |
| Maximum No Load Losses | 15 | 40 | 50 | 60 | 125 | 170 | 270 | 470 | 545 |
| Maximum total losses at | 35 | <u>84</u> | 135 | 190 | 340 | 475 | 780 | 1025 | 1510 |

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| | | | | | | | | | |
|---|----|-----|-----|-----|------|------|------|------|------|
| 50% loading | | | | | | | | | |
| Maximum *total losses at 100% Loading | 95 | 240 | 440 | 635 | 1140 | 1650 | 2300 | 3100 | 4300 |



*TOTAL LOSSES IN WATT AT 100 % LOADING = NO LOAD LOSSES IN WATT + FULL LOADLOSSES IN WATT AT 75 DEG. C

BIDS WITH HIGHER LOSSES THAN ABOVE SPECIFIED VALUES WOULD BE TREATED AS NON RESPONSIVE.

WHILE IN CASE OF TAPPED TRANSFORMER, BIDS WITH HIGHER LOSSES THAN ABOVE SPECIFIED VALUES AT MAXIMUM CURRENT TAP, WOULD BE TREATED AS NON RESPONSIVE. HOWEVER, THE MANUFACTURER CAN OFFER LOSSES LOWER THAN ABOVE.

NOTE:

5.3 PERCENTAGE IMPEDANCE:

| Rating of Transformer in KVA | Percentage Impedance at 75°C |
|------------------------------|------------------------------|
| 5 KVA | 4.00 % |
| 10 KVA to 100 KVA | 4.50 % |
| 200 KVA, 315 KVA & 500 KVA | 4.75% |

% IMPEDANCE SHALL BE SUBJECT TO TOLERANCE SPECIFIED IN IS: 2026.

BIDS NOT MEETING THE LIMITS INDICATED ABOVE WILL BE TREATED AS NON-RESPONSIVE.

5.4 TEMPERATURE RISE:

THE TEMPERATURE RISES OVER AMBIENT SHALL NOT EXCEED THE LIMITS DESCRIBED BELOW (TOTAL LOSSES GUARANTEED OFFERED IN GTP SHALL HAVE TO BE FED FOR TEMPERATURERISE TEST)

| Temperature Rise | | | | 5 KVA | 10 to 500 KVA |
|---------------------|------|----------|----|-----------|---------------|
| Top oil temperature | rise | measured | by | 30 deg. C | 35 deg. C |
| thermometer | | | | | |
| Winding temperature | rise | measured | by | 35 deg. C | 40 deg. C |
| resistance | | | | | |



Bids not meeting the above limits of temperature rise will be treated as non- responsive.

5.5 PENALTY FOR NON PERFORMANCE:

- A. During testing, if it is found that the actual measured losses are more than the values quoted by the bidder, the purchaser will have right to exercise one of the following options
REJECT THE COMPLETE LOT OR PENALTY SHALL BE RECOVERED FROM THE BIDDER FOR THE EXCESS LOSSES PER WATT AS UNDER
- Rs. 493.52 per Watt for No load loss.
 - Rs. 272.92 per Watt for Load loss.
- B. Transformers with temperature rise and impedance beyond guaranteed values:
- If the temperature rise exceeds the guaranteed values in any sample of the transformer during testing, purchaser reserves the right to reject the available lot of the transformer.
 - If the impedance values differ from the guaranteed values including tolerance in any sample of the transformer during testing, purchaser reserves the right to reject the available lot of the transformer.
 - Purchaser also reserves the right to retain the rejected transformer and take it into service until the supplier replaces it with a new transformer at no extra cost. The delivery as per contract will be counted when the new transformer as per specification is provided by the manufacture.
 - Purchaser also reserves the right to utilize the rejected lot of transformers with a penalty maximum up to 30% as per the clause of commercial terms and condition.

5.6 TANK :

TRANSFORMER TANK CONSTRUCTION SHALL CONFORM IN ALL RESPECT TO CLAUSE 15 OF IS 1180 (PART-1):2014. THE TRANSFORMER TANK CAN BE WITH RADIATOR FINS/ ROUNDED OR ELLIPTICAL COOLING TUBES OR MADE OF CORRUGATED PANELS.

A. FOR RECTANGULAR PLAIN TANK:

- The transformer tank shall be of robust construction rectangular in shape and shall be built up of tested MS sheets.

THE TANK SHALL BE MADE OF PRIME QUALITY MS SHEET OF THICKNESS STATED BELOW WITH NECESSARY STIFFENER TO WITHSTAND THE PRESSURE BUILT IN DURING THE EXPANSION OF OIL DUE TO TEMPERATURE RISE.

THE EXTERIOR OF THE TRANSFORMER TANK AND OTHER FERROUS FITTING SHALL BE THOROUGHLY CLEANED , SCRAPED /SAND BLASTED AND GIVEN A PRIMING COAT AND TWO FINISHING COATS OF DURABLE OIL AND WEATHER RESISTANT PAINT OF DARK ADMIRAL GREY CONFORMING TO COLOR CODE NO. 632 OF IS-5/1961.

THE INTERNAL CLEARANCE OF TANK SHALL BE SUCH THAT, IT SHALL FACILITATE EASY LIFTING OF CORE WITH COILS FROM THE TANK WITHOUT DISMANTLING LV BUSHINGS.



- ii. All joints of tank and fittings shall be oil tight and no bulging should occur during service. The tank design shall be such that the core and windings can be lifted freely. The tank plate shall be of such strength that the complete transformers when filled with oil may be lifted bodily by means of lifting lugs. Inside of tank shall be painted with Hot oil resistive paint.
- iii. Manufacturer should carry out all welding operations as per the relevant ASME standards and submit a copy of the welding procedure qualifications and welder performance qualification certificates to the customer.
- iv. Up to 200 KVA Transformers, the four walls of the rectangular tank shall be made of Two "L" shaped sheets (without joints) fully welded at the corners from inside and outside of the tank for withstanding a pressure of 80 kPa for 30 minutes and vacuum of 250 mm of mercury for 30 Min.

(OR)

ONE "U" SHAPED BEND SHEET WITH STRAIGHT PLATE AND WELDED OUTSIDE THE TANK AT 2 CORNERS FOR WITHSTANDING A PRESSURE OF 80 KPA FOR 30 MINUTES". WHILE 500 KVA TRANSFORMER WITHSTANDING A PRESSURE OF 80 KPA FOR 30 MINUTES AND VACUUM OF 500 MM OF MERCURY FOR 30 MIN. THERE SHOULD BE NO AIR LEAKAGE AT ANY POINT.

UNDER OPERATING CONDITIONS THE PRESSURE GENERATED INSIDE THE TANK SHOULD NOT EXCEED 0.4 KG/ SQ. CM POSITIVE OR NEGATIVE. THERE MUST BE SUFFICIENT SPACE FROM THE CORE TO THE TOP COVER TO TAKE CARE OF OIL EXPANSION. THE SPACE ABOVE OIL LEVEL IN THE TANK SHALL BE FILLED WITH DRY AIR OR NITROGEN CONFORMING TO COMMERCIAL GRADE OF IS 1747. THIS CLAUSE IS APPLICABLE FOR SEALED TYPE WITHOUT CONSERVATORS FOR BOTH SINGLE PHASE AND THREE PHASE TRANSFORMERS.

- v. Up to 500 KVA Transformers, the permanent deflection of flat plates, after pressure/ vacuum has been released, shall not exceed 5 mm up to 750 mm length and 6.5 mm up to 1250 mm length.
- vi. For single phase transformers, minimum Oil level mark shall be embossed inside the tank (at 250 C).
- vii. The Single Phase transformer shall be provided with two mounting lugs suitable for fixing the transformer to a single pole by means of 2 bolts of 20 mm diameter as per ANSI C 57.12.20-1988. The circular bottom plate edges of the tank should be folded upward, for at least 25 mm, to have sufficient overlap with vertical sidewall of the transformer.
- viii. TANK SEALING for Single Phase:
THE SPACE ON THE TOP OF THE OIL SHALL BE FILLED WITH DRY AIR OR NITROGEN. THE NITROGEN PLUS OIL VOLUME INSIDE THE TANK SHALL BE SUCH THAT EVEN UNDER EXTREME OPERATING CONDITIONS, THE PRESSURE



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GENERATED INSIDE THE TANK DOES NOT EXCEED 0.4 KG/SQ. CM POSITIVE OR NEGATIVE. THE NITROGEN SHALL CONFORM TO COMMERCIAL GRADE OF THE RELEVANT STANDARDS.



- ix. For single phase transformers, round tank shall withstand pressure of 100 kPa and a vacuum of 760 mm of mercury for 30 Min.

| Rating | Nominal thickness of plate in mm (tolerance applicable as per relevant IS) | |
|--------------------|---|-----------------------|
| (11 kV) | For sides (mm) | For Top & Bottom (mm) |
| 5 KVA (Round Tank) | 2.2 | 2.5 |
| Rectangular Tank | | |
| 5 kVA to 100 KVA | 3.15 | 5.0 |
| Above 100 KVA | 4.5 | 6.0 |

- x. Top cover of the transformer tank shall be slanting minimum 10 to 15 mm towards HV Bushing so that entry of water can be avoided.
THE RADIATORS CAN BE TUBE TYPE OR FIN TYPE OR PRESSED STEEL TYPE TO ACHIEVE THE DESIRED COOLING TO LIMIT THE SPECIFIED TEMPERATURE RISE. THE TRANSFORMER SHALL BE CAPABLE OF GIVING CONTINUOUS RATED OUTPUT WITHOUT EXCEEDING THE SPECIFIED TEMPERATURE RISE. BIDDER SHALL SUBMIT THE CALCULATION SHEET FOR HEAT DISSIPATION.
- xi. Lifting lugs: 2 Nos. of lifting lugs are to be provided in Transformers below 100 KVA rating and 4 Nos. lifting lugs are to be provided in Transformers for 100 KVA and above rating transformers. Lifting lugs of MS plate 8 mm thick (min) suitably reinforced by vertical supporting flat welded edgewise below the lug on the side wall.
- xii. Pulling lugs: 4 Nos. of welded heavy duty pulling lugs of MS plate 8 mm thick (min) shall be provided to pull the transformer horizontally.
- xiii. Top cover fixing bolts of Stainless Steel of grade 304 size 12mm dia.adequately spaced not more than 80 mm pitch and 6 mm Neoprene bonded cork gaskets conforming to type III as per IS 11149/ type-c as per IS 4253 (Part-2) shall be placed between tank and cover.
- xiv. The Stainless Steel bolts outside tank shall have 2 flat washers & one spring washer.

B. FOR ELLIPTICAL TANK:

THE BIDDER MAY OFFER TANK WITH ELLIPTICAL SHAPE FOR 10 &16 KVA TRANSFORMERS ALSO ROBUST IN CONSTRUCTION WITH ADEQUATE

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STRENGTH TO WITHSTAND THE PRESSURE BUILT IN DURING THE EXPANSION OF OIL DUE TO TEMPERATURE RISE. THE TANK SHEET OF THICKNESS STATED BELOW SHALL BE ELECTRICALLY WELDED TO IMPART PROPER MECHANICAL STRENGTH AND TO PLUG LEAKAGE OF OIL. ALL JOINTS OF TANK AND FITTINGS SHALL BE OIL TIGHT AND NO BULGING SHALL OCCUR DURING SERVICE. THE TANK SHEETS SHALL BE OF SUCH STRENGTH THAT THE COMPLETE TRANSFORMER WHEN FILLED WITH OIL MAY BE LIFTED BY MEANS OF LIFTING LUGS PROVIDED. ALL THE WELDING SHALL BE CONTINUOUS.

| Rating | Nominal thickness of plate in mm (tolerance applicable as per relevant IS) | |
|-----------------|--|-----------------------|
| (11 kV) | For sides (mm) | For Top & Bottom (mm) |
| 10 kVA & 16 kVA | 3.15 | 5.0 |

- The elliptical tank constructed by two welding joints only, one is at bottom cover and another is at the tank shell so that the leakages due to joints can be reduced. The tank shall withstand a pressure of 80kPa for 30 minutes and vacuum of 250mm of mercury for 30 minutes and the permanent deflection after pressure/vacuum has been released, shall not exceed 5mm. The exterior of the transformer tank and other ferrous fitting shall be thoroughly cleaned, scraped /sand blasted and given a priming coat and two finishing coats of durable oil and weather resistant paint of dark admiral grey conforming to color code No. 632 of IS-5/1961. The internal clearance of tank shall be such that, it shall facilitate easy lifting of core with coils from the tank without dismantling LV bushings.
- The tank design shall be such that the core and windings can be lifted freely. The tank plate shall be of such strength that the complete transformers when filled with oil may be lifted bodily by means of lifting lugs. Inside of tank shall be painted with Hot oil resistive paint.
- Manufacturer should carry out all welding operations as per the relevant ASME standards and submit a copy of the welding procedure qualifications and welder performance qualification certificates to the customer.
- Under operating conditions, the pressure generated inside the tank should not exceed 0.4 kg/ sq. cm positive or negative. There must be



sufficient space from the core to the top cover to take care of oil expansion. The space above oil level in the tank shall be filled with dry air or nitrogen conforming to commercial grade of IS 1747. This clause is applicable for sealed type transformers without conservators.

- v. Top cover of the transformer tank shall be slanting minimum 10 to 15 mm towards HV Bushing so that entry of water can be avoided. The radiators can be tube type or fin type or pressed steel type to achieve the desired cooling to limit the specified temperature rise. The transformer shall be capable of giving continuous rated output without exceeding the specified temperature rise. Bidder shall submit the calculation sheet for heat dissipation.
- vi. Lifting lugs: 2 Nos. of lifting lugs are to be provided in Transformers. Lifting lugs of MS plate 8 mm thick (min) suitably reinforced by vertical

SUPPORTING FLAT WELDED EDGEWISE BELOW THE LUG ON THE SIDE WALL.

- vii. Pulling lugs: 4 Nos. of welded heavy duty pulling lugs of MS plate 8 mm thick (min) shall be provided to pull the transformer horizontally.
- viii. Top cover fixing bolts of Stainless Steel of grade 304 size 12mm dia. adequately spaced not more than 80 mm pitch and 6 mm Neoprene bonded cork gaskets conforming to type III as per IS 11149/ type-c as per IS 4253 (Part-2) shall be placed between tank and cover.
- ix. The Stainless Steel bolts outside tank shall have 2 flat washers & one spring washer.

C. FOR CORRUGATED TANK

- 1. The transformer tank shall be of robust construction corrugated in shape and shall be built up of tested sheets.
- 2. The transformers with corrugation should be provided with proper safe packing during transportation, so that tank shall be prevented from any physical damage.
- 3. Corrugation panel shall be used for cooling. The transformer shall be capable of giving continuous rated output without exceeding the specified temperature rise. Bidder shall submit the calculation sheet in this regard.
- 4. Up to 200 KVA Transformers, the tank shall be design for a pressure of 25 kPa above atmosphere pressure, measured inside the tank for 30



minutes and vacuum of 250 mm of mercury for 30 minutes. While for 500 KVA transformers, the tank shall be design for a pressure of 25 kPa above atmosphere pressure, measured inside the tank for 30 minutes and vacuum of 500 mm of mercury for 30 minutes. There should be no air leakage at any point.

5. The nominal thickness of corrugation panel sheet is 1.2 mm.
6. The tank thickness shall be as per Rectangular Plain Tank.
7. Vacuum test and pressure test are applicable as per type test mentioned in this specification.

D. CONSERVATOR :

TRANSFORMERS OF RATING 63 KVA AND ABOVE WITH PLAIN TANK CONSTRUCTION, THE PROVISION OF CONSERVATOR IS MANDATORY. FOR SEALED TYPE TRANSFORMER WITH OR WITHOUT INERT GAS CUSHION, CONSERVATOR IS NOT REQUIRED.

FOR SEALED TRANSFORMER PRESSURE RELIEF VALVE SHALL BE PROVIDED. PRV SHALL BE OF 35 KPA WITH DIA. 12.5 MM. FOR 200 KVA & ABOVE RATING TRANSFORMERS, PRV FOR PLAIN TANK SHALL BE OF 70 KPA WITH DIA. 1". (ALL FORGED BRASS, STAINLESS STEEL COMPONENTS FOR USE IN EXTREME OUTDOOR CONDITIONS)

WHEN A CONSERVATOR IS PROVIDED, OIL GAUGE AND DEHYDRATING BREATHING DEVICE SHALL BE FIXED TO THE CONSERVATOR WHICH SHALL ALSO BE PROVIDED WITH A DRAIN PLUG AND A FILLING HOLE (1 1/4" NORMAL SIZE THREAD) WITH COVER. THE CAPACITY OF A CONSERVATOR TANK SHALL BE DESIGNED TO CONTAIN 10% OF THE TOTAL QUANTITY OF OIL AND ITS CONTRACTION AND EXPANSION DUE TO TEMPERATURE VARIATIONS. NORMALLY 3% QUANTITY OF TOTAL OIL WILL BE CONTAINED IN THE CONSERVATOR. IN ADDITION THE COVER OF MAIN TANK SHALL BE PROVIDED WITH AN AIR RELEASE PLUG TO ENABLE AIR TRAPPED WITHIN TO BE RELEASED, UNLESS THE CONSERVATOR IS SO LOCATED AS TO ELIMINATE THE POSSIBILITY OF AIR BEING TRAPPED WITHIN THE MAIN TANK.

THE INSIDE DIAMETER OF THE PIPE CONNECTING THE CONSERVATOR TO THE MAIN TANK SHOULD BE WITHIN 30 TO 50 MM AND IT SHOULD BE PROJECTED INTO THE CONSERVATOR SO THAT ITS END IS APPROXIMATELY 20 MM ABOVE THE BOTTOM OF THE CONSERVATOR SO

AS TO CREATE A SUMP FOR COLLECTION OF IMPURITIES. THE MINIMUM OIL LEVEL (CORRESPONDING TO -5 DEG C) SHOULD BE ABOVE THE SUMP LEVEL.

E. DEHYDRATING BREATHER:

BREATHES SHALL BE SCREWED TYPE. IT SHALL HAVE DIE CAST ALUMINUM BODY & FURTHER, INSIDE CONTAINER FOR SILICA GEL SHALL BE OF TIN SHEET. INVERTED U-SHAPE PIPE SHALL BE USED FOR CONNECTION OF BREATHES. THE DEHYDRATING AGENT SHALL BE SILICA GEL. THE MOISTURE ABSORPTION SHALL BE INDICATED BY A CHANGE IN THE COLOUR OF THE SILICA GEL CRYSTALS WHICH SHOULD BE EASILY VISIBLE FROM A DISTANCE. VOLUME OF BREATHES SHALL BE SUITABLE FOR 500G OF SILICA GEL CONFORMING TO IS 3401 FOR TRANSFORMERS UP TO 200 KVA AND 1 KG FOR TRANSFORMERS ABOVE 200 KVA. THE MAKE AND DESIGN OF BREATHES SHALL BE SUBJECT TO APPROVAL OF DISCOM, GUJARAT.

BREATHES: INDIVIDUAL BREATHES SHALL BE PACKED IN A COTTON BAG SHALL BE BOUND WITH INDIVIDUAL TRANSFORMER IN A CLEAR VISIBLE POSITION.

5.7 SURFACE PREPARATION & PAINTING

A. GENERAL :

1. All paints shall be applied in accordance with the paint manufacturer's recommendations. Particular attention shall be paid to the following:
 - i. Proper storage to avoid exposure as well as extremes of temperature.
 - ii. Surface preparation prior to painting.
 - iii. Mixing and thinning
 - iv. Application of paints and the recommended limit on time intervals between coats.
 - v. Self life for storage
2. All paints, when applied in a normal full coat, shall be free from runs, sags, wrinkles, patchiness, brush marks or other defects.
3. All primers shall be well marked into the surface, particularly in areas where painting is evident, and the first priming coat shall be applied as soon

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as possible after cleaning. The paint shall be applied by airless spray according to manufacturer's recommendations. However, wherever airless spray is not possible, conventional spray be used with prior approval of purchaser.

4. The Supplier shall, prior to painting protect nameplates, lettering gauges, sight glasses, light fittings and similar such items.

B. CLEANING AND SURFACE PREPARATION

- i. After all machining, forming and welding has been completed, all steel work surfaces shall be thoroughly cleaned of rust, scale, welding slag or spatter and other contamination prior to any painting.
- ii. Steel surfaces shall be prepared by shot blast cleaning (IS9954) to grade Sq. 2.5 of ISO 8501-1 or chemical cleaning by Seven Tank process including phosphating of the appropriate quality (IS 3618).
- iii. The pressure and volume of the compressed air supply for blast cleaning shall meet the work requirements and shall be sufficiently free from all water contamination to ensure that the cleaning process is not impaired.
- iv. Chipping, scraping and steel wire brushing using manual or power driven tools cannot remove firmly adherent mill-scale shall only be used where blast cleaning is impractical. Manufacturer to explain such areas in his technical offer clearly.

C. PROTECTIVE COATING

AS SOON AS ALL ITEMS HAVE BEEN CLEANED AND WITHIN FOUR HOURS OF THE SUBSEQUENT DRYING, THEY SHALL BE GIVEN SUITABLE ANTI-CORROSION PROTECTION.

D. PAINT MATERIAL:

- i. The color of the finishing coats shall be dark admiral gray conforming to No. 632 of IS-5 of 1961.
- ii. Inside of tank shall be painted with Thermo setting powder paint OR oil resistance paint of colour shade yellow/green. For external surfaces, one coat of thermosetting powder paint OR Liquid paint as mentioned in the table at point (vi) shall be used.
- iii. For highly polluted areas, chemical atmosphere or for places very near to the sea coast, paint as above with one coat of high build Micaceous iron oxide (MIO) as an intermediate coat may be used.
- iv. To the maximum extent practicable the coat shall be applied as a



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continuous film of uniform thickness and free of pores. Overspray, skips, runs, sags and drips should be avoided. Each coat of paint shall be allowed to harden before the next is applied.

- v. Particular attention must be paid to full film thickness at edges.
- vi. The requirements for the dry film thickness (DFT) of paint and the materials to be used shall be as given below.



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| Sr. No | Paint Type | Area to be painted | No. of coats | Total Dry film thickness (min.)in microns |
|--------|---|---------------------------------------|------------------------|---|
| 1. | Thermo setting powder paint OR Liquid paint a) Epoxy (Primer) b) Polyurethane (finished coat) | Outside Outside Outside | 01 01 02 | 60 30 25 Each |
| 2. | Thermo setting powder paint OR Liquid paint Hot oil resistant paint of colour shade yellow/green | Inside Inside | 01 01 | 30 35 |

Note : Supplier shall guarantee the painting performance requirement for a period of not less than 5 years.

E. PAINTING PROCEDURE:

- i. All painting shall be carried out in conformity with both Specification and with the paint manufacturer's recommendation. All paints in any one particular system, whether shop or site applied, shall originate from one paint manufacturer.
- ii. Particular attention shall be paid to the manufacturer's instructions on storage, mixing, thinning and pot life. The paint shall only be applied in the manner detailed by the manufacturer e.g. brush, roller,

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conventional or airless spray and shall be applied under the manufacturer's recommended condition.

- iii. All prepared steel surfaces should be primed before visible re-rusting occurs or within 4 hours, whichever is sooner. Chemical treated steel surfaces shall be primed as soon as the surface is dry and while the surface is still warm.
- iv. Where the quality of film is impaired by excess film thickness (wrinkling, mud cracking or general softness) the Supplier shall remove the unsatisfactory paint coating and apply another. As a general rule, dry film thickness should not exceed the specified minimum dry film thickness by more than 25%.
- v. Paint applied to items that are not be painted shall be removed at Supplier's expense, leaving the surface clean, unstained and undamaged.

F. DAMAGED PAINTWORK:

- i. Any damage occurring to painting of any part shall be made good to the same standard of corrosion protection and appearance as that originally employed, within guarantee/ warranty period at free of cost.
- ii. Any damaged paint work shall be made good as follows:
 - a) The damaged area, together with an area extending 25 mm around its boundary, shall be cleaned down to bare metal.
 - b) A priming coat shall be immediately applied, followed by a full paint finish equal to that originally applied and extending 50 mm around the perimeter of the original damage.
 - c) The repainted surface shall present a smooth surface. This shall be obtained by carefully chamfering the paint edges before and after priming.

G. TESTS FOR PAINTED SURFACE:

- i. The painted surface shall be tested for paint thickness.
- ii. The painted surface shall pass the cross hatch adhesion test and impact test as acceptance tests and Salt spray test and Hardness test as type tests as per the relevant ASTM standards.

5.8 BUSHINGS AND TERMINALS :

A. TRANSFORMER WITH BARE BUSHING OUTDOOR MOUNTING:

FOR 11 KV TRANSFORMERS - 17.5 KV CLASS BUSHINGS SHALL BE USED AND FURTHER FOR LV SIDE, VIZ. 250/433 VOLTS, 1KV TERMINAL BUSHING SHALL BE USED. BUSHING OF THE SAME VOLTAGE CLASS SHALL



BE INTERCHANGEABLE BUSHING WITH PLAIN SHED AS PER IS 3347. BUSHINGS SHALL BE MOUNTED ON TOP PLATE ONLY.

OR

HT BUSHING SHOULD BE KEPT IN SUCH A WAY THAT MINIMUM AIR CLEARANCES SHOULD BE MAINTAINED BY TILTING THE SAME.

SUITABLE INSULATING SHROUDS SHALL BE PROVIDED ON THE HT BUSHING TERMINALS.

THE HV BUSHINGS SHALL HAVE TO BE INSTALLED ON TOP PLATE ON TURRET, FLANGE AND GASKETS TO PREVENT EVENTUAL ENTRY OF WATER. THE TURRET HEIGHT FOR HV BUSHING SHOULD BE MINIMUM 25 TO 30MM. IN LV SIDE BUSHING, TURRET OF MINIMUM 10 MM SHOULD BE PROVIDED.

DIMENSIONS OF THE BUSHINGS OF THE VOLTAGE CLASS SHALL CONFORM TO THE STANDARDS SPECIFIED AND DIMENSION OF CLAMPING ARRANGEMENT SHALL BE AS PER IS 4257. BUSHING CAN BE OF PORCELAIN MATERIAL.

Note: Embossing on bushing showing the Manufacturer's name, year of manufacturing shall be clearly visible, even after fixing the same on Transformer.

BUSHINGS OF MAKE MENTIONED IN SCHEDULE-A, OR OTHER MAKES HAVING TYPE TESTED AS PER IS 2099 AND APPROVED BY THE GUVNL/ PGVCL/MGVCL/ DGVCL/ UGVCL SHALL ONLY BE USED & ARE ACCEPTABLE.

THE CROSS SECTION OF THE CONNECTING RODS ON LV SIDE SHALL BE AS PER IS 3347 PART1/SEC 2 1979 AND SHALL BE ADEQUATE FOR CARRYING THE RATED CURRENTS. ON THE HV SIDE THE TERMINAL ROD SHALL HAVE A DIAMETER OF NOT LESS THAN 12 MM OF BRASS UP TO 200 KVA AS PER IS 3347 PART3/SEC 2 1982 AND ABOVE 200 KVA SHALL BE OF COPPER.

THE BI-METALLIC CONNECTORS SHALL HAVE TO BE FITTED ON HV/LV TERMINALS HAVING CAPACITY TO WITHSTAND 1.5 TIMES OF RATED HV/LV CURRENT OF TRANSFORMER.



Note: For 5 KVA Single Phase & 10 KVA, 16 KVA and 25 KVA, Three Phase transformer having provision of MCCB, hence LV Bimetallic clamps are not required.

A. TRANSFORMER WITH CABLE TERMINATION BOX / PSS MOUNTING:

The transformer shall be fitted with suitable end termination boxes on 11 kV side to terminate one 11 kV/ 3 core Aluminum conductor XLPE/PILC cable up to 300 mm² size as per drawing. The HT cable box shall be prevented from ingress of moisture into the box due to rainwater directly falling on the box. The H.T. cable box shall be of split type with plain faces and machined and fitted with suitable gasket and complete with brass wiping gland to be mounted on separate split type gland plate with nut bolt arrangement and M.S earthing clamp. The bushings of the cable box shall be fitted with nuts and stem to take the cable cores without bending them. The stem shall be of copper with copper nuts. The cross section of the connecting rods shall be stated and shall be adequate for carrying the rated currents. On the HV side the terminal rod shall have a diameter of not less than 12 mm of brass up to 200 KVA and above shall be of Copper. The material of connecting shall be copper H.T Cable support clamp should be provided to avoid tension due to cable weight. Required diameter of hole for cable entry shall be provided at side as per requirement. Required size of glands shall be supplied as stated by the purchaser.

The transformer shall be fitted with suitable LV cable end box having non-magnetic metal material gland plate with appropriate size single compression brass glands as per the attached drawing on LV side to terminate 1.1 kV/ 1 core XLPE armored cable as mentioned herein below. Required diameter of holes for cable entry shall be done at site as per requirement or as stated by the purchaser before dispatch.

Mounting of HV and LV Bushings are mandatory on top side of transformer.

Terminal:

Primary: 12 kV Epoxy bushings as per IS: 2099 or Porcelain Bushings as per IS: 3347 as required by the purchaser for heavily polluted atmosphere having suitable diameter with nuts and check nuts for pad and platform mounted transformer as per drawing.



Secondary: Terminals shall be provided with 1.1 kV Epoxy bushings as per IS:3347 for heavily polluted atmosphere having fixed palm type connectors with suitable locking arrangement to restrict the rotation of palm assembly. Palm shall be of copper and stud of copper duly brazed at the joint.

Suitable clamps with nuts and bolts for 1 core 300 mm² XLPE/PVC cables as per details given for different size of transformers. Detachable clamps with nuts and bolts for ease of removing LV cables shall be provided with Epoxy bushings Clamp arrangement with copper terminal assembly.

AIR CLEARANCE IN CABLE BOX:

| <u>NOMINAL SYSTEM VOLTAGE</u> | <u>PHASE TO PHASE CLEARANCE IN MM</u> | <u>PHASE TO EARTH CLEARANCE IN MM</u> |
|-----------------------------------|---|---|
| <u>UP TO 1.1 KV</u> | <u>25</u> | <u>20</u> |
| <u>11 KV</u> | <u>130</u> | <u>80</u> |

HV AND LV TERMINALS:

THE LV AND HV BUSHING STEMS SHALL BE PROVIDED WITH SUITABLE TERMINAL CONNECTORS AS PER IS 5082 SO AS TO CONNECT THE JUMPER WITHOUT DISTURBING THE BUSHING STEM. TERMINAL CONNECTORS SHALL BE TYPE TESTED AS PER IS 5561.

CURRENT DENSITY IN HV AND LV TERMINALS SHALL NOT EXCEED 1 AMP/SQ.MM IN CASE OF BRASS TERMINALS AND 2 AMP/SQ.MM IN CASE OF COPPER TERMINALS.

B. INTERNAL CONNECTION:

1. HV WINDING:

- In case of HV winding all jumpers from winding to bushing shall have cross section double the winding conductor.
- Inter coil connection shall be done by brazing as per ASME, section-IX.
- In case of AL/CU winding Delta joint shall be with brazing only.
- Lead from Delta joint shall be connected to bushing rod by brazing only.
- Current density in any of the conductor (in Delta connections also) shall not exceed 1 Amp/sq.mm and 2Amp/sq.mm for aluminum



conductor and copper conductor respectively.

2. LV WINDING:

LV STAR POINT SHALL BE FORMED OF AL/CU FLAT OF SUFFICIENT SIZE AND LENGTH. LEAD FROM WINDING SHALL BE CONNECTED TO THE FLAT BY BRAZING.

FIRM CONNECTION OF LV WINDING TO BUSHING SHALL BE MADE OF ADEQUATE SIZE OF "L" SHAPE FLAT. CONNECTION OF LV COIL LEAD TO "L" SHAPE FLAT SHALL BE MADE BY BRAZING. THE "L" SHAPE FLAT SHALL BE OF COPPER FOR COPPER WINDING & ALUMINUM OF ALUMINUM WINDING. "L" SHAPE FLAT/LUG SHALL BE CLAMPED TO LV BUSHING METAL PART BY USING NUT, LOCKNUT AND WASHER.

5.9 TANK BASE CHANNEL:

TWO NUMBERS OF CHANNELS HAVING FOLLOWING MINIMUMSIZE ARE TO BE PROVIDED.

| Sr. No | Transformer capacity in KVA | Minimum Size of base Channel in mm |
|--------|-----------------------------|------------------------------------|
| 1 | 5 KVA to 100 KVA | 75 x 40 x 460 mm |
| 2 | 200 KVA &500 KVA | 100 x 50 mm |

THE TRANSFORMERS SHALL BE SUITABLE FOR LOADING AS PER IS: 6600 / 1972WITHLATEST AMENDMENT IF ANY.

THE UNDER BASE OF ALL TRANSFORMERS SHALL BE PROVIDED WITH HOLES TO MAKE THEM SUITABLE FOR FIXING ON A PLATFORM OR PLINTH.

5.10 NAME PLATE &TERMINAL MARKINGS:

5.10.1 High voltage phase windings shall be marked both in the terminal boards inside the tank and on the outside with capital letter 1U, 1V, 1W and low voltage winding for the same phase marked by corresponding letter 2U, 2V, 2W. The neutral point terminal shall be indicated by the letter 2N. Neutral terminal to be brought out.

5.10.2 Each Transformer shall be provided with combined non-detachable Name plate made of anodized aluminum/ stainless steel material securely fixed on the outer body, easily accessible. The information of Rating and terminal markings as per IS 1180 (Part-I) 2014, Clause No. 13 shall be engraved (punched) on combined name plate. The Transformers shall be marked with the Standard Mark. Details of Guarantee Period shall also be mentioned in combined Name Plate being a special requirement of DISCOM.

5.10.3 On opposite side of the combined name plate, other plate made of stainless steel material shall be welded on tank of Transformer. The Transformer

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Identification Number (TIN) shall be engraved (punched) on plate & it shall be clearly visible. The Transformer Identification Number (TIN) of minimum Nineteen digits/letters shall incorporate details of Name of DISCOM, Trans. KVA rating, supplier name code, month & Year of manufacturing, CPP tender no. and sr. no. given by supplier (Refer Annexure-II).

- 5.8.1 Current transformers for PSS Transformer and Cable Box type Transformers only: The current transformers of rating as specified shall be provided on LV side of the transformer. CTs shall be mounted on LV bushings and supported by Bakelite sheet of adequate thickness affixed to main tank by nut bolt arrangement so as to ensure easy replacement of CTs without disturbing LT bushings.
- Current transformers shall comply with IS:2705.
 - All secondary leads of bushing mounted CTs shall be brought to a terminal box. The CT terminals shall have shorting facility.
 - CT should not get saturated up to 200% of rated current.
 - CT parameters indicated under Technical parameters are tentative and are liable to change within reasonable limits. The contractor shall obtain approval before proceeding with the design of CTs.

| Sr. No. | Transformer Rating (kVA) | Size of Current Transformer |
|---------|--------------------------|-----------------------------|
| 1 | 100 | 250/5 |
| 2 | 200 | 400/5 |
| 3 | 315 | 600/5 |
| 4 | 500 | 1000/5 |

5.11 OTHER FITTINGS:

THE FOLLOWING OTHER FITTINGS OVER AND ABOVE STANDARD FITTINGS SHALL BE PROVIDED.

- Earthing terminals with earthing symbol having minimum size 1 1/2" X 1/2" with lugs - 2 Nos.
- HV bushings
3 nos. for 3 ph transformer
2 nos. for 1 ph transformer
- LV bushings
4 nos. for 3 ph transformer
2 nos. for 1 ph transformer

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- d. Terminal connectors on the HV bushings
- e. Terminal connectors on the LV bushings (above 25 KVA)
- f. Thermometer pocket with cap - 1 no.
- g. Oil filling hole (1.25 Inch, nominal size thread)/ with protection net / flatstrip to prevent oil theft
- h. Stiffener angle 40x40x5 mm and vertical strip of 50x5 mm flat
- i. Base channel having minimum size 75x40x460 mm for up to 100 KVA and 100 mm x 50 mm for 200 KVA & 500 KVA, with holes to make them suitable for fixing on a platform or plinth.
- j. 4 No. bi-directional rollers for transformers of 500 kVA.
- k. Radiators: No. & length may be mentioned (as per heat dissipation calculations)
- l. Arcing horns for HV bushings
- m. Breather if applicable
- n. Air release device (for non-sealed type transformers)
- o. Pressure relief device valve (PRV) - 1 No {for sealed type transformers (for all ratings) and non-sealed type transformers (for rating 200 KVA & above)}.
- p. Non return valve (NRV) -1 No (mandatory for sealed transformer with inert gas, otherwise optional).
- q. Anti-theft stainless steel fasteners with breakaway nut at Top Cover - 4 Nos. for 3 Phase and 2 nos. for 1 Phase
- r. Oil filter valve (1.25 Inch, nominal size thread) -1 No. at top of tank for 500 KVA
- s. Drain-cum-sampling metallic valve with plug (1.25 Inch, nominal size thread) -1 no. for 200 KVA & above transformer at bottom of tank with anti theft protection cover
- t. Off circuit tap changer switch with handle and locking device for 200 KVA & 500 KVA Transformers - 1 No
- u. LV Cable holding clamp with accessories for 63 KVA and above.
- v. LV earthing arrangement for single phase transformers (LV neutral terminal to be brought out for earthing)
- w. Inspection hole for 500 KVA
- x. Prismatic Oil level gauge indicating the position of oil marked with background of yellow color) as follows.

MIN. (-5 DEG.C), 30 DEG. C, MAX. 90 DEG.C

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1. Minimum and maximum positions correspond to the operating temperature of -5°C and 90°C respectively (for non-sealed type transformer).
2. Only Minimum position corresponds to the operating temperature of 30°C (for sealed type transformers).

5.12 OVER LOAD PROTECTION:

5.13.1 The transformer shall have external mounted LT circuit breaker on the secondary side up to 25 KVA capacity of transformer. The breaker shall be housed in an enclosure confirming to IP44 as per IS: 13947. Suitable louvers fitted with wire gauze shall be provided to ensure circulation of air but not to allow ingress of rain water. An operating handle shall be provided outside the enclosure in such a way that ON & OFF operation of the breaker can be conveniently performed from the ground level by means of an operating rod. The ON & OFF position of the handle shall be clearly and bodily mark on the enclosure.

5.13.2 The breaker box shall be mounted on side wall (short side) of the tank opposite side of the name plate for comfortable wiring at site.

5.13.3 The manufacturer will provide 1.1KV; Stranded PVC insulated armored Aluminum cable from Transformer terminal to Incoming of MCCB having below mentioned cable size and the purchaser will connect LT cable to the outgoing terminals of MCCB after installation of the transformer at site. Detachable gland plate with below mentioned sized cable shrinkable PVC gland to be provided at the bottom of the enclosure.

5.13.4 The circuit breaker shall generally confirm to the requirement of IS: 13947. The electrical characteristics of the breaker shall be mentioned by bidder as follows.

| Transformer rating (KVA) | Full load LV current of the transformer (Amp) | Transformer terminal to Breaker cable size (minimum)-Alum. |
|--------------------------|---|--|
| 5 | 16.2 | 2.5 mm ² |
| 10 | 13.33 | 4 mm ² |
| 16 | 21.33 | 6 mm ² |

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| | | |
|----|-------|--------------------|
| 25 | 33.33 | 10 mm ² |
|----|-------|--------------------|

THE CIRCUIT BREAKER SHALL CONFIRMED TO IS: 13947 PART-II AND CERTIFICATE FROM GOVERNMENT APPROVED LABORATORY FOR SHORT CIRCUIT TEST AT A POWER FACTOR NOT EXCEEDING 0.4 (LAGGING) SHALL BE SUBMITTED WITH THE OFFER.

5.13.5 MCCB Make mentioned in **Schedule-A**, or other makes having type tested as per relevant IS and approved by the GUVNL/PGVCL/MGVCL /DGVCL /UGVCL shall only be used & are acceptable. Bidder shall have to mention the make of MCCB to be provided with the offer. The bidder shall also submit the type test certificate. However any other make of MCCB having valid BIS Certificate of ISI mark shall be acceptable only at the discretion of the Purchaser. The decision of Purchaser shall be final & binding in this regard. For other make of MCCB, Bidder shall also have to submit certificate of satisfactory operation from other two Utilities.

THE SUCCESSFUL BIDDER SHALL BE REQUIRED TO FURNISH THE GUARANTEE CERTIFICATE OF 05 (FIVE) YEAR OBTAINED FROM THE MCCB MANUFACTURE ON RS. 100/- NON-JUDICIAL STAMP PAPER.

5.13.6 The circuit breaker shall have the following time v/s current characteristics and same shall be tested with all the 3 Ph. Loaded. The reference calibration temperature of the breaker shall be 50 degree centigrade. The test certificate for the same of NABL accredited laboratory shall be produced with bid as well as at the time of inspection.

| Multiple of normal current setting | Tripping time |
|------------------------------------|--------------------------------------|
| 1.05 Times | More than 2.5 Hrs. |
| 1.1 Times | More than 2 Hr. & less than 2.5 Hrs. |
| 1.15 Times | More than 1 Hr. & less than 2 Hrs. |
| 1.2 Times | More than 0.5 Hrs. & less than 1 Hr. |
| 1.3 Times | Less than 20 minutes |
| 1.4 Times | Less than 10 minutes |
| 2.5 Times | Less than 1 minute |
| 6.0 Times | Less than 5 seconds |

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| | |
|------------|---|
| 8.0 Times | Less than 40 milliseconds |
| 12.0 Times | Instantaneous (less than 20 milliseconds) |

5.13.7 The LT circuit breaker and the associated terminals / wiring shall be designed with reference to ambient temperature of 55°C instead of 40 °C due to operation in metallic enclosure installed outdoors. The permissible temperature rise limits stipulated in IS: 13947 shall be reduced accordingly and the supplier shall furnish necessary data to show that all the components ARE SUITABLE FOR THE EXPECTED TEMPERATURE RISE OVER AND ABOVE THE AMBIENT TEMPERATURE 55 °C UNDER VARIOUS LOADING CONDITIONS. THE SUPPLIER SHALL FURNISH ALL THE TYPE AND ROUTINE TEST CERTIFICATE OF THE CIRCUIT BREAKERS IN ACCORDANCE WITH IS: 13947 PT. 2.

5.13 FASTENERS:

ALL BOLTS/NUTS/WASHERS EXPOSED TO ATMOSPHERE SHALL BE OF STAINLESS STEEL.

ALL BOLTS, STUDS, SCREW THREADS, PIPE THREADS, BOLT HEADS AND NUTS SHALL COMPLY WITH THE APPROPRIATE INDIAN STANDARDS FOR METRIC THREADS, OR THE TECHNICAL EQUIVALENT. BOLTS OR STUDS SHALL NOT BE LESS THAN 6 MM IN DIAMETER EXCEPT WHEN USED FOR SMALL WIRING TERMINALS.

ALL NUTS AND PINS SHALL BE ADEQUATELY LOCKED.

WHEREVER POSSIBLE, BOLTS SHALL BE FITTED IN SUCH A MANNER THAT IN THE EVENT OF FAILURE OF LOCKING RESULTING IN THE NUTS WORKING LOOSE AND FALLING OFF, THE BOLT WILL REMAIN IN POSITION.

EACH BOLT OR STUD SHALL PROJECT AT LEAST ONE THREAD BUT NOT MORE THAN THREE THREADS THROUGH THE NUT, EXCEPT WHEN OTHERWISE APPROVED FOR TERMINAL BOARD STUDS OR RELAY STEMS. IF BOLTS NUTS ARE PLACED SO THAT THEY ARE INACCESSIBLE BY MEANS OF ORDINARY SPANNERS, SPECIAL SPANNERS SHALL BE PROVIDED.

TWO BOLTS SHALL BE PROVIDED DIAGONALLY WITH SEALING FACILITY AT TOP.

THE LENGTH OF THE SCREWED PORTION OF THE BOLTS SHALL BE SUCH THAT NO SCREW THREAD MAY FORM PART OF A SHEAR PLANE BETWEEN MEMBERS.

TAPER WASHERS SHALL BE PROVIDED WHERE NECESSARY.



PROTECTIVE WASHERS OF SUITABLE MATERIAL SHALL BE PROVIDED FRONT AND BACK OR THE SECURING SCREWS.

5.14 OVERLOAD CAPACITY

THE TRANSFORMERS SHALL BE SUITABLE FOR LOADING AS PER IS:6600/1972 WITH LATEST AMENDMENT, IF ANY.

5.15 SUBMISSION OF DRAWINGS AND CALCULATION SHEET:

THE MANUFACTURER HAS TO SUBMIT THE FOLLOWING DETAILS AND DRAWINGS ALONG WITH OFFER.

- i. General Arrangement.
- ii. Internal Construction.
- iii. Name Plate as per approved drawing.
- iv. Technical Details Sheet.
- v. HV Bi metallic connectors, clearly mentioned ampere capacity.
- vi. LV Bi metallic connectors (above 25 KVA capacity), clearly mentioned ampere capacity.
- vii. Month & Year of manufacture to be written on conservator tank & body.
- viii. Core details.
- ix. Metal part of HV/LV steams.
- x. Breather
- xi. Pressure Relief Device
- xii. Short circuit capacity calculation sheet.
- xiii. Cooling capacity calculation.
- xiv. Guaranteed technical particulars as per DISCOM's prescribed Performa for design & constructional details.
- xv. Flux density calculation sheet.
- xvi. MCCB box drawing (up to 25 KVA capacity)
- xvii. Drawing of combined name plate (minimum size 105mm x 175 mm x 1.5 mm) showing: Name of Supplier, A/T No., KVA capacity, Month & year of manufacturing, Sr.No. of Transformer etc. as per cl. no. 5.11.2 of technical specifications
- xviii. Drawing of Transformer Identification Number plate minimum size 150 mm x 20 mm x 1.5 mm) as per cl.no. 5.11.3 of technical specifications

THE ABOVE DRAWINGS/ DETAILS ARE ILLUSTRATIVE. HOWEVER, THE BIDDER MAY SUBMIT THEIR OWN DRAWING/ DETAILS IF THEY SO DESIRES. OFFER WITHOUT DRAWINGS/ DETAILS SHALL NOT BE CONSIDERED.



AFTER PLACING OF ORDER BY THE RESPECTIVE DISCOM TO SUCCESSFUL BIDDER, SUPPLIER HAS TO GET APPROVAL OF ALL ABOVE DRAWINGS BEFORE OFFERING PROTOTYPE SAMPLE FOR INSPECTION.

5.16 THE INSPECTION AND TESTING :

5.17.1 INSPECTION OF PROTO TYPE TRANSFORMER :

THE MANUFACTURER SHALL HAVE TO OFFER ONE NO OF PROTOTYPE TRANSFORMER ALONGWITH RELEVANT APPROVED DRAWINGS AS STATED ABOVE AT CLAUSE 5.14.

THE PROTO TYPE SHALL BE SUBJECTED TO FOLLOWING TEST CONFORMING TO IS 1180 PART-1 2014 & IS 2026 AND ALL RELEVANT IS WITH LATEST AMENDMENTS.

- 1) Verification of core laminations material documents and quality.
- 2) Verification of internal parameters with respect to approved drawings and GTP.
- 3) All Routine tests/ acceptance test as per clause 6
- 4) Temperature rise test as per clause no.6
- 5) Verification of Air pressure and vacuum test certificate from manufacturer of tank.

ON COMPLETION OF PROTO TYPE SAMPLE INSPECTION AND SCRUTINIZING THE REPORTS, APPROVAL WILL BE ACCORDED BY THE RESPECTIVE DISCOM. ON GETTING APPROVAL FROM RESPECTIVE DISCOM, BULK PRODUCTION SHALL BE COMMENCED BY THE SUPPLIER.

IF ANY OBSERVATION/ DEVIATION FOUND DURING PROTO INSPECTION, SUPPLIER SHALL HAVE TO RE-OFFER PROTO INSPECTION WITH RECTIFICATION/ NEW SAMPLE. HOWEVER, INSPECTION CHARGES FOR UNSUCCESSFUL PROTO SAMPLE WILL BE BORNE BY THE SUPPLIER.

6.0 TESTS:

- a. All the equipment offered shall be fully type tested by the bidder or his collaborator as per the relevant standards including the additional type tests mentioned at clause 6.2. The type test must have been conducted on a transformer of same design. The Bidder shall furnish four sets of type test reports along with the offer. All the required Type test reports for the tendered items as under should invariably furnish a Notarized Copy. Offers



without type test reports will be treated as Non-responsive.

1. Temperature rise test for determining the maximum temperature rise after continuous full load run.
 2. Lightning Impulse voltage test: As per Clause No. 13 (With chopped wave) of IS - 2026- part-III latest version. BIL for 11 kV shall be minimum 95 KV Peak.
 3. Vacuum Test: As per IS - 1180 / part-I/2014
 4. Pressure Test: As per IS-1180/part-I/2014.
 - (i) For transformers up to 200kVA test is to be carried out as per clause no.21.5.1.1 of IS 1180:2014 with latest amendments.
 - (ii) For transformers above 200kVA test is to be carried out as per clause no.21.5.2.1 of IS 1180:2014 with latest amendments.
 5. Short Circuit withstand test: Thermal and dynamic ability.
 6. Magnetic Balance Test. (Not applicable for single phase transformer)
 7. Noise-level measurement.
 8. Measurement of zero-phase sequence impedance. (Not applicable for single phase transformer)
 9. Measurement of Harmonics of no-load current.
 10. Pressure relief device test (if provided).The pressure relief device shall be subject to increasing fluid pressure. It shall operate before reaching the test pressure as specified in the above class. The operating pressure shall be recorded. The device shall seal-off after the excess pressure has been released.
 11. Type tests for MCCB as per relevant IS (Upto 25KVA)
- b. Special tests other than type and routine tests, as agreed between purchaser and Bidder shall also be carried out as per the relevant standards.

6.1 ROUTINE TESTS:

FOLLOWING TESTS SHALL HAVE TO BE CARRIED OUT BY MANUFACTURERS AT THEIR WORKS (TO BE CONDUCTED ON ALL UNITS) BEFORE OFFERING PROTO/LOT ACCEPTANCE TESTS AND RECORD OF THE SAME SHALL BE MAINTAINED AND PRODUCED AT THE TIME OF ACCEPTANCE TESTS FOR INSPECTOR'S VERIFICATION.

1. Measurement of winding resistance (at all taps if applicable) [IS1180 (PART1):2014].

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2. Measurement of voltage ratio, polarity, phase sequence and vector group [IS1180 (Part1):2014].
3. Measurement of short-circuit impedance (principal tapping, when applicable)
4. Load losses at rated current and normal frequency at 50 % and 100 % load [IS1180 (Part1):2014].
5. Measurement of no-load loss and current [IS1180 (Part1):2014].
6. Measurement of insulation resistance [IS1180 (Part1):2014].
7. Induced over-voltage withstand test [IS1180 (Part1):2014].
8. Separate-source voltage withstand test [IS1180 (Part1):2014]
9. Pressure test (as per IS: 1180-2014).
10. Oil leakage test (as per IS: 1180-2014).
11. Neutral current measurement, shall not be more than 2% of full load current (CEA Guideline 2008 clause no 34.9)
12. Oil samples (one sample per lot) to comply with IS 1866.
13. Measurement of no load losses and magnetizing current at rated frequency and at 90%, 100% and 112.5% voltage.

6.2 TYPE TESTS TO BE CONDUCTED ON ONE UNIT:

AS PER CLAUSE NO 6

6.3 ACCEPTANCE TESTS :

THE FOLLOWING TESTS SHALL BE CARRIED OUT ON TRANSFORMERS IN THE PRESENCE OF PURCHASER'S REPRESENTATIVE AT THE SUPPLIER'S WORKS BEFORE DISPATCH WITHOUT ANY EXTRA CHARGES.

THE TESTING SHALL BE CARRIED OUT IN ACCORDANCE WITH IS: 1180 PART-1 2014 AND IS: 2026 LATEST AMENDMENT & CEA GUIDELINE AS APPLICABLE.

VALID CALIBRATION CERTIFICATES FROM NABL LAB OF TESTING EQUIPMENT'S SHALL BE AVAILABLE AT SUPPLIER WORKS FOR TESTING OF TRANSFORMERS. MANUFACTURER SHALL POSSESS 0.1 CLASS OF ACCURACY INSTRUMENTS FOR MEASUREMENT OF LOSSES.

A: Physical verification to be carried out on one transformer from offered lot:-

1. Checking of weights of individual components and total weight,

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dimensions, fitting and accessories, tank sheet thickness, oil quantity, materials, finish and workmanship as per GTP , QA Plan and approved drawings.

2. Verification of thickness of paint coating.
3. Physical verification of core coil assembly and measurement of flux density of one unit of each rating, in every inspection with reference to short circuit test report.

B: Test to be carried out on all transformers:-

1. Measurement of load loss at 50 % and 100 % load at maximum current tap.
2. Measurement of short-circuit impedance at normal tapping.
3. Neutral current to be measured by clamp-on meter, it shall not be more than 2% of full load current (CEA Guideline 2008 clause no 34.9)
4. Measurement of no load losses & current at rated frequency and voltage. [IS1180 (Part1):2014].
5. Measurement of over excitation current at rated frequency and at 112.5% voltage.
6. Induced over-voltage withstand test [IS1180 (Part1):2014].
7. Separate-source voltage withstand test [IS1180 (Part1):2014].
8. Physical verification of finishing and workmanship as per GTP and QA Plan and approved drawings.
9. Verification of oil level through oil level gauge.

C: Test to be carried out on one transformer from offered lot:-

1. Measurement of winding resistance [IS1180 (Part1):2014].
2. Measurement of voltage ratio, polarity, phase sequence and vector group [IS1180 (Part1):2014].
3. Pressure test (as per IS: 1180-2014).
4. Measurement of insulation resistance [IS1180 (Part1):2014].
5. Oil leakage test (as per IS: 1180-2014).
6. Collection of Oil samples from any transformer, to be sent for testing at NABL lab to comply with IS 1866. Testing charges will be borne by DISCOM.
7. Magnetic balance test.
8. Temperature Rise Test on transformer having maximum load losses from each offered lot (Total losses guaranteed, offered in GTP at maximum current tap shall have to be fed for Temperature rise test).



9. To ascertain the quality of the transformer oil, the original manufacturer's tests report should be submitted at the time of inspection. Arrangements should also be made for testing of transformer oil, after taking out the sample from the manufactured transformers and tested in the presence of purchaser's representative.
10. Acceptance test for MCCB:-
 - (a) Verification for make of MCCB
 - (b) High Voltage test - 3KV (On random sample)
 - (c) Amp/Time curve characteristics (On random sample).

6.4 TOLERANCES:

Unless otherwise specified herein the test value of the transformers supplied would be within the tolerance permitted in the relevant standards. No positive tolerance is allowed on guaranteed losses.

7.0 INSPECTION:

ALL TESTS AND INSPECTION SHALL BE MADE AT SUPPLIER WORKS MENTIONED IN A/T. THE MANUFACTURER SHALL AFFORD THE INSPECTOR REPRESENTING THE PURCHASER ALL REASONABLE FACILITIES, WITHOUT CHARGE TO SATISFY HIM THAT THE MATERIAL IS BEING FURNISHED IN ACCORDANCE WITH SPECIFICATION.

THE MANUFACTURER SHALL PROVIDE ALL SERVICES TO ESTABLISH AND MAINTAIN QUALITY OF WORKMAN SHIP IN HIS WORKS AND THAT OF HIS SUB-CONTRACTORS (FOR BOUGHT OUT MATERIAL/EQUIPMENTS) TO ENSURE THE MECHANICAL / ELECTRICAL PERFORMANCE OF COMPONENTS, COMPLIANCE WITH DRAWINGS, IDENTIFICATION AND ACCEPTABILITY OF ALL MATERIALS, PARTS AND EQUIPMENT AS PER LATEST QUALITY STANDARDS OF ISO 9000.

ALONG WITH THE BID THE MANUFACTURER SHALL PREPARE QUALITY ASSURANCE PLAN IDENTIFYING THE VARIOUS STAGES OF MANUFACTURE, QUALITY CHECKS PERFORMED AT EACH STAGE AND THE CUSTOMER HOLD POINTS. THE DOCUMENT SHALL ALSO FURNISH DETAILS OF METHOD OF CHECKING, INSPECTION AND ACCEPTANCE STANDARDS / VALUES. HOWEVER, PURCHASER OR HIS REPRESENTATIVE SHALL HAVE THE RIGHT TO REVIEW THE INSPECTION REPORTS, QUALITY CHECKS AND RESULTS OF MANUFACTURER'S IN HOUSE INSPECTION DEPARTMENT WHICH ARE NOT CUSTOMER HOLD POINTS AND THE MANUFACTURER SHALL COMPLY WITH THE REMARKS MADE BY PURCHASER OR HIS REPRESENTATIVE ON SUCH

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REVIEWS WITH REGARDS TO FURTHER TESTING, RECTIFICATION OR REJECTION ETC. MANUFACTURER SHOULD SUBMIT THE LIST OF EQUIPMENT FOR TESTING ALONG WITH VALID CALIBRATION CERTIFICATES FROM NABL ACCREDITED LABORATORY TO THE PURCHASER ALONG WITH THE BID.

PURCHASER SHALL HAVE EVERY RIGHT TO APPOINT A THIRD PARTY INSPECTION TO CARRYOUT THE INSPECTION PROCESS. THE PURCHASER HAS RESERVED THE RIGHTS TO HAVE THE TEST CARRIED OUT AT HIS OWN COST BY AN INDEPENDENT AGENCY AT NABL ACCREDITED LABORATORY, WHEREVER THE DISPUTE REGARDING THE QUALITY OF SUPPLIES ARISE.

8.0 QUALITY ASSURANCE PLAN:

8.1 The Bidder shall invariably furnish following information along with his bid, failing which his bid shall be liable for rejection. Information shall be separately given for individual type of equipment offered.

- i. Statement giving list of important raw materials, names of sub-suppliers for the 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, copies of test certificates.
- ii. Information and copies of test certificates as in (i) above in respect of bought out accessories.
- iii. List of manufacturing facilities available.
- iv. Level of automation achieved and list of areas where manual processing exists.
- v. List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspection.
- vi. List of testing equipment available with the bidder for final testing of equipment along with valid calibration reports shall be furnished with the bid. Manufacturer shall possess 0.1 class accuracy instruments for measurement of losses.
- vii. Quality Assurance Plan (QAP) with all points for purchaser's inspection.

8.2 The successful Bidder shall within 30 days of placement of order, submit following information to the purchaser.

- i. List of raw materials as well as bought out accessories and the names of sub-suppliers selected from those furnished along with offer.
- ii. Type test certificates of the raw materials and bought out accessories.



- 8.3 The successful Bidder shall submit the routine test certificates of bought out accessories and central excise passes for raw material at the time of routine testing.
- 8.4 The successful bidder shall have to submit the declaration on company letter head regarding utilization of bought out raw materials conforming to relevant IS/IEC and applicable rules & regulations with latest amendments during the inspection as per format attached as Annexure-III.

9.0 DOCUMENTATION:

THE BIDDER SHALL FURNISH ALONG WITH THE BID THE DIMENSIONAL DRAWINGS OF THE ITEMS OFFERED INDICATING ALL THE FITTINGS.

- i) Dimensional tolerances
- ii) Weight of individual components and total weight

10.0 PACKING & FORWARDING:

THE PACKING SHALL BE DONE AS PER THE MANUFACTURER'S STANDARD PRACTICE. HOWEVER, IT SHOULD BE ENSURED THAT THE PACKING IS SUCH THAT, THE MATERIAL WOULD NOT GET DAMAGED DURING TRANSIT BY RAIL / ROAD / SEA. THE MARKING ON EACH PACKAGE SHALL BE AS PER THE RELEVANT IS.

11.0 DRAWINGS:

ONE COPY OF THE DIMENSIONAL DRAWING AND INTERNAL CONSTRUCTION DRAWING OF EACH RATING TRANSFORMER SHALL BE SUBMITTED WITH THE TENDER. THESE DRAWINGS SHALL BE OF A-3(420 X 297 MM) SIZE ONLY. GUARANTEED AND OTHER TECHNICAL PARTICULARS OF THE TRANSFORMERS AS PER THE A/T SHALL ALSO BE SUBMITTED IN A-4 SIZE FOR APPROVAL IN THE PERFORMA ATTACHED WITH TENDER ONLY.

12.0 GTP: GUARANTEED TECHNICAL PARTICULARS FOR TRANSFORMERS.

GTP TO BE FILLED IN AND SUBMITTED BY THE TENDERER IN THE ANNEXURE-I ATTACHED WITH THE TENDER. IN ANNEXURES, THE SPECIFIC VALUES SHALL BE FURNISHED AND ONLY QUOTING OF IS REFERENCE IS NOT SUFFICIENT. IF THE ANNEXURES ARE NOT SUBMITTED DULY FILLED IN WITH THE OFFER, THE OFFER SHALL BE LIABLE FOR REJECTION.

THE DISCREPANCIES BETWEEN THE SPECIFICATION AND THE CATALOGUES, LITERATURES AND INDICATIVE DRAWINGS WHICH ARE SUBJECT TO CHANGE,

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SUBMITTED AS PART OF THE OFFER, SHALL NOT BE CONSIDERED AND REPRESENTATION IN THIS REGARD WILL NOT BE ENTERTAINED.

IF IT IS OBSERVED THAT THERE ARE DEVIATIONS IN THE OFFER IN G.T.P. OR THOSE SPECIFIED IN THE RELEVANT ANNEXURE OF COMMERCIAL TERMS AND CONDITION THEN SUCH DEVIATIONS SHALL BE TREATED AS DEVIATIONS. THE DEVIATION BROUGHT OUT SHALL BE SUPPORTED BY AUTHENTIC DOCUMENTS, STANDARDS AND CLARIFICATIONS, OTHERWISE THE OFFER MAY BE LIABLE FOR REJECTION.

THE TENDERER SHALL SUBMIT THE LIST OF ORDERS FOR SIMILAR TYPE OF EQUIPMENTS, EXECUTED OR UNDER EXECUTION DURING LAST THREE YEARS, WITH FULL DETAILS TO ENABLE THE PURCHASER TO EVALUATE THE TENDER.

13.0 TENDER DRAWINGS AND OTHER DETAILS TO BE ENCLOSED:

THE BIDDER SHALL SUBMIT DRAWINGS AND DETAILS LISTED IN CLAUSE NO 5.14 ALONG WITH OFFER AS WELL AS BEFORE OFFERING THE PROTOTYPE TRANSFORMER.

15.0 GUARANTEE FOR THE TRANSFORMERS;

1. Guarantee period shall be 60 months from the date of taking over certificate by purchaser. If the goods, stores and equipment found defective due to bad design or workmanship, to be technically evaluated as per the detailed guidelines issued vide letter no. GUVNL/Tech-3/DE-1/Transformer/2204 DTD. 24.09.2018, the same should be repaired or replaced by you free of charge if reported within 66 months of their receipt at site or 60 months from the date of commissioning of equipment whichever is earlier. You will be responsible for the proper performance of the equipment / materials for the respective guarantee period.
2. The supplier shall return guarantee failed transformers duly repaired and tested as per approved GTP and tender specification within 45 days from the date of receipt at repair shop without any cost. If the same is not repaired / replaced within stipulated period, then the end cost of such equipment will be retained by way of recovering the amount from Suppliers pending / ensuing bills with the Company / other subsidiary Companies of GUVNL against any of the order, and / or by encashing Bank Guarantee available with the Company / other subsidiary Companies of GUVNL against any of the order, till the return of the equipment. No interest will be paid on the amount so retained / recovered. In case of material / item not returned duly repaired within 45 days, penalty shall be imposed @ 0.5% per week or part thereof, maximum up to 10% of the cost of undelivered material / equipment beyond specified time limit. In case of material / item not returned duly repaired within 5 months, total cost of the material / item along with penalty will be adjusted/recovered from the pending bills of the supplier or encashing available performance bank guarantee submitted against guarantee period. This clause itself shall be the notice to the supplier about encashment of Bank Guarantee in case of his failure to adhere to timelines & no separate notice will be served. The outage period i.e. period from the date of failure till unit is repaired/ replaced shall not be counted for arriving at the guarantee period.
3. After intimation of failure of transformer failed within guarantee period, DISCOM will arrange for the dispatch of guarantee period failed transformer to firm's works at the cost of DISCOM. On receipt of guarantee period failed transformer at firm's works, the external inspection will be carried out by the representative of DISCOM not below the rank of Junior Engineer. The cost of any outer component damage not because of supplier's fault and required to be provided will be reimbursed to the supplier as per the approved rate of DISCOM on the strength of joint external inspection report.

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NO INTERNAL INSPECTION OF FAILED UNIT IS TO BE CARRIED OUT IN PRESENCE OF REPRESENTATIVE OF DISCOM. HOWEVER, THE SUPPLIER MAY PREPARE AN INTERNAL INSPECTION REPORT OF FAILED UNIT FOR HIS STUDY AND ANALYSIS. IF REQUIRED, SUCH ANALYSIS SHALL BE FURNISHED TO DISCOM.

TESTING OF TRANSFORMER WILL BE DONE IN PRESENCE OF COMPANY'S ENGINEER TO ENSURE LOSSES AS PER GTP, TRANSFORMER FOUND WITH HIGHER LOSSES THAN GTP WILL NOT BE ACCEPTED AND COST THEREOF WILL BE RECOVERED. THE NEW TRANSFORMERS SUPPLIED IN THIS CIRCUMSTANCES MUST AS PER GTP SUBMITTED WITH TENDER AND SHALL MATCH THE LOSSES OFFERED BY THE SUPPLIER AS PER TENDER.

THE TESTING OF EACH G.P. FAILED TRANSFORMERS WILL BE CARRIED OUT FOR ALL ACCEPTANCE TESTS AS PER THE RELEVANT STANDARD WHERE NO LOAD LOSSES AND LOAD LOSSES ARE ALSO REQUIRED TO BE MAINTAINED IDENTICAL AS PER GTP.

4. The supplier situated outside Gujarat State shall have to establish suitable and adequate arrangement for repairing and testing of failed transformer in Gujarat State at his cost. This arrangement shall have to be continued up to the completion date of guarantee period of supply of last lot.
5. In case of effect of major natural calamity conditions, like transformer submerged in the water, or /and fall down in mass quantity, free repairing of the failed transformer during the guarantee period shall not be applicable. This natural calamity conditions will be decided by the concerned DISCOM."

16.0 THE TENDERER SHALL OFFER EITHER CONVENTIONAL CORE TYPE OF TRANSFORMER OR WOUND CORE TYPE OF TRANSFORMER. TENDERER SHALL NOT OFFER OR QUOTE THE RATE FOR BOTH TYPE OF TRANSFORMER AT A TIME WITH THIS TENDER.

Schedule A

H.V. BUSHINGS

- 1) JAYASHREE
- 2) BEPCO.
- 3) W.S. INSULATORS
- 4) ASSOCIATED PORCELAIN (11KV ONLY)
- 5) JAIPUR GLASS
- 6) SESHASAYEE

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=====

- 7) LUSTER CERAMICS
- 8) AGRAWAL SALT CO., BIKANER.
- 9) B.P.P.L., BIKANER.
- 10) VENKATESHWARA CERAMICS P.
- 11) CJI PORCELAIN INDIA LTD.
- 12) MAXWELL CERAMIC, WADHWAN, (ONLY 11KV)
- 13) RAVIKIRAN (ONLY 11KV)
- 14) VISHAL MALLEABLE LTD.
- 15) AS INSULATOR
- 16) REAL INSULATOR
- 17) REDIANT CERAMIC
- 18) SUN INSULATOR
- 19) PRIME INSULATOR
- 20) GENESIS ENTERPRISES PRIVATE LIMITED
- 21) M/s Suraj Cermaics Industries, Bikaner, Rajasthan
- 22) M/s Gujarat Heavy Electrical & Insulators Pvt Ltd, Surendranagar

L.V. BUSHINGS:

- 1) J.S.I. (RISHRA)
- 2) LUSTER CERAMICS
- 3) JAIPUR GLASS
- 4) AGRAWAL SALT CO., BIKANER.
- 5) B.P.P.L., BIKANER.
- 6) VENKATESHWARA CERAMICS, PVT. LTD.
- 7) CJI PORCELAIN
- 8) MAXWELL CERAMIC, WADHWAN.
- 9) RAVIKIRAN
- 10) VISHAL MALLEABLE LTD.
- 11) AS INSULATOR
- 12) REAL INSULATOR
- 13) REDIANT CERAMIC
- 14) SUN INSULATOR
- 15) PRIME INSULATOR
- 16) GENESIS ENTERPRISES PRIVATE LIMITED

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- 17) M/s Suraj Cermaics Industries, Bikaner, Rajasthan
18) M/s Gujarat Heavy Electrical & Insulators Pvt Ltd, Surendranagar

MCCB:

- 1) Siemens
- 2) L&T
- 3) ABB
- 4) GE POWER
- 5) Schneider
- 6) Crompton Greaves
- 7) Havells
- 8) HPL
- 9) Spaceage Switchgears Limited

17.0 FOR THE TRANSFORMER FAILED DURING GUARANTEE PERIOD ON ACCOUNT OF TECHNICAL REASONS MENTIONED IN DETAILED GUIDELINES ISSUED VIDE LETTER NO. GUVNL/TECH- 3/DE-1/TRANSFORMER/2204 DATED 24/09/2018, DISCOMS MAY GET SUCH TRANSFORMERS REPAIRED AT ANY SUPPLIER'S WORK, IF DEEMED FIT.

THE COST OF REPAIRING, AS PER PREVAILING RATES OF REPAIRING ORDERS PLACED TO REPAIRING AGENCIES FOR REPAIRING OF OGP FAILED TRANSFORMERS, WILL BE PAID TO SUCH SUPPLIER. THE COST FOR TRANSPORTATION FROM SUPPLIERS MANUFACTURING UNIT TO RESPECTIVE DIVISION OFFICE WILL BE BORNE BY THE SUPPLIER, WHILE OTHER CLAUSES OF REPAIRING ORDERS WILL BE APPLICABLE TO SUPPLIERS FOR REPAIRING OF SUCH TRANSFORMERS.

THE SUPPLIERS HAVE TO SUBMIT CONSENT FOR REPAIRING OF ABOVE MENTIONED FAILED TRANSFORMERS WITH BIDS IN CASE THEY ARE WILLING FOR THE SAME IN THE FORMAT MENTIONED AS ANNEXURE-X AS UNDER. IF BIDDER DOES NOT SUBMIT CONSENT ALONG WITH TECHNICAL BID, IT WILL BE PRESUMED THAT BIDDER IS NOT INTERESTED FOR REPAIRING OF FAILED TRANSFORMERS.

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Annexure-I GUARANTEED TECHNICAL PARTICULARS

| Sr. No. | Particulars | Unit / Type | As per Firm's Offer |
|---------|---|-------------------|---------------------|
| 1 | Name of manufacturer | | |
| 2 | Place of Manufacturing | | |
| 3 | Transformer capacity | KVA | |
| 4 | Voltage | 11/0.433-0.250 KV | |
| 5 | No. of Phases | 3 No./1 No. | |
| 6 | Vector Group | DYn-11 | |
| 7 | Type of Cooling | ONAN | |
| 8 | Type of Transformer | Sealed/Unsealed | |
| 9 | For 200 KVA/500 KVA transformers | | |
| | a) No. of tap positions in HV winding | | |
| | b) Voltage variation | | |
| 10 | Energy Efficiency Level | Level-1 | |
| 11 | Losses | | |
| i | Core loss | Watts | |
| | a) at Normal Voltage | Watts | |
| | b) at Maximum Voltage | Watts | |
| ii | a) Full Load losses at 75 deg. C (Normal Tap) | Watts | |
| | b) Full Load losses at 75 deg. C (Maximum Tap) For 200KVA & 500KVA Trans | Watts | |
| iii | a) Total losses at 50 % loading at 75 deg. C. (Normal Tap) | Watts | |
| | b) Total losses at 50 % loading at 75 deg. C. (Maximum Tap) For 200KVA, 315KVA & 500KVA Trans | Watts | |
| iv | a) Total losses at 100 % loading at 75 deg. C (Normal Tap) | Watts | |

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| | | | |
|---------|---|---------------------------------|---------------------|
| | b) Total losses at 100 % loading at 75 deg. C (Maximum Tap) For 200KVA & 500KVA Trans | Watts | |
| 12 | Percentage Impedance at 75 deg. C. | % | |
| 13 | Maximum temperature rise of | | |
| | a) Windings by resistance method | 40 deg C (35 deg C for 5KVA) | |
| | b) Oil by Thermometer | 35 deg C (30deg C for 5KVA) | |
| 14 | Clearances | | |
| | a) Core & LV | mm | |
| Sr. No. | Particulars | Unit / Type | As per Firm's Offer |
| | b) LV & HV | mm | |
| | c) HV Phase to Phase | mm | |
| | d) End insulation clearance to Earth | mm | |
| | e) Any point of winding to tank | mm | |
| | f) HV to earth creepage distance | mm | |
| | g) LV to earth creepage distance | mm | |
| 15 | Efficiency at 75 deg. C. | | |
| | a) Unity P.F. | | |
| | 1) 125% load | % | |
| | 2) 100% load | % | |
| | 3) 75% load | % | |
| | 4) 50% load | % | |
| | 5) 25% load | % | |
| | b) 0.8 P.F. | | |
| | 1) 125% load | % | |
| | 2) 100% load | % | |
| | 3) 75% load | % | |
| | 4) 50% load | % | |
| | 5) 25% load | % | |
| 16 | Regulation at | | |
| | a) Unity P.F. | | |

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| | | | |
|------|--|----------------------------|--|
| | b) 0.8 P.F. at 75 deg. C. | | |
| 17 | CORE | CRGO/ Amorphous | |
| i | Core Grade | | |
| ii | Core diameter | mm | |
| iii | Gross Core area | Mtr ² | |
| iv | Net Core area | Mtr ² | |
| v | Flux density | Wb/Mtr ² | |
| vi | Wt. of Core | Kg | |
| vii | Loss per kg. of Core at the specified Flux density | Watts | |
| viii | Core window height | mm | |
| ix | Centre to centre distance of the core | mm | |
| x | The nominal flux density at | | |
| | a) 100% rated voltage | ≤ 1.69 Wb/Mtr ² | |
| | b) 112.5% of rated voltage | ≤ 1.9 Wb/Mtr ² | |
| xi | % No load current of full load current at rated voltage and frequency on the secondary and Increase of voltage by 112.5% | | |
| | (i) CRGO Core: at 100% and 112.5% of rated Voltage | | |
| | a) Up to 200 KVA Transformer | ≤ 3% and ≤ 6 % | |
| | b) Above 200 KVA Transformer | ≤ 2% and ≤ 5 % | |
| | (ii) Amorphous Core: at 100% and 112.5% of rated Voltage | | |
| | a) All Ratings | ≤ 2% and ≤ 5 % | |
| 18 | WINDINGS | Aluminium / Copper | |
| i | No. of L.V. Turns | No. | |
| ii | No. of H V turns | No. | |
| iii | Size of LV Conductor bare/ covered | mm | |
| iv | Size of HV conductor bare/covered | mm | |
| v | No. of parallels | No. | |
| vi | Resistance of HV winding at 20 deg. C | Ohm | |
| vii | Resistance of LV winding at 20 deg. C | Ohm | |

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| | | | |
|-------|--|-------------|--|
| viii | Current density of LV winding | Amps/sq.mm. | |
| ix | Current density of HV winding | Amps/sq.mm. | |
| x | Wt. of the LV winding for Transformer | kg. | |
| xi | Wt. of the HV winding for Transformer | kg. | |
| xii | No. of LV Coils/phase | No. | |
| xiii | No. of HV coils / phase | No. | |
| xiv | Height of LV Windings | mm | |
| xv | Height of HV winding | mm | |
| xvi | ID/OD of LV winding | mm | |
| xvii | ID/OD of HV winding | mm | |
| xviii | Size of the duct in LV winding | mm | |
| xix | Size of the duct in HV winding | mm | |
| xx | Size of the duct between HV & LV | mm | |
| xxi | Inter layer insulation provided in design for | | |
| | 1) Top & bottom layer | | |
| | 2) In between all layer | | |
| | 3) Details of end insulation | | |
| | 4) Whether wedges are provided at 50% turns of | | |
| | the HV coil | | |
| xxii | Insulation materials provided | | |
| | a) For Conductors | | |
| | (1) HV | | |
| | (2) LV | | |
| | B) For Core | | |
| xxiii | Material and Size of the wire used | | |
| | 1) HV a) SWG | No. | |
| | b) Dia. | mm | |
| | 2) LV a) Strip size | mm X mm | |
| | b) No. of Conductors in parallel | No | |
| | c) Total area of cross section | sq.mm. | |
| 19 | Weight content of | | |

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| | | | |
|----|--------------------------------------|--------------|--|
| | a) Core lamination (min) | KG | |
| | b) Windings (min) Aluminium/Copper | KG | |
| | c) Tank & Fittings | KG | |
| | d) Oil | KG | |
| | e) Oil qty (min) | Litre | |
| | f) Total Weight | KG | |
| 20 | Oil Data | | |
| | 1. Qty for first filling (min) | Litre | |
| | 2. Grade of oil used | | |
| | 3. Maker's name | | |
| | 4. BDV at the time of filling | KV | |
| 21 | Transformer | | |
| | 1) Overall length x breadth x height | mm X mm X mm | |
| | 2) Shape of Tank | | |
| | 2) Tank length x breadth x height | mm X mm X mm | |
| | 3) Thickness of plates for | | |
| | a) Side plate (min) | mm | |
| | b) Top & Bottom plate (min) | mm | |
| | 4) Conservator Dimensions | mm X mm | |
| | 5) Tank base channel dimensions | mm X mm X mm | |
| 22 | HV Bushings & Terminals | | |
| | 1) Make of HV bushing | | |
| | 2) Rating in KV | KV | |
| | 3) Turret Height | mm | |
| | 4) Material of HV terminal | Brass/Copper | |
| | 5) Current Density of HV terminal | Amps/sq.mm. | |
| 23 | LV Bushings & Terminals | | |
| | 1) Make of LV bushing | | |
| | 2) Rating in KV | KV | |
| | 3) Turret Height | mm | |
| | 4) Material of LV terminal | Brass/Copper | |
| | 5) Current Density of LV terminal | Amps/sq.mm. | |

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| | | | |
|----|---|--------|--|
| 24 | Details of MCCB (for transformers having rating upto 25 KVA) | | |
| | Make | | |
| | Rated thermal current | Amp. | |
| | Current setting | Amp. | |
| | Minimum short circuit breaking current | KA | |
| 25 | Radiation | | |
| | 1) Heat dissipation by tank walls exclusive top & bottom | | |
| | 2) Heat dissipation by cooling tube | | |
| | 3) Dia. & 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. | Yes/No | |
| 26 | Whether the name plate gives all particulars as required in Tender | Yes/No | |
| 27 | Whether the transformer offered is already type tested for the design and test reports enclosed | Yes/No | |

| Digit/letter No. | Details | TIN | Remark |
|------------------|-----------------------|-----|---|
| 1 | Name of Company | M | First letter of DISCOM name |
| 2 | KVA rating | 5 | for 5/10/16/25/63/100/200/500/315 KVA ratings digits will be respectively 1/2/3/4/5/6/7/8/9 |
| 3 | Type of Core Material | 1 | CRGO-1, Amorphous-2 |
| 4 | Core construction | 1 | Stack-1, Wound-2 |
| 5 | | 1 | each supplier will be given 2digit code |

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PASCHIM GUJARAT VIJ COMPANY LIMITED

Regd. & Corporate Office : Nana Mava Main Road, Laxminagar : Rajkot : 360004
 CIN U40102GJ2003SGC042908 Phone No: (0281) 2380425 Fax : (0281) 2380428 Website: www.pgvccl.com

| | | | |
|----|---|---|---|
| 6 | Supplier NameCode | 5 | no. e.g.M/s XYZ given code no.15 |
| 7 | Month of manufacturing | 0 | 2 digits for Month of manufacturing |
| 8 | | 2 | |
| 9 | Year of manufacturing | 1 | 2 digits for Year of manufacturing |
| 10 | | 7 | |
| 11 | TenderNo. | 9 | 4 digits for CPP tender no. |
| 12 | | 0 | |
| 13 | | 3 | |
| 14 | | 2 | |
| 15 | Sr. No. of transformergiven by Supplier | 0 | 5 digits for transformer sr. no.given by supplier (e.g. M/s XYZ will give transformer sr. no. from 00001 to 00260 for P.O. of 260 no. transformers issued to them videCPP tender no.9032) |
| 16 | | 0 | |
| 17 | | 0 | |
| 18 | | 0 | |
| 19 | | 1 | |

All the parameters of Technical Specifications, GTP and Drawings for items utilized in this project shall be as per relevant IS and latest amendments thereof.

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GI Earthing Pipe

Earthing pipe should be made of 40 mm diameter ISI marked B class GI Pipe. 12 mm dia suitable holes on its circumference shall be made as per approved drawing. The pipe should be in one piece. No joints or welding would be allowed on its length. Clamps made of 50x6mm GI flat duly drilled with 12 mm size holes should be welded at the top end for connection of earth conductor.

Pipe used shall be 40mm NB diameter, ISI marked Galvanized Mild Steel Tubes continuously welded Electric Resistance Welded ERW/High Frequency Induction welded (HFIW)/Hot finished welded (HFW) type, conforming to IS-554-1985 with latest amendment of MEDIUM quality (Class B).

1. MANUFACTURE:

GI earth pipe (40 mm diameter & 3 metre long) shall be made of tubes which shall be made from tested quality steel manufactured by any approved process as follows:

- a) Electric Resistance Welded (ERW).
- b) High Frequency Induction Welded (HFIW) and
- c) Hot finished Welded (HFW).

Tubes made by manual welding are not acceptable.

2. DIMENSIONS:

The dimensions and weights of tubes shall be in accordance with Table-I and Table-II of IS: 1239 (Part-I)/1990 with latest amendments, subject to tolerance permitted therein. Necessary 12 mm diameter holes across the circumference shall be provided as per approved drawing. Drawings shall be approved by the owner before start of the manufacturing work. The tube, earthing pipe shall be provided with 50x6mm GS clamps on one end, one clamp is to be welded with the pipe and another is removable to enable measurement of earth resistance of the pit. Other end of the earth pipe should be cut half in slop to make it a sharp.

3. GALVANIZING:

Tubes shall be galvanized in accordance with IS-4736-1986 with latest amendment for not dip zinc coating of Mild Steel Tubes. The minimum mass of zinc coating on the tubes shall

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be in accordance with clause 5.1 of IS-4736-1986 (specification for hot dip zinc) and when determined on a 100mm long test piece in accordance with IS: 6745:1972 shall be 400 g/m². The zinc coating shall be uniform adherent reasonably smooth and free from such imperfections as flux, ash and dross inclusions, bare patches, black spots, pimples, lumpiness, rust, stains, bulky white deposits and blisters.

4. HYDRAULIC TEST:

(Before applying holes) Each tube shall withstand a test pressure of 5 M Pa maintained for at least 3 seconds without showing defects of any kind. The pressure shall be applied by approved means and maintained sufficiently long for proof and inspection. The testing apparatus shall be fitted with an accurate pressure indicator

5. TEST ON FINISHED TUBES AND SOCKETS:

The following tests shall be conducted by the manufacturer of finished tubes and sockets.

- a) The tensile strength of length of strip cut from selected tubes when tested in accordance with IS-1894-1972, (Method for tensile testing of steel tubes), shall be at least 320N/mm².
- b) The elongation percentage on a gauge length of 5.65/so (where so is the original cross-sectional area of test specimen) shall not be less than 20%.
- c) When tested in accordance with IS-2329-1985 (Method for Bend test on Metallic tubes) the finished tube shall be capable of with standing the bend test without showing any sign of fracture or failure. Welded tubes shall be bent with the weld at 90 degree to the plane of bending. The tubes shall not be filled for this test.
- d) Galvanized tubes shall be capable of being bent cold without cracking of the steel, through 90 degree round a former having a radius at the bottom of the groove equal to 8 times the outside diameter of tube.
- e) Flattening Test on Tubes above 50 mm Nominal Bore: Rings not less than 40 mm in length cut from the ends of selected tubes shall be flattered between parallel plates with the weld, if any, at 90 degree (point of maximum bending) in accordance with IS-2328-1983. No opening should occur by fracture in the weld unless the distance between the

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plate is less than 75 percent of the original outside diameter of the pipe and no cracks or breaks in the metal elsewhere than in the weld shall occur, unless the distance between the plates is less than 60% of the original outside diameter. The test rings may have the inner and outer edges rounded.

f) **GALVANISHING TEST:**

- **Weight of zinc Coating:** For tubes thickness upto 6 mm the minimum weight of zinc coating, when determined on a 100 mm long test piece in accordance with IS-4736-1986 shall be 400 gm/m².
- The weight of the coating expressed in gram/m² shall be calculated by dividing the total weight of the zinc (inside plus outside) by the total area (inside plus outside) of the coated surface.
- Test specimen for this test shall be cut approximately 100 mm in length from opposite ends of the length of tubes selected for testing. Before cutting the test specimen, 50 mm from both ends of the samples shall be discarded.

g) **Free Bore Test:** A rod 230mm long and of appropriate diameter shall be passed through relevant nominal bore of the sample tubes to ensure a free bore.

h) **Uniformity of Galvanized Coating:** The galvanized coating when determined on a 100 mm long test piece [see V (a) (iii)] in accordance with IS-2633-1986 (Method for testing uniformity of coating on zinc coated articles) shall with stand 4 one minute dips.

6. WORKMANSHIP:

The tubes shall be cleanly finished and reasonably free from injurious defects. They shall be reasonably straight, free from cracks, surface flaws, laminations, and other defects, both internally and externally. The screw tubes and sockets shall be clean and well-cut. The ends shall be cut cleanly and square with the axis of tube.

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7. MARKING:

The medium class of tubes shall be distinguished by Blue colour bands which shall be applied before the tubes leaves the manufacturers' works. Tubes shall be marked with the standard mark.

Cables Tags and Markers

Each cable and conduit run shall be tagged with numbers that appear in the cables and conduit schedule.

The tag shall be of aluminum with the number punched on it and securely attached to the cable conduit by not less than two turns of 20 SWG GI wire conforming to IS: 280. Cable tags shall be of rectangular shape for power cables and of circular shape for control cables. Location of cables laid directly underground shall be clearly indicated with cable marker made of galvanized iron plate.

Location of underground cable joints shall be indicated with cable marker with an additional inscription "Cable Joint".

The marker shall project 150 mm above ground and shall be spaced at analysis interval 30 meters and at every change in direction. They shall also be located on both sides of road and drain crossings.

Cable tags shall be provided on all cables at each end (just before entering the equipment enclosure), on both sides of a wall or floor crossing and on each duct/ conduit entry. Cable tags shall be provided inside the switchgear, motor control centers, control and relay panels, etc., wherever required for cable identification, such as where a number of cables enter together through a gland plate.

The price of cable tags and markers shall be included in the installation rates for cables/ conduits quoted by the contractor.

Specific requirements for cabling for cabling, wiring, ferrules as covered in respective equipment section shall also be complied with.

CABLE GLANDS

Double compression type cable glands shall be provided by the Contractor for all power and control cables to provide dust and weather proof termination. Required number of packing glands to close unused openings in gland plates shall also be provided.

CABLE LUGS

Solderless crimping of terminals shall be done by using corrosion inhibitory compound. The cable lugs shall suit the type of terminals provided. Crimping tool used shall be of approved design and make.

Storage and handling of cable drums

Cable drums shall be unloaded, handled and stored in an approved manner. Rolling of drums shall be avoided as far as practicable. For short distances, the drums may be rolled provided they are rolled slowly and in proper direction as marked on the drum. In absence

of any indication the drums may be rolled in the same direction it was rolled during taking up the cables.

CABLE SUPPORTS AND CABLE TRAY MOUNTING ARRANGEMENTS

Cable trenches in the control room are normally provided with embedded steel inserts on concrete floors/ walls. The Contractor shall secure supports by welding to these inserts or available building steel structures.

Insert plates will be provided at an interval of 600 mm wherever cables are to be supported without the use of cable trays, while at all other places these will be at an interval of 2000 mm.

CABLE TERMINATIONS AND CONNECTIONS

The termination and connection of cables shall be done strictly in accordance with cable and termination kit manufacturer's instructions, drawing and/ or as directed by the Owner.

The work shall include all clamping, fittings, fixing, plumbing, soldering, drilling, cutting, taping, heat shrinking (where applicable), connecting to cable terminal, shorting and grounding as required to complete the job.

The equipment will be generally provided with un-drilled gland plates for cables/ conduit entry. The Contractor shall be responsible for drilling of gland plates, painting, and touching up. Holes shall not be made by gas cutting.

The Contractor shall tag/ferrule the control cable cores at all terminations, as instructed by the Owner. In panels where a large number of cables are to be terminated and cable identification may be difficult, each core ferrule may include the complete cable number as well. Spare cores shall be similarly tagged with cable numbers and coiled up.

Control cables shall have stranded copper conductor. Bare portion of the solid conductors shall be tinned after removing the insulation and shall be terminated directly without using cable lugs.

All cable entry points shall be sealed and made vermin and dust proof. Unused openings shall be effectively closed.

If the cable-end box or terminal enclosure provided on the equipment is found unsuitable and requires modification, the same shall be carried out by the Contractor with the approval of the Owner.

DIRECTLY BURIED CABLES

The Contractor shall construct the cable trenches required for directly buried cables. The scope of work and unit rates for construction of cable trenches for cables shall include excavation, preparation of sand bedding, soil cover, supply and installation of brick or

concrete protective cover, back filling and reaming, supply and installation of route markers and joint markers. The Contractor/Supplier shall ascertain the soil conditions prevailing at site, before quoting the unit rates. Laying the cable and providing protective covering shall be as per approved drawing.

Installation of cables

Power and control cables shall be laid in separate tiers. The order of laying of various cables shall be as follows:

- Power cables on top tiers.
- Control, instrumentation and other service cables in bottom tiers.

Single core cable in trefoil formation shall be laid with a distance of three times the diameter of cables between trefoil center lines. All power cables shall be laid with a minimum center to center distance equal to twice the diameter of the cable.

Power and control cables shall be securely fixed to the trays/ supports. Trefoil clamps for single core cables shall be pressure die-cast aluminum (LM-6). Nylon-6 or fiber glass and shall include necessary fixing nuts, bolts, washer, etc. These are required at every 2 meter of cable run. Vertical and inclined cable runs shall be secured with 25 mm wide and 2 mm thick aluminum strip clamps at every 2 m Horizontal runs in cable trays and trenches shall be secured using 4 mm nylon cord at every 2 m.

Cables shall not be bent below the minimum permissible limit. The minimum bending radius of power cables shall be 12D and that of control cables shall be 10D, where D is overall diameter of cable.

Where cables cross roads, drains and rail tracks, the cables shall be laid in reinforced spun concrete or steel pipes, buried at not less than one meter depth.

In each cable run some extra length shall be kept at a suitable point to enable one (for LT Cables) or two (for H.T. cables) straight through joints to be made, should the cable develop fault at a later date.

Selection of cable drums for each run shall be so planned as to avoid using straight through joints. Cable splices will not be permitted except where called for by the drawings, unavoidable or where permitted by the Owner.

Control cable terminations inside equipment enclosures shall have sufficient lengths so that switching of termination in terminal blocks can be done without requiring any splicing.

Metal screen and armour of the cable shall be bonded to the earthing system of the station, wherever required.

Rollers shall be used at intervals of about 2.0 meters, while pulling cables.

All due care shall be taken during unreeling, laying and termination of cable to avoid damage due to twist, kink, sharp bends, etc.

Cable ends shall be kept sealed to prevent damage.

Inspection on receipt, unloading and handling of cables shall generally be in accordance with IS:1255 and other Indian Standard codes or practices.

Wherever cables pass through floor or through wall openings or other partitions, wall sleeves with bushes having a smooth curved internal surface so as not to damage the cables shall be supplied, installed and properly sealed at no extra charges.

The erection work shall be carried out in a neat workmanlike manner and the areas of work shall be cleaned of all scrap materials after the completion of work in each area every day. Contractor shall remove the RCC/steel trench covers before taking up the work and shall replace all the trench covers after the erection work in that particular area is completed or when further work is not likely to be taken up for some time.

Contractor shall furnish three copies of the report on work carried out in a particular week, such as cable numbers and a date on which laid, actual length and route, testing carried out, terminations carried out, along with the marked up copy of the cable schedule and interconnection drawing wherever the modifications are made.

In case the outer sheath of a cable is damaged during handling/ installation, the Contractor shall repair it at his own cost, and to the satisfaction of the Engineer-in- Charge. In case any other part of a cable is damaged, the same shall be replaced by a healthy cable, at no extra cost i.e. the Contractor shall not be paid for supply, installation and removal of the damaged cable.

All cable terminations shall be appropriately tightened to ensure secure and reliable connections. The Contractor shall cover the exposed part of all cable lugs whether supplied by him or not with insulating type, sleeve or paint.

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**Triple Pole Switch Fuse Units with Neutral Links
(200A, 320A & 400A/415 VOLTS RATINGS)**

This specification covers manufacture, testing before dispatch and delivery of Triple Pole Switch Fuse Units with neutral Link and HRC cartridge type fuses suitable for AC 3 Phase 4 wire 415 V with neutral solidly grounded system. The working conditions and technical requirements are as under:-

TECHNICAL REQUIREMENTS

- a) Rated Current : 200 Amps, 320 Amps & 400 Amps
- b) I) Rated Operational Voltage : 3 Phase 4 Wire, 415 Volts AC 50 Hz with solidly earthed neutral
- II) Highest System Voltage : 415V + 10%
- c) Type of Fuse to be used : Non-deteriorating quick arcing type ISI marked
- HRC Cartridge fuse Links suitable for Class-1
- category of duty of IS:13703(Part-I). The temperature rise shall be in accordance with
- IS:13703 (Part-I) (with latest amendments)
- over and above the ambient temperature of 45°C. It shall be used for protecting the
- distribution circuits and distribution transformers
- and shall be capable of carrying continuously
- the above stated rated current safely.

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- d) Number of Poles : Three
- e) Neutral Link : One
- f) Duty : Un-interrupted duty
- g) Rated fused short circuit : 40KA for 1 second.
withstands current
capacity at 415V
- h) Utilization category as : AC-23 (B) as defined in IS: 13947
(Pt-III)/ 1993

Busbar Material- Aluminium

GENERAL

1. CONTACTS AND BLADES & OPERATING MECHANISM

The switch shall be a combination of double beak per pole AB switch with HRC fuses in all the three phases. The switch shall be spring assisted, quick make and quick break type having operating mechanism independent of the speed of the operator to minimize the aging. If required, additional contact springs shall be provided to maintain correct contact pressures throughout operating life of the switches. The switch shall be so constructed that the alignment of its contacts & blades, which will be made of silver plated electrolytic copper/tinned copper, is maintained under asymmetrical fault conditions also. The tenders should furnish in their offers about the details of switching mechanism and the contacts. The switch shall have positive break feature such that it is possible to make it OFF even if the quick action spring fails due to ageing or other causes. The switch fuse unit shall be provided with double break per pole to ensure complete isolation of HRC Fuses from both incoming and outgoing circuits when the switch is in OFF position, in order to minimize the damage to the maintenance personnel. Ample flash over distances shall be provided so as to make the unit suitable for controlling highly inductive loads.

2. ENCLOSURES

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The Triple Pole Switch fuse units shall be totally enclosed in robust enclosures made out of 16 guage/1.5 mm pressed steel sheet (conforming to relevant ISS for M.S. sheet) designed to withstand humid and hot weather conditions. The enclosures should have adequate strength and rigidity to withstand rough usage without fracture or permanent distortion. Suitable mounting arrangement shall be provided on the enclosures for mounting the units on a supporting structure.

3. INTER LOCK

It should not be possible to open the switch cover when the switch is in 'ON' position and also it should not be possible to operate the switch 'ON' when the switch cover is open.

4. PAINTING

The inside and outside of the enclosure should be painted with a grey paint. Before painting the surface, the same should be chemically cleaned for removing rust, grease etc. Then it should be given phosphate coating, followed by two coats of anti-rust primer (i.e. Red zinc Chrome Primer), after which two coats of synthetic paint of light grey colour shall be applied on internal and external surfaces of the enclosures with a spray gun. The enclosures shall then be baked in oven so as to give an elegant and durable finish.

5. EARTHING

The enclosure shall be provided with earthing arrangements at two places.

6. TERMINAL CONNECTIONS

The switch shall be provided with aluminium lugs for termination of PVC coated aluminium cables of following sizes: -

| S.No | Capacity of TPN Switches | Size of Cable | No. of cable sockets required |
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| 1 | 200 Amps | 150 sq.mm. 3.5 Core stranded aluminium cable | 8 Nos. (3 Nos. phase leads and 1 natural lead for incoming and also 3 Nos. phase leads and 1 neutral for outgoing connections) |
| 2 | 320 Amps | 300 sq.mm. 3.5 Core stranded aluminium cable | -do- |
| 3 | 400 Amps | 300 sq.mm. 3.5 Core stranded aluminium cable | -do- |

7. All the surface contacts (e.g. lugs, connectors, fixed contacts, moving contacts etc.) should be fitted with GI nuts & bolts having yellowish OR whitish passivation with good finish.

8. TESTING & TEST CERTIFICATES FOR SWITCHES

The performance of the switch should conform to IS:10027/1981 with latest amendments. Accordingly, certificates from reputed laboratories such as CPRI, ERDA, IITs, for the type tests in accordance with IS:10027/1981 with latest amendment would necessarily be furnished by the tenderers along with offer.

9. USE OF ISI MARK HRC FUSES

The HRC Fuses with ISI mark only should be used. These HRC fuses should conform to IS:13703 (Part-I)/1993 or as per its latest revision. The rated current of HRC fuses must be 200 Amps for 200 Amps Switches, 315 Amps for 320 Amps Switches and 400 Amps for 400 Amps Switches.

10. IMPORTANT NOTE

The firms must consider supply of 'ISI' certificate (valid on date) products on their offer in the tender, Other certification such as ISO:9001 & 9002 shall be given due

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weightage while considering their offer, however, the attested photo copies of such certification must be enclosed with the offer.

11. INSULATION FOR LIVE PARTS

All live parts shall be fully shielded with bakelite shrouds.

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Technical Specification of HDPE DWC Pipe

1 Scope

This Specification covers design, manufacturing, testing, packing, supply of DWC HDPE Pipe.

2 Service Conditions:

Equipment to be supplied against this specification shall be suitable for satisfactory continuous operation under the following tropical conditions.

- l) Maximum ambient temperature of air: 50°C
- m) Maximum temperature of air in shade: 4°C
- n) Maximum daily average ambient temperature: 40°C
- o) Maximum yearly average ambient temperature: 30°C
- p) Relative Humidity: up to 95%
- q) Average number of thunder storm days per annum: 15
- r) Maximum annual Rainfall: 150cm
- s) Maximum Altitude above mean sea level: 1000Meter
- t) Maximum Wind Pressure: 150 Kg/cm² (As per IS 802 latest code)
- u) Maximum soil temperature at cable depth: 30°C
- v) Maximum soil thermal resistivity: 150°C cm/watt

3 Technical Parameters:

- (a) DWC high density Polyethylene pipe shall have corrugation on outer wall but inner wall shall be plain conforming to IS – 14930 Part I and II amended from time to time.
- (b) Terminology as defined in IS: 14930 shall be followed
- (c) DWC HDPE pipe to be supplied shall be 'ISI' marked.
- (d) Accessories like HDPE snap fit coupler with neoprene 'O' ring shall be part of supply to make the joints water / damp proof.

4 Code & Standards:

All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those (IS: Codes, standards, etc.) referred to herein, the former shall prevail.

- a) IS:14930Pt.-I: General requirements of Conduit System for Electrical and Communication installation
- b) IS:14930Pt.-II: Particular requirements of Conduit system for Electrical and Communication installation
- c) IS: 2530: Method for test for Polyethylene moulding material and polyethylene compounds.
- d) IS:7328: HDPE materials for moulding and extrusion
- e) IS:12063 : Classification of degrees of protection provided by Enclosures of electrical equipment

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- f) ASTM D 1693: Test method for environmental stress–Cracking of ethylene plastics
- g) ASTM D 638: Standard test method for tensile properties of plastic
- h) ASTM D 790: Test method for flexural properties of Un-reinforced and Reinforced Plastics and Electrical Insulating Materials.
- i) ASTM D 2240: Standard Test method for Rubber property.
- j) ASTM D 648: Standard Test method for deflection temperature of Plastic under flexure load in the Edge Wise Position.
- k) IS:11000(Pt-2): Glow-wire Test and guidance test methods for fire /Sec-1) Hazard Testing.

5 General Requirement:

General:

- i. The DWC HDPE pipe shall consist of two layers, the outer layer will be corrugated and the inner layer shall be plain and smooth.
- ii. DWC HDPE pipe shall be so designed and constructed that in normal use their performance is reliable and without danger to the user or surroundings.
- iii. When assembled in accordance with manufacturer's instruction as part of a conduit system, they shall provide mechanical protection to Signaling Cables' on tainted therein.
- iv. Within the conduit system there shall be no hardedge, burrs or surface projections which are likely to damage insulated conductors or cables or inflict injury to the installer or user.
- v. The protective properties of the joint between conduit and conduit fittings shall be not less than that declared for the conduit system.
- vi. The DWC HDPE pipe and fittings shall withstand the stresses likely to occur during transport, storage, recommended installation and application.
- vii. The DWC HDPE pipe shall be supplied in continuous length in coil for more straight length, suitable for shipping and handling purpose.
- viii. For conduit systems that are assembled by means other than threads, the manufacturer shall indicate whether the system can be disassembled and if so, how this can be achieved.

REQUIREMENTS OF RAW MATERIALS USED FOR THE DWC HDPE PIPE

- i. The base HDPE resin used for the outer and inner layer of the DWCHDPE Pipe shall conform to any designation of IS: 7328 or to any equivalent standard meeting the requirements given in Table No.1, when tested as per the standards given therein. However, the manufacturers shall furnish the designation for the HDPE resin as per IS: 7328 as applicable.
- ii. The anti-oxidants used shall be physiologically harmless.
- iii. None of the additives shall be used separately or together in quantities as to impair long term physical and chemical properties of the duct.

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- iv. Single pass rework material of the same composition produced from the manufacturer's own production may be used and it shall not exceed 10% in any case.
- v. The raw material used for extrusion shall be dried to bring the moisture content to less than 0.1%.
- vi. Suitable UV stabilizers shall be used only for manufacture of the nonblack colored HDPE duct to protect against UV degradation, when stored in open for minimum 8 months' period. The purchaser may ask for UV content test. The test result for UV Content test by FTIR method from any recognized laboratory shall be accepted and the Hindered Amine Light Stabilizer shall be minimum 0.15 %. UV Content test need not to be conducted in case of UV Stabilized raw material is used.

REQUIREMENT OF DWC HDPE PIPE

- i. Visual Requirement: The Pipe shall be checked visually for ensuring good workmanship that the ducts shall be free from holes, breaks and other defects. The ends shall be cleanly cut and shall be square with axis of the ducts.
- ii. Colour: The colour of the pipe viz. Green, Orange, Blue, Yellow, Brown, Violet, Grey and Red. The purchaser shall specify the colour of the duct at the time of ordering.
- iii. Dimensions: The dimensions of the DWC HDPE pipe shall be as per requirement / BOQ.
- iv. Standards Length: Duct up to 50 mm OD nominal size shall be supplied in standard length of 100 mtr. $\pm 1\%$ or 6 mtr $\pm 1\%$ and all other sizes will be supplied in standard length of 6 mtr. $\pm 1\%$
- v. Compression Strength: The conduit system shall have adequate mechanical strength. Conduits when bent or compressed either during, or after, installation according to manufacturer's instructions, shall not crack and shall not be deformed to such an extent that introduction of the insulated conductors or cables becomes difficult or that the installed insulated conductors, or cables are likely to be damaged while being drawn in. Compliance may be checked with the application of force which shall be at least 450 N, when reaching the deflection of 5%.
- vi. Impact Strength: The conduit system shall have adequate mechanical strength.
- vii. Conduits when exposed to impact either during, or after, installation according to manufacturer's instructions, shall not crack and shall not be deformed to such an extent that introduction of the insulated conductors or cables becomes difficult or that the installed insulated conductors, or cables are likely to be damaged while being drawn in. Compliance may be checked by ensuring there shall be no crack allowing the ingress of light or water between the inside and outside after the test.
- viii. Bending Strength: The conduit system shall have adequate mechanical strength. Conduits when bend either during, or after, installation according to manufacturer's instructions, shall not crack and shall not be deformed to such an extent that introduction of the insulated conductors or cables becomes difficult or that the installed insulated conductors, or cables are likely to be damaged while being drawn in. During the test sample shall not flatten Compliance shall be checked by passing a ball having a diameter equal to 95% minimum inner diameter of the sample

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- declared by the manufacturer, through the sample whilst it is bent around the test apparatus.
- ix. Oxidation Induction Test (OIT): The OIT in a qualitative assessment of the level (or degree) of stabilization of material.
 - x. Resistance to Flame Propagation: Non flame propagating ducts shall have adequate resistance to flame propagation. Samples of DWC HDPE Ducts shall be checked by applying a 1KW flame.
 - xi. Anti-Rodent Properties: Safety of ducts from the direct attack of subterranean organism anti rodent material is of utmost importance. These ducts shall be evaluated for their safety against rodents before laying them in the fields.
 - xii. Resistance to External Influences on DWC HDPE Duct Accessories: The accessories in Clause 11.5.4 shall be tested for external influences as per IS-12063 for ingress of dust & ingress of water. DWC Duct systems when assembled in accordance with the manufacturer's instructions shall have adequate resistance to external influences according to the classification declared by the manufacturer with a requirement of IP 67.
 - xiii. Marking Identification: The conduit shall be prominently marked at regular intervals along their length of preferably 1m but not longer than 3m using indelible ink with following.
 - Manufacturers name
 - Specification No.
 - Name of the duct with size
 - Lot No. of the Product
 - Date of manufacture
 - Product Length
 - Purchaser's Name/symbol

DWC HDPE PIPE ACCESSORIES

- i. The following accessories are required for jointing the ducts and shall be supplied along with the ducts against specific orders. The manufacturers shall provide complete procedure and method for installation of the accessories. The required quantities of accessories are to be mentioned by the purchasing authority in the purchase order.
 - a. Plastic Coupler:
The coupler shall be of Push-fit type with O-ring. It is used for jointing woor more ducts. The design of this shall be simple easy to install and shall provide air tight and water tight joint between the two ducts. The coupler shall insure that the two ducts are butted smoothly without any step formation in the inner surface. The coupler may be straight, bands, T-joints type as per requirements of purchaser.
 - b. End Cap:

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This cap made of suitable plastic material shall be fitted on the both ends of duct, coil after manufacturing the duct. This shall avoid entry of dust, mudandra in water in to the duct during the transit & storage.

Selection of pipe for different sizes Cables

Following guide of the pipe fill shall be used for sizing the pipe Size:

- a. 1 cable in pipe - 53% full
- b. 2 cable in pipe - 31% full
- c. 3 or more cables - 43% full
- d. 4 Multiple cables - 40% full

6 Tests

The following tests shall be carried out in accordance with IS or the latest version thereof:

a. TYPE TESTS

- i) Visual.
- ii) Requirement of Colour.
- iii) Dimension
- iv) Standard Length
- v) Compression Strength
- vi) Impact Strength
- vii) Bending Strength
- viii) Oxidation Induction Test
- ix) Resistance to Flame Propagation
- x) Anti-Rodent
- xi) Resistance to External influence on DWC HDPE Pipe

b. ACCEPTANCE TESTS

The following tests be carried out by the manufacturer after 240 hrs of manufacture:

- i) Visual Requirement
- ii) Requirement of Colour.
- iii) Dimension
- iv) Standard Length
- v) Compression Strength
- vi) Impact Strength
- vii) Bending Strength
- viii) Resistance to Flame Propagation

c. ROUTINETESTS

The following tests be carried out by the manufacturer after 240 hrs of manufacture:

- i) Visual Requirement
- ii) Requirement of Colour.
- iii) Dimension

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- iv) Standard Length
- v) Compression Strength
- vi) Impact Strength
- vii) Bending Strength
- viii) Resistance to Flame Propagation

7 Tests Procedure

a) COMPRESSION TEST

- i. Conduits are subjected to a compression test as per IS: 14930 (Pt-II). The tests for conduits shall not be rated until 240 hrs after manufacture.
- ii. Samples shall be 200 ± 5mm long.
- iii. Before the test the outside and inside diameters of the samples shall be as measures described in clause above.
- iv. The samples shall be compressed between two flat steel plates having minimum dimensions (100x200x15mm), the length 200mm being along the length of the sample. The sample shall be compressed at a rate of 15 ± 0.5mm/min and the load recorded at the vertical deflection equivalent to 5% of the average value of the original inside diameter of the sample.
- v. When reaching the deflection of 5 %, the applied force shall be at least 450N
- vi. After the test there shall be no crack allowing the ingress of light or water between the inside and the outside.
- vii. The deflection is calculated with the inner diameter but the measurement of the outside diameter may be sufficient. In case of doubt, it will be necessary to measure the inner diameter.

b) IMPACT TEST

- i. Twelve samples of the duct each 200 ± 5mm in length or fittings are subjected to an impact test as per IS: 14930 (Pt-II) by means of the apparatus shown Figure-1.
- ii. The test apparatus shall be placed on a firm flat surface. The samples shall be conditioned in a cold chamber at a temperature of -5 ± 1°C for 2h. The samples shall be removed from the cold chamber and placed on the vee block holder of the impact tester as shown in figure 1.
- iii. The striker shall fall once on each sample. The time between removal of the sample from the cold chamber and completion of impact shall not exceed 10 seconds. The impact height and mass shall be as follows.

| Nominal Size of Conduit | Mass of Striker | Fall Height (+0%/-1%)(mm) | Energy Joules |
|-------------------------|-----------------|---------------------------|---------------|
| Upto 60 mm | 5 | 300 | 15 |

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| | | | |
|------------|---|-----|----|
| 61to90 mm | 5 | 400 | 20 |
| 91to140 mm | 5 | 570 | 28 |
| Above140mm | 5 | 800 | 40 |

- iv. The test sample shall be made on the weakest part of the Duct fittings except that it shall not be applied within 5mm of any sample entry. Samples of ducts are tested on the center of their length.
- v. After the test, at least in nine of the samples, there shall be no crack allowing the ingress of light or water between the inside and the outside.

c) **BENDING TEST**

- i. This test shall be carried out on pliable conduits.
- ii. The test is made on six samples having an appropriate length as per IS: 14930 (Pt II). Three samples shall be tested at room temperature; the other three shall be tested at $-5 \pm 1^\circ\text{C}$. For the test at -5°C , the sample shall be conditioned in a cold chamber for 2 hours. The test apparatus as shown in Figure-2 shall allow bending the duct with a bending radius equal to the minimum bending radius values specified by the manufacturer. One of the ends of the samples shall be fixed. The sample is then bent to approximately 90 degrees (right angle) and held.
- iii. During the test, the sample shall not flatten. Compliance shall be checked by passing a ball having diameter equal to 95% minimum inner diameter of the sample declared by the manufacturer, through the sample whilst it is bent around the test apparatus.

d) **OXIDATION INDUCTION TEST PROCEDURE**

- i. A short length of completed duct (approximately 30cm) shall be sealed at the end and placed in an oven at temperature of $68 \pm 1^\circ\text{C}$ for 8 hours. The sample shall then be allowed to cool at room temperature for at least 16 hrs. The samples shall be clean and dry. The sample shall then be tested by means of a Differential Scanning Calorimeter (DSC) or by Differential Thermal Analyzer (DTA).
- ii. Instrument Test Procedure:
 - Cell Cleaning: The cell shall be held at approximately 400°C for 10 minutes in Nitrogen. The cell shall be cleaned after standing over night and between testing of different formulations.
 - Temperature Calibration: This has to be done according to the instrument manual. The temperature scale should be adjusted until the determined melting point of pure Indium metal is 156.6°C at a heat rate of 5°C per minute or any other heat rate as indicated in the manual of the equipment is permitted.
 - Aluminum Pan Preparation: Standard aluminum DSC pans as per ASTM D 4565 are required to hold specimens during testing. A fresh pan shall be used for each test.
 - Sample preparation: Take the sample weighing about 5mg from the duct

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- conditioned as indicated above. Position the sample in the center of the pan.
- Nitrogen Purge: Place the sample pan and reference pan in instrument cell. Flush for 5 minutes with cylinder of nitrogen (99.6%extra dry grade) at 60±10 cc per minute.
 - Oxidation Test: Rapidly increase the temperature of the sample (20°C/min or greater) from 100°C or lower initial temperature to 199±1°C. After thermal equilibrium is obtained (steady recorder signal) switch to 80±20cc per minute oxygen flow and simultaneously start time-base recording. The oxygen used for the test should be equivalent to or better than 99.6% extra dry grade.
 - Induction Period: The oxygen induction point shall be recorded as time zero, and the chart speed shall be sufficient to provide a clearly discernible loop at the start of the exothermic reaction. The test in the pure dry oxygen atmosphere shall continue until the exothermic peak is produced. The intersection of the tangent of the exothermic sloped line with the extended base line will be drawn. The time from time zero to intersection point is read from the base line and recorded as the oxidative induction time.

e) RESISTANCE OF LAME PROPAGATION TEST PROCEDURE

- i. Samples of DWC HDPE Ducts shall be checked by applying 1KW flame.
- ii. As sample of length 675±10 mm is mounted vertically in a rectangular metal enclosure with one open face, as shown in Figure-3-2 in an area substantially free from draughts. The general arrangement is shown in Figure-3 Mounting is by means of two metal clamps approximately 25mm wide spaced 550±10mm apart and approximately equal distance from the ends of the sample. A steel rod of 16±0.1 mm is passed through the sample. It is rigidly and independently mounted and clamped at upper end to maintain the sample in a straight and vertical position. The means of mounting is such as not to obstruct drops from falling on to the tissue paper. A suitable piece of white pine wood board, approximately 10 mm thick, covered with single layer of white tissue paper is positioned on the lower surface of the enclosure.
- iii. The assembly of sample, rod and clamping apparatus is mounted vertically in the center of the enclosure, the upper extremity of the lower clamp being 500±10mm above the internal allowed surface of the enclosure.
- iv. The burner is supported so that its axis is 45±20° to the vertical. The flame is applied to the samples that the distance from the top of the burner tube to the sample measured along the axis of the flame is 100±10mm and the axis of the flame intersects with the surface of the samples at a point 100±5 mm from the upper extremity of the lower clamp, and so that the axis of the flame intersects with the axis of the sample.

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v. The test is carried out on three samples. During the application of the flame, it shall not be moved except to remove it at the conclusion of the period of the test. After the conclusion of the test and after any burning of the sample has ceased, the surface of the sample is wiped clean by rubbing with a piece of cloth soaked with water.

vi. All three samples shall pass the test. If the sample is not ignited by the flame, it shall be deemed to have passed the test.

If the sample burns, or is consumed without burning, the sample shall be deemed to have passed the test if after burning has ceased, and after the sample has been wiped in accordance with 1.3 there is no evidence of burning or charring within 50mm of the lower extremity of the upper and also within 50mm of the upper extremity of the lower clamp.

If the sample burns, it shall be deemed to have failed the test if combustion is still in progress 30 seconds after removal of the flame.

If the tissue paper ignites, the sample shall be deemed to have failed the test. For the parts of the same below the burner, the presence of molten material on the internal or external surfaces shall not entail failure if the sample itself is not burned or charred.

vii. Compliance of DWC HDPE Duct fittings is checked by using the glow wire test IS: 11000 (Part 2/Sec 1). The glow wire shall be applied once to each sample in the most unfavorable position of its intended use, with the surface tested in vertical position, at a temperature of 750°C. The sample is deemed to have passed this test if there is no visible flame or sustained glowing or inflames or glowing extinguishes within 30 seconds after removal of the glow wire.

f) ANTI RODENT TEST PROCEDURE:

The test against rodent may be conducted as per following procedures:

The ducts are to be laid underground in fields and also near urban or rural settlements. Therefore, they should be exposed to 3-4 most predominant rodent species in habiting these locations. The test rodent species may include the lesser bandi cootrat, Bandi cotabengalensis, The Indian gerbils, tatera indica, the soft furred field rats, Millar diamelt ada and the house rats, Rattusrattus.

The test ducts should be exposed to the serodent species housed individually in iron mesh cages under laboratory conditions. Only freshly capture rodent are to be utilized for the study. The rodent sare first acclimatized in laboratory cages for 7-10 days and then the tests be initiated. For each trial, 3-4 rodents of uniform body weight are to be used for the trial. Two different types of testes may be under taken for all the ducts.

Choice Tests: In this trial the ducts of 15-30 cm length (ones ample each of treated and untreated/ control sample) are exposed to the test rodents along with food, thus the roden thada choice between the food and the test duct. This test may be run for longer periods (30-45 days). Tap water should be provided ad libitum to the rodents.

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NO Choice Test: The rodents are exposed to the test ducts only and no food is given to the rodents during the period of trial. The test ducts (one sample each of treated and untreated/control sample) are to be exposed to the test rodents. This trial may be run for 5-7 days depending upon the health status of starved test rodents. Tap water should be providing ad libitum to the rodents.

Observation on tooth marks, rodent behavior toward exposed ducts, and relative extent of damage in treated and untreated samples should be computed for both types of ducts. Health status of test animals in choice and no choice test must also be monitored for their cordancy effect of exposure of treated/ control ducts on these animals. Number of cases and the extent of rodent bites/scratch marks in control and anti-rodent treated ducts may indicate the relative deterrent/repellent properties of the test ducts.

GTP of HDPE DWC Pipe

| SR. | DESCRIPTION / PARAMETERS | OFFERED BY THE BIDDER |
|------------|--|------------------------------|
| 1 | Make | |
| 2 | Applicable Standard | |
| 3 | Grade | |
| 4 | Pressure rating (Kg/Sqcm.) | |
| 5 | Outside Diameter (mm) | |
| 6 | Inside Diameter (mm) | |
| 7 | Recommended For (Mention Maximum Armoured cable Type and Size) | |

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Erection Specification of LT Cabling Works

Scope :

This is defining the requirements for supply, wherever applicable the installation, testing and commissioning of the cabling system.

Standards:

The work shall be carried out in the best workmen like manner in conformity with this specification, the relevant specification and codes of practice of Indian standards institution, approved drawing and instruction of Engineer-in-charge or his authorized representative issued from time to time. In case of any conflict between the standards, the instructions of Engineer-in-charge shall be binding.

CABLE LAYING:

1.1 Cables as far as possible shall be laid in complete, uncut lengths from one termination to the other.

1.2 Cables shall be neatly arranged in the trenches in such a manner so that crossing is avoided and final takes off to the switchgear is facilitated. Arrangement of cables within the trenches shall be responsibility of the contractor. Cable routing between lined cable trench and equipment shall be taken through appropriate support arrangement.

1.3 All temporary ends of cables must be protected against dust and moisture to prevent damage to the insulation. For this purpose, ends of all XLPE insulated cables shall be taped with an approved XLPE or rubber insulation tape. Use of friction type or other fabric type tape is not permitted. Lead sheathed cables shall be plumbed with lead alloy.

1.4. Cables shall be handled carefully during installation to prevent mechanical injury to the cables. Ends of cables leaving trenches shall be coiled and provided with a protective pipe or cover, until such times the final termination to the equipment's is completed.

1.5. Directly buried cables, if required shall be laid underground in excavated cable trenches where specified. Trenches shall be of sufficient depth and width for accommodating of all cables correctly spaced and arranged with a view of heat dissipation and economy of design.

Minimum depth of buried cable trench shall be **750mm** for low voltage cables, the depth and the width of the trench shall vary depending upon the number of layers of cables as per Indian standard.

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1.6. As each row of cables is laid in place and before covering every cable shall be given an insulation test in the presence of Engineer-in-charge / PGVCL. Any cable, which proves defective, shall be replaced before the next groups of cables are laid.

All wall openings / pipe sleeves shall be effectively sealed after Installation of cables to avoid seepage of water inside building / lines trench.

1.7 Where cables rise from trenches to D.P. / S.S., MSP etc. they shall be taken in G.I. pipes / HDPE PVC pipe for mechanical protection up to a minimum permissible height. Cables ends shall be carefully pulled through the conduit, to prevent damaged to the cable. Where required, approved cable lubricant shall be used for this purpose. Where cable enters conduit the cable should be bent in large radius. Radius shall not be less than the recommended bending radius of the cables specified by the manufacture.

Following guide of the pipe fill shall be used for sizing the pipe Size:

1 cable in pipe - 53% full

2 cable in pipe - 31% full

3 or more cables - 43% full

4 Multiple cables - 40% full

After the cables are installed and all testing is complete, conduit Ends above grade shall be plugged with a suitable weatherproof Plastic compound / "PUTTI" for sealing purpose. Alternatively, G.I. Lids or XLPE bushes shall be deemed to have been included in the Cost for the same shall be deemed to have been included in the Installation of G.I. pipe and no separate payment shall be allowed.

1.8. Where cables pass through foundation walls or other underground structure, the necessary ducts or opening will be provided in advance for the same. However, should it become necessary to cut holes in existing foundations or structures. The electrical contractor shall determine their location and obtain approval of the Engineer-in-charge before cutting is done.

1.9. At road crossing / railway crossing and other places where cables enter pipe sleeves adequate bed of sand shall be given so that the cables do not slack and damaged by pipe ends.

1.10. Drum number of each cable from which it is taken shall be recorded against the cable number in cable schedule. Cables shall be so routed that they will not be subjected to heat from adjacent hot piping or vessels.

1.11. Cables installed above grade shall be run in trays, exposed on walls, ceilings or structures and shall be parallel or at right angles to beams, walls or columns.

1.12. In case of individual cables or small groups which run along structure / walls etc. will be clamped by means of 16 SWG GI saddles on 25*6 mm saddle bars. The cost of the saddle and saddle bars shall be deemed to have been included in the installation of

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cables and no separate payment shall be made on this account. Alternative small group of cables can be taken through 100 mm slotted channel / ISMC 100 / angle support. They shall be rightly supported on structural steel and masonry individual or in groups as required, if drilling of Steel must be resorted to, approval must be secured and steel must be drilled where the minimum weakening of the structure will result. Cables shall be supported so as to prevent unsightly sagging.

1.13. If required, Cable laid on supporting angle in cable trenches, structures, columns and vertical run of cable trays shall be suitably clamped by means of G.I. Saddle / clamps, whereas cable in horizontal run of cable trays shall be tied by mean of nylon cords.

1.14 The identification cable tag, having adequate size from 3 mm thick, 25 mm wide PVC strip, shall be placed on each cable at every 10 Mtrs intervals and at every cable joint locations. The Cable tag shall be tied by nylon string with cable. The tag shall be embossed by letter as stated below as applicable. In LT Cable- PSS Name/MSP Name

1.15 The XLPE Cable terminal ferrules for identification of phase sequence and feeder/PSS/MSP name of LT cables shall be provided at every termination of all cables stating detail as under. In LT Cable- PSS/MSP name/Phase(R/Y/B/N)

Testing:

2.1 Before energizing, the insulation resistance of every circuit shall be measured from phase to phase and from phase to ground.

2.2 Where splices or termination are required in circuit rates above 600volts, measure insulation resistance of each length of cable before splicing and or / terminating. Repeat measurements after splices and / or terminations are complete.

2.3 Measure the insulation resistance of directly buried cable circuits, before cable trenches are back-filled. Repeat measurement after back-filling.

For cables up to 1.1 KV grade 1000KV Megger and for H.V. Cables 2.5KV Megger shall be used.

2.4 D.C. High Voltage Test shall be conducted after installation on the following and test results are recorded as PGVCL format.

a (All 1000 volts grade cables in which straight through joints have been made.

b (All cables above 1.100 V grade.

For record purposes test date shall include the measure values of leakage current verses time. The D.C. High Voltage test shall be performed as detailed below in the presence of the Engineer-in-charge or his authorized representative only.

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Cable shall be installed in final position with the entire straight through joints complete. Termination shall be kept unfinished so that (if any) switchgears, transformers etc. are not subjected to test voltage.

The test voltage shall be 18KV DC for 1.1KV grade cables.