TECHNICAL SPECIFICATION
FOR
GAS INSULATED SWITCHGEAR
FOR
132/220 kV AC TRACTION SYSTEM OF
INDIAN RAILWAY

SPECIFICATION No. TI/SPC/PSI/HVGIS/0160

ISSUED BY

TRACTION INSTALLATION DIRECTORATE
RESEARCH DESIGNS & STANDARDS ORGANISATION
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LUCKNOW – 226 011

[Web site: www.rdso.indianrailways.gov.in]
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1.0 SCOPE OF THE SPECIFICATION

1.1 The Indian Railways employ 220/25 kV or 132/25 kV or 110/25 kV or 66/25 kV traction substation (TSS) for supplying power to the 25kV overhead lines for electric traction.

1.2 This specification covers the technical requirements for Indoor type Gas Insulated Switchgear for primary Side of Traction Power Transformer i.e. 220kV/132kV side at Traction Substation (TSS) complete with all accessories for trouble free and efficient performance including supply, design, manufacture, testing and installation & commissioning of SF₆ gas-insulated switchgear and associated equipment for use in Unattended/attended Railway Traction Sub- Stations in any part of India for controlling Power Supply to the 25kV a.c. 50 Hz Single Phase System for Traction Overhead Equipment (OHE).

1.3 The Gas Insulated Indoor switchgear shall be complete with all parts, fittings, accessories necessary for its efficient operation, including mounting frame work. All such parts, fittings and accessories shall be deemed to be within the scope of this specification, whether specifically Mentioned or not.

1.4 The Gas Insulated Indoor switchgear shall be installed by the Purchaser/Indian Railways. The Installation shall be carried in the supervisory (Presence) of the manufacturer. However, in case a defect / deficiency are noticed, the manufacturer will have to depute his Engineer for necessary remedial action without any cost to the Railways. In all the cases in which an order is placed either on new Manufacturer or for a new type/design of the Gas Insulated Indoor switchgear, the services of Manufacture’s Engineer shall be made available free of cost during the installation and proving/pre-commissioning test. For this purpose, prior intimation regarding the date and the location shall be given by the purchaser to the manufacturer.
SECTION 2
GOVERNING SPECIFICATIONS

2.1 The Gas Insulated switchgear shall, unless otherwise specified herein, conform to the latest revision of specifications/IEC as indicated below and the Indian Electricity Rules, wherever applicable.

<table>
<thead>
<tr>
<th></th>
<th>Standard/Code</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>1.</td>
<td>IEC 62271-200</td>
<td>High-voltage switchgear and control gear – Part 200: AC metal-enclosed switchgear and control gear for rated voltages above 1 kV and up to and including 52 kV</td>
</tr>
<tr>
<td>2.</td>
<td>IEC 62271-1</td>
<td>High-voltage switchgear and control gear – Part 1: Common specifications</td>
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<td>3.</td>
<td>IEC 62271-102</td>
<td>High-voltage switchgear and control gear – Part 102: Alternating current disconnectors and earthing switches</td>
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<td>4.</td>
<td>IEC 62271-100</td>
<td>High-voltage switchgear and control gear – Part 100: Alternating-current circuit-breakers</td>
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<td>5.</td>
<td>IEC 61869-1/61869-2</td>
<td>Current transformer</td>
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<td>6.</td>
<td>IEC 61869-1/61869-3</td>
<td>Voltage transformer</td>
</tr>
<tr>
<td>7.</td>
<td>IEC 61243-5</td>
<td>Voltage detection systems (VDS)</td>
</tr>
<tr>
<td>8.</td>
<td>IEC 60529</td>
<td>Degrees of protection provided by enclosures (IP Code)</td>
</tr>
<tr>
<td>9.</td>
<td>IEC 62271-203</td>
<td>Gas Insulated Metal enclosed switchgear for rated voltage above 52kV.</td>
</tr>
<tr>
<td>10.</td>
<td>IEC:60376</td>
<td>SF₆ Gas</td>
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<td>11.</td>
<td>IEC:61936-1</td>
<td>Installation</td>
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<td>12.</td>
<td>IS:1554 &amp; IS:694</td>
<td>Specification for PVC Insulated Electric Cables for working voltage up to including 11000 Volts.</td>
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<td>13.</td>
<td>EN 50525-3-41</td>
<td>For Wiring</td>
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<tr>
<td>14.</td>
<td>RDSO’s Specification no. TI/SPC/OHE/FASTNERS/0120</td>
<td>Specification for Steel and Stainless Steel Bolts, nuts and washers</td>
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2.2 Any deviation from this specification, proposed by the manufacturer for improving the performance, utility and efficiency of the equipment, will be given due consideration provided full particulars of the deviation with justification are furnished. In such case, the manufacturer shall quote according to this specification and the deviations, if any, proposed by him shall be quoted as alternate/alternatives.

2.3 In case of any overlapping or conflict between the contents of the above standards and this specification, the stipulation of this specification shall prevail.
SECTION 3

DESIGN CRITERIA / CONSIDERATION

The following aspects shall be kept in mind while designing the equipment for its better and efficient performance in field.

3.1 The switchgear assembly shall be suitable for indoor installation as specified in enclosed specification. Constructional features shall be selected not only to withstand satisfactorily the specified atmospheric conditions but allow for thermal expansion during its normal use, without any damage.

3.2 VIBRATIONS

The equipment are expected to be installed on foundation in the ground or on steel structures located by the side of Railway tracks and be subjected to vibrations due to the passage of trains. The amplitude of these vibrations which occur with rapidly varying time periods are in the range of 15ms to 70ms lie in the range of 30 to 150 microns at present, with the instantaneous peak going up to 350 microns.

3.3 OPERATING CONDITIONS:

The equipment shall be suitable for use in tropical climate and in areas subjected to heavy rainfall, pollution due to industrial and coastal climates and severe lightening surges in India.

| 1. Maximum ambient air temperature | 50°C |
| 2. Minimum ambient air temperature | 0°C |
| 3. Average ambient temperature over a period of 24 h | 40°C |
| 4. Maximum relative humidity | 100% |
| 5. Annual rainfall Ranging | Ranging between 1750mm & 6250mm |
| 6. Number of thunderstorm days per annum | 85(Max) |
| 7. Number of dust storm days per annum | 35(Max) |
| 8. Number of rainy days per annum | 120 days (Max) |
| 9. Altitude | Not exceeding 1000 Meters |

3.4 The switchgear and all its components and accessories shall be designed for minimum maintenance during service. The manufacturer shall state the minimum interval between minor inspections (which will be restricted to visual checking and adjustments of external parts only) and major inspection / overhaul, including refilling or replenishment of gas and cleaning of the contaminant or filter in the circuit breaker chamber(s). Viewing windows shall be provided in the circuit breaker, disconnect and grounding switch modules for inspection. The bearings and other such parts shall be permanently lubricated for the entire service life.

3.5 The number and position of expansion joints and flexible connections are to be determined by the GIS Manufacturer to ensure that the complete installation will not be subjected to any expansion stresses which could lead to distortion or premature failure of any component of the GIS equipment, support structures or foundations. The arrangement of assembly offered shall provide adequate access for operation, testing and maintenance of each bay.

3.6 The GIS normally operated through Remote Control. A single shot auto re-closing scheme shall be provided to facilitate the re-closing of the Circuit breaker automatically once within the preset “dead time” after the tripping of the Circuit breaker on an OHE faults. This feature helps in quick Restoration of Power Supply to the OHE, if the fault is of a transient Nature. The “Dead Time” is the period taken by the auto re-close Mechanism to close the Circuit breaker after the same has tripped on fault is set at 0.3 sec.

3.7 The Operating Mechanism shall also be provided with a suitable emergency device to manually open the Circuit Breaker in the failure of any part of dc control circuit including the opening coil in the Operating Mechanism.

3.8 The GIS shall be extendable to meet the requirement of additional bays in future.
### 4.1 ESSENTIAL TECHNICAL PARAMETER:

The GIS shall meet the following technical requirements.

<table>
<thead>
<tr>
<th>Electrical Data:</th>
<th>145 kV</th>
<th>245 kV</th>
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<tbody>
<tr>
<td>Rated system voltage</td>
<td>145 kV</td>
<td>245 kV</td>
</tr>
<tr>
<td>Rated operating voltage</td>
<td>132 kV</td>
<td>220kV</td>
</tr>
<tr>
<td>No of poles</td>
<td>Two / Three</td>
<td></td>
</tr>
<tr>
<td>Rated frequency [Hz]</td>
<td>50Hz ± 3%</td>
<td></td>
</tr>
<tr>
<td>Rated Normal Current at 50° C.</td>
<td>1600A</td>
<td>2000A</td>
</tr>
<tr>
<td>Rated power-frequency withstand voltage</td>
<td>275 kV rms</td>
<td>460kV rms</td>
</tr>
<tr>
<td>Rated lightning impulse withstand voltage</td>
<td>650 kV peak</td>
<td>1050 kV peak</td>
</tr>
<tr>
<td>Rated short-time withstand current</td>
<td>40 KA</td>
<td></td>
</tr>
<tr>
<td>Rated short-circuit duration</td>
<td>3 s</td>
<td></td>
</tr>
<tr>
<td>Rated breaking capacity (symmetrical)</td>
<td>5800 MVA (Two pole)</td>
<td>9800 MVA (Two pole)</td>
</tr>
<tr>
<td></td>
<td>10046 MVA (Three pole)</td>
<td>16974 MVA (Three pole)</td>
</tr>
<tr>
<td>Out of phase breaking current</td>
<td>10 ka (rms)</td>
<td></td>
</tr>
<tr>
<td>Rated single capacitor bank breaking current</td>
<td>400A</td>
<td></td>
</tr>
<tr>
<td>Rated line charging breaking current</td>
<td>50A</td>
<td>125 A</td>
</tr>
<tr>
<td>Rated small inductive breaking current</td>
<td>10A</td>
<td></td>
</tr>
<tr>
<td>Rated making current</td>
<td>100ka (peak)</td>
<td></td>
</tr>
<tr>
<td>Total break Time</td>
<td>Not more than 60ms</td>
<td></td>
</tr>
<tr>
<td>Rated operating sequence</td>
<td>O-0.3s-CO-3min-CO</td>
<td></td>
</tr>
<tr>
<td>First pole to clear factor</td>
<td>1.3 for 4 parameter</td>
<td></td>
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**Degree of Protection:**

- Main circuits: IP 65
- Drives: IP 4X
- Cable connection compartment: IP 31D
- Low voltage cabinet: IP 4X

**Auxiliary Voltage:**

- Control: 110 V DC, vary between 110% and 85% of the normal value
- Motor: 110 V DC
- Protection system: 110 V DC
- Remote control: 110 V DC
- Socket/lighting/heating: 230 V AC
5.1 GENERAL DESCRIPTION:

The existing Railway TSS layout is attached as Appendix-B. All the equipment in primary side of the Traction Power Transformer shall be covered by the GIS. The details of Items covered in each bay of SF6 Gas Insulated Switchgear assembly are as follows and their accessories specified in subsequent clauses.

a) Circuit Breakers (Double pole/Triple pole).

b) Disconnector & Ground Switches (Isolators).

c) Potential transformers.

d) Current transformers.

e) SF6 Surge Arrestor.

f) Terminations- Overhead line to indoor GIS via power cable and indoor GIS to Transformer bushing via power cable.

g) Local control panels and operating mechanism cabinets.

h) SF6 GIS Bus duct Indoor (where applicable).

5.2 The complete GIS module shall be covered the footprint area/ dimensions as. W=600mmXD=1800mmXH=2400mm to 2800mm.

5.3 A coloured diagram showing various gas compartments, piping, interconnections, valves, orifices and isolations to prevent current circulation, necessary controls and monitoring systems etc. together with normal and alarm ranges shall be provided in the drawing holder on the inside of each control cubicle for ease of supervision.

5.4 Circuit-breaker and three-position switch drives are to be designed with mechanical /hardwired interrogation interlocks and shall include all necessary auxiliary devices (auxiliary switches, releases etc.).

5.5 The three-position disconnector (ON-OFF-EARTH) is to be designed with separate manual and/or motorised drives for the disconnector and earth switch functions.

5.6 The GIS enclosure shall be sectionalised for each equipment into modular units or compartments, each separated by gas barriers with an effective sealing system. Each compartment shall be provided with the necessary filling/piping valves to allow isolation, evacuation and refilling of SF6 gas without evacuating of any other section. Busbar shall be sectionalized into small compartments only if busbar and busbar disconnector are in same gas compartment.

5.7 All switching device drives shall be located outside of the gas compartments, for easy access.

5.8 Under normal operating conditions for indoor switchgear units in accordance with IEC-62271 and when complying with the 5,000 number of operations, no maintenance is required.

5.9 SWITCHGEAR OPERATOR INTERFACES REQUIREMENTS:

- A standard mechanical user interface, ergonomically Positioned at a convenient height. It must be visible directly without opening of doors etc.

- The user interface comprises all the mechanical, panel-related interfaces and continuous interrogating interlocks.

- All the basic mechanical ON/OFF of CB, Isolator & earth switch operation, manual spring charge of CB must be possible without opening the door to ensure the operator safety.

- Mechanical mimic directly linked to mechanism should be provided at the panel front door.

- The basic switchgear unit is to be designed for suitable free-standing installation within a switch room.

- The Interlocking shall be as per IEC.
5.10 The mechanical control panel is located at an optimum height for operation and arranged in a recessed position on the switchgear front. Thus, the operating area is clearly visible while no control elements protrude from the switchgear front. The position of the individual elements has been selected according to their function, i.e. according to their allocation to the corresponding device functions. The elements which form part of a switching device, such as position indicators, crank ports or mechanical push buttons, are visually linked by a specific pattern and integrated in a mimic diagram. Mechanical operation is performed the same way as with the habitual operation with stationary switching devices. Separate control elements and mechanical switch position indicators are available for the following functions:

- Circuit-breaker ON - OFF
- Disconnector ON - OFF-EARTH

5.11 BUSBAR / PANEL CONNECTIONS:

The gas-insulated bus bar sections of the single panels shall be connected via three-phase solid-insulated connection elements which allows for easy exchange of a cubicle without SF6 works. Bus bar connection to be designed in such a way that no adjacent panels must be moved or opened for exchange of a panel. Bus bar couplings between adjacent panels should be designed with a minimised quantity of electrical sealing joints.

5.12 GAS COMPARTMENT TECHNOLOGY:

5.12.1 All the live parts including the CB, Three position Disconnector, and main busbar shall be encapsulated in Aluminium Alloy enclosure as per manufacturer design filled with SF6 gas.

5.12.2 All gas compartments must have their own independent and reliable gas supervision alarm system with annunciations. The devices shall be temperature compensated electrically isolated and independently adjustable, dust proof and vibration resistant. Two potential free electrical contacts shall be provided exclusively for each of the above alarm/trip conditions for wiring to supervisory control system. These contacts shall be in addition to those required for local indication and trip and shall be wired to the cable termination blocks in the local control panels.

5.12.3 By design there should be no need for gas works during the whole time on site, not even for exchanging a centre panel or extending the switchgear at later stage, e.g. no gas handling shall be necessary during the anticipated service life of the switchgear, under normal operating conditions. The gas-filled clad compartments are to be designed to be maintenance-free and hermetically sealed pressure systems in accordance with IEC 62271-203.

5.12.4 To facilitate transport and handling, lifting eyes or other suitable attachments shall be provided with each GIS module.

5.12.5 Each module of switchgear, consisting of individual elements intended to be directly connected together, shall be constructed as a transportable assembly suitable for shipping and transportation without being dismantled.

5.12.6 The GIS enclosure shall be safe to touch and fully ensure operational security and personnel safety under all normal and fault conditions.

5.12.7 Interior finishing material of the enclosure shall not contain any substances which could contaminate the enclosed SF6 gas or affect its insulating properties. If required, the GIS enclosures may be provided with suitable devices like particle traps to eliminate conducting particles which shall be based on the design of the manufacturer.

5.12.8 The GIS shall be divided into compartments separated by gas barriers. The gas barriers shall be suitably identified on the outside of the GIS.

5.12.9 All gas seals shall be designed to ensure that leakage rates are kept to specified minimum under all normal pressure, temperature, electrical load and fault conditions. Single gas seals with provision to monitor the failure of first seal shall be provided. Gas
leakage should be less than 0.1% / year. The material for the seals shall be non-

deteriorating.

5.12.10 Pressure relief devices may be provided in each gas section where it is considered
necessary to protect the main gas enclosure from damage or distortion during the
occurrence of abnormal pressure increase or shock waves generated by internal
electrical fault arcs.

5.12.11 The switchgear panels shall be filled with gas and checked for leakage in the factory.
For a proper recycling/emergency replacement, a gas valve in gas compartment has
to be provided. In addition, the standard tools for filling the SF6 Gas also have to be
provided during the supply of the GIS. The Gas handling as required, at site does be
done by the manufacturer’s representative during the commissioning activities.

5.12.12 Filters if necessary may also be provided in all the gas compartments.

5.13 INSULATING GAS:

Insulating gas shall be Sulphur hexafluoride (SF₆) confirming to the IEC:60376 and at a
pressure according to the manufacturer design. The pressure inside the enclosure shall be
mentioned on the rating plate of GIS. Type tests/ Acceptance test/ Routine tests shall be
carried out at the mentioned/specified pressure only.

5.14 INSTALLATION FACILITY:

The GIS module shall be delivered to the Traction Sub-Station (TSS) as factory
assembled and routine tested units. After linking the panels (or panel assemblies) by
the busbar connection system and connection of the power and control cables the
system should be ready for operation. Normally, no gas filling shall be required at site
during bus bar connection & installation.

5.15 It shall be responsibility of GIS manufacturer to provide sufficient numbers of ground
connection point on the GIS enclosure to connect with 75 X 8 MS Flats.
ASSOCIATED EQUIPMENT OF GAS INSULATED SWITCHGEAR

SECTION 6

6.1 CIRCUIT BREAKERS

6.1.1 The Circuit Breaker shall be installed horizontally or vertically in the gas compartment.

6.1.2 The Circuit Breaker shall be operated by a motor charged spring’s stored energy. Both opening and closing operations shall be done by the stored energy of spring(s). The motor shall be so rated that the time required for fully charging the closing spring is not more than 15 seconds. The closing action of the Circuit Breaker shall charge the opening spring so that the Circuit Breaker is ready for opening, at any time thereafter. The spring shall be of robust design, using tested steel as per IS: 7906-Pt. I-1976 or IS: 7907-Pt.I-1976 or equivalent international standard. The ends of the compression springs, if used, shall be flattened to enable proper fixing and shall minimise the possibility of misalignment.

6.1.3 The motor for spring charging shall be suitable for operation on 110V DC power from a Battery. The voltage at motor terminal is likely to vary between 110% and 85% of the normal value. The Carbon brushes shall have copper pigtails for carrying motor current. A miniature Circuit Breaker / HRC Fuses, of adequate ratings and of reputed make, shall be provided in the motor circuit for protection of the motor against over current and earth faults.

6.1.4 The Operating Mechanism shall be designed so that the Circuit Breaker can be operated from the operating mechanism cubicle itself as well as remotely from the control panel in the TSS and also from the remote control centre (RCC) which is situated away from the GIS. For his purpose “LOCAL/REMOTE” two way selector switch which shall be provided in the operating mechanism. When the switch is in the “LOCAL” position, the Circuit Breaker can be operated locally and when it is in the “REMOTE” position the Circuit Breaker can be operated from the control panel or from the RCC. The selector switch shall be spring loaded type/stay put type. For closing and opening the Circuit Breaker from the operating mechanism cubicle itself, the switch shall be of the push button type or knob type.

6.1.5 The closing coil and opening coil shall be suitable for operation from 110V dc power supply from a battery. The closing coil shall be suitable for operating at a voltage variation of +10% to -15%, while the opening coil shall be suitable for operating at a voltage variation of +10% to -30%. The "TRIP" and "CLOSE" coils shall be of reliable design and low consumption.

6.1.6 The Circuit Breakers shall be fitted with an electrical anti-pumping device, to give priority to tripping command in case of a persisting closing command being simultaneously present.

6.1.7 Facility for Trip Circuit Supervision shall be provided in control panel of TSS with indication to remote Location in Vacuum Circuit Breaker.

6.1.8 An operation counter having minimum five digit recording mechanism for the number of tripping operation shall be provided at a suitable place so as to be conveniently read by the operator standing on the Ground. The operation counter shall be of lock type and shall not have reset.

6.1.9 Mechanical indicators clearly visible from ground shall be provided for “CLOSED” and “OPEN” conditions of the CB.

6.1.10 All working parts of the Circuit Breaker shall be of corrosion resisting material, bearings, if any, shall be sealed type. Bearing, pins, bolts, nuts and other parts shall be adequately locked to prevent loosening.

6.1.11 In case of drop in pressure of SF6 gas below the set value the temperature compensated alarm pressure switch shall get actuated for generating an alarm. If the drop in the pressure continues, the temperature compensated Lock out pressure switch shall get actuated to cause the Circuit Breaker to trip and get locked in the tripped condition. Separate auxiliary contact from pressure switches shall be made available for tele-signalling the alarm condition from the alarm pressure switch and the trip and Lock out condition from the Lock out pressure switch. The maximum pressure, normal pressure, alarm actuating pressure and tripping & Lock out pressure of the Circuit Breaker shall be
furnished by the Manufacturer on the schematic drawing of the Circuit Breaker. Maximum and minimum permissible pressure of SF6 shall be indicated on the rating plate also.

6.1.12 The operation of closing device when Circuit Breaker is already in “CLOSED” condition shall not cause damage to any part of the Circuit Breaker or endanger the operator standing near the Circuit Breaker. The power requirement for tripping coil or closing coil not exceed 750W and power requirement at any time including spring charging motor shall not exceed 2500W.

6.1.13 In the event of 110V battery supply voltage dropping below 85V ±3V which is the minimum voltage prescribed for operation of tripping coil to trip the Circuit Breaker, the Circuit Breaker should trip automatically at 85V ±3V by means of a suitable arrangement i.e. Capacitive trip Device (CTD) & Under Voltage Relay etc.

6.1.14 Shock absorbers used (if any) shall not require any maintenance during the entire life of the Circuit Breaker

6.1.15 Suitable heaters(s) shall be provided in operating mechanism cubicle to operate at 240V ac, 50Hz single phase supply to prevent condensation of moisture during monsoon/winter. A 240V ac, 5A, Metal clad type, 3 pin socket outlet for an inspection lamp shall also be provided. Miniature Circuit Breaker/ Switch with thermostat of reputed make and of adequate rating shall be used for protection of heater circuit for overload and earth fault.

6.1.16 The entry of all cables into the operating mechanism cubicle shall be only through suitable cable glands which shall not allow ingress of vermin etc. into the cubicle. The cable glands shall be supplied with the Vacuum SF6 Circuit Breaker/Interrupter. Five cable glands shall be provided of which three shall be of 16.5 mm outside diameter while the Balance two glands shall be for cable of 14 mm outside diameter.

6.1.17 The wiring inside the operating mechanism cubicle shall be with 1100 V grade PVC insulated single core/multistrand cable conforming to IS: 1554 (Pt. 1-1988) or IS 694 (2010), with stranded copper conductors of adequate cross-section (with min 2.5 sq.mm strand copper) so proportioned as to reduce voltage drop and I²R losses to minimum. The ends of wires shall be terminated with crimped eye type lugs or without crimping in self-locking spring loaded terminal blocks. The wiring of 110V dc control circuit and 240V ac circuit shall be segregated and properly identified. The positive and negative wires of dc circuits shall also be segregated. The length of the cables used shall be kept to the minimum. Wire inside the cubicle shall be properly laid on trays or anchored to avoid breakage during vibration.

6.1.18 The terminal end of all wires shall be provided with numbered interlock type Ferrules which shall be of PVC or other durable material with marking (numbers) either engraved or punched so as to be indelible. The ferrules shall be of white/yellow colour with lettering thereon black. All wiring shall be properly supported and suitably protected to avoid rubbing against any Metallic part.

6.1.19 Terminal blocks of standard type shall be provided in the operating mechanism. There shall be insulating barriers between adjacent terminals. The terminals shall be stud type with spring washers/self-locking spring loaded type. The terminal blocks used for DC and AC circuits shall be clearly distinguished.

6.1.20 Contacts for SF6 GIS

(i) MAIN CONTACTS
The main, fixed and moving contacts of the Circuit Breaker shall have ample cross-section and contact pressure for carrying the rated current and short time current without excessive Temperature rise, pitting and welding. Arcing tips shall be made up of cupro-tungsten alloy or any other suitable material. The nozzle, main contacts and arcing contacts or parts thereof which are liable to wear shall be replaceable.

(ii) AUXILIARY SWITCH CONTACTS
Apart from the auxiliary switch contacts required exclusively by the Manufacturer for the functioning of the GISs at least 6 pairs of normally open (NO) contacts and 6 pairs of normally closed (NC) contacts shall be provided additionally for the exclusive use of the purchaser. The auxiliary contacts which are operated in conjunction with the main contacts shall be positively driven in both the directions.
6.2 **Isolators/Disconnetors and Earthing Switches**

6.2.1 Isolators or Isolators combined with earthing switches shall be motorised operated. The switches shall be three pole gang operated, no-load break, single stroke type shall be generally comply with the requirements of IEC-62271-102. In cases of emergency, manual operation must be possible.

6.2.2 The disconnect switch shall fully comply with the specified requirements of insulation level for the isolating distance as stated in IEC 62271-1.

6.2.3 The earthing position must be visible via a mechanical position indicator (MIMIC) directly connected to the drive shaft on panel front side.

6.2.4 The mechanical operation of isolator / 3 position disconnecter switch must be possible with door closed condition for operator safety.

6.2.5 The disconnect switches shall be equipped with adjustable, self-aligning, high pressure type silver-faced copper contacts. The contacts shall be capable of carrying full rated and short circuit currents without over heating or welding. Contact design shall be such that no shunt current shall flow through the contact springs.

6.2.6 The disconnect and grounding switches shall be provided with pad- locking facilities to permit locking both in open and closed positions.

6.3 **Interlocks**

6.3.1 Electrical and Mechanical interlocks shall be provided for absolute and positive protection against potentially harmful mal-operations of the switchgear. Electrical interlocking shall be fail-safe type.

6.3.2 Disconnect Switch and Grounding switch shall be electrically and/or mechanically interlocked such that it will not be possible to close the Grounding switch when the Disconnect Switch is closed or vice-versa.

6.3.3 The rated peak short-circuit current or the rated short time current carried by an Disconnect Switch or Grounding switch for the rated maximum duration of short circuit shall not cause:
   a) Mechanical damage to any part of the Disconnect Switch or Grounding switch.
   b) Separation of the contacts or contact welding.
   c) Excessive temperature rise which is likely to damage insulation.

6.3.4 After the passage of these currents, the Disconnect Switch shall be able to carry its rated current under specified conditions and the operation of the operating device shall not be impaired.

6.3.5 Where a Grounding switch is combined with a Disconnect Switch as a single unit, the rated peak short circuit current and the rated short time current of the Grounding switch shall be at least equal to those specified for the Disconnect Switch.

6.4 **Instrument Transformers**

6.4.1 **Potential Transformers**

   a) Potential Transformer shall be according to the IEC:61869-1/61869-2/61869-3 shall be acceptable. Current & voltage Sensors are not acceptable.
   b) Terminal and polarity marks shall be indelibly marked on each PT & CT on the associated terminals and these marks shall be in accordance with relevant standards.
   c) Secondary terminals of each potential and current transformer shall be brought out in a weather-proof terminal box. Facility shall be provided for shorting and Grounding the CT secondary at the terminal box. The star point, whenever required, shall be formed at the terminal box only.
   d) Each PT and CT shall be provided with a rating plate showing the particulars required by the relevant standard.
e) In case of ungrounded potential transformers both the terminals of the primary winding shall be brought out through bushings rated for full line voltage. In case of Grounded potential transformers, the end of the primary winding intended to be grounded shall be brought out through a bushing and Grounding connection shall be made outside.

f) The secondary terminal box for the potential transformers shall also include necessary HRC fuses/ MCBs for protecting the secondary circuit. Further, for the purpose of fuse supervision both terminals of fuse shall be brought out to the terminal box. MCBs shall be provided with auxiliary contacts for interlocking, Trip and alarm purposes.

g) Whenever a PT secondary winding is used for both measurement and protection application it shall have dual accuracy class of 0.5/3P, unless otherwise specified. However, for revenue class metering applications the accuracy class shall be 0.2/3P for that core.

h) The Potential Transformer shall be so designed to avoid ferro-resonance effects and shall be provided with adequate ferro-resonance-suppressor (if required) on the secondary windings. An electrostatic shield shall be employed between the windings of PT to prevent coupling of the transients generated in the GIS high voltage conductors with the control wires.

i) Potential Transformers shall not be mounted on the same compartment/Gas section as the Cable Feeder termination compartment in order to test the Cable feeder independent of the Potential Transformer.

6.4.2 Current Transformers

a) The current Transformer shall confirm to the IEC61869-1/IEC 61869-2.

b) The current transformers shall be toroidal-core type current transformers and shall be located outside the Gas Compartment.

c) CT Primary Current shall be 400-200 A.

d) CT Secondary Current shall be 5 A.

e) Accuracy class 5P.

f) Burden shall be 30 VA.

g) For the purpose of polarity checking, the position of each primary terminal in the current transformer SF6 gas section shall be clearly marked.

h) In the case of multi core CTs, it shall be possible to adjust the ratio taps on any core independent of the setting on the other cores, for which purpose these tappings shall have to be provided on the secondary windings only.

i) The CT cores shall be of low reactance type.

6.5 GIS Surge Arresters

a) The surge arresters shall fully comply with IEC-60099-4

b) Gap-less ZnO arrestors shall be provided before the termination to the transformer. Surge arrester shall be of the hermetically sealed, Gapless Metal Oxide, suitable for use with gas insulated switchgear. They shall have adequate thermal discharge capacity for sever switching surges, long duration surges and multiple shocks.

c) Normally isolable surge arrestors on the Bus Bar should be used. This will facilitate quick isolation and coupling whenever bus bars are required to be exposed to high voltage test.

d) Self-contained discharge counter shall be provided for each single pole unit. A leakage current detector as an integral part of the discharge counter shall be supplied. A counter along with detector shall be so arranged that it will be possible to read the leakage current values from the outside cubicle. The value of leakage current beyond which the operation is abnormal shall be clearly marked in red colour on the detector.

6.6 GIS Terminations

The power cable & their accessories of adequate capacity for cable termination from transmission line to GIS and GIS to Transformer bushing shall be in the scope of GIS supplier. The termination shall be carried out the GIS supplier or their authorized agency.
6.7 **Rating Plate**

The name/ rating plate shall be generally containing the following particulars:

Each GIS shall be provided with rating plates (Hindi/English) of weatherproof material fitted in a visible position showing the items indicated below. The letters/numbers on the plate shall be indelibly marked by etching/engraving.

i. Manufacturer’s name and country of origin.

ii. Type designation and number of pole.

iii. Serial number.

iv. Rated voltage.

v. Rated normal current.

vi. Rated frequency.


viii. Rated short circuit peak making current

ix. Rated single capacitor bank breaking current.

x. Rated out of phase breaking current.

xi. Rated short time with stand current and its duration.

xii. Rated insulation level

xiii. Rated operating sequence of Circuit Breaker.

xiv. Control circuit voltage with permissible variation for

   i. Closing coil

   ii. Opening coil

   iii. Motor voltage

xv. Total weight of GIS.

xvi. Specification conforming to IEC/RDSO.

xvii. Order reference

xviii. Month/Year of manufacture
SECTION 7

TESTS

7.1 General

7.1.1 The GIS manufacturer has to offer design and drawings of GIS including Quality Assurance Plan (QAP), SOGP, Design calculation (if required), Layout plan etc. for approval of RDSO before manufacture of prototype.

After approval of designs and drawings and clearance given by RDSO, the manufacturer shall take up manufacture of the prototype for inspection/testing by RDSO. It is to be clearly understood that any changes to be done on the prototype as required by RDSO, the same shall be done expeditiously.

7.1.2 Prior to giving a call to the Purchaser/Director General Traction Installations, Research Designs and Standards Organization, Lucknow (DG/TI/RDSO, Lucknow) for inspection and testing of the prototype, the manufacturer shall submit a detailed test schedule consisting of test procedures, schematic circuit diagrams, items/parameters to be checked and values required as per specification for each of the tests and the number of days required to complete all the Tests at one stretch. The schedule shall also indicate the venue of each of the tests. Once the schedule is approved, the test shall invariably be done accordingly.

However, during the process of type testing or even later, the purchaser/DG/TI/RDSO, Lucknow reserves the right to conduct any additional test(s), besides those specified herein, on any equipment/ item so as to test the equipment/ item to his satisfaction or for gaining additional information and knowledge. Incase any dispute or disagreement arises between the manufacturer and the representative of the purchaser/DG/TI/RDSO, Lucknow during the process of testing as regards the procedure for type tests and for the interpretation and acceptability of the results of type tests. It shall be brought to the notice of the purchaser/DG/TI/RDSO, Lucknow as the case may be whose decision shall be final and binding. Only after the prototype of the equipment is manufactured and ready in all respects, shall the manufacturer give the actual call for the inspection and testing with at least 15 days’ prior notice for the purpose.

7.1.3 In the event of the test not being carried through to completion at one stretch for any reason attributable to the manufacturer and it is required for the representative of the Purchaser/DG/TI/RDSO to go again or more numbers of times to the works of the manufacturer or to any reputed testing house/laboratory where tests are being done for continuing and/ or completing the tests on the prototype(s) of the equipment.

7.1.4 The tests shall be conducted on the prototype of the GIS at the works of the manufacturer or at any reputed testing house of laboratory in the presence of Purchaser/DG/TI/RDSO, Lucknow, authorised representative. The prototype shall be complete in all respects, including the terminal connectors as would be supplied if it had passed the tests. The tests shall be conducted as per relevant governing specification and as modified or amplified herein. Incase of test being conducted at government test laboratory, the presence of Purchaser’s representative for witnessing the test may be waived off subject to the discretion of the Purchaser/DG/TI/RDSO, Lucknow.

7.1.5 For the tests which are conducted in the Laboratories of Central Power Research Institute, Bhopal/Bangalore, Electrical Research Development Association, Vadodara or any government approved National/International testing Laboratory a clear certificate to the effect that the equipment has passed the tests as per the specification shall be obtained by the manufacturer and submitted to the Purchaser/DG (TI)/RDSO, Lucknow. Full details of the tests and the test parameters shall be furnished along with the test reports. These test reports shall be considered for acceptance, provided there is no any change between already tested material and offered material. In case, the prototype tests which can be conducted in-house at manufacturer works shall be required to be carried out and witnessed by RDSO during initial approval.
7.2 **TYPE TESTS**

The SF6 Gas Insulated metal-enclosed switchgear (GIS) and its parts i.e. Circuit Breakers, Disconnect switches, Grounding switches, SF6 interface and Instrument Transformers shall be fully type tested at well-equipped test Laboratory in accordance with IEC:62271-203, IEC 62271-100 and IEC:62271-1. Type test certificates shall be available for verification as evidence of successful completion of type tests.

The type tests shall comprises of:

<table>
<thead>
<tr>
<th>SN</th>
<th>Name of Tests</th>
<th>As per Clause of IEC 62271-203</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Dielectric Tests</td>
<td></td>
</tr>
<tr>
<td></td>
<td>a) Rated lightening Impulse Voltage withstand test</td>
<td>6.2</td>
</tr>
<tr>
<td></td>
<td>b) Rated One Minute Dry Power Frequency withstand Voltage Test</td>
<td></td>
</tr>
<tr>
<td></td>
<td>c) Rated One Minute wet Power frequency withstand Voltage</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Measurement of the Radio Interference Voltage</td>
<td>6.3</td>
</tr>
<tr>
<td>3</td>
<td>Temperature rise Test</td>
<td>6.4 &amp; 6.5</td>
</tr>
<tr>
<td>4</td>
<td>Rated Short Time Withstand Current &amp; Peak 10.2.5 Withstand Current Test</td>
<td>6.6</td>
</tr>
<tr>
<td>5</td>
<td>Rated making and breaking capacity of the included switching devices</td>
<td>6.101</td>
</tr>
<tr>
<td>6</td>
<td>Satisfactory operation of the included switching devices</td>
<td>6.102.1</td>
</tr>
<tr>
<td>7</td>
<td>Strength of Enclosure</td>
<td>6.103</td>
</tr>
<tr>
<td>8</td>
<td>Verification of degree of protection of the enclosure</td>
<td>6.102.2.1</td>
</tr>
<tr>
<td>9</td>
<td>Gas tightness test</td>
<td>6.8</td>
</tr>
<tr>
<td>10</td>
<td>Electromagnetic compatibility test (EMC)</td>
<td>6.9</td>
</tr>
<tr>
<td>11</td>
<td>Additional test on Auxiliary and control circuits</td>
<td>6.10</td>
</tr>
<tr>
<td>12</td>
<td>Tests on Partitions</td>
<td>6.104</td>
</tr>
<tr>
<td>13</td>
<td>Tests to prove the satisfactory operation at limit temperatures</td>
<td>6.102.2.2</td>
</tr>
<tr>
<td>14</td>
<td>Tests to prove the performance under thermal cycling and gas tightness tests on the insulators</td>
<td>6.106</td>
</tr>
<tr>
<td>15</td>
<td>Tests to evaluate the insulation of the equipment by the measurement of partial discharges</td>
<td>6.2.9</td>
</tr>
<tr>
<td>16</td>
<td>Tests to verify the protection of the equipment against external effects due to weather</td>
<td>6.2.105</td>
</tr>
<tr>
<td>17</td>
<td>Out of phase Making and Breaking test as per Clause 6.110 of IEC62271-100 (2008) or latest</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Capacitor current switching test as per Clause 6.111 of IEC62271-100 (2008) or latest</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Test to prove the rated Transient recovery Voltage (TRV) and rate of Rise of Recovery Voltage (RRRV) as per Clause 6.104.5 of IEC62271-100</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Line Charging Breaking Current test as per Clause 6.111.5.1 of IEC62271-100 (2008) or latest</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>Short Line Fault Test (Kilometric Fault) as per Clause 6.109 of IEC62271-100 (2008) or latest</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Test to prove the rated Transient recovery Voltage (TRV) and rate of Rise of Recovery Voltage (RRRV) as per Clause 6.104.5 of IEC62271-100</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>Mechanical Operation Test as per Clause 6.101 of IEC62271-100 (2008) or latest but the number of operations shall be 5000 instead of 2000 specified therein.</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>Any other test if required by Purchaser</td>
<td></td>
</tr>
</tbody>
</table>
### 7.3 ROUTINE TESTS

Every SF6 Insulated Metal Enclosed Switchgear shall be subjected to the routine Tests at the Manufacturer’s works as per Clause no. 7 of IEC 62271-200 (2011) or latest. The manufacturer shall make the record of the Routine Test and shall be made available to the inspecting authority whenever required. The routine tests shall comprise of:

<table>
<thead>
<tr>
<th>SN</th>
<th>Test</th>
<th>As per Clause of IEC:62271-203 (2011 or latest)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Dielectric Test on the Main Circuit</td>
<td>7.1</td>
</tr>
<tr>
<td>2.</td>
<td>Tests on Auxiliary and Control Circuits</td>
<td>7.2</td>
</tr>
<tr>
<td>3.</td>
<td>Measurement of resistance of the Main Circuit</td>
<td>7.3</td>
</tr>
<tr>
<td>4.</td>
<td>Tightness Test</td>
<td>7.4</td>
</tr>
<tr>
<td>5.</td>
<td>Design and Visual check</td>
<td>7.5</td>
</tr>
<tr>
<td>6.</td>
<td>Pressure tests of enclosures</td>
<td>7.101</td>
</tr>
<tr>
<td>7.</td>
<td>Partial Discharge Measurement</td>
<td>7.102</td>
</tr>
<tr>
<td>8.</td>
<td>Mechanical Operation tests</td>
<td>7.102</td>
</tr>
<tr>
<td>9.</td>
<td>Tests on auxiliary circuits, equipments and interlocks in the control mechanism</td>
<td>7.103</td>
</tr>
<tr>
<td>10.</td>
<td>Pressure test on Partitions</td>
<td>7.104</td>
</tr>
<tr>
<td>11.</td>
<td>Tests after Installation on site</td>
<td>10.2.101</td>
</tr>
<tr>
<td>12.</td>
<td>Any other test if required by purchaser</td>
<td>---</td>
</tr>
</tbody>
</table>

### 7.4 ACCEPTANCE TESTS

All the tests mentioned in the Clause no. 7.3 (Routine test) shall be for the acceptance test also. These acceptance tests are to be conducted on each GIS in the presence of Inspecting Authority.
TECHNICAL DETAILS AND DRAWINGS

SECTION 8

Technical data and drawing to be furnished by manufacturer

8.1 Details of the important parts and sub-assemblies shall be furnished by the manufacturer to RDSO after award of contract.

8.2 The manufacturer shall submit the following details/ dimensioned drawings as per Indian Railways Standard in sizes of 210mm x 297mm or any integral multiples thereof for approval.

i) Name / rating plate.
ii) General assembly /overall layout of GIS bays and routing of Bus and ducts showing mounting arrangement and overall dimensions
iii) Schematic and wiring diagram with explanation sheet.
iv) Details of main, fixed and moving contacts and arcing contacts.
v) Details of copper/Aluminium Alloy Bus bar
vi) Operating and coupling mechanism of complete CB along with schematic diagram showing the mechanical linkages with explanation sheet.
vii) Detailed drawings for springs for closing and opening,
viii) Full details of all sealing points with details of O rings and gaskets.
ix) Details of Terminal Connector
x) Details of porcelain/epoxy made hollow insulators for support and interrupting chamber
xi) Plain mass concrete foundation, drawing and design calculations
xii) Design calculation for structural safety along with the details of supporting structure
xiii) Erection, commissioning, operation and maintenance manual
xiv) Details of main parts/ sub assembly
xv) Details of control Panel
xvi) Any other drawing considered necessary by the manufacturer and / or Purchaser

8.3 Cross reference of identical drawing if approved for earlier contract shall be given in the drawing information required during commissioning and maintenance of equipment shall be shown in greater detail.

8.4 After approval, one set of approved drawings of hard copies and one set in pen drive in Auto CAD R14 / latest shall be sent to RDSO for record.

8.5 Five copies of the approved erection, commissioning, operation and maintenance manual shall be supplied to each consignee, in case order is more than 10 nos. In case order is less than 10 nos two copies of manual shall be supplied. Two copies of manuals shall be supplied to the Purchaser/DG (TI), RDSO, Lucknow (India) for record.

8.6 Drawings approved by RDSO after prototype approval shall be submitted for the future contracts also till the validity of prototype approval with a clear certification on the drawing that design, process and material have not been changed in the design of the subject equipment from the prototype already approved by RDSO.
Erection, Commissioning and Training

Erection and Commissioning:

9.1 The erection and commissioning & periodic/scheduled manual shall be provided with each GIS to the purchaser.

9.2 The GIS installation shall be erected and commissioned by the Purchaser/manufacturer. However, in case a defect/deficiency is noticed, the manufacturer will have to depute his engineer for necessary remedial action without any cost to the Railways. In all the cases in which an order is placed either on new manufacturer or for a new type/design of the GIS, services of manufacturer’s engineer shall be made available during the erection and proving/pre commissioning test for the first order of their GIS free of cost. For this purpose, prior intimation regarding the date and location shall be given by the purchaser to the manufacturer.

Training of Indian Railways’ Engineers:

9.3 The offer shall include the training of two engineers and four technicians of the Indian Railways free of cost at the manufacturer’s works in India or abroad and at the traction substation of a railway system or other public utility where GIS installation of similar/identical design are in operation. The total duration of training for each engineer/technician shall be 4 weeks of which approximately 2 weeks will be at the manufacturer’s works and 2 weeks on a railway system or public utility. The cost of travel to the country of manufacture and back will be borne by the Indian Railways.

9.4 The manufacturer shall make necessary arrangements for closely monitoring the performance of the GIS through periodical (preferably once in two months during warranty period) visit to the locations where they are erected for observations and interactions with operating and maintenance personnel of Indian Railways. Arrangements shall also be made by the manufacturer for emergency/stand by spare parts being kept readily available. To meet exigencies warranting replacements so as to keep the GIS in service with listed on time.

9.5 Manufacturer shall respond promptly and in a workman like manner to any call given by Indian Railway for any assistance by way of attending to failures, investigations into the causes of failures including the tests, if any, to be done and such other items with a view to seeing that the GIS serves for the purpose for which it is procured. Besides, technical guidance to ensure proper operation and maintenance of the GIS shall be constantly rendered.

9.6 Packing and Dispatch:

The various components of each GIS shall be securely packed in wooden crates/boxes. General packing list, together with weight and overall dimensions of each packing case shall be furnished for each GIS indicating the following.

<table>
<thead>
<tr>
<th>Crate/Box No.</th>
<th>Description of item/component in the crate/box</th>
<th>Gross weight in kg</th>
<th>Approximate outside dimensions</th>
</tr>
</thead>
</table>

As far as possible, the gross weight of a crate/box shall be so kept that it shall be possible to manually handle it by two persons.

9.7 In case of overseas supplies, packing shall be sea worthy.
**SCHEDULE OF GUARANTEED PERFORMANCE**

The manufacturer shall be required to submit the following detail to the purchaser as also confirmed point wise deviation to each clause of the tender paper so as to order to help the purchaser to evaluate the technical capability of the manufacturer to carry out the work. Ambiguous or incomplete information like “_”Or “shall be given later” can lead to technical rejection of the tender. Wherever deviations are quoted they shall be supposed to be supported with detailed technical benefits and/or financial benefits. In case no comments are given by the manufacturer for this section or a particular item of the section/Appendix, it is deemed to be considered by the purchaser that the manufacturer has understood the detailed technical requirement of the specification and there are no deviations to the specifications.

<table>
<thead>
<tr>
<th>S.N.</th>
<th>Description</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A.  System Description</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>01.</td>
<td>Maker’s name</td>
<td></td>
</tr>
<tr>
<td>02.</td>
<td>Country of manufacture</td>
<td></td>
</tr>
<tr>
<td>03.</td>
<td>Manufacturer’s Design / type Ref</td>
<td></td>
</tr>
<tr>
<td>04.</td>
<td>Location</td>
<td></td>
</tr>
<tr>
<td>05.</td>
<td>Scheme</td>
<td></td>
</tr>
<tr>
<td>06.</td>
<td>No. of Bays</td>
<td></td>
</tr>
<tr>
<td><strong>B  System Requirement</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>01.</td>
<td>Rated voltage</td>
<td>KV</td>
</tr>
<tr>
<td>02.</td>
<td>Highest system voltage</td>
<td>KV</td>
</tr>
<tr>
<td>03.</td>
<td>Rated frequency</td>
<td>Hz</td>
</tr>
<tr>
<td>04.</td>
<td>Rated current</td>
<td>Amps</td>
</tr>
<tr>
<td>05.</td>
<td>No. of phases</td>
<td>No.</td>
</tr>
<tr>
<td>06.</td>
<td>Dry 1 minute power frequency withstand test voltage</td>
<td>KV rms</td>
</tr>
<tr>
<td></td>
<td>(a) Between line terminal and Earth</td>
<td>KVRms</td>
</tr>
<tr>
<td></td>
<td>(b) Between terminals with breaker contacts open</td>
<td></td>
</tr>
<tr>
<td>07.</td>
<td>1.2/50 full wave impulse withstand test voltage</td>
<td>KVP</td>
</tr>
<tr>
<td></td>
<td>(a) Between line terminal and Earth</td>
<td>KVP</td>
</tr>
<tr>
<td></td>
<td>(b) Between terminals with breaker contacts open</td>
<td></td>
</tr>
<tr>
<td>08.</td>
<td>Switching Impulse (peak value)</td>
<td></td>
</tr>
<tr>
<td>09.</td>
<td>Rated short time withstand current (rms for 1Sec.)</td>
<td>Amps</td>
</tr>
<tr>
<td>10.</td>
<td>Rated peak withstand current (rms)</td>
<td>Amps</td>
</tr>
<tr>
<td>11.</td>
<td>Rated operating duty cycle</td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td>Control Voltage (DC)</td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td>Auxiliary AC Supply, Three phase</td>
<td></td>
</tr>
<tr>
<td>14.</td>
<td>Partial Discharge of switchgear assembly at highest voltage for equipment, pc</td>
<td></td>
</tr>
<tr>
<td>15.</td>
<td>Maximum Gas leakage Rate (%) of the respective volume, per year.</td>
<td></td>
</tr>
<tr>
<td><strong>C  Circuit Breaker</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>01.</td>
<td>Type</td>
<td></td>
</tr>
<tr>
<td>02.</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>03.</td>
<td>First Pole to clear factor</td>
<td></td>
</tr>
<tr>
<td>04.</td>
<td>Rated short circuit breaking capacity, kA(rms)</td>
<td></td>
</tr>
<tr>
<td>05.</td>
<td>Rated short circuit making capacity, kA(peak)</td>
<td></td>
</tr>
<tr>
<td>06.</td>
<td>Rated line charging breaking current capacity, A</td>
<td></td>
</tr>
<tr>
<td>07.</td>
<td>Rated cable charging breaking current capacity, A</td>
<td></td>
</tr>
<tr>
<td>08.</td>
<td>Small Inductive breaking capability</td>
<td></td>
</tr>
<tr>
<td>09.</td>
<td>Closing time</td>
<td>ms</td>
</tr>
<tr>
<td>10.</td>
<td>Breaking time</td>
<td>ms</td>
</tr>
<tr>
<td><strong>D.  Disconnector</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>01.</td>
<td>Type</td>
<td></td>
</tr>
</tbody>
</table>
2. Operation

3. Dry 1 minute power frequency withstand test voltage
   (a) Between line terminal and Earth
   (b) Between terminals with breaker contacts open
   KV rms
   KVrms

4. 1.2/50 full wave impulse withstand test voltage
   (c) Between line terminal and Earth
   (d) Between terminals with breaker contacts open
   KVp
   KVp

5. Switching Impulse (peak Value)

6. Rated capacitive current make and break capacity

7. Rated Bus Transfer Current

8. Rated Bus Transfer Voltage

E. Earthing Switch

1. Making Capacity kA (peak)

2. Rated short Time current

3. Rated Induced Current/Voltage for Electromagnetic Coupling (rms)

4. Rated Induced Current/Voltage for Electrostatic Coupling (rms)

F. Current Transformer

1. Name of the manufacturer and country

2. Governing specification

3. Type

4. Rated transformation ratio

5. Accuracy Class
   - For protection
   - For metering

6. Rated primary current
   A

7. Rated secondary current
   A

8. Rated burden
   VA

9. Rated accuracy limit factor

10. Current error at rated primary current
    %

11. Phase displacement at rated primary current
    Minute

12. Composite error at the rated accuracy limit primary current
    %

13. Rated short time thermal current (for one second)
    KA(rms)

14. Temperature rise with rated load and with specified overload over a maximum ambient air temperature of 50 degree C.
   a) of oil by thermometer
   Degree C
   b) of winding by resistance (secondary)
   Degree C

15. Porcelain housing
   a) Name of manufacturer
   KV
   b) Governing specification
   A
   c) Voltage class
   mm
   d) Rated current
   Kg
   e) Minimum creepage distance in air
   f) Weight

16. Core particulars
   a) Type of core
   T
   b) Maximum flux density at rated primary current
   V
   c) Minimum knee point (emf) voltage
   d) Exciting current at knee point (emf) voltage

17. Winding particulars
   a) Type of primary winding
   b) Current density in primary winding at rated current
   c) Resistance of secondary winding at 75 deg.C
   d) Class of insulation
      i) Primary winding
      ii) Secondary winding

18. a) Is the CT of sealed construction with nitrogen gas at the top?
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<td>b)</td>
<td>Pressure or amount of Nitrogen gas.</td>
<td>Yes/No</td>
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<td>c)</td>
<td>Pressure relief device provided or not.</td>
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**G. Potential Transformer**

1. Name of the manufacturer & country
2. Governing Specification
3. Type
4. Manufacturer’s type designation
5. Rated system voltage KV
6. Rated frequency VA
7. Rated burden VA
8. a) Rated primary/secondary voltage KV/Volt
   b) Transformation ratio
9. Rated voltage factor
10. Rated insulation level
    a) One minute wet p.f. withstand voltage KV
    b) 1.2/50 micr-second impulse withstand voltage KVP
11. Accuracy class
12. Maximum temperature rise after continuous full load operation
    a) Oil by thermometer Degree C
    b) Winding by resistance Degree C
13. Porcelain housing
    a) Name of manufacture KV
    b) Governing specification mm
    c) Voltage class Kg
    d) Creepage distance
    e) Weight
14. Whether the PT is of sealed construction with nitrogen at top or not Yes/No.
15. Pressure release device provided or not Yes/No

**H. Surge Arrestor**

1. Type
2. Rated arrestor Voltage
3. Nominal discharge Current
4. Energy Dissipation Capability
5. Partial Discharge at Highest Level

**I. Bus Bar**

1. Material
2. Short Circuit Rating
3. Metallic Enclosure
4. Burn Out Current