

ODISHA POWER TRANSMISSION CORPORATION LIMITED



ODISHA POWER SECTOR EMERGENCY ASSISTANCE PROJECT (PACKAGE – I, LOT – 1)

Technical Specification For 132/33 KV Gas Insulated Switchgear (GIS)

CONTENTS

- 1. General Specification**
- 2. Electrical Ratings**
- 3. Equipment Specification**
 - 3.1 General**
 - 3.2 Technical Specification of HV components**
 - Circuit breaker**
 - Dis-connector**
 - Maintenance earthing switch**
 - Fast acting earthing switch**
 - Current transformers**
 - Voltage transformers**
 - Surge Arresters**
 - SF6/Air bushings**
 - EVH-Power cable connection**
 - Local control cubicle**
 - Tools**
 - Spare parts**
 - Other services**
 - Standards and codes**
 - Others**

132 / 33 KV GIS SUB-STATION SYSTEM

GENERAL DESCRIPTION OF GAS INSULATED SWITCHGEAR .

STANDARD SPECIFICATIONS

The switchgear conforms to the following IEC standards:

SWITCHGEAR, GENERAL:

- IEC 62271-1 : High-voltage switchgear and control gear Part 1: Common specifications
- IEC 62271-203 : High-voltage switchgear and control gear Part 203: Gas-insulated metal-enclosed switchgear for rated voltages above 52 kV Circuit-breakers:
- IEC 62271-100 : High-voltage switchgear and control gear Part 100: Alternating-current circuit-breakers
- IEC 62271-101 : High-voltage switchgear and control gear Part 101: Synthetic testing Dis-connectors, earthing switches.
- IEC 62271-102 : High-voltage switchgear and control gear Part 102: Alternating-current dis connectors and earthing switches Instrument transformers:
- IEC 62271-303:High-voltage switchgear and controlgear – Use and handling of sulphur hexafluoride (SF₆)*
- IEC 61000 Electromagnetic compatibility (EMC)*
- IEC 60060 High voltage test techniques*
- IEC 60071 Insulation co-ordination*
- IEC 60255 Electrical relays*
- IEC 60265 High voltage switches*
- IEC 60270 High-voltage test techniques - Partial discharge measurements*
- IEC 60376 Specification and acceptance of new sulphur hexafluoride*
- IEC 60480 Guide to checking of sulphur hexafluoride (SF₆)*
- IEC 60529 Degrees of protection provided by enclosures (IP Code)*
- IEC 60815 Guide for the selection of insulators in respect of polluted conditions*
- IEC 61869 Instrument transformers*
- IEC 60364 / 60479 / 60621 / IEEE std. 80 Standards for station grounding.*
- IEC 60044-1 : Instrument transformers - Part 1: Current transformers
- IEC 60044-2 : Instrument transformers - Part 2: Inductive voltage transformers
- IEC 60044-6 : Instrument transformers - Part 6: Requirements for protective current transformers for transient performance

CABLE CONNECTIONS:

IEC 62271-209 : High-voltage switchgear and control gear Part 209: Cable connections for gas-insulated metal-enclosed switchgear for rated voltages above 52 kV – Fluid-filled and dry- type cable-terminations

OUTDOOR BUSHINGS:

IEC 60137 : Insulated bushings for alternating voltages above 1000 V Transformer direct connection:

IEC 61639 : Direct connection between power transformers and gas-insulated metal-enclosed switchgear for rated voltages of 72.5 kV and above.

SURGE ARRESTERS:

IEC 60099-4 : Surge arresters Part 4: Metal-oxide surge arresters without gaps for A.C. Systems SF₆-Gas:

IEC 60376 : Specification of technical grade sulphur hexafluoride (SF₆) for use in electrical equipment

IEC 60480 : Guidelines for the checking and treatment of sulphur hexafluoride (SF₆) taken from electrical equipment and specification for its re-use

IEC/TR 62271-303 : High-voltage switchgear and control gear Part 303: Use and handling of sulphur hexafluoride (SF₆)

LOCAL CONTROL CUBICLES:

IEC 61439 -1 : Low-voltage switchgear and control gear assemblies Part 1: General rules EMC.

IEC 62271-1 : High-voltage switchgear and control gear Part 1: Common specifications The enclosures of the switchgear conform to the following EN standards:

ENCLOSURE

CENELEC standard mentioned above

MODULAR DESIGN

Housings and expansion joints together form the pressure-resistant enclosure of the switchgear. The housings are made of cast or welded aluminium, the expansion joints of high-grade steel and the covers of steel or aluminium. The switchgear modules are single-phase or three-phase encapsulated.

The manufacturing and testing of the housings are state-of-the-art technology. Each housing is subject to a pressure and gas tightness test and complies with the requirements of the relevant CENELEC standard.

SURFACE TREATMENT

Steel (covers):

Indoor structure: Hot galvanised or painted

Outdoor structure: Hot galvanised and painted

High-Grade Steel (expansion joints):

Indoor Pre-treatment: none

Paint work: none

Outdoor Pre-treatment: degrease

Paint work: same as housings of cast aluminium

CAST-ALUMINIUM:

Pre-treatment (indoor and outdoor): Sand-blast or degrease alkaline

Internal surfaces (cast-aluminium): Seevenax protective paint RAL 7038 (grey)

Technical Specification for 132 KV & 33 KV GIS SS

Internal surfaces (aluminium wrought alloy): without surface treatment

External surfaces: material description: high-resistant 2-component polyurethane paint

Shade: **RAL 9010 (white)**

gloss: silk gloss - silk-matt

drying: air or stove dried

top coat: outdoor: Alexit top coat 5225, 5:1

indoor: Celerol top coat 362-24

reaction component: Alexit hardener 402

thinner: Alexit thinner 62 or 68

The used lacquers are free of harmful materials like cadmium, lead and chromic acids.

GAS

Gas compartments, monitoring of gas compartments:

- SF6 serves as insulant for the enclosure of several separately-sealed gas compartments
- static filters in all gas compartments - with single-phase encapsulation for each phase - for single phase encapsulation design absorb moisture and decomposition products; the filter material is placed in filter bags which are supplied in airtight cans
- all gas compartments are equipped with rupture diaphragms and, if necessary, with gas diverter nozzles; these nozzles are arranged in a way that, if the rupture diaphragm bursts, the gas flow is guided away in a direction not unnecessary hazardous to either personnel or equipment
- the modules of circuit-breakers, voltage transformers, cable connection module and surge arresters form separate gas compartments.
- the dis-connector gas compartment can contain other devices e.g. earthing switch.
- the switch operating shafts are supported and provided with lip seals against pressure and vacuum loss in such a way that during the evacuation process before commissioning no air can penetrate and no SF6 can escape during operation; the leakage rate is less than 0.5 % SF6 per year and gas compartment.
- the gas pressure is monitored by density monitors with indication; density monitors are installed directly at the gas compartment they monitor.

1. GENERAL SPECIFICATION

The intent of this specification is to provide the work enumerated to be fully complete in every detail for the function designated. It is hereby required that the BIDDER, in accepting the contract, agrees to furnish all apparatus, appliances, material not herein specifically mentioned or included, but which may be found necessary to complete, perfect or test any portion of the apparatus or equipment herein specified in a substantial manner, and in compliance with the requirements implied in this specification and without extra cost to the PURCHASER/OWNER.

NOTE: The Bus of the 132 KV & 33 KV GIS System shall be of **Aluminum** of adequate size and should be capable of withstanding the short circuit current level of 40 KA & 31.5 KA respectively for 3 sec. Care should be taken while designing the GIS system.

The tender work shall be carried out in accordance with the requirements of this specification and shall include design, manufacture, supply, testing at the factory, shipping to site, installation and testing at site and commissioning of the GIS and associated equipment.

Remarks:

All the Incomer feeders of 132 KV shall be with Gas Insulated Bus duct with termination of SF6 Gas to Air Bushings and the transformer feeders shall be with Gas Insulated Bus duct with termination of SF6 Gas to Air Bushings.

EQUIPMENTS TO BE SUPPLIED BY THE BIDDER:

The apparatus shall include but not be limited to the following:

(A) : To be used in GIS.

1. Circuit breakers
2. Dis connector switches (Bus / Line)
3. Maintenance earthing switches
4. Fast acting line earth switches
5. Bus Pts in 132 KV side
6. Bus Pts in 33 KV side
7. Current transformers
8. Surge arrester
9. Bus and elbow sections
10. Cable end enclosures / SF6 Bus – duct.
11. SF6 to air bushings / cable terminations
12. Ground connection to the station ground grid
13. Auxiliary material to complete the GIS installation (like density switches, auxiliary power/control cable and bolts)
14. Support structures for the GIS
15. Insulating SF6 gas
16. Local Control Cubicle
17. Special tools for installation , monitoring, testing & maintenance
18. Commissioning spares
19. Protection control and sub-station automation system with IEC 61850.

(B) Following equipment to be used in AIS:

1. Surge Arrester.(132 & 33 KV side)
2. Line Capacitor Voltage Transformer: 132 KV side.
3. 33/0.43 KV, 350 KVA Station Transformers

(C) Following auxiliary system also to be supplied.

1. ACDB,DCDB, other Switch Boards to be installed in the Switch yard and in other areas etc.
2. Fire Fighting, smoke detection facilities as per requirement.
3. Station Batteries, PLCC Batteries ,Battery Chargers.
4. Control & Power Cable as per requirement.
5. XLPE Power Cables for 33 KV Side (From Transformer to 33 KV side GIS & from 33 KV GIS to Station Transformers).

SERVICES TO BE SUPPLIED BY TENDERER:

1. All equipment and material shall be prefabricated, factory assembled, tested and shipped in the largest practical assemblies dependent on the mode of transport.
2. The Tenderer shall provide documentation as required in this specification.
3. The Tenderer shall provide the services of operation & maintenance for the purpose of installation, testing & commissioning and on-site training.
4. Construction of GIS Building for 132 KV and 33 KV sides, Power Transformer foundations, Foundations for switch yard columns & equipment etc.
5. Construction of concrete & bitumen roads, drainage system, Site surfacing, Fencing etc.
6. Construction of Control room Building & Quarters.
7. Sub-station earthing & Illumination for switchyard and other buildings.

All additional apparatus and services, listed below, which are required to successfully complete the GIS installation shall be supplied by the purchaser.

1. All detailed engineering for civil works for foundations of equipment/ tower gantry, embedded steel, cable ducts. The erection of GIS & auxiliaries building shall be done by purchaser based on the detailed engineering done & civil drawings issued for erection by purchaser.
2. Sealing ends
3. High Voltage cable
4. Overhead line connection
5. Auxiliary voltage supply

6. Station earthing

2. ELECTRICAL RATINGS:

The 145kV GIS equipment shall be provided with one enclosure per phase for all gas compartments. The apparatus shall have the following basic electrical and design characteristics:

			132 KV side
i)	Phase design		1-ph or 3-ph
ii)	Rated voltage	KV	145

	A	Rated lightning impulse withstand voltage (peak) phase to earth Across open contacts	KV	650KV _p 750kV _p
	B	Power frequency 1 minute (r.m.s.) phase to earth Across open contacts	KV	275kV 315 KV
iii)	Rated frequency		Hz	50
iv)	Rated current (bus bars) [At 40°C]		A	2000
v)	Rated short-time current (r.m.s) (3s)		KA	40
vi)	Rated making current (peak)		KA	100
vii)	Rated short circuit breaking current		KA	40
viii)	Partial discharge level, complete bay 1.5 x U//3		pC	< 5
ix)	SF6 gas pressure at 68 °F / 20 °C, for reference		kPa	Shall be submitted by the manufacturer.
x)	Enclosure			*Aluminum alloy

***Aluminum alloy: All external enclosure shall be of Aluminum alloy.**

3. EQUIPMENT SPECIFICATION

It is understood that each manufacturer has their own particular GIS design concept and it is not the purpose of this specification to impose any unreasonable restrictions. However, in the interest of safety, reliability and maintainability, the switchgear offered shall meet the following minimum requirements stipulated herein.

3.1 General

The GIS shall be made of tubular Aluminum alloy/steel enclosures and filled with SF6 gas for insulation. Enclosures shall be of single phase/3 phase encapsulation for 145kV for both the bus bars and the feeder section bays.

The switchgear shall be modular in design. Future extensions shall be easily accomplished by adding extra feeders without dismantling any major parts of the equipment. As much as possible the parts shall be of standard manufacture with similar parts and assemblies being interchangeable. The tenderer is encouraged to offer an optimized physical layout regarding minimized space requirements and maintainability.

Shipping sections which are tested in the factory shall be jointed in the field by using bolted and sealed flange connections only. Field welding of enclosures is not acceptable. The size of the per-assembled shipping sections shall be as big as practical for transportation. Complete station assembly in the factory for testing purpose and dis assembly for shipping is not preferred.

The flanged connections shall have gas seals between the flange surfaces. For outdoor application, suitable means shall be used to protect the gas seal from the external environment. Connections including bolts and nuts shall be adequately protected from corrosion and easy accessible with the proper tools.

Tenderer shall confirm the nominal rating of GIS components at 40°C

Bus Potential Transformer (PT) shall be provided with additional disconnector as shown in the Single Line diagram.

3.1.1 SECTIONALIZATION

The switchgear must be sectionalized, with gas tight barriers between sections or compartments. The sections shall be designed

- i) To minimize operational shut down when the gas pressure is reduced due to leakage or for maintenance purposes.
- ii) To minimize the quantity of gas that has to be evacuated and recharged before and after maintaining any item of equipment.

Continuous bus lengths without gas segregation shall not be acceptable.

Each section shall be provided with necessary valves to allow evacuation and refill of gas without evacuation of any other section.

The gas system proposed shall be submitted with the proposal. External fixtures shall be of non-corrosive material and be capped wherever required.

For the purpose of gas monitoring and maintenance, the GIS shall be provided with gas density monitoring device along with temperature compensated gas density switch having two stage contacts in each gas compartment.

Pressure relief devices shall be used where ever required.

3.1.2 CONDUCTOR TYPE AND CONTACTS

Conductors shall be made of **Aluminum** suitable for the specified voltage and current ratings. The electrical connections between the various gas sections shall be made by means of multiple contact connectors (plug-in type) so that electrical connection is automatically achieved when bolting one section to another. Field welding of the conductor is not acceptable. The surface of the connector fingers and conductor tubes on such connections shall be silver plated.

3.1.3 SUPPORT INSULATORS AND SECTION BARRIERS

Support insulators shall be used to maintain the conductors and enclosure in proper relation. Barrier insulators which are employed to isolate gas compartments as well as support insulators shall be manufactured from high quality epoxy resin, free of all voids and be designed to reduce the

electrical stress on the insulators to a minimum. The support insulator shall have holes on both sides for proper flow of gas.

The mechanical strength must be sufficient to ensure the conductor's space requirements and clearances when short circuit faults occur. In addition, the gas barrier insulators sealing to the conductors and the enclosure wall shall be designed to withstand the maximum gas pressure differential under normal operating condition and maximum pressure differential with one of the adjacent enclosures at three times operating gas pressure and the other at atmospheric pressure for five minutes.

Tests shall be carried out during the manufacturing of the switchgear to ensure that all insulators are free of partial discharge at a voltage which is at least 10% higher than the rated voltage.

3.1.4 GAS SYSTEM

The GIS shall be furnished with sufficient sulfur hexa-fluoride (SF6) gas to pressurize the complete system in a sequential approach, one zone or compartment at a time to the rated nominal density. During commissioning the dew point of SF6 gas shall be measured and documented. Maximum water content of SF6 -gas in GIS, within guarantee period:

CB \leq 150 PPM (volume)

Others \leq 500 PPM (volume)

The Gas loss of the switchgear shall be in no case higher than 0.5% per year.(as per IEC)

3.1.5 GAS SEALS

All gas seals shall be designed to ensure that leakage rates are kept to an absolute minimum under all normal pressure, temperature, electrical load and fault conditions. All gas seals located in the flanges of the equipment enclosures shall be of the O-ring type. The material and method of sealing used shall be stated in the tender.

3.1.6 GAS FILTERS / TREATMENT

Each gas compartment shall be fitted with gas filters, driers or desiccants for the absorption of moisture and the gaseous products of switching. The filter shall be effective for the duration of time between major overhaul. It shall be possible to replace the active material of the filter without extensive dismantling. The absorbent shall be located in an easy accessible location. The tenderer shall indicate the detail and type of filters used in the various gas sections

3.1.7 SF6 GAS QUALITY

The GIS shall be designed for use with SF6. All SF6 gas supplied as part of the tender shall comply with the requirements of IEC 60376 at a minimum.

3.1.8 GAS MONITORING DEVICES

Temperature-compensated gas density monitoring devices shall be provided for each gas compartment. The devices shall provide continuous and automatic monitoring of the density of the gas. The monitoring device shall have two alarm settings. These shall be set so that:

First stage: Advanced warning can be given that the gas density is approaching an unacceptably low level

Second stage: The relevant GCB can be locked for tripping/ closing.

3.1.9 GAS LOSS

Maximum guaranteed gas leakage loss of the switchgear shall be in no case be more than 0.2% per year.

3.1.10 SF6 GAS TREATMENT

Under normal operating conditions it shall not be necessary to treat the insulating SF6 gas between major overhauls. Normally closed valve shall be provided to facilitate filling and recharging. In all gas compartments permanent efficient filters and drying agent shall be at least effective for the duration of time between major overhauls. The filters shall be capable of absorbing the by-products of SF6 gas during interruption.

3.1.11 SUPPLY OF SF6 GAS

The tender shall include the supply of all SF6 gas necessary for filling and putting in commercial operation the complete switchgear installation with recommended extra quantity (minimum 10% extra).

3.1.12 PRESSURE RELIEF

Automatic external pressure relief devices shall be incorporated in the basic design as a precaution against bursting of enclosure. Internal pressure relief devices shall not be acceptable. The bursting pressure of the relief device shall be effectively coordinated with the rated gas pressure and the pressure rise due to arcing to avoid any mal-operation in normal operating conditions. Deflection devices shall be installed to ensure that personnel will not be endangered. Pressure relief shall be by means of a metallic bursting disc system with a preset opening pressure. For better gas tightness, bursting discs made of graphite or non-metallic material shall be avoided.

3.1.13 SWITCHGEAR ENCLOSURES

The metal enclosures for the GIS equipment modules shall be made from Aluminum alloy and tubular in construction. The tenderer shall state the material used for his particular design. All flanges shall be directly bolted together with good metallic contact to make enclosures equipotential.

Enclosures shall withstand normal and transient pressure in operation. They shall be designed and manufactured according to the related standards to guarantee safety and reliability of material, construction, welding technology and testing.

Enclosures shall be designed to withstand any internal arc specified in IEC 62271-203.

The gas-filled enclosures shall comply to the pressure vessel code applied in the country of manufacturer and shall be suitable for purchaser's environmental condition.

3.1.14 EXPANSION JOINTS AND FLEXIBLE CONNECTION

Expansion and installation alignment shall be considered in the design of the bus and enclosure. The continuity of service during thermal expansion / contraction and vibrations shall be ensured. The switchgear shall be fixed to the floor with minimum requirement on floor preparation. If required, expansion joints shall be provided with compensator for the enclosure and sliding plug-in contacts for the conductors. Expansion joints and flexible connections shall be considered in the design of the bus and enclosure to take care of thermal expansion / contraction and vibrations during service and to absorb the relative movement between the switchgear equipment and its fixing structure / floor. The position of expansion joints or flexible connections are to be considered by the manufacturer to ensure that the complete installation will not be subject to expansion stresses which could lead to distortion or failure of any piece of the SF6 equipment, support structures or foundations. These expansion joints shall be provided with each bay, which will provide maximum tolerance and the flexibility during the installation & maintenance.

Also, expansion joints, flexible connections and adjustable mountings shall be provided to compensate for reasonable manufacturing and construction tolerances in the associated equipment to which the GIS may be connected. This is to ensure that unreasonably excessive accuracy is not required when installing such equipment and constructing the associated foundations or support structures, e.g. transformers or the interconnection of isolated sections of switchgear by means of long GIS bus bar or duct installations. Flexible joints may also be provided to allow more efficient maintenance and future extensions of the GIS.

3.1.15 CORONA SHIELD

Corona shield, if necessary, shall be located at appropriate location inside the enclosure. The manufacturer to ensure that the shield do not vibrate or displaced throughout the plant life.

Material of the corona shield should be Alloy of Aluminum.

3.1.16 FINISH OF SURFACE AND CLEANING

The finish of interior surfaces of the GIS enclosures shall facilitate cleaning and inspection. Any paints or other coatings that may be used shall not deteriorate when exposed to the SF6 gas and arc products, etc., that may be present in the enclosures. They shall not contain any substances which could contaminate the enclosed SF6 gas or affect its insulating properties over a period of time.

The equipment shall be manufactured and assembled at the manufacturer's works under conditions of the utmost cleanliness. Before factory tests and packing for shipment, interior surfaces, insulators, barriers etc., must be thoroughly cleaned.

3.1.17 SUPPORTING STRUCTURES

All supporting structures necessary for the support of the GIS equipment including associated parts such as anchor bolts, beams etc. shall be supplied.

Access has to be considered in the design of the structures to all equipment of the GIS. It has to be possible to surround the GIS with the gas cart.

The specified stresses for outdoor equipment like wind, earthquake, snow, ice and thermal expansion due to current and sun radiation have to be considered.

Proper surface treatment for all parts especially in outdoor situation has to be considered. All steel members have to be hot-dipped galvanized according to DIN standards for heavily polluted environment.

3.1.18 FUTURE EXTENSION

For any type of bus bar configuration, it shall be possible to extend the switchgear by adding future feeders as decided by the owner with at least one of the bus bar systems service continuously and the existing feeders remaining in service continuously. The Vendor is required to demonstrate clearly in his submitted documents the suitability of the switchgear design in this respect.

3.1.19 REPAIR

In case of any internal fault in the bus bar or bus bar dis - connector, circuit breaker, repair works must be possible with at least one busbar in service.

Any failure shall be immediately signaled by the systems inherent self-supervision with clear description of the nature and the location of this failure. Generally any failure shall have impact only on the direct related devices and the rest of the substation shall remain in normal operation.

3.1.20 REMOVAL OF COMPONENTS

The GIS shall be designed so that any component of the GIS can be easily removed. As minimum flexibility in the layout arrangement, it shall be possible to remove the circuit breaker with both bus bar remaining in service and it shall be possible to remove the dis connector of the bus bars, with one bus bar remaining in service.

3.1.21 EARTHING OF THE SWITCHGEAR

(a) EARTHING OF MAIN CIRCUITS

To ensure safety during maintenance work all parts of the main circuit, to which access is required, shall be provided with facilities for connecting removable earthing device, after opening the enclosure, on the circuit element which is previously earthed via main earth switch.

(b) EARTHING OF ENCLOSURE

The enclosure shall be connected to earth. All metal parts other than main and auxiliary circuits shall be earthed.

Separate earthing strips to short circuit flanges and earth switches are not allowed. Earthing switches shall be connected to earth through enclosures. Individual earth leads for the earth switches are not recommended.

The continuity of the earthing circuits shall be ensured taking into account thermal and electrical stresses caused by the current they have to carry.

Each of the earthing strips shall be connected to the main earthing mesh installed below the GIS, at two ends.

(c) EARTHING OF GIS

The earthing system shall be based on a multi-point design ensuring the protection in case of indirect contact (Touch or step voltages, in case of system fault) and transient phenomena in case of lightning or switching operations.

Earthing conductors shall allow fault with short circuit current for at least 1 sec. Separate ground strips to short circuit flanges and earthing switches are not allowed. Grounding switches shall be connected to ground through the enclosure. Individual ground leads for the ground switches are not allowed.

3.1.22 AUXILIARY CONTACTS

Each equipment shall be furnished with adequate number of electrically independent contacts at user's disposal. They shall be wired to terminals located in the local control cabinet of the circuit breaker bay. Installation of auxiliary relays (contact multiplication) may be used to meet the overall control and protection requirements.

3.1.23 SPECIAL TOOLS

Any special tools needed for installation, operation and inspection shall be included in the quotation.

These special tools shall be supplied along with the GIS and shall not be taken back by the bidder. For gas handling purpose following tools shall be quoted as a minimum:

- i) Dew point meter**
- ii) Leakage detector**
- iii) Precision pressure gauge**

3.2 TECHNICAL SPECIFICATION OF THE HIGH VOLTAGE COMPONENTS OF GIS

3.2.1 CIRCUIT BREAKER

1. General

The GIS circuit breakers shall comply with the following general requirements for circuit breakers and the latest revisions of the relevant IEC specifications.

Circuit-breakers shall be the SF6 gas insulated type of single phase or single phase insulated & three phase encapsulated design with the specified ratings. The breaker shall be Self-Blast / Puffer type principle and consist of one interrupting arcing chambers.

Each circuit-breaker including the drive mechanism shall be completely factory assembled, adjusted and tested. The breaker shall include a suitable operating mechanism to assure proper opening and closing, and shall permit checking adjustments and opening characteristics. Each mechanism shall include dual trip coils in redundant design. The mechanism shall be capable of re-closing within the range specified in the applicable standards. The breakers are to be re-strike-free.

Breaker disposition must be horizontal. Horizontal to provide higher mechanical stability and ease in maintenance. The operating principle of the breaker shall ensure minimized dynamic floor loading. Low reaction forces on foundations especially dynamically, are favorable and considered in the evaluation.

2. Technical Particulars

		Gang pole operated mechanism
Nominal operating Voltage	kV	132
Highest system Voltage	kV	145

Nominal operating current(at 40°C)	A	2000
System earthing		Solidly earthed
Rated withstand voltage with respect to earth		
Lightning	kVp	750
Power frequency	kV	275
Rated short-circuit breaking current (r.m.s.), 3s:	kA	40
Rated making current (peak):	kA	100
Rated break time	ms	As per IEC-62271-100
Rated opening time	ms	As per IEC-62271-100
Rated closing time	ms	As per IEC-62271-100
Close-open time	ms	As per IEC-62271-100
Rated cable and line charging breaking current	A	250/125
Number of breaks per pole	Nos.	1
First pole to clear factor		1.5 minimum
Operating mechanism :		Hydraulic/Spring
Number per single phase circuit breaker		1
Rated operating sequence		O-0.3s-CO-3 min-CO / CO-15sec-CO
Time for recharging CO cycle		
Type		Hydraulic/Spring
Number of trip coils		2
Number of closing coils		1
Rated control voltage (DC)	V	220 DC

Auxiliary electrical equipment shall be suitable for operation on the following supply system.

(a)	Power Devices like drive Motors of rating maximum 1 KW	415 V, 3 phase 4 wire/230V 50Hz, neutral grounded AC supply.
(b)	Lighting, space heaters and Fractional KW motors.	240 V, single phase, 50 Hz neutral grounded AC supply.
(c)	Alarm, control and Protective devices.	220 V DC, 2 wire

Each of the foregoing supplies shall be made available by the Purchaser at the terminal point for each circuit breaker for operation of accessories and auxiliary equipment. Supplier's scope include supply of interconnecting cables, terminal boxes etc. The above supply voltage may vary as below and all devices shall be suitable for continuous operation over entire range of voltages.

I) AC supply : voltage $\pm 10\%$ frequency $\pm 5\%$

II) DC supply : - 15% to + 10%

3. Constructional features

All making and breaking contacts shall be designed to have adequate thermal and current carrying capacity for the duty specified and to have a life expectancy so that frequent replacements due to excessive burning will not be necessary. Provision shall be made for rapid dissipation of heat generated by the arc on opening.

Main contacts shall be first to open and last to close so that there is little contact burning and wear. Contacts shall be kept permanently under pressure of SF6 gas.

Arcing contacts shall be first to close and last to open. These shall be easily accessible for inspection & replacements.

Any devices provided for voltage grading to damp oscillations or to prevent re-strike prior to the complete interruption of the circuit or to limit over voltage on closing shall have a life expectancy comparable to that of the breaker as a whole.

Breaker shall be so designed that when operated within its specified rating, the temperature of each part is limited to the values consistent with a long life or the material used. The temperature shall not exceed the values indicated in IEC60694 under specified ambient conditions.

The material used in the construction of the circuit breaker shall be such as to be fully compatible with SF6 gas decomposition products.

All gasket surfaces shall be smooth, straight and reinforced.

4. Breaking capacity

The total breaking time from energizing of the trip coil at rated control voltage to final arc extinction shall be as short as possible.

The circuit breaker shall be capable of breaking all currents from zero up to the specified maximum fault current in accordance with the relevant IEC publications. Official test reports shall be submitted with the tender as evidence that the offered circuit breaker meets the specific rating.

5. Interrupting Duty:

Circuit breakers must be capable of coping with the interrupting duties produced by the switching of transformer magnetizing currents, line charging currents, cable charging currents, capacitor banks, short-line faults and out-of-phase switching duties.

6. Auto-reclosing

The circuit-breakers shall be capable of tripping and re closing according to the specified duty cycle.

7. Closing devices

All electrically operated closing devices and any mechanism charging motors or devices shall be suitable for operation at any voltage between 110% and 85% of the nominal control voltage measured at the device terminals.

The breaker shall close correctly when an electrical closing pulse of 50 ms duration is applied to the closing coil.

Closing coil rating shall be as per GIS manufacturers standard.

8. Tripping devices

All electrical tripping devices shall be suitable for operation at any voltage between 110% and 70% of the nominal voltage, measured at the device terminals. Tripping device tolerance shall be as per IEC/ANSI.

An emergency hand tripping (mechanical) device shall be provided in the operating mechanism. Trip coil rating shall be as per GIS manufacturers standard

9. Operating mechanism

Spring-Hydraulic operating mechanism/spring operating mechanism shall be supplied for each circuit-breaker. The operating mechanism should be spring loaded for single and three pole operation in any type of mechanism. Electric motor for the mechanism shall be DC operated. In case of failure of auxiliary supply, the mechanism shall have sufficient energy stored to perform at

least a O-CO cycle. Additionally, it should also be possible to operate the mechanism manually as a safety requirement (e.g. to ensure that the stored energy has been released in case of any assembly, maintenance or replacement work)

In order to reduce maintenance work and outage time, pneumatic operating mechanisms or pure hydraulic mechanism is not be accepted.

The mechanism shall be anti-pumping and trip free under every method of closing.
Spring operated mechanisms shall be complete with all control equipment. The only external requirement for operation shall be electrical supply.

Spring-Hydraulic operated mechanisms/spring operating mechanism shall be complete with all control equipment. The only external requirement for operation shall be electrical supply. Hydraulic pipe working on site or common system for substation shall not be acceptable.

Low stored operating energy shall be detected as per following operations:

1. start pump motor/spring charge motor
2. block auto-reclosing if stored operating energy is insufficient to complete a break-make-break operation
3. block closing if stored operating energy is insufficient to complete a make-break operation
4. block tripping if stored operating energy is insufficient to complete a break operation

Charging of the operating mechanism shall be possible in the event of failure of the motor drive.

The mechanism shall be in a dust and vermin proof box for indoor installation or in a weatherproof box for outdoor installation.

Each breaker shall have sufficient auxiliary switches all wired to terminals located in the local control cubicle.

Position indicating devices: Position indicators shall be provided to clearly indicate whether a circuit-breaker is open or closed.

Operation counter: Each circuit -breaker shall be provided with an operation counter per mechanism to record the number of tripping operations performed.

Discrepancy circuit shall be provided which shall detect pole position discrepancy.

Design of circuit breaker shall ensure that the contacts will not 'close' / 'open' automatically upon loss of gas pressure. The circuit breaker shall retain and continue to remain in the position prior to the loss of pressure.

10. Anti pumping

All circuit-breaker mechanisms shall be provided with means to prevent pumping while the closing circuit remains energized, should the circuit breaker either fail to latch, or be tripped during closing due to the operation of the protective relays.

11. Position indicating devices

Position indicators shall be provided to clearly indicate whether a circuit-breaker is open or closed. Each circuit-breaker shall be provided with an operation counter per mechanism to record the number of tripping operations performed.

3.2.2 DISCONNECTOR

1 General

The GIS dis connectors shall comply with the following general and the latest revision of the relevant IEC standards. Dis-connectors shall be three pole, group operated, no-load break, with one

motor operated mechanism per three-pole. They shall also have facilities for emergency manual operation and the necessary operating handles or hand cranks shall be supplied. Dis connector shall be interlocked to prevent the earthing switch from closing on a energized bus section.

All main contacts shall either be silver plated or shall have silver inserts. Each dis connector shall open or close only due to motor-driven or manual operation. The switch contact shall not move due to gravity or other means, even if a part fails. Once initiated, the motor mechanism shall complete an open or close operation without requiring the initiating contact to be held closed. The dis connectors shall be located as shown in single line diagram.

2 Technical Particulars

		132 KV SIDE
Rated Voltage	kV	145
- Lightning	kV	650
- Power frequency	kV	275
Nominal operating current(at 40°C)	A	2000
Rated short-circuit withstand current (r.m.s.), 3s	kA	40
Type of operating mechanism		Motor
Number of drives per 3 phase		1
Control voltage (DC)	V	220 DC
Number of CO permissible without maintenance	No.	As per latest IEC standard or equivalent.

Electric motor for the driving mechanism shall be DC operated. Mechanisms shall be arranged (mechanically ganged) so that all three phases of any particular disconnect switch operate simultaneously. All mechanisms shall be suitable for electrical motor operation to achieve a fully automatic operation in an unmanned substation.

For emergency situations manual operation shall be possible. Handles or hand cranks shall be provided. Manual operation shall be prevented if the interlocking conditions have not been satisfied. The auxiliary energy shall be electrically uncoupled from the motor when the switch is operated manually.

The mechanisms shall be arranged for locking in the open and in the closed position. Facilities shall be available to allow the switch to be padlocked in any position.

3. Position indicating

External mechanically connected position indicators shall be provided showing either open or close position.

3.2.3 MAINTENANCE EARTHING SWITCH

1. General

The GIS earthing switches shall comply with the following general requirements and the latest revision of the relevant IEC standards. Maintenance earthing switches shall be three pole, group operated, no-load break, with one motor operated mechanism per three-pole. They shall also have facilities for emergency manual operation and the necessary operating handles or hand cranks shall be supplied.

Maintenance earthing switches shall be electrically interlocked to prevent the earthing switch from closing on a energized bus section.

All main contacts shall either be silver plated or shall have silver inserts. Each earthing switch shall open or close only due to motor-driven or manual operation. The switch contact shall not move due to gravity or other means, even if a part fails. Once initiated, the motor mechanism shall complete an open or close operation without requiring the initiating contact to be held closed.

The maintenance earthing switches shall be located as shown in the single line diagram.

2. Technical Particulars

		132 KV SIDE
Rated Voltage	KV	145

- Lightning	kV	650
- Power frequency	kV	275
Rated current	A	NA
Rated short-circuit withstand current (r.m.s.), 3s:	kA	40
Type of operating mechanism		Motor
Number of drives per 3 phase	Nos.	1
Control voltage (DC)	V	220 DC
Number of CO permissible without maintenance	Nos.	As per latest IEC standard or equivalent.

3. Operating mechanism

Electric motor for the driving mechanism shall be DC operated. Mechanisms shall be arranged (mechanically ganged) so that all three phases of any particular earthing switch operate simultaneously.

All mechanisms shall be suitable for electrical motor operation to achieve a fully automatic operation in an unmanned substation. For emergency situations manual operation shall be possible. Handles or hand cranks shall be provided.

Manual operation shall be prevented if the interlocking system does not allow the operation of the switch.

The auxiliary energy shall be electrically uncoupled from the motor when the switch is operated manually.

The mechanisms shall be arranged for locking in the open and in the closed position. Facilities shall be available to allow the switch to be padlocked in any position.

4. Position indicating devices

External mechanically connected position indicators shall be provided showing either open or close position.

3.2.5 FAST ACTING EARTHING SWITCH

1. General

Fast acting earthing switches shall be located at the busbar and at all external HV connections of feeders (like HV cable or overhead line). The switching capability shall be class B (Earthing switches designated to be used in circuits having relatively long lines or high coupling to adjacent energized circuits) as per IEC 62271-102 Annex C standard. Furthermore it shall withstand the full making capability.

The fast acting earthing switches shall comply with the following general requirements of fast acting earthing switches and the latest revision of the relevant IEC specifications.

Fast acting earthing switches shall be three pole group operated, with one motor operated mechanism for three phase. They shall also have facilities for emergency manual operation and the necessary operating handles or hand cranks shall be supplied.

Fast acting earthing switches shall be electrically interlocked to prevent the fast acting earthing switch from closing on a energized bus section.

All main contacts, male and female, shall either be silver plated or shall have silver inserts.

Each fast acting earthing switch shall open or close only due to motor-driven or manual operation. The switch contact shall not move due to gravity or other means, even if a part fails. Once initiated, the motor mechanism shall complete an open or close operation without requiring the initiating contact to be held closed.

2. Technical Particulars

		132 KV SIDE
Rated Voltage	kV	145
Rated short-circuit withstand current 3s, (r.m.s.):	kA	40
Inductive current switching capability	A , kV	As per IE C standard
Capacitive current switching capability	A , kV	As per IEC standard
Type of Mechanism		Motor
No. of drives per three phase	Nos.	1
Closing time	ms	As per manufacturer standard
Control voltage	V	220 DC
Number of permissible CO without maintenance	Nos.	As per IEC
Short-circuit making 40/50kA:	Class	E1

3. Operating mechanism

Electric motor for the driving mechanism shall be DC operated. Mechanisms shall be arranged (mechanically ganged) so that all three phases of any particular fast acting earthing switch operate simultaneously.

All mechanisms shall be equipped with a motor suitable for operation from the auxiliary supply, and a set of springs for energy storage and closing. Motors shall be suitable for operation at any voltage between 85% and 110% of the rated auxiliary voltage.

For emergency situations manual operation shall be possible. Handles or hand cranks shall be provided, together with all necessary operation rods and rod guides.

The auxiliary energy shall be electrically uncoupled from the motor when the switch is operated manually. The mechanisms shall be arranged for locking in the open and in the closed position.

4. Auxiliary switches

Each fast acting earthing switch shall be furnished with adequate number of electrically independent contacts at user's disposal. The auxiliary switches shall indicate the position of the switch contacts, and shall be independent of the motor operation.

5. Position Indicating devices

External mechanically connected position indicators shall also be provided.

3.2.6 CURRENT TRANSFORMERS

1. General

The current transformers shall be supplied in accordance with the following general requirements and the latest revisions of the relevant IEC.

Each current transformer shall be arranged so that the enclosure current does not affect the accuracy or the ratio of the device or the conductor current being measured.

Current transformer secondary cores shall be terminated to shorting terminal blocks.

It shall be possible to test each current transformer without the removal of gas through the insulated grounding switches.

2. Position of the Current Transformers and Cores, Ratios and Characteristics.

The number and position of the current transformers relative to the circuit-breakers, disconnectors and earthing switches shall be as detailed in the attached single line diagram. However, there must have possibility of provision of CT on either side of CB.

The rating, ratio, accuracy class etc. for the individual current transformer secondary cores shall be as specified. Where multi-ratio current transformers are required, the various ratios shall be obtained by changing the effective number of turns on the secondary winding.

However, CT ratio shall be finalized during detailed engineering.

3. Rating and Diagram Plates

Rating and diagram plates shall be as specified in the IEC specification incorporating the year of manufacture.

The rated extended current rating voltage and rated thermal current shall also be marked on the name plate.

The diagram plates shall show the terminal markings and the relative physical arrangement of the current transformer cores with respect to the primary terminals (P1 & P2). The position of each primary terminal in the current transformer SF6 gas section shall be clearly marked by two plates fixed to the enclosure at each end of the current transformer.

4. Constructional Details:

Each current transformer shall be equipped with a marshalling box with terminals for the secondary circuits, which are connected to the local control cubicle or CT secondary terminals shall be directly terminated to the local control cubicle to avoid open circuiting in marshalling box. The star/ delta configuration and the inter connection to the line protection panels will be done at the CT terminal block located in the local control cubicle.

All the current transformers shall have effective electromagnetic shields to protect against high frequency transients.

Each current transformer shall be equipped with a marshalling box with terminals for the secondary circuits, which are connected to the local control cubicle. The star/ delta configuration and the inter connection to the line protection panels will be done at the CT terminal block located in the local control cubicle.

Current transformers guaranteed burdens and accuracy class are to be intended as simultaneous for all cores.

The wiring diagram, for the interconnections of the three single phase CTs shall be provided inside the marshalling box.

The current transformers shall be suitable for high speed auto re-closing.

Provisions shall be made for primary injection testing either within CT or outside.

Technical Particulars

		132 KV SIDE
Core number per phase	Nos.	04 cores *
Accuracy - Metering - Protection		Metering 0.2 & protection PS class *
Rating Primary	A	800-400-200 *
Rated secondary current	A	1
Continuous Thermal rating	%	120

*The details will be finalized later, based on the protection relay study.

3.2.7 POTENTIAL TRANSFORMERS (PT): Bus PT.

1. General

The voltage transformers shall be supplied in accordance with the following general requirements and the latest revisions of the relevant IEC.

Each voltage transformer shall be an electromagnetic, dry type SF6 –enclosed single phase unit with the specified ratings.

The voltage transformers are to be connected as shown in the attached single line diagram.

Voltage transformers shall be attached to the gas-insulated system in such a manner that they can be readily disconnected from the system if required for dielectric testing. The metal housing of the voltage transformer shall be connected to the metal enclosure of the GIS with a flanged, bolted and gasketed joint so that the transformer housing is thoroughly grounded to the GIS enclosure. Adequate measures shall be provided to prevent any unacceptable impact on the secondary control and protection circuits which might result from very fast transients (VFT) or ferro-resonance.

2. Ratios and Characteristics

The rating, ratio, accuracy class, connection, etc. for the voltage transformers shall be as specified below.

This shall be $132\text{kV}/(\sqrt{3})/110\text{V}/(\sqrt{3})/110\text{V}/(\sqrt{3})$ accuracy class 0.2/3P, connection Y/Y-Y. The voltage transformers shall have 2 secondary windings, each winding with one tap.

3. Rating and diagram plates

Rating and diagram plate shall be provided complying with the requirements of the IEC specification incorporating the year of manufacture and including turns ratio, voltage ratio, burden, connection diagram etc.

4. Secondary Terminals, Earthing, MCB's and Fuses

The beginning and end of each secondary winding and all secondary taps shall be wired to suitable terminals accommodated in the local control cabinet for the feeder bay. Fuses/ MCBs shall be also located in the local control cabinet.

All terminals shall be stamped or otherwise marked to correspond with the marking on the diagram plate. Secondary terminals shall have permanent marking as identification of polarity, in accordance with IEC. Provision shall be made for earthing of the secondary windings inside the terminal box.

The transformer shall be able to sustain full line to line voltage without saturation of transformer.

The accuracy class will be at maximum tap.

5. Constructional Details of Potential Transformers:

The potential transformers shall be located in a separate bay module on the bus and will be connected phase to ground and shall be used for protection, metering and synchronization.

The potential transformers shall be of inductive type, nonresistant and shall be contained in their own-SF6 compartment, separated from other parts of installation. The potential transformers shall be effectively shielded against high frequency electromagnetic transients. The voltage transformers shall have two secondary windings

Potential transformer's secondary shall be protected by fuses for all the windings. In addition fuses shall be provided for the protection and metering windings for fuse monitoring scheme. The secondary terminals of the PT's shall be terminated to the stud type non-disconnecting terminal blocks in the secondary boxes via the fuse.

The potential transformer should be thermally and dielectrically safe when the secondary terminals are loaded with the guaranteed thermal burdens.

The diagram for the interconnection of the VTs shall be provided inside the marshalling box.

6. Technical Particulars

		132 KV SIDE
Rated voltage	KV	145
- Lightning	kV	650
- Power frequency	kV	275
Primary winding	kV	132/ $\sqrt{3}$
Secondary winding	V	110/ $\sqrt{3}$
No of secondary windings	Nos.	2
Accuracy of secondary winding		
class		0.2 /3P
Burden		50//50
Partial discharge level at 1.5 U//3	pC	As per IEC

3.2.8 SURGE ARRESTERS:

When necessary, AIS surge arresters shall be placed at the line exits in close proximity to the line entrance.

GIS Surge Arresters shall be "Zinc Oxide" resistors type without spark gaps and with impulse characteristics suitable for use with SF6 gas insulated equipments. It shall be single phase SF6 insulated, self cooled suitable for installation as integrated part of GIS switchgear. Surge arresters shall be designed and tested in accordance with the requirements of IEC 60099-4/5 or latest.

The surge arresters form part of the overall GIS switchgear therefore they shall be positioned as near to the equipment to be protected and must be connected with as short connectors as possible to both line and earth; so that surge arresters can provide maximum protection in accordance with IEC 60099. All surge arresters shall be fitted with a pressure relief diaphragm which shall prevent explosive shattering of the housing in the event of an arrester failure and the arrester shall be tested accordingly to the high and low current tests specified in IEC 60099-1.

Each surge arrester shall be identified by a rating plate in accordance with the requirements of IEC 60099-4. Surge counters shall be provided as one per phase. The leakage current meters shall be for installation in the earth connection of the surge arresters and shall be designed for continuous operation and shall be placed in an accessible and visible location to be read from ground level with the arrester

Technical Particulars

		132kV
Rated voltage	KV	130
Line discharge class		3
Nominal discharge current (8/20 μ s)	kAp	10
Max. Lightning Impulse Residual Voltage with 8/20 μ s	kVp	650 kVp at 10kA

Note: The detailed parameters of surge arrestors will be finalized during detailed engineering.

3.2.9 SF6/AIR BUSHINGS

1. General

Outdoor SF₆ to air bushings, for the connection between the GIS and overhead lines or conventional air insulated equipment shall be furnished where specified.

Bushings shall comply with the relevant IEC standards.

Bushings with porcelain insulators is not acceptable.

The internal insulation of the bushings can be a resin impregnated paper winding (RIP body) or compressed SF₆-gas. The internal and external electrical field of the bushings can be controlled by a capacitive grading body or by grading shields.

The RIP body must consist of resin impregnated paper insulation with concentric aluminium layers. The space between the RIP body and the insulator must be filled with insulating foam compound or compressed SF₆-gas.

Bushings with composite insulators (fiber-reinforced resin tubes with silicon rubber sheds) can be pressurized with the normal service gas-pressure of the GIS.

Insulation levels and creepage distances:

2. Insulation levels and creep age distances:

The insulation levels are applicable to normal sea level atmospheric conditions. The creep age distance over the external surface of outdoor bushings shall not be less than 25 mm/kV.

3. Mechanical forces on bushing terminals:

Outdoor bushings must be capable of withstanding a cantilever force as per IEC standard

4. Interface definition

The flange and conductor connection between bushing and GIS component shall be the standard of the GIS supplier.

3.2.10 EHV-POWER CABLE CONNECTION

1. General

The design of the cable end box shall fully comply with the IEC 62271-209 standard. The Extra high voltage power cables, shall be supplied by the tenderer. The type and size of cables shall be as per requirement. The final connection of the high voltage cable circuits in the GIS will be by means of individual single-phase cables, with one cable per phase.

The cable end unit design shall include a facility for high voltage AC testing of the connected power cable on site. Removable bolted links or similar connections will be accepted. The design of the link and connections shall ensure that when removed the resulting gap can withstand the impulse and power frequency test voltages applicable to the switchgear and the cable high voltage AC test voltage.

2. Interface definition

Dimensions and division of work shall fully comply with IEC 62271-209 standard.

Note: The details of the XLPE cable to be estimated based on the layout during detailed engineering.

Followings are the sizes of the 33 KV XLPE cables proposed to be adopted in the GIS sub-station.

33 KV XLPE armoured single core, 800 Sq mm copper Cable to be used.

(1) From 33 KV side of the Power Transformer to the 33 KV GIS cubicle.

(2) 33 KV XLPE armoured three core, 95 Sq mm copper Cable to be used. From 33 KV GIS cubicle to 33 KV side of the Station Transformer.

33KV side XLPE cables are to be terminated at transformer end and also at GIS cubicle end. Quantity and type of such termination kit to be decided by the bidder.

3.2.11 LOCAL CONTROL CUBICLE

1. General

One local control cabinet (LCC) shall be supplied for the local control and operation of each circuit breaker bay. Each LCC shall contain the local control, interlocking, operation and indication devices for the associated GIS feeder bay.

The LCC shall operate as a link between GIS and Control, protection and substation automation system (SAS) in Control Room LCC shall generally include:

- mimic showing the single line diagram
- position indicators
- discrepancy type control switches for breaker, disconnector and earthing switch
- local / remote selections
- alarm and indication devices.
- Aux. relays or other devices as required by the design.

For easy overview, the LCC's should be integrated in the switchgear in front of the related circuit breaker bay. A general arrangement drawing showing the installation position shall be submitted with the quotation.

The LCC's shall be installed indoors. The LCC's shall also be dust and vermin proof and shall be located near GIS modules.

The control and operation circuits shall be well shielded and with safety measures to protect operator from touching energized parts. Power frequency withstand of control circuits shall be 2 kV for 1 minute. The LCC shall be factory tested and shipped together with the bay as one transport unit.

2. DC Supplies and Circuits

DC supplies shall be provided by the tenderer for all control, interlocking, alarm, indication and power supply circuits. The normal maximum and minimum voltage levels that will occur on the supply are specified.

At least one single MCB outlet from the substation DC distribution board will be provided for each local control cabinet.

The design of all circuits must be such that separately fused or sub fused circuits are always kept electrically separate.

3. A.C. Supplies and Circuits

A.C. power for heaters and other auxiliary loads will be provided by the tenderer by two 240 V, 50 Hz, 3-phase circuits.

The normal maximum and minimum voltages that will occur in the supply are as specified. All equipment supplied shall be capable of running continuously or switching the AC current within the range of the normal maximum and minimum voltages specified.

4. Cable connections within the GIS and their LCC's

All cable connections between the various GIS modules and the LCC's shall be made by prefabricated multi-core cables with multi-point plug-in connections on both ends. PT's and CT's shall be hard wired.

All cables shall be shielded and adequate for their application (indoor / outdoor).

Space Heater: Each panel shall be provided with a space heater rated for 240V, single phase, 50 Hz Ac supply for the internal heating of the panel.

3.2.12 TOOLS

The Tenderer shall include in his proposal the recommended tools required for installation, commissioning, operation and maintenance.

The following tools shall be supplied as a minimum:

Tools for gas handling	1 set
Leakage detector	1 piece
SF6 filling and evacuating device	1 set

These tools shall be supplied along with the GIS and shall not be taken back by the bidder.

3.2.13 SPARE PARTS

The Tenderer shall include in his proposal the recommended spare parts for installation, commissioning, operation and maintenance.

The following spare parts shall be supplied at a minimum:

(a) Maintenance earthing switch	1 unit
(b) Fast acting earthing switch	1 unit
(c) Disconnecter	1 unit
(d) Density monitors for circuit breaker	1 unit
(e) Density monitors for other gas compartments	1 unit
(f) Drive for circuit breaker	1 unit
(g) Drive for dis connector & earthing switch	1 unit
(h) Drive for fast acting earthing switch	1 unit

3.2.14 OTHER SERVICES

The following services shall be included in the proposal or quoted as optional items.

a) Training sessions on installation, commissioning, operation and maintenance of GIS shall be held by an experienced, English speaking instructor.

One week training for installation and commissioning shall be held prior to installation at site or at the owners' premises/at the factory.

One week training for operation and maintenance shall be held after the installation at the site.

b) Factory inspection/acceptance test: at the factory

c) Installation Supervision

The estimated time period for installation supervision shall be shown in the proposal.

d) Commissioning / High voltage test

The estimated time period shall be shown in the proposal.

3.2.17: INTERLOCKS

Electrical interlock shall be provided between :

1. Circuit breakers and disconnecter.
2. Dis connectors and earthing switches.

The principles of electrical interlocks are the following:

On each bay:

- The disconnecter from the bus bar may not be closed if the associated circuit breaker is closed.
The bus bar disconnecter may not be closed if the earthing switch located between itself and the circuit breaker is closed.
- The earthing switch located between the bus bar disconnecter and circuit breaker may not be closed if the bus bar disconnecter is closed.
- The circuit breaker may not be closed if the ear thing switch of the associated section of bus bar is closed.
- The feeder disconnecter may not be closed or opened if the associated circuit breaker is closed.
- The feeder disconnecter may not be closed if the earthing switch is closed.

On the bus bar:

- cable disconnecter can be opened and earthing switch can be closed only if the voltage transformer reads zero.
- Cable earth switch can be closed only if cable disconnecter is opened.
- Cable disconnecter can be opened only if the associated circuit breaker is opened.
- The feeder disconnecter cannot be closed if the switchgear is closed and bus bar disconnecter is closed.
- The earthing switch of each bus bar may be closed only if all the bus bar disconnections are opened.

3.2.18: ARRANGEMENTS

Wiring

The wiring must be carried out with stranded copper conductors of at least 7 strands. The size of the conductors shall be suitable enough for the expected usage, but it must not be less than 2.5 sq.mm. All precautions should be taken to minimize the inductive and capacity coupling between circuits of especially with the wiring of the AC and DC circuits. The cable trays shall be designed in such a way that it has at least 20% space for future usage.

Terminal Blocks

The design of the terminal shall be as per the relevant standards in vogue. The terminals permitting the direct control of SF 6 surveillance from pressure monitoring devices must be fitted with test point.

The outgoing terminal connection must be unique and comprises of 2 distinct parts:

- an arrangement for auxiliary voltage supply (alternating or direct current)
- an arrangement for control common.

Worker Safety

All precautions must be taken to ensure an efficient protection against accidental contact with the live elements.

Degree of protection

The required level of protection shall be established for the enclosures of boxes and cubicles as per the relevant standards in vogue.

Frame work

The boxes and cubicles shall have metallic enclosures to ensure effective protection against radio interference. If these enclosures are of non-metallic materials, the screen shall be connected to the earth to ensure efficient protection.

Cable entrance

Cable glands or grommets shall be provided for cable entry through the lower side. These cable glands should avoid electrolytic corrosion at the lower side of the box.

Closing devices

A simple handle will be suffice at the door of the cubicles.

The door must open at at least 120 deg.

Lighting and socket :

Lighting facility at the cubicles shall be activated by opening the door.

In each local control cubicle a single phase 3 pin socket with switch shall also be provided. The lighting points and sockets should be connected by a circuit separate from other circuits.

Space heaters

In each box and local control cubicle a space heater is required to prevent condensation. It should be connected by the same separate A.C. circuit as above.

The manufacturer shall indicate the electrical power of each heater.

Earthing of boxes and cubicles

Depending upon the location of boxes and cubicles, the earthing terminal is either linked to the metal enclosure, or linked directly to the general earth mat by an earthing conductor of reduced cross – section.

Equipotential connections between boxes, cubicles and doors shall be provided to ensure that no movable part of the enclosure can, once it is in place, be isolated from the part to which the earthing terminal is connected.

Voltage transformer

The cable from voltage transformers shall be terminated in the cubicles with removable fuses and shall be padlocked.

The fuses are connected in such a way that the locking devices forbids access to the cells corresponding to the conductors from the voltage transformers.

The fuse units shall be of 25 amp rating with a 6amp fuse cartridge.

Boxes and cubicles.

Other than stainless steel, all the boxes and cubicles shall be painted with a minimum one primer coat and one top coat.

Bolts, screws and nuts.

In case of stainless steel a diameter of 16mm and above shall be provided.

If the diameter is below 16mm hot galvanized will be allowed and in such case the thickness of zinc plating shall be 375 g /sq.m.

All precautions shall be taken:

- to ensure that contacting materials do not cause electrolytic corrosion.
- to avoid water stagnation.

The manufacturer shall specify the measures adopted to ensure the above conditions.

3.2.19: LOW VOLTAGE CABLES & CONTROL CABLES

The Low voltage cables & control cables shall be of 0.6/1kV XLPE/PVC insulated copper tape shielded control cables shall be complied with IEC 60502 and flame retardant to IEC 60332-1. The size of the above cables is more than 2.5 sqmm.

3.2.20: ACCESSORIES:

SF6 GAS SERVICE CART

The SF6 gas service cart shall be adequate to:

- refill each compartment between the first or second level of SF6 gas pressure to the rated pressure.
- check the SF6 monitoring.

(a) SF6 HANDLING PLANT

The SF6 handling plant shall contain compressors and vacuum pump necessary for recovering vacuum and filling SF6 gas. It shall be movable with wheels.

It shall allow the storage of SF6 in liquid state in a built – in tank having capacity sufficient to empty any three adjacent compartment of 132 KV GIS.

The capacity of compressors and vacuum pumps shall be selected in such a way for

- filling a compartment to the rated pressure within one hour.
- recovering SF6 gas from any compartment to the built in tank from the rated pressure to 50mb pressure within three hours.
- evacuating a compartment from 50 mb pressure to less than 1 mb pressure within one hour.

The cart shall have the following provisions:

- accessories for connections and operation (valves and coupling)
- dry type filters, dust and oil traps,
- tools and spares for operation and Maintenance,
- hand-book for description, commissioning, operation, and Maintenance.

(b) 132 KV SF 6 TEST BUSHINGS:

These bushings shall conform to IEC 60137 standard.

The design shall meet the following requirements:

- Minimum creep age distance : 31mm / KV for heavy pollution level according to the IEC60815 standard.
- The terminal clamp shall be supplied by the GIS manufacturer

Note- For 220kV GIS test bushings are not required as per tender SLD.

3.2.21: EARTHING

CONNECTION TO THE GENERAL EARTH MAT:

All metal parts intended which does not belong to a main or an auxiliary circuit, shall be connected to earth.

The general **HDG MS earth flat** earth circuit of the substation shall be formed by an uninterrupted loop which originates from the buried **HDG MS earth flat** conductor of a cross section of **300 sq.mm (50X6)**. These loops shall be fixed to the base of the chassis with the help of an earth riser connection bolted into a hole in the chassis or frame by the manufacturer of the metal-clad equipment, and situated at 0.30 m above the floor level of the switchgear. The general earth mat design, the connection device and the bimetallic plate shall be supplied by the GIS manufacturer. The earth connection from earth pad of equipment to the general earth mat near shall be provided by the supplier. The continuity of the earthing circuits shall be ensured taking into account the thermal and electrical stress by the current they may have to carry.

EQUIPOTENTIAL EARTH MAT:

When a fault current flows through the earthing connections into the soil, the enclosures, linked to the earthing circuits, are carried at the same potential as the earthing mat conductors but this potential is generally different from that on the soil surface.

In order to ensure the security of personnel, it is necessary to install an equipotential mat linked to the general earthing mat in the zones where metal enclosures and fixed accessories are accessible from the floor.

It is also necessary to provide an equipotential earthing mat in the zones where an emergency mechanical operation or a locking system is accessible from the floor. It is therefore possible to extend the equipotential mat to allow the operator to carry out his manoeuvres.

In order to ensure a good equipotential surface, each element of the equipotential mat must be connected to the general earthing network by the manufacturer.

This mat will be placed on the floor, all around the switch gears. It is not required in front of the control cubicles.

If it is an oxidizing material, it should be hot dip galvanized.

The manufacturer must provide and specify this equipotential earthing mat. The location of the equipotential mat should be defined by the supplier for all the GIS and at places where :

- the enclosures are accessible for the floor.
- Manual operation of apparatus or locking system is located.

Five copies of equipotential earth mat drawings along with design calculations may be submitted for approval by the successful Bidder.

3.2.22: TESTING & COMMISSIONING:

(a) TYPE TEST:

Type tests shall be according to the IEC 62271-203 and other relevant IEC standards. Copies of the type tests conducted shall be furnished along with the BID failing which the Bid is liable for rejection. These type tests should have been conducted in a Recognized independent institution / Laboratory.

(b) ROUTINE TESTS :

Routine tests shall be as per the IEC 62271-203 and other relevant standards. The manufacturer shall provide all the testing equipment required for the site tests.

(c) COMMISSIONING TESTS/ON SITE TESTS AFTER ERECTION :

After erection, and before putting into service, the gas-insulated metal enclosed Switchgear shall be tested for the correct operation and dielectric strength of the equipment.

These tests and verifications shall comprise:

(1) Tests to be conducted on the circuit breaker at site

At all required operating sequences

- Measurement of operating time

Checking of wiring and connections and dielectric checks

Indications, alarms and interlocks, auxiliary contacts

Operation at minimum and maximum control supply voltage/pressure

Operation of anti-pumping device.

(2) Test to be conducted on the Disconnectors at site

Checking of wiring and connections and dielectric checks

Indications, alarms and interlocks, auxiliary contacts

Operation at minimum and maximum control supply voltage/pressure

(3) Other Tests at Site

- Dielectric tests on auxiliary circuits
- Measurement of the resistance of the main circuit
- Measurement of gas condition
- Gas tightness tests
- General verifications

(4) POWER FREQUENCY TEST: ON SITE TESTING OF GIS

Power frequency tests for the completed GIS at site shall be complied as per IEC 60270.

Power frequency tests for the completed GIS at site shall be possible without removing the voltage transformers. The power frequency test voltage at site shall be 80% of the factory test voltage for 1 min at 100Hz.

The Supplier is responsible to furnish the test equipment for conducting following performance tests at site.

- Voltage tests on main circuits at reduced voltage (80% p.f.) comprising:

- 50 Hz A.C. voltage test for 1 min

- Partial Discharge test

The manufacturer shall provide :

- The test voltage source.

- All connections between the switchgear and the test voltage source.

The procedure to be implemented following a discharge during dielectric tests is as follows :

- if a disruptive discharge occurs at the first test while increasing of test voltage, a second test is performed.

- If a second disruptive discharge occurs in the same compartment before reaching the highest level, there are two possibilities :

- If the second disruptive discharge is higher than the first voltage again the voltage is immediately increased. If a new discharge occurs the value of which is again higher, a new test is carried out.

- If the second disruptive discharge is lower than or equal to the first, the test is stopped and the compartment dismantled.

The process is continued in order to reach the test voltage. If a disruptive discharge occurs at this voltage, there are two possibilities:

- if it is the first disruptive discharge in the compartment since the test was begun, voltage is again increased. If there is no other discharge, the test has been successful. The test is stopped and the compartment dismantled.

- if some discharge have previously occurred in this compartment during the increase in voltage, the test is stopped and the compartment dismantled.

3.2.23:**SCHEDULE OF EQUIPMENT/MATERIALS**

Item No	Description of Equipment/Materials	Quantity	Total Quantity
1	Package – 132 KV 132/33 KV GIS SUB-STATION		
	132 KV Indoor line bays with all equipment (Feeder)		
	132 KV Indoor Transformer bays with all equipment		
	Indoor bus bar VTs and bus bar earthing Switches etc.,		
	132 KV Indoor Bus-coupler bay with all equipment		
2	ACCESSORIES		
	SF6 Gas handling plant of adequate capacity	1 Set	-
	SF6 gas service cart with all accessories	1 Set	-
	Bushing for cable testing	1 set	-
3	TESTING EQUIPMENT		
	GIS testing equipment(Bidder should include all such testing equipment ,which are required for detail testing of GIS system)	1set	-

3.2.24:**SCHEDULE FOR ESSENTIAL TOOLS AND SPARES**

Item No	Description	Quantity
1	Single phase voltage transformer	1 Set
2	Single phase set of 5 cores current transformer including enclosure	1 Set
3	Enclosure insulators and main circuit of bus bar	1 Set
4	Tripping and closing coils	3 Sets
5	SF6 Pressure gauges	2 Sets
6	SF6 Pressure relief devices	2 Sets
7	Oil pressure switch	2 Sets
8	Auxiliary contacts for circuit breaker	1 Set
9	Auxiliary contacts for DS and ES	1 Set
10	SF6 gas in steel bottle 52 Kg / bottle	2 Nos.
11	Hydraulic Pump/spring charge motor for circuit breakers	1 unit
12	Complete drive mechanism for disconnect switches and grounding switches	1 unit
13	Motor for disconnect switches and grounding switches	1 unit
14	Complete drive mechanism for fast acting grounding switches	1 unit
15	Motor for fast acting grounding switches	1 unit
16	Rupture disc for circuit breakers / potential transformer	1 no
17	Set of spares for local control cabinet including M.C.B., fuses, time relays, auxiliary relay and terminals	

18	Rupture disc for other compartments	2 nos
19	SPECIAL TOOLS	
i)	SF6 gas leak detector	1 Set
ii)	Hygrometer	1 Set
iv)	Milli volt drop measurement appliance	1 Set
v)	One set of Box Spanner	1 Set
vi)	One set of adjustable Spanner	1 Set
vii)	Sf6 gas bottle locking, measuring and filling assembly with all hose	2 Set
viii)	One set of pipe grooving tools for the hydraulic operating mechanism	1 Set
ix)	Infra red camera	1 set

SPECIFICATIONS FOR CUBICLE INDOOR TYPE

33KV SF6 GAS INSULATED SWITCHGEAR (GIS)

DESIGN, CONSTRUCTION, PERFORMANCE TESTING, INSPECTION, PACKING AND DELIVERY OF 33KV CUBICLE GIS

1. SCOPE

- 1.1 This specification calls for supply of 33kV CUBICLE TYPE GAS INSULATED SWITCHGEAR (33kV GIS) and associated accessories as specified herein, for OPTCL.. The scope covers design, manufacture, inspection and testing at the

VENDOR's and/or his SUB-VENDOR's works; packing for shipment and delivery to OPTCL site including complete erection, testing & commissioning. GIS Manufacturer shall undertake Supervision activity for erection, site testing and commissioning of 33 kV Gas Insulated cubicle type switchgear and accessories, including the associated main bus bars and cable termination assemblies and associated platforms, supports and internal wiring etc.

- 1.2 **The intent of this specification is to provide the work enumerated to be fully complete in every detail for the function designated. It is hereby required that the BIDDER, in accepting the contract, agrees to furnish all apparatus, appliances, material not herein specifically mentioned or included, but which may be found necessary to complete, perfect or test any portion of the apparatus or equipment herein specified in a substantial manner, and in compliance with the requirements implied in this specification and without extra cost to the PURCHASER.**
- 1.3 It is not the intent to specify completely herein, all details of design and construction of the equipment. However, the equipment shall conform in all respects to high standards of engineering design and workmanship and be capable of performing in continuous commercial operation up to the VENDOR's guarantees in a manner acceptable to the purchaser, who will interpret the meaning of drawings and specifications and shall be entitled to reject any work / material which in his judgment is not in full accordance therewith.
- 1.4 Whether called for specifically or not, all accessories required for normal operation of equipment are deemed to be a part of VENDOR's scope of supply.

2. STANDARDS

- 2.1 The design, material, construction, manufacture, inspection, testing and performance of 33kV GIS shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. The GIS equipment shall also conform to the IEC 62271-200.
3. TYPE & RATING: The 33kV GIS shall be of cubicle type and shall comprise three /isolated phase copper main bus bars, circuit breakers, isolators, earth switches, CTs, VTs, Surge Arresters and other accessories with rating and electrical characteristics as given in the specific requirements.

4. FREQUENCY

The 33kV GIS shall be suitable for continuous operation with a frequency variation of 5% from normal of 50 Hz.

5. Availability Requirements:

- 5.1 The gas insulated switchgear and accessories shall be designed for maximum reliability and availability.
- 5.2 The design ambient temperature considered for continuous rating of the equipment shall be 50°C.
- 5.3 It shall be possible to interchange various cubicles. Bidders shall clearly bring out the modifications required to be carried out for interchanging/converting incomer/transformer bays and outgoing feeder bays.

6. Layout Requirements:

- 6.1 It is intended that the GIS shall be located indoors.
- 6.2 The GIS will be mounted on concrete foundations. Any necessary supporting framework and base plates shall be provided by the BIDDER.
- 6.3 Bidder shall indicate recommended clearance from the top of panel to the ceiling and also material handling facility. The BIDDER shall specifically review the area indicated and confirm suitability of the equipment offered to fit into the space shown including area required for future extensions. Deviations, if any, shall be highlighted in the bid
- 6.4 The bidder shall ensure that dimensions and weight of the largest package shipping/transport do not exceed the permissible values imposed by Transporting Authorities.

The 33KV Cubicle type GIS shall be with Double Bus bar (One bus shall be as Main & the other shall be as Reserve/Transfer Bus) as mentioned in the tender

7.0 SWITCHGEAR ASSEMBLY

The switchgear assembly shall essentially consist of following items:

- a. Circuit breakers
- b. Disconnect Switches (Isolators) and earth switches
- c. Voltage transformers, Current transformers and Surge Arresters
- d. Cable chamber for termination of Power cables along with termination arrangement
- e. Isolated or 3-phase main bus enclosures and accessories.
- f. Local control cubicle.
- g. SF6 gas sufficient for the entire switchgear including loss during installation + 10% extra SF6 gas.
- h. Dummy panels wherever necessary.

8.1 CIRCUIT BREAKERS

8.1.1 General

1 The circuit breakers shall be vacuum type isolated phase, for independent pole operation and shall have duplicate trip coils. They shall be electrically and mechanically trip free where applicable and anti-pumping with either or both of the duplicate trip circuits connected. A manual emergency trip facility is required to be provided.

2 The circuit breaker shall normally be suitable for remote electrical operation at DC voltage as specified in the "Specific Requirements" with either or both of the duplicate trip circuits connected. Pole discrepancy tripping shall be provided, if applicable.

3 The breaker enclosure shall have provision for easy with drawl of the interrupter assemblies. Checking the contact condition of the interrupter elements must be possible without disturbing any other gas compartment.

4 The name plate shall display the actual site rating of the equipment.

8.1.2 Circuit Breaker Performances

1 Duty Cycle: Open-0.3 seconds-Close-Open-3.0 minutes-Close-Open.

2 Breaking time : The maximum breaking time at the minimum operating pressure of the mechanism shall be 3.0 cycles.

8.1.3 Circuit Breaker Construction Features

The vacuum circuit breakers, vacuum monitor device shall be supplied to aid maintenance personnel to estimate whether vacuum levels are within acceptable/ permissible limits. This device can be portable and shall be designed to permit easy connection/ disconnection with any breaker without in any manner influencing the integrity of sealing of the vacuum interrupter.

It shall be possible to quickly isolate mechanically the interrupter unit of a vacuum circuit breaker from the breaker operating mechanism for checking loss of vacuum inside the interrupter.

Vacuum circuit breaker shall be provided with a suitable metal shield for protecting the testing/ maintenance engineer from X-ray radiations emitted during high voltage testing of interrupter unit.

8.1.5 Operating Mechanism

- 1 Circuit breakers shall be power operated by a motor charged spring operated mechanism. Main poles of the breaker shall be such that the design shall ensure a close pole spread with timings as per GIS manufacturers standard.
- 2 Circuit breakers shall feature high repeatability of absolute closing time over a wide range of parameters (ambient temperature, control voltages, etc.).
- 3 Main poles shall operate simultaneously. There shall be no objectionable rebound and the mechanism shall not require any critical adjustment. It shall be strong, rigid, positive and fast in operation.
- 4 Trip coil shall be rating shall be specified by the bidder for continuous rating.
- 5 A mechanical indicator shall be provided to indicate open and closed positions at a location from where it will be visible to a man standing on the ground. An operation counter shall also be provided.
- 6 A closing release shall operate correctly at all values of control voltage between 80% and 110% of the rated voltage. A shunt trip shall operate correctly under all operating conditions of the circuit breaker up to the rated breaking capacity of the circuit breaker and at all values of control supply voltage between 70% and 110% of rated voltage.
- 7 Working parts of the mechanism shall be of corrosion resisting material. Bearings which require grease shall be equipped with pressure type grease fittings. Bearing pin, bolts, nuts and other parts shall be adequately pinned or locked to prevent loosening or changing of adjustment with repeated operation of the breaker.

8.1.6 Spring Operated Mechanism

- 1) Spring operated mechanism shall be complete with motor, opening spring, closing spring with limit switch for automatic charging and all necessary accessories to make the mechanism a complete operating unit.
- 2) As long as power is available to the motor, a continuous sequence of closing and opening operations shall be possible.
- 3) After failure of power supply to the motor, at least one close-open (CO) operations of the circuit breaker shall be possible.
- 4) Breaker operation shall be independent of the motor which shall be used solely for compressing the closing spring.
- 5) Closing action of the circuit breaker shall compress the opening spring ready for tripping.

- 6) When closing springs are discharged after closing a breaker, closing springs shall automatically be charged for the next operation.

8.1.8 Contacts

- 1 Main contacts shall have ample area and contact pressure for carrying the rated current and the short time rated current of the breaker without excessive temperature rise which may cause pitting or welding. Contacts shall be easily replaceable and shall have a minimum of movable parts and adjustments to accomplish these results. Main contacts shall be the first to open and the last to close so that there will be little contact burning and wear.
- 2 Arcing contacts, if provided, shall be the first to close and the last to open and shall be easily accessible for inspection and replacement. Tips of arcing and main contacts shall be silver faced or have tungsten alloy tipping.

8.2 **DISCONNECT SWITCHES (ISOLATORS) AND EARTH SWITCHES**

8.2.1 Construction Features

- 1 The Isolators, earth switches and maintenance earth switches, as applicable, shall be complete with all parts that are necessary or essential for efficient and safe operation. Such parts shall be deemed to be within the scope of supply, whether specifically mentioned or not.
- 2 All similar parts shall be interchangeable.
- 3 The design shall be such that no lubrication of any part is required except at very infrequent intervals.
- 4 The isolator and earthing switch shall be provided with high current carrying contacts on the hinge and jaw ends and all contact surfaces shall be of silver/tinned faced copper, if required.
- 5 Arrangement shall be provided to enable manual operation of Isolators and earth switches. Whenever the emergency manual handle is inserted into the drive mechanism, it shall not be possible to control the device electrically.

8.2.2 Accessories

- 1 Position Indicator: A mechanical position indicating device shall be provided for each isolator/earthing switch which shall be clearly visible from ground.
- 2 Name Plate: A weather-proof and corrosion-proof name plate shall be provided on each isolator, earthing switch and operating devices etc. The name plates shall conform to applicable standards.

8.2.3 Earthing Switch

- 1 Earthing switch shall be designed in a manner to prevent transmitting of impact to earth switch bushing during high speed closing operation of the earth switch.
- 2 The earth switches shall have fault current rating as specified.
- 3 Earth switches shall be either be motor driven or stored energy operated and controlled from the local control panel as specified. After removal of the ground initiated by a fault making ground switch, it must be possible to re-energize the system without first carrying out maintenance. The BIDDER shall state what precautions are taken to minimize the accidental discharge of the stored energy operating mechanisms. This will not be applicable for hand

operated earth switches.

8.2.4 Interlocks among circuit breaker, earthing switches and doors shall be as per the recommendations of the GIS manufacturer.

8.2.5 Operating Mechanism and Controls

1. Isolators shall be motor operated and controlled from the local control panel and from a remote point. Connections, interlocking requirements and auxiliary switches shall be in accordance with the PURCHASER's requirements.

2. The operating mechanism shall provide a quick, simple and effective operation. One man shall be able to operate the isolator/earthing switch (when manually operated) without undue effort.

3. The isolator shall be provided with positive continuous control throughout the entire cycle of operation. The operating pipes and rods shall be sufficiently rigid to maintain positive control under most adverse conditions and when operated in tension or compression for isolator closing. They shall also be capable of withstanding all torsion and bending stresses due to operation of the isolator.

4. In addition to the limit switch contacts required for control of power operated isolators, the number of auxiliary contacts shall be provided. These switch contacts shall be positive acting type and shall be directly driven from the isolator shaft through minimum linkages. The auxiliary contacts shall be of silver faced copper. When make before break contacts are specified, they shall be wiping type. The contacts (including limit switch contacts) shall be designed to carry 10A continuously without undue temperature rise. All contacts (including limit switch contacts) shall be suitable for breaking an inductive current of 2A at specified DC voltage.

5. A local isolating switch fuse unit for disconnection of power supply, a local/remote selector switch and a set of open/close push buttons shall be provided in the associated local control panel for motor operated isolators.

6. The control shall be arranged such that the desired operation shall be completed when corresponding push button is pressed even momentarily. The control circuit shall be so designed that necessary interlocks with associated breakers and earthing switch shall be incorporated in it.

7. Arrangement shall be provided to permit manual operation of isolators. The arrangements shall be such that when manual operating handle is in the engaged position, the power operation shall be made inoperative.

8. Disconnecter and earthing switch mechanisms shall be able to store energy to always assure completed operations.

9. If the power supply to Isolator/ earthing switch is initially off and open/close command is given to isolator/earth switch which cannot be carried out due to non-availability of power at that moment, the operation of Isolator/Earth switch shall not take place when power supply is restored subsequently.

8.2.6 Short Circuit Requirements (except for Disconnecter for VT in incoming panel)

1. The rated peak short-circuit current or the rated short time current carried by an isolator or earthing switch for the rated maximum duration of short circuit shall not cause:

a) Mechanical damage to any part of the isolator or earthing switch.

b) Separation of the contacts or contact welding.

- c) A temperature rise likely to damage insulation.
- 2 After the passage of these currents, the isolator shall be able to carry its rated current under specified conditions and the operation of the operating device shall not be impaired.
- 3 If earthing switch is combined with an isolator as a single unit, the rated peak short circuit current and the rated short time current of the earthing switch shall be at least equal to those specified for the isolator.

8.3 CURRENT AND VOLTAGE TRANSFORMERS

8.3.1 General Requirements

1. Secondary terminals of each voltage and current transformers shall be brought out in a weather-proof terminal box. Facility shall be provided for short circuiting and earthing the CT secondary at the terminal box. The star point whenever required shall be formed at the terminal box only.
2. Terminal and polarity marks shall be indelibly marked on each VT & CT on the associated terminals and these marks shall be in accordance with relevant standards.
3. In case of unearthed voltage transformers both the terminals of the primary winding shall be brought out through bushings rated for full line voltage. In case of earthed voltage transformers, the end of the primary winding intended to be earthed shall be brought out through a bushing and earthing connection shall be made outside. This is required to facilitate meggering of the primary winding for which the earth connection has to be removed. The neutral side bushings of the voltage transformers shall be rated for 1.1 kV class.
4. The secondary terminal box for the voltage transformers shall also include necessary MCBs for protecting the secondary circuit
5. Whenever a VT secondary winding is used for both measurement and protection application, it shall have dual accuracy class of 0.2/3P, unless otherwise specified.
6. All CT cores in this specification shall be of low reactance type except metering core.
7. No turns compensation shall be used in case of 'Class PS' CTs.
8. Turns compensation, if any, should be clearly brought out in the offer in guaranteed particulars.
9. In case of multi ratio CTs, the minimum specified requirements in respect of VA, accuracy and knee point voltage (KPV) and maximum secondary resistance specified shall be met at all taps.
10. Magnetizing characteristics (extending well beyond KPV) and secondary impedance values shall be furnished in guaranteed particulars for all protection cores.
11. Voltage transformers shall be of electromagnetic type. Capacitor voltage transformers shall not be acceptable.
12. Voltage and current transformers shall be provided with the following accessories:
13. Voltage and current transformers shall be given tropicalised treatment for satisfactory operation in hot and humid climate.
 - a) Two earthing terminals for connecting the PURCHASER's earthing conductors specified.
 - b) Rating and diagram plates shall be provided as per IEC standards.

8.3.2 VOLTAGE TRANSFORMERS

- 1 Voltage transformers shall be of the metal enclosed, gas-insulated inductive type, mounted directly on the high voltage enclosure with plug in contacts without fuse that allow easy removal.
- 2 Minimum accuracy, burden and transient response characteristics shall be in accordance with the specification.
- 3 Secondary terminals must be located in accessible grounded terminal boxes on the PT enclosure itself. The secondary connections must be wired to the terminal strip in the respective bay marshalling cubicle.
- 4 BIDDER shall provide the VT selection scheme for outgoing feeders ie. potential supply to protection system shall be switched to bus VT depending on position of bus side disconnect switch (power supply to the feeder and VT potential supply for protection shall be from the same bus.)

8.3.3 CURRENT TRANSFORMERS

8.3.3.1 Number and Location of CTs

- a) The CTs shall be provided as per specification.
- b) The physical relative location of CT cores should be as per the locations shown in the single line diagrams, to ensure overlapping of protective zones.

8.3.3.2 Minimum Accuracy for Relaying Cores

PS class, Class 0.2 & Class PS shall be as per specification. The relaying cores shall be of low remanence design. Gaps in the core shall not be larger than necessary to limit remanence. The core remanence shall not exceed 10% of the saturation flux that is created by the application of 10 DC ampere turns per inch length of core around the magnetic path.

8.3.3.4 Other CT Requirements.

- a) For each type of CT, application data shall be supplied in accordance with IEC 60185.
- b) Readily accessible name plate(s) shall be provided for each CT showing ratings, terminal markings and low remanence designation.
- c) The position of each primary terminal in the current transformer shall be clearly marked by two plates permanently fixed to the metal cladding at each end of the current transformer section.
- d) In addition to the information requested, short time rating factors for 5, 15, 30 and 60 minutes shall also be provided.

8.3.3.5 Current transformers must have secondary terminals outside the high voltage enclosure, mounted in suitable accessible terminal boxes. All secondary leads of all CTs must be wired to shorting type terminals on the terminal strip in the local control panel of each breaker bay.

Note: The details of the CTs will be finalized later, based on the protection relay study.

8.4 Surge Arresters

The specifications and characteristics of the surge arresters shall be finalized during detailed engineering.

8.5 LOW VOLTAGE PANELS

The accessories and auxiliary equipment required for the correct functioning of each circuit element shall be installed in conveniently located mechanism cabinet or could be an integral part of the circuit element.

8.5.1 General Requirements

- a) Individual local control panels/Cabinets/Cubicles for each circuit shall be supplied as a part of this contract to facilitate local control of circuit breakers, isolators and earth switches. These panels shall also house the various relays, timers, etc. to realise various interlocks as per PURCHASER's requirement among circuit breakers, isolators and earth switches. The contacts, signals and conditions originating from/going to the gas insulated switchgear, associated auxiliary and monitoring equipment shall be wired up to the local control panel, for PURCHASER's further

use.

- b) Completely separate and isolated circuit shall be used for switchgear control, tripping, alarms and auxiliary devices. CLOSE and TRIP circuits shall be kept isolated to their final mechanical or electrical actuators. Trip circuits shall be individually and permanently monitored for continuity.

Each auxiliary control circuit shall be monitored and shall be protected by a two pole miniature circuit breaker with auxiliary contacts.

c) Constructional Features

1. All panels shall be totally enclosed rigid sheet steel structures. All doors, removable covers and plates shall be gasketed all around with neoprene gaskets. All accessible live connections shall be shrouded and it shall be possible to change individual fuses, switches, MCBs without danger of contact with live metal.
2. A ground bar for terminating the ground wires of shielded control cables shall be located near the cable entrance location.
3. A receptacle rated 415V, 20A, AC 3 phase, 4 wire shall be installed in each panel in addition to a light point with door switch and one 6 pin, 240V AC, 5/15A socket outlet.
4. Adequate safety precautions shall be taken to avoid accidental contact with 415V potential. The following precautions shall be observed:
 - i) All live parts shall be completely shielded using a halogen free fire retardant insulating material.
 - ii) 600V terminal blocks shall have removable covers and wiring shall be separated from other potentials.
 - iii) A clear and legible warning notice carrying wording "DANGER-415V" shall be located on the enclosure door.
5. All control equipment shall be suitable for operating in an ambient temperature varying between +10 deg. C and +40 deg.C.
6. Cabinet doors shall have provision for padlocking. Door shall be constructed such that they do not seize in the event of an internal fire.
7. All live parts shall be provided with at least phase to phase and phase to earth clearance in air of 25 mm and 20 mm respectively.
8. Adequate interior cabling space and suitable removable cable gland plate shall be provided. Necessary number of cable glands including cable glands for cables from control room to GIS shall be supplied and fitted on to this gland plate. Cable glands shall be screwed-on type and made of brass. The cable entry shall be from bottom only.
9. All the hardware required for fixing the panel shall be in BIDDER's scope.
10. Terminal blocks for terminating all control, indication and monitoring wiring from the associated circuit element shall be installed in each cabinet. All terminal blocks shall be identified with marking strips. The conductor size range which the terminals can accommodate shall be clearly shown on the BIDDERS drawings. The terminal blocks used for cable connections shall be disconnecting type. All terminal blocks shall be covered by acrylic covers.
11. Disconnecting type terminal links shall be provided for current transformer circuits.

d) Switches/ MCBs

- 1 Switches/MCBs shall be hand operated, air break, heavy duty, quick make, quick break type conforming to applicable IEC standards.
- 2 It shall be the responsibility of the VENDOR to fully coordinate the overload and short circuit tripping of the MCBs with the downstream MCBs/fuses provide satisfactory discrimination.
- 3 A single throw isolating switches for complete isolation of the DC control circuits shall be provided.

f) Control & Auxiliary Power Supply

- 1 All control equipment shall be suitable for operation on specified DC voltage system.
- 2 In case two systems are working on two different battery potentials, say A and B, both A and B potentials shall not be connected to the contacts of same relay. However, it is permissible to use, for example, the relay coil on A and the contacts on B battery. Dissimilar potentials shall not occur on contacts of same relay.
- 3 DC & AC power supply shall be done in a manner which will enable isolation of individual equipment. Common supply bus will be formed in the cubicle and then power supply shall be distributed into individual equipment through MCCBs.
- 4 Separate circuits with switches, fuses etc of adequate rating shall be provided for control of space heater, lighting and power receptacle etc. These shall be on 240V, 1 phase AC supply.

g) Relays

- 1 Relays for various control, monitoring and blocking functions of a particular circuit element shall be installed in associated local control panel. Protective relays shall be subject to transient tests and shall be approved by the PURCHASER. All relay shall have dust covers. Please refer Section C3 for detailed specifications of BCUs and BCPUs.
- 2 Necessary auxiliary relays for alarm, time-delay relays, voltage relays as required for control and protection shall be mounted inside the local control panel. Voltage relays shall have sufficient thermal capacity for continuous energisation, using external resistors, if necessary.
- 3 Auxiliary relays shall be rated to operate satisfactorily between 80% and 110% of the rated voltage.
- 4 Each relay shall be provided with atleast 4 NO and 4 NC potential free contacts for the PURCHASER's use.
- 5 Coils of all the relays shall be adequately rated to avoid spurious operation of relays on DC system ground or induced surges. Minimum pick up current of relay coil shall be 100 milli amps.
- 6 All relays shall be tropicalised and suitable for maximum ambient temperature of 40 deg. C.
- 7 Make and type of relay shall be subject to the PURCHASER's approval.

h) Space Heater

Strip type space heaters of adequate capacity shall be provided inside each cabinet. Heaters shall be complete with rotary type ON-OFF switch, HRC fust on phase or a single-pole MCB with overload and short circuit protection, link on the neutral and a thermostat to cut off the heaters at 45 deg.C. The heaters shall be suitable for connecting to 240V, 1

phase, and 50 Hz supply.

i) Interior Lighting and Receptacle

Control cabinet shall be provided with a 240V, 1 phase, 50 Hz, 40W preferably fluorescent lighting fixture for interior illumination controlled by an ON-OFF switch and 240V, 1 phase, 5/15 amp. 6 pin receptacle. Power source for interior lighting and receptacles shall be completely independent of control power source.

j) Internal Wiring

1 LV control panels shall be completely wired, ready for the PURCHASER's external connections at the terminal blocks. All wiring shall be carried out with wires of 600V grade, stranded copper conductors. The insulation shall be fire retardant low smoke type, approved and tested in accordance with PURCHASER's requirement. Power circuits shall be wired with stranded tinned copper conductors of adequate sizes to suit the rated current. Alarm and indication circuits shall be wired with stranded, tinned copper conductors of sizes not smaller than 1.25 sq.mm and shall be shielded type. CT circuits shall be wired with stranded copper conductor of size not smaller than 2.0 sq.mm.

2 Engraved identification ferrules, marked to correspond with the wiring diagram shall be fitted at both ends of each wire. All wiring shall be terminated on terminal blocks. Terminals shall be adequately rated for the circuit current the minimum rating shall be 20 A. Control wiring shall be protected against mechanical damage and shall be colour coded in accordance with PURCHASER's requirement. Colour sleeves may be used in lieu of continuous colouring. Physical separation between various colour wiring shall be maintained as much as possible.

3 The wire terminations shall be made with solderless crimping type of tinned copper lugs which firmly grip insulation and conduction.

4 Panel wiring shall be securely supported, neatly installed by lacing and tying, readily accessible and connected to equipment terminals and terminal blocks. Flame retardant plastic wiring channels/troughs with strap on covers shall be used for this purpose.

k) Mimic Diagrams (Optional)

Mimic diagrams shall be provided on local control panels. The mimic strips shall be screwed onto the panel and shall be made of anodised aluminium. Colours of the various voltages of the mimic bus shall be subject to the PURCHASER's approval. The width of mimic strip shall not be less than 7 mm.

l) Local Alarm/Annunciation

1 Window type alarm annunciation shall be provided on local control panels of each bay for various abnormal conditions. The alarm windows should have provisions for detecting cleared and un-cleared faults and flashing for new faults.

2 The following abnormal conditions shall be annunciated (additional to list). i) Low gas pressure for each gas compartment of the bay. ii) Low-Low gas pressure for each gas compartment of the bay. iii) High gas pressure for each gas compartment of the bay. iv) Spring motor excessive start. v) Spring motor run excessive. vi) Spring motor overload. vii) Spring motor circuit trouble. viii) Spring is charged. xiii) Breaker pole discrepancy. xiv) Isolator open/close incomplete. xv) Isolator motor overload, one for each bay, xvi) D.C. control supply failure. xvii) Alarm circuit D.C. healthy (continuously 'ON'), xviii) Selector switch local, xix) Four spare windows.

m) Labels and Diagram Plate

1 Every equipment mounted in the cabinet shall be provided with individual labels with equipment designation/rating. Also, the cabinet shall be provided on the front with a non-rusting label engraved with the designation of the cabinet.

2 Inside the door, a circuit diagram engraved on non-rusting metal shall be fixed for reference.

9. SF6 Gas

9.1 Density and Pressure

The nominal operating pressure of SF6 insulated gas in the equipment shall be as low as is compatible with the requirements for electrical insulation and space limitations to reduce the effects of leaks and to ensure that there is no chance of the gas liquefying at the lowest ambient temperature. The initial gas pressure or density at the time of charging the equipment shall provide a sufficient margin above the minimum allowable pressure for the plant to be safely operated for a reasonably long period before recharging is necessary.

10.2 SF6 Gas Purity

- a) The SF6 switchgear shall be designed for use with SF6 gas complying with the recommendations of IEC-60376 at the time of the first charging with gas. All SF6 gas supplied as part of the contract shall comply with the requirements of IEC. 60376.
- b) Molecular sieve or activated alumina or other absorbent for removal of SF6 arc products and moisture absorbents shall be provided in each gas compartment.
- c) The SF6 gas shall have the following characteristics:
 - 1) Physical properties: Colourless, odourless, non-toxic and non-flammable.
 - 2) Density at 20°C and/Bar 6.08 g/l 8) Preferred cylinder size 40 Ltr.
 - 3) Type of cylinder Seamless type

10.3 SF6 Gas Monitoring Devices

- 1. All gas compartments must have their own independent gas supervision and alarm systems. Each gas supervision circuit shall be equipped with a temperature compensated pressure gauge, test connection point and maintenance connection point and the same shall be easily accessible. Bus bar side Disconnecter (DS)/Earth Switches (ES) shall have common gas density monitor for all the three phase.

All other equipments such as Circuit breaker, Line side DS/ES can either have common or separate gas density monitor system for all the three phases.

- 2. The gas density and pressure sensitive devices, together with all relays supplied by the manufacturer for use in protection, shall be approved by the PURCHASER. It shall be possible to test all gas monitoring relays without de-energising the primary equipment and without reducing pressure in the main section. Disconnecting type plugs and sockets shall be used for test purposes; the pressure/density device shall be suitable for connecting to the male portion of the plug.
- 3. Two potential free electrical contacts shall be provided with each and every alarm condition. These are to be grouped together and wired to the cable termination blocks in the local control panels to give remote alarm indications/annunciations in equipment being supplied

by the PURCHASER. The BIDDER will be advised of the grouping required after the contract has been placed.

4. BIDDER shall advise if the breakers are suitable for breaking the load current even if SF6 gas pressure has reduced to atmospheric pressure.

10.5 Sectionalisation

10.5.1 The assembly shall consist of completely separate, pressurized sections. The switchgear gas enclosures must be sectionalised with gastight barriers between sections or compartments as per the below:

- a) One compartment for bus bar, Isolator and earthing switch
- b) One compartment of circuit breaker and cable connection

10.5.5 The mass of gas in all the individual compartments at rated nominal density shall be indicated in the bid.

10.6 Support Insulators and Section Barriers

10.6.1 The support insulators and section barriers/insulators shall be manufactured from the highest quality material. They shall be free from all voids and the design shall be such as to reduce the electrical stresses in the insulators to a minimum. They shall be sufficiently strong to ensure that the conductor spacing and clearances are maintained when short circuit faults occur.

10.6.2 Tests shall be carried out during the manufacture of the switchgear to ensure that all insulators and barriers are free of partial discharge at a voltage which is at least 20% greater than the maximum service voltage.

10.6.3 The Gas section barriers including seals to the conductor and enclosure wall shall be gas-tight and shall be capable of withstanding the maximum differential pressure that could occur across the barrier i.e with a vacuum drawn on one side of the barrier and on the other side, at least twice the rated gas service pressure that can exist under normal operating and maintenance conditions or the maximum gas over pressure, at least equal to the operating pressure of the relief devices, that could be attained with a persistent internal arc fault.

10.7 Gas Seals

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.

10.8 Expansion Joints and Flexible Connections

10.8.1 Expansion joints or flexible connections, in the metal enclosures, to absorb the actual or relative thermal expansion and contraction of the SF6 equipment as well as structures, foundations and floors on which the equipment is mounted, resulting from variations in the temperature of the switchgear equipment shall be provided, if required.

10.8.2 The number and position of expansion joints or flexible connections are to be determined by the BIDDER to ensure that the complete installation will not be subjected to any expansion stresses which could lead to distortion or premature failure of any piece of the GIS equipment, support structure or foundations.

10.8.3 Electrical continuity of the connection for all enclosures across bolted joints/expansion/flexible connections shall be achieved.

10.9 Supply of SF6 Gas

The contract shall include the supply of all the SF6 gas necessary for filling and putting into commercial operation the complete switchgear installation being supplied including loss during installation. In addition, ten percent of the total SF6 gas required for the GIS shall be supplied as spare and shall be included in the contract.

11. Earthing

1. The MANUFACTURER shall provide a "Main Ground Bus", rated 31.5 kA for 3 sec to which all intentionally earthed parts of the assembly must be connected.
2. It shall be the responsibility of the VENDOR to provide a sufficient number of earth points so that dangerous voltages are not induced in the enclosure by the fault currents circulating in the inner conductor.
3. Every section of the SF6 switchgear equipment including all panels, cubicles, kiosks and boxes shall be solidly bonded to the earthing system.
4. Earth switches, voltage transformers and panels shall be bonded to the earthing system as specified in the relevant previous clauses.
8. All steelwork, access decking, handrails etc., shall also be effectively bonded to the earthing system.
9. The design of the earthing system shall be such as to ensure the safety and protection of all operating and maintenance personnel under all normal and fault conditions.
10. The enclosure of the equipment and support structure of GIS shall be earthed in such a way that the following conditions are obtained:
 - (a) The touch potential at any part of the enclosure is less than 65 V.
 - (b) The induced current during normal operation is prevented from entering the earthing grid.

12. Interlocks

All interlocks required between circuit breaker, disconnect and earth switches shall be as per the recommendation of the GIS manufacturer.

13. Future Extension

It is proposed to make provision for additional bays at a later date.

- 1 It shall be possible in future to extend the bus bars. BIDDER shall separately quote for additional items required to be provided now to facilitate future extension without necessitating complete outage of the bus bars.
- 2 It is a firm requirement that no changes are made to the enclosure during future extension. Also, the downtime must be minimum when extension is carried out. During erection/testing of extension, outage of only one bus section and associated equipment will be available. Under no circumstances outage of both the bus sections (resulting in complete shutdown of the station) will be permissible. The BIDDER is required to bring out in detail his proposal for achieving future extension and indicate if shutdown of any part of the equipment/circuit will be required for erection, dielectric testing along with Gas Line Diagram etc. The bidder will give step by step procedure for extension of bays on either side of GIS, at later date.

14. Foundation Channels & Supporting frame work

1 All supporting steel structures for switchgear bays, bus duct support, etc. shall be a part of Bidder's supply.

2 All 33kV GIS shall be supplied with bolts, nuts, washers and accessories required for fixing the GIS to the foundation.

15. Temperature Rise Temperature rise of enclosure and conductor shall be such that the final temperature does not exceed the values specified for specified site conditions including the effects of solar radiation. BIDDER shall provide test reports/ calculations to prove this.

16. Gas Leakage The guaranteed maximum gas leakage shall be less than 1% per year for any individual gas compartment and for the whole equipment.

17. Losses Manufacturers shall provide details of the losses at rated current.

18. Tests and Test Reports

19.1 The Type test reports shall be submitted with the bid.

19.2 Acceptance and routine tests for all supply equipments/components parts shall be carried out as per the relevant standards for the respective equipment. These test reports and shall be submitted to the PURCHASER before despatch of the equipment.

19.3 Local control panel shall be subjected to the following tests:

i. High Voltage test (2000V for 1 minute)

ii Megger test.

iii Electrical control, interlock and sequential operation tests

20. DRAWINGS DATA AND GUARANTEED TECHNICAL PARTICULARS TO BE FURNISHED BY THE BIDDER

20.1 The following drawings/information for each items are to be supplied as part of this contract:

a) Outline dimensional drawings of 33kV GIS and accessories.

b) Shipping drawings showing dimensions and weights of each package.

c) Assembly drawings and weights of main component parts.

d) Drawings giving the weights for foundations.

e) Name plate diagrams.

f) Schematic control along with logic block diagram and wiring diagram for all auxiliary equipment.

j) Test reports

k) Crane requirements for assembly and dismantling

l) Cable box connections.

m) Foundation drawing of GIS, support structures, cable box etc.

20.2 Manufacturer shall submit following for Purchaser's reference before despatch of the transformer.

a) Six (06) copies of instruction books/operation and maintenance manuals and spare part bulletins.

b) Descriptions literature and data on GIS construction.

20.3 After the award of the contract six (6) copies of drawings, drawn to scale, describing the equipment in detail shall be forwarded for Purchasers approval, and shall subsequently provide eight (8) complete sets of final drawings, one of which shall be auto positive and editable soft copy suitable for reproduction, before the despatch of the equipment.

21. Technical particulars of 33KV Cubicle GIS.

Sl. No.	Particulars	33 kV GIS (Cubicle type)
1.		
a)	Type (Model No.)	To be specified by the bidder.
b)	Standard Applicable	IEC-62271-100 / IEC-62271-200
2.	Service	Indoor
3.	Enclosure	Sheet Steel with anti corrosion paints.
4.	Nominal System Voltage	33 kV
5.	Highest System Voltage	36 kV
6.	No. of phases and frequency	3ph. 50 Hz
7.	Busbar material	Aluminium
8.	Bus Color code	RYB
9.	System Earthing	Solidly earthed
10.	Circuit Breaker Rating	
10.1	Continuous Current Rating at 40 Deg C	2000A
10.2	Short Circuit Rating	31.5 kA
10.3	Short Circuit duration	3 sec
11.	Rated making Current	As per IEC-62271
12	Operating duty	O-0.3sec-CO-3 minutes -CO
13	Leakage rate per year in gas compartment as per IEC	Less than 0.5%
12.	Busbar rating	As per SLD
13.	Outgoing feeder rating	As per SLD
13.	Power Frequency Withstand voltage	70 kV for 1 minute
14.	Impulse withstand voltage (1.2/50 micro sec)	170 kV
15.	Control Voltage	220 V DC
16	Spring charge motor voltage	220 V DC
17.	CT Ratio	Secondary Current 1A (Ratio during detail engineering)
18.	PT ratio -STAR/ STAR/ Open delta	(33//3) / (.11//3) / (. 11/3)
19.	Aux. Contacts	As per manufacturer standard
20.	Termination	
20.1	Incomers	XLPE Cables **
20.2	Outgoings	XLPE Cables **
21.	Degree of protection (HV equipment)	IP – 65 for Gas Compartment

**** Notes:**

- 1) The length details of the XLPE cables shall be estimated during detailed engineering.
- 2) Interface of 33kV GIS the feeder bays to be finalized during detailed engineering.
- 3) From the 33 KV GIS XLPE cable shall be used for station transformers.

**GUARANTEED TECHNICAL PARTICULARS FOR 33KV GIS
SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS FOR BREAKERS / PANELS**

01.	Manufacturer's Name and Country of origin	
02.	Manufacturer's Design / type Ref	
03.	Frequency	
04.	Rated Voltage	
05.	Highest system voltage	
06.	Rated current	
07.	Short Circuit current rating with duration	

08.	Certificate or report of short circuit type test	
09.	Rated operating duty cycle	
10.	Short Circuit Breaking Current : (a) Symmetrical (b) Symmetrical at rated voltage (c) Asymmetrical at rated voltage (i) Per Phase (ii) Average (iii) D.C.Component	
11	Arcing time (at rated breaking current) in ms.	
12	Opening time	
13	Total break time in milli sec.	
	(a) At 10% rated interrupting capacity (b) At rated interrupting capacity	
14.	Make time in ms.	
15.	Dry 1 minute power frequency withstand test voltage (a) Between line terminal and Earth KV rms (b) Between terminals with breaker contacts open	
16.	1.2/50 full wave impulse withstand test voltage (a) Between line terminal and Earth KV p (b) Between terminals with breaker contacts open KVp	
17.	Contact pressure	
18.	Contact Resistance	
19	Control Circuit Voltage AC / DC	
20	Power required for Closing Coil at 220 V	
21	Power required for Tripping Coil at 220V	
22	Whether Trip free or not	
23	Whether all the interlocks provided	
24	Overall dimensions	
25	Gauge of the MS sheet used for the fabrication of the cubicle Size and type of stiffeners used	
26	Total weight of one complete Breaker	

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS FOR 33KV CURRENT TRANSFORMERS

01.	Manufacturer's Name and country of origin	
02.	Manufacturer's design Ref / Model	
03.	Applicable Standards	
04.	Type	
05.	Rated Primary current	
06.	Rated secondary current	
07.	Rated frequency	
08.	Transformation ratios	
09	Number of cores	
10	Rated output (Core wise)	
11	Class of insulation	
12	Class of accuracy (a) For metering (b) For Protection	
13	Short circuit current rating and its duration	
14	Secondary resistance at 70 Deg C	
15	Continuous over load (percentage)	
16	One minute power frequency dry withstand voltage	
17	1.2/50 micro sec. impulse withstand test voltage	
18	One minute power frequency withstand test voltage on	

	secondary	
19.	Instrument safety factor	
20.	Type of primary winding	

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS FOR 33KV POTENTIAL TRANSFORMERS

01.	Manufacturer's Name and country of origin	
02.	Manufacturer's design reference	
03.	Applicable Standards	
04.	Type	
05.	Ratio	
06.	Rated Primary voltage	
07.	Rated secondary voltage	
08.	Rated frequency	
09.	Class of accuracy	
10.	No. of phase and method of connection	
11.	Burden	
12.	One min. power frequency dry flash over voltage	
13.	1.2/50 micro sec. impulse withstand test voltage	
14.	Class of insulation	

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS FOR NUMERICAL RELAYS

01.	Manufacturer's Name and country of origin	
02.	Manufacturer's design Ref / Type	
03.	Applicable Standards	
04.	Current setting range for	
	(a) Over current relay	IDMTL Instantaneous
	(b) Earth-fault relay	IDMTL Instantaneous
	(c) Contact Rating	
05.	Details on IDMTL characteristics	
06.	Whether High Set is Transient free	
07.	Whether separate Time setting for IDMTL / Instantaneous Elements available	
08.	Whether Relay senses True RMS Current	
09.	Accuracy for different settings and limits of errors	
10.	Whether settings site selectable and HMI provided	
11.	Whether Alpha Numeric LED display	
12.	Whether Compatible for 220 V DC	
13.	Whether Compatible for 1 A CT Secondary	
14.	Whether Self diagnostic features available	
15.	Whether Communication Port RS 485 Compatible for MODBUS / IEC / DNP.3 provided	
16.	Whether Blocking characteristics available for blocking the unscrupulous tripping of Upstream Breakers	
17.	a) Whether relay test block is provided b) Type of test block with literature	
18.	Whether draw out type unit or not	
19.	Types of case	
20.	Reset time	
21.	Burden of relay	
22.	Maximum and Minimum operating ambient air temperature	