

**Technical Qualifying Requirements & Experience
for
220kV Gas Insulated Switchgear (GIS) with Local Control Cabinet (LCC) & Accessories**

The bidder must have manufactured, supplied and commissioned at least one (1) type tested (as per IEC or equivalent standard) Gas Insulated Switchgear (GIS) having at least two (2) circuit breaker bays* of 220kV class and these GIS bays must have been in satisfactory operation# for at least one (1) year as on the originally scheduled date of technical bid opening for this tender.

Note:

1. #Satisfactory operation means certificate issued by the customer certifying the operation without any adverse remark(s).
2. *Circuit breaker bays for the purpose of qualifying requirement means one no. of circuit breaker bay used for controlling a line or a transformer or a reactor or a bus section or a bus coupler and comprising of at least one circuit breaker, one dis-connector and CTs. The bidder shall submit the approved single line diagram for mentioned bays.

Requisite documents:

1. Proof of manufacture, supply, commissioning of equipment (s)
2. Proof and successful operation of equipment (s)
3. Approved single line diagram of bays

	BHARAT HEAVY ELECTRICALS LIMITED TRANSMISSION BUSINESS ENGINEERING MANAGEMENT NOIDA						
	DOCUMENT NO.	TB-411-316-001		REV02	PREPARED	CHECKED	APPROVED
	TYPE OF DOC.	TECHNICAL SPECIFICATION		NAME	DKS	VK	AG
	TITLE 220kV GIS with LCC & its Accessories <i>(Suitable for highly corrosive environment of process/ petrochemical industry)</i>			SIGN	-sd-	-sd-	-sd-
				DATE	09.09.2020	09.09.2020	09.09.2020
				GROUP	TBEM		
				WO NO.	I19TB00003 REV00		
	CUSTOMER	Indian Oil Corporation Limited (IOCL)					
	CONSULTANT	TATA Consulting Engineers Limited (TCE)					
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	LOA. NO.	RPRC182491/26286965 dtd. 24.01.2020					
	WO. No.	26286965 dtd. 24.01.20120					
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SECTION 1:

SCOPE, PROJECT SPECIFIC TECHNICAL REQUIREMENTS & BILL OF QUANTITIES

1. Scope

This technical specification covers the requirements of design, engineering, fabrication, manufacturing, shop assembly, inspection and testing at manufacturer's works before supply, proper packing and delivery to project site, supervision of unloading & storage at site, and supervision of installation/ erection, site testing & commissioning, putting into successful operation complete with all materials, support structures, anchoring bolts, accessories, commissioning spares & maintenance spares, special spanners, tools & tackles, any specific required ancillary services, SF6 gas for first filling & spare etc. including training of Customer/ BHEL personnel for 220kV GIS with LCC & its Accessories complete in all respects for efficient & trouble-free operation mentioned under this specification.

Hence, the electrical scope of work under this requisition shall include but not be limited to basic and detailed engineering, as required, manufacturing, supply, transportation to site, inspection at manufacturer's work, supervision of installation, commissioning including site testing along with necessary equipment, training to Customer/ BHEL personnel, Insulation coordination studies, supply of all mandatory spares, commissioning spares, special tools and tackles as defined in the equipment datasheet, drawings, standard specifications, standards etc. attached or referred with technical specification.

This section covers the specific technical requirements of 220kV GIS with LCC & its Accessories. This constitutes minimum technical parameters for the above item as specified by the BHEL/ Customer. The offered 220kV GIS with LCC & its Accessories shall also comply with the Section-3 (Project Details and General technical requirements for all equipment under the Project) of this specification.

The specification comprises of following sections:

- | | | |
|-----------|---|--|
| Section-1 | : | Scope, Project Specific Technical Requirements & Bill of Quantities |
| Section-2 | : | Equipment Specification under scope of Supplies |
| Section-3 | : | Project Details & General Technical Requirements (For All Equipment under the Project) |
| Section-4 | : | Annexures |
| | | Annexure A- Compliance Certificate |
| | | Annexure B- Schedule of Technical Deviations |
| | | Annexure C- Guaranteed Technical Particulars |
| | | Annexure D- Technical Checklist |

The following order of priority shall be followed. In case of conflict between requirements specified in various documents, the more stringent one shall be followed. BHEL/Customer concurrence shall, however, be obtained before taking a final decision in such matters.

1. Statutory Regulations

In particular, the latest version of the following statutory regulations, as applicable, shall be followed for system,

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- o Indian Electricity Act
 - o CEA regulations
 - o The Factory Act
 - o The Petroleum Rules
 - o OISD standards
 - o Requirements of other statutory bodies as applicable, e.g. CEA, CCE, LPCB.
2. Section-1
 3. Section-2
 4. Section-3
 5. Codes & Standards

Bidder shall furnish list of conflicts/ ambiguities/ deviations, if any, along with their technical offer and also furnish the basis that is considered for submitting technical offer. BHEL/Customer will resolve listed conflicts prior to award. In case of ambiguity, bidder shall inform BHEL/Customer of their interpretation. In case bidder fails to convey the same prior to award, BHEL/ Customer decision on interpretation shall be considered final if need arises during the execution. No additional cost or extra time on account of conflicts/ ambiguities/ deviations shall be admissible.

The 220kV GIS being supplied shall be with double bus bar arrangement and with eleven (11) bay configuration and integrated LCC (Local control center). Due integration of outdoor 220 KV facilities and transformer system shall be in the bidder's scope. The scope includes supply of a minimum of following items also,

- (a) The incoming line bays will have Gas insulated bus duct connectivity with the overhead line.
- (b) The termination of incoming ACSR Moose conductors with Gas Insulated Bus-duct shall be through proper AIS-GIS bushing complete with all accessories.
- (c) The connectivity of transformer bays with 220 KV/34.5 KV outdoor transformer shall also be through Gas insulated Bus-duct. The connectivity with GIB and Transformer HV bushing shall also be through proper AIS-GIS bushing system complete with all accessories. Any intermediate conductors or connectors required for GIB to Transformer connectivity shall also be in bidder's scope

In general, no deviation from the requirements specified in various clauses of this specification shall be allowed and hence, a certificate to this effect shall have to be furnished along with the offer (Annexure-B), however bidder shall furnish list of conflicts/ ambiguities/ deviations (Annexure-A), if any. Any conflicts/ ambiguities/ deviations mentioned elsewhere in technical offer shall not be reviewed.

The equipment is required for the following project:

Name of the Customer	: Indian Oil Corporation Limited (IOCL)
Name of Consultant	: Tata Consulting Engineers Limited
Name of Main Contractor	: Bharat Heavy Electricals Limited
Name of the Project	: LSTK job for ISBL work of 220KV Grid Power Import at IOCL, Panipat Refinery

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The scope of supplies shall be as per commercial terms and conditions enclosed separately with the notice inviting tender/ enquiry.

2. Codes & Standards

The performance, testing and rating of the switchgear shall conform to the latest edition of the following IEC / IS publications,

IEC 60694	Common clauses for High Voltage Switchgear & Control Gear
IEC 62271-203	Gas Insulated metal-enclosed Switchgear for rated voltages above 52kV
IEC 62271-207	Seismic Qualification for Gas-insulated Switchgear Assemblies for rated voltages above 52kV
IEC 60376	New Sulphur Hexafluoride
IEC 62271-100	High Voltage Alternating Current Circuit Breakers
IEC 62271-1	Common Clauses for High Voltage Switchgear and Control-Gear Standards
IEC 62271-102	Alternating Current Disconnections (Isolators) and Earthing Switches
IEC 60044-1	Current Transformers
IEC 60044-2	Voltage Transformers
IEC 60137	Bushings for Alternating Voltages above 1000V
IEC 62271-209	Cable Connections for Gas-insulated Switchgear
IEC 60480	Guide to Checking of Sulphur Hexafluoride taken from Electrical Equipment
IEC 60099-1/4	Non-linear Resistor type Arresters for AC Systems
IEC 60439	Factory-built Assemblies of Low-voltage Switchgear and Control Gear.
IEEE 80 (2000)	IEEE Guide for Safety in AC Substation Grounding.
CIGRE-44	Earthing of GIS- An Application Guide. (Electra no. 151, Dec'93).
IEC 61639	Direct connection between Power Transformers and Gas-insulated metal-enclosed Switchgear for Rated Voltage 72.5kV and above

These are only indicative list and hence any other codes & standards, if applicable shall be complied by bidder.

3. Specific Technical Requirements

Specific technical requirements 220kV GIS with LCC & its Accessories shall be as follows,

Sl. No.	Technical Parameters	Unit	Particulars
	Type of GIS		Indoor Type, phase segregated/ phase encapsulated
	Installation		Indoor
	Meteorological data		
1.1	Maximum ambient temperature	°C	50

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1.2	Minimum ambient temperature	0C	-5
1.3	Average ambient temperature	0C	35
1.4	Design ambient temperature	°C	45
2	Average no. of thunder storm days	Days	45
3.1	Maximum Relative humidity	%	95
3.2	Maximum Relative humidity	%	26
4	Average Annual Rain Fall	mm	900
5	Maximum Wind Pressure	Kg/ sqm	195
6	Maximum Altitude above Mean Sea Level	m	1000
7	Isoceraunic Level	Days/ Year	45
8	Seismic Level (Horizontal Acceleration)	Zone	4
9	Average no. of rainy day per Year	Days/ Year	120
	Switchgear Design Data		
10	Service Voltage	kV	220
11	Maximum Service Voltage	kVp	245
12	Rated Insulation Level		
	-at power frequency 1 min	kV	460
	-at lightning impulse (1.2/50 µs wave)	kV	1050
13	Frequency	Hz	50
14	Rated service current (minimum)		
	- Bus bar	A	2000
	- Input Feeder bay	A	2000
	- Transformer bay	A	2000
	- Bus coupling bay	A	2000
15	Rated short time withstand current (Symmetrical)	kA	50
	- Duration	Seconds	3
16	Internal fault withstand time without burn Through	ms	As per IEC-62271-203
17	Temperature rise at rated service current (indicative)		
	- Conductor	°C	As per IEC-60694
	- Enclosure	°C	
18	Rated SF6 gauge pressure at 20°C		
	- Circuit breaker	bar rel.	As per standard
	- Switchgear	bar rel.	
19	Enclosure design pressure		
	- Circuit breaker	bar rel.	As per standard
	- Switchgear	bar rel.	
20	Leakage rate of SF6 per annum for the whole substation	%	< 0.5

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21	Maximum partial discharge level	pC	≤ 5
22	Factory Dielectric routine test 50Hz	kV	460
23	Site dielectric test	kV	380
24	Painting of switchgear		
	- Coating design and execution	RAL	As per detailed Specification/ Standard.
	- Top coat colour	RAL	
25	Surface protection of steel frames		Hot-dip Galvanizing with Zinc with 610gm/ square meter
26	Degree of Protection	IP	42

All current carrying components of the equipment specified shall be capable of continuous operation at the specified rated current without exceeding the maximum temperature rise specified in the relevant IEC standards. Thermal calculations shall be based on the climatic conditions mentioned elsewhere in specification.

4. Other General Requirements

Other general requirements 220kV GIS with LCC & its Accessories shall be as follows,

1. Storage shall be provided by BHEL/ its contractor. However, bidder shall provide their tentative space requirement for covered and/ or open store area during tender stage only. In addition to this, bidder shall submit their standard storage instruction manual specifically specifying the item detailed with details of type of storage.
2. Bidder shall submit list of consumables with shelf life of less than six months and same shall be dispatched just before the erection and only after specific clearance from BHEL/Customer.
3. Project Site is located in petrochemical/ process industry, which is highly corrosive & abundance of hydrocarbon area. Hence, GIS should be compatible with above requirements during design, material selection and construction of GIS & its accessories and all equipment, accessories and wiring shall have tropical protection, involving special treatment of metal and insulation against fungus, insects and corrosion.
4. Packing of GIS & its accessories shall be suitable for long term storage without any deterioration in quality and performance (minimum 1 years, if required).
5. Bidder shall offer their latest type tested compact model to accommodate the specified & allocated space as per attached layout drawing of GIS. Bidder to note that if bidder fails to meet above requirement, its technical offer is liable for non-evaluation.
6. Bidder shall conduct insulation co-ordination studies in line with IEC:60071 for establishing surge arrester rating, quantity and any other requirement for successful operation of GIS.
7. Bidder shall be required to submit 3D OGA Drawing compatible with Primtech for complete GIS & its accessories.
8. Bidder shall check and ensure adequacy of system protection for successful operation of GIS. After checking of system by bidder, GIS shall be installed and if any failure, malfunction of any part occurs after/ during commissioning, same shall be replaced immediately without any extra cost.
9. The 220kV GIS building shall comprise an EOT (Electric overhead travel) crane of minimum capacity 5 (Five) Ton at 7.00m height from FFL and hence bidder shall comply GIS according to EOT crane providing for erection as well as maintenance related activities.

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~~lifting of any components of GIS switchgear EOT crane shall be provided for GIS. However, EOT crane for GIS is not envisaged in bidder's scope but bidder shall provide all the calculations basis for sizing of EOT crane during tender stage only.~~

10. CT/ VT parameters mentioned in CT VT parameter document is indicative only. Bidder has to ensure correctness of CT/VT sizing for GIS during contact stage / detailed Engineering stage.
11. Any change in bay pitch (distance between bays) as per civil requirement for during detailed engineering stage shall be incorporated by the bidder without any cost and delivery implication to BHEL.
12. Bidder shall include painting and marking of all buses, individual incomers, all outgoing feeders etc. with details such as tag no., feeder rating, sending end source reference etc. for all switchboards.
13. The GIS shall be designed in such a way that suitable walkways are provided all around the switchgears so that the operators will be able to have free access to all the operating mechanism.
14. The GIS Equipment shall be complete with all necessary supports, ladders, galleries, staircases, catwalks, movable platforms or walkways (for accessing the equipment above two meters for maintenance and operation), mechanism cabinets, internal cable raceways etc for each bay and it shall be of modular construction and extendable design. All structures, galleries, staircases and walkways shall conform to the relevant Occupational Safety and Health Administration (OSHA).
15. Special tools & tackles for installation and testing kits for testing & commissioning shall be in bidder's scope, however, it shall be brought at site on returnable basis only.
16. Bidder shall provide list of general tools, tackles, slings, spanners, gauges and other lifting devices, drills, instruments, testing kits and appliances necessary for the complete assembly, installation, gas filling, maintenance, site testing of the GIS, however, the same shall be arranged by BHEL.

5. Earthing of GIS

Bidder to submit detailed calculations and layout drawings for earthing system during detailed engineering stage based on technical specification Section-2 of technical specification, bidder's design philosophy, IS/IEC requirement as applicable. Bidder to provide the bill of quantity of entire items required for the earthing of the GIS. However, supply of 40mm MS ROD, 75X12/50x6mm GI Flat shall be done by BHEL. Any other earthing material, as per design/BOQ, shall be in bidder's scope of supply only. Erection of earthing will be done by BHEL team under the supervision of bidder/manufacture, as per manufacturer's design.

6. Modular Design & Future extensions

1. The GIS switch gear shall be of modular design offering high degree of flexibility. Each module shall be complete with SF6 gas circuit breaker, disconnectors, Maintenance Grounding switches, fast Earthing switches, voltage transformers, Current transformers, bus & elbow sections, Gas Insulated Bus-duct, local control cubicle and all necessary components required for safe & reliable operation and maintenance.
2. The GIS shall be of either single-phase enclosure type or three-phase enclosure type for voltage levels of 220kV.
3. In those design where bus bar is continuous, provision is to be made available for isolation of

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- individual bay without disturbing adjacent bay.
4. The switchgear shall be of the freestanding, self-supporting dead-front design, with all high-voltage equipment installed inside gas-insulated, metallic grounded enclosures, and suitably sub-divided into individual arc and gas proof compartments, preferably for:
 - (1) Bus bars
 - (2) Intermediate compartment
 - (3) Circuit breakers
 - (4) Line dis-connectors
 - (5) Voltage transformers
 - (6) Gas Insulated bus duct section between GIS and,
 - (7) Gas insulated bus section between GIS and oil filled transformer.
 - (8) Current Transformers.
 5. The bus enclosure shall be sectionalized in a manner that maintenance work on any bus disconnector (when bus and bus disconnector are enclosed in a single enclosure) can be carried out by isolating and evacuating the small effected section and not the entire bus.
 6. Arc faults caused by external reasons shall be positively confined to the originating compartment and shall not spread to other parts of the switchgear. In case of any internal arc fault in a busbar, busbar disconnector or circuit breaker, of double bus system, repair works must be possible without shutting down complete substation and at least one busbar and the undisturbed bays must remain in operation.
 7. The busbar system shall be sectionalized for each bay and contained in individual SF6 gas tight bus compartments to prevent contamination of the gas of the whole bus bar due to fault in one bay zone and refill lesser quantity of SF6 gas.
 8. Where bus Coupler is specified and in case of any internal arc fault in a busbar, busbar disconnector or sectionaliser, repair work must be possible without shutting down the complete substation and at least one half of the substation must remain in operation.
 9. Documents indicating sequence of repair work steps and description of necessary restrictions during work shall be submitted with the technical manual during as built drawing submission.
 10. Each bay module should be equipped with suitable arrangement for easy dismantling and refitting during maintenance without disturbing other units.
 11. Bus duct lengths shall be taken from the end of bay equipment (VT, LA etc.) to end equipment (SF6 to air bushing, SF6 to oil bushing/ connection etc.)
 12. Material clearance certificate shall be issued after demonstration of the functionality of maintenance equipment.
 13. Structure Materials for support of GIS, Bus Ducts, SF6 to oil bushing/ connection and SF6 to air bushing/ connection including Foundation Bolts, Embedded Items, Rails and/ or other items structural items required. All steel structure members shall be hot-dip galvanized after fabrication. Unless otherwise specified, minimum mass of zinc coating for Galvanizing shall be 610 gm/square meter. All field assembly joints shall be bolted. Field welding shall not be acceptable. Noncorrosive metal or plated steel shall be used for bolts and nuts throughout the work. Manufacturer shall provide suitable foundation channels and anchor bolts to support the switchgear assemblies. All mounting bolts, nuts and washers shall be provided to fasten the switchgear base frames to the foundation channels.

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7. Maintenance and Repair of Circuit Breaker

1. The positioning of the circuit breaker in the GIS shall be such that it shall be possible to access the circuit breaker of any feeder from the front side for routine inspection, maintenance and repair without interfering with the operation of the adjacent feeders.
2. The GIS shall be so designed that any component of the GIS can be removed easily. With minimum flexibility in the layout arrangement it shall be possible to remove the circuit breaker with both busbars remaining in service and it shall be possible to remove the disconnectors of the busbars, with one bus bar remaining in service. For achieving this requirement, adequate number of intermediate compartments, if required, shall be provided to ensure equipment & operating personnel's safety.
3. The bidder shall be required to demonstrate clearly in his submitted documents the suitability of the switchgear design in this respect. The arrangement shall be such that expansion of the original installation can be accomplished with minimum GIS down time.
4. In case of extension, the interface shall incorporate facilities for installation and testing of extension to limit the part of the existing GIS to be re-tested and to allow for connection to the existing GIS without further dielectric testing.
5. All the elements shall be accessible without removing support structures for routine inspections and possible repairs.

8. Interchangeability & Future Extension

1. As much as possible, all the parts shall be of standard manufacturer with similar parts and assemblies being interchangeable.
2. The GIS system shall be suitable for future extension on either end by the addition of extra feeders, bus couplers, bus-bars, circuit breakers, dis-connectors, and other switch gear components. The arrangement of gas sections or compartments shall be such as to facilitate future extension without any drilling, cutting or welding on the existing equipment. To add equipment, it shall not be necessary to move or dislocate the existing switchgear bays.
3. The layout shall ensure that GIS bus link section is provided for future extension of the GIS buses to avoid de-gassing and modification of the existing bus.
4. The physical layout shall ensure free movement of the SF6 Gas Cart and easy access to all components of the GIS for maintenance purposes.

9. Bill of Quantities

Quantities for supply and services for 220kV GIS with LCC & its Accessories shall be as per Annexure-220kV GIS BOQ. However, the scope broadly covers the following requirements,

The 220kV GIS and accessories with double bus bar arrangement and with eleven (11) bay configuration and integrated LCC (Local control centre) including due integration of outdoor 220 KV facilities and transformer system.

Unit ref. price of GIS part item/ equipment supply & service shall be taken up separately, however it shall be used in evaluation. The quantities in BOQ may vary up to $\pm 20\%$ in line with quantity variation clause. However, individual quantities may be deleted or vary up to any extent.

10. Drawings / Documents required for Engineering Manufacturing Clearance

The drawings/ documents, as follows shall be used for providing technical clearance for manufacturing of GIS and furthermore, it shall be used for delay analysis, if any, from bidder. The schedule for submission and resubmission shall be in line with details provided in section-3. The

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first drawing submission will be counted from the date of submitting correct drawings.

Sl. No.	Overall Drawings approval required in Cat I /Cat II
1	220KV GIS- Gas Schematics with Single Line Diagram (Including CT VT Parameters)
2	220KV GIS- Guaranteed Technical Particulars (Including all GIS equipment
3	220KV GIS- Layout Plan & Section
4	220KV GIS- Interfacing Drawings for Cable Connection Module, SF6 to Air Bushing, SF6 to Oil Module with Guaranteed Technical Particulars
5	220KV GIS- Equipment Layout with Earthing philosophy
6	220KV GIS- Type Test Reports (Including all GIS equipment)
7	220KV GIS- Secondary Engineering Base Design
8	220KV GIS- Control Schematics for GIS and Local Control Cabinet
9	220KV GIS- Maintenance Equipment Catalogue with Guaranteed Technical Particulars
10	220KV GIS- Quality Assurance Plan & Inspection Test Schedule
11	220KV GIS- Civil Design Specification with Foundation Loading Diagram (Including interfacing details)
12	220KV GIS- Quantification for main Items, Spares, Consumables

The Manufacturing clearance shall be provided Lot wise, however lot item can be clubbed together subject to approval of drawing/ documents. MFC date will be counted from the date of approval of drawings in Cat I/ cat II , for each lot , as per the following table. Please refer to Sl. No. of items in the BOQ also,

Lot description covering BOQ items	Sl. No. of approved Drawing required in Cat I/ Cat II for MFC
Lot-1 (BOQ item A1 to A9)	Sl. No. 1, 2, 3, 6, 10,11 and 12
Lot-2 (BOQ item A10 to A14)	Sl. No. 1, 2, 4, 6 and 10
Lot-3 (BOQ item A16 and A17)	Sl. No. 3, 5, 10, 11 and 12
Lot-4 (BOQ item A15 and A18)	Sl. No. 2, 3, 10 and 12
Lot 5 (BOQ item B, C and D)	Sl. No. 9, 10 and 12

11. Type Testing

Bidder shall ensure that 220kV GIS with LCC & its Accessories, being procured should have valid type test certificates as per specified in IEC standard 62271 – 203 & 62271-100 (amended up to date) at any ISO/IEC accredited laboratories.

Type test certificates shall not be more than ten (10) years old as on original scheduled date of technical bid opening. In those cases, where type test certificates are more than ten (10) years old from original scheduled date of technical bid opening, OEM/ bidder shall carry out the type tests at at any ISO/IEC accredited laboratories prior to dispatch of equipment with no commercial implication to BHEL/Customer.

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In case any of Type tests have not been conducted on the offered design or there has been a change in the design after the type tests. The requisite tests shall be conducted by bidder on the offered design without any extra cost and delivery impact to BHEL/ Customer.

Type test should have been carried out as per relevant IEC standards at the type test must have been carried out at any ISO/IEC accredited laboratories. The following type test certificates, as specified in IEC standard 62271 – 203 & 62271-100 (amended up to date) shall be required for verification as evidence of successful completion of type tests.

1. Tests to verify the insulation level (Lightning impulse, switching impulse and ac withstand test with PD) test on each GIS device (CB, Disconnecter, bus, etc).
2. Dielectric tests on auxiliary circuits.
3. Tests to prove the radio interference voltage (RIV) level.
4. Tests to prove the temperature rise of any part of the equipment and measurement of the resistance of the main circuit.
5. Tests to prove the ability of the main and earthing circuits to carry the rated peak and the rated short time withstand current.
6. Tests to verify the making and breaking capacity of the included switching devices.
7. Tests to prove the satisfactory operation of the included switching devices.
8. Tests to prove the strength of enclosures.
9. Verification of the degree of protection of the enclosure.
10. Gas tightness tests
11. Electromagnetic compatibility tests (EMC).
12. Additional tests on auxiliary and control circuits.
13. Tests on partitions.
14. Tests to prove the satisfactory operation at limit temperatures.
15. Tests to prove performance under thermal cycling and gas tightness tests on insulators.
16. Corrosion test on earthing connections (if applicable).
17. Tests to assess the effects of arcing due to an internal fault.
18. Tests on solid dielectric components (operating rods, spacers, etc)
19. Seismic test
20. Test on Auxiliary switches (Electrical & Mechanical Endurance, Heat run, IR & HV test)

12. Quality Plan

The successful bidder shall submit Quality Assurance Plan for major components such as breakers, disconnecting switches, lightning arrestors, earth switches, etc. with in-process inspection methods, tests, records, etc. for BHEL/ Customer approval. Customer hold points will also be included in the plan, which shall be mutually agreed by the BHEL/ Customer and Bidder and approved. In case bidder has reference Quality Assurance Plan agreed with BHEL/Customer, same shall be submitted for specific project to BHEL/ Customer approval. There shall be no commercial implication to BHEL/ Customer on account of Quality Plan approval.

Superior quality control system shall be adopted to assure high product quality. Raw materials of the best commercial grade quality and high reliability shall be used in the manufacture of GIS. High reliability of materials shall be ensured so as to keep maintenance work to a minimum. All

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materials shall be procured, manufactured, inspected and tested by vendor/ sub-vendor as per approved quality plan. The supplier shall perform all tests necessary to ensure that the material and workmanship conform to the relevant standards and comply with the requirements of the specification. Charges for all these tests for all the equipment & components shall be deemed to be included in bidder's scope.

13. Inspection & Testing

1. GIS and its associated materials shall be subject to inspection by BHEL/ Customer or authorized representative at bidder/manufacturers' works. Hence, Bidder shall furnish all necessary information concerning the supply to BHEL/ Customer.
2. During fabrication, the equipment shall be subject to inspection by BHEL/ Customer or by an agency authorized by BHEL/ Customer to assess the progress of work as well as to ascertain that only quality raw material is used.
3. Bidder shall ensure that the hazardous area equipment provided shall have the necessary test certificates and valid CCOE approval certificates.
4. Bidder shall also furnish factory acceptance test (FAT) from manufacturers for BHEL/ customer approval in line with specific requirements mentioned in Section-2.

14. Field Testing & Commissioning

1. Bidder shall carry out the supervision of installation, field testing and commissioning of 220kV GIS with LCC & its Accessories. Further appropriate test and commissioning reports and as-built documentation as necessary be submitted.
2. Field testing and commissioning of 220kV GIS with LCC & its Accessories shall be done by Bidder/OEM only.
3. Bidder shall also submit site acceptance testing (SAT) procedures and get them approved from BHEL/ Customer before carrying out the site testing at site.
4. All switchboard protection shall be subject to primary injection test before commissioning.
5. Bidder/ OEM shall coordinate with manufacturers of other equipment wherever required and shall freely and readily supply all technical information for this purpose as and when called for.
6. All electrical equipment shall be said to be installed and mechanically complete after circuit testing, primary and secondary injection testing and loop simulation is complete. Due care and consideration shall be given to the installation of 220kV GIS with LCC & its Accessories.

15. Makes of Equipment/ Components

Bidder/ vendor while ordering shall ensure the availability of spare parts and maintenance support services for the offered equipment at least for 15 years from the date of supply. Bidder/ OEM shall give a notice of at least one year to the BHEL/ Customer before phasing out the products/spares to enable the owner for placement of order for spares and services.

16. Packing and Dispatch

1. The equipment shall be carefully packed for transport by sea, rail and road in such a manner that it is protected against the climatic conditions and for any damage during transportation, transit and storage. Packing of the equipment shall be suitable for long storage (minimum 1 year).

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2. The SF6 equipment shall be shipped in the largest factory assembled units within transport and loading limitations and considering handling facilities on site to reduce the erection and installation work on site to a minimum. Where possible all items of equipment or factory assembled units shall be boxed in substantial crates or containers to facilitate handling in a safe and secure manner.
3. Each individual piece to be shipped, whether crate, container or large unit, shall be marked special notations such as 'Fragile', 'This side up', 'Centre of gravity', 'Weight', 'Owner's particulars', 'PO no.' etc., and other details as per purchase order.
4. The equipment may be stored outdoors for long periods before installation. The packing shall be completely suitable for outdoor storage in areas with heavy rains and high ambient temperature.
5. Special precautions shall be taken to protect any parts containing electrical insulation against the ingress of moisture. This applies particularly to the equipment of which each gas section shall be sealed and pressurized prior to shipping. Either dry nitrogen/air or dry SF6 gas shall be used and the pressure shall be such as to ensure that, allowing for reasonable leakage, it will always be greater than the atmospheric pressure for all variations in ambient temperature and the atmospheric pressure encountered during shipment to site and calculating the pressure to which the sections shall be filled to ensure positive pressure at all times during shipment.
6. All blanking plates, caps, seals, etc., necessary for sealing the gas sections during shipment to site shall be provided. Any seals, gaskets, 'O' rings, etc. that will be used as part of the arrangement for sealing off gas sections for shipment of site, shall not be used in the final installation of the equipment at site. Vendor to provide quantity of components accordingly considering permanent installation and commissioning.

17. Abbreviations Used

The following terminology/ acronym hereunder and elsewhere in the technical specification used and their grammatical variations shall unless repugnant to the subject or context thereof, have the following full form hereunder respectively assigned to them, namely,

GIS:	Gas Insulated Switchgear
LCC:	Local Control Centre
CT:	Current Transformer
DC:	Direct Current
HV:	High Voltage
EHV:	Extra High Voltage
kV:	Kilovolt
Hz:	Hertz
IP:	Ingress Protection
SAT:	Site Acceptance Testing
CCOE:	Chief Controller of Explosives
OEM:	Original Equipment Manufacturer
kV:	Kilovolt
Hz:	Hertz
IP:	Ingress Protection
PE:	Poly Ethylene

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ANSI:	American National Standards Institute
ASTM:	American Society for Testing and Materials
BIS:	Bureau of Indian Standards
BS:	British Standard
IEC:	International Electro Technical Commission
IEEE:	Institute of Electrical & Electronics Engineers
IS:	Indian Standards
NEMA:	National Electrical Manufacturers Association
CEA:	Central Electricity Authority
DIN:	Deutsches Institut für Normung
CCE:	Continuous and Comprehensive Evaluation
LPCB:	Loss Prevention Certification Board
CCOE:	Chief Controller of Explosives
OEM:	Original Equipment Manufacturer
BHEL:	Bharat Heavy Electricals Limited
OISD:	Oil Industry Safety Directorate
IOCL:	Indian Oil Corporation Limited
HVPL:	Haryana Vidyut Prasaran Nigam Limited
ISBL:	Inside Battery Limit
OSBL:	Outside Battery Limit
LSTK:	Lump sum Turnkey
PRPC:	Petroleum Refining and Petrochemical
PNC:	Panipat Naphtha Cracker Complex
PR:	Panipat Refinery Complex
GIS:	Gas Insulated Sub-station
URT:	Unit Ratio Transformer
QAP:	Quality Assurance Plan
BOQ:	Bill of Quantities

18. Definitions Used

The following expressions hereunder and elsewhere in the technical specification used and their grammatical variations shall unless repugnant to the subject or context thereof, have the following meanings hereunder respectively assigned to them, namely:

1. Battery Limit: The demarcated area within which the Unit is to be located.
2. Bid/Bidding Documents: The totality of the documents comprising the Bidding Document for the notice inviting tender.
3. Contract: The totality of agreement between Customer/ Purchaser/ Owner/IOCL and the Contractor/ LSTK Contractor/ BHEL as derived from the contract documents.
4. Contractor/ LSTK contractor: The bidder selected by the Customer/ Purchaser/ Owner/IOCL for the performance of the work and supply of materials. In this case, it is BHEL.
5. Customer/ Purchaser/ Owner: Indian Oil Corporation Limited.
6. Consultant: Any person(s)/ Firm nominated/ assigned by the Contractor/ LSTK Contractor/ BHEL for providing the engineering consultant services. In this case, it is TCE.
7. Bidder/ vendor: The bidder selected for this intended work shall be known as vendor.

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19. List of Documents/ Drawings

Following drawing/ documents are attached for information purpose,

1. TB-3-411-510-001: 220/33kV Switchyard- Single Line Diagram
2. TB-2-411-316-006: 220/33kV Switchyard- Layout Plan & Section
3. TB-3-411-316-015: GIS cum Control Room Building- Conceptual Layout

Annexure-220kV GIS BOQ.

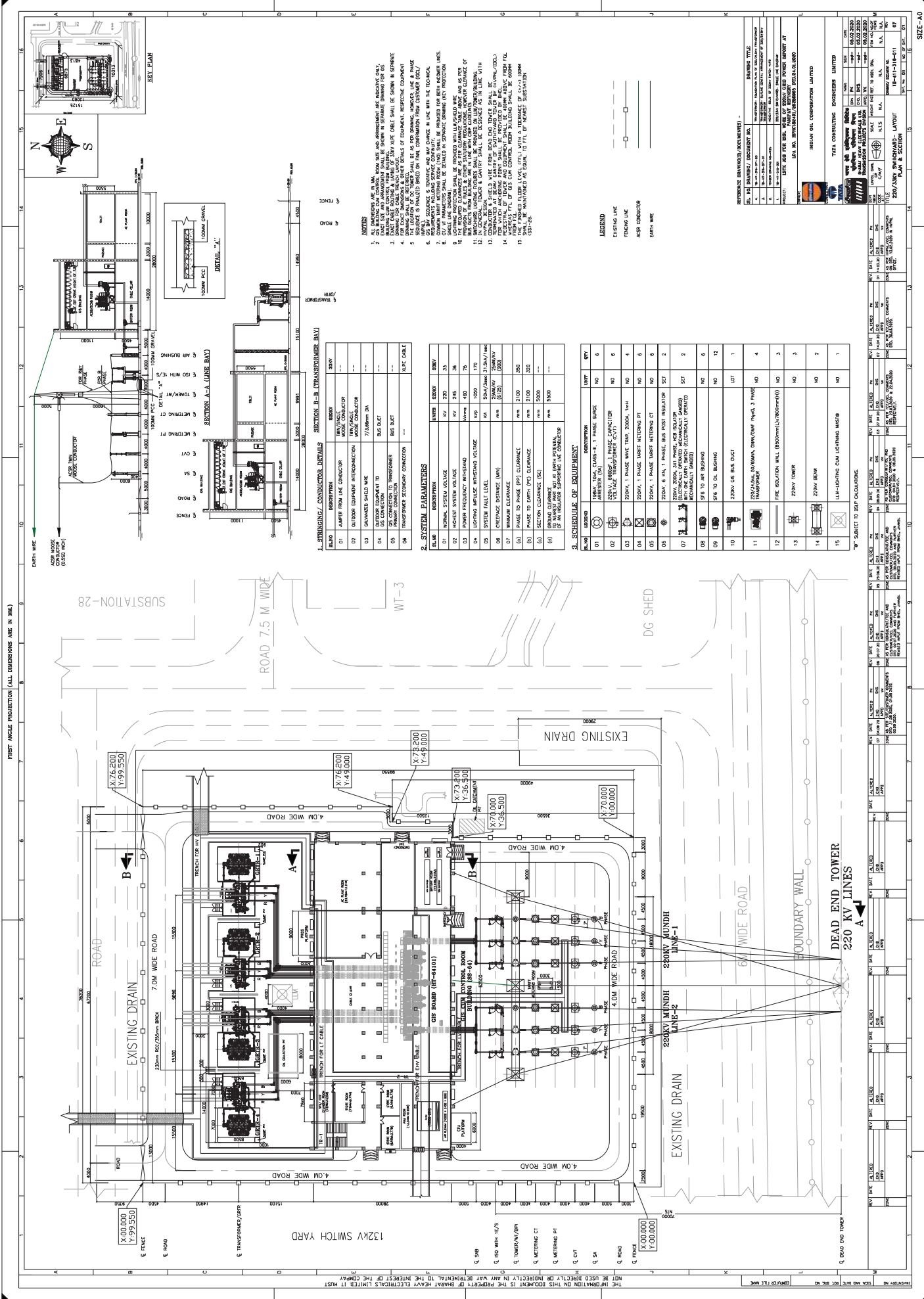
Sl. No.	PEERS Description	Detailed Description	Unit	Qty
A	Supply- GIS: 220kV, 50kA for 3 second, 2000A GIS double main bus scheme	GIS shall be 220kV, 2000A, 50kA for 3 second Double Bus GIS configuration complete with local control centre (LCC). Typical Bay includes Busbar, Circuit Breaker, Disconnector & Maintenance Grounding Switch, Fast Acting Make Proof Grounding Switches, Voltage Transformer, Current Transformer, Surge Arrestor, SF6 to Air Bushings/ Connection Module, SF6 to Oil Connection Module, Cable Connection Module, GIS bus duct, Gas Monitoring Devices, Online PD Monitoring System, Pressure Switches etc. (Refer attached Single Line Diagram). GIS shall comprise following bays but not limited to, a. 2 Set- Fully Equipped Line GIS Bay b. 4 Set- Fully Equipped Transformer GIS Bay c. 4 Set- Fully Equipped Spare GIS Bay d. 1 Set- Fully Equipped Buscoupler GIS bay, complete with local control cabinet (LCC), cable etc. Typical Bay includes Busbar, Circuit Breaker, Disconnector, Maintenance Earthing Switch, High-Speed Earthing Switch, Current Transformer, Voltage Transformer, Surge Arrestor, SF6 to EHV Cable termination Module, SF6/Air termination module, SF6 to Oil Termination Module, Gas Monitoring Devices, Online PD Monitoring System, Pressure Switches etc. GIS shall be complete with all necessary terminal boxes, inspection windows, SF6 gas filling, interconnecting cabling & wirings, grounding connections, gas monitoring systems and pipings, trays, support structures. Hence, the scope shall include supply, erection and mounting of hardware and interconnecting cables between GIS to LCC and between LCC to LCC including Cable Trays, Tags, Glands, Ferrules, Lugs etc, however cables beyond LCC panel shall be supplied and laid by BHEL under the supervision and input of the bidder.	Lot	1
A.1	Supply- GIS: 220kV, 50kA for 3 second, 2000A GIS double main bus scheme - Line GIS bay	220kV, 50kA for 3 second, 2000A GIS double main bus scheme grid incomer GIS bay, each set comprising of following but not limited to, (a) 1 set- 1x3 phase circuit breaker, complete with operating mechanism (b) 1 set- 1x3 phase disconnector without maintenance grounding switch, complete with operating mechanism. (c) 2 set- 1x3 phase disconnector with single maintenance grounding switch, complete with operating mechanism. (d) 1 set- 1x3 phase high speed make proof grounding switch, complete with operating mechanism. (e) 3 no-1 phase multi ratio current transformers as per CT VT parameters (f) 3 no-1 phase multi winding voltage transformers with mechanical link as per CT VT parameters (g) PD sensors, gas monitoring device, pressure relief device, busbar, insulator, expansion joint/ flexible, insulators etc. as required. (h) Any other item required to complete the system in all respects but not limited to above. (i) GIS bus duct, SF6 to air bushing/ connection module are not included in this bay description and these items are covered separately else where in the BOQ.	Set	2
A.2	Supply- GIS: 220kV, 50kA for 3 second, 2000A GIS double main bus scheme - Transformer GIS bay	220kV, 50kA for 3 second, 2000A GIS double main bus scheme transformer GIS bay, each set comprising of following but not limited to, (a) 1 set- 1x3 phase circuit breaker, complete with operating mechanism (b) 1 set- 1x3 phase disconnector without maintenance grounding switch, complete with operating mechanism. (c) 2 set- 1x3 phase disconnector with single maintenance grounding switch, complete with operating mechanism. (d) 1 set- 1x3 phase high speed make proof grounding switch, complete with operating mechanism. (e) 3 no-1 phase multi ratio current transformers as per CT VT parameters (f) 3 no-1 phase multi winding voltage transformers with mechanical link as per CT VT parameters (f) PD sensors, gas monitoring device, pressure relief device, busbar, insulator, expansion joint/ flexible, insulators etc. as required. (g) Any other item required to complete the system in all respects but not limited to above. (h) GIS bus duct, SF6 to oil bushing/ connection module, surge arrester etc. are not included in this bay description and these items are covered separately else where in the BOQ.	Set	4
A.3	Supply- GIS: 220kV, 50kA for 3 second, 2000A GIS double main bus scheme - Spare GIS bay	220kV, 50kA for 3 second, 2000A GIS double main bus scheme spare GIS bay, each set comprising of following but not limited to, (a) 1 set- 1x3 phase circuit breaker, complete with operating mechanism (b) 1 set- 1x3 phase disconnector without maintenance grounding switch, complete with operating mechanism. (c) 2 set- 1x3 phase disconnector with single maintenance grounding switch, complete with operating mechanism. (d) 1 set- 1x3 phase high speed make proof grounding switch, complete with operating mechanism. (e) 3 no-1 phase multi ratio current transformers as per CT VT parameters (f) 3 no-1 phase multi winding voltage transformers with mechanical link as per CT VT parameters (f) PD sensors, gas monitoring device, pressure relief device, busbar, insulator, expansion joint/ flexible, insulators etc. as required. (g) Any other item required to complete the system in all respects but not limited to above. (h) GIS bus duct, SF6 to EHV cable connection module are not included in this bay description and these items are covered separately else where in the BOQ.	Set	4
A.4	Supply- GIS: 220kV, 50kA for 3 second, 2000A GIS double main bus scheme - Buscoupler GIS bay	220kV, 50kA for 3 second, 2000A GIS double main bus scheme buscoupler GIS bay, each set comprising of following but not limited to, (a) 1 set- 1x3 phase circuit breaker, complete with operating mechanism (b) 1 set- 1x3 phase disconnector with single maintenance grounding switch, complete with operating mechanism. (c) 3 no-1 phase multi ratio current transformers as per CT VT parameters (f) 3 no-1 phase multi winding voltage transformers with mechanical link as per CT VT parameters (d) PD sensors, gas monitoring device, pressure relief device, busbar, insulator, expansion joint/ flexible, insulators etc. as required. (e) Any other item required to complete the system in all respects but not limited to above.	Set	1
A.5	Supply- GIS: 220kV, 50kA for 3 second, 2000A GIS double main bus scheme - Bus Measurement Bay	220kV, 50kA for 3 second, 2000A GIS double main bus scheme bus measurement GIS bay, each set comprising of following but not limited to, (a) 1 set- 1x3 phase disconnector with single maintenance grounding switch, complete with operating mechanism. (b) 3 no-1 phase multi winding voltage transformers as per CT VT parameters (c) PD sensors, gas monitoring device, pressure relief device, busbar, insulator, expansion joint/ flexible, insulators etc. as required. (f) Any other item required to complete the system in all respects but not limited to above.	Set	2
A.6	Supply- GIS: 220kV, 50kA for 3 second, 2000A GIS double main bus scheme - Bus Earth Switch Bay	220kV, 50kA for 3 second, 2000A GIS double main bus scheme bus earth switch bay GIS bay, each set comprising of following but not limited to, (a) 1 set- 1x3 phase high speed make proof grounding switch, complete with operating mechanism. (b) PD sensors, gas monitoring device, pressure relief device, busbar, insulator, expansion joint/ flexible, insulators etc. as required. (c) Any other item required to complete the system in all respects but not limited to above.	Set	2
A.7	Supply- GIS: 220kV, 50kA for 3 second, 2000A GIS double main bus scheme - GIS Extension Module	220kV, 50kA for 3 second, 2000A GIS double main bus scheme GIS extension module 1 phase, shall be as follows, but not limited to, (a) Extension of bus bars, bus duct connections, and shall be used to create electrical connectivity considering the thermal expansion, accommodating of GIS Modules due to shifting of GIS bays, arising due to civil and architectural requirements or expansion joint in the building that houses GIS. (b) Bidder shall consider the bus bar modules including the bellows/ compensators like lateral mounting units, Axial compensators, Parallel compensators, tolerance compensators and vibration compensators etc. (a) The GIS system shall be suitable for future extension on either end by the addition of extra feeders, bus couplers, bus-bars, circuit breakers, dis-connectors, and other switch gear components. The arrangement of gas sections or compartments shall be such as to facilitate future extension without any drilling, cutting or welding on the existing equipment. To add equipment, it shall not be necessary to move or dislocate the existing switchgear bays (b) The layout shall ensure that GIS bus link section is provided for future extension of the GIS buses to avoid de-gassing and modification of the existing bus. (c) The physical layout shall ensure free movement of the SF6 Gas Cart and easy access to all components of the GIS for maintenance purposes It shall be in line with clause 6.4.7, Section-2 of technical specification and mentioned elsewhere in Technical Specification.	Set	1
A.8	Supply- GIS: 220kV, 50kA for 3 second, 2000A GIS double main bus scheme - GIS Bus Extension Module	220kV, 50kA for 3 second, 2000A GIS double main bus scheme GIS bus extension module 3 phase, shall be as follows, but not limited to, (a) Between sections of bus bars, bus duct connections, and shall be used to create electrical connectivity considering the thermal expansion, accommodating of GIS Modules due to shifting of GIS bays, arising due to civil and architectural requirements or expansion joint in the building that houses GIS. (b) Bidder shall consider the bus bar modules including the bellows/ compensators like lateral mounting units, Axial compensators, Parallel compensators, tolerance compensators and vibration compensators etc. It shall be in line with clause 6.4.7, Section-2 of technical specification and mentioned elsewhere in Technical Specification.	Set	2
A.9	Supply- GIS: 220kV, 50kA for 3 second, 2000A GIS double main bus scheme - GIS Surge Arrestor Module with Surge Counter	220kV, 50kA for 3 second, 2000A GIS double main bus scheme GIS extension module, shall be as follows, but not limited to, between sections of bus bars, bus duct connections, and shall be used to create electrical connectivity considering the thermal expansion, accommodating of GIS Modules due to shifting of GIS bays, arising due to civil and architectural requirements or expansion joint in the building that houses GIS. Bidder shall consider the bus bar modules including the bellows/ compensators like lateral mounting units, Axial compensators, Parallel compensators, tolerance compensators and vibration compensators etc.	No	24
A.10	Supply- GIS: 220kV, 50kA for 3 second, 2000A GIS double main bus scheme - Gas Insulated Bus Duct	220kV, 2000A SF6 gas insulated GIS Bus duct shall include the following but not limited to, (a) 1 phase SF6 gas insulated bus duct to connect line GIS bay with SF6 to air bushing/ connection. (b) 1 phase SF6 gas insulated bus duct to connect transformer GIS bay with SF6 to oil bushing/ connection of transformer. (c) PD sensors, gas monitoring device, pressure relief device, busbar, insulator, expansion joint/ flexible, insulators etc. as required. The total tentative length indicated is the sum of all 1 phase SF6 bus duct from respective bay to SF6 to air bushing/ connection/ SF6 to oil bushing/ connection. However, exact length shall be decided based on the details finalized during detailed engineering.	Mtr	600
A.11	Supply- GIS: 220kV, 50kA for 3 second, 2000A GIS double main bus scheme - SF6 to air bushing/ connection	Single phase 220kV, 2000A SF6 to Air Bushing shall be supplied for the air termination of the GIS shall be as per IEC. (a) Single phase, 220kV, 2000A, termination module for terminating GIS SF6 bus duct in outdoor switchyard. (b) Scope of supply shall be as per latest version of IEC. (c) Gas monitoring system, pressure relief device, busbar, insulator, expansion joint/ flexible connection etc. as required. (d) Barrier cones, mechanism box and other items as required. (e) Any other item required to complete the system in all respects but not limited to above.	No	6
A.12	Supply- GIS: 220kV, 50kA for 3 second, 2000A GIS double main bus scheme - SF6 to oil bushing/ connection	Single phase 220kV, 2000A SF6 to Air Bushing shall be supplied for the air termination of the GIS shall be as per IEC. (a) Single phase, 220kV, 2000A, termination module for terminating GIS SF6 bus duct in Potheadyard. (b) Scope of supply shall be as per latest version of IEC62271-111. (c) Gas monitoring system, pressure relief device, busbar, insulator, expansion joint/ flexible connection etc. as required. (d) Barrier cones, mechanism box and other items as required. (e) Any other item required to complete the system in all respects but not limited to above.	No	12

A.13	Supply- GIS: 220kV, 50kA for 3 second, 2000A GIS double main bus scheme - SF6 to EHV cable GIS connection module	220kV, 50kA for 3 second, 2000A GIS double main bus scheme SF6 to EHV cable GIS connection module 1 phase, shall be as follows, but not limited to, (a) It shall be of the plug-in type with dry-type or fluid-filled terminations. The interfaces conform to IEC standards. A removable link, which disconnects and isolates the GIS from the cable during high-voltage test for convenience and ease of operations shall also be provided. (b) Termination kit (Male and female part with capacitive type voltage detectors) for fixing of cable shall also be provided. in line with IEC 62271-209. (c) PD sensors, gas monitoring device, pressure relief device, busbar, insulator, expansion joint/ Flexible, insulators etc. as required. (d) Any other item required to complete the system in all respects but not limited to above.	No	36
A.14	Supply- GIS: 220kV, 50kA for 3 second, 2000A GIS double main bus scheme - Local Control Centre (LCC)	Local Control Centre (LCC) for each bay shall include the following but not limited to, (a) Line GIS bay- 2 set (b) Transformer GIS bay- 4 set (c) Spare GIS bay- 4 set (d) Buscoupler GIS bay- 1 set Bidder shall meet the all the requirement of control & protection for the complete GIS System in minimum 11 nos of LCC, however exact no of LCC shall be decided during detailed engineering, and hence any additional requirement during detailed engineering shall not be payable extra.	Set	11
A.15	Supply- GIS: 220kV, 50kA for 3 second, 2000A GIS double main bus scheme - SF6 gas required for placing GIS into successful operation	First filling of SF6 gas for the equipment supplied plus an additional quantity sufficient for conducting all the tests on equipment at site before placing it into successful operation.	Kg	3000
A.16	Supply- GIS: 220kV, 50kA for 3 second, 2000A GIS double main bus scheme - Structure Materials for support of GIS, Bus Ducts, SF6 to oil bushing/ connection and SF6 to air bushing/ connection including Foundation Bolts, Embedded Items, Rails and/ or other items structural items required	Structure Materials for support of GIS, Bus Ducts, SF6 to oil bushing/ connection and SF6 to air bushing/ connection including Foundation Bolts, Embedded Items, Rails and/ or other items structural items required. All steel structure members shall be hot-dip galvanized after fabrication. Unless otherwise specified, minimum mass of zinc coating for Galvanizing shall be 610 gm/square meter. All field assembly joints shall be bolted. Field welding shall not be acceptable. Noncorrosive metal or plated steel shall be used for bolts and nuts throughout the work. Manufacturer shall provide suitable foundation channels and anchor bolts to support the switchgear assemblies. All mounting bolts, nuts and washers shall be provided to fasten the switchgear base frames to the foundation channels. In addition to above, supports, platforms, foundation bolts, embedded parts in floors etc., are also included in the scope as per the specification, but not limited to the following. (a) Base Plate, Channel, Metallic / Structural Member for seating of GIS system (b) Lattice / Pipe structure required for GIS bay, GIS, SF6 to oil bushing/ connection and SF6 to air bushing/ connection. (c) Foundation bolt / Anchor Fastening bolts for GIS system, if required. (d) Equipment fixing hardware. (e) Cable tray arrangement (mounted on structures of) GIS bay, GIS, SF6 to oil bushing/ connection and SF6 to air bushing/ connection. (f) Any other structural item required to complete the system in all respects but not limited to above. It shall be in line with clause 8.19, Section-2 of technical specification and mentioned elsewhere in Technical Specification.	MT	20
A.17	Supply- GIS: 220kV, 50kA for 3 second, 2000A GIS double main bus scheme - Complete Earthing Materials including High Frequency Earthing	Earthing Materials, except 40mm MS rod, 75x12mm / 50x6 GI Flat, which shall be provided by BHEL as free issue item (FIM), however, exact requirement shall be intimated by bidder based on the earthing philosophy approved, and Supervision of erection of all earthing connection for GIS to Earth Mesh on Floor shall be scope including any special requirements including high frequency earthing. In case, high frequency earthing is not required, necessary design and calculations shall be submitted by bidder. Option of flat or braided earthing for GIS system may be adopted if allowed in applicable standards and complying the safety requirements of OEM design. Vendor to provide the relevant documents for support. It shall be in line with clause 8.25, Section-2 of technical specification and mentioned elsewhere in Technical Specification. Bidder to provide detailed break up during technical offer submission.	Lot	1
A.18	Supply- GIS: 220kV, 50kA for 3 second, 2000A GIS double main bus scheme - Consumables for GIS system	All consumables including grouting material and chemicals for the chemical anchors bolts etc., if applicable for GIS system shall be provided by bidder, however, in case of consumables with shelf life less than six months shall be supplied with special permission and intimation from BHEL. Bidder to provide detailed break up during technical offer submission.	Lot	1
B	Supply: Maintenance Equipment	Maintenance Equipment shall be shipped in separate containers, clearly marked with the name of the equipment for which they are intended. However, Breaker Timing Measurement Kit shall be brought by bidder during commissioning on returnable basis.		
B.1	Supply: Maintenance Equipment- Dew Point Measurement Meter	It shall be in line with clause 8.24, Section-2 of technical specification and mentioned elsewhere in Technical Specification. It shall be of reputed make, however make and model shall be subject to detailed engineering.	Nos	1
B.2	Supply: Maintenance Equipment- SF6 Leakage Detector Meter	It shall be in line with clause 8.24, Section-2 of technical specification and mentioned elsewhere in Technical Specification. It shall be of reputed make, however make and model shall be subject to detailed engineering.	Nos	1
B.3	Supply: Maintenance Equipment- Precision Pressure Gauge	It shall be in line with clause 8.24, Section-2 of technical specification and mentioned elsewhere in Technical Specification. It shall be of reputed make, however make and model shall be subject to detailed engineering.	Nos	1
B.4	Supply: Maintenance Equipment- Gas recovery unit with required accessories	It shall be in line with clause 8.24, Section-2 of technical specification and mentioned elsewhere in Technical Specification. It shall be of reputed make, however make and model shall be subject to detailed engineering.	Nos	1
B.5	Supply: Maintenance Equipment- SF6 gas purity detector/ analyzer for SO2, H2O, CF4, AIR etc.	It shall be in line with clause 8.24, Section-2 of technical specification and mentioned elsewhere in Technical Specification. It shall be of reputed make, however make and model shall be subject to detailed engineering.	Nos	1
B.6	Supply: Maintenance Equipment- Online Portable PD analyzer/ measurement kit suitable for GIS along with required accessories	Online Portable PD analyzer/ measurement kit shall be compatible for PD measurement for GIS and Power Transformer system. It shall be in line with clause 8.24, Section-2 of technical specification and mentioned elsewhere in Technical Specification. It shall be of reputed make, however make and model shall be subject to detailed engineering.	Nos	1
B.7	Supply: Maintenance Equipment- Air/ gas humidity tester	It shall be in line with clause 8.24, Section-2 of technical specification and mentioned elsewhere in Technical Specification. It shall be of reputed make, however make and model shall be subject to detailed engineering.	Nos	1
B.8	Supply: Maintenance Equipment- A mobile SF6 gas treatment plant, which shall be suitable for draining, filtration/ purification and refilling the equipment shall be provided. The plant shall have storage capacity for at least two of the largest switchgear compartments and shall be supplied with complete accessories such as vacuum pump, pressure gauge, valves, hoses, couplings, adaptors, etc., necessary for evacuating and filling, together with storage facilities for these items. Maintenance Equipment- A SF6 Gas maintenance cart, which shall be easily moved by one (1) person, shall be provided with enclosed storage facilities for proper storage of cylinders and other accessories including power leads. The enclosed storage shall have facilities for padlocking	It shall be in line with clause 8.18, 8.24, Section-2 of technical specification and mentioned elsewhere in Technical Specification. It shall be of reputed make, however make and model shall be subject to detailed engineering.	Nos	1
B.9	Supply: Maintenance Equipment- A two wheel gas maintenance cart fitted with a cylinder of SF6 gas, a vacuum pump, a vacuum and pressure gauge and all necessary valves, hoses and couplings for evacuating and filling the switchgear	It shall be in line with clause 8.24, Section-2 of technical specification and mentioned elsewhere in Technical Specification. It shall be of reputed make, however make and model shall be subject to detailed engineering.	Nos	1
B.10	Supply: Maintenance Equipment- SF6 gas leakage test equipment shall be suitable for testing SF6 gas as per recommendations of IEC 60376. s. Instruments for automatic and continuous monitoring for the presence of SF6 gas in the atmosphere of the switchgear room shall be provided. The recommended positions, exact number of detectors, type of mounting, facilities for alarm etc. shall be indicated during the drawing approval stage.	It shall be in line with clause 8.24, Section-2 of technical specification and mentioned elsewhere in Technical Specification. It shall be of reputed make, however make and model shall be subject to detailed engineering.	Nos	1
B.11	Supply: Maintenance Equipment- All special tools required for the purpose of installation, maintenance, overhauling and testing of GIS and also for the measurement of moisture in SF6.	It shall be in line with clause 8.24, Section-2 of technical specification and mentioned elsewhere in Technical Specification. It shall be of reputed make, however make and model shall be subject to detailed engineering.	Lot	1
B.12	Supply: Maintenance Equipment- Any other special tools and tackles required for proper maintenance of GIS units has to be supplied by the bidder	It shall be in line with clause 8.24, Section-2 of technical specification and mentioned elsewhere in Technical Specification. It shall be of reputed make, however make and model shall be subject to detailed engineering.	Lot	1
C	Supply: Mandatory Spares			
C.1	Supply: Mandatory Spares- Spare SF6 gas required for the complete GIS	1 Lot- 10% of the total quantity. This spare quantity shall be supplied in non-returnable containers in ready to use condition.	Lot	1
C.2	Supply: Mandatory Spares- Handle for dis-connector switch drive		No	4
C.3	Supply: Mandatory Spares- Handle for earthing switch drive		No	4
C.4	Supply: Mandatory Spares- Pre selection key for three position switch		No	1
C.5	Supply: Mandatory Spares- Tripping coil		No	4
C.6	Supply: Mandatory Spares- Closing coil		No	4
C.7	Supply: Mandatory Spares- Capacitive type voltage detectors		Set	1

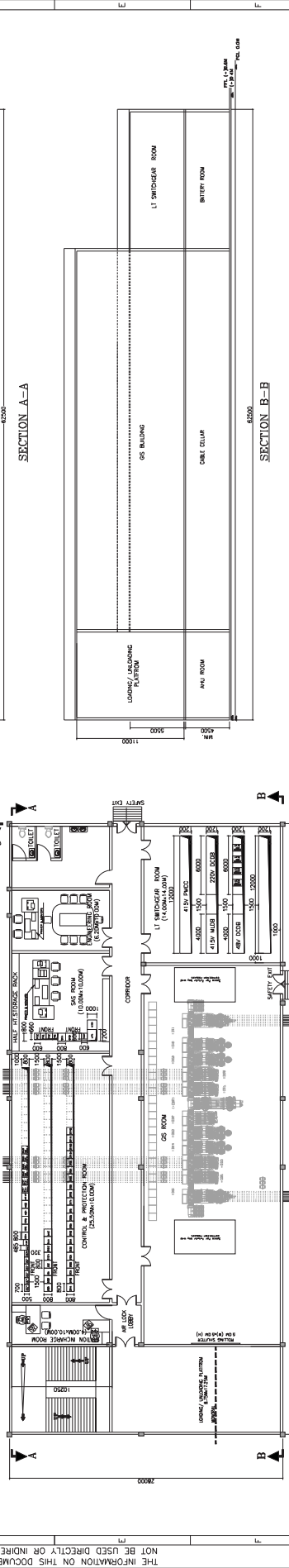
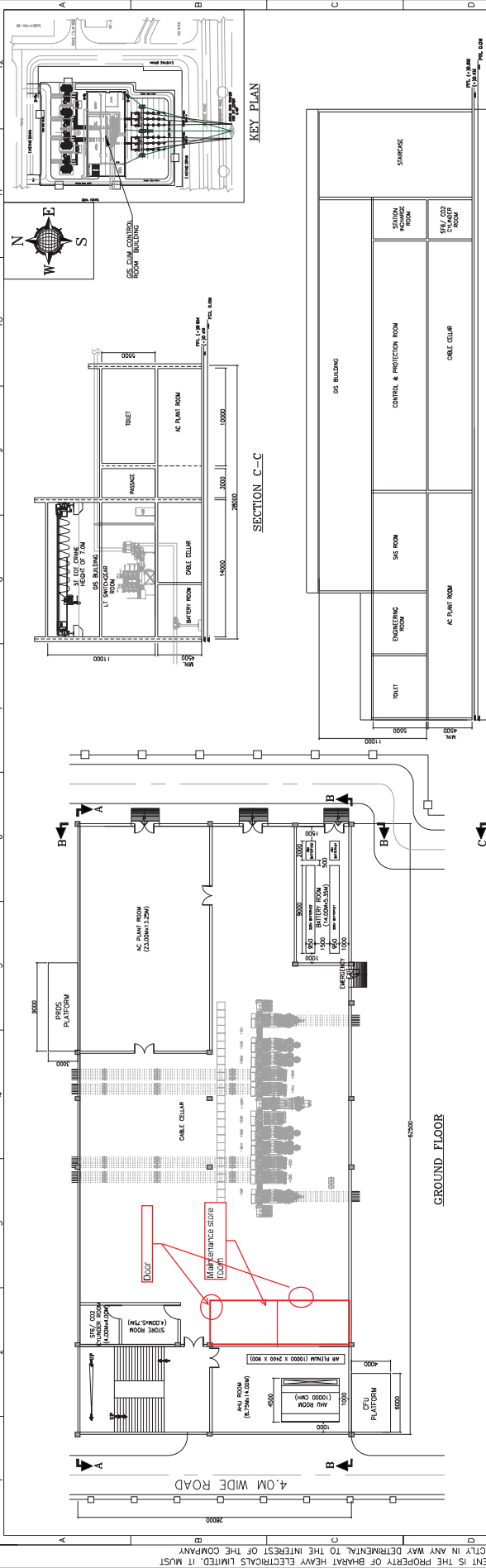
C.8	Supply: Mandatory Spares- Control fuses / MCB	1 Set+ 10 no of each type and rating	Set	1
C.9	Supply: Mandatory Spares- Density monitoring device	1 Set+ 2 no of each type	Set	1
C.10	Supply: Mandatory Spares- Pressure Gauge	1 Set+ 2 no of each type	Set	1
C.11	Supply: Mandatory Spares- Indicating lamps covers	1 Set+ 5 no of each colour	Set	5
C.12	Supply: Mandatory Spares- Indicating lamps	1 Set+ 20% or 3 no (min), whichever is more	Set	1
C.13	Supply: Mandatory Spares- Spring charging motor assembly with gear system	1 Set+ 2 no of each type	Set	1
C.14	Supply: Mandatory Spares- PT of GIS system	1 Set+ 2 no, <i>single phase</i> of each type	Set	1
C.15	Supply: Mandatory Spares- CT of GIS system	1 Set+ 2 no, <i>single phase</i> of each type	Set	1
C.16	Supply: Mandatory Spares- Isolator power and auxiliary contact		Set	1
C.17	Supply: Mandatory Spares- Isolator operating motor/ SOV assembly		Set	1
D	Supply: Operation & Maintenance Spares	Bidder to quote BOQ for recommended spares for two years of normal operation & maintenance from the date of commissioning. Bidder shall quote recommended spares for two years of normal operation & maintenance from the date of commissioning. In case of no such requirement, bidder shall submit the certification stating that "We do not hereby recommend any operation & maintenance spares for the period of two years from the date of commissioning, however in case of such requirement in future, same shall be supplied free of cost."	Lot	1
E	Service: GIS- Supervision of Erection, Testing & Commissioning and handing over to Customer	These activities shall be carried out at site in stages as per requirement or front availability at site, and hence multiple visits for completion of work are envisaged.		
E.1	Service: GIS- 220KV, Site visit for supervision of unloading & verification of GIS materials for proper storage and up-keeping at site	Site visit for supervision of unloading & verification of materials for proper storage and up-keeping at site includes following activities but not limited to, (a) Supervision of safe unloading of GIS & its accessories at site. (b) Reconciliation, storage & upkeeping of materials, with due instructions/ training to site persons for long storage.	Lot	1
E.2	Service: GIS- 220KV, Supervision of erection of GIS bays including LCC	Supervision of complete GIS bays along with all bay equipment such as GIS extension module, GIS bus extension module, surge arrester, voltage transformer, LCC including structure, cabling, earthing & other associated activities shall be included in the scope.	Lot	1
E.3	Service: GIS- 220KV, Supervision of erection of GIS- For gas insulated bus duct	Supervision of complete GIS bays along with all bay equipment including support structure, earthing & other associated activities shall be included in the scope.	Mtr	600
E.4	Service: GIS- 220KV, Supervision of erection of GIS- SF6 to air bushing/ connection	Supervision of erection of GIS- SF6 to air bushing/ connection including support structure, earthing & other associated activities shall be included in the scope.	No	6
E.5	Service: GIS- 20KV, Supervision of erection of GIS- SF6 to oil bushing/ connection	Supervision of erection of GIS- SF6 to oil bushing/ connection including support structure, earthing & other associated activities shall be included in the scope.	No	12
E.6	Service: GIS- 220KV, Supervision of erection of GIS- SF6 to EHV cable GIS connection module	Supervision of erection of GIS- SF6 to EHV cable GIS connection module including support structure, earthing & other associated activities shall be included in the scope.	No	36
E.7	Service: GIS- 220KV, Testing & commissioning of GIS bays including LCC	Testing & commissioning of complete GIS bays including other associated activities in line with site acceptance testing as per customer approved SAT procedure shall be in bidder's scope.	Lot	1
E.8	Service: GIS- 220KV, Testing & commissioning of GIS- SF6 to air bushing/ connection	Testing & commissioning of complete GIS- SF6 to air bushing/ connection including other associated activities in line with site acceptance testing as per customer approved SAT procedure shall be in bidder's scope.	No	6
E.9	Service: GIS- 220KV, Testing & commissioning of GIS- SF6 to oil bushing/ connection	Testing & commissioning of GIS- SF6 to oil bushing/ connection including other associated activities in line with site acceptance testing as per customer approved SAT procedure shall be in bidder's scope.	No	12
E.10	Service: GIS- 220KV, Testing & commissioning of GIS- SF6 to EHV cable GIS connection module	Testing & commissioning of GIS- SF6 to EHV cable GIS connection module including other associated activities in line with site acceptance testing as per customer approved SAT procedure shall be in bidder's scope.	No	36
E.11	Service: GIS- 220KV, Testing & commissioning of GIS- Final Successful High Voltage/ Power Frequency Testing of complete GIS	Carrying out successful HV/ Power Frequency Testing of GIS as per IEC including Arrangement of HV Test kit (on returnable basis) shall be in scope of bidder, which includes charges HV test kit with operator, accessories & tools required for completion of HV testing. Bays may be commissioned separately. No delay shall be permitted on account of the non availability of the HV test kit.	Lot	1
E.12	Service: GIS- 220KV- Insulation Co-ordination Studies for GIS System	Insulation co-ordination activities shall in bidder's scope. In case of non availability of exact input details, same shall be done on basis of standard inputs available and shall be revised after availability of exact input details.	Lot	1
E.13	Service: GIS- 220KV- Final Documentation	Final Documentation including As Built Drawing/ Document, Site Testing Reports/ Protocols, Handing over protocols along with manuals shall be submitted etc. by bidder.	Lot	1
F	Service: Training			
F.1	Service: Training- Training for GIS of 12 no Engineers (10 no customer engineers+2 no BHEL engineers) for a period of at least 7 working days at Manufacturer's works	It shall be in line with clause 13, Section-2 of technical specification and mentioned elsewhere in Technical Specification.	Lot	1
F.2	Service: Training- Training for GIS of 12 no Engineers (10 no customer engineers+2 no BHEL engineers) for a period of at least 7 working days at project site	It shall be in line with clause 13, Section-2 of technical specification and mentioned elsewhere in Technical Specification.	Lot	1
G	Supply: Unit reference price of GIS part item/ equipment	GIS part item/ equipment shall be required for supply as a mandatory spares or any addition/ deletion of equipment, due to damage, theft, additional requirement by customer during detailed engineering or later stage. It is to be ensured by bidder that unit prices have a logical relationship with prices of assemblies in main items (Bay, Busbar etc). The reference prices shall be used for breakup rates, if required at any stage. The reference prices shall be considered for evaluation.		
G.1	Supply: Unit reference price of GIS part item/ equipment- 220kV , 2000A Circuit Breaker	1 Set+ 1 No of each rating and type with one poles with enclosure & without operating mechanism	Set	1
G.2	Supply: Unit reference price of GIS part item/ equipment- 220kV , 2000A Disconnector with Maintenance Earthing Switch	1 Set+ 1 No of each rating and type with all three poles with enclosure & without operating mechanism	Set	1
G.3	Supply: Unit reference price of GIS part item/ equipment- 220kV , 2000A Disconnector without Maintenance Earthing Switch	1 Set+ 1 No of each rating and type with all three poles with enclosure & without operating mechanism	Set	1
G.4	Supply: Unit reference price of GIS part item/ equipment- 220kV , 2000A Fast acting make proof grounding switch/ High speed make proof grounding switch	1 Set+ 1 No of each rating and type with all three poles with enclosure & without operating mechanism	Set	1
G.5	Supply: Unit reference price of GIS part item/ equipment- Surge Arrester including Surge Counter (Rated arrester voltage – 198kV)	1 Set+ 1 No, <i>single phase</i> of each rating and type with enclosure. Rated voltage may be changed after insulation coordination study.	Set	1
G.6	Supply: Unit reference price of GIS part item/ equipment- 220KV Current Transformer	1 Set+ 1 No, <i>single phase</i> of each rating and type with enclosure	Set	1
G.7	Supply: Unit reference price of GIS part item/ equipment- 220KV Voltage Transformer	1 Set+ 1 No, <i>single phase</i> of each rating and type with enclosure	Set	1
G.8	Supply: Unit reference price of GIS part item/ equipment- Operating Mechanism for Circuit Breaker	1 Set+ 1 No of each rating and type	Set	1
G.9	Supply: Unit reference price of GIS part item/ equipment- Operating Mechanism box for Disconnector with Maintenance earthing switch	1 Set+ 1 No of each rating and type	Set	1
G.10	Supply: Unit reference price of GIS part item/ equipment- Operating Mechanism box for Disconnector without Maintenance earthing switch	1 Set+ 1 No of each rating and type	Set	1
G.11	Supply: Unit reference price of GIS part item/ equipment- Operating Mechanism for Fast acting make proof grounding switch/ High speed make proof grounding switch	1 Set+ 1 No of each rating and type	Set	1
G.12	Supply: Unit reference price of GIS part item/ equipment- 220kV, 1 Phase bus bar conductor		Mtr	1
G.13	Supply: Unit reference price of GIS part item/ equipment- 220kV, 1 phase GIS metallic enclosure for bus bar/ any equipment		Mtr	1
G.14	Supply: Unit reference price of GIS part item/ equipment- 220kV, 1 Phase conductor for bus duct		Mtr	1
G.15	Supply: Unit reference price of GIS part item/ equipment- 220kV, 1 phase GIS metallic enclosure for bus duct		Mtr	1
G.16	Supply: Unit reference price of GIS part item/ equipment- Gas permeable/ communication/ barrier type Insulator	1 Set+ 1 No of each rating and type	Set	1
G.17	Supply: Unit reference price of GIS part item/ equipment- Gas non- permeable/ non - communication/ non-barrier type Insulator	1 Set+ 1 No of each rating and type	Set	1
G.18	Supply: Unit reference price of GIS part item/ equipment- PD sensor	1 Set+ 1 No of each rating and type	Set	1
G.19	Supply: Unit reference price of GIS part item/ equipment- Pressure/ density monitor monitor device & Switch	1 Set+ 1 No of each rating and type	Set	1
G.20	Supply: Unit reference price of GIS part item/ equipment- Pressure relief device	1 Set+ 1 No of type	Set	1
G.21	Supply: Unit reference price of GIS part item/ equipment- Rupture disc	1 Set+ 1 No of type	Set	1
G.22	Supply: Unit reference price of GIS part item/ equipment- Elbow/ bend/ cross and T section	1 Set+ 1 No of type	Set	1
G.23	Supply: Unit reference price of GIS part item/ equipment- Expansion joint	1 Set+ 1 No of type	Set	1
G.24	Supply: Unit reference price of GIS part item/ equipment- Flexible connections	1 Set+ 1 No of type	Set	1
G.25	Supply: Unit reference price of GIS part item/ equipment- Gas seals	1 Set+ 1 No of type	Set	1

H	Service: Unit reference price of GIS part item/ equipment			
H.1	Service: Unit reference price of GIS part item/ equipment- Services of supervision for Erection of GIS	Services of supervision for Erection of GIS	Manday	1
H.2	Service: Unit reference price of GIS part item/ equipment- Services of Testing & Commissioning of GIS	Services of Testing & Commissioning of GIS	Manday	1
H.3	Service: Unit reference price of GIS part item/ equipment- Hiring charges of HV test kit with operator	Additional HV test kit charges including charges of operator, HV test kit, accessories & tools required for completion of HV test (Dielectric Test after installation of GIS). HV test kit charges include one or more bay at site.	Lot	1
I	Supply: GIS- Any item(s) required for completion of project but not covered in Supply Items	Any supply item(s) required for completion of GIS system, but not covered above shall be covered in bidder's scope.	Lot	1
J	Service: GIS- Any service(s) required for completion of project but not covered in service Items	Any service item(s) required for completion of GIS system, but not covered above shall be covered in bidder's scope.	Lot	1

Note:	The Manufacturing clearance shall be provided Lot wise, however lot item can be clubbed together subject to approval of drawing/ documents. MFC date will be counted from the date of approval of Cat I/ cat II drawings as per the following table. Please refer to SI. No. of items in the BOQ also,			
	Lot description covering BOQ items	SI. No. of approved Drawing required in Cat I/ Cat II for MFC (For SI. No. of drawings please refer section 1 of TS)		
	Lot-1 (BOQ item A1 to A9)	SI. No. 1, 2, 3, 6, 10, 11 and 12		
	Lot-2 (BOQ item A10 to A14)	SI. No. 1, 2, 4, 6 and 10		
	Lot-3 (BOQ item A16 and A17)	SI. No. 3, 5, 10, 11 and 12		
	Lot-4 (BOQ item A15 and A18)	SI. No. 2, 3, 10 and 12		
	Lot 5 (BOQ item B, C and D)	SI. No. 9, 10 and 12		

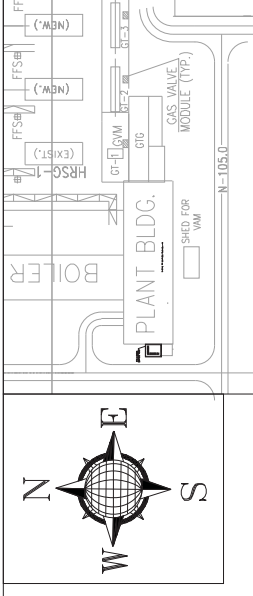
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FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN mm)

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SIZE-A1

(ALL DIMENSIONS ARE IN mm)



SECTION F-F

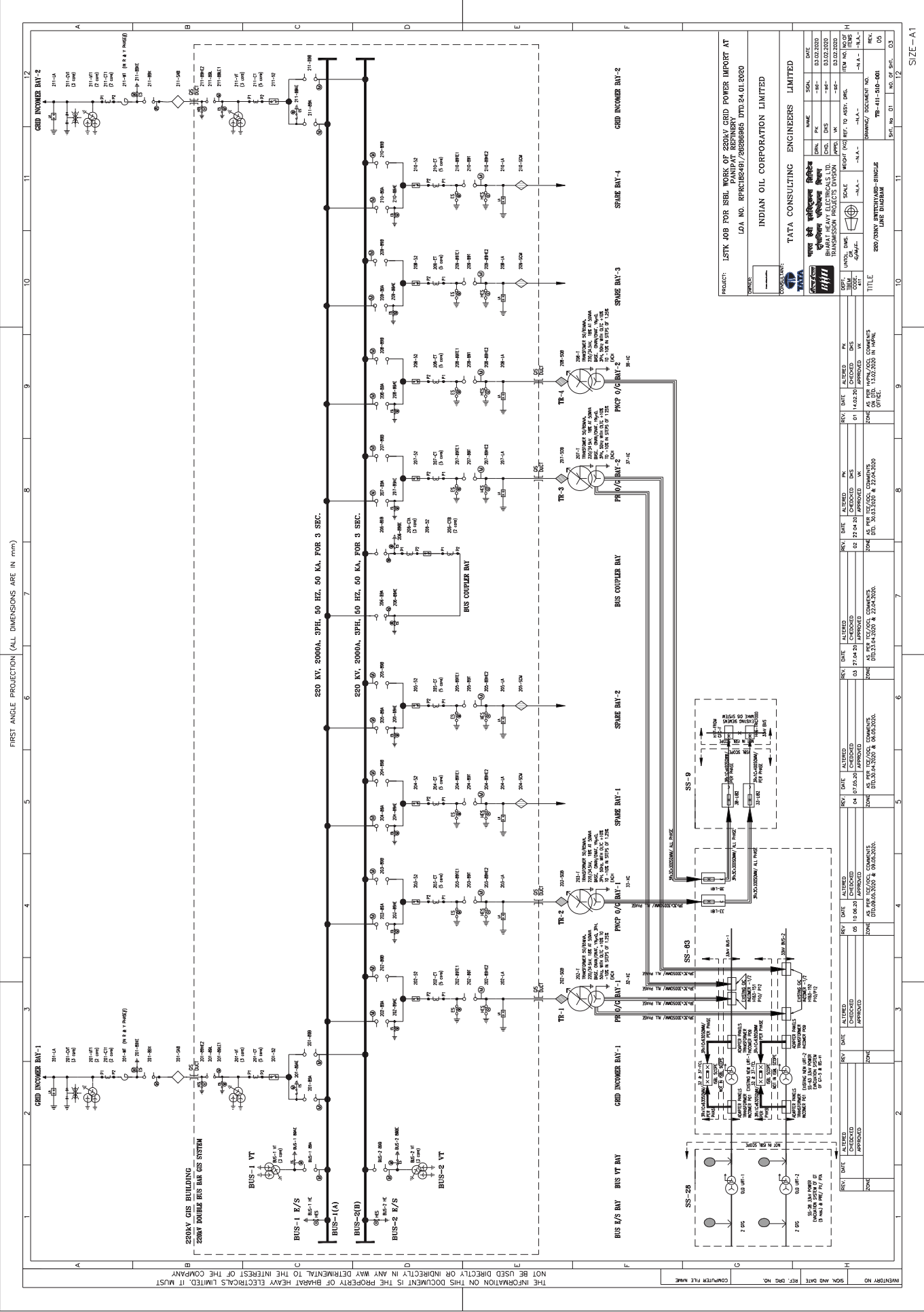
- SECTION E-E

REV.	DATE	ALT	PK	REV.	DATE	ALT	PK	REV.	DATE	ALT	PK	REV.	DATE	ALT	PK
04	20.07.20	CHD	DKS	03	17.06.20	CHD	DKS	02	28.04.20	CHD	DKS	01	14.04.20	CHD	DKS
ZONE AS PER CONSULTANT/ CUSTOMER COMMENTS ON DTD. 19.06.2020 & 19.06.2020 RESPECTIVELY & FURTHER INPUTS FROM MECHANICAL GROUP.				ZONE AS PER CONSULTANT/ CUSTOMER COMMENTS ON DTD. 07.05.2020 & 07.05.2020 RESPECTIVELY & FURTHER INPUTS FROM MECHANICAL GROUP.				ZONE AS PER CONSULTANT/ CUSTOMER COMMENTS ON DTD. 21.04.2020 & 24.04.2020 RESPECTIVELY.				ZONE AS PER CUSTOMER COMMENTS ON DATED 08.03.2020 DURING MEETING AT OCL PANIPAT OFFICE			
  कार्ड हेवी इलेक्ट्रिकल्स लिमिटेड कार्ड इलेक्ट्रिकल्स लिमिटेड SHARAD HEAVY ELECTRICALS LTD. PANIPAT PROJECT DIVISION DATE: 20.07.20 UNITS: DMS, CODE: 994/7 ITEM NO. 411															
 SCALE N.T.S WEIGHT (KG) REF. TO ASSY. DRG. NAME N.A. SIGN N.A.															
ISSUED FOR: 1B-411-316-020 ISSUED BY: 1B-411-316-020															
ISSUED FOR: 1B-411-316-020 ISSUED BY: 1B-411-316-020															

SIZE-A3

PANEL/ BOARDS DETAILS								
IOCL, Panipat Project								
		Designation	QTY		ACTUAL			Total Width
					W	D	H	
A. 220kV GIS cum Control Room Building								
1. CONTROL & PROTECTION ROOM								
LINE-1	Bay-201	2R1A, 2R1B	2	No	800	800	2315	1600
PR TRAFO-1	Bay-202	2R2A, 2R2B	2	No	800	800	2315	1600
PNCP TRAFO-1	Bay-203	2R3A, 2R3B	2	No	800	800	2315	1600
SPARE BAY-1	Bay-204	2R4A, 2R4B	2	No	800	800	2315	1600
SPARE BAY-2	Bay-205	2R5A, 2R5B	2	No	800	800	2315	1600
BUS COUPLER	Bay-206	2R6	1	No	800	800	2315	800
PR TRAFO-2	Bay-207	2R7A, 2R7B	2	No	800	800	2315	1600
PNCP TRAFO-2	Bay-208	2R8A, 2R8B	2	No	800	800	2315	1600
SPARE BAY-3	Bay-209	2R9A, 2R9B	2	No	800	800	2315	1600
SPARE BAY-4	Bay-210	2R10A, 2R10B	2	No	800	800	2315	1600
LINE-2	Bay-211	2R11A, 2R11B	2	No	800	800	2315	1600
220kV BUSBAR PROTN PANEL		2BB1, 2BB2	2	No	800	800	2315	1600
220kV GRID ISLANDING PANEL		2IS1, 2IS2	2	No	800	800	2315	1600
220kV FAST BUS TRANSFER PANEL		2FBT1, 2FBT2	2	No	800	800	2315	1600
AUXILIARY BCU PANEL		SUX1, SUX2	2	No	800	800	2312	1600
RTCC PANEL		RTCC	4	No	660	600	2295	2640
COMUNICATION EQUIPMENTS		DIGITAL PLCC	6	No	700	500	2230	4200
		EPAX	1	No	485	320	220	485
		FODP	1	No	600	600	2200	600
CENTRAL TRANSDUCER PANELS		TRP1, TRP2, TRP3	3	No	800	800	2315	2400
IMB Panel (for Existing PR ECS I/f)		IMB1, IMB2	2	No	800	800	2315	1600
LMS SYSTEM (CENTRAL UNIT PANEL)		LMS-CP	1	No	800	800	2315	800
LMS SYSTEM (RTU PANEL)		LMS-RTU-220kV	2	No	800	800	2315	1600
2. SAS ROOM								
SAS NETWORKING PANEL		SAS1, SAS2	2	No	800	800	2315	1600
PLCC MODEM PANEL			1	No	800	800	2312	800
COMUNICATION EQUIPMENTS		FODP	1	No	600	600	2200	600
UPS PANEL WITH ACDB		UPS+ACDB	1	No	1200	1000	2315	1200
	OTHER SAS EQUIPMENTS							
	2 OWS + 1 EWS + 2 PRINTERS(A3) + 1 PRINTERS(A4) + 2 INVERTERS/UPS + FURNITURE							
3. ENGINEERING ROOM								
	OTHER SAS EQUIPMENTS							
	1 EWS + 1 Historian Server PC + 1 DR PC + 1 PRINTERS(A4) + FURNITURE							
4. LT SWITCHGEAR ROOM								
415V PMCC			1	No	12000	1200	2450	12000
415V MLDB			1	No	4000	1200	2450	4000
220V DCDB			1	No	6000	1100	2450	6000
48V DCDB			1	No	4000	1100	2450	4000
220V BATTERY CHARGER			2	No	700	1000	1900	1400
48V BATTERY CHARGER			2	No	700	1000	1900	1400

5. BATTERY ROOM								
220V BATTERY BANK			2	No	9000	950	1500	18000
48V BATTERY BANK			2	No	2000	950	1500	4000
6. AC PLANT ROOM								
415V VAM MCC			1	No	5000	1200	2450	5000
B. Tariff Metering Room (In Outdoor Switchyard)								
	ENERGY METERING PANEL	EMP	2	No	800	800	2315	1600
C. PR CPP Extension Control Room								
PR SCAP PANEL (FOR 21 No. Bays)		SCAP1, SCAP2,...SCAP21	21	No	400	800	2315	8400
LMS SYSTEM (RTU PANEL)		LMS-RTU-PR	2	No	800	800	2315	1600
	OTHER SAS EQUIPMENTS							
	2 OWS + 1 PRINTERS(A4) + 60inch Video Wall Screen + FURNITURE							
D. PNCP CPP Control Room (Existing Building)								
PNCP SCAP PANEL (FOR 6 No. Bays)		SCAP1, SCAP2,...SCAP6	6	No	400	800	2315	2400
IMB Panel (for Existing PNCP ECS I/f)		IMB1	1	No	800	800	2315	800
LMS SYSTEM (RTU PANEL)		LMS-RTU-PNCP	2	No	800	800	2315	1600
	OTHER SAS EQUIPMENTS							
	2 OWS + 1 PRINTERS(A4) + 60inch Video Wall Screen + FURNITURE							
E. 220kV Mundh S/S (Remote End Panels) (Existing Building)								
1. CONTROL & PROTECTION ROOM								
PLCC MODEM PANEL			1	No	800	800	2312	800
COMUNICATION EQUIPMENTS		DIGITAL PLCC	6	No	700	500	2230	4200
		FODP	1	No	600	600	2200	600
2. LT SWITCHGEAR ROOM								
48V DCDB			1	No	1000	1100	2450	1000
48V BATTERY CHARGER			2	No	700	1000	1900	1400
48V BATTERY BANK			2	No	9000	950	1500	18000



SIZE-A1

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN mm)											
SYSTEM PARAMETERS -											
SL. NO.	DATA	220kV SYSTEM	33kV SYSTEM								
01	NOMINAL VOLTAGE (kV)	220kV±10%	33kV±0%								
02	FREQUENCY (Hz)	50±0.5%	50±0.5%								
03	SYSTEM EARTHING	SOLIDLY EARTHED	SOLIDLY EARTHED								
04	SHORT-TERM CURRENT RATING (kA/Sec)	50kA/3sec	31.5kA/1sec								
05	RATED PEAK WITHSTAND CURRENT (kA)	125	80								
06	BASIC INSULATION LEVEL (kV)	1050	170								
07	RATED CURRENT AT 50°C (A)	2000	2500								
08	RATED TOWER FREQUENCY WITHSTAND VOLTAGE (kV)	460	70								
09	LIGHTNING IMPULSE WITHSTAND VOLTAGE (kV)	1050	170								
10	CREEPAGE DISTANCE (mm/kV)	25	25								
11	MINIMUM AMBIENT TEMPERATURE (°C)	-35	-35								
12	MAXIMUM AMBIENT TEMPERATURE (°C)	+50.0°C	+50.0°C								
13	EQUIPMENT DESIGN TEMPERATURE (°C)	+45.0°C	+45.0°C								
14	AUXILIARY SUPPLY VOLTAGE (Vdc)	240V±3 PHASE / 240V±1 PHASE	110V±3 PHASE / 240V±1 PHASE								
15	PROTECTION & CONTROL SUPPLY (Vdc)	220 ±5% 220 -70% +110% 1. THREE COIL SUPPLY 2. TWO COIL SUPPLY 3. JUMPING CAPACITOR MOTOR SUPPLY	220 ±5% 220 -70% +110% 220 -80% +110% 220 -80% +110%								

NOTES: -											
1. BAY SCHEME FOR THE TOWERING AND THE CHARGE IN LINE WITH THE REQUIREMENTS OF THE COMPANY'S STANDARD DRAWING (SD) SHALL BE PROVIDED FOR BOTH INDICATOR BAYS.											
2. LOCATION OF CO-2 IN BAY CHARGE AS PER COMPANY'S STANDARD DRAWING (SD) SHALL BE PROVIDED FOR BOTH INDICATOR BAYS.											
3. LOCATION OF CO-2 IN BAY CHARGE AS PER COMPANY'S STANDARD DRAWING (SD) SHALL BE PROVIDED FOR BOTH INDICATOR BAYS.											
4. LOCATION OF CO-2 IN BAY CHARGE AS PER COMPANY'S STANDARD DRAWING (SD) SHALL BE PROVIDED FOR BOTH INDICATOR BAYS.											
5. LOCATION OF CO-2 IN BAY CHARGE AS PER COMPANY'S STANDARD DRAWING (SD) SHALL BE PROVIDED FOR BOTH INDICATOR BAYS.											
6. LOCATION OF CO-2 IN BAY CHARGE AS PER COMPANY'S STANDARD DRAWING (SD) SHALL BE PROVIDED FOR BOTH INDICATOR BAYS.											
7. LOCATION OF CO-2 IN BAY CHARGE AS PER COMPANY'S STANDARD DRAWING (SD) SHALL BE PROVIDED FOR BOTH INDICATOR BAYS.											
8. LOCATION OF CO-2 IN BAY CHARGE AS PER COMPANY'S STANDARD DRAWING (SD) SHALL BE PROVIDED FOR BOTH INDICATOR BAYS.											
9. LOCATION OF CO-2 IN BAY CHARGE AS PER COMPANY'S STANDARD DRAWING (SD) SHALL BE PROVIDED FOR BOTH INDICATOR BAYS.											
10. LOCATION OF CO-2 IN BAY CHARGE AS PER COMPANY'S STANDARD DRAWING (SD) SHALL BE PROVIDED FOR BOTH INDICATOR BAYS.											
11. LOCATION OF CO-2 IN BAY CHARGE AS PER COMPANY'S STANDARD DRAWING (SD) SHALL BE PROVIDED FOR BOTH INDICATOR BAYS.											
12. LOCATION OF CO-2 IN BAY CHARGE AS PER COMPANY'S STANDARD DRAWING (SD) SHALL BE PROVIDED FOR BOTH INDICATOR BAYS.											

SYSTEM PARAMETERS -											
SL. NO.	DATA	220kV SYSTEM	33kV SYSTEM								
01	NOMINAL VOLTAGE (kV)	220kV±10%	33kV±0%								
02	FREQUENCY (Hz)	50±0.5%	50±0.5%								
03	SYSTEM EARTHING	SOLIDLY EARTHED	SOLIDLY EARTHED								
04	SHORT-TERM CURRENT RATING (kA/Sec)	50kA/3sec	31.5kA/1sec								
05	RATED PEAK WITHSTAND CURRENT (kA)	125	80								
06	BASIC INSULATION LEVEL (kV)	1050	170								
07	RATED CURRENT AT 50°C (A)	2000	2500								
08	RATED TOWER FREQUENCY WITHSTAND VOLTAGE (kV)	460	70								
09	LIGHTNING IMPULSE WITHSTAND VOLTAGE (kV)	1050	170								
10	CREEPAGE DISTANCE (mm/kV)	25	25								
11	MINIMUM AMBIENT TEMPERATURE (°C)	-35	-35								
12	MAXIMUM AMBIENT TEMPERATURE (°C)	+50.0°C	+50.0°C								
13	EQUIPMENT DESIGN TEMPERATURE (°C)	+45.0°C	+45.0°C								
14	AUXILIARY SUPPLY VOLTAGE (Vdc)	240V±3 PHASE / 240V±1 PHASE	110V±3 PHASE / 240V±1 PHASE								
15	PROTECTION & CONTROL SUPPLY (Vdc)	220 ±5% 220 -70% +110% 1. THREE COIL SUPPLY 2. TWO COIL SUPPLY 3. JUMPING CAPACITOR MOTOR SUPPLY	220 ±5% 220 -70% +110% 220 -80% +110% 220 -80% +110%								

REFERENCE DRAWING (S) / DOCUMENT(S) -											
SL. NO.	DRAWING / DOCUMENT NO.	DRAWING TITLE									
1.											

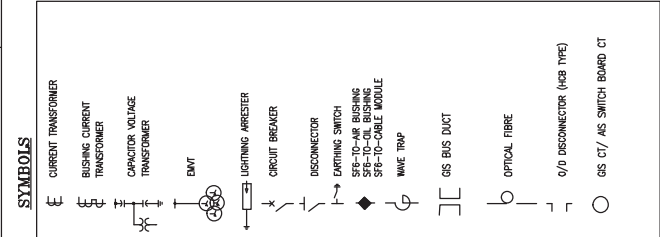
SIZE-A1

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

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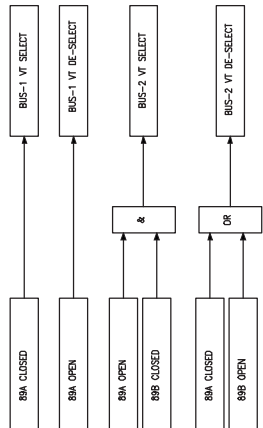
DEVICE	FUNCTION
67D1/2	LINE DIFFERENTIAL PROTECTION MAIN-1/2
21M/2	DISC. PROTECTION MAIN-1/2
79	AUTO-RECLOSE FUNCTION
25	CHECK SYNCHRONISING FUNCTION
D5	DISBURGE/FAULT LOCATOR
88	VT FUSE FAIL RELAY
59	OVER VOLTAGE RELAY
67D1/2N	DIRECTIONAL DMT PHASE O/C / E/F PROTECTION WITH HIGH SET FUNCTION
85	CARRIER-ASSD INR-TRIPPING PROTECTION
SER	SEQUENCE OF EVENT RECORDER
27	UNDER VOLTAGE PROTECTION
DR	DISTURBANCE RECORDER
BCU	BAY CONTROL UNIT
67B1/22	BUSBAR DIFFERENTIAL PROTECTION MAIN-1/2 (WITH IN-BUILT CHECK ZONE)
50 LBB	LOCAL BREAKER BACKUP PROTECTION
EM V/C	ENERGY METER MAIN/CHECK
67T1/2	TRANSFORMER DIFFERENTIAL PROTECTION MAIN-1/2
64T HV/V	TRANSFORMER REF PROTECTION
50/50N	NON DIRECTIONAL INSTANTANEOUS PHASE O/C / E/F PROTECTION WITH HIGH SET FUNCTION
63 PRX	PRESSURE RELIEF DEVICE, TRIP
63 AV/TK	BUSCHALZ RELAY, ALARM/TRIP
63W A/TX	WINDING TEMPERATURE HIGH, ALARM/TRIP
490 A/TX	OIL TEMPERATURE HIGH, ALARM/TRIP
OXAX	OIL LEVEL LOW, ALARM
SCAP	SYNCHRONISATION, CONTROL & ANNUNCIATION PANEL
LUS	LOAD MANAGEMENT SYSTEM
TRANS PANEL	CENTRAL TRANSODUCER PANEL
51N HV/V	TRANSFORMER STAND-BY E/F PROTECTION HV/V NEUTRAL
67D2	CABLE DIFFERENTIAL PROTECTION
MFN	MULTI-FUNCTION METER
OSR TX	OIL SURE RELAY, TRIP
FTBS	FAST BUS TRANSFER RELAY
68	BLOCKING RELAY
155/295	TRIP CIRCUIT SUPERVISION
186/286	MASTER TRIP RELAY
80A/80B	PANEL DC SUPERVISION RELAY



- NOTES (FOR IOC1 PANIPAT END)**
- ALL PROTECTION FEATURES SHOWN IN THIS DRAWING SHALL BE PROVIDED IN THE OFFERED SYSTEM.
 - REFERENCE DRAWING: SINGLE LINE DIAGRAM FOR 220/33KV SWITCHYARD SINGLE LINE DIAGRAM FOR 220/33KV SWITCHYARD.
 - FOR THE 220 KV SYSTEM, IF RATING OF CT SHALL BE BROOFD AND RATING OF WAVE TRAPS SHALL BE 1250A, 1.0mH, 31.5kV/1000; IOC1/ MPNL TO CONFIRM THE SAME.
 - DIFFERENTIAL CUM DISTANCE PROTECTION RELAY AT IOC1 END SHALL MATCH WITH THAT PROVIDED FOR REMOTE END.
 -
 -
 -
 -
 - DIFFERENTIAL CUM DISTANCE PROTECTION RELAY AT BOTH ENDS WILL BE CONNECTED THROUGH DIRECT FIBRE CONNECTION (SINGLE MODE).
 - THROUGH DIRECT FIBRE CONNECTION (JOINT BOX, FOTE (MULTIPLEXER SDV/PPH etc) ARE NOT IN BHEL / IOC1 SCOPE.
 -
 - ALL VT SELECTION SCHEMES SHALL BE AUTOMATIC CHANGEOVER SCHEMES BASED ON LOADS.
 - DIFFERENTIAL CUM DISTANCE PROTECTION RELAY AT REMOTE END (MUNGH S/S) WILL BE CHECK SWITCH FEATURE ALONG WITH DEAD BUS CHARGING PROVISION SHALL BE KEPT FOR ALL 220KV BREAKERS AS PART OF BCU AS WELL AS SWM PANEL.

- NOTES (FOR REMOTE END - HVPNL MUNGH S/S)**
- ALL PROTECTION FEATURES SHOWN IN THIS DRAWING SHALL BE PROVIDED IN THE OFFERED SYSTEM.
 - FOR THE 220 KV SYSTEM, IF RATING OF CT SHALL BE BROOFD AND RATING OF WAVE TRAPS SHALL BE 1250A, 1.0mH, 31.5kV/1000; IOC1/ MPNL TO CONFIRM THE SAME.
 - DIFFERENTIAL CUM DISTANCE PROTECTION RELAY AT MUNGH S/S END SHALL MATCH WITH THAT PROVIDED FOR REMOTE END.
 - ASSOCIATED DC SYSTEM AT MUNGH S/S ARE IN THE SCOPE OF BHEL.
 - REMOTE END DIFFERENTIAL CUM DISTANCE PROTECTION RELAY SHALL BE SUPPLIED LOOSE BY BHEL TO DISBURGE/FAULT LOCATOR (D5) AT MUNGH S/S.
 - DIFFERENTIAL CUM DISTANCE PROTECTION RELAY AT REMOTE END (MUNGH S/S) WILL BE CHECK SWITCH FEATURE ALONG WITH DEAD BUS CHARGING PROVISION SHALL BE KEPT FOR ALL 220KV BREAKERS AS PART OF BCU AS WELL AS SWM PANEL.
 - DIFFERENTIAL CUM DISTANCE PROTECTION RELAY AT BOTH ENDS WILL BE CONNECTED THROUGH DIRECT FIBRE CONNECTION (SINGLE MODE).
 - THROUGH DIRECT FIBRE CONNECTION (JOINT BOX, FOTE (MULTIPLEXER SDV/PPH etc) ARE NOT IN BHEL / IOC1 SCOPE.
 - EXISTING DETAILS OF REMOTE END STATION TO BE INFORMED BY MPNL (SAL, CT, VT, etc) TO BE PROVIDED TO BHEL FOR THE SAME.
 - EXISTING BUS VT SELECTION CIRCUIT SHALL BE USED FOR EXTENDING VT INPUT TO 21M1 / B2 AT MUNGH SUBSTATION.

220KV BUS-VT SELECTION LOGIC TO BE DEVELOPED IN BCU



CUSTOMER: ISTK JOB FOR ISBL WORK OF 220KV GRID POWER IMPORT AT PANIPAT REFINERY
LOA NO. RPRCIB2491/20206905 DTD.24.01.2020

OWNER:

CONSULTANT:

INDIAN OIL CORPORATION LIMITED

TATA CONSULTING ENGINEERS LIMITED

BHARAT HEAVY ELECTRICALS LTD.
TRANSMISSION BUSINESS GROUP

SCALE: 1/1000
UNITS: MM
DATE: 05/06/2022
BY:

REVISIONS: 01 29/04/2020 CHD/APPD VK
ZONE REVISED AS PER TCE & IOC1 COMMENTS DT 19/03/2020

TITLE: 220/33KV SWITCHYARD - KEY METERING & PROTECTION SINGLE LINE DIAGRAM

SHEET NO. 01 NO. OF SHEET 08

INVENTORY NO. SIGN. AND DATE REF. DRG. NO. COMPUTER FILE NAME THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED. IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY

REV.	DATE	ALTERED	RO
04	04/06/2020	CHD/APPD	WK
03	28/05/2020	CHD/APPD	WK
02	23/05/2020	CHD/APPD	WK
01	29/04/2020	CHD/APPD	WK

ZONE DT 03/06/2020
ZONE DT 28/05/2020
ZONE DT 28/05/2020
ZONE DT 04/05/2020
ZONE DT 19/03/2020

CUSTOMER: LSTK JOB FOR ISBL WORK OF 220KV GRID POWER IMPORT AT PAINTAL REFINERY
LDA NO. RPTC182481/28288885 DTD 24.01.2020

OWNERS: INDIAN OIL CORPORATION LIMITED

CONSULTANT: TATA CONSULTING ENGINEERS LIMITED

ENGINEER: BHARAT HEAVY ELECTRICALS LTD. TRANSMISSION BUSINESS GROUP

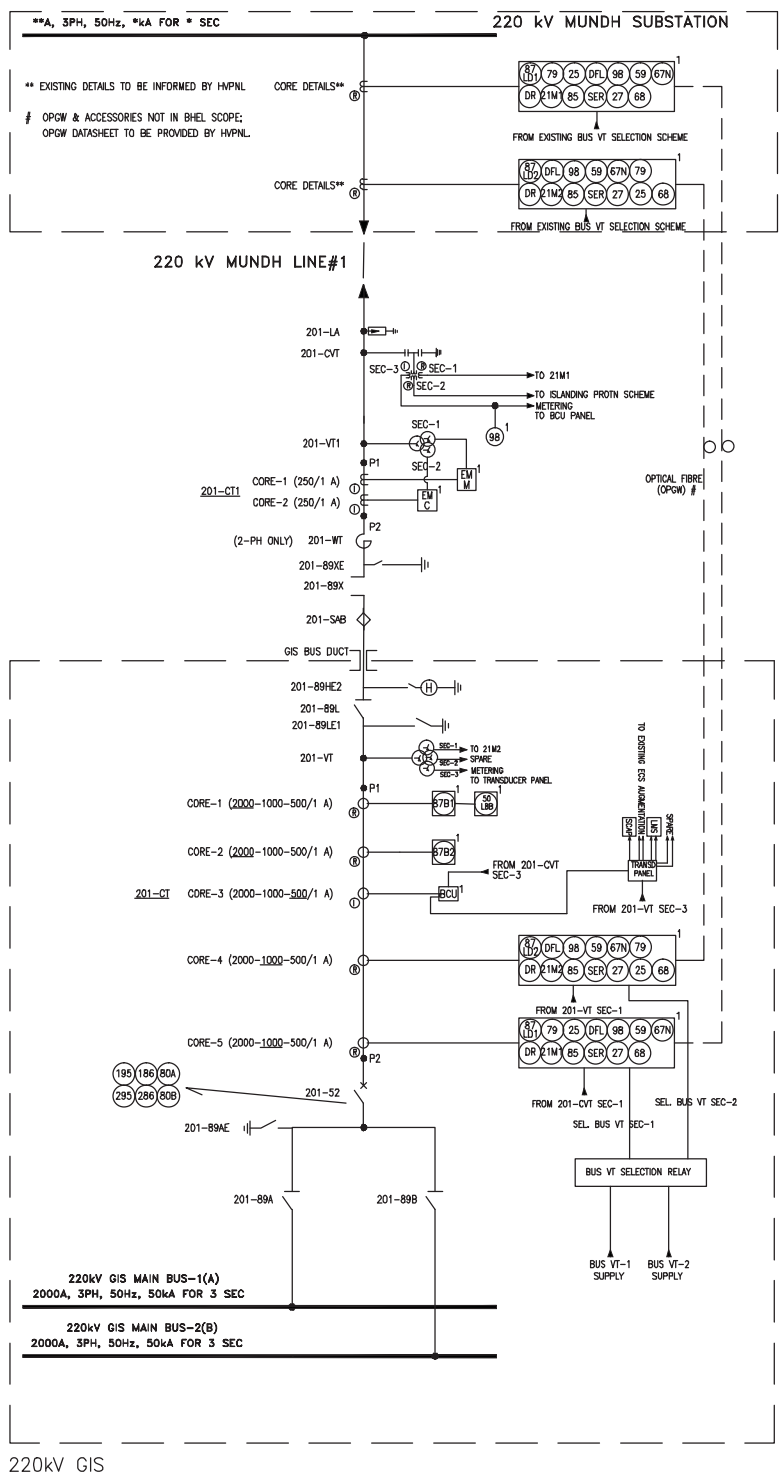
SCALE: N.T.S.

WEIGHT (KG) REF. TO ASST. DRG.

ITEM NO. / DATE

1B-3-411-510-002

14



THIS DIAGRAM APPLICABLE FOR 220KV LINE BAY# 211 ALSO.
APPLICABLE FOR 220KV GRID INCOMER BAY# 1/2 FROM HVPNL

FIRST ANGLE PROJECTION
(ALL DIMENSIONS ARE IN mm)

SIZE-A3

INVENTORY NO	SIGN. AND DATE	REF. DRG. NO.	COMPUTER FILE NAME	THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED. IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY
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REV.	DATE	ALTERED	RO	REV.	DATE	ALTERED	RO	REV.	DATE	ALTERED	RO	REV.	DATE	ALTERED	RO
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	DT 03/06/2020				DT 28/06/2020				DT 04/06/2020				DT 19/03/2020		

BHARAT HEAVY ELECTRICALS LTD.
TRANSMISSION BUSINESS GROUP

CONSULTANT:

TATA CONSULTING ENGINEERS LIMITED

OWNER:

INDIAN OIL CORPORATION LIMITED

CUSTOMER: LSTK JOB FOR ISBL WORK OF 220KV GRID POWER IMPORT AT PAINTAL REFINERY

LOA NO. RPTCIB2491/28288985 DTD 24.01.2020

PROJECT: 220/33KV SWITCHBOARD - KEY METERING & PROTECTION SINGLE LINE DIAGRAM

SCALE: 1/1

DATE: 12.03.2020

BY: [Signature]

CHECKED: [Signature]

DATE: 12.03.2020

BY: [Signature]

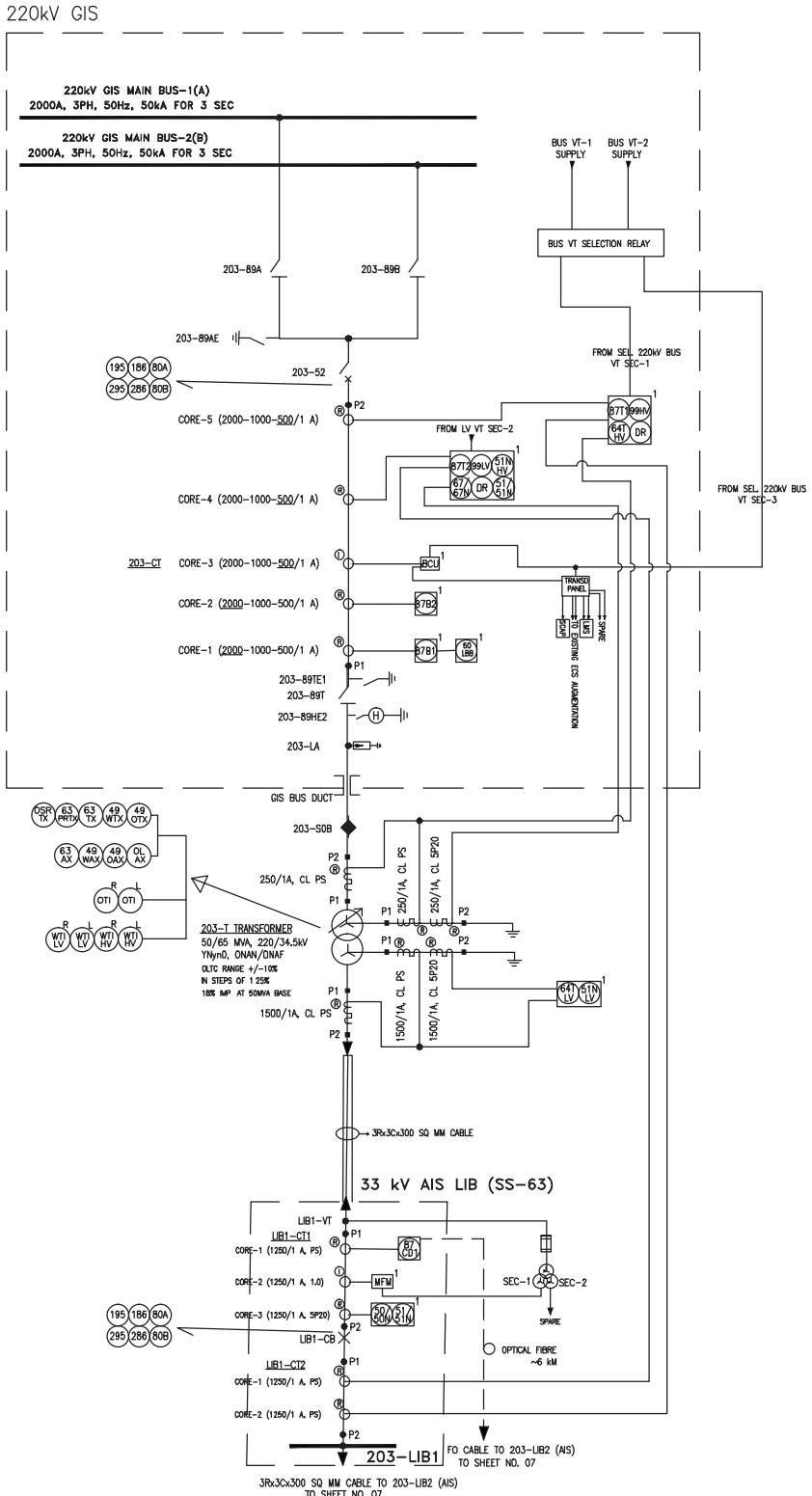
CHECKED: [Signature]

DATE: 12.03.2020

BY: [Signature]

CHECKED: [Signature]

DATE: 12.03.2020



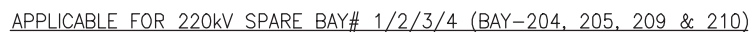
APPLICABLE FOR 220/34.5kV PNCP O/G TRAF0 BAY# 1/2 (BAY-203 & 208)

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

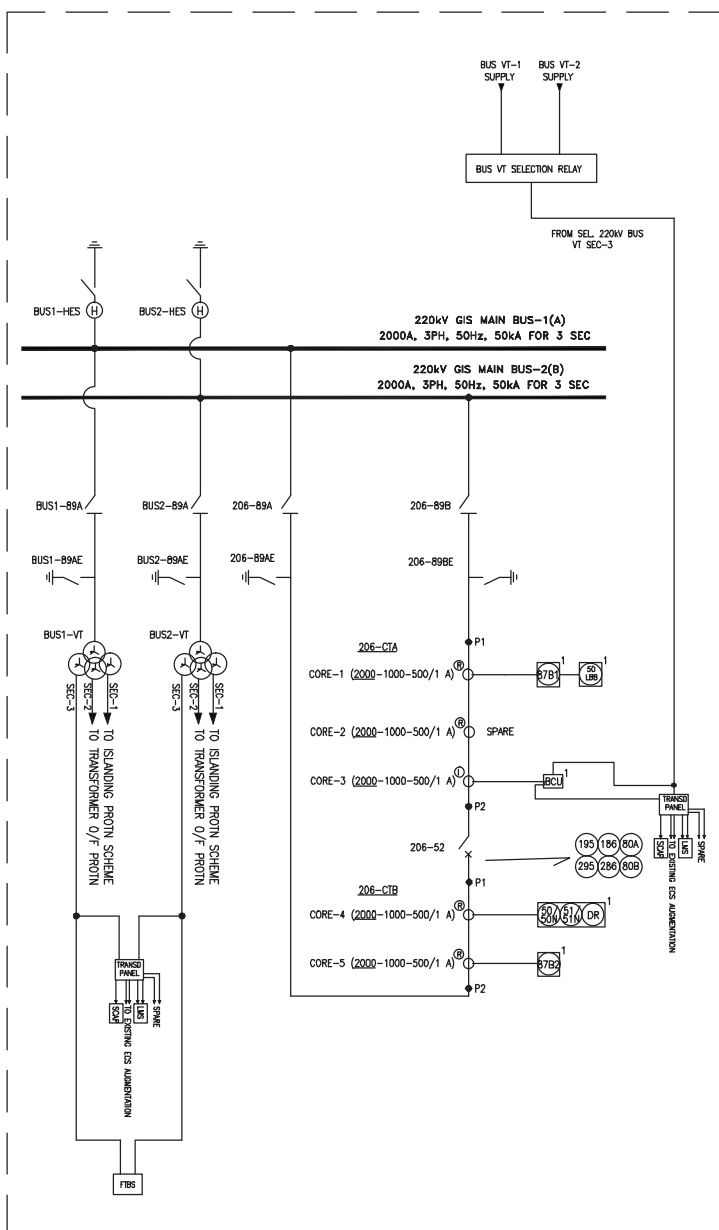
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(ALL DIMENSIONS ARE IN mm)

[illegible]SIZE-A3

(ALL DIMENSIONS ARE IN mm)

220kV GIS



APPLICABLE FOR 220kV BUS COUPLER (BAY-206) & BUS VT-1/2

SIZE-A3

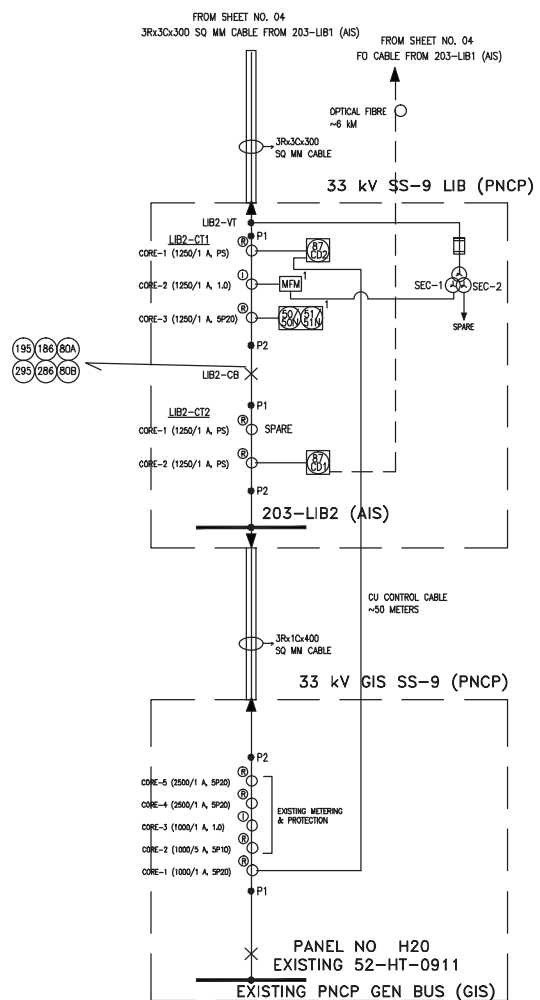
FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

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INVENTORY NO
SIGN. AND DATE
REF. DRG. NO.
COMPUTER FILE NAME

REV.	DATE	ALTERED	RO
04	04/06/2020	CHD/APPD	WK
ZONE REVISED AS PER TCE & IOCL COMMENTS DT 03/06/2020			
REV.	DATE	ALTERED	RO
03	28/05/2020	CHD/APPD	WK
ZONE REVISED AS PER TCE & IOCL COMMENTS DT 28/05/2020			
REV.	DATE	ALTERED	RO
02	23/05/2020	CHD/APPD	WK
ZONE REVISED AS PER TCE & IOCL COMMENTS DT 04/05/2020			
REV.	DATE	ALTERED	RO
01	29/04/2020	CHD/APPD	WK
ZONE REVISED AS PER TCE & IOCL COMMENTS DT 19/03/2020			



APPLICABLE FOR 33kV FEEDERS TO PNCP SS-9 (203-LIB1/2 & 208-LIB1/2)

BHARAT HEAVY ELECTRICALS LTD.
TRANSMISSION BUSINESS GROUP

TATA CONSULTING ENGINEERS LIMITED

INDIAN OIL CORPORATION LIMITED

LSPK

CUSTOMER: LSPK JOB FOR ISBL WORK OF 220kV GRID POWER IMPORT AT PANIPAT REFINERY

LOA NO. RPTCIB2491/28288985 DTD 24.01.2020

DATE: 12.03.2020

TIME: 12.03.2020

SCALE: N.T.S.

UNIT: mm

DATE: 12.03.2020

TIME: 12.03.2020

PROJECT NO. 220/33kV SWITCHYARD - KEY METERING & PROTECTION SINGLE LINE DIAGRAM

DATE: 12.03.2020

PROJECT NO. 220/33kV SWITCHYARD - KEY METERING & PROTECTION SINGLE LINE DIAGRAM

DATE: 12.03.2020

PROJECT NO. 220/33kV SWITCHYARD - KEY METERING & PROTECTION SINGLE LINE DIAGRAM

DATE: 12.03.2020

PROJECT NO. 220/33kV SWITCHYARD - KEY METERING & PROTECTION SINGLE LINE DIAGRAM

DATE: 12.03.2020

SIZE-A3



Insulation body		Resin Impregnated Paper (RIP)
SFs6 side design according to		IEC 62271-211:2014
Connection to transformer winding		Copper conductor
CT extension E		300 mm
Flange		Made of corrosion free aluminium alloy
Test tap (AC test)	50Hz/1min.	2 kVAC
Weight		176 kg

According to	IEC 60137:2008
Rated voltage (U _r)	245 kV
Rated frequency (f _r)	50 Hz
Power frequency voltage withstand (A _C)	Dry 505 kV/min.
Lightning impulse withstand voltage (B _{IL})	1,2/50µs 1050 kV
Switching impulse (S _{IL})	250/2500µs 850 kV
Max. Rated current (I _n)	1600A
Rated thermal short-time current (I _{th})	I=2s
Rated dynamic current (I _{td})	40 kA
Rated dynamic current (I _{td})	100 kA
Partial discharge level	≤ 5pC
	1,05 U _m / V3

Ambient temperature		-40 / +40 °C
Oil temperature	Max. Max. Daily mean	100 °C 95 °C
Sf6 temperature	Max. Daily mean	75 °C
Min. operating pressure at 20 °C		350kPa abs.
Mounting angle		0 - 90°
Min. cantilever test load	IEC 60137 class II	4000 N / 60s

	Tol. as per DIN ISO 2768-1 (c)	Pages	1	FORMAT:	A3
		SCALE:	1:10		

		DATE	NAME	
		Check	10.11.2016	net
F	Billing old new 455	Check	04.05.2016	ymu
E	order cables / 400V		21.03.2016	ymu
			Apr.	04.05.2016
				net
				www.fipg.co.uk
D	BE 0271		14.03.2016	net
C	new 440V		10.03.2016	net
B	Insulated 440V		03.03.2016	net
A	Quality details		02.03.2016	net
REV.	DESCRIPTION	DATE	NAME	



DTOX oil-SF6 bushing

24.5kV / 1600A

E-300 (DF) / Cu-Ag / 64.50/4.00/190

DRAWING NO.

610.15.0177

REVISION

F

Bharat Heavy Electricals Limited

Project: LSTK job for ISBL work of 220KV Grid Power Import at IOCL, Panipat Refinery

Technical Specification: 220kV GIS with LCC & its Accessories

Doc No. TB-411-316-001 Rev 02

SECTION 2:

EQUIPMENT SPECIFICATION UNDER SCOPE OF SUPPLIES

1. Technical Specification for 220kV GIS
2. Technical Specification for 220kV GIS- Technical Corrigendum 1
3. Technical Specification for 220kV GIS- Technical Corrigendum 2
4. Technical Corrigendum consolidated dtd. 15.06.20202

SECTION-2: EQUIPMENT SPECIFICATION UNDER SCOPE OF SUPPLIES
(Technical Specification for 220kV GIS)

INDIAN OIL CORPORATION LIMITED

PANIPAT REFINERY



Technical Specification

For

220kV Gas Insulated Switchgear

IOCL, PANIPAT REFINERY	220kV Gas Insulated Switchgear	SECTION-3 CHAPTER-1
------------------------	--------------------------------	---------------------

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SL. NO.	DESCRIPTION	PAGE NO.
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3.0	GENERAL	6
4.0	SCOPE OF SUPPLY	7
5.0	DESIGN CONCEPT, CONSTRUCTION & PERFORMANCE OF SF6 GIS	8
6.0	MAINTENANCE AND REPAIR OF A CIRCUIT BREAKER	10
7.0	INTERCHANGEABILITY & FUTURE EXTENSION	11
8.0	GAS INSULATED SWITCHGEARS : SPECIAL REQUIREMENTS	12
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10.0	INSPECTION AND TESTS	59
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IOCL, PANIPAT REFINERY	220kV Gas Insulated Switchgear	SECTION-3 CHAPTER-1
------------------------	--------------------------------	---------------------

The specification covers scope of design, engineering, fabrication, manufacturing, shop assembly, inspection and testing before supply, transportation, delivery at destination, unloading & storage at site, site erection, site testing, commissioning and putting in to successful operation complete with all materials, support structures, anchoring bolts, accessories, commissioning spares & maintenance spares, special spanners, tools & tackles, any specific required ancillary services, SF6 Gas for first filling & spare, etc., for efficient and trouble free operation for complete **220kV GIS system** including metal (aluminum alloy) encapsulated SF6 gas insulated switch-gear suitable for INDOOR installation.

1. STANDARDS (AS PER THEIR LATEST VERSIONS)

1.1 Gas Insulated Switchgear:

- a. Common clauses for high voltage switchgear & control gear: IEC 60694
- b. High voltage metal enclosed switchgear for 72.5 KV & above: IEC 62271-203
- c. Specification for acceptance of new Sulphur Hexa fluoride: IEC 60376
- d. Guide to checking of Sulphur Hexa fluoride taken from Electrical equipment: IEC 60480
- e. Surge Arresters : IEC 60099
- f. Over head line, Cable and Transformer : IEC 60137
- g. Terminals Bushings for alternating voltages above 1000 V
- h. Cable connections for gas insulated metal enclosed Switchgear for rated voltages of 72.5KV and above: IEC 60859
- i. High voltage test techniques : IEC 60060
- j. Insulation coordination : IEC 60071
- k. Electrical Relays : IEC 60255
- l. High voltage switches : IEC 60265
- m. Partial discharge measurement : IEC 60270
- n. Degree of protection : IEC 60529
- o. Pollution levels : IEC 60815
- p. EMC : IEC 61000
- q. Use and handling of SF6 gas : IEC 61634
- r. Standards for station grounding. : IEC 60364/60479/IEEE 80
- s. Pressure vessel code : CENELEC/SVDB
- t. Recommendation for heat treated Aluminum alloy bus-bar material of the aluminum magnesium-silicon type: IEC 60114

IOCL, PANIPAT REFINERY	220kV Gas Insulated Switchgear	SECTION-3 CHAPTER-1
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- u. IEEE Guide for Gas-Insulated Substations : IEEE std C37.122.1-1993
- v. Seismic design : IEC 693

1.2 Instrument Transformers

- a) Instrument transformers : IEC 60044
- b) Current transformers : IEC 60185 & IS2705
- c) Voltage transformers : IEC 60186 & IS3156
- d) Coupling capacitor and capacitor divider : IS 7311
- e) Coupling capacitors and capacitor dividers : IEC 60186B
- f) Requirements for instrument transformers: IEC 60481
- g) Requirements for power line carrier coupling capacitor: ANSI- C93.1

1.3 Circuit Breaker

- a) High voltage Alternating current circuit breakers: IEC 62271-100
- b) Report on Synthetic testing of high voltage alternating Current Circuit breakers: IEC 60427

1.4 Dis/connectors and earthing switch

- a) Alternating current Disconnectors (isolators) IEC 60129 and earthing Switch: IEC 62271-102
- b) Alternating current disconnectors, Bus transfer current Switching by disconnectors: IEC 61128
- c) Alternating current earthing switches, Induced current Switching: IEC 61129
- d) Artificial pollution test on HV insulators to be used on ac system: IEC 60507
- e) Gas insulated metal enclosed switchgear for rated voltages of 72.5 kV and above: IEC 60517
- f) Classification of degree of protection provided by enclosures: IEC 60529.

2. DESIGN DATA

2.1 CLIMATIC CONDITIONS:

The equipment and the accessories to be supplied against this technical specification shall be suitable for satisfactory continuous operation under the tropical conditions as detailed in the ~~Section-2~~ Annex- S-2/C-1/8. 

IOCL, PANIPAT REFINERY	220kV Gas Insulated Switchgear	SECTION-3 CHAPTER-1
------------------------	--------------------------------	---------------------

2.2 SWITCHGEAR DESIGN DATA: The switchgear basic design data has been stipulated below.

Description	Unit	Values
Installation		Indoor
Ambient minimum temperature	°C	-2.5
Ambient maximum temperature	°C	50
Service voltage		
Maximum service voltage	kV	220
Rated insulation level (withstand voltages, to ground)	kV	245
- at power frequency 1 min	kV	460
- at lightning impulse (1.2/50 μ s wave)	kVp	1050
Frequency	Hz	50
Rated service current (minimum)		
- Busbar	A	2000
- Input Feeder bay	A	2000
- Transformer bay	A	2000
- Bus coupling bay		2000
Rated short time withstand current(Symmetrical)	kA	50
Duration	Seconds	3
Rated peak withstand current	KAp	125
Internal fault withstand time without burn Through		
Temperature rise at rated service currentent (indicative)	ms	As per IEC-62271-203
- Conductor	°C	
- Enclosure	°C	As per IEC-60694
Rated SF6 gauge pressure at 20 °C		
- Circuit breaker	bar rel.	
- Switchgear	bar rel.	As per standard
Enclosure design pressure		

IOCL, PANIPAT REFINERY	220kV Gas Insulated Switchgear	SECTION-3 CHAPTER-1
------------------------	--------------------------------	---------------------

- Circuit breaker	bar	As per standard
- Switchgear	bar	
Leakage rate of SF6 per annum for the whole substation	%	< 0.5
Maximum partial discharge level	pC	≤ 5
Factory Dielectric routine test 50Hz	kV	460
Site dielectric test	kV	380
Painting of switchgear		
- Coating design and execution	RAL	As per detailed specification/Standard.
- Top coat colour		
Surface protection of steel frames		Hot-dip Galvanizing

2.3 Other Electric data

Auxiliary Supply: For Operation, control and signaling: 220 Volts DC (+10% & -20%)

Note: The control voltage shall be considered as per BOQ of respective tender only.
For other loads: 440 / 230 Volts, AC 50 Hz. (+10% & -15%)

2.4 Seismic requirements:

The GIS shall comply with IEEE STD 693 – 1984 guideline to ensure functional adequacy under seismic disturbances. The design of equipment must be made considering the location to be under **Seismic Zone 4**.

3. GENERAL

3.1 The Scope of the proposal shall be on the basis of a single Bidder's responsibility, completely covering all the supply, erection & commissioning of 220kV GIS and Substation for import of grid power as per the annexed Technical Specifications.

3.2 This specification covers the design, detail engineering, supply, erection & commissioning and handing over in ready to switch on condition to IOCL of complete, including fixing of

accessories, 220KV GIS building along with 220 KV GIS and other sub-station equipment on lump sum turnkey basis.

- 3.3 ~~The 220 KV GIS building should be a state of the art building with good architectural design following best engineering standards. The vendor should design the building with good architectural point of view and aesthetic look and get it approved by IOCL. Apart from the building, the approach road as per engineering standards to the building & transformer shall also be aesthetically designed~~
- 3.4 Integration of 220 KV Overhead lines from point of termination to 220 KV GIS switchgear and connectivity of transformer with 220 KV switchgear is in vendors scope including Gas insulated bus duct, ~~gantry towers~~, Air to GIS termination bushings, ~~overhead conductors~~, all support works and complete in all.
- 3.5 The distances between overhead line to 220 KV GIS and 220 KV GIS to transformer is site specific and as per layout of GIS & transformer during detailed engineering. Contractor to make site visit and estimate the requirements accordingly prior to bidding.
- 3.6 **The provision of double earthing mat connected with the main earthing grid suitable for 220kV GIS shall be in the scope of the contractor only.**
- 3.7 The 220kV GIS building shall comprise an EOT (Electric overhead travel) crane of minimum capacity 5 (Five) Ton or as per GIS OEM recommendation, whichever is higher for lifting of any components of GIS switchgear
- 3.8 ~~The scope shall include provision of air conditioned system for complete switchgear room including GIS area, CRP (control relay panel room), UPS, battery charger room, and the workstation required for provision of SCADA including ergonomically designed basic furniture for two (02) nos. operators.~~
- 3.9 ~~The lighting of the GIS building, the switchyard including the indoor, outdoor and lighting of CRP room shall be of LED type only and a part of the tender. The lighting specifications are attached and the design shall be done to provide Lux levels as per the OISD requirement inside the refinery.~~
- 3.10 ~~The scope shall include dielectric insulated paint type flooring for 220kV GIS in compliance with IS 15652 standards.~~
- 3.11 All new gaskets, sealants and desiccants for permanent sealing of all field joints and all access covers, removed during assembly, shall also be provided
- 3.12 Electromagnetic Compatibility: Field strengths in the switchgear room are held down to a level unobjectionable for human beings and equipment by the fully bonded metal enclosure of the SF6 switchgear and the interconnected earthing system. Transient voltage surges imposed on control and instrument circuits are minimized by design practices and remain below the levels called for by the most recent IEC requirements. Particularly current

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and voltage transformers are constructed so that no excessive high peak voltages will be transmitted to the local control system.

4. SCOPE OF SUPPLY

The 220kV GIS being supplied shall be as per the SLD attached as Annex-S-3/C-1/1, with double bus bar arrangement and with eleven (11) bay configuration and integrated LCC (Local control centre). Due integration of outdoor 220 KV facilities and transformer system shall be in the scope of vendor. The scope includes supply of a minimum of following items also:

- a) The incoming line bays will have Gas insulated bus duct connectivity with the overhead line.
- b) The termination of incoming ACSR Moose conductors with Gas Insulated Bus-duct shall be through proper AIS-GIS bushing complete with all accessories.
- c) The connectivity of transformer bays with 220 KV/34.5 KV outdoor transformer shall also be through Gas insulated Bus-duct. The connectivity with GIB and Transformer HV bushing shall also be through proper AIS-GIS bushing system complete with all accessories. Any intermediate conductors or connectors required for GIB to Transformer connectivity shall also be in vendor's scope.
- d) ~~The line bays shall have the special dedicated CT and PT of 0.2S and 0.2 class respectively for tariff metering purpose. The separate metering panel shall be provided near to GIS switchgear complete with ABT and TOD meters (in main and check meter configuration) as per HVPNL guidelines attached as Annex S-3/C-1/2. Multi-core CT and PT option is not acceptable.~~

The SLD attached as Annex-S-3/C-1/1 in the tender is indicative; the vendor shall provide the type tested design for the switchboard to be duly approved by IOCL during detailed engineering and shall have provision for earthing the de-energized equipment both on bus & line side without any uncovered zone along with the respective breakers.

5. DESIGN CONCEPT, CONSTRUCTION & PERFORMANCE OF SF6 GIS

- a. The tentative station layout plan is attached as Annex- S-3/C-3/1. The detailed layout plan shall be worked out by vendor as per project requirement along with meeting the statutory requirements. The layout plan envisaged by the vendor shall be submitted along with bid for evaluation. The layout plan shall be developed within the limits of the available plot size.
- b. All equipment, accessories and wiring shall have tropical protection, involving special treatment of metal and insulation against fungus, insects and corrosion

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- c. Furthermore, no part of the enclosure, or any loose parts may fly off the switchgear in such an event, and no holes may burn through the enclosure until the nearest protective relay has tripped. All grounding connections must remain operational during and after an arc fault.
- d. Proper grounding for mitigating over voltages during disconnect operation shall be included. Each section shall have plug-in modules or easily removable connection pieces to allow for easy replacement of any component with the minimum of disturbance to the remainder of the equipment.
- e. The number of transport/shipping splits shall be minimized to keep installation time of GIS to a minimum. The arrangement shall afford maximum flexibility for routine maintenance.
- f. Equipment removal and SF6 handling should be accomplished with ease. The ease of operation shall be ensured. In general the contours of energized metal parts of the GIS and any other accessory shall be such as to eliminate areas or points of high electrostatic flux concentrations. Surfaces shall be smooth with no projection or irregularities, which may cause corona.
- g. The conductors and the live parts shall be mounted on high graded epoxy resin insulators. These insulators shall be designed to have high structural strength and electrical dielectric properties and shall be free of any voids and free of partial discharge. They should be designed to have high structural and dielectric strength properties and shall be shaped so as to provide uniform field distribution and to minimize the effects of particle deposition either from migration of foreign particles within the enclosures or from the by-products of SF6 breakdown under arcing conditions
- h. Temperature rise of current carrying parts shall be limited to the values stipulated in IEC-694, under rated current and the climatic conditions at site. The temperature rise for accessible enclosure shall not exceed 20 degree C above the ambient temperature of 50 degree C. In the case of enclosures, which are accessible but need not be touched during normal operation, the temperature rise limit may be permitted upto 30 degree C above the ambient of 50 degree C.
- i. The minimum required components in each GIS bay are -
 - i. Circuit breakers
 - ii. Disconnect Switches
 - iii. Ground switches (Maintenance and High Speed types)
 - iv. Voltage transformers as per project requirement
 - v. Current transformers as per project requirements
 - vi. Online Partial Discharge Monitoring devices with data acquisition and monitoring system.

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- vii. SF6 Gas insulated Bus-duct Indoor/outdoor (as applicable) and as per project requirements.
 - viii. AIS-GIS bushing systems as per project requirements.
 - ix. Bus enclosures and accessories with different bus arrangements.
 - x. Local control panels and operating mechanism cabinets.
 - xi. Pressure/density monitors and switches
 - xii. Any other item specifically covered in of the Tender document.
- j. The GIS shall be design in such a way that suitable walkways are provided all around the switchgears so that the operators will be able to have free access to all the operating mechanism.
- k. The elbows, bends, cross and T-sections of interconnections shall include the insulators bearing the conductor when the direction changes take place in order to ensure that live parts remain perfectly centered and the electrical field is not increased at such points.
- l. All the feeders in the 220kV GIS shall have facility for LOTO provision i.e., for lock-out & Tag-out as a safety feature
- m. The GIS Equipment shall be complete with all necessary supports, ladders, galleries, staircases, catwalks, movable platforms or walkways (for accessing the equipment above two meters for maintenance and operation), mechanism cabinets, internal cable raceways etc for each bay and it shall be of modular construction and extendable design. All structures, galleries, staircases and walkways shall conform to the relevant Occupational Safety and Health Administration (OSHA).
- n. **Modular Design & Future extensions**
- i. The GIS switch gear shall be of modular design offering high degree of flexibility. Each module shall be complete with SF6 gas circuit breaker, disconnectors, Maintenance Grounding switches, fast Earthing switches, voltage transformers, Current transformers, bus & elbow sections, Gas Insulated Bus-duct, local control cubicle and all necessary components required for safe & reliable operation and maintenance.
 - ii. The GIS shall be of either single-phase enclosure type or three-phase enclosure type for voltage levels of 220kV.
 - iii. Vendor shall submit Gas SLD with partitions explicitly shown for the gas filled compartments during detailed engineering.
 - iv. In those design where bus bar is continuous, provision is to be made available for isolation of individual bay without disturbing adjacent bay.

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- v. Materials used in the manufacture of the switchgear equipment shall be of the type, composition and physical properties best suited to their particular purposes and in accordance with the latest engineering practices.
- vi. The switchgear shall be of the freestanding, self-supporting dead-front design, with all high-voltage equipment installed inside gas-insulated, metallic grounded enclosures, and suitably sub-divided into individual arc and gas proof compartments, preferably for:
 - 1) Bus bars
 - 2) Intermediate compartment
 - 3) Circuit breakers
 - 4) Line dis-connectors
 - 5) Voltage transformers
 - 6) Gas Insulated bus duct section between GIS and overhead conductors
 - 7) Gas insulated bus section between GIS and oil filled transformer.
 - 8) Current Transformers.
- vii. The bus enclosure shall be sectionalized in a manner that maintenance work on any bus disconnector (when bus and bus disconnector are enclosed in a single enclosure) can be carried out by isolating and evacuating the small effected section and not the entire bus.
- viii. Arc faults caused by external reasons shall be positively confined to the originating compartment and shall not spread to other parts of the switchgear. In case of any internal arc fault in a busbar, busbar disconnector or circuit breaker, of double bus system, repair works must be possible without shutting down complete substation and at least one busbar and the undisturbed bays must remain in operation.
- ix. The busbar system shall be sectionalized for each bay and contained in individual SF6 gas tight bus compartments to prevent contamination of the gas of the whole bus bar due to fault in one bay zone and refill lesser quantity of SF6 gas.
- x. Where bus Coupler is specified and in case of any internal arc fault in a busbar, busbar disconnector or sectionaliser, repair work must be possible without shutting down the complete substation and at least one half of the substation must remain in operation.
- xi. Documents indicating sequence of repair work steps and description of necessary restrictions during work shall be submitted with the technical manual during as built drawing submission.
- xii. Each bay module should be equipped with suitable arrangement for easy dismantling and refitting during maintenance without disturbing other units. The maximum

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temperature in any part of the equipment at specified rating shall not exceed the permissible limits as stipulated in the relevant standards. There shall not be any kind of interference to the connected & nearby equipment and system, when the equipment is operated at maximum service voltage.

- xiii. Viewing glass shall be provided for disconnections and earth switches.
- xiv. All equipment and components of the switchgear including bus support insulators shall be free of partial discharges when operated at the rated voltage. The maximum permissible partial discharge level shall not exceed 5 pC of the test voltage specified in Table 106 of IEC 62271-203: 2003.
- xv. The SF6 GIS shall be of INDOOR type. **Indoor GIS shall be having degree of protection as IP-42** and suitable for the atmosphere of the location which is heavily polluted, windy, sandy desert & service condition indicated elsewhere.
- xvi. The required switchgear shall be capable of being supplied in a completely gas-insulated version in which case all switchgear components including the bus-bars shall be of gas-insulated type.

6. MAINTENANCE AND REPAIR OF A CIRCUIT BREAKER

- i. The positioning of the circuit breaker in the GIS shall be such that it shall be possible to access the circuit breaker of any feeder from the front side for routine inspection, maintenance and repair without interfering with the operation of the adjacent feeders.
- ii. The GIS shall be so designed that any component of the GIS can be removed easily. With minimum flexibility in the layout arrangement it shall be possible to remove the circuit breaker with both busbars remaining in service and it shall be possible to remove the disconnector of the busbars, with one bus bar remaining in service. For achieving this requirement, adequate number of intermediate compartment, if required, shall be provided to ensure equipment & operating personnel's safety.
- iii. The Vendor is required to demonstrate clearly in his submitted documents the suitability of the switchgear design in this respect. The arrangement shall be such that expansion of the original installation can be accomplished with minimum GIS down time.

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- iv. In case of extension, the interface shall incorporate facilities for installation and testing of extension to limit the part of the existing GIS to be re-tested and to allow for connection to the existing GIS without further dielectric testing.
- v. All the elements shall be accessible without removing support structures for routine inspections and possible repairs

7. INTERCHANGEABILITY & FUTURE EXTENSION

- a. As much as possible, all the parts shall be of standard manufacturer with similar parts and assemblies being interchangeable.
- b. The GIS system shall be suitable for future extension on either end by the addition of extra feeders, bus couplers, bus-bars, circuit breakers, dis-connectors, and other switch gear components. The arrangement of gas sections or compartments shall be such as to facilitate future extension without any drilling, cutting or welding on the existing equipment. To add equipment, it shall not be necessary to move or dislocate the existing switchgear bays
- c. The layout shall ensure that GIS bus link section is provided for future extension of the GIS buses to avoid de-gassing and modification of the existing bus.
- d. The physical layout shall ensure free movement of the SF₆ Gas Cart and easy access to all components of the GIS for maintenance purposes

8. GAS INSULATED SWITCHGEARS : SPECIAL REQUIREMENTS

8.1 The 220 kV GIS switch-gear shall be of Double bus bar design.

8.2 Current Rating: The current rating of the switchgear should be assessed on the following requirements

- 8.1.1** Capable of handling power to an extent of as to an ambient day-time mean temperature between – 2.5 deg C and + 50 deg C.
- 8.1.2** The switchgear described in this specification is intended for continuous duty at the specified ratings and under **all system operating conditions including sudden change of load and voltage within its ratings and at specified** ambient conditions 24 hours a day, 365 days a year unless indicated otherwise.

8.3 Electrical, Mechanical and Thermal Capability

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The assembled equipment shall be capable of withstanding the electrical, mechanical and thermal ratings of the specified system both for continuous and short time duties.. All joints and connections shall be required to withstand the forces of expansion, vibration, contraction, and specified seismic requirements without deformation or malfunction and leakage. The apparatus shall be capable of withstanding the specified environment.

8.4 Insulation level

The switchgear and other equipment shall be designed for a maximum operating voltage and rated impulse withstand voltage as specified in cl. 2.2 or as per relevant IS/IEC standards. Circuit breakers shall be capable of interrupting line, transformer, capacitor bank & cable charging currents as per project requirements. During detailed engineering the design calculation showing the above capabilities shall be submitted for due approval as per approval process.

8.5 Physical arrangement

- 8.1.1** The layout shall be properly designed by the bidder to completely accommodate the present & future requirements of the substation as per the furnished single line diagram and the enclosed site plan. They may be adjusted as necessary to suit the manufacturer's standard design and IOCL need.
- 8.1.2** Vendor shall submit a copy of the Gas SLD for the GIS being offered along with the tender, explicitly showing the compartmentalized sections.
- 8.1.3** The arrangement of the switchgear offered must provide adequate access for checking and maintenance.
- 8.1.4** Optimized arrangements are required so as to reduce installation time, minimize maintenance & repair cost, provide ease of operation and facilitate future expansions.
- 8.1.5** The enclosure shall be sized for carrying induced current equal to the rated current of the Bus. The conductor and the enclosure shall form the concentric pair with effective shielding of the field internal to the enclosure. The GIS interface points shall be carefully coordinated with other equipment such as overhead lines, cables, transformers, reactors, capacitor banks, etc. supplied by other manufacturers in order to ensure full compatibility.

8.6 Gas Sectionalization

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- 8.6.1 Gas barrier insulators shall be provided so as to divide the GIS into separate compartments. They shall be suitably located in order to minimize disturbance in case of leakage or dismantling. They shall be designed to withstand any internal fault thereby keeping an internal arc inside the faulty compartment. The gas tight barriers shall be clearly marked on the outside of the enclosures.
- 8.6.2 The material and thickness of the enclosures shall be such as to withstand an internal flash over without burn through as per IEC standards. The material shall be such that it has no effect of environment as well as from the by-products of SF6 breakdown under arcing condition.
- 8.6.3 Each pressure filled enclosure shall be designed and fabricated to comply with the requirements of the applicable pressure vessel codes CENELEC and based on the design temperature and design pressures as defined in IEC-62271-203.

8.7 Expansion Joints and Flexible Connections

- 8.7.1 The layout shall sufficiently take care to the thermal expansion / contraction of the assembly by the provision of expansion joints. Expansion joints shall be placed in between any bay section of the bus-bar. All joint surfaces shall be properly machined, and fabricated.
- 8.7.2 If necessary, the number and position of expansion joints or flexible connections are to be determined by the manufacturer to ensure that the complete installation will not be subject to any expansion stresses which could lead to distortion or premature failure of any piece of the SF6 equipment, support structures or foundations.
- 8.7.3 Bracing shall be provided for all mechanical components against the effects of short circuit currents specified under system parameter. The design of the equipment shall be such that the agreed permitted movement of foundations or thermal effects does not impair the assigned performance of the equipment. The design calculations for all the supports shall be submitted during engineering to ensure the above compliance.
- 8.7.4 The continuity of service during thermal expansion / contraction and vibrations shall be ensured. Expansion joints, flexible connections and

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adjustable mountings shall be provided to compensate for reasonable manufacturing and construction tolerances in the associated equipment to which the GIS may be connected. Required sliding plug-in contacts for conductors shall be provided.

- 8.7.5 This is to ensure that reasonable accuracy is required when installing such equipment and constructing the associated foundations or support structures, e.g. transformers or the interconnection of isolated sections of switch-gear by means of long GIS bus-bar or duct installations to ensure for proper alignment of all equipments at site.. Flexible joints may also be provided to allow more efficient maintenance and future extensions of the GIS.

8.8 Barrier and Non-Barrier Insulators

- 8.8.1 Support insulators shall be used to maintain the conductors and enclosure in proper relation. These support insulators may be of two types. Barrier insulators which are employed to isolate gas compartments and non-barrier insulators which allow the gas pressure to equalize.
- 8.8.2 The gas barrier insulators sealing to the conductors and the enclosure wall shall be designed to withstand the maximum pressure difference that could occur across the barrier, i.e. maximum operating pressure at one side while a vacuum is drawn at the other side & in case of internal arc fault with a safety factor of 2.
- 8.8.3 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 also be of sufficient strength to ensure that the conductor spacing and clearances are maintained when short circuit faults occurs.
- 8.8.4 The solid insulators shall be non-hygroscopic, track resistant and free from voids and contaminants. The design shall be such as to reduce the electrical stresses in the insulators to a minimum
- 8.8.5 Tests shall be carried out during the manufacture of the Switchgear to ensure that all parts of the equipment are free of partial discharge with a partial discharge extinction voltage which is at least 10% higher than the rated voltage.

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8.9 Gas seals, Gas Density & pressure and other requirements.

- 8.9.1** 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. Double gas seals with provision to monitor the failure of first seal is preferred.
- 8.9.2** The leakage rates shall be kept to an absolute minimum under all normal pressure, temperature, electrical load and fault conditions. The guaranteed leakage rate of each individual gas compartment and between compartments must be less than 0.5% p.a. for the service life of equipment.
- 8.9.3** Piping and fittings for gas monitoring and gas supply shall be made of copper or brass. The gas monitor device should be installed at each individual compartment of the module. Each gas compartment must be independent, external gas pipe connections should be avoided to minimize leakage.
- 8.9.4** All gas compartments shall be fitted with filter material which absorbs the residual moisture and moisture entering inside the High-voltage enclosure. Filters in gas compartments with switching devices must also be capable to absorb the gas decomposition products resulting from the switching arc or during any type of interruptions.
- 8.9.5** The rated pressure of the SF6 insulating gas in the metal-clad 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.
- 8.9.6** The SF6 switch-gear shall be designed for use with SF6 gas complying with the recommendations of IEC – 60376 at the time of the first charging with gas as a minimum requirement.
- 8.9.7** Connections including bolts and nuts shall be adequately protected from corrosion and easily accessible with the proper tools.
- 8.9.8** All components shall be fire retardant and shall be tested in accordance with relevant standards. Gas emissivity when the Material is heated shall be minimal.

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- 8.9.9** The SF6 gas manufacturer shall provide the data regarding gas characteristics corresponding to the degree of deterioration beyond which treatment or replacement of gas would become necessary along with procedural instructions for gas treatment to restore original quality.
- 8.9.10** The GIS enclosure shall be sectionalized for each equipment into modular units or compartments, each separated by gas barriers with an effective sealing system. Each compartment shall be provided with the necessary piping and valves to allow isolation, evacuation and refilling of SF6 gas without evacuating of any other section.
- 8.9.11** Gas barriers and sealing systems shall have adequate mechanical strength to withstand the dynamic forces caused by short circuits, and effects of internal arc faults as well as maximum pressure differential that could exist between adjoining compartments, i.e. with full vacuum drawn on one side of the barrier and 1.5 times the operating pressure on the other side in line with IEC-62271-203.
- 8.9.12** SF6 gas in each individual compartment shall be monitored by suitable temperature-compensated pressure gauges and pressure switches with suitable number of stages, temperature compensated gas density monitors to monitor the loss of SF6 gas. The dial of the pressure gauges shall be graduated to read pressures and colored green, yellow and red to indicate normal, different Alarm Stages pressure conditions. Gas-density monitor shall be readable from the ground. Potential-free auxiliary contacts for multi-stage alarm initiation shall be provided. These alarm contacts shall be wired to the annunciator in the respective GIS bay control panel.
- 8.9.13** The gasket shall be synthetic elastomeric type. The gasket shall resist oil and waste by-products of the SF6 gas decomposition. The gasket shall have minimum deformation in service life of GIS and also low gas and moisture permeability.
- 8.9.14** **Design pressure as per IEC-62271-203:** In determining the design pressure, the gas temperature shall be taken as the mean of the upper limits of the enclosure temperature and the main circuit conductor temperature with rated normal current flowing unless the design pressure can be established from existing temperature-rise test records.

8.10 Gas Treatment Requirements:

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Under normal operating conditions it shall not be necessary to treat the insulating SF₆ gas between major overhauls. In all gas compartments permanent efficient filters and desiccants shall be effective for the duration of time between major overhauls. Notwithstanding this, the insulators in the circuit breaker shall be made of epoxy resin composition that will resist decomposition products in contact with moisture.

8.11 Gas Monitoring Devices

Gas density and pressure monitoring devices shall be provided for each gas compartment. The devices shall provide continuous and automatic monitoring of the state of the gas. The SF₆ gas monitoring device shall have two supervision and alarm settings. These shall be set so that, an advanced warning can be given that the gas density/pressure is reducing to an unacceptable level.

After an urgent alarm, operative measures can be taken to immediately isolate the particular compartment electrically by tripping circuit breakers and opening disconnectors. It shall be ensured that there is no chance of the gas liquefying at the lowest ambient temperature.

The gas monitoring device shall monitor at least the following, locally and on remote for following conditions:.

- i. "Gas Refill" Level- This will be used to annunciate the need for gas refilling.
- ii. "Breaker Block" Level- This is the minimum gas density at which the manufacturer will guarantee the rated fault interrupting capability of the breaker. At this level the device contact may trip the breaker and block the closing circuits.
- iii. Gas density falling below the minimum safe operating limit and shall block breaker tripping and closing.
- iv. Over pressure alarm level- This alarm level shall be provided to indicate abnormal pressure rise in the gas compartment.

It shall be possible to test all gas monitoring relays without de-energizing 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. Two potential free electrical contacts shall be provided with each and every alarm condition.

Following features have to be taken care during design of gas section:

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- a) All gas compartments shall have their own coupling valve, so that all maintenance jobs, like drawing gas samples or conditioning and replenishing the SF₆ gas can be carried out during normal operation of the switchgear without difficulty or loss of gas.
- b) It shall be possible to test and replace each pressure gauge and the density switch/relay with the GIS in service.
- c) At each gas compartment, provisions shall be made for connecting online moisture measurement instrumentation and the gas service cart. The moisture content in the gas shall not exceed 150 ppmv (parts per million per volume) in circuit breakers, and 250 ppmv in other equipments. Provision for disconnection of gas pipelines shall be incorporated. 100cm or smaller sintered stainless steel particle filter disk, suitable for pressure involved, shall be installed at the gas service connection.
- d) The switchgear assembly supply shall include the initial complete filling of SF₆ gas for the assembly, and in addition, any gas lost during installation and commissioning procedures.
- e) Interior finishing material of the enclosure shall not contain any substances which could contaminate the enclosed SF₆ gas or affect its insulating properties. The GIS enclosures may be provided with suitable devices like particle traps to eliminate conducting particles which shall be based on the design of the manufacturer but is not mandatory if the manufacturer does not practice the use of Particle trap as a standard design requirement.
- f) In the event of gas leakage, all parts of the switchgear in the affected compartment shall be able to withstand continuously the maximum rated voltage with SF₆ gas at atmospheric pressure.

8.12 Pressure Relief Device / Rupture Discs

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

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- ii. The effect of an arc shall be confined to the compartment in which it has been initiated and under no circumstances shall be allowed to spread out to adjacent compartments/Gas Sections or other parts of the GIS
- iii. The pressure relief device or rupture discs shall be located away from gauges, meters, gas filling ports and gas density device calibrating point.
- iv. Deflectors shall be provided to direct all escaping gases, arcing products and fragments of the bursting rupture discs away from operating personnel and nearby devices. The direction of the escaping gas shall so oriented so as to cause no damage to the GIS equipment.

8.13 Conductors

The conductors shall be made of aluminum alloy suitable for 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 conductor is not acceptable. The surface of the connector fingers and conductor on such connections shall be silver plated. Both, the conductors as well as the contacts for the conductor connections must be designed for the continuous rated current of the switch gear under the ambient conditions furnished, and shall not exceed the permissible temperature rise.

8.14 Enclosures

- a) The metal enclosures for the SF6 gas insulated equipment modules shall be made from Aluminum alloy. Suitable anti corrosive paints shade 631 of IS: 5 must be applied on the exterior of the enclosures. The enclosure shall be separate phase wise *separate metallic type*. The external fixtures should be made of corrosion-resistant material and should be capped wherever required. *Necessary provisions shall be made in enclosure for providing on line PD monitoring systems which are also included in the scope of supply*. Bidder shall provide adequate number of UHF sensors in the offered GIS for connection to PD meter and the number and location of these sensors shall be placed in strategic locations subject to approval of the purchaser.
- b) Bellow compensators shall be made of Stainless steel to preserve the mechanical strength of the equipment at the connection portions to deal with the following problems:
 - a) Expansion and Contraction of outer enclosure and conductor due to temperature variations.

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- b) Mismatch in various components of GIS.
- c) Vibration of the transformer and switching equipment.
- d) Dimensional variations due to uneven settling of foundation.
- e) Seismic forces as mentioned in climatic condition.

Standard paint shade 631 of IS: 5 shall be used with satin mat finish having high scratch resistance.

- c) The gas-filled enclosures shall conform to the pressure vessel code applied in the country of manufacturer. Gas section barriers including seals to the conductor and enclosure wall shall be gas-tight and shall be capable of withstanding the maximum pressure differential that could occur across the barrier, i.e., with a vacuum drawn on the one side of the barrier and on the other side, at least the maximum gas pressure that can exist under normal operating or maintenance conditions and in case of internal arc fault.
- d) The finish of interior surfaces of the metal-clad enclosures shall facilitate cleaning and inspection. High quality primer followed by two coats of anti corrosive paint of glossy white shade shall be used such that they will not deteriorate when exposed to the SF6 gas and other vapors, Arc products, etc., which may present in the enclosures. They shall also not contain any substances which could contaminate the enclosed gas or affect its insulating properties over a period of time.
- e) The GIS enclosure shall be safe to touch and fully ensure operational security and personnel safety under all normal and fault conditions with the maximum allowed induced voltage in the enclosure of 65 volts or as per relevant IEC standard.
- f) The GIS enclosures shall have a minimum burn-through time greater than the back-up clearance time as specified standard, if rupture disc/pressure relief device is provided. The burn-through time shall be in accordance with IEC 62271-203.
- g) Gas enclosures and flange joints shall be designed to withstand 1.5 times the operating pressures by provision of suitable reinforcement(s) at all the required locations.
- h) The enclosure & support structure shall be designed that a mechanic 1780 mm in height and 80 Kg in weight is able to climb on the equipment for maintenance. The enclosure & support structure shall be designed that a mechanic 1780 mm in height and 80 Kg in weight is able to climb on the equipment for maintenance.
- i) The GIS enclosure for Outdoor application shall have an enclosure protection Class of IP 54. All components of the GIS shall be able to withstand the environmental conditions

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for outdoor application including temperature variation during the various seasons. The GIS enclosure for Outdoor application shall have an enclosure protection Class of IP 54. All components of the GIS shall be able to withstand the environmental conditions for outdoor application including temperature variation during the various seasons.

- j) The degree of protection for all terminal boxes, operating mechanism enclosure, control cabinets, auxiliary equipment enclosures and all accessories shall be IP 41 for Indoor application and shall be IP 54 for Outdoor application

8.15 Internal Fault Location: The manufacturer of the GIS should provide appropriate system for the determination of the location of a fault.

8.16 General Finish and Cleaning

8.16.1 The equipment shall be manufactured and assembled at the manufacturer's works under conditions of the utmost cleanliness.

8.16.2 Very dusty / sandy conditions may exist at the site hence, whenever possible, the complete feeders or major assembly of components should be shipped as transport units. Before the metal clad enclosed sections are joined together and charged with the SF6 gas they must be thoroughly cleaned.

8.16.3 Paints shall be carefully selected to withstand heat and weather conditions. The paint shall not scale-off or crackles or gets removed by abrasion due to normal handling. Sufficient quantities of all paints and preservatives required for touching up at sites shall be furnished with GIS.

8.16.4 Permanently fixed gas pipe work shall be installed. The design, material, specification and associated fittings for all gas pipe work shall be rated for operation under normal and fault conditions and shall form part of the switchgear assembly during all testing carried at the manufacturer's works and at site. The gas piping system, valves etc. shall minimize the possibility of accidental third party damage and eliminate the need to dismantle the pipe work during maintenance and/or removal of modules, other than the pipe work associated with the maintenance item.

8.17 Gas filling and Evacuating Plant for 220kV GIS units.

8.17.1 All apparatus necessary for filling, evacuating, and recycling the SF6 gas into and from the switch-gear equipment shall be supplied along with GIS system suitable for any maintenance work to be carried out.

8.17.2 Where any item of the filling and evacuating apparatus is of such a weight that it cannot easily be carried by maintenance personnel, it shall be provided with facilities for lifting and moving with the overhead cranes.

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- 8.17.3 The apparatus for filling, evacuating and recycling all gases to be used shall be provided with all necessary pipes, couplings flexible hoses, tubes and valves for coupling to the switch-gear equipment.
- 8.17.4 The gas compartments shall preferably be fitted with permanent vacuum couplings through which the gas is pumped into or evacuated from the compartments.
- 8.17.5 Details of the filling and evacuating apparatus that will be supplied, and also a description of the filling, evacuating and recycling procedures, shall be provided during the drawing approval stage.
- 8.17.6 The initial gas filling of the entire switch-gear including the usual losses during commissioning shall be supplied over and above the required quantity of spare gas.
- 8.17.7 An additional quantity of SF₆ gas for compensation of possible losses during installation and service of 3 years shall be supplied or Spare Gas cylinder equivalent to gas requirement of one bay, whichever is higher to be provided. The quantity of the same shall be indicated in GTP, considering leakage rate of 1% per year for complete GIS system, even if, the designed leakage rate is lower than 0.5% per annum
- 8.17.8 Such spare gas shall be supplied in sealed cylinders of uniform size, which shall be decided during detailed engineering.
- 8.17.9 Gas filling and Evacuating Plant shall have gas storage facility of sufficient capacity.

8.18 SF₆ Gas Processing Unit:

- 8.18.1 An SF₆ gas-processing unit suitable for evacuating, liquefying, evaporating, filling, drying and purifying SF₆ gas during the initial installation, subsequent maintenance and future extension of GIS shall be provided. The cart shall be equipped with rubber wheels and shall be easily maneuverable within the GIS building.
- 8.18.2 A wheeled maintenance unit shall be supplied which shall be self-contained (except for additional gas storage bottles and external power supply at 415 V AC, 3-phase, 50 Hz) and fully equipped with an electric vacuum pump, gas compressor, gas drier, gas filter, refrigeration unit, evaporator, gas storage tank, full instrumentation for measuring vacuum, compressor inlet temperature, tank pressure and temperature, valving and piping to perform the following operations as a minimum requirement:
 - i. Evacuation from a gas filled compartment using the vacuum pump,
 - ii. ii) Transfer of SF₆ gas from a system at some positive or negative pressure to the storage tank via the gas drier and filter;

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- iii. iv) Recirculation of SF₆ gas in any switchgear or bus duct compartment through the drier and filter;
- iv. v) Evaporating and filling SF₆ gas,
- v. vi) Drawing off and liquefying SF₆ gas,
- vi. vii) A combination operation of filling SF₆ gas into a gas system and evacuating a second gas system using the vacuum pump.

8.18.3 Adequate length of hoses with necessary adaptors shall be provided for filling of SF₆ gas in any of the gas compartment with the help of gas cart.

8.18.4 GA drawing and Schematic drawing for gas processing unit shall be submitted for approval.

8.19 Support Structures

All supporting structures necessary for the support of the GIS equipment including associated parts such as anchor bolts, beams, **rollers**, etc. shall be supplied. Sufficient attachment points to the apparatus and concrete foundations shall be furnished to ensure successful installation, with required clearances, while taking into account thermal expansion and contraction. Earthquake requirements are also to be considered.

Any scaffolding or a movable platform, required for maintenance, shall also be supplied. All steel structure members shall be hot-dip galvanized after fabrication. ***Unless otherwise specified, minimum mass of zinc coating for Galvanizing shall be 610 gm/square meter.*** All field assembly joints shall be bolted. Field welding shall not be acceptable. Non-corrosive metal or plated steel shall be used for bolts and nuts throughout the work. Manufacturer shall provide suitable foundation channels and anchor bolts to support the switchgear assemblies. All mounting bolts, nuts and washers shall be provided to fasten the switchgear base frames to the foundation channels.

Foundation channels and anchor bolts shall be installed in the civil works in accordance with instructions provided by the manufacturer.

The support structure shall meet the minimum of following requirements in line with IEC standards:

- a. The minimum vertical clearance from any energised metal part to the bottom of the circuit breaker (structure) base, where it rests on the foundation pad, shall be 2.85 meters for 72.5kV, 3.85 meters for 145kV and 4.85 meters for 245 kV.
- b. The minimum vertical distance from the bottom of the lowest part of the bushings, enclosures or supporting insulators to the bottom of the circuit breaker base, (from the ground level) shall be 2.55 meters for all voltages.

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- c. The minimum clearance between the live parts and earth shall be 0.8 meters for 72.5kV, 1.3 meters for 145kV and 2.4 meters for 245kV.

8.20 Auxiliary Equipment

The following items shall be included for a complete installation:

- a) Control system including local control cabinets.
- b) Cable and wiring between individual items of supplier supplied equipment.
- c) Name plates.
- d) All ladders, platforms, stairs, walkways, and supports necessary to operate and maintain all equipment safely and efficiently.
- e) Special tools and tackles for installation.
- f) Special tools and tackles for maintenance.

8.21 Local Control Panels-

- a) Separate Local control Panels shall be provided for each bay which shall be integrated on the switchgear for local control & monitoring of respective switchgear bay. Local control cubicle for GIS shall be equipped with suitable hardware for remote control operation. Relays will be provided in separate Relay room with control and measuring wire extended upto Relay panels.
- b) All interlocks that prevent potentially dangerous mal-operations shall be constructed such that they cannot be operated easily, i.e. the operator must use tools or brute force to over-ride them.
- c) The cabinet shall have full height, hinged, gasketed, lockable doors. The door shall have a safety glass window through which the various switchgear controls can be viewed without opening the doors. The degree of protection shall be IP 43

8.22 Safety Precautions

- 8.22.1 The switch-gear must provide a maximum degree of safety for the operators and others in the vicinity of the switch gear under all normal and fault conditions. The safety clearances of all live parts of the equipment shall be as per relevant standards.
- 8.22.2 It must be made impossible to touch any live part of the switch-gear unwillingly, i.e. without use of tools or brute force.
- 8.22.3 An operator standing in the normal operating position should not be endangered by any moving external part of the switch-gear.

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8.23 Interlocks:

Mechanical & electrical interlocks must be provided to ensure absolute and reliable protection against potentially harmful Mal-operation of the switchgear. All interlocks that prevent potentially dangerous mal-operations shall be so constructed such that they cannot be defeated easily, i.e. the operator must use tools and/or technique to over-ride them only in case of emergency. The following functions shall be provided:

- a) The operator must be forced in to the only safe and logical sequence to actuate the circuit breakers, disconnectors & earthing switches.
- b) The actual, completely closed or completely opened position of all switching devices must be checked before and after each move.
- c) Implementation of logic checks and issuing the resultant signals Enabled or Blocked for the switching device.
- d) If in spite of all possible safety measures if any arc occurs, the following is required.
- e) The effects of an internal arcing fault must be limited to the related gas compartment.
- f) Each gas compartment must have its own *automated external* pressure relief device to provide instant and safe discharge of accidental overpressure during internal arc. Rupture diaphragms shall be preferably used as pressure relief mechanisms. The bursting pressure of relief device should be effectively coordinated with the rated gas pressure and the pressure rise due to arcing. PRD shall be positioned such that it will not be below any circuit breaker or disconnector drive or LCC.
- g) All earthing connections must remain operational.
- h) The enclosure of the switch gear must withstand the thermal effects of an arc at the full rated short circuit current until the nearest protective relay has acted and tripped the breaker.
- i) To limit the effects of an internal arc the switch gear shall be suitably subdivided into individual arc and gas-proof compartments, preferably for
 - i. Bus-bar together with bus-bar isolator and earthing switch
 - ii. Circuit breaker
 - iii. Line isolators and earthing switch, (Line, transformer)
 - iv. Instrument transformers.
 - v. Intermediate compartment
- j) **The following requirements are to be followed.**
 - a. The bracing/welding of all components subject to mechanical forces caused by short circuit currents shall be capable so as to withstand the effects of at least 2.5 times the rated symmetrical short time withstand current.

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- b. The thermal rating for all current carrying parts and insulating materials shall be a minimum of three seconds for the rated short time withstand current.
- c. All components of the switch gear which are on ground potential shall be electrically interconnected and effectively earthed.

8.24 Special tools, tackles and equipments

Special tools, tackles and equipment that are required to perform installation, commissioning, operation & maintenance of the gas insulated switch gear shall be included in scope of supply.

- a) 1 Dew point measurement meter
- b) Gas leakage detectors of an approved type shall be provided
- c) Precision pressure gauge
- d) Gas recovery unit with required accessories
- e) On line PD monitoring system for 220 kV GIS modules.
- f) SF6 gas purity detector / analyzer for SO2, H2O, CF4, AIR etc.
- g) Portable PD analyzer/measurement kit suitable for GIS along with required accessories
- h) Air / gas humidity tester,
- i) Breaker timing measurement kit (In scope of vendor only during commissioning)
- j) The GIS manufacturer shall include the supply of all the SF6 gas necessary for initial filling (including usual losses during commissioning.) and putting into commercial operation of the complete switchgear. In addition, ten percent of the total SF6 gas required for the complete GIS shall also be supplied as spare in non-returnable containers in ready to use condition and shall be included in the scope of supply.
- k) A mobile SF6 gas treatment plant, which shall be suitable for draining, filtration/purification and refilling the equipment shall be provided. The plant shall have storage capacity for at least two of the largest switchgear compartments and shall be supplied with complete accessories such as vacuum pump, pressure gauge, valves, hoses, couplings, adaptors, etc., necessary for evacuating and filling, together with storage facilities for these items.
- l) A two wheel gas maintenance cart fitted with a cylinder of SF6 gas, a vacuum pump, a vacuum and pressure gauge and all necessary valves, hoses and couplings for evacuating and filling the switchgear.
- m) A SF6 Gas maintenance cart, which shall be easily moved by One (1) person, shall be provided with enclosed storage facilities for proper storage of cylinders and other

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- accessories including power leads. The enclosed storage shall have facilities for padlocking.
- n) SF6 gas leakage test equipment shall be suitable for testing SF6 gas as per recommendations of IEC 60376.
 - a. Instruments for automatic and continuous monitoring for the presence of SF6 gas in the atmosphere of the switchgear room shall be provided. The recommended positions, exact number of detectors, type of mounting, facilities for alarm etc. shall be indicated during the drawing approval stage.
 - b. Each set of analyser shall comprise of:
 - i. SO2 content in SF6 gas
 - ii. Purity of SF6 gas
 - iii. SF6 gas moisture content
 - o) All special tools required for the purpose of installation, maintenance, overhauling and testing of GIS and also for the measurement of moisture in SF6.
 - p) Any other special tools and tackles required for proper maintenance of GIS units has to be supplied by the bidder.

The tools shall be shipped in separate containers, clearly marked with the name of the equipment for which they are intended. The requirement of HV testing during commissioning or repairing or replacement shall be fulfilled by successful bidder by arranging the required HV testing equipment at no extra cost to IOCL. No delay shall be permitted on account of the non availability of the HV test equipments.

8.25 Grounding of GIS:

- 8.25.1 GIS will be housed on GIS floor. The bidder will provide under-ground mat below the substation. The bidder shall also provide adequate number of Galvanized steel risers to be connected to grounding mat, as per relevant standards and in consultation with IOCL during detailed engineering, in the event of an order.
- 8.25.2 The bidder shall supply entire material for ground bus of GIS such as conductor, clamps, joints, operating and safety platforms etc. to be laid /embedded in GIS floors. The bidder is also required to supply all grounding connectors and associated hardware material for:
 - a. Connecting all GIS equipment, Bus duct, enclosures, control cabinets, supporting structures etc. to the ground bus of GIS
 - b. Connecting ground bus of GIS to the ground mat risers.
- 8.25.3 The grounding arrangement of GIS shall ensure that touch and step voltages are limited to safe values as per IEEE std. 80-2000. The enclosures of the GIS

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shall be grounded at several points such that there shall be a grounded cage around all live parts. The ground continuity between each enclosure shall be affected over flanges, with or without links or straps to bridge the flanges.

8.25.4 Copper/Aluminum straps shall however bridge the metallic expansion bellows.

8.25.5 The grounding switches shall be connected to ground through the enclosure. Individual ground leads for the ground switches are not allowed. The inductive voltage against ground in each part of the enclosure shall not be more than 65 Volts.

8.25.6 Where operating mechanism cabinets are mounted on the switchgear, the grounding shall be made by separate conductor. Bay control cabinets shall be grounded through a separate conductor.

8.25.7 All conduits and control cable sheaths shall be connected to the control cabinet grounding bus. All steel structures shall be grounded.

8.25.8 Each removable section of catwalk shall be bolted to the support structure for ground continuity.

8.25.9 The enclosure grounding system shall be designed to minimize circulating currents and to ensure that the potential rise during an external or internal fault is kept to an acceptable level. The guidelines of IEEE Std. 80-2000 on GIS grounding, especially the transient ground potential rise caused by high frequency phenomena, shall be taken into consideration while designing the grounding system for GIS.

8.25.10 The manufacturer shall furnish readily accessible connectors of sufficient mechanical strength to withstand electromagnetic forces as well as capable of carrying the anticipated maximum fault current without overheating by at least from two paths to ground from the main ground bus.

8.25.11 Provisions of IEC 517 & 694 regarding safeguards in grounding of connected cables, testing during maintenance and other safety measures shall be ensured.

8.25.12 Earthing conductors shall be designed to allow flow of short circuit current. Conductors with copper bars are preferred over copper wires.

9 GAS INSULATED SWITCHGEAR COMPONENTS:

9.1 General:

9.1.1 The GIS circuit breakers shall comply with the following general requirements for circuit breakers and the latest revisions of the relevant IEC-62271-100 specifications

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- 9.1.2 Circuit – breakers shall be of single pressure, single break, **self compression self blast / auto puffer** type with SF₆ as arc quenching & insulation medium and with a minimum- maintenance contact system
- 9.1.3 **For 220 kV class enclosure shall be phase wise separate metallic type.**
- 9.1.4 Ratings of the circuit breaker shall be as per enclosed technical parameters.
- 9.1.5 They should be shipped as a completed three-phase unit within a complete bay module.
- 9.1.6 Each circuit-breaker shall have spring drive mechanism *ensuring proper closing and opening, and shall permit checking of adjustments and opening/closing characteristic.* The ON/OFF latches shall be mechanically interlocked with each other. The circuit breaker shall be completely factory assembled, adjusted and tested.
- 9.1.7 Single circuit breaker having continuous current rating as per the technical parameter requirements under cl.2.2 shall be offered. Two circuit breakers (with lower rating) in parallel for a single circuit is not acceptable.
- 9.1.8 The total break time from energizing the trip coil at rated control voltage to final arc extinction shall be as short as possible and in line with applicable IEC standards, but in any event not greater than 3 cycles i.e. 60 ms.
- 9.1.9 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 recommendations.
- 9.1.10 The breakers are to be restrike-free.
- 9.1.11 The circuit-breakers shall be capable of tripping and re-closing (Auto reclose) according to the specified duty cycle without derating: O – 0.3 s –CO – 3 min. – CO.
- 9.1.12 Breaker shall be suitable for following switching duties:
- Short line faults
 - Out of phase switching
 - Interruption of small inductive current including transformer magnetizing inrush currents.
 - Interruption of line and cable charging currents.
 - Terminal faults
- 9.1.13 The circuit breaker shall meet all the double Circuit overhead transmission line and cable characteristics for any type of fault or fault location, and also for line charging and dropping when used on an effectively grounded system. Effect of second circuit in parallel shall also be considered.
- 9.1.14 The circuit breakers shall be capable of being operated locally or from remote. Local operation shall be by means of an open/close control switch located in the bay control cabinet.

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- 9.1.15 The minimum guaranteed nos. of maintenance free operations of complete GIS shall be 10000 nos. at rated capacity.
- 9.1.16 The Drive shall have sufficient stored energy for completing O-C-O with auxiliary power switched off.
- 9.1.17 Circuit breakers, being an arcing device, shall not house any passive device like current transformer in its housing.
- 9.1.18 The breaker layout arrangement shall be vertical or horizontal but shall 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 elevation.
- 9.1.19 The stationary mounted circuit breakers shall be fully type-tested. Test certificates, as evidence of successful completion of type tests shall be submitted with the tender.
- 9.1.20 External Line to ground capacitors or grading capacitors shall not be used to mitigate the TRV for Short Line Faults test duty. External Line to ground capacitors or grading capacitors, if used to mitigate the TRV for Short Line Faults, will have to be indicated separately and can only be accepted if specifically approved.
- 9.1.21 The Circuit Breakers shall have a First Pole to Clear factor of 1.5 for Circuit Breakers up to 245 kV class

9.2 Closing Devices

- 9.2.1 The closing coils shall be suitable for operation at any voltage between 110% and 85% of the nominal control voltage measured at the device terminals
- 9.2.2 The breaker shall close correctly when an electrical closing pulse of 50 msec. duration is applied to the closing coil.

9.3 Tripping Devices

- 9.3.1 All electrical tripping coils shall be suitable for operation at any voltage between 110% and 85% of the nominal control voltage measured at the device terminals.
- 9.3.2 Each circuit-breaker shall be equipped with two shunt trip system. The one shunt trip system shall be electrically separated from the other system.
- 9.3.3 An emergency hand tripping (mechanical) device shall be provided in the operating mechanism.

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- 9.3.4 Two trip coils to be provided in the Breaker system. The design should be such that in case of failure of primary trip coil, the secondary trip must come into effect with an annunciation of the failure of the primary trip coil.

9.4 Anti-Pumping

- 9.4.1 The circuit-breaker mechanism 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.

9.5 Operating Mechanism

- 9.5.1 The breaker shall include suitable spring operating mechanism to assure proper opening & closing operations. The provision shall be made for checking adjustments and opening characteristics. The mechanism shall be capable of re-closing within the range specified in the applicable standards. The mechanism shall include dual trip coils. Charging of opening mechanism shall be possible in the event of failure of the motor drive.
- 9.5.2 Densimeter contacts and pressure switch contacts shall be suitable for direct use as permissives in closing and tripping circuits. Separate contacts have to be used for each of tripping and closing circuits. If contacts are not suitably rated and multiplying relays are used then fail safe logic/schemes are to be employed. DC supplies for all auxiliary circuit shall be monitored and for remote annunciations and operation lockout in case of dc failures.

9.6 Spring Operated Mechanism

- 9.6.1 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.
- 9.6.2 As long as power is available to the motor, a continuous sequence of closing and opening operations shall be possible.
- 9.6.3 After failure of power supply to the motor, at least ONE close-open (C-O) operations of the circuit breaker shall be possible.
- 9.6.4 Breaker operation shall be independent of the motor which shall be used solely for compressing the closing spring.
- 9.6.5 Motor rating shall be such that it shall not take more than 60 seconds for fully charging the closing spring.

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- 9.6.6 Closing action of the circuit breaker shall compress the opening spring ready for tripping.
- 9.6.7 When closing springs are discharged after closing a breaker, closing springs shall automatically be charged for the next operation.
- 9.6.8 The trip coil shall be suitable for trip circuit supervision during both open and close position of breaker.
- 9.6.9 The auxiliary switch of the breaker shall be positively driven by the breaker operating mechanism.
- 9.6.10 Spring operated mechanism shall be complete with motor. Opening spring and closing spring with limit switch for automatic charging and other necessary accessories to make the mechanism a complete operating unit shall also be provided.
- 9.6.11 As long as power is available to the motor, a continuous sequence of the closing and opening operations shall be possible. The motor shall have adequate thermal rating for this duty.
- 9.6.12 Provisions shall be made to prevent a closing operation of the breaker when the spring is in the partial charged condition.
- 9.6.13 Mechanical interlocks shall be provided in the operating mechanism to prevent discharging of closing springs when the breaker is in the closed position.

9.7 Auxiliary Switches

Each breaker shall have auxiliary switches with 8NO+8NC number of contacts in addition to the NO and NC contacts required for switchgear internal circuit interlock/wiring and shall be wired to terminals located in the local control cabinet of the circuit breaker bay. 20 % spare contacts should be provided. Any breaker contact multiplication for any purpose to be done only through latching contactor or latching relays.

9.8 Indicating Devices

Indicators shall be provided on all circuit breakers, isolators and earth-switches, which shall clearly show whether the switches are open or closed. The indicators shall be mechanically coupled directly to the main contact operating drive rod or linkages and shall be mounted in a position where they are clearly visible from the floor or the platform in the vicinity of the equipment. Viewing glass shall also be provided with all isolators and earth switches so that the switch contact positions can be verified by direct visual inspection

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Position indicators shall be provided to clearly indicate whether a circuit breaker is open or closed and should be available in case of loss of control supply.

Status Colour

Open position Open Green

Closed position Closed Red

9.8.1 Each circuit-breaker shall be provided with an operation counter to record the number of tripping operations performed. The counter may be located at the local control cabinet.

9.8.2 All position indicators and counters shall be readable at a convenient elevation i.e. from the place of operation.

9.9 Gas Connections

Necessary valves and connections shall be provided to assure ease in handling the SF6 gas.

9.10 Timing Test

Timing tests are to be carried out after the switch gear has been completely charged with SF6 gas.

9.11 Testing Facilities:

Timing test facility shall be provided with switchgear such that it is not necessary to open up any gas section to make test connections to the circuit breaker terminals.

9.12 PRINCIPLE PARAMETERS (min. required and actual values shall be finalized as per detailed engineering)

The Circuit Breakers of GIS equipment shall confirm to the specific technical requirements given as under.

i. Circuit Breaker

Sr No.	Particulars	220kV
1) Enclosure		Either of phase segregated or all phases encapsulated.
2) Enclosure material		As per relevant IEC standard

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3) Rated voltage	245 kV
4) Rated current	2000A
5) Rated frequency	50 Hz
6) Rated short-circuit breaking current Duration	50 kA rms for 3 sec
7) Rated break-time	3 cycle
8) Rated short-circuit making current	125 kAp
9) Difference for simultaneity of 3 poles	4 ms (Max.)
10) Rated insulation level under minimum SF6 gas pressure	
a) Power frequency withstand voltage	460 kVrms
b) Lighting impulse withstand voltage Switching impulse voltage	1050 kVp (As per IEC 62271-1)
9) Rated operating sequence	O-0.3s-CO-3min-CO
10) Type of operating mechanism for circuit Breaker	Spring
11) Rated control voltage	220V DC
Closing coil	
Tripping coil	
12) Mechanical Endurance class	M2
13) Electrical Endurance class	E1

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14) Re-striking probability class	C2
15) Rated line charging breaking current	As per project requirement
16) Rated cable charging breaking current	
17) Rated capacitor bank switching current	
18) Rated out of phase making and breaking current in % of rated short circuit breaking current	As per applicable IEC
19) Characteristic for short line fault related to rated short circuit breaking current	As per IEC 62271 - 100
20) TRV characteristics	As per IEC 62271 - 100
21) Inductive current breaking capability	Switching No Load current of transformer
22) First pole to clear factor	As per IEC 62271 - 100
23) Opening time in ms	Not more than 40
24) Closing time in ms	Not more than 100
25) Noise level at the base of CB	As per NEMA standard
26) No of tripping coils per breaker	2
27) No of closing coils per breaker	1

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ii. Disconnecter Switches and Maintenance Grounding switches

a) General

- i. The GIS disconnector switches and grounding switches shall comply with the following general requirements of disconnect switches and the latest version of the relevant specifications IEC 60129, 61128, 61129, 61259.
- ii. The GIS disconnector shall comply with the latest version of relevant specifications IEC 60129, 61128, 61129, 61259.
- iii. Disconnect switches and grounding switches shall have electrical **and** Mechanical interlocks to prevent grounding switch from closing on an energized section.
- iv. However, pad locking arrangement shall be provided to have mechanical interlock manually.
- v. Interlocks with other bays for bus transfer switching shall be done through bay control cabinets. Actuation of the emergency manual operating device shall also disable the electrical control. Disconnectors in open condition shall be secured against reclosure.
- vi. Disconnecting switches and adjacent safety grounding switches shall have electrical interlocks to prevent closure of the grounding switches when the disconnecting switches are in the closed position and to prevent closure of the disconnecting switch when the grounding switch is in the closed position.
- vii. The disconnector shall be pad lockable in the close & open position.
- viii. The single pole group operated disconnectors shall be operated by electric motor suitable for use on 220 DC system and shall be equipped with a manual operating mechanism for emergency use. The motor shall be protected against over current and short circuit.
- ix. The operating mechanism consists of a motor with gearbox and the mechanically coupled auxiliary control and alarm switches. Emergency manual operation by hand crank and mechanical interlocking are standard. The three modes –motor operation, emergency manual operation, and mechanical interlocking – each mechanically locks the others out.
- x. The opening and closing of the disconnectors shall be achieved by either local or remote control. The local operation shall be by means of a two-position control switch located in the bay control cabinet.
- xi. The disconnector operations shall be inter-locked electrically as well as mechanically with the associated circuit breakers in such a way that the disconnector control is inoperative if the circuit breaker is closed.

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- xii. Each disconnecter shall be supplied with auxiliary switch having four normally open and four normally closed contacts for future use over and above those required for switchgear interlocking.
- xiii. The disconnectors and safety grounding switches shall have a mechanical key (pad locking key) and electrical inter-locks to prevent closing of the grounding switches when isolator switches are in the closed position and to prevent closing of the disconnectors when the grounding switch is in the closed position.
- xiv. The disconnecting switches shall be arranged in such a way that all the three phases operate simultaneously. All the parts of the operating mechanism shall be able to withstand starting torque of the motor mechanism without damage until the motor overload protection operates.
- xv. The disconnecting switches shall be provided with rating plates and shall be accessible for inspection.
- xvi. Similar kind of high speed grounding switches shall also be provided for each bus of GIS system with all electrical interlocks with all bay breakers and line breakers to avoid accidental charging of bus when earthing switch is ON. Similarly electrical interlock to be provided to avoid application of bus earthing switch when bus is charged.

b) Interlocks

Interlocking devices must provide absolute and positive protection against potentially harmful mal-operations of the switchgear. The following functions shall be assured:

- i. Forcing the operator into the only safe and logic sequence to actuate breakers, switches, isolators and grounding switches.
- ii. Checking the actual fully closed or fully open position of all switching elements before and after each move.
- iii. Providing the logical checks and issuing the resulting PERMISSIVE or BLOCKED signals for the switchgear.
- iv. Indicating positively the absolute condition/position of the supervised equipment.
- v. Local manual and remote electrical operation of all essential functions.
- vi. Local emergency unlocking facilities via safety-key switches under the full responsibility of the operator.
- vii. Intrabay and interbay interlocking shall be provided.
- viii. Electrical interlocking arrangement shall be fail-safe type.
- ix. Mechanical interlocks for isolator & Earthing Switch shall be fail-safe type.
- x. All main contacts, male and female, shall be silver plated.

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- xi. Each disconnect switch and grounding switch shall open or close only due to motor driven or manual operation independently. 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 be held closed. Operation of respective end position limit switches shall only disconnect the motor mechanism. There should also be a pre-set timer in motor circuit for protection against time over –run in case of inadvertent failure of drive mechanism in any intermediate position of the disconnect travel path.
- xii. The disconnect switches and grounding switches shall be located as shown in the Single Line Diagram attached as Annex-S-3/C-1/1.
- xiii. The disconnect switches shall be capable of interrupting the charging current of the connected GIS bus & associated components.

c) Duty requirements:

The disconnecting switches shall have breaking capabilities as per IEC requirements. Contact shielding shall be designed to prevent re-strikes and high local stresses caused by the transient recovery voltages when currents are interrupted.

The bus disconnecting switches shall reliably handle capacitive currents due to the making and breaking of switchgear components as well as commutation currents due to bus bar reconfiguration.

The fast acting ground switches, used for overhead double circuit lines and underground cable feeders shall be capable of switching induced current as per IEC requirement.

d) Short Circuit Requirements

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:

- i. Mechanical damage to any part of the isolator or earthing switch.
- ii. Separation of the contacts or contact welding.
- iii. A temperature rise likely to damage insulation.

e) Access for maintenance and repair:

Suitable means of access should be provided in each disconnect-switch and grounding-switch housing and mechanism for repair and/or maintenance of contacts.

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f) Operation Mechanism

- i. Mechanism shall be arranged mechanically, electrically, so that all three phases of any particular disconnect switch or grounding switch operate simultaneously.
- ii. All mechanisms shall be suitable for electrical motor operation to achieve a fully automatic operation. For emergency situations manual operation shall be possible. Handles or hand cranks shall be provided, together with all necessary operation rods and rod guides. Manual operation shall be prevented if the interlocking system does not allow the operation of the switch.
- iii. The auxiliary supply shall be electrically decoupled from the motor when the switch is operated manually.
- iv. The mechanisms shall be arranged for locking in the open and in the closed position. Facility shall be available to allow the switch to be padlocked in any position.
- v. Disconnecting operating mechanism of all disconnectors/ isolator & earth switches shall be at easy operable height.
- vi. The isolator shall be provided with positive continuous control throughout the entire cycle of operation.
- vii. 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 torsional and bending stresses due to operation of the isolator.
- viii. It shall not be possible, after final adjustment has been made, for any part of the mechanism to be displaced at any point in the travel sufficiently to allow any speed.
- ix. The operating mechanism design shall be such that during the operation of the isolator (especially manual operation), once the moving blades reach the sparking distance, springs shall take over to give a quick, snap action closing so that the isolator closing is independent of manual efforts. Similarly, the springs must assist during the opening operation to give quick breaking feature.
- x. Disconnector and high speed motor operated earthing switch mechanisms shall be provided with a mechanism with stored energy to always assure completed operations **OR** High speed earth switch shall be motor drive spring charged mechanism whereas disconnector switch shall be motorized.
- xi. It shall be possible to operate the disconnecting switches manually by cranks. The contacts shall be both mechanically and electrically disconnected during the manual operation.

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- xii. The operating mechanism consists of a motor with gearbox and the mechanically coupled auxiliary control and alarm switches. Emergency manual operation by hand crank and mechanical interlocking are standard. The three modes –motor operation, emergency manual operation, and mechanical interlocking – each mechanically locks the others out.
- xiii. The opening and closing of the disconnectors shall be achieved by either local or remote control. The local operation shall be by means of a two-position control switch located in the bay control cabinet.
- xiv. Remote control of the disconnectors from the control room shall be made by means of remote/ local transfer switch.
- xv. The signaling of the closed position of the disconnector shall not take place unless it is certain that the movable contacts will reach a position in which the rated normal current, peak withstand current and short-time withstand current can be carried safely.
- xvi. The signalling of the open position of the disconnector shall not take place unless the movable contacts have reached such a position that the clearance between the contacts is at least 80 percent of the rated isolating distance.
- xvii. The local control of the Isolator and high-speed grounding switches from the bay module control panel should be achieved from the individual control switches with the remote/local transfer switch set to local.
- xviii. All electrical sequence interlocks will apply in both remote and local control modes.

g) Auxiliary Switches:

All disconnecting switches shall be provided with electrically independent auxiliary switch, directly driven by the common operating shaft. Each disconnect switch and grounding switch shall furnished with sufficient Nos. of NO – NC as per entire scheme requirement plus two (2) NO-NC electrically independent contacts terminated up to terminal board, at user's disposal. The auxiliary switches shall indicate the position of the switch contacts, and shall be independent of the motor operation.

All auxiliary switches and auxiliary circuits shall be capable of carrying a current of at least 10 A DC continuously.

The auxiliary switches shall be capable of breaking at least 2 A in a 220 DC circuit with a time constant of not less than 20 milliseconds.

h) Position Indicators

Mechanically connected position indicators shall be provided externally to permit observation of close/open position of the disconnect switch and grounding switch. Each disconnecter shall have a clearly identifiable local, positively driven mechanical position indicator, together with position indicator on the bay module control cabinet and provisions for taking the signals to the control room.

The place of Position Indicators should be easily visible from the place of operation of respective equipment.

Status Colour

Open position Open Green

Closed position Closed Red

Visual verification shall be provided for each pole of each disconnect switch and grounding switch to permit visual inspection of each switchblade position.

Technical Data Requirement (min. required and actual values shall be finalized as per detailed engineering)

Disconnectors:

Sr No.	Particulars	Parameters
1)	Enclosure	Separate phase wise
2)	Enclosure material	Aluminum Alloy
3)	Rated voltage	245 kV
4)	Rated current	2000 A
5)	Rated short-time current Duration	50 kA rms 3 sec
6)	Rated control and operating voltage	220V DC
7)	Type of operating mechanism	Motor operated
8)	Type	Mechanically and electrically ganged operated

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- | | | |
|-----|--|-------------------|
| 9) | Rated insulation level | |
| | a) Power frequency withstand voltage | 460kV rms |
| | Across the isolating distance | 510kV rms |
| | b) Lightning impulse withstand voltage | |
| | phase to phase, between phases | 1050kV peak |
| | Across the isolating distance | 1200kV peak |
| 10) | Mechanical Endurance Class | M1 |
| 11) | Bus transfer switching capability (% of rated current) | 80 % (max. 1600A) |

Low-voltage test provision:

A low-voltage test provision may be supplied with a grounding switch to permit test voltages of up to 10kV (optional 2.5kV) and upto 200 A to be applied to the conductor without removing SF6 gas or other components, except for ground shunt leads.

c. Fast Acting Make Proof Grounding Switches:

i. General.

- a) Fast acting grounding switches to be located at the each line bays of GIS bus system. They shall be able to switch safely load currents of overhead lines. They must have fault making capability and be able to switch on a live line. Applicable standards are IEC 60129, 60517, 61129.
- b) The fast acting grounding switches shall comply with the following general requirements of fast acting grounding switches and the latest revision of the relevant IEC specifications.
- c) Fast acting grounding switches shall be of three phase, encapsulated, three phase linkage group operated by a maintenance-free self contained electrical

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motor. They shall also have facilities for emergency manual operation and the necessary operating handles or hand cranks shall be supplied.

- d) Fast acting grounding switches shall be electrically and mechanically interlocked with related disconnectors, to prevent the fast acting grounding switch from closing on an energized bus section.
- e) All main contacts, male and female, shall either be silver plated or shall have silver inserts.
- f) Each fast acting grounding switch shall open or close only due to motordrive or manual operation but shall be operable from local only. 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.
- g) Each fast acting grounding switch shall be fully insulated and connected to ground by a removable bolted link in order that the grounding switch may be used for various test purposes. The insulation shall be capable of withstanding an applied power frequency voltage of 5 kV.
- h) The short circuit making current rating of each ground switch shall be at least equal to its peak withstand current rating. The switches shall have inductive/capacitive current switching capacity as per IEC-62271-102.
- i) Each high speed make proof grounding switch shall have clearly identifiable local positive driven mechanical indicator together with position indicator on the bay module control cabinet and provision for taking the signal Control Room
- j) These high speed grounding switches shall be electrically as well as mechanically interlocked with their associated circuit breakers and dis-connectors so that the grounding switches cannot be closed if the circuit breakers and dis-connectors are closed.
- k) Interlocks shall be provided so that the insertion of the manual operating devices will disable the electrical control circuits.
- l) Each high speed ground switch shall be fitted with auxiliary switches having four NO & four NC auxiliary contacts for use by others, over and above these required for local interlocking and position indication. All contacts shall be wired to terminal blocks in the local bay control cabinet. Provision shall be made for padlocking the ground switches in their open or closed position.
- m) All portions of the grounding switch and operating mechanism required for grounding shall be connected together utilizing flexible copper conductors.

ii. Operation Mechanism.

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- a. Mechanisms shall be coupled either mechanically or electrically or by both, so that all three phases of any particular fast acting grounding switch operate simultaneously *without any discrimination*.
- b. All mechanisms shall be equipped with a motor suitable for operation from the auxiliary supply, and a set of springs so arranged that energizing of the motor will cause the springs to be charged and then released. The springs in turn shall close the fast acting grounding switch.
- c. Motors shall be suitable for operation at any voltage between 85% and 110% of the rated auxiliary voltage, measure at the motor terminals.
- d. For emergency situations manual operation shall be possible. Handles or hand cranks shall be provided, together with all necessary operation rods and rod guides.
- e. The auxiliary energy shall be electrically uncoupled from the motor when the switch is operated manually.
- f. The mechanisms shall be arranged for locking in the open and in the closed position.

iii. Auxiliary Switches

Each of the fast acting grounding switch shall be furnished with sufficient Nos. of **NO – NC as per entire scheme requirement** plus two (2) NO-NC electrically independent contacts, suitably terminated at terminal blocks, at user's disposal. The auxiliary switches shall indicate the position of the switch contacts, and shall be independent of the motor operation.

iv. Position Indicators

Mechanically connected position indicators shall be provided externally to ascertain the open/close position of the grounding switch. It should be easily visible from the place of operation of equipment.

Position Indicator Status Colour

Open position Open Green

Closed position Closed Red

Visual verification shall be provided for each pole of each disconnect switch and grounding switch to permit visual inspection of each switchblade position.

d. Test Facility

Each fast acting grounding switch shall be fully insulated and connected to ground by a removable bolted link in order that the grounding switch may be used for various test

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purposes. The insulation shall be capable of withstanding an applied power frequency voltage of 5 kV.

High speed earthing switches shall be capable of interrupting line coupling currents upon opening and in worst conditions closing.

e. Technical Data Requirement

- High Speed Earthing Switch

Sr. No	Particulars	220kV
1) Enclosure		(Separate phase wise)
2) Enclosure material	Aluminum Alloy	
3) Rated voltage		245kV
4) Rated short-time current		50kA for 3 sec
5) Rated peak withstand current		125kAp
6) Type of operating mechanism		Motor operated
7) Rated control and operating voltage		220V DC
8) Power frequency withstand voltage		460kV rms
across the open gap		510kV rms
9) Lightning impulse withstand voltage		1050kV peak
across the open gap		1200kV peak
10) Electrical Endurance class		E1
11) Rated induced current switching capability		As per IEC 62271 – 102 class B

iii. Current Transformers:

a. General

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- The current transformers provided for each phase shall be supplied in accordance with the following general requirements and the latest revisions of the relevant IEC 60044 specifications.
- The current transformers must be suitable for continuous operation when installed on the conditions.
- The current transformer shall be cast resin type with multi ratio with fully distributed secondary windings with accuracy as per IEC 60185, incl. IEC 60044-1, multi core as per requirement and shall be mounted inside the high voltage enclosure.
- In each line bay, one dedicated metering CT of 0.2S class shall be provided exclusively for open access metering purpose. This CT shall not be used for any other metering purpose. This CT design shall be in line with HVPNL guidelines for open access metering as attached as annex S-3/C-1/2
- The secondary terminals of current transformers shall be placed outside the high voltage enclosures, mounted in suitable, accessible terminal boxes and the secondary leads of all the current transformers shall be wired to shorting type terminals.
- It shall be possible to test each current transformer without the removal of gas through the insulated grounding switches.
- The number and position of the current transformers shall be relative to the circuit-breakers, disconnecting switches and ground switches. The detailed engineering drawing shall be discussed in event of order.
- The rating, No of cores, accuracy class, characteristics etc. for the individual current transformer secondary cores shall be as specified below. Although the details have been mentioned below for the purpose of tendering, yet these values are liable to change in event of order and actual values shall be intimated during detailed engineering stage.
- The various ratios of current transformers shall be obtained by changing the effective number of turns on the secondary winding.
- Each current transformer shall be provided such that the enclosure current does not affect the accuracy or the ratio of the device or the conductor current being measured. Provision shall be made to prevent arcing across the enclosure insulation. ***CT shall be provided with effective electromagnetic shields to protect against high frequency transients typically 1-30 MHz.***
- The current transformers incorporated into the GIS will be used for protective relaying and metering and shall be of metal- enclosed type. All the current transformers shall have effective electromagnetic shields to protect against high frequency transients.
- The instrument security factor at all ratios shall be less than five (5) for metering core. If any auxiliary CTs/reactor are used in the current transformers then all

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parameters specified shall have to be met treating auxiliary CT's as an integral part of the current transformer. The auxiliary CTs/reactor shall preferably built in construction of the CTs.

- The current transformers shall be suitable for high speed auto-reclosing.
- The particulars of the various cores may change within reasonable limits as per the requirements of protection relay supplier. The Manufacturer is required to have these values confirmed from the purchaser before proceeding with design of the cores. The other characteristics of CTs shall be furnished along with the specification. Atleast one CT shall be provided of 0.2S class.
- 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.

b. Rating and Diagram Plates

Rating and diagram plates shall be provided. The information to be supplied on each plate shall be as specified in the relevant IEC specification, which shall be given for the tap for which the rated performance is specified and for each transformer core.

iv. Voltage transformer:

a. SF6 insulated:

Each voltage transformer shall be *metal enclosed*, SF6 insulated *inductive type* in accordance with relevant IEC 60044-2. The location, polarity, ratios, and accuracy shall be as specified during detailed engineering stage.

b. Construction:

- VTs should be in segregated compartment and not forming a part of bus bar.
- In each line bay, one dedicated metering PT of 0.2 class shall be provided exclusively for open access metering purpose. This PT shall not be used for any other metering or protection purpose. This PT design shall be in line with HVPNL guidelines for open access metering as attached as annex S-3/C-1/2
- Transformers should be of either plug-in construction or the disconnect-link type, and be attached to the gas-insulated system in such a manner that they can be easily disconnected while the system is being dielectrically tested.

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- Alternately, a voltage transformer designed so that it does not have to be disconnected during dielectric testing may be specified. The metal housing of the transformer should be connected to the metal enclosure of the GIS with a flanged, bolted, and gasketed joint so that the transformer housing is 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 fast transients (VFT) or Ferro-resonance.*
- The beginning and end of each secondary winding shall be wired to suitable terminals accommodated in a terminal box mounted directly on the voltage transformer section of the SF6 switchgear.
- All terminals shall be stamped or otherwise marked to correspond with the marking on the diagram plate. Provision shall be made for earthing of the secondary windings inside the terminal box
- Provision shall be made for grounding of the secondary windings inside the local control cabinet.
- Test condition for tests at site: Power frequency tests for the completed GIS at site shall be possible without removing the VT. The primary and secondary neutral terminal points, intended to be earthed, should be insulated and shall withstand power frequency voltage of 3 kV rms for 1 minute. The VT shall be capable to withstand discharge current arising from capacitance of underground cable circuits.
- The transformer shall be able to sustain full line to line voltage without saturation of transformer.
- The voltage 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 voltage transformers shall be effectively shielded against high frequency electromagnetic transients.
- Voltage transformers secondaries shall be protected by MCB for all the windings. The secondary terminals of the VT's shall be terminated to the terminal blocks in the secondary boxes.
- The voltage 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.
- Suitable protections to be provided on the PT primary side as well as suitable for project requirements.

c. Covers and shields:

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Special covers and any necessary corona shields should be supplied so that the system can be pressurized and dielectrically tested after removal of the transformer.

d. Primary and secondary terminals:

Primary and secondary terminals should have permanent markings for identification of polarity, in accordance with IEC. *The secondary terminals of voltage transformers shall be placed outside the high voltage enclosures, and the secondary leads of all the voltage transformers shall be wired up to terminals mounted in suitable & accessible terminal boxes.*

v. Metal-Enclosed Surge Arresters:

- 360 kV, 20 kA, CI-4 / 198 kV, 10 kA, CI-3 / 120 kV, 10 kA, CI-3 / 60 kV, 10 kA, CI-3 hermetically sealed, Gapless, ZnO, Surge arrestor, suitable for use with GIS, for each phase, at the 220kV line underground cable entry terminals of GIS shall be provided, in each of the bays in the 220kV GIS switchgear being provided
- Each feeder shall be provided with surge arrestor suitable for operation with 220kV GIS
- Each Surge Arrester shall be provided with self leakage current monitoring device at convenient elevation. Location of SF6 Surge Arrester shall be as per approved drawings.
- They shall have adequate thermal discharge capacity for severe switching surges, long duration surges and multiple strokes. The surge arresters when provided with pressure relief devices shall be capable of withstanding the internal pressures developed during the above discharges without operation of the pressure relief devices.
- Surge Arresters, if any provided, shall be of either the "plug-in" construction or the disconnect-link type and be attached to the gas-insulated system in such a manner that they can be readily disconnected from the system while the system is being dielectrically tested. The metal housing of the arrester shall be connected to the metal enclosure of the GIS with a flanged, bolted joint.
- The ground connection shall be sized for the fault level of the GIS. It shall be insulated from the GIS-enclosure and grounded externally to permit periodic maintenance and monitoring of the leakage current.
- If the arresters are not equipped with removable links, special covers and any necessary corona shields should be supplied so that the system can be pressurized and dielectrically tested after removal of the arrester.
- Access to the arrester ground connection, when it is provided with means for leakage current monitoring should not be obstructed.

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vi. Insulating Gas and gas leakage rate

- 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. The guaranteed leakage rate of each individual gas compartment and between compartments must be less than 0.5% p.a. for the service life of equipment.
- The quality of new filled-in SF₆ gas shall meet the following requirements in line with IEC 60376.
 - SF₆ > 99.90 % by weight
 - Air < 500 ppm by weight (0.25 vol.-%)
 - CF₄ < 500 ppm by weight (0.1 vol.-%)
 - H₂O < 15 ppm by weight (0.012 Vol.-%)
 - Mineral oil < 10 ppm by weight
 - Acidity, in terms of HF < 0.3 ppm by weight
 - Hydrolysable fluorides, in terms of HF < 1 ppm by weight
- The SF₆ gas insulated metal-clad switchgear shall be designed for use with SF₆ gas complying with the recommendations of IEC 376, 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 as above as a minimum & should be suitable in all respects for use in the switchgear under all operating conditions.
- The high pressure cylinders in which SF₆ gas is supplied & stored at site shall comply with the requirements of standards & regulations. After delivery the cylinders will be sent back to the GIS factory.
- SF₆ gas shall be tested for purity, dew point, air, hydrolysable fluorides and water contents as per IEC: 376 and test certificates shall be furnished to the owner indicating all test results as per IEC standards for each lot of SF₆ gas. Further site tests for moisture, air content, flash point and dielectric strength to be done during commissioning of GIS. Gas bottles should be tested for leakage during receipt at site.
- The bidder shall indicate diagnostic test methods for checking the quality of gas in the various sections during service. The method proposed shall, as a minimum check the moisture content & the percentage of purity of the gas on annual basis.

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- The bidder shall also indicate clearly the precise procedure to be adopted by maintenance personnel for handling equipment that are exposed to the products of arcing in SF6 Gas so as to ensure that they are not affected by possible irritants of the skin and respiratory system. Recommendations shall be submitted for suitable protective clothing, method of disposal of cleaning utensils and other relevant matters.
- The bidder shall also indicate the details and type of filters used in various gas sections at the time of detailed engineering.

vii. Gas sections including Monitoring devices:

- The GIS enclosures shall be divided into several gas sections separated by gas-tight barriers. Each section shall be provided with necessary valves to allow evacuation and refill of gas without evacuation of any other section.
- Location of gas barrier insulators is to be clearly discriminated outside the enclosure by a band of distinct colour normally used for safety purposes.
- The gas system proposed shall be shown on a “gas single line diagram” and submitted during the drawing approval stage in the event of an order for approval. It should include the necessary valves, connections, density monitors, gas monitor system and controls, indication, orifices, and isolation to prevent current circulation. Means of calibrating density monitors without deenergizing the equipment should be specified by the supplier.
- For the purpose of gas monitoring and maintenance, the GIS shall be divided into various individual zones in each bay. The CB gas zone shall be independent from all other gas compartments and shall meet the requirement of relevant IEC.
- The temperature compensated gas density monitoring devices with associated pressure gauge will be provided. The devices shall provide continuous & automatic monitoring of the state of the gas & a separate device shall be provided for each gas compartment so that each compartment can be monitored simultaneously
- Provisions shall be made for connecting pressure gauges, service cart, and moisture test instrumentation to any one of the gas sections.
- Gas compartments shall be designed in such a way that instrument transformers can be easily removed without degassing any of the bus-bar compartments.
- The sections shall be so designed as to minimize the extent of plant rendered inoperative when gas pressure is reduced, because of excessive leakage or for maintenance purposes. The design shall be such as to minimize the quantity of gas that has to be evacuated and then recharged before and after carrying out

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maintenance of equipment. Cable box where cable-sealing end is installed shall have its own independent gas compartment, with gas monitoring.

Every gas compartment consists of:

- a. Its own gas supply with quick-disconnect coupling. An integral filter keeps dust and contaminants from getting into the compartment. The gas supply is designed to permit the connection of all instruments and maintenance equipment.
 - b. A pressure-relief device to guard against excessive overpressure.
 - c. An absorber to take up residual moisture and degradation products.
 - d. A density switch.
 - e. The standard density switch is a purely mechanical device functioning as a temperature-compensated pressure monitor.
 - f. A two-level alarm is actuated if the gas density drops.
 - a. Gas Refill level
 - b. 'Zone Trip' level
- **Reuse or recycling of removed gas:**
The supplier should provide guidelines or recommended practices for the reuse or recycling of SF₆ gas removed from the equipment. These guidelines should be consistent with current industry practices, as they pertain to the effect of SF₆ on global warming; i.e. SF₆ gas should be reused and recycled whenever possible and never be unnecessarily released into the atmosphere. Clear instructions shall be provided by bidder about handling, recycling & treatment of new and used SF₆ gas. During commissioning dew point of SF₆ gas shall be measured and documented. Components may be filled with N₂ for transportation and refilled with SF₆ at site.
 - **Permanent Gas Treatment Devices:**
Means shall be provided inside each enclosure for treating the SF₆ gas by the use of Desiccants, driers, filter, etc. to remove impurities in the gas. All gas compartments shall be fitted with static filter material containers that will absorb residual and entering moisture inside the high voltage enclosures. Filters inside the breaker compartment shall also be capable of absorbing gas decomposition products resulting from the switching arc or any other type of interruptions. The total design shall incorporate facilities for SF₆ storage adjacent to the installed switchgear assembly.

viii. **Online PD monitoring system:**

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a. General:

- The equipment shall be used for detecting different types of defects in Gas Insulated Stations (GIS) such as Particles, Loose shields and Partial Discharges as well as for detection of Partial discharges in other types of equipment such as Cable Joints, CTs and PTs.
- It shall be capable for measuring PD in charged GIS environment as EHV which shall have bandwidth in order of >500 kHz with possibility to select a wide range of intermediate bandwidths for best measurement results. The principal of operation shall be on UHF technique and the method of measurement shall be non-intrusive. These UHF sensors shall be provided at strategic locations in 220kV GIS.
- It is essential to provide minimum one no. PD sensor near the breaker and one no. near cable terminations of all feeder bays. Other PD sensors shall be placed strategically within a distance of maximum 7-8m.
- The instrument shall be able to detect partial discharges in cable joints, terminations, CTs and PTs etc.
- The portable PD analyser kit shall be used for detection and measurement of PD and bouncing particles shall be displayed on built in large LCD display and the measurement shall be stored in the instrument and further downloadable to a PC for further analysis to locate actual source of PD such as free conducting particles, floating components, voids in spacers, particle on spacer surfaces etc.

b. Technical specification:

- i. Measurement shall be possible in noisy environment.
 - a. Stable reading shall be possible in presence of vibrations within complex GIS assemblies, which can produce signals similar to PD.
 - b. Equipment should have necessary synchronizing circuits to obtain PD correlation with power cycle and power frequency.
 - c. The PDM system shall operate on a safe DC operating voltage derived from the D.C system available in the station. Suitable DC to DC converters shall be utilized for the purpose with a complete redundancy for a fail proof system.
 - d. Measurement shall be possible in the charged switchgear in the presence of EMI/EMC.
- ii. Supplier should have supplied similar detector for GIS application to other utilities.

- a. Instrument shall be supplied with standard accessories i.e., UHF charge injector kit, re-locatable sensors (including additional sensors) with mounting arrangements, connecting cables (duly screened) to sensors, Lap-top PC, diagnostic software, carrying case, rechargeable battery pack with charger suitable for 230V AC, 50Hz supply connecting cables (duly screened) to view in storage.
- b. The function of software shall be covering the following:
 - Data recording, storage and retrieval in computer
 - Data base analysis
 - Template analysis for easy location of fault inside the GIS
 - Evaluation of PD measurement i.e, Amplitude, Phase Synchronization etc.
 - Evaluation of bouncing/loose particles with flight time and estimation on size of particle.
 - Report generation
- iii. To prove the suitability in charged switchyard condition, practical demonstration shall be conducted before acceptance.
- iv. Supplier shall have "Adequate after sales service" facility in India.
- v. Necessary training may be accorded to personnel to make use of the kit for locating PD sources inside the GIS
- vi. The PDM system sensors or couplers shall be designed not to spark over when open circuited.
- vii. The PDM system sensors/couplers shall be free from the Cellular/Radio signal interference and shall not record wrong signals.
- viii. The PDM system shall have a self-diagnostic feature to detect failure of the system components. No single component failure shall affect the satisfactory performance of the system.
- ix. The PDM sensors/couplers when installed internal to the GIS shall not cause leakage of SF6 gas.
- x. The PDM system shall be provided with a monitoring system locally within the Substation and shall also have provision for remote connection to SCADA system through Fiber Optic Communication links. All required devices for a total monitoring locally and remotely shall be provided.
- xi. The Data capture resolution time shall be 1 ms or less.
- xii. The Data Storage system shall be capable of storing data up to 30 days.
- xiii. The monitoring system shall be compatible with IEC 60870-5-104 protocol or IEC 61850 (as applicable) and shall be able to communicate via the Internet (TCP/IP protocol), Ethernet/ICCP link.

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- xiv. The PDM system shall be designed in such a way that the failure of the power supply will not result in any data loss captured up to the point of Power Supply failure.
- xv. Instrument shall be robust and conform to relevant standard.

ix. **GIS Connection:**

a. **SF6 to Air Bushings**

- i. Bushing shall be composite silicon polymer type only. Necessary valid type test reports as per relevant applicable standards. Suitable clamp & connectors shall be supplied with bushing. The dimensional and clearance requirements for the metal clad enclosure shall be maintained as per requirement of relevant standards. All the bushings shall have an impulse & power frequency withstand level that is higher or equal to the level specified in cl. 2.2. Only SF6 insulated composite silicon bushings will be accepted.
- ii. SF6 to Air Bushings shall conform to IEC 60037/ IEC60137 and IEC-62271-203 and shall have an impulse and power frequency withstand level that is greater than or equal to the level specified for the GIS.
- iii. SF6 to Air Bushings shall have minimum creepage as per relevant IEC standard. All creepage requirements shall be calculated on the basis of rated Line-to-Line Voltage.
- iv. Bushing shall be suitable for hot line washing and shall be provided with "water cut sheds".
- v. Puncture strength of bushings shall be greater than the dry flash-over value. When operating at normal rated voltage, there shall be no electric discharge between the conductors and bushing which would cause corrosion or injury to conductors, insulators or supports by the formation of substances produced by chemical action. No radio interference shall be caused by the bushing when operating at the normal rated voltage.
- vi. All hardware used for current carrying parts shall be SS 304 and other iron parts shall be hot dip galvanized.
- vii. All joints shall be air tight. Bushing design shall be so as to ensure uniform compressive pressure on the joints.
- viii. All current carrying contact surfaces shall be silver faced.
- ix. The manufacturer shall recommend procedures for SF6 handling according to IEC 60480 and IEC 61634.
- x. GIS Manufacturer shall furnish details of precaution taken to prevent bimetallic corrosion wherever dissimilar materials (such as Copper, Aluminum) are used in line with IEC1639, including the following.

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- Aluminum conductor in the bus duct and the current carrying part in the bushing.
- Terminal clamp and the current carrying part in the bushing if bushing stud is not of Copper.

b. GIS to Transformer:

i. 220 kV side by GIS bus duct.

The transformer shall be connected to the outgoing of 220kV GIS bus through GIB (Gas insulated Bus, of make same that of OEM of 220kV GIS). When the SF6 to the bushing of an oil-insulated transformer is connected, the transformer bushing must be oil-tight, gas-tight and pressure resistant. Any temperature related movement and irregular setting of the switchgear's or transformer's foundations are absorbed by the expansion fittings.

- Gas tight seals shall be provided at the interface of the bushings.
- All such GIS apertures intended for future use shall be provided with gas tight cover plates.
- The termination apertures shall be matched with the transformer dimensions with suitable expansion fittings to be provided for taking care of the temperature correlated expansions.
- SF6-to-Oil transformer terminations shall include all necessary materials such as SF6 busduct, gas monitoring devices, busbar extensions, removable links, bellow assembly, flexible interconnecting copper straps to minimize vibration transfer from the transformer, and supporting structures, etc., to ensure complete termination. The bellows shall be self compensated or compensated in compression by tie-rods, springs.
- The SF6-to-oil bushing at the power Transformer termination shall allow for disconnection from the gas-insulated bus through a removable link and provide means to permit field testing of the Transformer at the point of connection.
- It is to be noted that any disconnection or re-connection must ensure that no leakage of gas occurs without affecting other sections of the GIS bus-duct and transformers units.

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- Direct transformer connection parts delivered with the SF6 gas-insulated switchgear shall include the minimum of following:
 - i. The connecting electrode, which can be adapted to the transformer.
 - ii. An expansion element with bellows allows for thermal expansion, tolerances and vibrations. The vendor's to supply the materials accordance with the IEC Recommendations.
 - iii. Any other material required for complete GIB to Transformer connection.
- GIB layout shall be designed based on the following criteria.
 - a. Only two vertical layers shall be provided.
 - b. Outer to Outer (not center to center) vertical clearance between layers shall be minimum one meter.
 - c. The minimum outer to outer horizontal clearance between each GIS bus ducts shall be a minimum of 0.75 meter.
 - d. GIS bus ducts of each circuit shall be arranged in horizontal formation only and the clearance between the nearest bus ducts of two adjacent circuits shall be minimum one meter.
 - e. Minimum vertical ground clearance of bus duct at road crossing shall be 7 meter.
 - f. The GIB route shall not obstruct easy access to GIS and control buildings and shall not obstruct movement of cranes, equipments including HV test equipments for maintenance work.
 - g. For the maintenance of GIB of one circuit, only that circuit shall be isolated.

c. SF6-to-Air Overhead Line Termination

- For connecting overhead lines with the GIS, SF6-to-Air outdoor bushings, mounted on suitable steel structures shall be installed. The bushings shall be Composite silicon polymer Insulator bushing type only and shall conform to IEC 60137. The bushings shall have adequate Mechanical strength to withstand the Short circuit forces, Wind force and loading for the type connection.
- The SF6-to-Air terminations shall include all necessary materials such as SF6 busduct, gas monitoring devices, busbar extensions, removable links to ensure

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complete termination. The SF6-to-Air termination shall be provided with bursting/rupture disc. To obtain the necessary air clearance at the outdoor terminals, the bushings shall be splayed using suitable shaped enclosure section.

x. Local & Remote Control and Operation

a. General

- a) One local control cabinet (LCC) of **OEM of GIS** shall be supplied for the local control and peration of each bay. Each LCC shall contain the local control, interlocking, operation and indication devices for the associated GIS bay.
- b) The LCC shall be mounted on each GIS bay. The LCC's shall be located with sufficient space for access and the possibility to work at the equipment even when the LCC doors are open, or directly at the switch-gear in front of the related circuit breaker.
- c) The LCC's shall be installed indoor and care must be taken with the design to ensure that all LCC's are drip and splash proof. The LCC's shall also be dust and vermin proof. LCC shall comply degree of protection class IP-42 for Indoor installation according to IEC60529. 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.
- d) The LCC should have required arrangement for control and operations of GIS from Remote i.e. from the control room through *SCADA as well as SCADA compatible control and protection panel*.
- e) The LCC shall include all required functions for control and supervision of a complete GIS as well as the marshalling of all connections to and from the GIS bays.
- f) Safe station operation is ensured through following base functions.
 - Feeder & station interlocking, depending on the position of all high voltage components with their blocking functionality.
 - ii) Blocking of commands when crank handle of disconnect or earthing switches is introduced.
 - iii) Extensive circuit breaker supervision through "Anti-Pumping", pole discrepancy, Gas density and position supervision of circuit breaker.

b. Technical Specification of Control Cabinets:

- i. Control cabinets shall be of the free standing floor mounting type in case of 245 kV SF6 Circuit Breaker.

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- ii. Control cabinets shall be sheet steel enclosed and shall be dust, weather and vermin proof. Sheet steel shall be at least 2.6mm thick (2 mm if CRCA) sheet used. Control cabinets shall be provided with a hinged door and padlocking arrangement. The door hinges shall be of union joint type to facilitate easy removal. Door shall be properly braced to prevent wobbling. There shall be provision in the bottom sheet for entrance of cables from below.
- iii. Equipment and devices shall be suitable for operation on a 415 V, 3 phase 3/4 wire 50 Hz AC system. The wiring shall be of stranded copper with minimum cross section of 2.5 Sq.mm with 1100 V PVC insulation.
- iv. Bus bars shall be of tinned copper of adequate cross-section to carry the normal current, without exceeding the permissible temperature rise over an ambient temperature of 50C outside the cubicle. The buses shall be braced to withstand forces corresponding to short circuit current of 25 kA.
- v. Motors rated 1 KW and above being controlled from the control cabinet shall be suitable for operation on a 415 V, 3 phase 50 Hz system. Fractional KW motors shall be suitable for operation on a 240 V, 1-phase, 50 Hz supply system.
- vi. Isolating switches shall be group operated units 3-pole for use on 3-phase supply systems and 2 pole for single phase supply systems) quick make quick break type, capable of breaking safely and without deterioration, the rated current of the associated circuit. Control cabinet door shall be interlocked with the operating handle of the switch so as to prevent opening of the door when the switch is closed. A device for bypassing the door interlock shall also be provided. Switch handle shall have provision for locking in both fully open and fully closed positions.
- vii. Fuses shall be HRC cartridge link type having prospective current rating of not less than 46 kA (rms). They shall be provided with visible operation indicators to show when they have operated. One fuse pulling handle shall be supplied for every ten fuses or a part thereof.
- viii. Push button shall be rated for not less than 6 Amps, 415V AC or 2 Amps, 220V DC and shall be flush mounted on the cabinet door and provided with appropriate name plates. Red, Green and Amber indicating lamps shall be flush mounted and provided with series resistors to eliminate the possibility of short circuiting of control supply in the event of fusing of lamps.
- ix. For motors upto 5 KW , contactors shall be direct-on-line, air break, single throw type and shall be suitable for making and breaking the starting current of the associated motor which shall be assumed equal to 6.5 times the full load current of the motor at 0.2 p.f. For motors above 5 KW, automatic star delta type starters shall be provided. 3 pole contactors shall be furnished for 3 phase

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motors and 2-pole contactors for single phase motors. Reversing contactors shall be provided with electrical interlocks between forward and reverse contactors. If possible, mechanical interlocks shall also be provided. Contactors shall be suitable for uninterrupted duty and shall be of duty category class AC4 as defined in IS: 2959. The main contacts of the contactors shall be silver plated and the insulation class for the coils shall be class F or better. The dropout voltage of the contactors shall not exceed 70% of the rated voltage.

- x. Contactors shall be provided with a three element, positive acting, ambient temperature compensated, time lagged, hand reset type thermal overload relay with adjustable setting. Hand reset button shall be flush with the front door of the cabinet and suitable for resetting with starter compartment door closed. Relays shall be either direct connected or CT operated depending on the rated motor current.
- xi. Single phasing preventer relay shall be provided for 3 phase motors to provide positive protection against single phasing.
- xii. Mini starters shall be provided with no volt coils whenever required
- xiii. All necessary cable terminating accessories such as glands, crimp type tinned copper lugs etc., for control cables shall be included in Bidder's scope of supply. Suitable brass cable glands shall be provided for cable entry.
- xiv. Wiring for all control circuits shall be carried out with 1100/650 volts grade PVC insulated tinned copper stranded conductors of sizes not smaller than 2.5 sq. mm atleast 10% spare terminal blocks for control wire terminations shall be provided on each panel. The terminal blocks shall be ELMEK type or equivalent. All terminals shall be provided with ferrules Visibly marked or numbered and these identifications shall correspond to the designations on the relevant wiring diagrams. The terminals shall be rated for adequate capacity which shall not be less than 10 Amps.
- xv. Control cabinet shall be provided with 240 V, 1-phase 50 Hz, 20 W fluorescent light fixture and 5 amps, 3 pin socket for handlamp.
- xvi. Space heaters shall be provided inside each cabinet complete with thermostat (preferably differential type) to prevent moisture condensation. Heaters shall be controlled by suitably rated double-pole miniature Circuit Breakers.
- xvii. Signal lamps provided shall be of neon screw type with series resistors, enclosed in bakelite body. Each signal lamp shall be provided with a fuse integrally mounted in the lamp body.
- xviii. All AC control equipment shall be suitable for operation on 240 V, 1 phase 50 Hz

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system.

- xix. Items inside the cabinet made of organic material shall be coated with a fungus resistant varnish.
- xx. All doors, panels, removable covers and breaker openings shall be gasketed all around. All louvers shall have screens and filters. Cabinets shall be dust, moisture and vermin proof.

c. Required features for local control cabinets

The LCC's shall be provided with the following features:

- A mimic diagram showing the single line diagram.
- Position indicators, on/off switches for the HV devices and local / off / remote switches shall be installed on or adjacent to the various symbols of the mimic diagram.
- The following devices shall be supplied as a minimum:
 - Circuit breaker control switch with ON – OFF indicating lamps.
 - Circuit breaker “local-remote” selector switch.
 - Disconnect switch, control switch with ON – OFF indicating lamps.
 - Grounding switch, control switch with ON – OFF indicating lamps.
 - Mimic bus including symbols according to the single line diagram.
 - Monitoring control of all high voltage switching devices in a bay.
 - Digital display of current, voltage, active and reactive power, power factor etc. shall be provided by way of MFM
 - Analog voltage meter also shall be provided
- Any interposing relays and control switches associated with the circuit breakers disconnect switches, grounding switches etc.
- The alarm and indication for devices specified **e.g. gas, DC & AC supervision.**
- Fuses and links. These shall be installed in the interior of the LCC's
- Terminal blocks for the terminating and marshalling of auxiliary supply circuits, control, interlocking, and indication & alarm circuits from the GIS and for cable connections to the remote control room or the owner's control system.
- Each LCC shall be furnished with a guarded resistance heater to prevent the internal equipment from humidity deposit. The heater shall be rated 230 V AC and fed through a two pole fused disconnect switch.
- A CFL lamp and a duplex convenience outlet rated 230 V AC, 15 amps with ground fault interrupter shall be installed in each LCC.

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- The Local control cubicle shall be fitted with pre wired interface terminal blocks for connection to user's control & protection panels. The interface includes CT & PT inputs for protection & Measuring system, Protection trip 1 & 2 signals, Aux switch contacts etc.

d. Wiring Requirements

- Each circuit breaker shall have control suitable for operation on 220 VDC with two electrically independent trip circuits.
- The miniature circuit-breakers (MCB) shall be provided for the closing circuit and an independent separate switch fuse unit of suitable rating shall be provided for the primary and back up trip circuits.
- Wiring shall be complete in all respects to ensure proper functioning of the control, protection, and monitoring and interlocking schemes.
- DC circuit for trip coil 1 & 2 shall be wired separately.
- Wiring shall be done with flexible 1100V grade, FRLS, PVC insulated, switchboard wires with minimum 1.5 mm² stranded copper conductor however, based on functional requirement higher size shall be provided.. *The control wire in a grouped environment shall not convey flame, continue to burn.* Wiring between equipment and control cubicle shall be routed through G.I. rigid conduits and shall be done by PVC & screened cable only, *with safety measures to protect operator from touching energized parts.*
- Each wire shall identify at both ends with permanent markers bearing wire numbers as per Contractor's wiring diagram.
- Each termination shall be marked with straight and cross ferrules for identification of circuits as per the approved drawings.
- Wire termination shall be done with crimping type connectors with insulating sleeves. Wires shall not be spliced between terminals.
- All spare contacts of relays, push buttons, auxiliary switches etc. shall be wired up to terminal blocks in the control cubicle.
- Terminal blocks shall be 1100V grade, stud type with engraved numbers suitable for termination of at least two numbers of 2.5 mm² stranded copper conductor. Terminal blocks for CT, PT, auxiliary AC & DC supply shall be disconnecting link type.
- Not more than two wires shall be connected to any terminal. Spare terminals equal in number to 20% active terminals shall be furnished.
- Terminal blocks shall be located to allow easy access. Wiring shall be so arranged that individual wires of an external cable can be connected to consecutive terminals.
- Terminal connectors that carry power supply should be shrouded from adjoining connectors.

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- xiv. Manufacturer shall provide all control wiring and terminations internal to the switchgear, and connecting the switchgear to the bay control cabinets.
- xv. All control cables shall be shielded. Cable shields shall be grounded. Grounding connections shall be as short and direct as possible and shall terminate at the point of entry to cabinets or terminal boxes.
- xvi. Co-axial type cable glands suitable for use with shielded cables shall be used at each termination.
- xvii. All control cables shall be installed and terminated in such a manner as to limit the effects of transient electromagnetic voltages on the control conductors to an acceptable level.
- xviii. Any cabling within GIS shall be supported on cable tray. No cable shall be in hanging position.
- xix. Insulator cones shall be embedded in full return current carrying metal fixing rings in order to avoid mechanical stresses to the cast resin part and to impart full conductivity across the flange connection. Earthing of different gas compartments/enclosures is not allowed with cross bonding with any metal strips.

e. Connections within the GIS and their LCC's

- i. All cable connections between the various GIS modules and the LCC's shall be made by prefabricated multi-core cables with multipoint plug in connections on both the ends. PTs & CTs circuit shall be wired with crimped type copper lugs.
- ii. All cables shall be shielded and adequate for their application (indoor / outdoor). The cables shall be fire retardant low smoke.
- iii. The length and the number of terminal points of control wiring & SF6 gas connections shall be minimized.
- iv. The electrical connections between the various gas sections shall preferably be made by means of multiple contact connectors so that electrical connection is automatically achieved when bolting on section to another. The surface of the connector fingers and conductor tubes on such connections shall be silver plated.

f. Name plate

Name plates of the following types shall be furnished in a convenient central location to provide information for operation and maintenance.

- a. Gas Single Line Diagram showing all HV devices in a single line diagram with the gas sectionalizing of the GIS indicated. Also shown shall be the GIS nomenclature, a legend, Manufacturer's type and serial number and year of manufacture.

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b. GIS Rating / Name plate:

- g. **Manufacturer's name & address, type & designation, Sr. No:**
- h. Maximum ambient temperature, System frequency, Maximum continuous voltage, Maximum continuous current at 40 degC ambient temperature, Basic Impulse Level, Power Frequency one minute voltage, Short circuit current, rms., symmetrical Short time (rms) current & duration, symmetrical Momentary current, peak, Total weight of gas at rated density, Rated gas pressure at 20oC. Opening pressure of the bursting disc, recommended moisture limits of insulation gas (PPMV), Auxiliary voltages, Contract/Purchase Order numbers, and Total weight of the equipment.
- i. Equipment nameplate containing nameplate rating information for all HV modules (like circuit breaker, disconnect switches, current transformer, voltage transformer, surge arrester, etc.) as required in relevant IEC.
- j. Nameplates showing serial numbers and similar data specific to individual components shall be mounted on the components. **Each instrument transformer must have its own rating plate mounted adjacent to each terminal box cover, will all terminal and ratio markings. Each bay auxiliary control cubicle must be identified with its designation to which it is assigned.**

10 INSPECTION AND TESTS

a) **Type Tests:**

Following type test reports, as specified in IEC standard 62271 – 203 & 62271-100 (amended up to date) shall be submitted for the offered type, rating of GIS invariably with the technical bid. The type test reports shall not be older than TEN years and shall be valid up to expiry of validity of offer. The type test must have been carried out at any ISO/IEC accredited laboratories.

Tests to verify the insulation level (Lightning impulse. Switching impulse and ac withstand test with PD) test on each GIS device (CB, Disconnecter, bus, etc).

- i. Dielectric tests on auxiliary circuits.
- ii. Tests to prove the radio interference voltage (RIV) level.
- iii. Tests to prove the temperature rise of any part of the equipment and measurement of the resistance of the main circuit.
- iv. Tests to prove the ability of the main and earthing circuits to carry the rated peak and the rated short time withstand current.
- v. Tests to verify the making and breaking capacity of the included switching devices.
- vi. Tests to prove the satisfactory operation of the included switching devices.
- vii. Tests to prove the strength of enclosures.

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- viii. Verification of the degree of protection of the enclosure.
- ix. Gas tightness tests
- x. Electromagnetic compatibility tests (EMC).
- xi. Additional tests on auxiliary and control circuits.
- xii. Tests on partitions.
- xiii. Tests to prove the satisfactory operation at limit temperatures.
- xiv. Tests to prove performance under thermal cycling and gas tightness tests on insulators.
- xv. Corrosion test on earthing connections (if applicable).
- xvi. Tests to assess the effects of arcing due to an internal fault.
- xvii. Tests on solid dielectric components (operating rods, spacers. etc)
- xviii. Seismic test
- xix. Test on Auxiliary switches (Electrical & Mechanical Endurance, Heat run. IR & HV test)

b) Routine / Acceptance Testing:

During manufacture and on completion, all equipment shall be subjected to the Routine tests as laid down in IEC Standard IEC 62271-203. All the acceptance tests shall be carried out in presence of TPI who may also be accompanied by IOCL representative on offering the material for inspection and testing by successful bidder. Tests shall include the following:

- i. Dielectric test on the main circuit.
- ii. PD test
- iii. Tests on auxiliary and control circuits.
- iv. Measurement of the resistance of the main circuit.
- v. Tightness test.
- vi. Design and visual checks.
- vii. Pressure tests of enclosures.
- viii. Functional tests
- ix. Tests on auxiliary circuits, equipment and interlocks in the control mechanism.
- x. Pressure test on partitions
- xi. ***LCC – Complete functional & interlock test as per approved drawings with LCC duly connected to respective Bay GIS module in all respect.***
 - ***IR test***
 - ***HV test***

c) Site Acceptance Test (After Erection): Test after erection on site (IEC 62271-203, Clause 10.2.101)

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After erection and before putting into service, the gas insulated switchgear shall be tested to check the correct operation and the dielectric strength of the equipment.

- a. Dielectric tests on auxiliary circuits (IEC 62271-203, Clause 10.2.101.2)
To find out possible damages on auxiliary circuits a 2 kV power frequency test will be performed after the erection.
- b. Measurement of the resistance of the main circuit (IEC 62271- 203, Clause 10.2.101.3)
To control the quality of the connected assemblies at site, the resistance of the main circuit will be evaluated by measuring the voltage drop on 100 A DC, normally from bay to bay.
- c. Gas leakage tests (IEC 62271-203, Clause 10.2.101.4)
All sealing locations of the enclosures fitted together at site will be checked with a gas leakage detector.
- d. Checks and verifications (IEC 62271-203, Clause 10.2.101.5)
The following inspections and tests will be carried out:
- e. Switchgear
Conformity of the assembly with the GIS's manufacturer drawings and instructions. Tightness of all bolts including the terminals on the apparatus. Gas density meter's operating points and gas pressure. Proper function of the mechanical interlocking system (if applicable)
- f. Control cubicle (local control)
Conformity of the wiring with the diagrams. Correct functioning of all apparatus, operating mechanisms, auxiliary contacts and the local control. Correct functioning of the alarm announcements through to the customer's terminals in the local control cubicles.
- g. Control of the auxiliary voltage input (AC and DC)
Control of the cables to be delivered by according to the respective list of cables issued by GIS manufacturer.
- h. Proper function of the electrical interlocking system

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- i. Proper function of the heating and lighting
- j. Tightness of all bolts on the terminals and on the apparatus in the control cubicles

Additional inspections

Final testing of the current transformers on site according to IEC 60044 1 (for example accuracy test, Clause 11.5) Final testing of the voltage transformers on site according to IEC 60044-2 (for example accuracy test, Clause 12.4)

- k. Measurement of moisture (IEC 62271-203, Clause 10.2.101.6)

The moisture content of the insulating gas will be determined for each gas compartment. The maximum limit permitted by the GIS manufacturer shall not be exceed.

- l. High Voltage tests after erection on site (IEC 62271-203, Clause 10.2.101.1)

The dielectric strength of the completely erected switchgear will be tested according to IEC 62271-203, clause 10.2.101.1.4, table 107 in order to locate hidden defects such as wrong fastening, damages during handling, transportation, storage and erection or the presence of foreign particles etc.

11 DRAWINGS, DATA & MANUALS:

The LSTK contractor shall submit the documents for owner's approval post endorsement of the documents by listed agencies/consultancy firm as detailed in clause 10.6 of Section-1 Chapter-1.

Sr No	Description with bids	With Bids	Post order		Final documents with equipments	
			For review	For records	soft copy	Prints
1	Schedule of Vendor Documents			x		
2	Data sheets (Duly filled - in)	x			x	x

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3	Dimensional / Assembly Drawings		x			
	a. GA drawings (Elevation and Plan) of switchboard including clearance requirements	x	x		x	x
	b. Installation Plan including foundation, cut-out and mounting details.	x	x	x	x	x
	c. Earth Mat Design		x	x		
	d. Gas Schematic Diagram and Gas system installation procedures, gas handling procedures.		x		x	x
	e. Bus Duct Termination Drawing		x			x
	f. Cubicle Arrangement Drawing		x	x		x
	g. Component Drawing		x	x		x
	h. Name plate Drawing		x	x		x
	I. Arrangement of cable termination		x			x
4	Electrical Wiring Drawings					
	a. Single Line diagram		x		x	x
	b. Control Schematic		x	x	x	x
	c. Wiring Diagram and Terminal Details		x	x	x	x
	d. Inter-panel Wiring Diagram		x	x	x	x

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5	Panel Schedule & Bill Of Material		x	x		x
6	Calculations		x			x
6.1	Bus-bar sizing Calculation		x			x
6.2	Calculation of CT/PT burden, Vk, Im, RCT etc for class PS CTs		x			x
7	Protection philosophy		x	x		x
8	Relay Characteristics Curve			x		x
9	Auxiliary Power Requirement data(AC&DC)		x	x		x
10	QA plan of Vendor		x			x
11	Inspection Plan and testing procedure (For review by inspection)		x			x
12	Test Records			x		x
13	Type Test Certificate (For Panel ,Breaker & Bus ducts)	x		x		x
14	List of Commissioning spares	x				
15	List of Maintenance Spares	x				x
16	List Of special Tools & Tackles	x				x
17	Data Book/ Manual					
	a. Installation manual			x		x
	b. Operating/Maintenance manual					
	c. Catalogues/ Brochures			x		x

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18	Filled-in check -list(technical)	x				
19	Equipment storage procedure at site including environmental guide for handling SF6 gas & decommissioning.		x		x	x

Note:

- Drawings, Data and Manuals shall be submitted in triplicate to IOCL for approval during engineering and in quantities and procedures as specified in General Conditions on Contract and/or elsewhere in this specification for approval and subsequent distribution after the issue of Letter of Intent.
- The bidder shall note that the approval of drawings & documents by the Owner does not relieve him of his contractual obligation.
- The bidder may note that the drawings, data and manuals listed herein are minimum required only. The bidder shall ensure that all other necessary write-up, curves, etc require to fully describe the equipment are to be submitted with the bid.
- All drawings shall be prepared by using AutoCAD and documents shall be generated using Electronic version. The paper copy of the drawings & document shall be submitted for approval & reference. All final drawings and documents shall be submitted in CD in AutoCAD 2010 and MS office format as applicable for Owner's future reference. Also AutoCAD version of Main GA drawings is to be submitted for Owner's layout finalization.

12 MAINTENANCE:

The operational integrity of the GIS switchgear shall not subject to external influences, such as pollution, moisture, dust etc. As a consequence of this GIS switchgear should be practically maintenance free; however, the details of inspection required at regular interval shall be indicated in the operation and maintenance manual.

Visual inspection shall be required not below 2 (two) years interval.

Inspection shall not be required often than every 10 years. During inspection it must not be necessary to open the switchgear enclosures for interrupt operation of substation.

Provision of functional testing of the close and trip coils, auxiliary switches, pressure and control switches etc. shall be provided.

Following minimum maintenance period shall be accepted.

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- i. Circuit breaker: 5000 closing and opening or 20 interruption at max rated current
- ii. Dis-connector: 5000 closing and opening operations.
- iii. Fast acting earth switch: 2000 closing and opening operations or 2 making operations on to max rated fault current.

The bidder shall provide the services of experienced persons, supervisors, engineers, experts, etc., for complete specified work for satisfactory operation. Successful bidder shall depute OEM expert to site annually for the period of FIVE years from date of commissioning, to inspect GIS for carrying out status evaluation of GIS performance. This is intended to share the operational challenges and confirm the maintenances followed by IOCL.

The bidder shall have dedicated localized after sales & service team which should be capable any activity to operate complete GIS satisfactorily.

13 TRAINING:

Training to Ten (10) persons of IOCL on construction, installation, commissioning and O&M shall be imparted by bidder free of cost. Duration of the complete training shall be 7 working days, covering minimum below specified curriculum. Any other specific area may be brought to notice and included.

1. General Explanation for GIS
2. Layout and Architecture of GIS
3. Gas Sectionalisation of GIS
4. Construction of CB
5. Operating Mechanism of CB
6. Maintenance of CB
7. Overhaul of CB (Interrupting chamber)
8. Overhaul of CB (Operating Unit)
9. Construction of DS/ES
10. Maintenance of DS/ES
11. Overhaul of DS/ ES
12. Construction of Bus/ Cable head/ SF6 – air bushing
13. Maintenance of Bus/ Cable head/ SF6 – air bushing
14. Overhaul of Bus/ Cable head
15. Overhaul of various transformer connections
16. Operation of GIS with SCADA
17. Construction & Maintenance of Lightning Arrester
18. Construction & Maintenance of VT/CT
19. Construction & Maintenance of Local control panel
20. Erection of GIS at site.

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21. Installation & Testing of GIS at site
22. Type tests of GIS
23. Routine tests of GIS.
24. Faults simulation of GIS
25. Localization of GIS fault.

Bidder shall at his cost arrange for the above training facilities and in addition shall bear all living expenses plus inland travel expenses of all the trainees. The Purchaser shall only pay to and fro passage of the trainees.

14 PACKING, SHIPMENT, STORAGE AND INSTALLATION:

All equipments shall be suitably packed and protected during shipment/transportation. Each shipping unit shall be sealed in a clean dry condition with leak-tight shipping covers securely mounted for shipment. All covers to be removed during installation shall be clearly marked. Each shipping section shall be carefully sealed and filled with dry gas to a slightly positive pressure to prevent the entrance of moisture and contamination.

The packing method for the GIS equipment shall be standard and it shall be guaranteed that each component of the equipment will not be damaged, deformed or lost. The storage instructions shall be submitted by bidder for long term storage. Component requiring indoor storage shall be so identified.

Gas insulated switchgear (GIS) shall be properly packed to protect during ocean shipment, inland transport, carriage at site and outdoor storage during transit and at the site. Completely assembled bays (subject to transport limitations) of the GIS shall be transported as one shipment unit.

Packing materials shall be dust and waterproof. All packages shall be clearly, legibly and durably marked with uniform block letters on at least three sides. Fragile items like bushings, CTs, VTs, LAs and fully assembled bays shall be securely packaged and shipped in containers. Silica gel or approved equivalent moisture absorbing material in small cotton bags shall be placed and tied at various points on the equipment wherever necessary.

As far as possible, transshipment should be avoided.

Impact recorders (Accelerometers) shall be provided on the packages to confirm that GIS has not suffered any shocks during shipment, transport, handling, etc. The impact recorder readings are to be noted on receipt of equipment at site and reported to user & manufacturer, in case the readings are exceeding the permissible values. It shall be at discretion of user to accept or reject the same.

All the equipment shall be carefully packed for transport by road in such a manner that it is protected against the climatic conditions and the variations in such conditions that will be encountered enroute from the GIS's manufacturer works to the site.

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The SF6 metal clad equipment shall be shipped in the largest factory assembled units that the transport and loading limitations and handling facilities on site will allow to reduce the erection and installation work on site to a minimum.

Where possible all items of equipment or factory assembled units shall be boxed in substantial crates or containers to facilitate handling in a safe and secure manner. Should the units be considered too large for packing in crates, they shall be suitably lagged and protected to prevent damage to any part, particularly small projections, during transport and handling. Special lugs or protective supports shall be provided for lifting to prevent slings and other lifting equipment from causing damage. Each crate, container or shipping unit shall be marked clearly on the outside to show where the weight is bearing and the correct position for the slings.

Each individual piece to be shipped, whether crate, container or large unit, shall be marked with a notation of the part or parts contained therein.

Special precautions shall be taken to protect any parts containing electrical insulation against the ingress of moisture. This applies particularly to the metalclad equipment of which each gas section shall be sealed and pressurized prior to shipping. Either dry nitrogen or dry SF6 gas shall be used and the pressure shall be such as to ensure that, allowing for reasonable leakage, it will always be greater than the atmospheric pressure for all variations in ambient temperature and the atmospheric pressure encountered during shipment to site and calculating the pressure to which the sections shall be filled to ensure positive pressure at all times during shipment. The type of gas, the maximum pressure to which sections will be filled prior to shipment and the minimum allowable pressure during shipment shall be advised prior to dispatch.

All blanking plates, caps, seals, etc., necessary for sealing the gas sections during shipment to site shall be provided as part of the contract and shall remain the property of Owner. If considered necessary, blanking plates or other sealing devices shall be provided with facilities for measuring the gas pressure and recharging at any time during the transport period. Any seals, gaskets, 'O' rings, etc. that may be used as part of the arrangement for sealing off gas sections for shipment of site, shall not be used in the final installation of the equipment at site. Identification serial numbers shall be stamped into the blanking plates, etc., and on the switchgear equipment to which they are fitted so that they can easily be identified and refitted should it ever be necessary to ship sections of the switchgear back to the GIS's manufacturer works for repair.

Valves and other gas couplings associated with the switchgear gas systems shall be adequately protected against damage from any bumps or physical blows. They shall also

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be capped to prevent ingress of dirt or moisture or damage to any coupling, pipes, threads or special fittings. Any explosion vents and other pressure relief devices, shall be suitably sealed and protected to prevent accidental exposure of the sealed sections during shipment to site.

For bus ducts involving male and female joints of the current carrying conductor, the same shall be transported in disassembled condition to avoid any damage during transit. All bright parts liable to rust shall receive a coat of anti rusting composition and shall be suitably protected.

15 QUALITY ASSURANCE

Superior quality control system shall be adopted to assure high product quality.

Raw materials of the best commercial grade quality and high reliability shall be used in the manufacture of GIS. High reliability of materials shall be ensured so as to keep maintenance work to a minimum.

A quality assurance plan for major components such as breakers, disconnecting switches, lightning arrestors, earth switches, etc. with in-process inspection methods, tests, records, etc. shall be submitted during the drawing approval stage. Customer hold points will also be included in the plan, which shall be mutually agreed by the PURCHASER and MANUFACTURER, and approved.

16 MANDATORY SPARE FOR GIS SYSTEM :

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Annexure-I

**17 SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS
FOR GAS INSULATED SUBSTATION**

Sr No		Particulars to be filled by Bidder
1.	General	
2.	Name of manufacturer (OEM)	
3.	Country of Origin	
4.	Delivery from (location)	
5.	Type & Designation	
6.	Type tested at Name of Laboratory	
	Address of laboratory	
7.	Installation	
8.	Standards applicable	
9.	No. of Phases	
10.	Single or Three Phase design	
11.	Configuration	
i)	Number of Feeder bays	
ii)	Number of transformer bays	
iii)	Number of Bus coupler bay	
iv)	iv GIS to transformer connection	
v)	v GIS to Feeder connection	
vi)	vi Number of VT	
vii)	vii Number of SA	
	Future extension possibility	
12.	Service conditions	
i)	Ambient Air Temp. in Deg. C	
ii)	Max Temp. in Deg. C	
iii)	Min Temp. in Deg. C	
iv)	Daily Average Temp. in Deg. C	
v)	Solar Radiation W/sq mtr	
vi)	Altitude above MSL, in mtr	
vii)	Pollution class	
viii)	Creepage distance, in mm/kV	
ix)	Relative humidity	
x)	Condensation	
xi)	Vibration level	
xii)	Noise level	
xiii)	Induced Electromagnetic Disturbance, in kV	

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xiv)	Seismic conditions	
a	Vertical	
b	Horizontal	
13.	Enclosure	
i)	Code of pressure vessel	
ii)	Type of manufacturing	
iii)	Design temperature in Deg.C	
iv)	Material	
v)	Material grade & applicable standard	
vi)	Outside diameter in mm	
vii)	Minimum Wall Thickness, in mm	
viii)	Painting Shade & Thickness	
a	External	
b	Internal	
ix)	Degree of Protection	
x)	Inductance in H/mt	
xi)	Capacitance in pF/mt	
xii)	Resistance in Ohm/mt	
xiii)	Expansion Bellow	
a	Material	
b	Min allowable adjustable displacement	
	Longitudinal	
	Transverse	
xiv)	xiv Sealing system	
a	Type	
xv)	Estimated life in years	
xvi)	Barrier	
a	Material	
b	Dielectric strength	
14.	Support Structure	
	Material	
	Minimum thickness of galvanizing	
	Foundation channels /Anchor bolts	
15.	Grounding	
i)	Grounding Material	
ii)	Grounding of complete GIS	
iii)	Grounding of individual compartment	
iv)	Grounding at flange joints	
16.	System Parameters 220 kV	

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i)	Highest System voltage in kV	
ii)	Rated voltage of System in kV	
iii)	Rated voltage of Equipment in kV	
iv)	Rated Insulation level Phase to Earth and between Phases	
a	One Min Power Frequency withstand voltage kVrms	
b	Switching impulse withstand voltage, kVp	
	- Phase to Earth	
	- Between Phases	
c	Lightning Impulse withstand voltage, kVp	
v)	Rated Frequency	
vi)	Rated current in Amp	
vii)	Rated current at 50 °C (equipment) in Amp	
viii)	Rated current at 50 °C (bus bar) in Amp	
ix)	Rated short circuit withstand current kArms	
a	Duration in sec	
B	Peak kAp	
x)	Enclosure withstand time for an internal fault in sec.	
xi)	Estimated total energy loss at	
	100 % of rated capacity	
	75 % of rated capacity	
	50 % of rated capacity	
	25 % of rated capacity	
xii)	Measures taken to minimize Over Voltage	
xiii)	Phase labeling	
xiv)	Auxiliary supply (AC Voltage, Frequency: DC voltage)	
	- Operation	
	- Control	
	- Illumination & heater	
17.	Delivery conditions	
i)	Bays fully assembled at works	

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ii)	Dimensions of longest section for transportation	
iii)	Weight of heaviest package	
iv)	Pressure of SF6 gas during transportation	
v)	SF6 gas monitoring system provided during transportation	
18.	Bus Bar 220 kV	
i)	Configuration (Single / Double)	
ii)	Nos of Phases	
iii)	Material	
iv)	Size	
v)	Rating	
vi)	Current density adopted	
vii)	Current density as per type test report	
viii)	Short time current withstand rating in kA	
ix)	Duration	
x)	Resistance per phase	
xi)	Surge impedance	
xii)	SF6 immersed insulator	
a	Material	
b	Dielectric strength	
xiv)	Maximum Partial Discharges measured at HSV	
19.	19 SF6 Gas	
i)	Applicable standard	
ii)	Quantity of SF6 Gas of complete GIS at filling pressure, in kg	
iii)	Quantity of SF6 Gas of largest compartment GIS at filling pressure, in kg	
iv)	No's of Gas compartments	
v)	Quantity of SF6 Gas of individual compartment GIS at filling pressure, in kg	
vi)	Maximum permissible dew point, in Deg.C	
vii)	Composition of Gas	
a	SF6 > 99.90 % by weight	

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b	Air < 500 ppm by weight (0.25 vol.-%)	
c	CF ₄ < 500 ppm by weight (0.1 vol.-%)	
d	H ₂ O < 15 ppm by weight (0.012 Vol.-%)	
e	Mineral oil < 10 ppm by weight	
f	Acidity, in terms of HF < 0.3 ppm by weight	
g	Hydrolysable fluorides, in terms of HF < 1 ppm by weight	
vii)	PRESSURE in MPa in kG/sqcm	
viii)	Design pressure	
a	a Circuit breaker	
b	b Other compartments	
ix)	ix Rated filling pressure	
a	a Circuit breaker	
b	b Other compartments	
x)	x Type tested pressure.	
a	a Circuit breaker	
b	b Other compartments	
xi)	xi Routine test pressure	
a	a Circuit breaker	
b	b Other compartments	
xii)	xii Operating pressure of PRD	
a	a Circuit breaker	
b	b Other compartments	
xiii)	xiii Alarm Pressure	
a	a Circuit breaker	
b	b Other compartments	
c	c CB lock out Pressure	
d	d Over pressure signaling	
xiv)	xiv Maximum SF ₆ Gas leakage rate, in % per year	
xv	xv	
	Density Monitor to be provided for each	
	Individual gas compartment.	
20.	20 Circuit Breaker 220kV	
i. i	Applicable standard	

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	)		
ii.	i i)	Type	
iii.	i i i)	Designation	
iv.	i v)	Operating Mechanism type	
v.	v)	Nos. of phases	
vi.	v i)	Rated current in Amp	
vii.	v i i)	Mechanical Endurance class	
viii.	v i i i)	Electrical Endurance class	
ix.	i x)	Re-strike probability class	
x.	x)	Rated SC breaking current	
xi.	x i)	Rated SC breaking current - single phase test	
xii.	x i i)	Rated Line charging breaking current	
xiii.	x i i i	Rated Cable charging breaking current	

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xiv.	Capacitor bank switching capability,	
xv.	Inductive current	
xvi.	Reactive current	
xvii.	Out of phase making & breaking current	
xviii.	Rated short line fault current	
xix.	TRV characteristic	
xx.	First Pole to Clear factor	
xxi.	Nos. of interrupters per phase	
xxii.	Type of arc control device provided, if any	
xxiii.	Type of arcing contacts	
xxiv.	Material of main contact	
xxv.	Material of Arcing contacts	
xxvi.	Filter material	
xxvii.	Timings of operations	
a	Opening at nominal control voltage	
	Opening at minimum control voltage	
b	Closing time at nominal control voltage	
xxviii.	Maximum pole discrepancy time	
	Tripping	
	Closing	
xxix.	Rated operating duty cycle	
xxx.	Tripping Coils	
-	No of coils	
-	Rated Voltage	
-	Rated Current	
-	Rated Watts	
-	Resistance	
xxxi.	Closing Coil	
-	Rated Voltage	
-	Rated Current	

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-	Rated Watts	
-	Resistance	
xxxii.	Spring Charging Motor	
-	Rated Voltage	
-	Rated Current	
-	Rated Watts	
xxxiii.	xxxiii Spring charging time at rated Aux supply	
xxxiv.	xxxiv Spring charging time at min Aux supply	
xxxv.	Maintenance required after nos. of operation at	
a	No load	
b	Rated current	
c	25% of rated SC current	
d	50% rated SC current	
e	Rated SC current	
f	Provision of anti pumping	
g	No of operations after switching off of motor	
	Aux. supply	
xxxvi.	Provision of Manual trip	
xxxvii.	Electrical interlocking	
xxxviii.	Padlocking	
xxxix.	Type of Operation counter provided	
21.	DISCONNECTORS 220kV	
i	i Applicable standards	
ii)	Type	
iii)	Rated current in Amp for	
-	Bus disconnecter	
-	Line disconnecter	
-	Transformer disconnecter	
-	PT disconnecter	
iv)	Maximum Current that can be safely Interrupted by the Isolator (Amp).	
-	Inductive	
-	Capacitive	
v)	Rate Short time withstand Current in kA, for 3 sec	

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vi)	Rated peak short time Current, kAp	
vii)	Rated bus charging current, in Amp	
viii)	Type of contacts	
ix)	Material of contacts	
x)	Current Density at minimum cross section	
xi)	Rated lightning impulse withstand voltage	
	across the open gap, kVp	
xii)	Rated Power Freq withstand voltage across	
	the open gap, kVrms	
xiii)	Mechanical Endurance class	
xiv)	Type of Operating Mechanism	
xv)	Operating Motor details	
-	Type	
-	Rated Voltage	
-	Rated Current	
-	Rated Watts	
xvi)	Operating Time	
-	Closing	
-	Opening	
xvii)	Mechanical indication on drive shaft	
22.	Maintenance Grounding Switch	
	220kV	
i)	Applicable standards	
ii)	Type	
iii)	Rate Short time withstand Current in kA, for 3 sec	
iv)	Rated peak short time Current, kAp	
v)	Rated lightning impulse withstand voltage	
	across the open gap, kVp	
vi)	Rated Power Freq withstand voltage across	
	the open gap, kVrms	
vii)	Type of Operating Mechanism	
viii)	Operating Motor details	
-	Type	
-	Rated Voltage	

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-	Rated Current	
-	Rated Watts	
ix)	Operating Time	
X	Mechanical indication on drive shaft	
23.	23 Fast Acting Grounding Switch 220kV	
i)	Applicable standards	
ii)	Type	
iii)	Rate Short time withstand Current in kA, for 3 sec	
iv)	Rated peak short time Current, kAp	
v)	Rated induced current switching capability	
vi)	Rated capacitive current switching capability	
vii)	Rated lightning impulse withstand voltage across the open gap, kVp	
viii)	Rated Power Freq withstand voltage across the open gap, kVrms	
ix)	Electrical Endurance class	
x)	Type of Operating Mechanism	
xi)	Operating Motor details	
-	- Type	
-	- Rated Voltage	
-	- Rated Current	
-	- Rated Watts	
xii)	xi Operating Time	
-	- Closing	
-	- Opening	
xiii)	xii Mechanical indication on drive shaft	
24.	Current transformers 400 kV 220 kV 132 kV 66 kV	
i)	Type	
ii)	Material	
iii)	Position of Current Transformer	
iv)	Reference Standard	
v)	Rated Continuous thermal current	
vi)	Rated Short Time current	
vii)	Duration	

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a	Feeder Bay CT	
I	Metering Core	
-	Ratio	
-	Output Burden	
-	Accuracy Class	
-	ISF	
II	Protection Core -1	
-	Ratio	
-	Output Burden	
-	Accuracy Class	
-	ALF	
III	Protection Core -2	
-	Ratio	
-	Output Burden	
-	Accuracy Class	
-	ALF	
b	Transformer Bay CT	
I	Metering Core	
-	Ratio	
-	Output Burden	
-	Accuracy Class	
-	ISF	
II	Protection Core	
-	Ratio	
-	Output Burden	
-	Accuracy Class	
-	ALF	
III	Protection Core -2	
-	Ratio	
-	Accuracy Class	
-	Minimum Knee Point Voltage at highest ratio	
-	Maximum Excitation Current at V_k	
-	Maximum Resistance at highest ratio	
IV	Protection Core -3	
-	Ratio	
-	Accuracy Class	
-	Minimum Knee Point Voltage at highest	

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	ratio	
-	Maximum Excitation Current at V _k	
-	Maximum Resistance at highest ratio	
c	Bus Coupler Bay CT 220kV	
I	Metering Core	
-	Ratio	
-	Output Burden	
-	Accuracy Class	
-	ISF	
II	Protection Core -I	
-	Ratio	
-	Burden	
-	Accuracy Class	
-	ALF	
III	Protection Core -2	
-	Ratio	
-	Burden	
-	Accuracy Class	
-	ALF	
25.	Voltage Transformer 220kV	
	Type	
	Position of Voltage Transformer	
	Reference Standard	
	Rated Over Voltage Factor - Continuous	
	Short Time Over Voltage Factor	
	Duration	
	Partial Discharge Level	
	Thermal Rating of Primary Winding	
26.	Line & Bus VT 220kV	
I	Metering Core	
-	Ratio	
-	Output Burden	
-	Accuracy Class	
II	Protection Core -I	
-	Ratio	
-	Output Burden	
-	Accuracy Class	
III	Protection Core -2	

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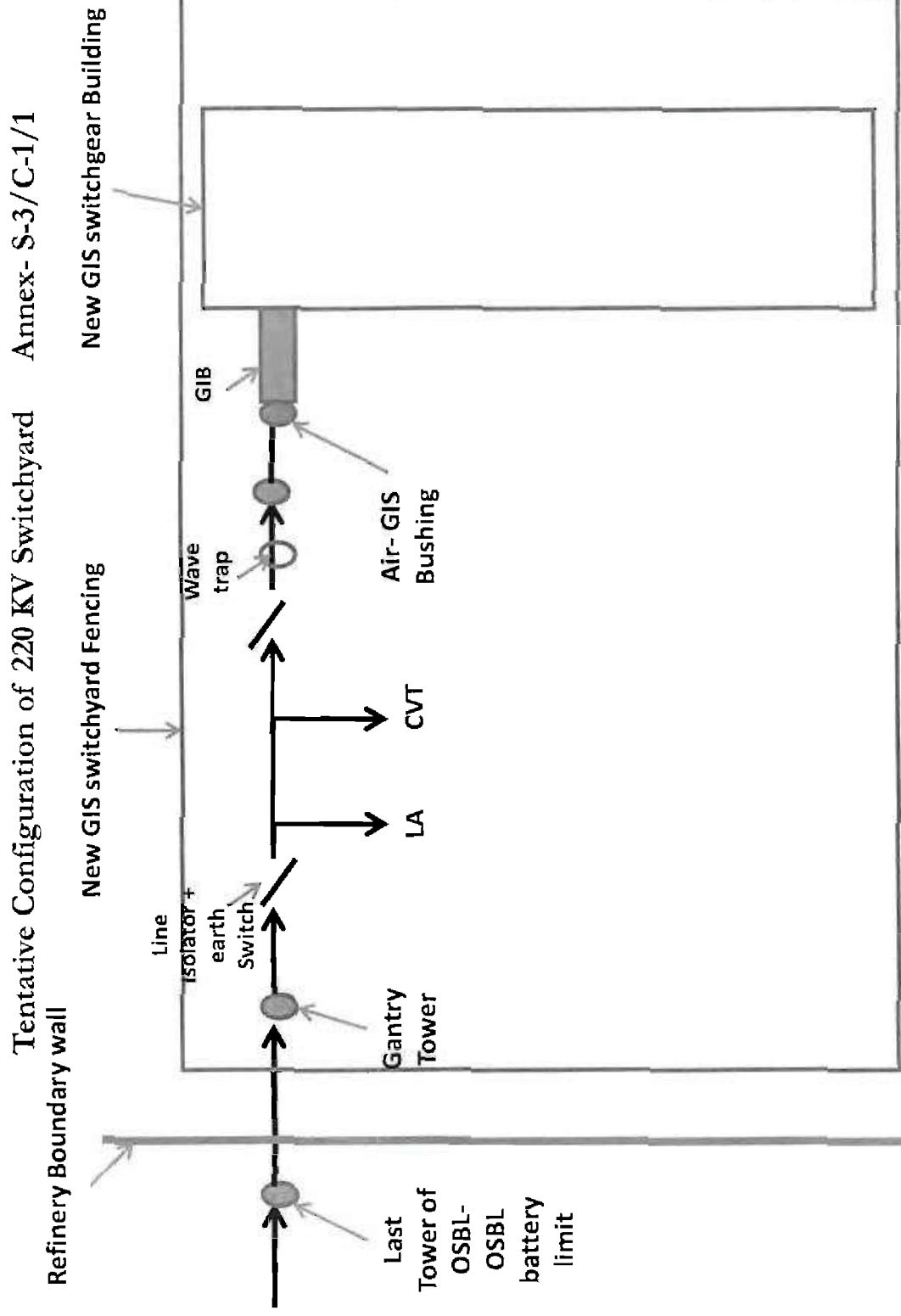
-	Ratio	
-	Output Burden	
-	Accuracy Class	
27.	Enclosed Surge Arrester 220kV GIS	
i)	Name of Manufacturer	
ii)	Arrester Class & Type (with mfr type designation)	
iii)	Applicable Standard	
iv)	Rated system voltage (kV)	
v)	Rated Arrester Voltage (kV)	
vi)	Max continuous operating voltage (MCOV) –(kV)	
vii)	Nominal Discharge Current (KA) with 8/20 Micro-second wave	
viii)	Max resistive component of cont. current at MCOV-mA crest	
ix)	Max capacitive component of cont current at MCOV -mA crest	
x)	Long Duration Discharge Class	
xi)	Min. Energy Discharge Capability (KJ/KV rating)	
xii)	Max. switching current impulse residual voltage (KVP)	
-	1000 Amps	
-	250 Amps	
xiii)	Pressure Relief Class KA (rms)	
xiv)	High Current short duration impulse withstand level with 4/10 micro-second wave (KA) peak	
xv)	Over –voltage withstand capability – KV	
A	100 Seconds	
B	10 Second	
C	1.0 Second	
D	0.1 Second	
E	Reference Voltage (KV)	
F	Reference Current (KA)	
xvi)	xv Surge counter	
xvii)	xvi Leakage monitor	
28.	Local Control Cubical 220 kV	

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i)	Name of Manufacturer (OEM of GIS)	
ii)	Location in GIS	
iii)	Material	
iv)	Sheet Thickness	
v)	Degree of Protection	
vi)	Padlocking arrangement	
vii)	Major components of LCC	
-	Bay control mimic diagram	
-	Control Switches	
-	Indicating lamps	
-	Position indicators	
-	Annunciation scheme	
-	Auxiliary relays	
-	Contact multiplication relays	
-	System parameters display	
-	Heater with thermostat	
-	Interface terminal blocks for relaying & protection	
29.	Line to GIS connection 220 kV	
i)	Nos of XLPE cable can be terminated	
ii)	Type of cable termination required	
30.	GIS to Transformer connection 220 kV	
i)	Nos of XLPE cable can be terminated	
ii)	Type of cable termination required	
31.	Maintenance	
i)	Maximum down time for replacement or removal of any part	
ii)	Maximum down time for degassing and refilling the biggest compartment	
iii)	Time between two refilling of SF6 gas.	
iv)	Recommended period for overhauling	
v)	Operation and Maintenance manual attached	
vi)	Nearest local service centre	
vii)	Minimum time of availability of local service	
viii)	Availability of spares at local service centre	

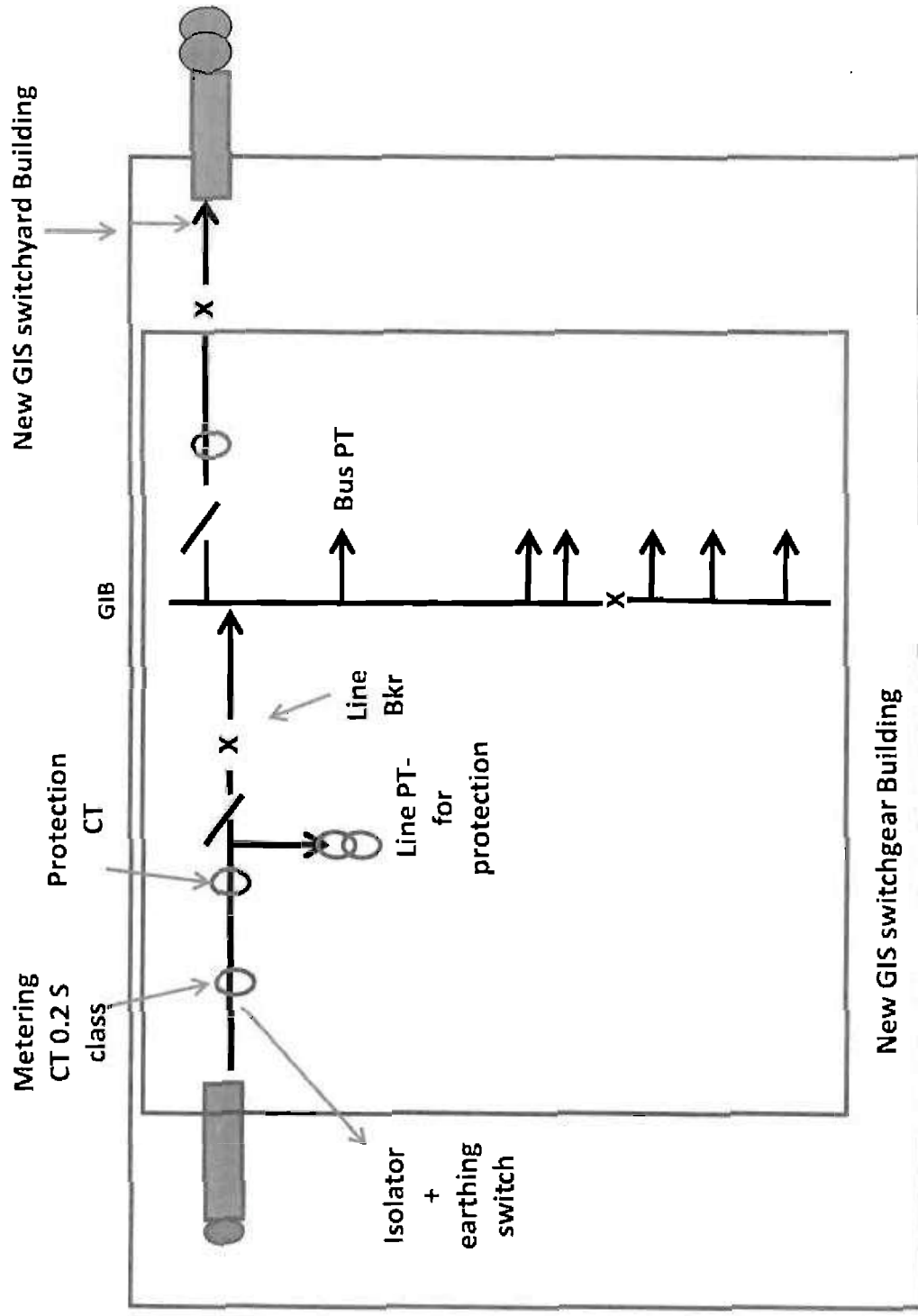
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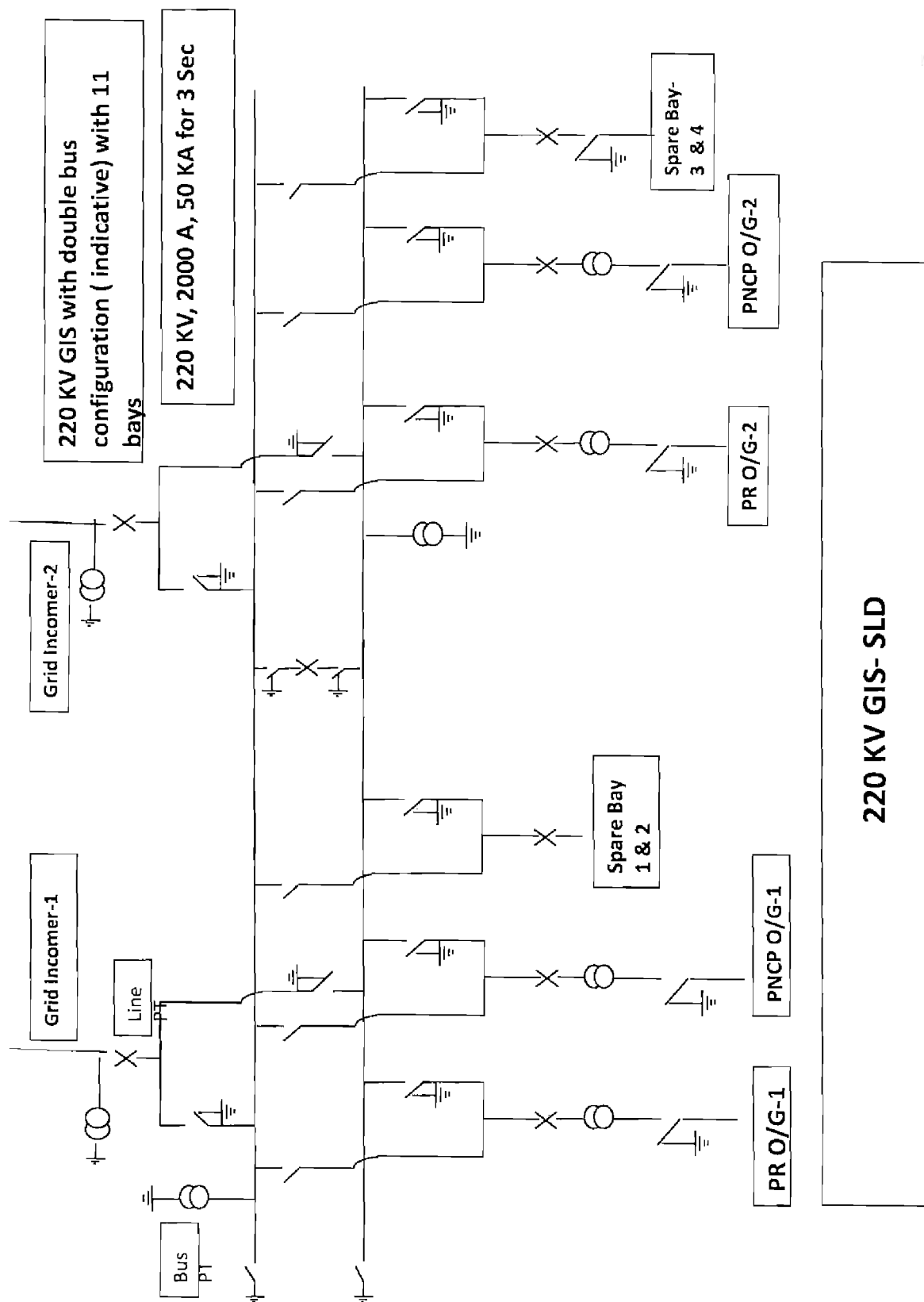
ix)	List of recommended spares attached?	
x)	List of recommended special tools, etc. attached?	
xi)	List of commission spares attached?	
xii)	List of maintenance spares attached?	



Note: GELO preparation as per HVPNL guidelines, its approval from HVPNL and design, supply installation and commissioning accordingly is in the scope LSTK contractor.

Tentative Configuration of 220 KV GIS Substation





HARYANA VIDYUT PRASARAN NIGAM LIMITED

GUIDELINES FOR INSTALLATION OF METERING EQUIPMENTS AND ARRANGEMENTS AT THE PREMISES OF OPEN ACCESS CUSTOMERS.

The following guidelines are to be strictly implemented for installation of Interface metering equipments including ABT compliant special energy meters (SEM) of accuracy class 0.2S and connecting arrangements for metering of open access customers. The location of interface meter shall be at the outgoing feeder (for generator) & at the transmission licensee's sub-station or as agreed with the transmission licensee/distribution licensee. The interface meters conforms to the standards on "Installation and Operation of Meters" and as amended from time to time. The supplier or buyer in whose premises the interface meters are installed shall be responsible for their safety.

- i) Open Access Customers injecting power in to HVPNL/DISCOM system shall provide separate line bay with line protection scheme at both ends to take care of any fault on line. At Sub Station end Supply should not be tapped from Bus PT. Exclusive line CTs and PTs are to be installed for at Sub Station end. The Meters are to be installed near line bay in Sub Station Yard
- ii) Meters are to be installed directly on line without any isolator in between line and metering CTs/PTs.
- iii) Metering CTs/PTs should be exclusively for interface metering. Customers may install any additional meter with separate CT/PT for their reference.
- iv) Customers who have interconnection with Inter- State Transmission System or Intra- State Transmission System / Distribution System and have been permitted Open Access shall be provided with interface meters.
- v) The scheme for location of meters shall be submitted to HVPNL or licensee by consumer in advance before installation of the Scheme.
- vi) The meter should be installed nearest to the CT/PT to reduce the potential drop in the secondary circuit with easy/ free access by HVPNL/DISCOM staff for installation, testing, commissioning reading and recording and maintenance of meters. The place of installation of meter shall be such that minimum inconvenience and disruptions are caused to the site owners and the concerned organisation.
- vii) HVPNL/Licensee shall examine, test before installation and only correct meter shall be installed.
- viii) Meter is not to be installed in the control room of consumer's substation.
- ix) The operation, testing and maintenance of meter shall be carried out by the licensee.
- xi) Unique identification code of meter:- Every meter shall have a unique identification code, which shall be marked permanently on the front as well as in its memory. The series of unique identification code of meter shall be provided by HVPNL before installation & testing.
- xii) The calendar & clock of meter shall be correctly set at the manufacture's work.
- xiii) Microprocessor based 3 phase 4 wire meter (Model-A) shall conform to accuracy class 0.2S as per IS 14697 or IEC-62053-22 & HVPNL technical specification No HPD/S-72/HPM-461/Vol-II/Prot (Jan 2012) or amended. The meter is suitable for being connected through TTB to VT having secondary line to line voltage of 110V & to CT having a rated secondary current of 1A.
- xiv) Polarity:- As per HVPNL Technical specification.
- xv) The output data of ABT Compliant Special Energy Meters should be in ASCII as well as Excel format. The Base Computer software (BCS) may be got installed at Energy Centre, HVPNL, Sector-6, Panchkula, at respective sub-station & consumer PC. Suitable MRI be also procured.
- xvi) The meter shall be identical in all respect except for their unique identification codes. They shall also be totally sealed and tamper proof, with no possibility of adjustment at site except for a restricted clock correction.

- xvii) Each meter shall have a test output device (visual) for checking the accuracy of active energy and reactive energy (VARh) measurement using a suitable test equipment. The test output shall be software configurable for active energy import/ export & reactive energy import/ export.
 - xviii) All the CT/PT used in conjunction with metering shall also be of accuracy class not inferior to meter & conform to the relevant IEC/ IS & HVPNL/Discom specifications. The rating shall take into account the burdens imposed by lead wires and metering. The existing Consumers who have installed CT of 0.2 Accuracy class shall replaced the same with 0.2S accuracy class with in 60 day.
 - iv) CTs of 0.2S with CT output is 1A . However PTs of accuracy class 0.2 of secondary line to line voltage of 110 V shall be use.
 - v) Metering CT/PT should be exclusive for metering purpose. These will not be allowed for protection purpose. The main meter & check meter shall be connected to the same core of CTs and VTs
 - vii) All connecting cables from CT/PT of 4C²x4 mm² to meters should be routed 2.5'dia HDD PVC pipe .
 - viii) Un-climbable fencing around metering, CT, PT area is to be provided which will be sealed by DISCOM/HVPNL as the case may be.
 - ix) Use of only single ratio metering CTs will be allowed. Multi ratio CTs are not to be used in any case.
 - x) Metering CTs/PTs, bottom plate needs to be welded after testing/installation at site.
 - xi) Open access customer (non-consumer of DISCOM) is required to provide communication channels at his own cost for communication of metering data to HVPNL if required so.
 - xii) Consumers who have already installed CT/PT without witness/checking of DISCOM/HVPNL shall get the same tested in the presence of DISCOM/HVPNL representative. The CT/PT may be got tested from NABL accredited lab.
 - xv) Data shall be collected from both the main and check metering schemes.
 - xvi) The meter shall operate with the power from the VT secondary circuits, without the need for any auxiliary power supply. The total burden imposed by a meter for measurement and operation shall not exceed 10 VA on any of the phase.
 - xvii) Inspection & testing:- The meter shall be fully type tested as per IS 14697 or IEC 62053-xviii). All routine test as per IS shall be carried out by manufacturer on the meters . The Type & Routine test report of Meter & CT/PT as per ISS or IEC shall be submitted by Open Access Customers after taking it from Manufacturer before deputing representative for witnessing site testing/witnessing test as per ISS/technical specification. The HVPNL shall ensure that all type, routine, & Acceptance test are carried out by the manufacturer on metering equipment as per ISS/IEC.
 - xix) At the time of commissioning, meter Testing & Commissioning of interface meters may be carried out in the presence of the representative of the parties at site.
 - xix) Sealing of meter shall be done at following points:-All meter shall be sealed by the manufacturer at its work, in addition to seal provided by the manufacturer at its work, the sealing of all meters shall be done as at following sealing points:- a) TTB- each Meter test terminal Block shall have the provision for two seal b) Meter body or cover c) meter terminal cover / meter terminal Block including each optical communication port.d) Meter cabinet. Suitable sealing of CT/PT may also be provided to ensure no tampering to made .Sealing of interface meters, shall be done by both the supplier & buyer.
- Meter reading & Recording:- HVPNL or Discom is responsible to take down the meter reading & EAC would verify the correctness of metered data & furnish the same to various agencies
- Removal of seals from meters:- When ever seals have to be removed advance notice be given to other party for witnessing the removal of seals and resealing of interface meter. The breaking & re-sealing of the meters shall be recorded by the party, who carried out the work, in meter register , mentioning the date of removal and resealing , serial number of the broken and new seals and the reason for removal of seals.
- xx) The output data of ABT Compliant Special Energy Meters should be in ASCII as well as Excel format. The Base Computer software (BCS) may be got installed at Energy Centre, HVPNL, Sector-6, Panchkula.

Suitable MRI be also procured. The test results duly witnessed by representative of concerned M&P Division of DHBVN and Haryana Vidyut Prasaran Nigam Limited may be submitted to this office for further analysis. A copy of Technical specifications of HVPN for SEM's be refereed

The other commercial terms & condition regarding warranty, etc shall be settled with supplier of equipment by Open Access Consumer.

SECTION-2: EQUIPMENT SPECIFICATION UNDER SCOPE OF SUPPLIES
Technical Corrigendum-1

Following clarifications / additional informations are provided:

Sl. No.	Clause No.	Did Read	Should Read	Re
1	Tender Section-C Sub Section-1 Chapter-3 Clause 4 - C	The connectivity of transformer bays with 220 KV/34.5 KV outdoor transformer shall also be through Gas insulated Bus-duct. The connectivity with GIB and Transformer HV bushing shall also be through proper AIS-GIS bushing system complete with all accessories. Any intermediate conductors or connectors required for GIB to Transformer connectivity shall also be in vendor's scope.	The connectivity of transformer bays with 220 KV/34.5 KV outdoor transformer shall also be through Gas insulated Bus-duct. The connectivity with GIB and Transformer HV bushing shall also be through proper Gas to Oil bushing system complete with all accessories. Any intermediate accessories required for GIB to Transformer oil bushing connectivity shall also be in vendor's scope. The Gas to Oil bushing shall have provision of disconnection and testing points for maintenance and schedule testing requirements.	

TECHNICAL CORRIGENDUM POINT (TENDER NO.: RPRC182491)

Sl. No.	Tender Reference	DID READ	SHOULD READ
1	Section-1/CL no. 2 a/Pg. no.1	Construction of 11 bays, 220KV GIS Switchyard with allied switchgear and protective equipments (Inclusive of four numbers 220 KV bays for P-25 project costing 27.01 Cr.)	Construction of 11 bays, 220KV GIS Switchyard with allied switchgear and protective equipments inclusive of 4 Nos. of spare 220 K V transformer bays.
2	Section-1/CL no. 2 b/Pg. no.1	Provision of 04 nos. of 220/33 KV 50 MVA grid transformers	Provision of 04 nos. of 220/34.5 KV 50/65 MVA (ONAN/ONAF) grid transformers
3	Section-1/CL no. 2 f/Pg. no.1	Fault current limiters for installation in parallel of URT.	Fault current limiter shall be provided in parallel with existing URTs in SS-63. The detailed scope and specification is attached as Section-3 Chapter-18.

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6.	Section-2 /Cl. no. 4.0 /Pg. no. 2	The brief description of proposed power evacuation philosophy is given in annexure-3 with SLD of existing system.	The brief description of proposed power evacuation philosophy is given in Annex-S-2 C-1/5 and S-2/C-1/6 with SLD of existing system.
7.	Section-2/Part-A/Cl. no. 18	The meteorological data of the substation is indicated at Annex-S-2/C-1/8. However, for design purpose, ambient temperature should be considered as 50° C.	The meteorological data of the substation is indicated at Annex-S-2/C-1/8. Equipment design temperature shall be 45 deg C as per applicable IS and maximum ambient temperature shall be considered as 50 deg C.
8.	Section-2/Part-A/Cl. no. 9.1.2/Pg no. 3	220 KV GIS indoor switchgears with 11 bays including all its control, relay, monitoring facility inclusive of all accessories.	220 KV GIS indoor switchgears with 11 bays including all its control, relay, monitoring facility. The 11 bays are comprising of 2 line incomer bays, 1 bus-coupler bay, 8 Nos. of Transformer bays complete in all respect. Also the GIS installation shall be designed with the provision of space for extension of bays in either directions for minimum two numbers including its floor cutout arrangement. The building design, GIS system and switchgear floor designs shall be done accordingly.

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9.	Section-2/Part-A/C Full facility to develop connectivity with 220 KV double circuit feeder from Point of connection (refinery premises) to new 220 KV GIS switchgear including 220 KV overhead conductors, AIS/ GIS termination bushings, gantry towers, Outdoor CVT, L.A, outdoor Isolators, Wave Traps inclusive of all accessories as detailed in the tender documents	Full facility to develop connectivity with 220 KV double circuit feeder from Point of connection (refinery premises) to new 220 KV GIS switchgear including 220 KV overhead conductors, AIS/ GIS termination bushings, gantry towers, Outdoor CVT, L.A, outdoor Isolators, Wave Traps inclusive of all accessories as detailed in the tender documents.	For detailed specifications, please refer component wise chapters in Section-3.
10.	Annexure-S-3/C-4/3 Clause 1.2 on Pg 467	The line traps as specified shall be installed at the receiving end (IOCL Panipat end) of the transmission lines and shall be in coordination with sending end equipments. The design, selection of equipments, compatibility with the system shall be the responsibility of the LSTK contractor. All co-ordination and liasoning required with HVPNL shall be in the scope of LSTK contractor. The line traps as specified shall be installed at the receiving end (IOCL Panipat end) of the transmission lines and also for the sending end substation of HVPNL. The supply of identical wave trap for sending end is in the scope of LSTK contractor. Due coordination for installation of the same at sending end shall be responsibility of LSTK contractor. All the device shall be identical for both sending and receiving end. The design, selection of equipments, compatibility with the system shall be the responsibility of the LSTK contractor. All co-ordination and interaction required with HVPNL shall be in the scope of LSTK contractor. The wave traps shall be required in two phases of each incoming circuit i.e. total 4 nos. of wave traps will be required.	

11.	Section-2/Part-A/C I. no. 10.1.1.2/Pg no. 97	220 KV SF-6 based full indoor GIS switchgears of 11 bays comprising of breakers, isolators, all type of Current Transformers & Potential transformer including 0.2 S class dedicated CT/PT for metering. In addition to above switchyard shall have Earth switches, dis-connectors switches, CVTs, LA, wave trap & PLCC equipments. The tentative SLD of switchyard system shall be attached as Annexure S-2/C-1/3 and tentative revised GELLO of switchyard shall be attached as Annexure-S-2/C-1/4. The compliance of HVPNL guidelines, CEA guidelines and other standard requirements while preparing detailed SLD and GELOs will be in the scope of vendor. Outdoor LAs will required in 220 KV incoming line bays and LA will not be required in 220 KV Transformer bays.	220 KV SF-6 based full indoor GIS switchgears of 11 bays comprising of breakers, isolators, all type of Current Transformers & Potential transformer including 0.2 S class dedicated CT/PT for metering. In addition to above switchyard shall have Earth switches, dis-connectors switches, CVTs, LA, wave trap, outdoor metering CT, PT & PLCC equipments. The tentative SLD of switchyard system shall be attached as Annexure S-2/C-1/3 and tentative revised GELLO of switchyard shall be attached as Annexure-S-2/C-1/4. The compliance of HVPNL guidelines, CEA guidelines and other standard requirements while preparing detailed SLD and GELOs will be in the scope of vendor. Outdoor LAs will required in 220 KV incoming line bays and LA will not be required in 220 KV Transformer bays.
12.	Section-2/Part-A/C I. no. 9.1.8/Pg no. 3	4x50/65 MVA, 220/34.5 kV Transformer & its bays along with allied switchgear and protective equipments, fire fighting facilities, online dehydration facilities including all associated accessories.	4x50/65 MVA, 220/34.5 kV Transformer & its bays along with allied switchgear and protective equipments, HVWS and NIFP based fire fighting facilities, online dehydration facilities including all associated accessories.

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15	Section-2/Part-A/CI. no. 9.1.20 & 9.1.21 /Pg no. 96	The following hook up shall be done by GIS bus duct – Between incoming 220 KV D/C line and indoor GIS GIS switchgear. & Indoor GIS switchgear to Outdoor transformers	The following hook up shall be done by GIS bus duct – Between incoming 220 KV D/C line and indoor GIS switchgears through AIS-GIS bushings. & Indoor GIS switchgear to Outdoor transformers through GAS to Oil Bushings. No EHV cables is envisaged in the project.
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16	Section-2/Part-A/CI. no. 10.1.1.2/Pg no. 4 220 kV SF-6 based full indoor GIS switchgears of 11 bays comprising of breakers, isolators, all type of Current Transformers & Potential transformer including dedicated CT/PT for metering. In addition to above switchyard shall have Earth switches, dis-connectors switches, CVTs, LA, wave trap & PLCC equipments. The tentative SLD of switchyard system shall be attached as Annexure S-2/C-1/3 and tentative GELO of switchyard shall be attached as Annexure-S-2/C-1/4. The compliance of HVPNL guidelines, CEA guidelines and other standard requirements while preparing detailed SLD and GELOs will be in the scope of vendor.	220 kV SF-6 based full indoor GIS switchgears of 11 bays comprising of breakers, isolators, all type of Current Transformers & Potential transformer including 0.2 S class dedicated CT/PT for metering. In addition to above switchyard shall have Earth switches, dis-connectors switches, CVTs, metering CT, PT LA, wave trap & PLCC equipments. The tentative SLD of switchyard system shall be attached as Annexure S-2/C-1/3 and tentative revised GELO of switchyard shall be attached as Annexure-S-2/C-1/4. The compliance of HVPNL guidelines, CEA guidelines and other standard requirements while preparing detailed SLD and complete GELOs will be in the scope of vendor. 0.2s class metering for tariff purpose shall be through outdoor CT, PT and metering system while normal 0.5 class metering for internal purpose shall be part of GIS. The special purpose metering for line bays shall be provided only for IOCL end. Remote end metering is not the part of ISBL.
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32	Section -1 /Additional Design Guidelines/Cl. no. 23	Layout of substation shall comply with OISD regulations, IE rules, TAC regulations and any other applicable statutory rules and regulations	Layout of substation shall comply with OISD regulations, IE rules, TAC regulations and any other applicable statutory rules and regulations. For reference the OISD standards such as OISD-SID-110,113,118,173, OISD-RP-146,147,148,149 & OISD-GDN-180 may be referred
33	Section-3 /Chapter-1/Cl. no. 3.7	The 220kV GIS building shall comprise an EOT (Electric overhead travel) crane of minimum capacity 5 (Five) Ton or as per GIS OEM recommendation, whichever is higher for lifting of any components of GIS switchgear	The 220kV GIS building shall comprise an EOT (Electric overhead travel) crane of minimum capacity 5 (Five) Ton or as per GIS OEM recommendation, whichever is higher for lifting of any components of GIS switchgear. The girder system shall be double for the EOT system. One side walkway of suitable size shall be provided for maintenance purpose.
34	Section 1/ Additional Design / Guidelines clause 7.0, &	Power Factor Correction Equipment &	No capacitor bank is envisaged for 220 KV or 33 KV system. For 220 KV GIS auxiliary load, capacitor banks to be provided if new GIS auxiliary system running power factor is less than design limit or else no capacitor bank for PF correction is required.
35	Section-3 Chapter-9 Clause 1.4(e) & Section 1/ Additional Design / Guidelines/Cl. no. 16.2	Lighting control, PF control for new 220 KV GIS switchgear and switchyard area. Cable trays shall be sized considering single layer of cables	Lighting control for new 220 KV GIS switchgear and switchyard area. Lighting control must be done for lighting circuit level. Cable trays shall be sized considering single layer of cables for power cables (HT or LT). For control or instrumentation cables maximum double layer per tray is acceptable.
36	Section-3 chapter-9 part- C. Section-2 part -A clause 10.1.1.28, Annexure S-2/C-1/2 clause 34	The I/O integration of new GIS substation with existing ECS & integration at PR and PNCP	The scope of ECS work shall be followed as per attached annexure -S-3/C-9/3

57.	Annexure S-3/C-4/3 clause 1.4	Type test requirement of wave trap	Type test reports as mentioned in latest IEC standards to be offered for similar or higher rating. The list provided in clause 1.4 is
58	Annexure S-3/c-4/4 clause 1.3	Line trap - Short circuit level 50 kA or as per standards	Line trap - Short circuit level shall be 31.5 kA for one second or as per HVPNL specification relevant to 220 KV system.
59	Section-3 Chapter-1 clause 3.4	Integration of 220 KV Overhead lines from point of termination to 220 KV GIS switchgear and connectivity of transformer with 220 KV switchgear is in vendors scope including Gas insulated bus duct, gantry towers, Air to GIS termination bushings, overhead conductors, gas to oil termination bushing all support works and complete in all. All the bus duct entry in GIS switchgear shall be from bottom. All The ground clearances & inter-phase clearances shall be as per applicable IS and IEC standards and as per site condition. Height of transformer shall be minimum 500 mm from FFL or as per project specific standards requirement. A tentative layout plan is attached as Annexure S-3/ C-3/1 . Detail layout plan shall be developed by LSTK contractor was per project specific and requirement of applicable standards/ OEM guidelines.	Integration of 220 KV Overhead lines from point of termination to 220 KV GIS switchgear and connectivity of transformer with 220 KV switchgear is in vendors scope including Gas insulated bus duct, gantry towers, Air to GIS termination bushings, overhead conductors, gas to oil termination bushing all support works and complete in all. All the bus duct entry in GIS switchgear shall be from bottom. All The ground clearances & inter-phase clearances shall be as per applicable IS and IEC standards and as per site condition. Height of transformer shall be minimum 500 mm from FFL or as per project specific standards requirement. A tentative layout plan is attached as Annexure S-3/ C-3/1 . Detail layout plan shall be developed by LSTK contractor was per project specific and requirement of applicable standards/ OEM guidelines.

60. Section-3 Chapter-1 clause 5 (i)	The minimum required components in each GIS bays as: iv. Voltage transformer as per project requirement vi. Online PD Monitoring devices with data acquisition and monitoring system Voltage transformer as per project requirement shall be provided in GIS system for Both line bays for metering and protection purpose In both Bus section for metering and protection purpose AIS PT is exclusively for tariff metering purpose and shall not be used for any other application. LA of line bays are part of AIS system while LA in transformer bays are not required.
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61	Section-3 Chapter-1 ix b pg 59	GIB lay out shall be designed as - Only two vertical layers shall be provided. - Outer to Outer (not center to center) vertical clearance between layers shall be minimum one meter. - The minimum outer to outer horizontal clearance between each GIS bus ducts shall be a minimum of 0.75 meter. - GIS bus ducts of each circuit shall be arranged in horizontal formation only and the clearance between the nearest bus ducts of two adjacent circuits shall be minimum one meter. - Minimum vertical ground clearance of bus duct at road crossing shall be 7 meter. - The GIB route shall not obstruct easy access to GIS and control buildings and shall not obstruct movement of cranes, equipments including HV test equipments for maintenance work. - For the maintenance of GIB of one circuit, only that circuit shall be isolated.	GIB lay out shall be designed as - Only two vertical layers shall be provided. - Outer to Outer (not center to center) vertical clearance between layers shall be minimum one meter. - The minimum outer to outer horizontal clearance between each GIS bus ducts shall be a suitable for easy maintenance and as per applicable standards/ guidelines. - GIS bus ducts of each circuit shall be arranged in horizontal formation only and the clearance between the nearest bus ducts of two adjacent circuits shall be minimum one meter. - Minimum vertical ground clearance of bus duct at road crossing shall be 7 meter. - The GIB route shall not obstruct easy access to GIS and control buildings and shall not obstruct movement of cranes, equipments including HV test equipments for maintenance work. - For the maintenance of GIB of one circuit, only that circuit shall be isolated.
62	Section-3 Chapter-1 pg 47 of 91	CT & VT details of GIS system	CT & VT details of GIS system for number of cores, VA, Ratio, accuracy shall be governed by the guidelines provided in System design basis (section-1 chapter-2) and as per project specific requirement. Its detail design is in the scope of LSK contractor.

63	Section 3/Chapter 1 pg 48 & 49 of 91	GIS CT specifications: In each line bay, one dedicated metering CT of 0.2S class shall be provided exclusively for open access metering purpose. This CT shall not be used for any other metering purpose. This CT design shall be in line with HVPNL guidelines for open access metering as attached as annex S-3/C-1/2. The GIS system shall have metering CT & PT for internal measurement purpose of 0.5 class or better in each bay & bus system (for bus voltage).	In each line bay, one dedicated metering CT & PT of 0.2S class shall be provided exclusively for open access metering purpose. This CT & PT shall be installed outdoor and part of AIS system. This CT & PT shall not be used for any other metering purpose. This CT design shall be in line with HVPNL guidelines for open access metering as attached as annex S-3/C-1/2. The GIS system shall have metering CT & PT for internal measurement purpose of 0.5 class or better in each bay & bus system (for bus voltage).
64	Section 3/Chapter 16/ clause 3.1 (d)	Computer room, console room, UPS room, battery room, rack room etc of control room/ SRR shall be protected by clean agent system as per NFPA-2001. (If applicable for this project)	Clean agent system is not applicable for this project.
65	Section 3/Chapter 16/ clause 3.1 (e)	Detection of fire and toxic gas	Detection of fire.
66	Section 3/Chapter 16/ clause 3.1 (j)	Landing Valve	Landing valve shall be double headed
67	Section 3/Chapter 16/ clause 6	Fire Extinguishers, landing Valves, Monitors, Hose Reel valves, Nozzles, Lock, Handles, couplings, caps, DCP, etc. shall be as per IS standards, QISD and this specification.	Fire Extinguishers, landing Valves, Monitors, Hoses, Hose Reel valves, Nozzles, Lock, Handles, couplings, caps, DCP, etc. shall be as per IS standards, QISD -std- 116 and this Specification.
68	Section 3/Chapter 16/ clause 5.0	Sprinkler system for cable cellar area	Sprinkler system for cable cellar area shall be MWWS type as per applicable standards.

81	Plot no. IOCL/PR/0001/REV 19/OVERALL PLOT PLAN	Boundary Wall	Boundary to be constructed through Chain link fencing around complete 220 KV switchyard area from all four sides as per applicable IS standards and CEA rules with due earthing of the same at multiple points as per IS/ CEA requirement. Due footing for fence support shall be developed as per standard design requirements. Proper structural type entry gate shall be developed at two entrance point as shown in GELO.
82	Clause 18.19 of General Guidelines for civil work, Section".	Chain link fencing. The design shall be as per drawings attached with the tender.	Chain link fencing. The design shall be as per drawings attached with the tender. The details of chain link fencing is attached as Section-3 Chapter-19.
83	Section-3 Chapter-11 Clause 4.8.3	The Switchboards shall be metal enclosed cubicle type, suitable for indoor installation, floor - mounting and free - standing. The design shall be totally enclosed, dust-tight, damp-proof and vermin proof offering degree of protection not less than IP4X.	The Switchboards shall be metal enclosed cubicle type, suitable for indoor installation, floor - mounting and free - standing. The design for the total enclosure shall be dust-tight, damp-proof, vermin proof and totally enclosed offering degree of protection not less than IP4X.
84	Section-3 Chapter-11 Clause 4.8.7	The switchgear cubicles shall be rigid and robust in design & construction. Sheet steel used for fabrication shall be cold rolled. Cubicles shall be made from rigid welded structural frames made of structural steel sections or of pressed / formed sheet steel of not less than 3 mm thickness. The frames shall be enclosed by sheet steel of at least 2 mm thickness, smoothly finished, leveled and free from flaws. Stiffeners shall be provided wherever necessary.	The switchgear cubicles shall be rigid and robust in design & construction. Panel Sheet used for fabrication shall be cold rolled steel or suitable metallurgy material. Cubicles shall be made from rigid welded structural frames made of structural steel or suitable material sections or of pressed / formed sheet of not less than 2 mm thickness. The design shall have to be type tested for full short circuit rating, internal arc resistance and ingress protection..

118 Annex- S-2/C-1/2 Clause 10.0	Gantry (Tower and Beam) for 220kV double circuit line termination from refinery battery wall to new GIS switchyard including all required strings, ACSR moose conductor, support insulator, clamps, connectors etc. The connectivity from point of supply to ISBT, shall be in the scope of vendor including design, supply and commissioning.	Gantry (Tower and Beam) for 220kV double circuit line termination from refinery battery wall to new GIS switchyard including all required strings, double ACSR moose conductor, support insulator, clamps, connectors etc. The connectivity from point of supply to ISBT, shall be in the scope of vendor including design, supply and commissioning.
119 Section-3 Chapter-1 Clause 8.14	The metal enclosures for the SF6 gas insulated equipment modules shall be made from Aluminum alloy. Suitable anti corrosive paints shade 631 of IS: 5 must be applied on the exterior of the enclosures. The enclosure shall be separate phase wise separate metallic type. The external fixtures should be made of corrosion-resistant material and should be capped wherever required. Necessary provisions shall be made in enclosure for providing on line PD monitoring systems which are also included in the scope of supply. Bidder shall provide adequate number of UHF sensors in the offered GIS for connection to PD meter and the number and location of these sensors shall be placed in strategic locations subject to approval of the purchaser.	The metal enclosures for the SF6 gas insulated equipment modules shall be made from Aluminum alloy. Suitable anti corrosive paints or suitable metallurgy of construction shall be used as per relevant IS/IEC standards to ensure durability of all components. The enclosure shall be separate phase wise separate metallic type. The external fixtures should be made of corrosion-resistant material and should be capped wherever required. Necessary provisions shall be made in enclosure for providing on line PD monitoring systems which are also included in the scope of supply. Bidder shall provide adequate number of UHF sensors in the offered GIS for connection to PD meter and the number and location of these sensors shall be placed in strategic locations subject to approval of the purchaser.

120	Section-3 Chapter-1 Clause 9.12	Disconnect switches and grounding switches shall have electrical and Mechanical interlocks to prevent on grounding switch from closing on an energized section.	Disconnect switches and grounding switches shall have electrical and Mechanical interlocks to prevent grounding switch from closing on an energized section. Padlocking system can also be provided for interlocking.
121	Section-3 Chapter-1 Clause 9.1.3	For 220 kV class enclosure shall be phase wise separate metallic type.	For 220 kV Class enclosure may be single phase encapsulated or three phase encapsulated type as per OEM design and architecture. However the offered design must be type tested in line with relevant IEC standard.
122	Section-3 Chapter-1 Clause 9.1.21	The Circuit Breakers shall have a First Pole to Clear factor of 1.5 for Circuit Breakers up to 245 kV class.	The Circuit Breakers shall have a First Pole to Clear factor for Circuit Breakers up to 245 kV class shall be in line with relevant IEC standard
123	Section-3 Chapter-1 Clause 9.5.1	The breaker shall include suitable spring operating mechanism to assure proper opening & closing operations. The provision shall be made for checking adjustments and opening characteristics. The mechanism shall be capable of reclosing within the range specified in the applicable standards. The mechanism shall include dual trip coils, Charging of opening mechanism shall be possible in the event of failure of the motor drive.	The breaker shall include suitable spring operating mechanism or spring-hydraulic mechanism to assure proper opening & closing operations. All auxiliaries required for operating mechanism shall be in the scope of L&K T contractor including its design supply installation and commissioning. The offered design must be a proven design and shall not be proto-type. The provision shall be made for checking adjustments and opening characteristics. The mechanism shall be capable of reclosing within the range specified in the applicable standards. The mechanism shall include dual trip coils. Charging of opening mechanism shall be possible in the event of failure of the motor drive.
124	Section-3 Chapter-1 Clause	One local control cabinet (LCC) of OEM of GIS shall be supplied for the local control and operation of each bay. Each LCC shall contain the local control, interlocking, operation and indication devices for the associated GIS bay.	One local control cabinet (LCC) of OEM of GIS shall be supplied for the local control and operation of each bay. Each LCC shall contain the local control, interlocking, operation and indication devices for the associated GIS bay. The LCC can be either standalone or integrated type

125	iv.a on Pg 216	Bus VT	Each voltage transformer shall be metal enclosed, SF6 insulated inductive type in accordance with relevant IEC 60044-2. The location, polarity, ratios, and accuracy shall be as specified during detailed engineering stage. Also each Bus VT shall be provided with dedicated disconnect switch
126	Section-3 Chapter-1 Clause 2.0 point no 13a & 14a	13a. Rated short duration Power frequency withstand Voltage for 1 minute (kV rms): HV side: 395 KVrms 14a. Rated lightning impulse withstand Voltage 1.2/50 microsecond impulse (kVp): HV side: 950 KVp	13a. Rated short duration Power frequency withstand Voltage for 1 minute (kV rms): HV side: 460 KVrms 14a. Rated lightning impulse withstand Voltage 1.2/50 microsecond impulse (kVp): HV side: 1050 KVp
127	Section-3 Chapter-1 Clause 2.0 point no 21.c & 2.2.1	Tan delta 0.01 max. for winding, & for 0.007 max. for bushing The Maximum Limit of value of tan delta at 20°C shall be 0.5% for windings, 0.4% for bushings and 0.2 % for oil.	The Maximum Limit of value of tan delta at 20°C shall be 0.5% for windings, 0.7% for bushings and 0.2 % for oil.
128	Section-3 Chapter-1 Clause 3.1.4	Cast iron shall not be used for any parts other than the radiator valve bodies. Corresponding parts liable to replace shall be interchangeable.	Cast iron shall not be used for any parts other than the radiator valve bodies. Corresponding parts liable to replace shall be interchangeable. However also in case of valves up to and including 100 mm shall be of GM and larger valves shall be of Cast Iron bodies with GM fittings. They shall be of full way type with internal screw and shall open when turned counter clock wise when facing the hand wheel, along with suitable locking in open and close positions.

129	Section-3 Chapter-1 Clause 5.4	Short circuit test : Short circuit test in accordance with latest IS-2026 Part (5) clause 4.2, IEC-60076-5 and CEA regulation-2010 (CEA regulation no. 10(3)(g), 34(4)(k), 43(2)(a)(vi)) shall be got conducted on one of the units of each voltage and capacity at any test Agencies where facilities exist in the presence of Purchaser's representative. However, in case of those manufacturers who have already got short circuit test in accordance with Cl. 4.2 of IS-2026 Part(5) or latest edition conducted during the last 7 years on same design and Page 39 of 89 capacity (same or higher) of the Transformer, fresh short circuit test is not required to be conducted. The bidder in such a case shall submit the copy of type test report along with the bid. If this test is not conducted by the firm earlier, then charges and all necessary testing arrangements shall be in the scope of the bidder.	Short circuit test : Short circuit test in accordance with latest IS-2026 Part (5) clause 4.2, IEC-60076-5 and CEA regulation-2010 (CEA regulation no. 10(3)(g), 34(4)(k), 43(2)(a)(vi)) shall be got conducted on one of the units of each voltage and capacity at any test Agencies where facilities exist in the presence of Purchaser's representative. However, in case of those manufacturers who have already got short circuit test in accordance with Cl. 4.2 of IS-2026 Part(5) or latest edition conducted on similar Transformer, fresh short circuit test is not required to be conducted. The definition of similar transformers shall be as per IEC-60076-5. The bidder in such a case shall submit the copy of type test report along with the bid. If this test is not conducted by the firm earlier, then charges and all necessary testing arrangements shall be in the scope of the bidder.
130	Section-3 Chapter-5 Clause 1.1.2.1	Design and fabrication of Control & Protection Panels for mounting the relay and relay assemblies along with all necessary accessories like switches, measuring & recording instruments & indicating lamps etc. and wiring up of the same to provide self contained and ready to use protection as per this specification.	Design and fabrication of Control & Protection Panels for mounting the relay and relay assemblies along with all necessary accessories like switches, measuring & indicating lamps etc. and wiring up of the same to provide self contained and ready to use protection as per this specification.

168	Section-3 Chapter-1 Online PD Monitoring System Annexure-S-3/C-2/6 A point-41	Online PD Monitoring system (as per CL11.1 and 11.2)	Online PD Monitoring system -Power transformers as per clause 11.1 & 11.2 -220KV GIS as per Clause 9.12/viii (page no-54of91)
169	Section-3 Chapter-1 Special Tools Tackles and Equipment Section-3 Chapter-1 clause 8.24 e Section-3 Chapter-1 clause 8.24 g	On line PD monitoring system for 220 KV GIS modules. Portable PD analyzer/measurement kit suitable for GIS along with accessories	On line PD monitoring system for power transformers Portable PD analyzer/measurement kit suitable for GIS along with required Accessories
170	Section-3 Chapter-1 Mandatory Spares Section-3 Chapter-1 clause-16	MANDATORY SPARE FOR GIS SYSTEM :	MANDATORY SPARE FOR GIS SYSTEM : All the mandatory spares shall be provided as per section-1 chapter-3 clause 6.1

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171	Annexure S-2/C-1/2 Sr. No. 13	Supply, Installation & commissioning of 50/65 MVA ONAN/ONAF 220/34.5KV Transformer with 18% impedance at 50 MVA base including firefighting facility, C&R panels, complete earthing, RTCC with digital redundant AVR system, etc	Supply, Installation & commissioning of 50/65 MVA ONAN/ONAF 220/34.5KV Transformer with 18% impedance at 50 MVA base including firefighting facility, complete earthing, RTCC with digital redundant AVR system, etc
172	Section-2 Part-A Clause : 9.1.16	All approval and certifications including its liaisoning with state transmission authorities, CEA, statutory bodies shall be in scope of LSTK contractor.	All approval and certifications including its co-ordination with state transmission authorities (HVPNL/HHBVN), CEA, OISD, PESO, statutory bodies shall be in scope of LSTK contractor.
173	Technical Specification for 220KV GIS/ Section-3 Chapter-1 Clause 5.n.ix	Where bus Coupler is specified and in case of any internal arc fault in a busbar, busbar disconnect or sectionalized, repair work must be possible without shutting down the complete substation and at least one half of the substation must remain in operation.	The bus bar system shall be sectionalized for each bay and contained in individual SF6 gas tight bus compartments to prevent contamination of the gas of the whole bus bar due to fault in one bay zone and refill lesser quantity of SF6 gas.

174	Technical Specification for 220kV GIS/ Section-3 Chapter-1 Clause 7.b	The GIS system shall be suitable for future extension on either end by the addition of extra feeders, bus couplers, bus-bars, circuit breakers, dis-connectors, and other switch gear components. The arrangement of gas sections or compartments shall be such as to facilitate future extension without any drilling, cutting or welding on the existing equipment. To add equipment, it shall not be necessary to move or dislocate the existing switchgear bays	The GIS system shall be suitable for future extension on either end by the addition of extra feeders, bus couplers, bus-bars, circuit breakers, dis-connectors, and other switch gear components. The arrangement of gas sections or compartments shall be such as to facilitate future extension without any drilling, cutting or welding on the existing equipment. To add equipment, it shall not be necessary to move or dislocate the existing switchgear bays
175	Technical Specification for 220kV GIS/ Section-3 Chapter-1 Clause 8.9.1	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. Double gas seals with provision to monitor the failure of first seal are preferred.	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. Double gas seals with provision to monitor the failure of first seal is preferred.

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176	Technical Specification for 220kV GIS/ Section-3 Chapter-1 Clause 8.2.3.	To limit the effects of an internal arc the switch gear shall be subdivided into individual arc and gas-proof compartments, preferably for i. Bus-bar together with bus-bar isolator and earthing switch ii. Circuit breaker iii. Line isolators and earthing switch, (Line, transformer) iv. Instrument transformers, v. Intermediate compartment	To limit the effects of an internal arc the switch gear shall be suitably subdivided into individual arc and gas-proof compartments, preferably for i. Bus-bar together with bus-bar isolator and earthing switch ii. Circuit breaker iii. Line isolators and earthing switch, (Line, transformer) iv. Instrument transformers, v. Intermediate compartment
177	Technical Specification for 220kV GIS/ Section-3 Chapter-1 Clause 9.1.3	For 220 kV class enclosure shall be phase wise separate metallic type.	For 220 kV class enclosure shall be phase wise separate metallic type.
178	Section-C Page 70/1047 Clause. 8.2	Bus bars shall be of electrolytic grade copper for 220 KV and 33 KV system and for 6.6 KV system electrolytic grade aluminum/copper to be provided.	Bus bars shall be of electrolytic grade copper for 220 KV and 33 KV system and for 6.6 KV system electrolytic grade aluminum/copper to be provided.
179	Section-3 Chapter-9 PART A - TECHNICAL SPECIFICATION FOR SUBSTATION AUTOMATION SYSTEM Clause: 1 (ii)	Station Human Machine Interface (HMI) at Sub-station Operator room (2 Nos.), PR Control Room (2 nos.), PNC Control Room (Total 2 Nos.) and Engineering / Cabinet Room (1 No.) The engineering server shall be a independent system.	Station Human Machine Interface (HMI) at Sub-station Operator room (2 Nos.), PR Control Room (2 nos.), PNC Control Room (Total 2 Nos.) and Engineering / Cabinet Room (1 No.) The engineering server shall be a independent system.

SECTION-2: EQUIPMENT SPECIFICATION UNDER SCOPE OF SUPPLIES
Technical Corrigendum-2

Annexure-7P
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3	Section C - Sheet 71/1047 Clause 8.6 & 8.7	Busduct shall be supplied with busbar flexible links for connection at both the ends and expansion joints support for every 3m of busduct and busduct support materials.	Busduct shall be supplied with busbar flexible links for connection at both the ends and expansion joints for every 3m of busduct or as per the OEM design calculations. The bidder to submit the design calculation in line with relevant standards
4.	Clause 13. Of technical corrigendum-1 (Annexure-A)	33/19 KV Copper Cable minimum sizing for the complete project shall be considered as stated below: Cabling from 220 KV/34.5 KV Transformer to PR generation bus at SS-28---3Runs X 3 Core X 300 sqmm per feeder i.e. total 6 sqmm per feeder i.e. total 6 Runs for PR connectivity. Cabling from 220 KV/34.5 KV Transformer to PR side LIB at SS-63 ---3Runs X 3 Core X 300 sqmm per feeder i.e. total 6 Runs per feeder i.e. total 6 Runs for PNCP connectivity.	33/19 KV Copper Cable minimum sizing for the complete project shall be considered as stated below: Cabling from 220 KV/34.5 KV Transformer to PR generation bus at SS-63---3Runs X 3 Core X 300 sqmm per feeder i.e. total 6 Runs for PR connectivity per transformer Cabling from 220 KV/34.5 KV Transformer to PR side LIB at SS-63 ---3Runs X 3 Core X 300 sqmm per feeder i.e. total 6 Runs for PNCP connectivity.

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	The list of firms/agencies for the purpose of carrying out the electrical system study is as following: • ☐ Engineers India Limited • ☐ Project & Development India Limited • ☐ TOYO Engineering India Pvt. Limited • ☐ JACOBS Engineering Group • ☐ MECON Limited • ☐ Foster Wheeler India Pvt. Limited. • ☐ National Thermal Power Corporation Limited • ☐ Sterlin & Wilson Pvt. Limited • ☐ Bechtel India Pvt. Limited. • ☐ Tata Consulting Engineers Limited • ☐ Tractebel Engineering Pvt. Ltd. • ☐ Power Grid Corporation of India Limited • ☐ ABB Ltd • ☐ Siemens Ltd • ☐ GE • ☐ Toshiba • ☐ L&T Or any other reputed agency with approval of EIC	The list of firms/agencies for the purpose of carrying out the electrical system study is as following: • ☐ Engineers India Limited • ☐ Project & Development India Limited • ☐ TOYO Engineering India Pvt. Limited • ☐ JACOBS Engineering Group • ☐ MECON Limited • ☐ Foster Wheeler India Pvt. Limited. • ☐ National Thermal Power Corporation Limited • ☐ Sterlin & Wilson Pvt. Limited • ☐ Bechtel India Pvt. Limited. • ☐ Tata Consulting Engineers Limited • ☐ Tractebel Engineering Pvt. Ltd. • ☐ Power Grid Corporation of India Limited • ☐ ABB Ltd • ☐ Siemens Ltd • ☐ GE • ☐ Toshiba • ☐ L&T Or any other reputed agency with approval of EIC	The GIS system shall be suitable for future extension on either end or single end as per OEM design by the addition of extra feeders, bus couplers, bus-bars, circuit breakers, dis-connectors, and other switch gear components. The arrangement of gas sections or compartments shall be such as to facilitate future extension without any drilling, cutting or welding on the existing equipment. To add equipment, it shall not be necessary to move or dislocate the existing switchgear bays
18	Technical Specification for 220kV GIS/ Section-3 Chapter-1 Clause 7.b	The GIS system shall be suitable for future extension on either end by the addition of extra feeders, bus couplers, bus-bars, circuit breakers, dis-connectors, and other switch gear components. The arrangement of gas sections or compartments shall be such as to facilitate future extension without any drilling, cutting or welding on the existing equipment. To add equipment, it shall not be necessary to move or dislocate the existing switchgear bays	The GIS system shall be suitable for future extension on either end or single end as per OEM design by the addition of extra feeders, bus couplers, bus-bars, circuit breakers, dis-connectors, and other switch gear components. The arrangement of gas sections or compartments shall be such as to facilitate future extension without any drilling, cutting or welding on the existing equipment. To add equipment, it shall not be necessary to move or dislocate the existing switchgear bays

9	Technical specification clause 8.2 on Page 70 of 1047 of Section-C.	GIS Manufacturer shall furnish details of precaution taken to prevent bimetallic corrosion wherever dissimilar materials (such as Copper, Aluminum) are used in line with IEC1639, including the following. ☐ Aluminum conductor in the bus duct and the current carrying part in the bushing. ☐ Terminal clamp and the current carrying part in the bushing if the bushing is not of Copper. Bus bars shall be of electrolytic grade materials of proper sizing and metallurgy as per requirements of tender specifications and applicable standards.	GIS Manufacturer shall furnish details of precaution taken to prevent bimetallic corrosion wherever dissimilar materials (such as Copper, Aluminum) are used in line with IEC1639, including the following. ☐ Aluminum conductor in the bus duct and the current carrying part in the bushing. ☐ Terminal clamp and the current carrying part in the bushing if the bushing is not of Copper. Bus bars shall be of electrolytic grade materials of proper sizing and metallurgy as per requirements of tender specifications and applicable standards.
10	Sect-3 chapter-9 clause -1.0 (iii)	Redundant managed switched Ethernet Local Area Network communication infrastructure with hot standby	SAS system shall have redundancy as detailed below 1- Redundant RTU units 2- Redundant Power supply units 3- Redundant managed switched Ethernet Local Area Network communication infrastructure with hot standby 4- Redundant ring/ start topology of communication network.



11	Clause 1.1.1 of on page 266 of 1047 of Section-C	This specification covers design, manufacture, assembly, testing at manufacturer's works before dispatch, inspection, supply & delivery (including loading, transportation & unloading on platform at site), erection, installation, all civil work including foundation, site testing & commissioning of 04 nos. oil filled 220/34.5kV, 50/65MVA (ONAN/ONAF) power transformers as detailed in this specification including Nitrogen injection based fire system, high velocity water spray based fire system, On line dehydratation system, On line PD monitoring system, FO sensor based temperature monitoring, OLTC, RTCC with AVR and complete with all other required accessories for safe, efficient, satisfactory and trouble free operation of the equipment and in compliance with IS/ IEC/ HVPNL & CEA guidelines. The online PD monitoring shall be similar of GIS system. All required sensors shall be permanently installed in transformers and portable data acquisition system shall be provided which be both in GIS as well as transformers for periodic online PD monitoring. The portable PD analyser kit shall be used for detection and measurement of PD and the measurement shall be stored in the instrument and further downloadable to a PC for further analysis to locate actual source of PD..	This specification covers design, manufacture, assembly, testing at manufacturer's works before dispatch, inspection, supply & delivery (including loading, transportation & unloading on platform at site), erection, installation, all civil work including foundation, site testing & commissioning of 04 nos. oil filled 220/34.5kV, 50/65MVA (ONAN/ONAF) power transformers as detailed in this specification including Nitrogen injection based fire system, high velocity water spray based fire system, On line dehydratation system, On line PD monitoring system, FO sensor based temperature monitoring, OLTC, RTCC with AVR and complete with all other required accessories for safe, efficient, satisfactory and trouble free operation of the equipment and in compliance with IS/ IEC/ HVPNL & CEA guidelines. The online PD monitoring shall be similar of GIS system. All required sensors shall be permanently installed in transformers and portable data acquisition system shall be provided which be both in GIS as well as transformers for periodic online PD monitoring. The portable PD analyser kit shall be used for detection and measurement of PD and the measurement shall be stored in the instrument and further downloadable to a PC for further analysis to locate actual source of PD..
12	Section-3 Chapter-1 Special Tools Tackles and Equipment Section-3 Chapter-1 clause 8.24/(e) and (g)	On line PD monitoring system for 220 kV GIS modules. Portable PD analyzer/measurement kit suitable for GIS along with required accessories	In line with tender clause viii – a on Page 222 of 1047 of Section-C, Portable PD analyzer/measurement kit suitable for both GIS and Power Transformer along with required Accessories as per tender specification is to be provided.

13	Clause 9.1.5 of Section-2 Part on Page no.: 95 of 1047.	Online PD analyzer comprising of both acoustic based as well as capacitive coupler based system along with hardware and monitoring system is also to be provided for 220 KV system. This system shall be integrated with new SCADA system for online monitoring of PD parameters.	In line with tender clause viii – a on Page 222 of 1047 of Section-C, Periodic Online PD analyzer comprising of acoustic based with detailed specification as mentioned in Section-3 Chapter-1 and Section-3 Chapter-2.
14	Sl. No.: 104 on Page 43 of 80 of Annexure-A of Technical corrigendum-1.	Bushing CTs shall preferably be provided for REF protection as specified in Part – II Cl. 2.5. The bushing shall be removable without disturbing the CTs. The detailed design of the CTs shall be in the scope of the LSTK contractor considering the tender and project requirements.	Bushing CTs shall preferably be provided for REF protection. The bushing shall be removable without disturbing the CTs. The detailed design of the CTs shall be in the scope of the LSTK contractor considering the tender and project requirements. The REF bushing CTs are exclusively are part of new transformers and its sizing and selection shall be as per transformer rating and applicable standards and is in the scope of LSTK contractor. For transformer differential protection, the zone of protection shall be as detailed below: a. For PR Transformers: The zone will be from 220 KV transformer bay CT to grid incomer panel in SS-63. The feeder detail of SS-63 is attached as Annex-S-2/C-1/10. b. For PNCP Transformers: The zone will be from 220 KV transformer bay CT to LIB panel in SS-63.
15	ANNEXURE – S-3/C-2/3 Clause 6.0 on Page 328 of 1047.	Each system of Dual Redundant AVR relay shall have facility to control all the four transformers in parallel.	Each system of Dual Redundant AVR relay shall have facility to control all the four transformers in parallel. An automatic switch-over to AUTO-2 in case of any malfunctions in AUTO-1 should be available. During normal operation, the output commands for tap changes from selected working Relay and commands from other must be in blocked condition.

19 Sl. No.: 197 on Page 76 of 80 of Annexure-A of technical corrigendum-1	The available space along with existing 132 KV switchyard to be dismantling, removal, leveling, soil filing, scrap removal of existing structure on this plot like building, any abandon foundations to be done by vendor. The shifting of disposable materials/ dismantled earth work to the refinery premises shall be in the scope of disposal to the vendor. Owner shall indicate the location of disposal to the vendor. The disposal of all scrap, debris, dismantled materials associated with LSTK scope of work from new 220 KV GIS plot, all cable routes, SS28, SS-63 and SS-9, control room to the place shown by IOCL within the refinery premises shall be in the scope of LSTK bidder.	The available space along with existing 132 KV switchyard to be used for new ISBL facility. The dismantling, removal, leveling, soil filing, scrap removal of existing structure on this plot like store building any abandon foundations to be done by vendor. The shifting of disposable materials/ dismantled earth work to locations inside the refinery premises shall be in the scope of vendor. Owner shall indicate the location of disposal to the vendor. The disposal of all scrap, debris, dismantled materials associated with LSTK scope of work from new 220 KV GIS plot, all cable routes, SS28, SS-63 and SS-9, control room to the place shown by IOCL within the refinery premises shall be in the scope of LSTK bidder.
20 Section-2/Part-A/CI. no. 10 1.1.2/Pg no 97.	220 kV SF-6 based full indoor GIS switchgears of 11 bays comprising of breakers, isolators, all type of Current Transformers & Potential transformer including 0.2 S class dedicated CT/PT for metering. In addition to above switchyard shall have Earth switches, dis-connectors switches, CVTs, LA, wave trap & PLCC equipments. The lightning arrestors (LA) will be required in following locations: a. Outdoor LA at the incoming point of 220 KV overhead lines, (both lines) b. GIS LA in outgoing of transformer bays (all eight transformer bays). The tentative SLD of switchyard system shall be attached as Annexure S-2/C-1/3 and tentative GELO of switchyard shall be attached as Annexure-S-2/C-1/4. The compliance of HVPNL guidelines, CEA guidelines and other standard requirements while preparing detailed SLD and GELOs will be in the scope of vendor.	220 kV SF-6 based full indoor GIS switchgears of 11 bays comprising of breakers, isolators, all type of Current Transformers & Potential transformer including 0.2 S class dedicated CT/PT for metering. In addition to above switchyard shall have Earth switches, dis-connectors switches, CVTs, LA, wave trap & PLCC equipments. The lightning arrestors (LA) will be required in following locations: a. Outdoor LA at the incoming point of 220 KV overhead lines, (both lines) b. GIS LA in outgoing of transformer bays (all eight transformer bays). The tentative SLD with above clarification of switchyard system shall be attached as Annexure S-2/C-1/3 and tentative GELO of switchyard shall be attached as Annexure-S-2/C-1/4. The compliance of HVPNL guidelines, CEA guidelines and other standard requirements while preparing detailed SLD and GELOs will be in the scope of vendor.

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25	Clause 10.1.1.2 on page 97 of 1047 of Section-C 220 kV SF-6 based full indoor GIS switchgears of 11 bays comprising of breakers, isolators, all type of Current Transformers & Potential transformer including 0.2 S class dedicated CT/PT for metering, In addition to above switchyard shall have Earth switches, dis-connectors switches, CVTs, LA, wave trap & PLCC equipments. The tentative SLD of switchyard system shall be attached as Annexure S-2/C-1/3 and tentative GELO of switchyard shall be attached as Annexure S-2/C-1/4. The compliance of HVPNL guidelines, CEA guidelines and other standard requirements while preparing detailed SLD and GELOs will be in the scope of vendor. Supply and installation of all the PLCC component in sending end shall also be in the scope of LSTK contractor. All required material and services shall be arranged by LSTK contractor. In case the system is not ready for installation at sending end or HVPNL clearances are not available for installation, the sending end relays and accessories may be supplied at loosed items and same shall be considered by mechnicla completion for the subject item. However final commissioning of the line differential scheme shall be in the scope of LSTK contractor.
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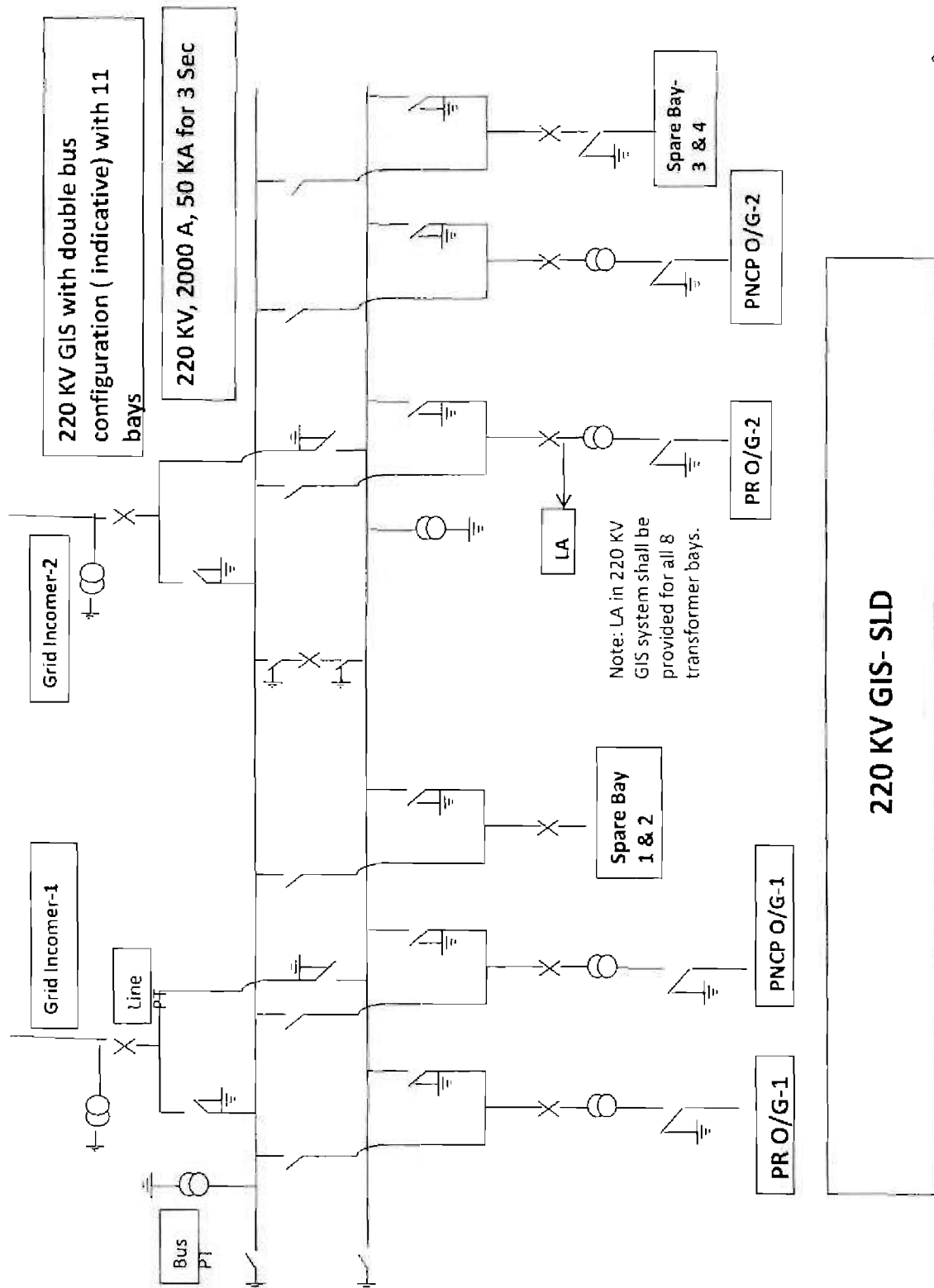


44	Clause 34 on Page 101 of 1247 of Section-C	Modification of existing ECS system of PR and PNCP for monitoring of proposed system and integration of load shedding scheme. Scope included supply of all materials, installation, laying and termination complete in all respect.	Modification of existing ECS system of PR and PNCP for monitoring of proposed system and integration of load shedding scheme. Comprehensive scope of ECS shall be followed as per Annexure-S-3/C-9/4.
45	Clause 177 on Page-70 of 80 on Annexure-A of Technical corrigendum-1	For 220 kV class enclosure shall be phase wise separate metallic type	In line with SI. No.: 121 of technical corrigendum-1, For 220 KV Class enclosure may be single phase encapsulated or three phase encapsulated type as per OEM design and architecture. However the offered design must be type tested in line with relevant IEC standard.
46	SI. No : 176 on Page 70 of 80 of technical corrigendum-1	To limit the effects of an internal arc the switch gear shall be suitably subdivided into individual arc and gas-proof compartments, preferably for i. Bus-bar together with bus-bar isolator and earthing switch ii. Circuit breaker iii. Line isolators and earthing switch, (Line, transformer) iv. Instrument transformers. v. Intermediate compartment	To limit the effects of an internal arc the switch gear shall be suitably subdivided into individual arc and gas-proof compartments, preferably for i. Bus-bar together with bus-bar isolator and earthing switch ii. Circuit breaker iii. Line isolators and earthing switch, (Line, transformer) iv. Instrument transformers. v. Intermediate compartment However specific to design of compartments, GIS OEM type tested designs are also accepted.

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47	Sl. No.: 173 on Page 70 of 80 of technical corrigendum-1	The bus bar system shall be sectionalized for each bay and contained in individual SF6 gas tight bus compartments to prevent contamination of the gas of the whole bus bar due to fault in one bay zone and refill lesser quantity of SF6 gas.	The bus bar system shall be sectionalized for each bay and contained in individual SF6 gas tight bus compartments to prevent contamination of the gas of the whole bus bar due to fault in one bay zone and refill lesser quantity of SF6 gas. However specific to design of compartments, GIS OEM type tested designs are also accepted.
48	Sl. No.: 194 on Page 75 of 80 of technical corrigendum-1	*** BCU unit shall be a part of LCC and SCAP shall be part of remote control & monitoring.	*** BCU unit shall be a part of LCC or CRP and SCAP shall be part of remote control & monitoring.
49	Section-2 Part-A/C1, 220 KV GIS indoor switchgears with 11 bays including all its control, relay, monitoring facility no. 9, 1.2 Pg no. 95 of 1047 of Section-C	220 KV GIS indoor switchgears with 11 bays including all its control, relay, monitoring facility. The 11 bays are comprising of 2 line incomer bays, 1 bus-coupler bay, 8 Nos. of similar rating of Transformer bays complete in all respect. The spare 4 No. 1 transformer shall have all the GIS components, protection components, Local and Remote Control schemes, CT and PTs, metering, all remote operation and monitoring connectivities as per scope of work, so that any spare bays are in ready to use conditions for any future requirements. The outgoing of 4 Nos. of spare transformer bays shall be designed for termination of minimum 3 runs of single core 220 KV outgoing cables per phase. In spare transformer bay, only suitable cable termination/cable adopter box shall be provided so that in future cable termination can be done without any modification in GIS bays. Also the GIS installation shall be designed with the provision of space for extension of bays in either directions for minimum two numbers including its floor cutout arrangement. The building design, GIS system and switchgear floor designs shall be done accordingly.	

Annex-S-3/c-1/3



DOCUMENT TITLE: 220kV GIS & ACCESSORIES- EXCEPTIONS & DEVIATIONS
 REVISION NO: 01

Sl. No.	Ref. Clause No.	Description	Technical Corrigendum dtd. 15.06.2020
1		Revised and approved CT VT parameters along with approved Single Line Diagram and Key Protection Single Line Diagram.	The revised and approved drawings/ documents are attached. 1. Layout Pan & Section, 2. GIS cum Control Room Building Conceptual Layout, 3. SLD, 4. Key SLD, and 5. CT VT Parameters. Bidders to note that 120VA for metering core of VT is to be provided. It is also to be noted that details provided in CT VT parameters and key protection SLD supersede the requirement mentioned elsewhere. Total requirement of 120VA shall be complied by providing metering windings with 60VA/ 2nos or 120VA/ 1nos. Bidders to comply the above requirement in line with revised and approved drawing and technical specifications.
2	BOQ	B.10: Supply: Maintenance Equipment- SF6 gas leakage test equipment shall be suitable for testing SF6 gas as per recommendations of IEC 60376. a. Instruments for automatic and continuous monitoring for the presence of SF6 gas in the atmosphere of the switchgear room shall be provided. The recommended positions, exact number of detectors, type of mounting, facilities for alarm etc. shall be indicated during the drawing approval stage. b. Each set of analyser shall comprise of: i. SO2 content in SF6 gas ii. Purity of SF6 gas iii. SF6 gas moisture content	The equipment supplied under B.10 is required for automatic and continuous monitoring for the presence of SF6 gas in the atmosphere of the switchgear room shall be provided. The recommended positions, exact number of detectors, type of mounting, facilities for alarm etc. shall be indicated during the drawing approval stage. This requirement specific for subject tender and shall be complied. Bidders to comply the above requirement in line with technical specifications.
3	BOQ	Scope clarity between interfacing of GIB duct and transformer bushing/ joints and Cable Module to XLPE cable	The design and construction for transformer bushing shall be as per IS/ IEC Standards (IEC 62271-211) whereas for cable connection module, it shall be as per IS/ IEC Standards (IEC 62271-209). Reference drawing is attached. Bidders to note the above requirements in line with BOQ for scope of supply and Service.
4	Earthing	Clarity about GIS earthing/ HF earthing	Complete GIS earthing design and calculation in line with relevant standards (IEEE 80) shall be done by vendor. For GIS earthing, braided and flexible earthing shall be preferable. However, Options for flat or braided earthing for GIS system may be adopted if allowed in applicable standards and complying the safety requirements of OEM design. In case HF earthing is not required, same shall be proved in line with calculations. Bidders to comply the above requirement in line with technical specifications.
5	General Requirements	Heat load data	Tentative data per bay is to be provided with technical offer. Bidders to comply the above requirements.
6	General Requirements	Crane capacity with hook details from floor level	The EOT crane shall be of minimum 5 T capacity and in compliance clause 3.7 of Section-2 (Section-3, Chapter-1) and subsequent technical corrigendum -1 point no.: 33 of Section-2. Exact requirements shall be provided with technical offer. Bidders to comply the above requirements.
7	General Requirements	AC/ DC load for GIS	Details of AC/ DC load for GIS is to be provided with technical offer. Bidders to comply the above requirements.
8	BOQ	ID/ Link arrangement in Voltage Transformer	The bus VTs shall be provided with disconnector switches, which shall have capability for online isolation of VT. In line with tender specification clause iv.(b) of Section-2 (Section-3, Chapter-1). Line Voltage Transformers should be of either plug-in construction or the disconnect-link type. Bidders to comply the above requirements, in line with technical specifications and BOQ.
9	BOQ	Link arrangement in Cable connection module	The provision to be kept for cable disconnection without requirement of minimum gas work and necessary mechanism is to be provided accordingly. The requirement is a preferred requirement. However type tested design of GIS OEMs shall be considered, in case of otherwise. Bidders to comply the above requirements, in line with technical specifications.
10	General Requirements	Bidder shall be required to submit 3D OGA Drawing compatible with Printtech for complete GIS & its accessories.	Bidder shall be required to submit 3D OGA Drawing compatible with Printtech for complete GIS & its accessories. Bidders to comply the technical specifications.
		Customer/ IOCL	
1	Section-3, Chapter-1- 220kV Gas Insulated Switchgear, Clause 2	2. DESIGN DATA 2.3 Other Electric data Auxiliary Supply: For Operation, control and signaling: 220 Volts DC (+10% & -20%) Note: The control voltage shall be considered as per BOQ of respective tender only. For other loads: 440 / 230 Volts, AC 50 Hz. (+10% & -15%)	The voltage variation for auxiliary control supply shall be in as per relevant IS/ IEC standards (IEC 62271-203 and further to IEC 62271-1). Bidders to comply the above requirements.
2	Section-3, Chapter-1- 220kV Gas Insulated Switchgear, Clause 5	5 DESIGN CONCEPT, CONSTRUCTION & PERFORMANCE OF SF6 GIS n. Modular Design & Future extensions ii. The GIS shall be of either single-phase enclosure type or three-phase enclosure type for voltage levels of 220kV.	For 220 KV Class enclosure may be single phase encapsulated or three phase encapsulated type as per approved vendor design and architecture. However the offered design must be type tested in line with relevant IS/IEC standards. Bidders to comply the above requirements.
3	Section-3, Chapter-1- 220kV Gas Insulated Switchgear, Clause 5	5 DESIGN CONCEPT, CONSTRUCTION & PERFORMANCE OF SF6 GIS n. Modular Design & Future extensions ix. The busbar system shall be sectionalized for each bay and contained in individual SF6 gas tight bus compartments to prevent contamination of the gas of the whole bus bar due to fault in one bay zone and refill lesser quantity of SF6 gas.	In line with technical corrigendum 2 of Section-2, GIS OEM type tested design for continuous bus bar is also acceptable, however service continuity requirements for maintenance and repair shall be complied in line with technical specifications. Bidders to comply the above requirements.
4	Section-3, Chapter-1- 220kV Gas Insulated Switchgear, Clause 5	5 DESIGN CONCEPT, CONSTRUCTION & PERFORMANCE OF SF6 GIS n. Modular Design & Future extensions vi. The switchgear shall be of the freestanding, self-supporting dead-front design, with all high-voltage equipment installed inside gas-insulated, metallic grounded enclosures, and suitably sub-divided into individual arc and gas proof compartments, preferably for, -- B) Current Transformers.	In line with technical corrigendum-2 point no.: 46 of Section-2, specific to design of compartments. GIS OEM type tested designs are also accepted, however service continuity requirements for maintenance and repair shall be complied in line with technical specifications. Bidders to comply the above requirements.
5	Technical Corrigendum 2 Point 13	In line with tender clause vii-a on page 222 of 1047 of section-C. Periodic online PD analyzer comprising of acoustic based with detailed specification as mentioned in section-3, chapter-1 and section-3, chapter-2.	In line with the tender specification clause (vii) of Section-2, the compliance of following points to be ensured: . • It is essential to provide minimum one no. PD sensor near the breaker and one no. near cable terminations of all feeder bays. Other PD sensors shall be placed strategically within a distance of maximum 7-8m. • The portable PD analyser kit shall be used for detection and measurement of PD and bouncing particles shall be displayed on built in large LCD display and the measurement shall be stored in the instrument and further downloadable to a PC for further analysis to locate actual source of PD such as free conducting particles, floating components, voids in spacers, particle on spacer surfaces etc. Bidders to comply the above requirements.
6	Section-3, Chapter-1- 220kV Gas Insulated Switchgear, Clause 6	8. GAS INSULATED SWITCHGEARS : SPECIAL REQUIREMENTS 8.14 Enclosures d) --. High quality primer followed by two coats of anti corrosive paint of glossy white shade shall be used such that they will not deteriorate when exposed to the SF6 gas and other vapors, Arc products, etc., which may present in the enclosures. --	In line with the point: 109 of technical corrigendum-2; the equipment specific painting requirements shall be as per OEM guidelines or applicable standards. Bidders to comply the above requirements.

7	Section-3, Chapter-1-220kV Gas Insulated Switchgear, Clause 8	8. GAS INSULATED SWITCHGEARS : SPECIAL REQUIREMENTS 8.9 Gas seals, Gas Density & pressure and other requirements 8.9.1 – --. Double gas seals with provision to monitor the failure of first seal is preferred.	Sealing system for GIS shall be as per OEM type tested design, complying the requirements of technical specification for gas leakage requirements. Bidders to comply the above requirements.
8	Section-3, Chapter-1-220kV Gas Insulated Switchgear, Clause 8	8. GAS INSULATED SWITCHGEARS : SPECIAL REQUIREMENTS 8.11 Gas Monitoring Devices c) At each gas compartment, provisions shall be made for connecting online moisture measurement instrumentation and the gas service cart. The moisture content in the gas shall not exceed 150 ppmv (parts per million per volume) in circuit breakers, and 250ppmv in other equipments. Provision for disconnection of gas pipelines shall be incorporated. 100cm or smaller sintered stainless steel particle filter disk, suitable for pressure involved, shall be installed at the gas service connection.	At each gas compartment, provisions shall be made for connecting online moisture measurement instrumentation and the gas service cart so that required gas testing can be done periodically while GIS system is in service. The gas leakage test equipment for the presence of SF6 gas in the atmosphere of the switchgear room shall be provided. The recommended positions, exact number of detectors, type of mounting, facilities for alarm etc. shall be indicated during the drawing approval stage. All required instruments and equipments for maintenance purpose shall be inline with the clause 7.16 of Section-2 (Section-3, Chapter-1) and mentioned elsewhere is the tender. Bidders to comply the customer comments.
9	Section-3, Chapter-1-220kV Gas Insulated Switchgear, Clause 8	8. GAS INSULATED SWITCHGEARS : SPECIAL REQUIREMENTS 8.11 Gas Monitoring Devices The gas monitoring device shall monitor at least the following, locally and on remote for following conditions, i. "Gas Refill" Level- This will be used to annunciate the need for gas refilling. ii. "Breaker Block" Level- This is the minimum gas density at which the manufacturer will guarantee the rated fault interrupting capability of the breaker. At this level the device contact may trip the breaker and block the closing circuits. iii. Gas density falling below the minimum safe operating limit and shall block breaker tripping and closing. iv. Over pressure alarm level	It is recommended to over pressure inline with the tender specification, until and unless it is the design limitation with respect to type tested design. Bidders to comply the customer comments.
10	Section-3, Chapter-1-220kV Gas Insulated Switchgear, Clause 8	8. GAS INSULATED SWITCHGEARS : SPECIAL REQUIREMENTS 8.15 Internal Fault Location The manufacturer of the GIS should provide appropriate system for the determination of the location of a fault.	The localisation/ identification of fault is required by use of all applicable technologies. Bidders to comply the customer comments.
11	Section-3, Chapter-1-220kV Gas Insulated Switchgear, Clause 8	8. GAS INSULATED SWITCHGEARS : SPECIAL REQUIREMENTS 8.8 Barrier and Non-Barrier Insulators 8.8.5 Tests shall be carried out during the manufacture of the Switchgear to ensure that all parts of the equipment are free of partial discharge with a partial discharge extinction voltage which is at least 10% higher than the rated voltage.	The partial discharge test voltages shall be in line with the relevant IS/IEC Standards (IEC 62271-203). Bidders to comply the customer comments.
12	Section-3, Chapter-1-220kV Gas Insulated Switchgear, Clause 8	8. GAS INSULATED SWITCHGEARS : SPECIAL REQUIREMENTS 8.24 Special tools, tackles and equipments e) On line PD monitoring system for 220 kV GIS modules. g) Portable PD analyzer/measurement kit suitable for GIS along with required accessories	The online PD monitoring shall be similar of GIS system. All required sensors shall be permanently installed in transformers and portable data acquisition system shall be provided which be both in GIS as well as transformers for periodic online PD monitoring. The portable PD analyser kit shall be used for detection and measurement of PD and the measurement shall be stored in the instrument and further downloadable to a PC for further analysis to locate actual source of PD Inline with the tender specification clause (viii) of Section-2 (Section-3, Chapter-1), the compliance of following points to be ensured.: • It is essential to provide minimum one no. PD sensor near the breaker and one no. near cable terminations of all feeder bays. Other PD sensors shall be placed strategically within a distance of maximum 7-8m. • The portable PD analyser kit shall be used for detection and measurement of PD and bouncing particles shall be displayed on built in large LCD display and the measurement shall be stored in the instrument and further downloadable to a PC for further analysis to locate actual source of PD such as free conducting particles, floating components, voids in spacers, particle on spacer surfaces etc. Bidders to comply the customer comments.
13	Section-3, Chapter-1-220kV Gas Insulated Switchgear, Clause 9	9 GAS INSULATED SWITCHGEAR COMPONENTS: 9.12 PRINCIPLE PARAMETERS ii. Disconnect Switches and Maintenance Grounding switches a) General ii. Disconnect switches and grounding switches shall have electrical and Mechanical interlocks to prevent grounding switch from closing on an energized section.	The mechanical padlocking arrangement may be provided in line with the technical corrigendum-1 point no.: 120 of Section-2. Bidders to comply the same.
14	Section-3, Chapter-1-220kV Gas Insulated Switchgear, Clause 9	9 GAS INSULATED SWITCHGEAR COMPONENTS: 9.12 PRINCIPLE PARAMETERS viii. Online PD monitoring system: a) General ii. It is essential to provide minimum one no. PD sensor near the breaker and one no. near cable terminations of all feeder bays. Other PD sensors shall be placed strategically within a distance of maximum 7-8m.	The online PD monitoring shall be similar of GIS system. All required sensors shall be permanently installed in transformers and portable data acquisition system shall be provided which be both in GIS as well as transformers for periodic online PD monitoring. The portable PD analyser kit shall be used for detection and measurement of PD and the measurement shall be stored in the instrument and further downloadable to a PC for further analysis to locate actual source of PD Inline with the tender specification clause (viii) of Section-2 (Section-3, Chapter-1), the compliance of following points to be ensured.: • It is essential to provide minimum one no. PD sensor near the breaker and one no. near cable terminations of all feeder bays. Other PD sensors shall be placed strategically within a distance of maximum 7-8m. • The portable PD analyser kit shall be used for detection and measurement of PD and bouncing particles shall be displayed on built in large LCD display and the measurement shall be stored in the instrument and further downloadable to a PC for further analysis to locate actual source of PD such as free conducting particles, floating components, voids in spacers, particle on spacer surfaces etc. Bidders to comply the above requirements.
15	Section-3, Chapter-1-220kV Gas Insulated Switchgear, Clause 9	9 GAS INSULATED SWITCHGEAR COMPONENTS: 9.12 PRINCIPLE PARAMETERS ix. GIS Connection: b. GIS to Transformer: i. 220 kV side by GIS bus duct - GIB layout shall be designed based on the following criteria. a. Only two vertical layers shall be provided. b. Outer to Outer (not center to center) vertical clearance between layers shall be minimum one meter. c. The minimum outer to outer horizontal clearance between each GIS bus ducts shall be a minimum of 0.75 meter.	The standard type tested design shall be considered during detailed engineering. Bidders to comply the above requirements.
16	Section-3, Chapter-1-220kV Gas Insulated Switchgear, Clause 9	9 GAS INSULATED SWITCHGEAR COMPONENTS: 9.12 PRINCIPLE PARAMETERS 9) Difference for simultaneity of 3 poles-4 ms (Max.)	Pole discrepancy for closing shall be as per relevant IS/IEC standard (IEC 62271-1). Bidders to comply the same.
17	Section-3, Chapter-1-220kV Gas Insulated Switchgear, Clause 9	9 GAS INSULATED SWITCHGEAR COMPONENTS: 9.6 Spring Operated Mechanism 9.6.13 Mechanical interlocks shall be provided in the operating mechanism to prevent discharging of closing springs when the breaker is in the closed position.	OEM type tested design on mechanical interlocking acceptable. Bidders to comply the above requirements.
18	Section-3, Chapter-1-220kV Gas Insulated Switchgear, Clause 12	12 MAINTENANCE: -- --Successful bidder shall depute OEM expert to site annually for the period of FIVE years from date of commissioning, to inspect GIS for carrying out status evaluation of GIS performance. -- --.	The terms & conditions shall be inline with the defect liability period mentioned in NIT. Bidders to comply the above.
19	Section-3, Chapter-1-220kV Gas Insulated Switchgear, Clause 13	13 TRAINING: Bidder shall at his cost arrange for the above training facilities and in addition shall bear all living expenses plus inland travel expenses of all the trainees. The Purchaser shall only pay to and fro passage of the trainees.	The training terms shall be in line with technical specification clause 13 of Section-2 (Section-3, Chapter-1) to be read in conjunction with. However the living expenses shall be borne by the purchaser only. Bidders to comply the above.

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SECTION 3:

PROJECT DETAILS & GENERAL TECHNICAL REQUIREMENTS (FOR ALL EQUIPMENT UNDER PROJECT)

1. General

1. This section stipulates the general technical requirements under the contract and will form integral part of the technical specification.
2. The provisions under this specification are intended to supplement requirement for the materials, equipment and services covered under this specification and is not exclusive. However, in case of conflict between requirements specified in this section and requirements specified in other sections the requirements specified under respective sections shall hold good.

2. Project Details

Panipat Refinery is a PSU Refinery and is having capacity of 15 MMTPA, catering the customers of northern India and is strategically important as per national interest. The refinery is located at Panipat, Haryana and was commissioned in the year 1998.

Presently 132KV supply to Panipat Refinery is provided from 2 sections of grid (one from PTPS and one from Munak) and point of supply is at Panipat Refinery 132KV switchyard Panipat Refinery complex is consisting of Refinery (will be marked as PR here onwards) and Naphtha cracker complex (will be marked as PNCP here onwards). As a strategic initiative, Panipat Refinery is planning for Bulk power import from HVPNL (Haryana Vidyut Prasaran Nigam Limited) at 220 KV level of 70 MW.

In view of this, Indian Oil Corporation Ltd. (IOCL) - Panipat Refinery is in the process of developing infrastructure to import 70 MW power from grid at 220 KV. Infrastructure development for grid power import at 220KV jobs consists of Inside Battery Limit (ISBL) jobs, Outside Battery Limit (OSBL) jobs.

Sl. No.	Description	Particulars
1	Customer	Indian Oil Corporation Ltd.
2	Consultant	TATA Consulting Ltd.
3	Project	LSTK job for ISBL work of 220KV Grid Power Import at IOCL, Panipat Refinery
4	Project location	Panipat (City): 16 Km (approx.) Chandigarh Highway: 11 Km (approx.) Noida (Advant)/ Delhi: 150 Km/ 80 Km (approx.)
5	Transport facilities	Well connected by road, rail & air with other parts of the country.

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3. Meteorological Data

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

Sl. No.	Technical Parameters	Unit	Particulars
1	Location	Panipat, Haryana, India	
1.1	Maximum ambient temperature	°C	50
1.2	Minimum ambient temperature	°C	-2.5 - 5
1.3	Average ambient temperature	°C	35
1.4	Design ambient temperature	°C	45
2	Average no. of thunder storm days	Days	45
3.1	Maximum Relative humidity	%	95
3.2	Maximum Relative humidity	%	26
4	Average Annual Rain Fall	Mm	900
5	Maximum Wind Pressure	Kg/ sqm	195
6	Maximum Altitude above Mean Sea Level	M	1000
7	Isoceraunic Level	Days/ Year	45
8	Seismic Level (Horizontal Acceleration)	Zone	4
9	Average no. of rainy day per Year	Days/ Year	120

NOTE: Moderately hot and humid tropical climate conducive to rust and fungus growth. The climate conditions are also prone to wide variations in ambient condition. Smoke is also present in the atmosphere. Heavy lightening also occurs during June to October. Switchyard is inside the refinery premise which is also prone to other corrosive gases like sulphur, H₂S, Chlorine etc.

4. Instruction to Bidders

1. The bidders shall submit the technical requirements, data and information as per the technical specifications provided in the bid documents.
2. The bidders shall furnish catalogues, engineering data, technical information, design document, drawings etc fully in conformity with the technical specification.
3. It is recognised that the contractor may have standardised on the use of certain components, materials, processes or procedures different than those specified herein. Alternate proposals offering similar equipment based on the manufacturer's standard practice will also be considered provided such proposals meet the specified designs, standard and performance requirements and are acceptable to the owner. Unless brought

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out clearly, the Bidder shall be deemed to conform to this specification scrupulously; All deviations from the specification shall be clearly brought out in the respective schedule of deviations. Any discrepancy between the specification and the catalogues or the bid, if not clearly brought out in the schedule, will not be considered as valid deviation.

4. Equipment furnished shall be complete in every respect with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/or needed for erection, completion and safe operation of the equipment as required by applicable codes though they may not have been specifically detailed in the technical specifications unless include in the list of exclusions. Materials and components not specifically stated in the specification but which are necessary for commissioning and satisfactory operation of the switchyard shall be deemed to be included in the scope of the specification. All similar standard components/parts of similar standard equipment provided, shall be interchangeable with one another.
 5. Unless brought out clearly in the respective schedule of deviations, it will be considered that, the bid proposal scrupulously confirms compliance to the specification. The bidder must bring out all the deviations in the bid proposal.
 6. In case there is a discrepancy between the data offered equipment and catalogue furnished, and unless the deviations are brought out clearly in the Technical Deviation Schedule, the equipment will be deemed to conform compliance to the specification scrupulously.
5. Standards
1. The works covered by the specification shall be designed, engineered, manufactured, built tested and commissioned in accordance with the Acts, Rules, Laws and Regulations of India.
 2. The equipment to be furnished under this specification shall conform to latest issue with all amendments of standard specified of this section as well as under respective Sections/Chapters of the specification.
 3. In addition to meeting the specific requirement called for in the respective sections of the Technical Specification, the equipment shall also conform to the general requirement of the relevant standards and shall form an internal part of the specification.
 4. The Bidder shall note that standards mentioned in the specification are not mutually exclusive or complete in themselves, but intend to complement each other.
 5. The Contractor shall also note that list of standards presented in this specification is not complete. Wherever necessary the list of standards shall of the specification shall take precedence.
 6. When the specific requirements stipulated in the specification exceed or differ than those required by the applicable standards, the stipulation of the specification shall take precedence.

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7. Other internationally accepted standards which ensure equivalent or better performance than that specified in the standards referred shall also be accepted.
8. In case governing standards for the equipment is different from IS or IEC, the salient points of difference shall be clearly brought out in deviation sheets along with English language version of standard or relevant shall be subject to Owner's approval.
9. Indicative List of Standards and Specifications General Standards Indian Electricity Rules shall be as per Annexure- A.
6. Services to be Performed by the Equipment being furnished
 1. The 220/33 kV system is being designed to limit the switching surge over voltage and the power frequency over voltage within limits of IEC. The equipment furnished under this specification shall perform all its functions and operate satisfactorily without showing undue strain, re-strike etc. under such over voltage conditions and in system where line lengths would extend up to 200 km.
 2. All equipment shall also perform satisfactorily under various Electro-mechanical and meteorological conditions of the site of installation.
 3. All the Equipment shall be able to withstand all external and internal mechanical, thermal and electromechanical forces due to various factors like wind load, temperature variation, short circuit etc for the equipment.
 4. The bidder shall design the various forces for terminal connectors of the equipment are required to withstand.
 5. The equipment shall also comply to the following:
 - All outdoor EHV equipment shall be suitable for hot line washing.
 - To facilitate erection of equipment, all items to be assembled as site shall be "match marked". All piping, if any between equipment control cabinet operating mechanism to marshalling box of the equipment shall bear proper identification to facilitate the connection at site.
7. Engineering Data
 1. The furnishing of engineering data by the Contractor shall be in accordance with the schedule for each set of equipment as specified in the technical specifications.
 2. The review of these data by the owner will cover only general conformance of the data to the specifications and documents, interfaces with the equipment provided under the specifications, external connections and of the dimensions which might affect substation layout. This review by the owner may not indicate a thorough review of all dimensions, quantities and accuracy of the information submitted. This review and/or approval by the owner shall not be considered by the Contractor, as limiting any of his responsibilities and liabilities for mistakes and deviation from the requirements, specified under these specifications and documents.
 3. All engineering data submitted by the Contractor after final process including review and

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approval by the owner shall from part of the Contract Document and the entire works performed under these specifications shall be performed in strict conformity, unless otherwise expressly requested by the owner in Writing.

4. LIST OF DOCUMENTS

4.1 The bidder must furnish a detailed list of drawings/documents along with the bid proposal which he intends to submit to the owner after awarded of the contract.

4.2 The supplier shall necessarily submit all the drawings/ documents unless anything is waived. The supplier shall submit required sets of drawings/design documents/test reports as may be required for the approval of the owner.

4.3 All engineering data submitted by the Contractor after final process including review and approval by the Owner shall from part of the Contract Document and the entire works performed under these specifications shall be performed in strict conformity, unless otherwise expressly requested by the owner in Writing.

5. DRAWINGS

5.1 All drawing submitted by the Contractor including those submitted at the time of bid shall be in sufficient detail to indicate the type, size, arrangement, material description, Bill of Materials, weight of each component, break-up for packing and shipment, the external connections, fixing arrangement required, the dimensions required for installation and interconnections with other equipment and materials, clearances and spaces required for installation and interconnection between various portions of equipment and any other information specifically requested in the specifications.

5.2 Each drawing submitted by the Contractor shall be clearly marked with the name of the Owner, the unit designation, the specifications title, the specification number and the name of the Project. If standard catalogue pages are submitted, the applicable items shall be indicated therein. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.

5.3 Further work by the Contractor shall be in strict accordance with these drawing and no deviation shall be permitted without the written approval of the Owner if so required.

5.4 All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawing shall be at the Contractor's risk. The Contractor may make any changes in the design which are necessary to make the equipment conform to the provisions and intent of the Contract and such changes will again be subject to approval by the Owner. Approval of Contractor's drawing or work by the Owner shall not relieve the contractor of any of his responsibilities and liabilities under the Contract.

5.5 APPROVAL PROCEDURE

The scheduled dates for the submission of these as well as for, any data/information to be furnished by the Owner would be discussed and finalised at the time of award. The supplier shall also submit six (6) copies of all drawings/design documents/test report for approval of the Owner. The following tentative schedule shall be followed

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in general for approval. However final schedule shall be prepared with approval of Engineer in-charge post award of approval.

1	Submission, comments, by resubmission and approval recommended agency	Within 4 weeks of receipt
2	Approval/ comments/ by Owner on initial submission	Within 4 weeks of receipt.
3	Resubmission	Within 3 (three) weeks (whenever from date of comments required) including both ways postal time.
4	Approval or comments	Within 3 weeks of receipt of commented drawing/ documents.
5	Furnishing of distribution copies	1 weeks from the date of last approval.

NOTE: The contractor may please note that all resubmission must incorporate all comments given in the submission by the Owner failing which the submission of documents is likely to be returned.

5.6 The drawing which are required to be referred frequently during execution should be submitted on cloth lined paper.

5.7 OTHER REQUIREMENTS OF DOCUMENTATION

5.7.1 One set of soft copy of all drawings, manual, catalogues to be submitted along with 6 sets of hardcopies during submission of as built documents.

5.7.2 6 copies of instruction/operation manuals for complete project shall also be furnished. The instruction Manuals shall contain full details of drawing of all equipment being supplied under this contract, their exploded diagrams with complete instruction for storage, handling, erection, commissioning, testing, operation, trouble shooting, servicing and overhauling procedures.

5.7.3 If after the commissioning and initial operation of the substation, the instruction manuals require any modifications/additions/changes, the same shall be incorporated and the updated final instruction manual in the form of one (1) reproducible original and twelve (12) copies shall be submitted by the Contractor to the Owner.

The Contractor shall furnish to the Owners, twelve (12) sets of spare part catalogue.

5.8 TITLE BLOCK

Title block for project shall be as follows,

Customer:	Indian Oil Corporation Ltd.
Consultant:	TATA Consulting Ltd.
LSTK Contractor:	Bharat Heavy Electricals Ltd.
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8. Colour Scheme and Codes

1. The contractor shall propose parts a colour scheme for those equipment/ Items for which the colour scheme has not been specified in the specification, for the approval of Owner. The decision of Owner shall be final. The scheme shall include,
 - Finishing colour of Indoor equipment.
 - Finishing colour of Outdoor equipment.
 - Finishing colour of all cubicals.
 - Finishing colour of various auxiliary system equipment including piping.
 - Finishing colour of various building items.
2. All steel structures, plates etc shall be hot dip galvanised or painted with noncorrosive paint on a suitable primer as per the provisions of the respective Section. It may be noted that normally all Owner's electrical equipment in Owner's switchyard are painted with shade 631 of IS-5 and Owner will prefer to follow the same for this project also. All the indoor cubicles shall be of same colour scheme and for other miscellaneous items colour scheme will be approved by the Owner.

9. Material/ Workmanship

1. GENERAL REQUIREMENTS

- 1.1 Where the specification does not contain characteristics with reference to workmanship, equipment, materials and component of the covered Equipment, it is understood that the same must be new, of highest, grade of the best quality of their kind, conforming to the best engineering practice and suitable for the purpose for which they are intended.
- 1.2 The equipment must be new, of highest grade, the best quality of their kind, to best engineering practice and latest state of art in accordance with purpose for which they are intended and to ensure satisfactory performance throughout the service life.
- 1.3 In case where the equipment, material or components are indicated in the specification as "similar" to any special standard, the Owner shall decide upon the question of similarity. When required by the specification or required by the Owner the supplier shall submit, for approval, all the information concerning the material or components supplied, installed or used without such approval shall run the risk of subsequent rejection, it being understood that the cost as well as the time delay associated with the rejection shall be borne by the Supplier.
- 1.4 The design of the work shall be such that installation, future expansions, replacement and general maintenance may be undertaken with a minimum of time and expenses. Each component shall be designed to be consistent with its duty and suitable factors of safety, subject to mutual agreements and shall be used throughout the design. All joints and fastenings shall be devised; constructed and documented so that the

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component part shall be accurately positioned and retained to fulfil their required function. In general, screw threads shall be standard metric threads. The use of other thread forms will only be permitted when prior approval has been obtained from the Owner.

- 1.5 Whenever possible, all similar part of the works shall be made to gauge and shall also be made interchangeable with similar parts. All spare parts shall be interchangeable with, and shall be made of the same material and workmanship as the corresponding parts of the equipment supplied under specification. Where feasible, common component units shall be Employed in different pieces of the equipment in order to minimize spare parts stocking requirements. All equipment of the same type and rating shall be physically and electrically interchangeable.
- 1.6 All material and equipment shall be installed in strict accordance with the manufacturer's recommendation(s). The erection procedure must be approved by the OEM and erection completion shall be certified by OEM for satisfactory completion. The commissioning of all major equipment as recommended by Engineer in-charge.
- 1.7 Only first-class work in accordance with the best modern practice will be accepted. Installation shall be constructed as being the erection of equipment at its permanent location. This, unless otherwise specified, shall include unpacking, cleaning and lifting into position, grouping, levelling, aligning, coupling of or bolting down to previously installed equipment bases/ foundation, performing the alignment check and final adjusting prior to initial operation, testing and commissioning in accordance with the manufacturer's tolerances and instruction and the specification. All factory assembled rotating machinery shall be checked for alignment and adjustments made as necessary to re-establish the manufacturer's limits suitable guards shall be provided for the protection of personnel on all exposed rotating and/or moving machine parts and shall be designed for easy installation and removal for maintenance purpose. The spare equipment(s) shall be installed at designated location and tested for healthiness.
- 1.8 The Supplier shall apply oil and grease of the proper specification to suit the machinery, as is necessary for the installation of the equipment. Lubricants used for installation purpose shall be drained out and the system flushed through where necessary for applying the lubricant required for operation. The Supplier shall apply all operational lubricants to the equipment installed by him.
- 1.9 All oil, grease and other consumable used in the Works/Equipment shall be purchased in India unless the Supplier has any special requirement for the specific application of a type of oil or grease not available in India. In such is the case he shall declare in the proposal, where such oil or grease is available. He shall help Owner in establishing equivalent India make and Indian supplier. The same shall be applicable to other consumable too.
- 1.10 A cast iron or welded steel base plate shall be provided for all rotating equipment

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which are to be installed on a concrete base unless otherwise agreed to by the Owner. Each base plate shall support the units and its drive assembly, shall be of design with pads for anchoring the units and shall have a raised up all around and shall have threaded in air connections, if so required.

2. PROVISION FOR EXPOSURE TO HOT HUMID CLIMATE

Outdoor equipment supplied under the specification shall be suitable for service and storage under tropical conditions of high temperature, high humidity, heavy rainfall and environment favourable to the growth of fungi and mildew. The indoor equipment located in non- air conditioned areas shall also be same type.

2.1 SPACE HEATERS

2.1.1 The heater shall be suitable for continuous operation at 240 V as supply voltage. On-off switch and fuse shall be provided.

2.1.2 One or more adequately rated permanently or thermostatically connected heater shall be supplied to prevent condensation in any compartment. The heaters shall be installed in the lower portion of the compartment and electrical connection shall be made from below the heaters to minimize deterioration of supply wire insulation. The heaters shall be suitable to maintain the compartment temperature to prevent condensation. This shall be demonstrated by tests.

2.1.3 The heaters shall be suitably designed to prevent any contact between the heater wire and the air and shall consist of coiled resistance wire centred in a metal sheath and completely encased in a highly compacted powder of magnesium oxide or other material having equal heat conducting and electrical insulation properties, or they shall consist of resistance wire wound on a ceramic and completely covered with a ceramic material to prevent any contact between the wire and the air. Alternately, they shall consist of a resistance wire mounted into a tubular ceramic body and embedded in vitreous gale. The surface temperature of the heater shall be restricted wire is wound on a tubular ceramic body and embedded in vitreous glaze. The surface temperature of the heaters shall be restricted to a value which will not shorten the life of the heater sheaths or that of insulated wire or other component in the compartments.

2.2 FUNGISTATIC VARNISH

Besides the space heaters, special moisture and fungus resistant varnish shall be applied to parts which may be subjected or predisposed to the formation of fungi due to the presence or deposit of nutrient substances. The varnish shall not be applied to any surface of part where the treatment will interfere with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application of the varnish.

2.3 VENTILATION OPENING

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In order to ensure adequate ventilation, compartments shall have ventilation openings provided with fine wire mesh of brass or galvanized steel to prevent the entry of insects and to reduce to a minimum the entry of dirt and dust. Outdoor compartment openings shall be provided with shutter type blinds.

2.4 DEGREE OF PROTECTION

The enclosures of the control cabinets, junction boxes and marshalling boxes to be installed shall provide degree of protection as detailed here under:

- a) Installed outdoor: IP 55
- b) Installed indoor in air conditioned area: IP31
- c) Installed in covered area: IP 52
- d) Installed indoor in non-air-conditioned area where possibility of entry of water is limited: IP 41

The degree of protection shall be in accordance with IS: 13947(Part-I) or IEC-947 (Part-I). Type test report for degree of protection test, on each type of the box shall be submitted for approval.

The above requirement is indicative only. Requirements as provided in respective technical specification shall prevail.

10. Rating Plates, Name Plates and Labels

- 1. Each main and auxiliary item of substation is to be permanently attached to it in a conspicuous position a rating plate of non-corrosive material upon which is to be engraved manufacturer's name, year of manufacture, equipment name, type or serial number together with details of the loading condition under which the item of substation in question has been designed to operate, and such diagram plates as may be required by the Owner. The rating plates of each equipment shall be according to IEC requirement.
- 2. All such nameplates instruction plates, rating plates shall be bilingual with Hindi inscription first followed by English. Alternatively, two separate plates one with Hindi and the other English Instruction may be provided.

11. First Fill of Consumable, Oil and Lubricant

All the first fill consumable such as SF6, AC refrigerant, oil, lubricant, filling compounds, touch up paints, soldering/brazing material for all copper piping of circuit breakers and essential chemicals etc. which will be required to put the equipment covered under the scope of the specifications, into successful operation, shall be supplied by the Contractor unless specification excluded under the exclusions in these specifications and documents.

12. Design Improvements

- 1. The bidder may note that the equipment offered by him in the bid only shall be acceptable, however, the Purchaser or the Supplier may propose changes in the specification of the

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equipment or quality thereof and if the parties agreed upon any such changes, the specification shall be modified accordingly.

2. If any such agreed upon change is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any change in the price and/or schedule of the completion before the contractor proceeds with the change. Following such agreement, the provision thereof, shall be deemed to have been amended accordingly.

13. Quality Assurance Programme

1. To ensure that the equipment and services under the scope of this contract whether manufactured or performed within the contractor's Work or at his Subcontractor's premises or at the Owner's site or at any other place of work are in accordance with the specification, the Contractor shall adopt suitable quality assurance programme to control such activities at all points necessary.

Such programme shall be outlined by the contractor and shall be finally accepted by the Owner after discussions before award of contract. A quality assurance programme of the contractor shall be generally covered the following,

- a) His Organization structure for the management and implementation of the proposed quality assurance programme.
- b) Qualification data for bidder's key personnel.
- c) Documentation control System.
- d) The procedure for purchases of material, parts components and selection of subcontractor's services including vendor analysis, source, inspection, incoming raw material inspection, verification of material purchases etc.
- e) System for shop manufacturing and, site erection control including process controls and fabrication and assembly control.
- f) Control and non-conforming items and system for corrective actions.
- g) Inspection and test procedure both for manufacture and field activities.
- h) Control of calibration and testing of measuring instruments and field activities.
- i) System for indication and appraisal of inspection status.
- j) System for quality audits.
- k) System for authorising release of manufactured product to the Purchaser.
- l) System for maintenance of records.
- m) System for handling storage and delivery. and
- n) A quality plan detailing out the specific quality control measures and procedures adopted for controlling the quality characteristics relevant to each item of equipment furnished and/or services ordered.

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The Owner or his duly authorised representative reserves the right to carry out quality audit and quality surveillance of the system and procedure of the Contractor/his vendor's quality management and control activities.

2. QUALITY ASSURANCE DOCUMENTS

The contractor shall be required to submit the following quality Assurance Documents within three weeks after despatch of the equipment.

All Non-destructive Examination procedures, stress relief and weld repair procedure actually used during fabrication and report including radiography interpretation reports.

Welder identification list, listing welder's and welding operator qualification procedure and welding identification symbols.

Welder and Welding operator qualification certificate.

Raw material test reports on components as specified by the specification and for agreed to in the quality plan.

Stress relief time temperature chart/oil impregnation time temperature chart.

Factory test results for testing required as per applicable codes/ mutually agreed quality plan/standards referred in the technical specification.

The quality plan with verification of various customer inspection points(CAP) as mutually agreed and methods used to verify the inspection and testing points in the quality plan were performed satisfactory.

14. Inspection, Testing and Inspection Certificate

1. The Owner his duly authorised representative and/or outside inspection agency acting on behalf of the Owner shall have at all reasonable times free access to the Contractor's premises or Works and shall have the power at all reasonable times to inspect and examine the material and the Workmanship of the Works during its manufacture or erection and if part of the works during its manufacturing or erection and if the part of works being manufactured or assembled at other premises or works, the contractor shall obtain for the Engineer and for his duly authorised representative permission to inspect as if the work were manufactured or assembled on the Contractor own premises or works, Inspection may be made at any stage of manufacture, despatch or at site at the option of the Owner and equipment if found unsatisfactory due to bad workmanship or quality, material is liable to be rejected.
2. All equipment being supplied shall conform to type tests and shall be subject to routine tests in accordance with relevant standards.
3. The Contractor shall give the Owner/Inspector thirty (30) days written notice of any material being ready for testing along with work test certificate. Such tests shall be to the

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Contractor's account. The Owner unless witnessing of the tests is virtually waived, will attend such tests with thirty (30) days of the date of which the equipment is notified as being ready for tests/inspection, the contractor must ensure TPI for all inspections in line with tender documents.

4. The Owner or Inspector shall, within fifteen (15) days from the date of inspection as defined here in give notice in writing to the contractor, of any objection to any drawings and all any equipment and workmanship which in his opinion is not in accordance with the contract. The Contractor shall give due consideration to such objections and shall either made the modifications that may be necessary to meet the said objections or shall confirm in writing to the Engineer/Inspector giving reasons therein, that no modifications are necessary to comply with the Contract.
5. When the, factory tests have been completed at the Contractor's or Subcontractor's Works the Owner/Inspector shall issue a certificate to this effect within fifteen (15) days after completion of tests. The completion of these tests or the issue of the certificate shall not bind the Owner to accept the equipment should, it, on further tests after erection be found not to comply with the Contract. The equipment shall be dispatched to site only after approval of test reports and issuance of dispatch clearances in approved by the Owner.
6. In all cases where the Contract provides for tests whether at the premises or at the works of the contractor or of any Sub-Contractor. The Contractor except where otherwise specified shall provide free of charge such items as labour, material electrically, field water, stores, apparatus and instruments as may be reasonably demanded by the Owner/Inspector or his authorized representative to carry out effectively such tests of the equipment in accordance with the contractor and shall give facilities to the Owner/inspector or to his authorised representative to accomplish testing.
7. The inspection by Owner and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed quality assurance programme forming a part of the contractors.
8. The Owner will have the right of having at his own expenses any other test(s) of Reasonable nature carried out at Contractor premises or at site of in any other place in addition of aforesaid type and routine tests, to satisfy that the materials comply with the specification.
9. The Owner reserves the right for getting any field tests conducted on the completely assembled equipment at site.

15. Tests

1. CHARGING

On completion of erection of the equipment and before charging, each item of the equipment shall be thoroughly cleaned and then inspected jointly by the Owner and the Contractor for correctness and completeness of installation and acceptability for charging, leading to initial pre-commissioning tests at site. The list of pre-commissioning tests to be

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performed are given in section-7 and shall be included in the Contractor's quality assurance programme.

2. COMMISSIONING TESTS

2.1 The available instrumentation and control equipment will be used during such tests shall calibrated. However un-measurable parameters shall be taken into account in a reasonable manner by the Owner for the requirement of these tests. The tests will be conducted at the specified load points and as near the specified cycle condition as practicable. The Owner will apply proper corrections in calculation, to take into account conditions which do not correspond to the specified condition.

2.2 Any special equipment, tools and tackles required for the successful completion of the Commissioning Tests shall be provided by the Contractor, free of cost.

2.3 The specified tests to be conducted on equipment have been brought out in the respective chapters of the technical specification.

2.4 The Contractor shall be responsible for obtaining statutory clearances from the concerned authorities for commissioning the equipment and the switchyard. However, necessary fee shall be paid by Owner.

16. Packing and Shipping

All the equipment shall be suitably protected, coated, covered or boxes and crated to prevent damage or deterioration during transit, handling and storage at site till the time of erection. While packing all the materials, the limitation from the point of view of availability of Railway wagon sizes in India should be taken account. The Contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. Owner takes no responsibility of the wagons.

17. Protection

All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protecting device. All ends of all valves and pilings and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage. The parts which are likely to get rusted, due to exposure to weather should also be properly treated and protected in a suitable manner.

18. Painting and Finishing of Metal Surfaces

1. GENERAL

All metal surfaces shall be subjected to treatment for anti-corrosion protection. All ferrous surfaces for external use shall be hot-dip galvanized after fabrication. High tensile steel nuts and bolts and spring washers shall be electro-galvanized to service condition. All steel conductors including those used for earthing/grounding (above ground level) shall also be galvanized according to IS: 2629.

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2. HOT DIP GALVANIZING

2.1 The minimum weight of the zinc coating shall be 610g/sq.m and minimum thickness of coating shall be 85 microns for all items thicker than 6mm. For items lower than 6mm thickness requirement of coating thickness shall be as per relevant ASTM.

2.2 The galvanized surfaces shall consist of a continuous and uniform thick coating of zinc, firmly adhering to the surface of steel; The finished surfaces shall be clean and smooth and shall be free from defects like colour patches, are spots, unevenness of coating, plate which is loosely attached to the steel globules, spiky deposits, blistered surface, flaking or peeling off, etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection.

2.3 After galvanizing, no drilling or welding shall be performed on the galvanized parts of the equipment excepting that nuts may be threaded after galvanizing. Sodium dichromate treatment shall be provided to avoid formation of white rust after hot dip galvanization.

2.4 The galvanized steel shall be subjected to six one minute dips in copper sulphate solution as per IS-2633.

2.5 Sharp edges with radii less than 2.5mm shall be able to withstand four immersions of the standard price test. All other coating shall withstand six immersions. The following galvanizing tests should essentially be performed as per relevant Indian Standards.

- Coating
- Uniformity of zinc
- Adhesion test
- Mass of Zinc

2.6 Galvanized material must be transported properly to ensure that galvanized surfaces are not damaged during transit. Application of zinc rich paint at site shall not be allowed.

3. PAINTING

3.1 All sheet steel work shall be degreased, pickled, phosphated in accordance with the IS-6005 "code of practice for phosphating iron and sheet". All surfaces which will not be easily accessible after shop assembly shall beforehand be treated and protected for the life of the equipment. The surface which are to be finished painted after installation, shall be shop painted with at least two coats of primer. Oil, grease, dirt and swart shall be thoroughly removed by emulsion cleaning. Rust and scale shall be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly alkaline hot water and drying.

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- 3.2 After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and over drying. The phosphate coating shall be sealed with application of two coats may be "flash dried" while the second coat shall be stoved.
- 3.3 After application of the primer, two coats of finishing synthetic enamel paint shall be applied, each coat followed by stoving. The second finishing coat shall be applied after inspection of first coat of painting.
- 3.4 The exterior colour of the paint shall be as per shade No.:631 of IS-5 and inside shall be glossy white. Each coat of primer and finishing paint shall be of slightly different shade to enable inspection of the painting. A small quantity of finishing paint shall be supplied for minor touching up required at site after installation of the equipment.
- 3.5 In case the bidder proposes to follow his own standard surface finish and protection procedures or any other established painting procedures, like electrostatic painting etc. the procedure shall be submitted along with the bids for Owner's review & approval.

19. Handling, Storing and Installation

- 1. In accordance with the specific installation instructions as shown on manufacturer's drawings or as directed by the Owner or his representative, the contractor shall unload, store, erect, install, wire test and place into commercial use all the electrical equipment included in the contract. Equipment shall be installed in a neat, workmanlike manner so that it is level, plumb, square and properly aligned and oriented. Commercial use of switchyard equipment means completion of all site tests specified and energisation at rated voltage.
- 2. Contractor may engage manufacturer's engineer to supervise the unloading, transportation to site, storing and erection. The contractor shall engage the manufacturer's Engineer's for testing and commissioning of the various equipment being procured by them separately. Contractor shall unload, transport, store, erect, test and commission the equipment as per instructions of the manufacturer's supervisory Engineer(s)/ as per Manufacturer's approved process and shall extend full cooperation to them.
- 3. In case of any doubt or misunderstanding as to the correct interpretation of manufacture's drawing or instruction, necessary clarifications shall be obtained from the Owner/ Manufacturer. Contractor shall be held responsible for any damage to the equipment consequent to not following manufacturer's drawing/instructions correctly.
- 4. Where assemblies are supplied in more than one section, Contractor shall make all necessary mechanical and electrical connections between section including the connection between buses. Contractor shall also do necessary adjustments/alignments necessary for proper operation of circuit breakers, isolators and their operating mechanisms. All

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components shall be protected during testing and commissioning. Any equipment damaged due to negligence or carelessness or otherwise shall be replaced by the Contractor at his own expense.

5. Supplier shall be responsible for examining all the shipment and notify the Owner immediately of any damage, shortage, discrepancy etc. for the purpose of Owner's information only. The supplier shall submit to the Owner every week a report detailing all the receipts for any shortages or damages in transit, handling and/or in storage and erection of the equipment at Site. Any demurrage, wharf age and other such charges claimed by the transporters, railways etc. shall be to the account of the Supplier.
6. The Contractor shall be fully responsible for the equipment material unit the same is handed over to the Owner in an operating condition after commissioning. Contractor shall be responsible for the maintenance of the equipment material while in storage as well as after erection unit taken over by Owner, as well as protection of the same against theft, element of nature, corrosion, damages etc.
7. Where material/equipment is unloaded by Owner before the Contractor arrives at site or even when he is at site. Owner by right can hand over the same to Contractor and there upon it will be the responsibility of Contractor to store the material in an orderly and proper manner.
8. The Supplier shall be responsible for making suitable indoor storage facilities, to store all equipment which require indoor storage.
9. The words 'erection' and 'installation' used in the specification are synonymous.
10. Exposed live parts shall be placed high enough above ground to meet the requirements of electrical and other statutory safety codes.
11. The minimum phase to earth, phase to phase and section clearance for the various 132 kV, 66 kV and 33 kV sections of the switchyard are given below,

Voltage Grade	220kV	132kV	33kV
Phase to earth (mm)	2100	1300	320
Phase to Phase (mm)	2100	1600	350
Section clearance (mm)	5000	4000	2800

The design and workmanship shall be in accordance with the best engineering practices to ensure satisfactory performance throughout the service life.

20. Protective Guard

Suitable guards shall be provided for protection of personnel on all exposed rotating and/or moving machine parts. All such guards with necessary spares and accessories shall be designed for easy installation and removal for maintenance purpose.

21. Design Co-ordination

1. The Contractor shall be responsible for the selection and design of appropriate equipment to provide the best co-ordinate performance of the entire system. The basic design

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requirements are detailed out in this Specification. The design of various components, sub-assemblies and assemblies shall be so done so that it facilitates easy field assembly and maintenance.

2. The Contractor has to coordinate designs and termination with the agencies (If any) who are LSTK vendors/ contractor for the Owner if applicable. The names of agencies shall be intimated to the successful bidders.

22. Design Co-Ordination Meeting

The Contractor will be called upon to attend design co-ordination meeting with the Engineer, other Contractor's and the LSTK vendors of Owner (if any) during the period of Contract. The Contractor shall attend such meeting at his own cost as and when required and fully cooperate with such person and agencies involved during those discussions.

23. Tools and Tackles

The Contractor shall supply with the equipment one complete set of all special tools and tackles for the erection, assembly, dis-assembly and maintenance of the equipment. However, these tools and tackles shall be separately, packed and brought on to Site.

24. Equipment Bases

A cast iron or welded steel base plate shall be provided for all rotating equipment which is to be installed on a concrete base unless otherwise agreed to by the Owner. Each base plate shall support the unit and its drive assembly, shall be of a neat design with pads for anchoring the units, shall have a raised lip all around, and shall have threaded drain connections.

25. Support Structure

1. The support structures should be hot dip galvanised with minimum 610 gram/m² net of Zinc.
2. In case of any deviation in this regard the bid is liable to be rejected.
3. Support structure shall meet the following mandatory requirements.
4. The minimum vertical distance from the bottom of the lowest porcelain part of the bushing, porcelain enclosures or supporting insulators to the bottom of the equipment base, where it rests on the foundation pad shall be 2.55 meters or as per applicable standard.
5. The design calculations taking into account the environmental conditions of the substations shall be furnished for sizing of the structures.

26. Clamps and Connectors including Terminal Connectors

1. All power clamps and connectors shall conform to IS:5561 & NEMA CC1 and shall be made of materials listed below,

a)	For connecting ACSR Conductors	Aluminium alloy casting conforming to designation A6 of IS:617 and shall be tested for all
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		test as per IS:617
b)	For connecting equipment terminals made of copper with ACSR conductors	Bimetallic connectors made from aluminium alloy casting, conforming to designation A6 of IS 617 with 2mm thick bimetallic liner and shall tested as per IS:617
c)	For connecting GI shield wire	Galvanised mild steel
d)	Bolts, nuts & plain washer galvanised Spring washers for items 'a' to 'c'	Electro galvanisation for sizes Plain, washers below M12, for others hot dip galvanised. Electro-galvanised mild steel suitable for at least service condition-3 as per IS:1573

2. Each equipment shall be supplied with the necessary terminals and connectors, as required by the ultimate design for the particular installation. The conductor termination of equipment shall be suitable for Moose ACSR Conductor. The requirement regarding external RIV as specified for any equipment shall include its terminal fittings and the equipment shall be factory tested with the connectors in position.
3. Where copper to aluminium connections are required, bi-metallic clamps shall be used, which shall be properly designed to ensure that any deterioration of the connection is kept to a minimum and restricted to parts which are not current carrying or subjected to stress. The design details of the joint shall be furnished to the Owner by the supplier.
4. Low voltage connectors, grounding connectors and accessories for grounding all equipment as specified in each particular case, are also included in the scope of work.
5. No current carrying part of any of any clamp shall be less than 12 mm thick. All ferrous parts shall be hot dip galvanised. Copper alloy liner of minimum 2 mm thickness shall be cast integral with aluminium body for Bi-metallic clamps.
6. Lateral load deflection test shall be carried out as an acceptance test. The test procedure and accepted norms shall be mutually discussed and agreed to.
7. All casting shall be free blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off.
8. Clamp shall be designed to carry the same current as the conductor and the temperature rise shall be equal or less than that of the conductor at the specified with respect to the specified reference ambient temperature, shall also be indelibly marked on each component of the clamp/connector, except on the hardware.
9. All current carrying parts shall be designed and manufactured to have minimum contact resistance.
10. Clamps and connectors shall be designed to be corona controlled. RIV level for 220 kV system shall not be more than 1000/ micro volts respectively at the specified test voltage as per IS/NEMA.
11. TESTS
Clamps and connectors shall conform to type tests and shall be subjected to routine tests

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as per IS:5561.

27. Control Cabinets, Junction Boxes, Terminal Boxes & Marshalling Boxes for Outdoor Equipment

1. All type of boxes, cabinets etc. shall generally conform to & be tested in accordance with IS5039/IS-8623, IEC-439, as applicable, and the clauses given below.
2. Control cabinet, junction boxes, marshalling boxes & terminal boxes shall be made of sheet steel or aluminium and shall be dust, water and vermin proof. Sheet used shall be least 2.0 mm cold rolled or 2.5 mm hot rolled. The box shall be properly braced to prevent wobbling. There shall be sufficient reinforcement to provide level surfaces, resistance to vibrations and rigidity during transportation and installation. In case of aluminium enclosed box the thickness of aluminium shall be such that it provides adequate rigidity and long life as comparable with sheet of specified thickness.
3. The enclosures of the control cabinets, junction boxes, terminal boxes & marshalling boxes shall provide a degree of protection of not less than IP 55 as per IS: 2147. The bidder shall offer type tested (IP:55) Marshalling kiosk and type test report for degree of protection test each type of box shall be furnished for arrival. After protection degree test of marshalling kiosk, 2.0 kVrms for 1 (one) minute, insulation resistance and functional test should have been conducted. In case these tests have not been carried out during IP55 test, then the contractor shall carry out the IP-55 test along with these tests, at his cost.
4. Cabinet/boxes shall be free standing floor mounting type, wall mounting type or pedestal mounting type as per requirements.
5. All door, removable covers and plates shall be gasketed all around with suitably profiled EPDM gaskets. The gasket shall be tested in the presence of Owners representative. The quality of gasket shall be such that it does not get damaged/ cracked during the years of the equipment or its major overhaul whichever is earlier. All gasketed surfaces shall be smooth straight and reinforced of necessary to minimize distortion and to make a tight seal. Ventilating Louvers, if provided, shall have screen and filters. The screen shall be fine wire mesh made of brass or GI wires.
6. All boxes/cabinets shall be designed for the entry of cables from bottom by means of weather proof and dust-proof connection. Boxes and cabinet shall be designed with generous clearances to avoid interference between the wiring entering from below and any terminal blocks or accessories mounted within the base of the marshalling kiosk/box shall be provided for this purpose along with the proper blanking plates. Necessary number of cable glands shall be supplied and fitted on this gland plate. The gland shall project at least 25mm above gland plate to prevent entry of moisture in cable crutch. Gland plate shall have provision for some future glands to be provided later, if required. The Nickel plated glands shall be dust proof, screw on & double compression type and made of brass. The gland shall have provision for securing armour of the cable separately and shall be

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provided with earthing tag. The glands shall conform to BS:6121.

7. A 240V, single phase, 50Hz, 15amp AC plug and socket shall be provided the cabinet with ON-OFF switch for connection of hand lamps. Plug and socket shall be of industrial grade.
8. For illumination of control cabinet, a 7 Watt LED shall be provided.
9. All control switches shall be of rotary switch type and Toggle/piano switches shall not be provided.
10. EARTHING

Positive earthing of the cabinet shall be ensured by providing two separate earthing pads. The earth wire shall be terminated on to the earthing pad and secured by the use of star of self-etching washer. Earthing of hinged door shall be done by using a separate earth wire.

11. TESTS

The marshalling kiosks shall be subject to routine tests as per 18:5039. The following routine tests shall also be conducted:

- Check for wiring
- Visual and dimension check

Marshalling kiosks shall be provided with danger plate and a diagram showing the numbering/connection/ferruling by pasting the same on the inside of the door.

28. Auxiliary Switches

The auxiliary switch shall confirm to the following type tests:

- a) Electrical endurance test -A minimum of 2000 operation for 2A DC with a time constant examination of mV drop/visual defects/temperature rise test.
- b) Mechanical endurance test. A minimum of operations as specified in the relevant IS with a subsequent checking of contact pressure test visual examination. Heat run test on contacts.

29. Terminal Blocks and Wiring

1. Control and instrument leads from the switchboards or from other equipment will be brought to terminal boxes or control cabinets in conduits. All inter-phase and external connections to equipment or to control cubicles will be made through terminal blocks.
2. Terminal blocks shall be 1100 v grade and have continuous rating to carry the maximum expected current on the terminals. Those shall be of moulded piece complete with insulated barriers stud type terminals, washers, nuts and lock nuts. Screw clamp, overall insulated, insertion type, rail mounted terminals can be used in place of stud type terminals. But preferably the terminal blocks shall be non-disconnecting stud type equivalent to Elmex type CATM4, Phoenix cage clamp type of Wedge or equivalent. The insulating material of terminal block shall be nylon 6.6 which shall be free of halogens, fluorocarbons etc.
3. Terminal block for current transformer and voltage transformer secondary leads shall be

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provided with test links and isolating facilities. The current transformer secondary leads shall also be provided with short circuiting and earthing facilities.

4. The terminal shall be that maximum contact area is achieved when a cable is terminated. The terminal shall have a locking characteristic to prevent cable from escaping from the terminal clamp unless it is done intentionally.
5. The conducting part in contact with cable shall preferably be tinned or silver plated however Nickel plated copper or zinc plated steel shall also be acceptable.
6. The terminal blocks shall be of extensible design.
7. The terminal blocks shall have locking arrangement to prevent its escape from the mounting rails.
8. The terminal blocks shall be fully enclosed with removable covers of transparent, non-deteriorating type plastic material. Insulating barriers shall be provided between the terminal blocks. These barriers shall not hinder the operator from carrying out the wiring without removing the barriers.
9. Unless otherwise specified terminal blocks shall be suitable for connecting the following conductors on each side.

a)	All circuits except CT circuits	Minimum of 2.5 sq.mm copper flexible
b)	All CT circuits copper flexible.	Minimum of 4 sq.mm.

10. The arrangements shall be in such a manner so that it is possible to safely connect or disconnect terminals on live circuits and replace fuse links when the cabinet is live.
11. At least 20 % spare terminals shall be provided on each panel/cubicle/box and these spare terminals shall be uniformly distributed on all terminals rows.
12. There shall be a minimum clearance of 250 mm between the First bottom row of terminal block and the associated cable gland plate. Also the clearance between two rows of terminal blocks shall be a minimum of 150 mm.

The Supplier shall furnish all wire, conduits and terminals for the necessary interphase electrical connection (where applicable) as well as between phases and common terminal boxes or control cabinets. The wiring required in these items shall be run in metallic ducts or shielded cables in order to avoid surge overvoltage either transferred through the equipment or due to transients induced from the EHV circuits.

13. All input and output terminals of each control cubicle shall be tested for surge withstand capability and transverse modes. The supplier shall also provide all necessary to achieve an impulse withstand level at the cable interfaces of equipment.

30. Lamps and Sockets

1. LAMPS

All indication lamps shall also be LED based. Socket base shall be as per IS-1258, except in the case of signal lamps.

2. SOCKETS

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All sockets (convenience outlets) shall be suitable to accept both 5 A & 15 A pin round Standard Indian plugs. They shall be switched sockets with shutters.

3. HAND LAMP

A 240 Volts, single phase, 50 Hz AC plug point shall be provided in the interior of each cubicle with ON-OFF Switch for connection of hand lamps.

4. INTERIOR LIGHTING

Each panel shall be provided with a LED lighting fixture of Standard Indian type rated for 240 Volts, single phase, 50 Hz supply for the interior illumination of the panel during maintenance. The Fitting shall be controlled by the respective panel door switch.

5. SWITCHES AND FUSES

5.1 Each control panel shall be provided with necessary arrangements for receiving, distributing, isolating and fusing of DC and AC supplies for various control, signaling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with switch fuse units. Selection of the main and Sub-circuit fuse rating shall be such as to ensure selective clearance of sub-circuit faults. Potential circuits for relaying and metering shall be protected by fuses.

5.2 All fuses be of HRC cartridge type conforming to IS:9228 mounted on plug-in type fuse bases.

5.3 Miniature circuit breakers with thermal protection and alarm contacts will also be accepted. All accessible live connection to fuse bases shall be adequately shrouded. Fuses shall have operation indicators for indicating blown fuse condition. Fuses carrier base shall have imprints of the fuse rating and voltage.

31. Bushings, Hollow Column Insulators, Support Insulators

1. The bidder shall offer composite silicon rubber polymer insulator for all insulation purpose as per project requirement, conforming to IEC-61109. In case of non-compliance of composite insulators with respect to State/National electricity authorities' guidelines/requirements, the anti-fog type porcelain insulators may be used wherever mandatory. The required deviations with respect to above requirements shall be clearly mentioned in the deviation sheet along with the supporting documents. In absence of such deviations statements, the compliance of this point is mandatory and binding on the vendor.
2. Bushing shall be manufactured and tested in accordance with IS:2099 & IEC: 137 while hollow column insulators shall be manufactured and tested in accordance with IEC 233/18 5621. The support insulators shall be manufactured and tested as per IS 2544/IEC 168 and IEC 273. The Insulators shall also conform to IEC 815 as applicable.
3. Following requirements to be fulfilled if anti-fog porcelain insulators are provided as instructed in point 29.1 of this chapter.

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- 3.1 Support insulators, bushings and hollow column insulators shall be manufactured from high quality porcelain. Porcelain used shall be homogeneous, free from lamination, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified tough and impervious to moisture.
- 3.2 Glazing of the porcelain shall be uniform brown in colour, free from blisters, burrs and similar other defects.
- 3.3 Support insulators/ bushings/ hollow column insulators shall be designed to have ample insulation, mechanical and rigidity for the conditions under which they will be used.
- 3.4 When operating at rated voltage there shall be no electric discharge between the conductors and busing which would cause corrosion or injury to conductors, insulators or supports by the formation of substances produced by chemical action. No radio interference shall be caused by the insulators/bushings when operating at the normal rated voltage.
- 3.5 Bushing porcelain shall be robust and capable of withstanding the internal pressures likely to occur in service. The design and location of clamps and the shape and the strength of the porcelain flange securing the bushing to the tank shall be such that there is no risk of fracture. All portions of the assembled porcelain enclosures and support other than gaskets, which may in any way be exposed to the atmosphere shall be composed of completely non hygroscopic material such as metal as metal or glazed porcelain.
- 3.6 All iron parts shall be hot dip galvanised and all joints shall be air tight. Surface of joints shall be trued up porcelain parts by grinding and metal parts by machining. Insulator/bushing design shall be such as to ensure a uniform compressive pressure on the joints.

4. TESTS

Bushing hollow column insulators and support insulators shall conform to type tests and shall be subjected to routine tests in accordance with IS:2099 & IS: 2544.

4.1 Technical parameters of bushing/ Hollow column insulators/ support insulators,

Sl. No.	Voltage Class	220kV System	132kV System	66kV System	33kV System
a)	Rated Voltage (kV)	245	145	72.5	36
b)	Impulse withstand voltage (dry and wet) (kVp)	1050	650	325	170
c)	Power frequency with stand voltage (dry and wet (kVrms))	460	275	140	75
d)	Total creepage distance (mm)	25mm/kV			
e)	Pollution	Class – III heavy (as per IEC 71) and as			

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	specified in section 2 for all class of equipment.
f)	Insulator shall also meet requirement of and IEC-815 as applicable having alternate long and short sheds.

32. Motors

Motors shall be "Squirrel Cage" three phase induction motors of sufficient size capable of satisfactory operation for the application and duty as required for the driven equipment and conform to type tests and shall be subjected to routine tests as per applicable standards. The motors shall be of approved make.

1. ENCLOSURES

- Motor to be installed shall have enclosure equivalent to IP 55 as per IS:4691.
- Two independent earthing points shall be provided on opposite sides of the motor for bolted connection of earthing conductor.
- Motors shall have drain plugs so located that they will drain water resulting from condensation or other causes from all pockets in the motor casing.
- Motor weighing more than 25 kg shall be provided with eyebolts, lugs or other means to facilitate lifting.

33. Rating Plates, Name Plates and Labels

Each main and auxiliary item of equipment is to have permanently attached to it in a conspicuous position a rating plate of non-corrosive material upon which is to be engraved manufacturer's name, year of manufacture, equipment, type or serial number together with details of loading conditions under which the item of equipment in question has been designed to operate and such diagram plates as may be required by the Owner. The rating plate shall conform to IEC requirement.

All such name plates, instruction plates rating plates etc. shall be in bilingual with Hindi inscription first followed by English. Alternatively, two separate plates one with Hindi & the other with English inscription may be provided.

34. Radio Interference Voltage (RIV) Test

1. GENERAL

Unless otherwise stipulated, all equipment together with its associated connectors, where applicable, shall be tested for measurement of radio interference voltage (RIV).

2. TEST LEVELS

The test voltage levels for measurement of external RIV are listed under the relevant clauses of the specification.

3. TEST METHOD FOR RIV

3.1 RIV tests shall levels for according to measuring as per International Special-Committee on radio Interference (CISPR) Publication 16-1 (1993) Part-1. The measuring circuit shall preferably be tuned to frequency with 10 % of 0.5 MHz but other frequency

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being recorded. The results shall be in microvolts.

- 3.2 Alternatively, RIV tests shall be in accordance with NEMA standard Publication No.107-1964, except otherwise noted herein.
- 3.3 In measurement, RIV, temporary additional external shielding may be provided. In measurements of RIV only standard fitting of identical type supplied with the equipment and a simulation of the connections as used in the actual installation will be permitted in the vicinity within 3.5 meters of terminals.
- 3.4 Ambient noise shall be measured before and after each series of tests to ensure that there is no ambient noise level. If variation is present, the lowest ambient noise level will form basis for the measurements. RIV levels shall be measured at increasing voltages 85%, 100%, 115% and 130% of the specified RIV test voltage for all equipment unless otherwise specified.
- 3.5 The metering instruments shall be as per CISPR recommendation or equivalent device so long as it has been used by other testing authorities.
- 3.6 The metering instruments shall be as per CISPR recommendation or equivalent device so long as it has been used by other testing authorities.

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Annexure-A:

List of Standards and Specifications/ General Standards/ Indian Electricity Rules

IS-5:	Colours for Ready Mixed Paints and Enamels
IS-335:	Insulating Oil for Transformers and switchgear
IS-375:	Marketing and Arrangement for Bus-bars, Main Connection & Auxiliary Winding
IS-617:	Aluminium and Aluminium alloy & Ingots and Castings for General Engineering Purposes
IS-1448:	Methods of Test for Petroleum and its Products.
IS-2071:	Measuring Devices
IS-2147:	Degree of Protection Provided by Enclosures of for Low voltage switch gear and control Gear
IS-2165:	Phase-to-Phase Insulation Co-ordination, Principles and Rules
IS-2362:	Determination of Water by the Karl fisher Method
IS-3043:	Codes of practice for earthing
IS-3202:	Code of Practice for climate proofing of electrical equipment
IS-3637:	Gas Operated Relays
IS-6103:	Methods of Test for specific resistance (Resistivity) of Electrical Insulating Liquids
IS-6104:	Method of Test for Interfacial Tension of Oil against Water by the Ring Method.
IS-6262:	Method for Determination of Electric strength of insulating liquids.
IS-6792:	Method for Radio Interference Tests on High Voltage insulators
IEC-214:	On-Load Tap-Changers
IEC-289:	Reactors
IEC-354:	Loading Guide for Oil Immersed power transformers.
IEC-551:	Determination of Transformer and reactor Sound levels
ANSI-C57, 12, 80:	General requirements for Distribution, Power and Regulating Transformers.
ANSI-C57, 12, 90:	Test Code for Distribution, Power and Regulation Transformers.
ANSI-C57, 16:	Terminology & Test Code for current limiting Reactors.
ANSI-C57, 21:	Requirements Terminology and Test Code for Shunt Reactors Rates over 500 KVA.
ANSI-C57, 92:	Guide for loading Oil-Immersed Power Transformer up to and including 100 MVA with 55oC or 65oC Winding Rise
ANSI-CG, IEEE-4:	Standard Techniques for high Voltage Testing
NEMA-TR-1:	Transformers, Regulators and Reactors
IS-4379:	Identification of the Contents of Industrial Gas Cylinders

1. Circuit Breakers

IEC-56:	High Voltage Alternating Current Circuit Breakers
IS 13118/ IEC-427:	Synthetic Testing of high voltage alternating current circuit breakers

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2. Current Transformers, Voltage Transformers and Coupling Capacitor Voltage Transformers

IS-2705:	Current Transformers
IS-3156:	Voltage Transformers
IS-7311:	Coupling capacitor and capacitor divider
IEC-185:	Current transformers
EC-186A:	Voltage Transformers
IEC-186B:	Coupling capacitors and capacitor dividers
IEC-44:	Instrument Transformers measurement of Partial discharges
IEC-481:	Requirements for instrument transformers
ANSI-C93.1:	Requirements for power line carrier coupling capacitor

3. Bushing Insulators

IS-2099:	Bushing for alternating Voltages above 1000V
IEC-137:	Insulated Bushings for Alternating voltages above 1000 V
IEC-61109:	Composite Silicon Rubber polymer insulators.
IEC-60437:	Radio Interference Test on High voltage Insulators
IEC-60507:	Artificial pollution test on high voltage insulators to be used on AC systems
IEC-60815:	Guide for the selection of insulators in respect of polluted conditions.
IEC-61952:	Insulators for overhead lines, composite line, post insulators for alternative current within nominal voltage greater than 1000 volts upto 245 KV- Definitions, test methods and acceptance criteria.
IEC-61466/1:	Composite strings, insulator units for overhead lines for nominal voltage greater than 1 KV-part-1 Standard strength classes and end fittings.
IEC-61466/2:	Composite strings, insulator units for overhead lines for nominal voltage greater than 1 KV-part-2 Dimensional and electrical characteristics.

4. Surge Arresters

IS-3070:	Lightning arrestors for alternating current systems: Metal (part-3) oxide lightning arrestors without gaps.
IEC 99-4:	Metal oxide surge arresters without gaps

5. Cubicles and Panels & Other related Equipment

IS:722:	AC Electricity Meters (P1 to P9)
IS 1248	Direct acting indicating analogue electrical measuring instruments their accessories.
IS722, IS-1248: (PO-3)	Electrical relays for power system protection.
IS-3231, 3231, IEC-68.2.2:	Basic environmental testing procedures Part 2: Test B: Dry heat
IEC-529:	Degree of Protection provided by enclosures
IEC-158:	Low Voltage control gear, contractors
IEC-439:	Low voltage switchgear and control gear assemblies
ANSI-C37.20:	Switchgear assemblies, including metal enclosed bus.
ANSI-C37.50:	Test Procedures for low voltage alternating current power circuit breakers

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- ANSI-C39: Electric Measuring instrument.
- ANSI-C83: Components for electric equipment
- IS:8623: Specification for sugar NEMA-AB-Moulded Case circuit and systems

6. Lt Switchgear

- IS:8623: Specification for factory built assemblies of Switchgear & Control gear for voltages upto and including 1000 V AC/ 1200V DC
- IS:4237: General requirements for switchgear and control gear for voltage not exceeding 1000 V.
- IS:2147: Degree of protection provided by enclosures for low voltage switchgear and control gear.
- IS:3202: Code of practice for climate proofing of electrical equipment.
- IS:3072: Code of practice for installation and maintenance of switchgear
- IS:8544: AC motor starters of voltage not exceeding 1000 Volts
- IS:4064: Air-break switches, air break dis-connectors air break dis-connectors and fuse combination unit for voltages not exceeding 1000V AC or 1200V DC.
- IS:3231: Electrical relays for power system protection.
- IS:1248: Electricity indicating instruments
- IS:722: AC Electricity meters.
- IS:375: Marking and arrangements of bus bars.
- IS:9224: HRC Cartridge fuses (Part II)
- IS:6875: Switches and push-buttons
- IS:6005: Code of practice of phosphating iron and steel
- IS:5082: Wrought Aluminium and Aluminium alloys for electrical purposes.

7. Disconnecting Switches

- IEC-129: Alternating Current Dis-connectors (Isolators) and Earthing switches
- IS-9921: Isolators
- IEC-265: High voltage switches
- ANSI-C37.32: Schedule of preferred Ratings, manufacturing specification and application guide of high voltage air switches, bus supports and switch accessories.
- ANSI-C37.34: Test code for high voltage air switches
- NEMA-SG6: Power switching equipment.

8. Protection and Control Equipment

- IEC-51: Recommendations for Direct acting indicating analogue electrical measuring instruments and their accessories.
- IEC-255: Electrical relays
- IEC-297: Dimensions of mechanical structures of the 482.6mm (19 inches) series.
- IEC-359: Expression of the performance of electrical & electronic measuring equipment. IEC-387 Symbols for Alternating-Current Electricity meters
- IEC-447: Man machine interface/ MM-Alternating principles
- IEC-521: Class 0.5, 1 and 2 alternating current wall hour meters

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- IEC-547: Modular plug-in unit and standard 19-inch rack mounting unit based on NIM standard (for electronic nuclear instruments)
- ANSI-81: Screw threads.
- ANSI-B18: Bolts and Nuts
- ANSI-C37.1: Relays, Station controls etc.
- ANSI-C37.2: Manual and automatic station control, supervisory and associated telemetering equipment.
- ANSI-C37.2: Relays and relay system associated with electric power apparatus.
- ANSI-C39.1: Requirements for electrical analogue indicating instruments.

9. Motors

- IS-325: Three phase induction motors
- IS-4691: Degree of protection provided by enclosure for rotating electrical machinery
- IEC-34: Rotating electrical machines
- IEC-68 (P1 to P5): Environmental testing
- IEC-326 (P1 to P2): Printed boards.

10. Material and Workmanship Standards

- IS-1363: Hexagon head bolts, screws and nuts of product grade C.
- IS-1364: Hexagon head bolts, screws and nuts of products grades A and B
- IS-3138: Hexagonal Bolts and nuts (M42 to M150)
- IS-898: Fasteners: Bolts, screws and studs

11. Clamps and Connectors

- IS-2121: Fitting for aluminium and steel cored aluminium conductors for overhead power lines.
- IS-731: Porcelain insulators for overhead power line with a nominal voltage than 1000 V
- IS-2486: Insulator fitting for overhead power lines with a nominal voltage greater than 1000 V
- IEC-120: Dimensions of Ball and socket couplings of string insulator units.
- IEC-137: Insulated turning for alternating voltages above 1000 V.
- IEC-168: Tests on indoor and outdoor post insulators of glass for system with nominal voltages greater than 1000 V.
- IEC-233: Tests on Hollow insulators for use in electrical equipment.
- IEC-273: Characteristics of indoor and outdoor post insulators for systems with nominal voltage greater than 1000 V.
- IEC-305: Insulators for overhead lines with nominal volt above 1000 V-ceramic or glass mull units for AC system characteristics of string insulator units of the cap and pin type.
- IEC-372: Locking devices for ball and socket couplings of string insulator units dimensions and tests
- IEC-383: Insulators for overhead lines with a nominal voltage above 1000 V.
- IEC-433: Characteristics of string insulator units of the long rod type.
- IEC-471: Dimensions of Clevis and tongue coupling of string insulator units
- ANSI-C29: Wet Process porcelain insulators
- ANSI-C29.1: Test Methods for electrical power insulators

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ANSI-C29.2: For insulators, wet-process porcelain and toughened glass suspension type. ANSI-C29.8
For wet-process porcelain insulators apparatus, post-type.

ANSI-G.8: Iron and steel hardware

ASTM A-153: Zinc Coating (Hot-Dip) on iron and steel hardware

12. Strain and Rigid Bus-Conductor

IS-2678: Dimensions & tolerances for wrought aluminium and aluminium alloys.

IS-5082: Wrought aluminium and aluminium alloy bars, Rods, tubes and sections for electrical purposes.

ASTM-B 230-82: Aluminium 1350 H19 Wire for electrical purposes

ASTM-B 221-81: Concentric – lay – stranded, aluminium 1350 conductors

ASTM-B 221: Aluminium – Alloy extruded bar, rod, wire shape.

ASTM-B 236-83: Aluminium bars for electrical purpose (Bus-bars)

ASTM-B 317-83: Aluminium – Alloy extruded bar, rod, pipe and structural shapes for electrical purposes (Bus Conductors)

13. Battery Chargers

IS:3895: Mono-Crystalline Semiconductor Rectifier Cells and stacks

IS:4540: Mono-crystalline semiconductor rectifier assemblies and equipment

IS:6619: Safety code for semiconductor rectifier equipment.

IS:2026: Power Transformer

IS:2959: AC Contractors for voltage not exceeding 1000 Volts

IS:1248: Indicating Instruments

IS:2208: HRC Fuses

IS:4064: Air break switches, air break Disconnecter & fuse combination units for voltage not exceeding 1000V Ac or 1200V DC.

IS:2147: Degree of protection provided by enclosures for low voltage switchgear and controlgear.

IS: 600/S: Code of practice for phosphating of Iron and steel.

IS:3231: Electrical relays for power system protection

IS:3842: Electrical relay for AC systems.

IS:5: Colours for ready mix paints.

14. Battery

IS:1651: Stationary Cells and Batteries, Lead-Acid Type (with Tubular Positive Plates).

IS:1652: Stationary Cells and Batteries, Lead-Acid Type (with Plant Positive Plates).

IS:1146: Rubber and plastic containers for Lead-Acid Batteries

IS:6071: Synthetic separators for Lead-Acid batteries.

IS:266: Specification for Sulphuric Acid.

IS:1069: Specification of water for storage batteries

IS:3116: Specification for sealing compound for lead-acid batteries

IS:1248: Indicating Instruments

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15. Wire and Cables

- IS-694: PVC insulated cables for working voltages upto and including 1100Volts.
- IS-1255: Code of practice for installation and maintenance of power cables upto and including 33 kV rating.
- IS-1554: PVC insulated (heavy duty) electric cables (part 1) for working voltage upto and including 1100 V Part (2) for working voltage from 3.3 upto including 11 kV.
- IS-1753: Aluminium conductors for insulated cables
- IS-2982: Copper conductors in insulated cables and cords.
- IS-3961: Recommended current rating for cables.
- IS-3975: Mild steel wires, formed wires and tapes for armouring of cables
- IS-5831: PVC insulated and sheath of electric cables
- IS-6380: Elastomeric insulating and sheath of electric cables.
- IS-7098: Cross linked polyethylene insulated PVC sheathed cables for working voltage up to and including 1100 volts. Part (2) Cross-linked polyethylene insulated PVC sheathed cables for working voltage from 3.3 kV up to and including 33 kV.
- IS-8130: Conductors for insulated electrical cables and flexible cords.
- IS-10418: Specification for drums for electrical cables. IEC-96 Radio Frequency cables
- IEC-183: Guide to the selection of High Voltage Cables.
- IEC-189: Low frequency cables and wires with PVC insulation and PVC Sheath
- IEC-227: Polyvinyl Chloride insulated cables of rated voltages up to and including 450/750 V.
- IEC228L: Conductors of insulated cables.
- IEC-230: Impulse tests on cables and their accessories.
- IEC-287: Calculation of the continuous current rating of cables (100% load factor).
- IEC-304: Standard colours for insulation for low frequency cables and wires.
- IEC-331: Fire resisting characteristics of Electric cables.
- IEC-332: Tests on electric cables under fire conditions
- IEC-502: Extruded solid dielectric insulated power cable for rated voltages from 1 kV up to 30 kV.
- IEC-754: Tests on gases evolved during combustion of electric cables.
- NEMA-WC1: Asbestos and asbestos-varnished cloth and asbestos thermoplastic insulated wire and cable
- NEMA-WC2: Steel armour and associated covering for impregnated paper insulated cables
- NEMA-WC3: Rubber insulated wire and cable for transmission and distribution of electrical energy.
- NEMA-WC5: Thermoplastic insulated wire and cable for the transmission and distribution of electric energy.
- NEMA-WC7: Cross linked thermo setting polyethylene insulated wire and cable for the transmission and distribution of electrical energy.
- NEMA-WC8: Ethylene-propylene-rubber insulated wire and cable for the transmission and distribution of electrical energy.
- NEMA-W67: Cross linked thermo setting polyethylene
- IS-659: Safety code for air conditioning
- IS-1391: Room air conditioners.

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IS-6272: Industrial cooling fans.

16. Galvanizing

IS-209: Zinc Ingot.

IS-2629: Recommended practice for Hot-Dip galvanizing on iron and steel.

IS-2629: Methods for testing uniformity of coating of zinc coating articles.

ASTM-a-123: Specification for zinc (Hot galvanizing) coatings on products fabricated from rolled, pressed and forged steel shapes, plates, bars and strips.

ASTM-A-153: Specification for Zinc coating (Hot Dip) on iron and steel hardware

ASTM-A-239: Test method for locating the thinnest. Spot in a Zinc (galvanised) coating on iron and steel articles by the preece test (Copper sulfated dip).

17. Fire Protection

IS-554: Dimensions for pipe threads where pressure tight joints are required on the threads.

IS638: Sheet rubber jointing and rubber insertion jointing.

IS-778: Copper alloy gate, globe and check valves for water works purposes.

IS-780: Sluice valves for water-works purposes (50 to 300 mm size)

IS-1536: Centrifugally cast (spun) iron pressure pipes for water gas and sewage.

IS-1538(1993): Cast iron fitting for pressure pipes for water gas and sewage.

IS-1703(1989): Copper alloy bar valves (horizontal plunger type) for water supply fittings.

IS2379(1990): Colour code for identification of pipe lines.

IS-2643 (P1 to P3: 1990): Dimensions for pipe threads for fastening purposes.

IS-2685(1992): Code of practice for selection, installation and maintenance of sluice valves.

IS-2906(1990): Specification for sluice valves for water works purposes (350 to 1200 mm size)

IS-3589(1991): Seamers or ectectically welded steel pipes for water, gas and sewage (168.3 to 2032 mm outside diameter).

IS-4038(1990): Foot valves for water works purposes

IS-4927(1991): Unlined flax canvas hose for firefighting.

IS-5321-(P1 and P2 1991): Swing check type reflux (non-return) valves

IS-13095 (1991): Butterfly valves for general purposes

18. Steel Structures

IS-228: Method of chemical analysis of pig iron, cast iron and plain carbon and low alloy steels.

IS-802: Code of practice for use of structural steel in overhead transmission line towers.

IS-806: Code of practice for use of steel tubes in general building construction.

IS-808: Dimensions for hot rolled steel beam column channel and angle sections.

IS-814: Covered electrodes for manual arc welding of carbon manganese steel

IS-816: Code of practice for use of metal arc welding for general construction in mild steel.

IS817: Code of practice for training and testing of metal arc welders. Part 1: Manual metal arc welding

IS-875: Code of practice for design loads (other than earthquake) for buildings and structures.

IS-1161: Steel tube for structural purposes.

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IS-1182:	Recommended practice for radiographic examination of fusion welded but joints in steel plates.
IS-1363:	Hexagonal head bolts, screws and nuts of products grade C.
IS-1364:	Hexagon head bolts, screw & nuts of products grade A and B.
IS-1367:	Technical supply condition for threaded steel fasteners
IS-1599:	Method for bend test.
IS-1608:	Method for tensile testing of steel products.
IS-1893:	Criteria for earthquake resistant design of structures
IS-1978:	Line pipe
IS-2062:	Steel for general structural purposes
IS-2595:	Code of practice for Radiographic testing
IS-3063:	Single built rectangular section spring washers for bolts, nuts and screws.
IS-3664:	Code of practice for ultra-sonic pulse echo testing by contact and immersion methods.
IS-7205:	Safety code for erection of structural steel work.
IS-9595:	Recommendations for metal arc welding of iron and carbon manganese steels.
ANSI B18.2.1:	Inch series square and Hexagonal bolts and screws.
ANSI-B18.2.2:	Square and hexagonal nuts
ANSI-G8.14:	Round head bolts

19. Other Civil Works Standards

IS-269 33:	Grade ordinary portland cement
IS-2721:	Galvanized steel chain link fence fabric.
IS-278:	Galvanized steel barbed wire for fencing
IS-383:	Coarse and fine aggregates from natural sources for concrete.
IS-432:	Mild steel and medium tensile steel bars and hard-drawn steel wire for concrete reinforcement
IS-456:	Code of practice for plain and reinforced concrete.
IS-516:	Method of test for strength of concrete
IS-800:	Code of practice for general construction in steel
IS-806:	Steel tubes for structural purposes
IS-1172:	Basic requirements for water supply, drainage and sanitation
IS-1199:	Method of sampling and analysis of concrete
IS-1566:	Hard-drawn steel wire fabricated concrete reinforcement
IS-1742:	Building drainage
IS-1785:	Plain hard-drawn steel wire for pre stressed concrete
IS-1786:	High strength deformed and wires for concrete reinforcement
IS-1811:	Method of sampling Foundry sands.
IS-1893:	Criteria for earthquake resistant design of structures. IS-2062 Steel for general structural purposes
IS-2065:	Code of practice for water supply in buildings
IS-2090:	High tension steel bars used in pre-stressed concrete

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IS-2140:	Standard galvanised steel wire for fencing
IS-2470:	Code of practice for installation of septic tanks
IS-2514:	Concrete vibrating tables
IS-2645:	Integral cement waterproofing compounds
IS-3025:	Method of sampling and test physical chemical for water waste water.
IS-4091:	Code of practice for design and construction of foundations for transmission line tower and poles
IS-4111:	Code of practice for ancillary structure in sewerage system
IS-4990:	Plywood for concrete shuttering work
IS-5600:	Sewage and drainage pumps

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SECTION 4:

ANNEXURE-A: COMPLIANCE CERTIFICATE OF TECHNICAL SPECIFICATION

The bidder shall confirm compliance to the following by signing and stamping this compliance certificate and furnishing same with the offer.

1. The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusion/ deviation with regard to same.
2. There are no deviation(s) with respect to specification
3. I have read all the clauses of respective sections of technical specifications consisting of annexure/ drawing/ technical checklist etc. (total pages 226nos.) and understood the requirements and there is no deviation/ change request. I also understand that non compliance to technical specification shall be liable for rejection of my technical offer.
4. Any comments/ clarifications on technical/ inspection requirements furnished as part of bidder's covering letter shall not be considered by BHEL, and bidder's offer shall be construed to be in conformance with the specification.
5. Any changes made by the bidder in the price schedule with respect to the description/ quantities from those given in 'BOQ' of the specification shall not be considered (i.e., technical description & quantities as per the specification shall prevail).

Date:

Bidder's Stamp & Signature

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SECTION 4:

ANNEXURE-B: DEVIATION/ CHANGE REQUEST OF TECHNICAL SPECIFICATION

Bidder shall list out all technical potential deviation/ change request (s) along with clause with respect to technical specifications.

Sl. No.	Page No.	Clause No.	Deviation	Reason/ Justification(s)
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Any deviation not specifically brought out in this section shall not be admissible for any commercial implication at later stage. Except to the technical deviations listed in this schedule, bidder's offer shall be considered in full compliance to the tender specifications irrespective of any such deviation indicated / taken elsewhere in the submitted offer.

Date:

Bidder's Stamp & Signature

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SECTION 4:

ANNEXURE-C: GUARANTEED TECHNICAL PARTICULARS

Sl. No.	Description	Particulars to be filled by Bidder
1.	General	
2.	Name of manufacturer (OEM)	
3.	Country of Origin	
4.	Delivery from (location)	
5.	Type & Designation	
6.	Type tested at Name of Laboratory	
	Address of laboratory	
7.	Installation	
8.	Standards applicable	
9.	No. of Phases	
10.	Single or Three Phase design	
11.	Configuration	
i)	Number of Feeder bays	
ii)	Number of transformer bays	
iii)	Number of Bus coupler bay	
iv)	GIS to transformer connection	
v)	GIS to Feeder connection	
vi)	Number of VT	
vii)	Number of SA	
viii)	Future extension possibility	
12.	Service conditions	
i)	Ambient Air Temp. in Deg. C	
ii)	Max Temp. in Deg. C	
iii)	Min Temp. in Deg. C	
iv)	Daily Average Temp. in Deg. C	
v)	Solar Radiation W/sq mtr	
vi)	Altitude above MSL, in mtr	
vii)	Pollution class	
viii)	Creepage distance, in mm/kV	
ix)	Relative humidity	
x)	Condensation	
xi)	Vibration level	
xii)	Noise level	
xiii)	Induced Electromagnetic Disturbance, in kV	
xiv)	Seismic conditions	
a	Vertical	
b	Horizontal	
13.	Enclosure	
i)	Code of pressure vessel	

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ii)	Type of manufacturing	
iii)	Design temperature in Deg.C	
iv)	Material	
v)	Material grade & applicable standard	
vi)	Outside diameter in mm	
vii)	Minimum Wall Thickness, in mm	
viii)	Painting Shade & Thickness	
a	External	
b	Internal	
ix)	Degree of Protection	
x)	Inductance in H/mt	
xi)	Capacitance in pF/mt	
xii)	Resistance in Ohm/mt	
xiii)	Expansion Bellow	
a	Material	
b	Min allowable adjustable displacement	
	Longitudinal	
	Transverse	
xiv)	Sealing system	
a	Type	
xv)	Estimated life in years	
xvi)	Barrier	
a	Material	
b	Dielectric strength	
14.	Support Structure	
	Material	
	Minimum thickness of galvanizing	
	Foundation channels /Anchor bolts	
15.	Grounding	
i)	Grounding Material	
ii)	Grounding of complete GIS	
iii)	Grounding of individual compartment	
iv)	Grounding at flange joints	
16.	System Parameters 220 kV	
i)	Highest System voltage in kV	
ii)	Rated voltage of System in kV	
iii)	Rated voltage of Equipment in kV	
iv)	Rated Insulation level Phase to Earth and between Phases	
a	One Min Power Frequency withstand voltage kVrms	
b	Switching impulse withstand voltage, kVp	
	- Phase to Earth	

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	- Between Phases	
c	Lightning Impulse withstand voltage, kVp	
v)	Rated Frequency	
vi)	Rated current in Amp	
vii)	Rated current at 50 °C (equipment) in Amp	
viii)	Rated current at 50 °C (bus bar) in Amp	
ix)	Rated short circuit withstand current kArms	
a	Duration in sec	
B	Peak kAp	
x)	Enclosure withstand time for an internal fault in sec.	
xi)	Estimated total energy loss at	
	- 100 % of rated capacity	
	- 75 % of rated capacity	
	- 50 % of rated capacity	
	- 25 % of rated capacity	
xii)	Measures taken to minimize Over Voltage	
xiii)	Phase labeling	
xiv)	Auxiliary supply (AC Voltage, Frequency; DC voltage)	
	- Operation	
	- Control	
	- Illumination & heater	
17.	Delivery conditions	
i)	Bays fully assembled at works	
ii)	Dimensions of longest section for transportation	
iii)	Weight of heaviest package	
iv)	Pressure of SF6 gas during transportation	
v)	SF6 gas monitoring system provided during transportation	
18.	Bus Bar 220 kV	
i)	Configuration (Single / Double)	
ii)	Nos of Phases	
iii)	Material	
iv)	Size	
v)	Rating	
vi)	Current density adopted	
vii)	Current density as per type test report	
viii)	Short time current withstand rating in kA	

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ix)	Duration	
x)	Resistance per phase	
xi)	Surge impedance	
xii)	SF6 immersed insulator	
a	Material	
b	Dielectric strength	
xiv)	Maximum Partial Discharges measured at HSV	
19.	SF6 Gas	
i)	Applicable standard	
ii)	Quantity of SF6 Gas of complete GIS at filling pressure, in kg	
iii)	Quantity of SF6 Gas of largest compartment GIS at filling pressure, in kg	
iv)	No's of Gas compartments	
v)	Quantity of SF6 Gas of individual compartment GIS at filling pressure, in kg	
vi)	Maximum permissible dew point, in Deg.C	
vii)	Composition of Gas	
a	- SF6 > 99.90 % by weight	
b	- Air < 500 ppm by weight (0.25 vol.%)	
c	- CF4 < 500 ppm by weight (0.1 vol.%)	
d	- H2O < 15 ppm by weight (0.012 Vol%)	
e	- Mineral oil < 10 ppm by weight	
f	- Acidity, in terms of HF < 0.3 ppm by weight	
g	- Hydrolysable fluorides, in terms of HF < 1 ppm by weight	
vii)	PRESSURE in MPa in kG/sqcm	
viii)	Design pressure	
a	- Circuit breaker	
b	- Other compartments	
ix)	Rated filling pressure	
a	- Circuit breaker	
b	- Other compartments	
x)	Type tested pressure.	
a	- Circuit breaker	
b	- Other compartments	
xi)	Routine test pressure	
a	- Circuit breaker	
b	- Other compartments	
xii)	xii Operating pressure of PRD	
a	- Circuit breaker	

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b	- Other compartments	
xiii)	Alarm Pressure	
a	- Circuit breaker	
b	- Other compartments	
c	- CB lock out Pressure	
d	- Over pressure signaling	
xiv)	Maximum SF6 Gas leakage rate, in % per year	
xv	Density Monitor to be provided for each Individual gas compartment.	
20.	Circuit Breaker 220kV	
i)	Applicable standard	
ii)	Type	
iii)	Designation	
iv)	Operating Mechanism type	
v)	Nos. of phases	
vi)	Rated current in Amp	
vii)	Mechanical Endurance class	
viii)	Electrical Endurance class	
ix)	Re-strike probability class	
x)	Rated SC breaking current	
xi)	Rated SC breaking current - single phase test	
xii)	Rated Line charging breaking current	
xiii)	Rated Cable charging breaking current	
xiv)	Capacitor bank switching capability	
xv)	Inductive current	
xvi)	Reactive current	
xvii)	Out of phase making & breaking current	
xviii)	Rated short line fault current	
xix)	TRV characteristic	
xx)	First Pole to Clear factor	
xxi)	Nos. of interrupters per phase	
xxii)	Type of arc control device provided, if any	
xxiii)	Type of arcing contacts	
xxiv)	Material of main contact	
xxv)	Material of Arcing contacts	
xxvi)	Filter material	
xxvii)	Timings of operations	
a	Opening at nominal control voltage	
	Opening at minimum control voltage	
b	Closing time at nominal control voltage	
xxviii)	Maximum pole discrepancy time	

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	- Tripping	
	- Closing	
xxix.	Rated operating duty cycle	
xxx.	Tripping Coils	
	- No of coils	
	- Rated Voltage	
	- Rated Current	
	- Rated Watts	
	- Resistance	
xxxi.	Closing Coil	
	- Rated Voltage	
	- Rated Current	
21.	DISCONNECTORS 220kV	
i)	Applicable standards	
ii)	Type	
iii)	Rated current in Amp for	
	- Bus disconnector	
	- Line disconnector	
	- Transformer disconnector	
	- PT disconnector	
iv)	Maximum Current that can be safely Interrupted by the Isolator (Amp).	
	- Inductive	
	- Capacitive	
v)	Rate Short time withstand Current in kA, for 3 sec	
vi)	Rated peak short time Current, kAp	
vii)	Rated bus charging current, in Amp	
viii)	Type of contacts	
ix)	Material of contacts	
x)	Current Density at minimum cross section	
xi)	Rated lightning impulse withstand voltage across the open gap, kVp	
xii)	Rated Power Freq withstand voltage across the open gap, kVrms	
xiii)	Mechanical Endurance class	
xiv)	Type of Operating Mechanism	
xv)	Operating Motor details	
	- Type	
	- Rated Voltage	
	- Rated Current	
	- Rated Watts	
xvi)	Operating Time	

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	- Closing	
	- Opening	
xvii)	Mechanical indication on drive shaft	
22.	Maintenance Grounding Switch 220kV	
i)	Applicable standards	
ii)	Type	
iii)	Rate Short time withstand Current in kA, for 3 sec	
iv)	Rated peak short time Current, kAp	
v)	Rated lightning impulse withstand voltage across the open gap, kVp	
vi)	Rated Power Frequency withstand voltage across the open gap, kVrms	
vii)	Type of Operating Mechanism	
viii)	Operating Motor details	
	- Type	
	- Rated Voltage	
	- Rated Current	
	- Rated Watts	
ix)	Operating Time	
x)	Mechanical indication on drive shaft	
23.	Fast Acting Grounding Switch 220kV	
i)	Applicable standards	
ii)	Type	
iii)	Rate Short time withstand Current in kA, for 3 sec	
iv)	Rated peak short time Current, kAp	
v)	Rated induced current switching capability	
vi)	Rated capacitive current switching capability	
vii)	Rated lightning impulse withstand voltage across the open gap, kVp	
viii)	Rated Power Freq withstand voltage across the open gap, kVrms	
ix)	Electrical Endurance class	
x)	Type of Operating Mechanism	
xi)	Operating Motor details	
	- Type	
	- Rated Voltage	
	- Rated Current	
	- Rated Watts	
xii)	Operating Time	

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-	- Closing	
-	- Opening	
xiii)	Mechanical indication on drive shaft	
24.	Current transformers 400 kV 220 kV 132 kV 66 kV	
i)	Type	
ii)	Material	
iii)	Position of Current Transformer	
iv)	Reference Standard	
v)	Rated Continuous thermal current	
vi)	Rated Short Time current	
vii)	Duration	
a	Feeder Bay CT	
I	Metering Core	
	- Ratio	
	- Output Burden	
	- Accuracy Class	
	- ISF	
II	Protection Core -1	
	- Ratio	
	- Output Burden	
	- Accuracy Class	
	- ALF	
III	Protection Core -2	
	- Ratio	
	- Output Burden	
	- Accuracy Class	
	- ALF	
b	Transformer Bay CT	
I	Metering Core	
	- Ratio	
	- Output Burden	
	- Accuracy Class	
	- ISF	
II	Protection Core	
	- Ratio	
	- Output Burden	
	- Accuracy Class	
	- ALF	
III	Protection Core -2	
	- Ratio	
	- Accuracy Class	
	- Minimum Knee Point Voltage at highest	

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	ratio	
	- Maximum Excitation Current at V_k	
	- Maximum Resistance at highest ratio	
IV	Protection Core -3	
	- Ratio	
	- Accuracy Class	
	- Minimum Knee Point Voltage at highest ratio	
	- Maximum Excitation Current at V_k	
	- Maximum Resistance at highest ratio	
c	Bus Coupler Bay CT 220kV	
I	Metering Core	
	- Ratio	
	- Output Burden	
	- Accuracy Class	
	- ISF	
II	Protection Core -1	
	- Ratio	
	- Burden	
	- Accuracy Class	
	- ALF	
III	Protection Core -2	
	- Ratio	
	- Burden	
	- Accuracy Class	
	- ALF	
25.	Voltage Transformer 220kV	
	Type	
	Position of Voltage Transformer	
	Reference Standard	
	Rated Over Voltage Factor - Continuous	
	Short Time Over Voltage Factor	
	Duration	
	Partial Discharge Level	
	Thermal Rating of Primary Winding	
26.	Line & Bus VT 220kV	
I	Metering Core	
	- Ratio	
	- Output Burden	
	- Accuracy Class	
II	Protection Core -1	
	- Ratio	
	- Output Burden	

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	- Accuracy Class	
III	Protection Core -2	
	- Ratio	
	- Output Burden	
	- Accuracy Class	
27.	Enclosed Surge Arrester 220kV GIS	
i)	Name of Manufacturer	
ii)	Arrester Class & Type (with mfr type designation)	
iii)	Applicable Standard	
iv)	Rated system voltage (kV)	
v)	Rated Arrester Voltage (kV)	
vi)	Max continuous operating voltage (MCOV) –(kV)	
vii)	Nominal Discharge Current (KA) with 8/20 Micro-second wave	
viii)	Max resistive component of cont. current at MCOV-mA crest	
ix)	Max capacitive component of continuous current at MCOV -mA crest	
x)	Long Duration Discharge Class	
xi)	Min. Energy Discharge Capability (KJ/KV rating)	
xii)	Max. switching current impulse residual voltage (KVP)	
	- 1000 Amps	
	- 250 Amps	
xiii)	Pressure Relief Class KA (rms)	
xiv)	High Current short duration impulse withstand level with 4/10 microsecond wave (KA) peak	
xv)	Over –voltage withstand capability – KV	
A	100 Seconds	
B	10 Second	
C	1.0 Second	
D	0.1 Second	
E	Reference Voltage (KV)	
F	Reference Current (KA)	
xvi)	xv Surge counter	
xvii)	xvi Leakage monitor	
28.	Local Control Cubical 220 kV	
i)	Name of Manufacturer (OEM of GIS)	

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ii)	Location in GIS	
iii)	Material	
iv)	Sheet Thickness	
v)	Degree of Protection	
vi)	Padlocking arrangement	
vii)	Major components of LCC	
	- Bay control mimic diagram	
	- Control Switches	
	- Indicating lamps	
	- Position indicators	
	- Annunciation scheme	
	- Auxiliary relays	
	- Contact multiplication relays	
	- System parameters display	
	- Heater with thermostat	
	- Interface terminal blocks for relaying & protection	
29.	Line to GIS connection 220 kV	
i)	Nos of XLPE cable can be terminated	
ii)	Type of cable termination required	
30.	GIS to Transformer connection 220 kV	
i)	Nos of XLPE cable can be terminated	
ii)	Type of cable termination required	
31.	Maintenance	
i)	Maximum down time for replacement or removal of any part	
ii)	Maximum down time for degassing and refilling the biggest compartment	
iii)	Time between two refilling of SF6 gas.	
iv)	Recommended period for overhauling	
v)	Operation and Maintenance manual attached	
vi)	Nearest local service centre	
vii)	Minimum time of availability of local service	
viii)	Availability of spares at local service center	
ix)	List of recommended spares attached?	
x)	List of recommended special tools, etc. attached?	
xi)	List of commission spares attached?	
xii)	List of maintenance spares attached?	

Date:

Bidder's Stamp & Signature

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SECTION 4: ANNEXURE-D: TECHNICAL CHECKLIST

Sl. No.	Particulars	Confirmation by Bidder	
1	Technical Qualifying Requirement		
1.1	The bidder to furnish relevant documents for meeting the qualifying requirement. Performance certificates shall be submitted in English. Translated pages should be attested by the ultimate customer, if attested only by the bidder it shall be notarized.	Confirmed	Yes/ No
1.2			
1.3	All the documents shall be submitted in English. Translated pages should be attested by the ultimate customer, if attested only by the bidder it shall be notarized.	Confirmed	Yes/ No
2	Un-priced BOQ		
2.1	Confirm that all items have been quoted separately. (If any item has not been quoted, the same shall be specifically brought out with technical reasons thereof, else offer shall be liable for rejection).	Confirmed	Yes/ No
2.2	Any other supply/ service required for the execution for the complete work of GIS & its accessories is deemed to be included in the offer, whether specifically mentioned in the specification or not. Bidder to submit list of items along with their respective quantities required for completeness of GIS & its accessories.	List of items required to be attached.	Yes/ No
2.3	Building for GIS shall be constructed by Civil contractor based on the input (configuration, structure loads and other interfacing details etc.) provided by bidder. The supply of all structural material to be embedded including foundation bolts, plates etc. as well as consumables like grouting material etc. shall be in bidder's scope. The erection of structure shall be done by BHEL under supervision of bidder.	Confirmed	Yes/ No

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2.4	Bidder shall provide the details for Cable Connection module, SF6 to Air Bushing and SF6 to Oil connection etc. and hence, Interfacing details for connection with other parts shall be provided by the bidder.	Confirmed. (Details is submitted)	Yes/ No
2.5	Bidder shall submit list of consumables with shelf life of less than six months and same shall be dispatched just before the erection and only after specific clearance from BHEL/Customer.	Confirmed (List is attached)	Yes/ No
2.6	Commissioning spares for testing & commissioning of GIS till handing over shall be under bidder's scope.	Confirmed	Yes/ No
2.7	Detailed list of Tools & tackle & Testing Equipment to be supplied at site on returnable/ non-returnable basis.	List attached	Yes/ No
2.7	Detailed list of Tools & tackle & Testing Equipment to be supplied at site on returnable/ non-returnable basis.	List attached	Yes/ No
2.8	GIS shall be complete with all necessary terminal boxes, SF6 gas filling, interconnecting cabling & wiring, grounding connections, gas monitoring equipment and piping, support structures etc.	Confirmed	Yes/ No
2.9	The scope of supply shall also include all erection and mounting hardware and interconnecting cables within GIS.	Confirmed	Yes/ No
2.10	Design philosophy of earthing submitted with the bid	Confirmed	Yes/ No
2.11	Design of Earthing of GIS shall be in bidder scope. The items and accessories required for completeness of earthing shall be in bidder's scope. Mesh on floor shall be provided by BHEL as per bidder's design.	Confirmed	Yes/ No
3	Technical		
3.1	The 220kV GIS building shall comprise an EOT (Electric overhead travel) crane of minimum capacity 5 (Five) Ton or as per GIS OEM/ bidder recommendation, whichever is higher for lifting of any components of GIS switchgear EOT crane shall be provided for GIS. However, EOT crane for GIS is not envisaged in bidder's scope but bidder shall provide all the calculations basis for sizing of EOT crane during tender stage only.	Confirmed	Yes/ No
3.2	Thermal rating for all current carrying parts shall be minimum 50kA for 3sec as mentioned in technical specification.	Confirmed	Yes/ No
3.3	Internal components maintenance free for at least 10 years/ as mentioned in technical specification.	Confirmed	Yes/ No
3.4	Material of enclosure – non-magnetic material	Confirmed	Yes/ No

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3.5	Bidder shall provide AC and DC auxiliary loads for GIS.	Confirmed (Enclosed with bid)	Yes/ No
3.6	Catalogues of GIS	Confirmed (Enclosed with bid)	Yes/ No
3.7	Catalogues of all Maintenance equipment. Bidder to confirm that offered equipment meets the requirements of specification.	Confirmed (Enclosed with bid)	Yes/ No
4	Calculations		
4.1	The design of the equipment shall be such that the agreed permitted movement of foundations and mechanical or thermal effects do not impair the assigned performance of the equipment.	Confirmed	Yes/ No
4.2	Insulation co-ordination study shall be conducted and based on the same the number & location of surge arresters shall be decided. The number and location of surge arresters shall be indicated with the bid.	Confirmed	Yes/ No
4.3	Measures to limit external over voltages (e.g. surge arresters) should be considered and detailed out based on the site conditions etc.	Enclosed with bid	Yes/No
5	Technical Deviations		
5.1			
6	Bar-chart		
6.1	Bidder will submit detailed bar chart indicating all the milestones from Engineering till manufacturing/ testing, dispatch to site and commissioning based on the drawing & document schedule attached in section1.	Confirmed	Yes/ No
7	Conditions		
7.1	Storage shall be provided by BHEL/ its contractor. However, bidder shall provide their tentative space requirement for covered and/ or open store area during tender stage only. In addition to this, bidder shall submit their standard storage instruction manual specifically specifying the item detailed with details of type of storage.	Details given with the bid.	Yes/ No
8	Site Test		

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8.1	Special tools & tackles for installation and testing kits for testing & commissioning shall be in bidder's scope, however, it shall be brought at site on returnable basis only.	Confirmed	Yes/ No
8.2	Bidder shall provide list of general tools, tackle, slings, spanners, gauges, slings and other lifting devices, drills, instruments, testing kits and appliances necessary for the complete assembly, installation, gas filling, maintenance, site testing of the GIS, however, it shall be arranged by BHEL.	Confirmed	Yes/ No
8.3	All field tests including tests during installation, pre-commissioning, commissioning, field acceptance tests shall be conducted by the bidder, in presence of representative of the BHEL/ Customer. No separate site test will be conducted by BHEL/ Customer	Confirmed	Yes/ No
9	Type Test Requirements		
9.1	Bidder shall ensure that 220kV GIS with LCC & its Accessories, being procured should have valid type test certificates as per specified in IEC standard 62271 – 203 & 62271-100 (amended up to date) at any ISO/IEC accredited laboratories.	Confirmed	Yes/ No
9.2	Type test certificates shall not be more than ten (10) years old as on original scheduled date of technical bid opening. In those cases, where type test certificates are more than ten (10) years old from original scheduled date of technical bid opening, OEM/ bidder shall carry out the type tests at at any ISO/IEC accredited laboratories prior to dispatch of equipment with no commercial implication to BHEL/Customer.	Confirmed	Yes/ No
9.3	Type test report for GIS shall be submitted along with the bid. Differences, if any, in the items offered and those which have been type tested shall be clearly brought out along with explanation for suitability.	Confirmed and enclosed with bid	Yes/ No
9.4	In case any of Type tests have not been conducted on the offered design or there has been a change in the design after the type tests. The requisite tests shall be conducted by bidder on the offered design without any extra cost and delivery impact to BHEL/ Customer. Technical valid- Any error or incompleteness (any/all additional type tests not carried out) or discrepancy in the test reports vis-à-vis offered equipment due to any design / manufacturing changes (including substitution of components) or non-	Confirmed	Yes/ No

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	compliance with the requirement stipulated in the Technical Specification.		
9.5	The type tests conducted earlier should have either been conducted in an accredited independent laboratory (accredited base on ISO / IEC Guide 25 / 17025 or EN 45001 by the national accreditation body of the country where laboratory is located). The short circuit test should have been conducted in a laboratory which should be a member of STL (Short-Circuit Testing Liaison - www.stl-liaison.org). If the laboratory is not a national laboratory and member of STL, relevant papers of accreditation shall be submitted in English. If the laboratory is in-house, the tests should have been witnessed by a client.	Confirmed. Details provided with bid.	Yes/ No
9.6	The type test report shall be complete including the list of test objects, photographs, oscillographs, test arrangement, drawing of tested objects (GIS, equipment etc.) and test connections. The type test report shall be in English. If it is in any other language, it should include an English version (Translation shall be attested by the Bidder). The English version should be complete with measured values and conclusion.	Confirmed	Yes/No

Date:

Bidder's Stamp & Signature

