

CPCL- Annexure: Technical Pre- Qualifying Requirements

230kV & 66kV Gas Insulated Switchgear with its accessories

Pre Bid Tie up for Design, Engineering, Supply, Supervision of Erection, Testing & Commissioning of 230kV & 66kV GIS for Cauvery Basin Refinery (CBR), Chennai Petroleum Corporation Ltd. (CPCL) at Nagapattinam, Tamil Nadu

Tender Enquiry No. SPEC. NO. TCE.12416A-ELGIS-40101

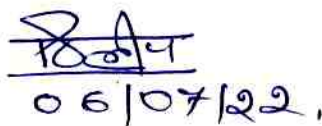
The Bidder shall meet following technical qualification criteria/ requirements:

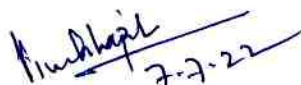
The Bidder shall be the manufacturer of Gas Insulated Sub-station (GIS) of rating minimum 230kV voltage class, and should have executed and completed the Contract, on Single Point Responsibility/ Reasonability involving Detailed Engineering, Procurement, Supply, Fabrication, Erection, Testing & Commissioning or Supervised Erection, Testing & Commissioning, which should have completed operation for at least one (1) year after commissioning within the last twelve (12) years ending on last day of the month immediately previous to the month in which bid due date falls (in case of extended bid due date, original bid due date shall be considered).

Note:

1. For qualifying against the Technical experience criteria, Bidder (Parent Company), shall be allowed to use the credential of its Subsidiary Company (either fully owned or where the parent company has a controlling interest of over 50% of the equity shares and over 50% of voting rights of the given subsidiary company and controls the composition of Board of Directors of the Subsidiary company). However, it would be necessary for a bidder to show that it has the relevant experience either on its own or in the name of such subsidiary.
2. Bidder shall ensure submission of complete authentic information/ documentation along with the Bid.
3. Bidder shall also render assistance in facilitating visit to the GIS unit, if so, considered necessary by Owner/ Consultant. Cost of visit shall not be to the bidder's account.
4. If the bidder cites any reference of a job executed for CPCL or executed for some client through Consultant and the bidder is not able to furnish documentary evidence, the internal records of CPCL/ TCE, as the case may be, shall be considered.
5. Documentation
The bidder shall furnish documentary proof of fulfilling the Bidder's Qualification Criterion/ Requirements, and shall submit the documents as per following details,
 - a) Copy of work orders(s)/ contract agreements(s)/ relevant pages of contract documents(s) mentioning the scope of work for the reference units(s) submitted for qualification, the first page and the signature page, Completion certificate(s) issued by owner/ Consultant indicating certificate(s) of commissioning of referred plants from Owner/ Consultant, fulfilling the qualification requirements.
 - b) Certificate(s)/ Communication of Unit/ Plant from Owner(s)/ Owner's Consultant/ User/ LSTK Contractor having completed one (1) year of operation after commissioning for the reference unit(s) submitted for qualification. However, for operation for at least one (1) year after commissioning, any one of the following Document is required to be submitted by the bidder along with the Bid,
 - Certificate for Operation for one (1) year from Client; OR
 - For any job carried out for CPCL, in support of successful operation of one year, bidder need not submit any additional certificate. However, the qualification of the reference job order submitted by the bidder for the tender will be checked internally by CPCL based on the information submitted with the bid.


06/07/22


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BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION BUSINESS ENGINEERING MANAGEMENT
NOIDA

DOCUMENT NO.	TB-PBTU-CPCL-230kV & 66kV GIS	Rev 00	Prepared	Checked	Approved	
TYPE OF DOC.	TECHNICAL SPECIFICATION	NAME	PC	DKS	VK	
TITLE 230kV & 66kV Gas Insulated Switchgear with its accessories		SIGN				
		DATE				01.07.2022
		GROUP	TBEM			
		WO No.				
CUSTOMER	Chennai Petroleum Corporation Ltd. (CPCL)					
CONSULTANT	TATA Consulting Engineers (TCE)					
PROJECT	Pre Bid Tie up for, Design, Engineering, Supply, Supervision of Erection, Testing & Commissioning of 230kV & 66kV GIS for Cauvery Basin Refinery (CBR), Chennai Petroleum Corporation Ltd. (CPCL) at Nagapattinam, Tamil Nadu					
<u>Contents</u>						
Section No.	Description	No of Pages				
Section-1.1	Part A- Scope Matrix for GIS					
Section-1.2	Part B- CPCL					
Section-1.3	Part C- Project Information					
Section-1.4	Annexure- Vendor List for GIS and its components					
Section-1.5	Annexure- BOQ of 230kV & 66kV GIS					
Section-1.6	Annexure- Project Drawings					
Section-2	Equipment Specification under scope of Supplies (230kV GIS & 66kV GIS)					
Annexures	Annexure-A and Annexure-B					
Remarks: Bidder to note that data and details of Guaranteed Technical Particulars shall not be reviewed during Technical Evaluation/ Review, hence compliance of Guaranteed Technical Particulars in line with Technical Specification has to be ensured by the bidder.						
Rev. No	Date	Altered	Checked	Approved		
Distribution			To			
			Copies			

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16. EXCLUSION FROM BIDDER'S SCOPE

This document covers broader guideline for bidder's scope of supply & services. The same shall be prevailing on all other section of technical specification.

1. SCOPE

This technical specification covers the requirements of (1.) design, type testing, engineering, fabrication, manufacturing, shop assembly, inspection and testing at manufacturer's works, proper packing, supply and delivery to project site, (2.) supervision of material reconciliation, installation / erection, (3.) execution of site testing & commissioning along with necessary kits, tools & equipment , putting GIS with LCC & its Accessories into successful operation complete with all materials, support structures, anchoring bolts, chemical anchor, accessories, commissioning spares & maintenance spares, special spanners, special tools & tackles, any specific required ancillary services, SF6 gas for first filling & spare etc. including design studies, training of BHEL / Customer personnel for offered GIS & its Accessories complete in all respects for efficient & trouble-free operation mentioned under this specification.

This section covers bidder's scope for GIS with LCC & its Accessories. The offered GIS with LCC & its Accessories shall comply with the Section-1, 2 & ~~3~~ of technical specification.

The complete technical specification comprises of following sections:

Section-1	:	Scope, Project Specific Technical Requirements & Bill of Quantities including scope matrix
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

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
2. Section-1(PART-A) Standard Scope Matrix
3. Section-1(PART-B)
4. Section-2
5. ~~Section-3~~

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 will address the bidder's listed conflicts prior to award. In case of ambiguity, bidder shall inform BHEL of their interpretation. In case bidder fails to convey the same prior to award, BHEL 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.

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-A), however bidder shall furnish list of conflicts/ ambiguities/ deviations (Annexure-B), if any.

Please note, any deviation not specifically brought out in Annexure-B (Schedule of Technical Deviations) **shall not be admissible** for any time and 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. Any conflicts/ ambiguities/ deviations mentioned elsewhere in technical offer shall not be reviewed.

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

2. SPECIFIC TECHNICAL REQUIREMENTS

Please refer Section-1(PART-B) of technical specification.

3. NOTE FOR BILL OF QUANTITIES

1. SF6 gas for initial installation of complete GIS System, including wastage during installation, testing and successful commissioning shall be deemed included in the bidder's scope.
2. The offered GIS with LCC & its Accessories shall be complete in all respect in compliance to technical specification and relevant IS / IEC / IEEE standards as applicable. Any other equipment/material required to complete the specified GIS scope of work are inclusive of bidder's scope of supply & services.
3. All essential and desirable accessories are deemed inclusive of offer i.e. and not limited to Gas Monitoring Devices, Pressure Switches, PD sensors, Pressure relief device, insulator, expansion joint/ flexible, bellows/ compensators like lateral mounting units, Axial compensators, Parallel compensators, tolerance compensators and vibration compensators etc. complete in all respect.
4. Total contract value may vary up to $\pm 30\%$ at contract stage.
5. Any Item not quoted mentioned "**Not Applicable**" in bid price schedule and found applicable as per technical specification and system requirement shall be supplied free of cost by bidder without any time / cost implication to BHEL / Customer.
6. Length & route of GIB is purely indicative and same shall be finalized during detailed engineering stage.
7. BHEL reserve rights to amend Bay sequence during contract stage, no separate claim shall be admissible in this regards.
8. ~~Supply scope of Testing & Maintenance Equipment – Scope of supply of following Equipments shall be applicable only if covered in BOQ / BPS.~~
 - ~~a. SF6 Gas leakage detector~~
 - ~~b. Gas filling and evacuating plant: (Gas Processing unit)~~
 - ~~c. SF6 gas analyser~~
 - ~~d. Portable Partial Discharge(PD) monitoring system~~
 - ~~e. Online Partial Discharge Monitoring System~~
9. **Main Bus** 1 / 2 / ~~Transfer Bus~~ etc. Gas Insulated Bus Bars running across the length of the switchgear to interconnect each of the bay modules (as per layout) and necessary interfaces (as applicable under the technical requirement) is deemed inclusive in the scope. The same may or may not be indicated with

break-up in BOQ / BPS.

Remark: BPS: Bid Price Schedule

4. NOTES ON MODE OF MEASUREMENT

- ~~1. The price of Bus-duct inside the GIS hall (upto **outer** wall face of GIS Hall) shall be integral part of the respective bay module and it will not be paid separately. However, the payment of bus-duct for outside the GIS hall along with support structure shall be paid as per running meters in line with provision of Technical Specification & Bid Price schedule.~~
- ~~2. In the case of outdoor type GIS, Gas Insulated Bus Duct (GIB) length of bus duct outside the GIS BAY MODULE shall be considered for mode of measurement from the end of Bay equipment (VT, LA etc.) to end equipment (SF6 to air bushing / SF6 to oil bushing/ Cable connection module etc.).~~
3. Any change in bay pitch (distance between bays): In a case where shifting of GIS bays shall be called by BHEL (during contract stage) due to layout requirement / cost optimization / revision / change in civil architectural requirement or due to expansion joint requirement in the GIS building, Bidder to incorporate the same with full compliance of technical requirement. Payment equivalent of BPS / BOQ item under head "Gas Insulated Bus Duct" shall be operated for additional length of Main Bus, subject to such shifting is not attributed to bidder.

5. SUPPORT STRUCTURE & HARDWARES (INCLUDING STRUCTURE STEEL)

Structural Steel, Support Structure & Hardwares (required for installation of complete GIS system with LCC & its Accessories etc.) are deemed inclusive of bidder's scope of supply. The same may or may not be indicated with break-up in BOQ / BPS.

All steel structure members shall be hot-dip galvanized after fabrication (excluding floor embedded items for which standard practice is to be followed). All field assembly joints shall be bolted. Field welding shall generally not be acceptable. Noncorrosive metal or plated steel shall be used for bolts and nuts throughout the work.

The minimum weight of the zinc coating shall be 610 gm/sq.m and minimum average thickness of coating shall be 86 microns for all items having thickness 6mm

and above and 900 gm/sq.m for coastal area (if defined in Section-1B / Section-2 of technical specification) For items lower than 6mm thickness requirement of coating thickness shall be as per relevant ASTM. For surface which shall be embedded in concrete, the zinc coating shall be 610 gm/sq.m minimum and **900 gm/sq.m for coastal area** (if defined in Section-1B / Section-2 of technical specification).

1. Lattice / Pipe structure Materials for support of GIS, Bus Ducts, ~~SF6 to oil bushing~~/ SF6 to cable connection and SF6 to air bushing/ connection including Anchor Fastener Bolts, Foundation Bolts, Base Plate / Channel / Metallic / Structural Member for seating of GIS system, all floor and wall Embedded Items, wall crossing arrangements, Rails and/ or other items structural items as required. Manufacturer shall provide suitable foundation channels and anchor bolts to support the switchgear assemblies. All mounting bolts, Anchor Fasteners, foundation bolts, nuts and washers, equipment fixing hardware shall be provided to fasten the switchgear base frames to the foundation channels as applicable
2. 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.
3. Structural steel for complete GIS system with LCC & its Accessories is deemed inclusive in bidder's scope of supply.

6. EARTHING MATERIALS OF GIS

Bidder to submit detailed calculations and layout drawings for earthing system during detailed engineering stage based on technical specification, bidder's design philosophy, IS/IEC/IEEE requirement as applicable. Bidder to provide the bill of quantity of entire GIS system with LCC & its Accessories

1. Supply of 40 mm MS ROD, 75X12 mm GI Flat, 50X06 mm GI Flat is **not in bidder's scope** of supply.
2. All other earthing materials including complete Hardwares, nut, bolts washers, lug etc. required, as per earthing design shall be in bidder's scope of supply.
3. Installation / Erection of earthing will be done by BHEL ~~team~~ under the supervision of bidder/manufacturer, as per manufacturer's design.

7. SCOPE FOR CABLES

1. Power, control & instrumentation cables for **Cabling** (1.) within GIS, (2.) GIS to LCC, (3.) LCC to LCC shall be deemed inclusive in bidder's scope of supply.
2. Scope includes for completeness for GIS system with LCC & its Accessories
3. Cabling between LCC to LCC shall be applicable if required in bidder's design philosophy.
4. Cables required for bidder supplied GIS sub-system i.e. condition monitoring system (Gas monitoring system, PD monitoring system etc) are to be supplied by bidder as complete system.
5. Necessary Cable Lug, Glands & shroud etc. required for installation of bidder's supplied cable are deemed inclusive in bidder's scope.
6. Bidder to provide detailed "Bill of Quantity" during detailed engineering stage. Cabling & termination schedule for the same shall be provided by successful bidder along with AS BUILT drawing during contract stage.
7. Power Cable TB's (for both AC & DC incoming feeder cables) shall be suitable for termination of requisite cable.

8. OTHER GENERAL REQUIREMENTS

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

1. Guaranteed Technical Particulars: Bidder to submit detailed GTP in line with technical specification during contract stage for review and approval. GTP & drawings submitted with technical bid shall only be reviewed during contract stage only. Bidder to please note, deviations / conflict if any please be mentioned in schedule of technical deviations only.
2. 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.
3. The physical layout shall ensure free movement of the SF6 Gas Cart and easy access to all components of the GIS for operation and maintenance purposes.
4. Bidder shall submit list of consumables with shelf life of less than six months and same shall be dispatched before commencement of erection or after clearance from BHEL/Customer whichever is earlier. No separate dispatch clearance shall be

- required for consumables. Cost of the same deemed inclusive.
5. Bidder shall offer their latest type tested model to accommodate the specified & allocated space as per attached layout drawing of GIS.
 6. Bidder shall conduct insulation co-ordination studies in line with IEC for establishing surge arrester rating, quantity and any other requirement for successful operation of GIS.
 7. Bidder to submit Study report of VFTO generated for 400kV GIS installation.
 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. Final documentation shall be submitted in hard copy (Four prints) and soft (Three CDs/DVDs)~~
 - ~~10. In the case if CSD is specifically called in BPS / BOQ / Section-1(PART-B) of technical specifications, the same should have display facility at the front for the display of settings and measured values. In case where CSD does not have complete display facility for settings and measured values, bidder to supply one number laptop PC with pre-installed, licensed software for each site. Special cable required for integration is deemed inclusive in bidder's scope.~~
 11. Bidder to submit all supporting documents in English. If document submitted by bidder is other than English language, self-attested English translated document should also be submitted.

9. DRAWINGS / DOCUMENTS FOR 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 first drawing submission will be counted from the date of submitting reasonably correct drawings.

Sl. No.	Overall Drawings approval required in Cat I /Cat II
LOT-1	
1	GIS- Gas Schematics with Single Line Diagram (Including CT VT Parameters)
2	GIS- Guaranteed Technical Particulars (Including all GIS equipment)

3	GIS- Layout Plan & Section
4	GIS- Interfacing Drawings for Cable Connection Module / SF6 to Air Bushing / ~~SF6 to Oil Module (as applicable under scope)~~ with Guaranteed Technical Particulars
5	GIS- Equipment Layout with Earthing philosophy
6	GIS- Type Test Reports (Including all GIS equipment)
7	GIS- Quality Assurance Plan & Inspection Test Schedule
LOT-2	
8	GIS- Earthing Design, philosophy, Layout
9	GIS- Secondary Engineering Base Design
10	GIS- Control Schematics for GIS and Local Control Cabinet
11	GIS- Maintenance Equipment Catalogue with Guaranteed Technical Particulars, test reports
12	GIS- Quantification for main Items, Spares, Consumables
13	GIS- Civil Design Specification with Foundation Loading Diagram (Including interfacing details)
14	Other documents as per Technical Specification / BPS / BOQ shall be finalized during detailed engineering stage.
OTHER	
15	GIS- 3D OGA Drawing (3D-Model with complete editable data base) compatible with Autocad & Primtech for complete GIS & its accessories.
16	Manuals on unloading, safe storage, transportation, installation, testing, commissioning, routine check, preventive maintenance

10. TYPE TEST

Please refer Section-1(PART-B) and Section-2 of technical specification for the details of type test requirement. All equipment being supplied shall conform to type tests as per technical specification and shall be subject to routine & acceptance tests in accordance with requirements stipulated under respective sections of technical specification.

11. QUALITY PLAN

Bidder to follow valid customer approved (1.) Manufacturing Quality Plan, (2.) factory acceptance test (FAT) procedure & (3.) Site acceptance test (SAT) procedures, as per Customer procedure. In case the bidder doesn't have Customer approved Quality Plan, it will be the bidder's responsibility to get its Quality Plan approved from the ultimate Customer within 30 days from the date of issue of after award of LOI / PO whichever is earlier.

All 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.

GIS and its associated materials shall be subject to inspection by BHEL/ Customer / authorized representative at bidder / manufacturing works. Hence, Bidder shall furnish all necessary information concerning the supply to BHEL. 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.

12. SITE SERVICES

Site service activities shall be carried out at in stages as per requirement or front availability at site, and hence multiple visits for completion of work are envisaged as per site requirements hence any claim in this regards shall not be admissible on account of multiple mobilization or idling during project execution stage.

12.1. SUPERVISION AT SITE

1. Supervision of complete installation / erection of GIS with LCC & its Accessories are in the scope of bidder.
2. Scope also includes verification of materials for proper storage with due

- instructions/ training to site persons for long storage.
3. Standard storage instruction manual specifically specifying the item detailed with details of type of storage.
 4. Supervision for reconciliation and spares / accessories and handing over to customer.
 5. Final documentation

12.2. TESTING & COMMISSIONING

1. The complete GIS System shall be subjected to the site tests as per technical specifications, IEC-62271-203. Bidder to submit site acceptance testing (SAT) procedures and get the same approved from BHEL / Customer before carrying out the site testing at site.
2. Carrying out successful HV/ Power Frequency Testing of GIS as per IEC shall be in scope of bidder, which includes HV test kit with operator, accessories & tools required for completion of HV testing. Bays may be commissioned separately.
3. BHEL shall provide free support at site for HV Test Kit i.e. it's unloading, assembling of HV test kit, dismantling & loading back on carrier.
4. Complete Field testing and commissioning of GIS system with LCC & its Accessories are under the scope of Bidder.
5. Bidder supplied special equipment, T&P if required OEM supervision, the same is to be arranged by bidder, cost of the same shall be deemed inclusive of respective item.
6. 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.
7. ETC work schedule for all the GIS may vary according to readiness of site. Respective dates for the commencement of erection, testing and commissioning activities of GIS shall be communicated to manufacturers from time to time as per the readiness of site.

13. TESTING KITS, TOOLS & TACKLES

1. All the Instruments/ Testing kits including HV Test Kit, SF6 Gas handling

- Equipments required for successful installation, testing, commissioning, maintenance of offered GIS are to be arranged by bidder on **returnable** basis. Cost of the same shall be deemed inclusive in the offer.
2. Special tools & tackles for installation, maintenance, testing & commissioning of GIS shall be in bidder's scope, it shall be brought at site on **returnable** basis only.
 3. The general Tools and Tackles shall be provided by BHEL, list of the requirement i.e. general tools-tackle, spanners, gauges, slings and other lifting devices, crane, welding machines, drills, general instruments and appliances necessary for the installation of GIS is to be submit by bidder along the technical bid. In case bidder fails to convey the same along with technical bid, BHEL decision on interpretation of general tools tackle shall be considered final and any tools & tackles required shall be brought at site by bidder without any claim.
 4. Bidder to furnish detailed BOQ for non-returnable special Tools and Tackles, if applicable along with unit prices to be handed over to ultimate customer. The prices for the same shall be considered during evaluation.

14. SPARES

1. Any equipment which is not supplied as main equipment or part of main equipment, mandatory spare for that is not applicable.
2. In case contractor offers circuit breaker, dis-connector, current transformer, SF6/Air Bushing etc. under main equipment of higher rating than equipment rating specified in the specifications, the mandatory spare of same higher rating offered by contractor identical to main equipment offered in the package shall be required to be supplied against spares without any cost implication.
3. The Mandatory Spares shall be included in the bid proposal by the bidder. The prices of these spares shall be given by the Bidder in the relevant schedule of Bid Price Schedule and shall be considered for evaluation of bid. It shall not be binding on the Employer to procure all of these mandatory spares.
4. The bidder is clarified that no mandatory spares shall generally be used during the commissioning of the equipment.
5. Start-up & Commissioning spares are included in bidder's scope of supply and shall be included in the base price. Adequate stock of start-up & commissioning

spares shall be made available at the site such that the start-up and commissioning of the equipment /systems, performance testing and handing over the equipment/ systems to the Purchaser can be carried out without any hindrance or delays. The unutilized Start-up & Commissioning spares brought for commissioning purpose by bidder shall be taken back by the bidder.

6. Wherever spares in BPS / BOQ/Technical Specification have been specified as "each type/each rating/each type & rating": If the offered spare/spares is sufficient to replace the respective main equipment of all types/ratings, then such offered spare/spares shall be acceptable. It implies that common spare/spare set fulfilling the spare requirement of all types/ratings shall also be acceptable, provided it is configurable at site itself without special assistance of OEM.
7. Mandatory Spares, wherever mentioned, are envisaged for the equipment/items being supplied under the main equipment heads under present scope meeting the requirements of Technical Specifications. The component/sub-component of an equipment/item specified in BPS / BOQ under Mandatory Spare, which is not applicable as per the offered design of respective main equipment, shall not be referred to.
8. Bidder to submit price break-up of spares during tender stage. It shall not be binding on the BHEL to procure all of these mandatory spares.
9. Bidder/ vendor 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 shall give a notice of at least one year to the Customer & BHEL (both) before phasing out the products/spares to enable the owner for placement of order for spares and services.

15. 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).
2. The GIS transport units 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 & technical specification.
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. Dry nitrogen/air or dry SF6 gas (in full compliance to technical requirement) 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.

16. SPECIFIC- EXCLUSIONS (NOT IN BIDDER'S SCOPE)

The following items are specifically excluded from the bidder's scope of supply & services, irrespective of the same if covered under any section of technical specification other than Section-1 (PART-B). If specific requirement mentioned in the Section-1(PART-B) of technical specification shall overrule this specific exclusion.

1. Any scope of supply / services mentioned in Section-2 ~~or Section-3~~ of technical specification but not having any relationship with GIS, LCC & its Accessories and not covered in Section-1(PART-B) or BPS / BOQ shall be deemed excluded from bidder's scope.
2. Installation / Erection of GIS with LCC & its Accessories except supervision work.

3. Cable laying & terminations, however supervision work & termination of special cables shall be in bidder's scope.
4. Open & Closed stores at site. (Bidder to provide space requirement in tech bid)
5. Local transportation/ conveyance for bidder's engineers shall be arranged by BHEL between local stay and site.
6. Office assistance shall be provided BHEL including sitting facility etc.
7. Receipt & unloading of material at site except supervision work
8. Terminal connector for SF6 to Air Bushing to conductor or any other interfacing equipment.
9. Watch & Ward of GIS material at BHEL Store
10. Civil Works i.e. GIS Hall, civil works requirement for GIS System. (Please refer clause "Structure-Steel" for bidder's scope of supply)
11. EOT crane, Air Conditioning & Ventilation System, Illumination System & Fire detection & alarm system, however complete input shall be provided for EOT and other system
12. Control Relay & Protection Panels, Numerical Relays, Bus Bar Protection Panel, SAS & ECS system, ACDB, DCDB, Battery & Charger
13. Earthing material i.e. 40 mm MS Rod, 50X6 GI Flat & 75X12 GI Flat for earthing
14. Outdoor AIS Equipments
15. Power & Control cable beyond LCC
16. BHEL / Customer / BHEL appointed 3rd party inspector travel, lodging & boarding charges during testing / inspection.

Rev Number	Date	Initiated by	Reviewed by	Approved by	Updates
Rev.0	19 Feb 2022	JAİK	SKS	AG	
Rev.1	04 March 22	JAİK			Clause 4.1 revised Clause 3.9 added Clause 5 900 gm/sq.m for coastal area
Rev.2	09 March 22	JAİK			Clause 5 updated (yellow highlight)

This technical specification for Pre-bid tie-up before participation is as per following details,

Name of the Customer	Chennai Petroleum Corporation Limited
Name of Main Contractor	Bharat Heavy Electricals Limited
Name of Project	9 MMTPA CBR PROJECT AT NAGAPATTINAM, TAMILNADU
Name of Tender	Pre-bid tie-up for Design, Engineering, Supply, Supervision of Erection, Testing & Commissioning of 230kv & 66kv GIS for Cauvery Basin Refinery (CBR), Chennai Petroleum Corporation Ltd. (CPCL) at Nagapattinam, Tamil Nadu
Locations	Panangudi, Tamilnadu, India

[1] SPECIFIC TECHNICAL PARAMETERS

1. Please refer **Section 1/ Section 2** for Specific Technical Parameters.

[2] BILL OF QUANTITIES

1. Please refer following Annexures for Bill of quantities: **Annexure- BOQ of 230kv & 66kv GIS.**
2. During tender stage, no of GIS bays may vary and hence it shall be finalized after receipt of firm order from Customer.

[3] SPECIFIC TECHNICAL REQUIREMENTS

1. Please follow Project specific requirements, as detailed in document **Annexure: Section Project.**
2. Technical Specification of GIS shall be as per **Section-2.**

[4] OTHER TECHNICAL REQUIREMENTS for GIS WITH ITS ACCESSORIES

1. Factor of safety for design of equipment structures and foundations shall be as below:
 - a. Factor of safety for design of equipment structures shall be 1.5 under normal condition and 1.2 under short-circuit condition.
 - b. Factor of safety for design of equipment foundation shall be 1.5 in both normal and short circuit condition as per IS 456.
 - c. Factor of safety for stability of equipment foundation like overturning shall be 2 (without wind or seismic), 1.5 (with wind or seismic) for normal and short circuit condition as per IS 1904.
2. LT Auxiliary Supply
 - a. AC
415 V (± 10%), 50Hz (± 5%), 3 phase, 4 wire solidly earthed
240 V (± 10%), 50Hz (± 5%), 1 phase, 2 wire solidly earthed
 - b. DC
190 V to 220 V, DC, 2 wire, isolated

50 V, DC, 2 wire, positive earthed

[5] TECHNICAL QUALIFYING REQUIREMENTS

The Technical Qualifying Requirement/ criterion shall be as per **Annexure-Technical Qualifying Requirement**.

Bidder to submit complete supporting documents required for technical qualifying requirement along with technical bid.

[6] TYPE TESTING, INSPECTION, TESTING & INSPECTION CERTIFICATE

The offered GIS equipment shall conform to the type tests as per IEC-62271-203. Contractor shall submit type test reports for the following type tests & additional type tests.

1. Tests to verify the insulation level of the equipment and dielectric test on auxiliary circuits
2. Tests to prove the temperature rise of any part of the equipment and measurement of the resistance of the main circuit
3. Tests to prove the ability of the main and earthing circuits to carry the rated peak and rated short time withstand current.
4. Tests to verify the making and breaking capacity of the included switching Devices.
5. Tests to prove the satisfactory operation of the included switching devices.
6. Tests to prove the strength of the enclosures.
7. Gas tightness tests.
8. Tests on partitions.
9. Tests to prove the satisfactory operation at limit temperatures
10. Tests to assess the effects of arcing due to internal fault
11. Verification of the degree of protection of the enclosure
12. Tests to prove performance under thermal cycling and gas tightness tests on Insulators.
13. Additional tests on auxiliary and control circuits
14. Reactor current switching test for Reactive Current switching capability as per Clause 6.4.1.
15. Test to demonstrate the Power frequency withstand capability of breaker in open condition at lock out pressure
16. Electromagnetic compatibility tests (if applicable)
17. Radio inference voltage tests

The test reports of the above type tests for GIS (including type test report on Circuit breaker, Disconnect Switch, Grounding switches, Current and Voltage transformers as per relevant IEC and type tests of SF6/ Air & Oil bushing as per IEC 60137, if applicable shall be submitted for approval as per **Section 3 GTR, Section 2 Technical Specification**.

The validity of type test reports shall be as per the latest CEA guidelines for the validity period of type test(s) conducted on major electrical equipment in Power Transmission system. In case the item/equipment is not listed in the CEA guidelines, the validity of the respective items/ equipment shall be as per TS.

Further, in the event of any discrepancy in the test reports i.e. any test report not acceptable due to any design/manufacturing changes or due to non-compliance with the requirement stipulated in the Technical Specification or any/all type tests not carried out, same shall be carried out without any additional cost and delivery implication to BHEL/ customer.

Note:

Type test report shall be reviewed for approval in detailed engineering stage only. However, for evaluation purpose, the test reports are to be submitted along with the technical bid.

SPEC. NO. 12416A-EL-GIS- 40101	TATA CONSULTING ENGINEERS LIMITED	SECTION: B
	Section B: Project Information	SHEET 1 OF 2

PROJECT INFORMATION

1.0	Owner	:	Chennai Petroleum Corporation Limited
2.0	Project Name	:	9 MMTPA CBR PROJECT AT NAGAPATTINAM, TAMILNADU
3.0	Location of the Plant	:	Panangudi, Tamilnadu, India
4.0	Nearest Railway station	:	Nagore (5 KM)
5.0	Nearest Airport / Sea port	:	Airport: Thiruchirappalli city (145 KM) Port: Karaikal (5 KM)
6.0	Nearest Highway	:	National Highway 32
7.0	Nearest Town / Village	:	Nagapattinam (12 KM)
8.0	Elevation above mean sea level	:	3.5 m
9.0	Barometric Pressure		
(i)	Maximum value	:	1014 mbar
(ii)	Minimum value	:	1001 mbar
(iii)	Normal value	:	1009 mbar
10.0	Ambient air Temperature		
(i)	Maximum value	:	45 °C
(ii)	Minimum value	:	18 °C
(iii)	Normal value	:	35 °C
11.0	Relative humidity @ambient temperature		
(i)	Maximum value	:	80% at max. temperature
(ii)	Minimum value	:	71%
(iii)	Normal value	:	75%
12.0	Rainfall data		
(i)	Maximum rainfall data for 1hour period	:	100mm

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SPEC. NO. 12416A-EL-GIS- 40101	TATA CONSULTING ENGINEERS LIMITED	SECTION: B
	Section B: Project Information	SHEET 2 OF 2

(ii)	Maximum rainfall data for 24hour period	:	400mm
13.0	Basic wind parameters		
(i)	Wind direction	:	North East
(ii)	Max. wind velocity	:	180 Km/hr
14.0	Seismic Zone	:	Seismic Zone- II
15.0	Source of water	:	1. Sea water 2. Sooranur wells
16.0	Data for Equipment design		
(i)	Design Dry bulb temperature	:	38 °C
(ii)	Design Wet bulb temperature	:	29 °C
(iii)	Min. Design temperature for electrical equipment	:	45 °C
17.0	Performance guarantees point temperature and relative humidity	:	38 °C and 75%
18.0	Language for correspondence and Technical Documentation		English

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 14BA		Description : BIMETAL RELAYS		
Approved Suppliers				
1	S450A	SCHNEIDER ELECTRIC INDIA P LTD-HYDERABAD	INDIA	
2	B002	BCH ELECTRIC LTD	INDIA	
3	S003	SIEMENS LIMITED	INDIA	
4	L103	SCHNEIDER ELECTRIC INDIA PRIVATE LIMITED	INDIA	
5	G147	GE INDIA INDUSTRIAL PVT LTD	INDIA	
6	A200	ABB INDIA LTD (BANGALORE)	INDIA	



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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 14CA Description : CABLE GLANDS (HAZARDOUS AREA)				
Approved Suppliers				
1	3704	METAL CRAFT INDUSTRIES	INDIA	
2	C205	COMET INDUSTRIES	INDIA	
3	F141	FCG POWER INDUSTRIES PVT LTD	INDIA	
4	3681	FCG POWER INDUSTRIES PVT LTD	INDIA	
5	27421	CMP PRODUCTS LIMITED	UNITED KINGDOM	
6	B024	BALIGA LIGHTING EQUIPMENTS (P) LIMITED	INDIA	
7	3890	AKSHAR BRASS INDUSTRIES	INDIA	
8	C195	COMET BRASS PRODUCTS	INDIA	
9	F024	FLEXPRO ELECTRICALS PVT LTD	INDIA	
10	F036	FLAMEPROOF EQUIPMENTS PVT.LTD	INDIA	
11	F165	FCG FLAMPROOF CONTROL GEARS P. LTD(C-157	INDIA	
12	K173	KAYSONS TECHNO EQUIPMENTS PVT. LTD.	INDIA	
13	S158	SUDHIR SWITCHGEARS PVT LTD	INDIA	
14	S375	STANDARD METAL INDUSTRIES	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 14CD		Description : CONTACTORS		
Approved Suppliers				
1	S450A	SCHNEIDER ELECTRIC INDIA P LTD-HYDERABAD	INDIA	
2	G147	GE INDIA INDUSTRIAL PVT LTD	INDIA	
3	B002	BCH ELECTRIC LTD	INDIA	
4	L103	SCHNEIDER ELECTRIC INDIA PRIVATE LIMITED	INDIA	
5	S003	SIEMENS LIMITED	INDIA	
6	A200	ABB INDIA LTD (BANGALORE)	INDIA	



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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 14CE		Description : CONTROL SWITCHES (BREAKER)		
Approved Suppliers				
1	A392	GE T&D INDIA LIMITED	INDIA	
2	S373	SWITRON DEVICES	INDIA	
3	R159	RELIABLE ELECTRONIC COMPONENTS PVT LTD	INDIA	



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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 14CF		Description : CONTROL SWITCHES / SELECTOR SWITCHES		
Approved Suppliers				
1	H142	HOTLINE SWITCHGEAR & CONTROLS	INDIA	
2	K143	KAYCEE INDUSTRIES LTD.	INDIA	
3	L103	SCHNEIDER ELECTRIC INDIA PRIVATE LIMITED	INDIA	
4	S373	SWITRON DEVICES	INDIA	
5	S003	SIEMENS LIMITED	INDIA	
6	R159	RELIABLE ELECTRONIC COMPONENTS PVT LTD	INDIA	
7	A392	GE T&D INDIA LIMITED	INDIA	



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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 14EA		Description : EARTH LEAKAGE CIRCUIT BREAKER		
Approved Suppliers				
1	3824	HAVELLS INDIA LIMITED	INDIA	
2	3726	NOVATEUR ELECTRICAL & DIGITAL SYSTEMS PVT. LTD.	INDIA	
3	G147	GE INDIA INDUSTRIAL PVT LTD	INDIA	
4	S450	SCHNEIDER ELECTRIC INDIA PVT LTD	INDIA	
5	A372	ABB INDIA LTD	INDIA	
6	L071	LEGRAND (INDIA) PVT. LTD (FORM. M-006)	INDIA	
7	S003	SIEMENS LIMITED	INDIA	



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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 14FA		Description : FUSES		
Approved Suppliers				
1	C194	EATON POWER QUALITY PRIVATE LIMITED	INDIA	
2	G147	GE INDIA INDUSTRIAL PVT LTD	INDIA	
3	S003	SIEMENS LIMITED	INDIA	
4	L103	SCHNEIDER ELECTRIC INDIA PRIVATE LIMITED	INDIA	
5	I013	NOVATEUR ELECTRICAL & DIGITAL SYSTEMS P	INDIA	



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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 14LA		Description : LIGHTNING ARRESTORS		
Approved Suppliers				
1	O009	OBLUM ELECTRICAL INDUSTRIES (P) LTD	INDIA	
2	E091	ELPRO INTERNATIONAL LIMITED	INDIA	
3	C010	CG POWER AND INDUSTRIAL SOLUTIONS LIMITED	INDIA	
4	W035	W.S. INSULATOR OF INDIA	INDIA	



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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 14MA		Description : MCB		
Approved Suppliers				
1	A372	ABB INDIA LTD	INDIA	
2	3824	HAVELLS INDIA LIMITED	INDIA	
3	S003	SIEMENS LIMITED	INDIA	
4	S450	SCHNEIDER ELECTRIC INDIA PVT LTD	INDIA	
5	1168	INDIANA CURRENT CONTROL LTD	INDIA	
6	3726	NOVATEUR ELECTRICAL & DIGITAL SYSTEMS PVT. LTD.	INDIA	
7	L071	LEGRAND (INDIA) PVT. LTD (FORM. M-006)	INDIA	
8	S393	STANDARD ELECTRICALS LTD	INDIA	
9	3888	POLYCAB INDIA LIMITED	INDIA	



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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 14MB		Description : MCCB		
Approved Suppliers				
1	S450A	SCHNEIDER ELECTRIC INDIA P LTD-HYDERABAD	INDIA	
2	S003	SIEMENS LIMITED	INDIA	
3	L001C	LARSEN & TOUBRO LTD-POWAI	INDIA	
4	G147	GE INDIA INDUSTRIAL PVT LTD	INDIA	
5	A200B	ABB INDIA LTD	INDIA	



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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 14MC		Description : METERS		
Approved Suppliers				
1	S141	SECURE METERS LIMITED	INDIA	
2	R042	RISHABH INSTRUMENTS PVT LTD	INDIA	
3	N130	NIPPEN ELECTRICAL INSTRUMENTS CO.	INDIA	
4	M239	MECO INSTRUMENTS PVT LTD	INDIA	
5	3901	NEWTEK ELECTRICALS	INDIA	
6	A028A	AUTOMATIC ELECTRIC LTD.	INDIA	



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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 14PA		Description : PROTECTION RELAYS		
Approved Suppliers				
1	A392	GE T&D INDIA LIMITED	INDIA	
2	S003B	SIEMENS LTD - GOA	INDIA	
3	E143	EASUN REYROLLE LTD	INDIA	
4	A070	ABB INDIA LTD (BARODA)	INDIA	
5	S450A	SCHNEIDER ELECTRIC INDIA P LTD-HYDERABAD	INDIA	
6	S824	SCHWEITZER ENGINEERING LABORATORIES	UNITED STATES	



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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 14PB		Description : PUSH BUTTON AND INDICATING LAMPS		
Approved Suppliers				
1	T166	TEKNIC ELECTRIC (I) PVT. LTD.	INDIA	
2	B002	BCH ELECTRIC LTD	INDIA	
3	L001C	LARSEN & TOUBRO LTD-POWAI	INDIA	
4	H142	HOTLINE SWITCHGEAR & CONTROLS	INDIA	
5	P291	PRECIFINE PRODUCTS PVT. LTD.	INDIA	
6	S003	SIEMENS LIMITED	INDIA	
7	S365	SHRI TULSI SWITCHGEARS PVT LTD	INDIA	
8	S450A	SCHNEIDER ELECTRIC INDIA P LTD-HYDERABAD	INDIA	
9	E173	ESSEN DEINKI	INDIA	



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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 14SA		Description : FUSE SWITCH COMBINATION		
Approved Suppliers				
1	3825	HAVELLS INDIA LIMITED	INDIA	
2	G147	GE INDIA INDUSTRIAL PVT LTD	INDIA	
3	S393	STANDARD ELECTRICALS LTD	INDIA	
4	L103	SCHNEIDER ELECTRIC INDIA PRIVATE LIMITED	INDIA	
5	S003	SIEMENS LIMITED	INDIA	
6	I013	NOVATEUR ELECTRICAL & DIGITAL SYSTEMS P	INDIA	



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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 14TA		Description : TIMERS		
Approved Suppliers				
1	B002	BCH ELECTRIC LTD	INDIA	
2	L103	SCHNEIDER ELECTRIC INDIA PRIVATE LIMITED	INDIA	
3	E151	ELECTRONIC AUTOMATION PVT LTD	INDIA	
4	S003	SIEMENS LIMITED	INDIA	



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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15PI		Description : PRESSURE SWITCHES		
Approved Suppliers				
1	U503	UNITED ELECTRIC CONTROLS CO	UNITED STATES	
2	R526	ROBERTSHAW CONTROLS CO	UNITED STATES	
3	A555	ASCO JOUCOMATIC LTD	UNITED KINGDOM	
4	S573	SIRCO CONTROLS LIMITED	UNITED KINGDOM	
5	S552	SOR INC.	UNITED STATES	
6	S087	SWITZER PROCESS INSTRUMENTS PVT. LTD.	INDIA	
7	K175	KAUSTUBHA UDYOG	INDIA	
8	3638	GAUGES BOURDON (I) PVT LTD (GEN. INST)	INDIA	
9	D027	DAG PROCESS INSTRUMENTS PVT LTD	INDIA	
10	D510	DELTA CONTROLS LTD	UNITED KINGDOM	
11	I132	INDFOS INDUSTRIES LIMITED	INDIA	
12	R613	REGULATEURS GEORGIN S.A	FRANCE	
13	P608	PYROPRESS LIMITED	UNITED KINGDOM	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15UA		Description : CONTROL PANEL & ACCESSORIES		
Approved Suppliers				
1	3626	CONTROL SYSTEMS ENGINEERS	INDIA	
2	R084	RADHA KRISHNA CONTROLS	INDIA	
3	A212	ACCUSONIC CONTROLS PVT LTD	INDIA	
4	P214	PYROTECH ELECTRONICS PVT LTD	INDIA	
5	P213	PRIMA AUTOMATION INDIA PVT LTD	INDIA	
6	P134	POSITRONICS PVT LTD	INDIA	
7	I206	IRIS AUTOMATION PVT LTD	INDIA	
8	I010	INDUSTRIAL CONTROLS & APPLIANCES PVT LTD	INDIA	
9	3902	PREI POLAR ENGINEERING PVT LTD	INDIA	
10	D129	DRESSER RAND INDIA PVT LTD	INDIA	
11	E004	ELECTRONIC CORPORATION OF INDIA LTD.	INDIA	
12	E184	ELECTRONIC INSTRMNTATION & CONTROL P LTD	INDIA	

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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15YA		Description : ALARM ANNUNCIATORS		
Approved Suppliers				
1	E004	ELECTRONIC CORPORATION OF INDIA LTD.	INDIA	
2	M154	MTL INSTRUMENTS PVT LTD	INDIA	
3	M171	MINILEC (INDIA) PVT LTD	INDIA	
4	I545	IDEC IZUMI CORPORATION	JAPAN	
5	R540	RONAN ENGINEERING COMPANY	UNITED STATES	
6	P014	PROCON INSTRUMENTATION PVT LTD	INDIA	
7	I083	INSTALARM INSTRUMENTS PVT LTD.	INDIA	



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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 15ZA		Description : RUPTURE DISCS		
Approved Suppliers				
1	B017	BS & B SAFETY SYSTEMS (INDIA) LTD	INDIA	
2	R519	REMBE GMBH SAFETY+CONTROL	GERMANY	
3	F575	FIKE CORPORATION-USA	UNITED STATES	



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Sr No	Supplier Code	Supplier Name	Country	Holiday Description
Item Code : 16AA		Description : METER PROVERS		
Approved Suppliers				
1	A682	ABB AUTOMATION LTD	UNITED KINGDOM	
2	F640	FMC MEASUREMENT SOLUTIONS	UNITED STATES	
3	D509	EMERSON PROCESS MANAGEMENT ASIA PACIFIC PTE LTD	UNITED STATES	
4	S716	SKELTONHALL LTD	UNITED KINGDOM	
5	B617	BOPP & REUTHER MESSTECHNIK GMBH	GERMANY	



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Annexure_BOQ_230kV & 66kV GIS CPCL_TABLE

Pre Bid Tie up for,

Design, Engineering, Supply, Erection*, Testing & Commissioning of 230kV & 66kV GIS for Cauvery Basin Refinery (CBR), Chennai Petroleum Corporation Ltd. (CPCL) at Nagapattinam, Tamil Nadu.

* - only supervision of Erection will be in bidder's scope.

Sl. No.	BOQ DESCRIPTION
A	230kV GIS for CBR, CPCL at Nagapattinam, Tamil Nadu
A.1	Annexure_BOQ_CPCL_230kV GIS- MAIN & INSTRUMENTS
A.2	Annexure_BOQ_CPCL_230kV GIS- SPARE
A.3	Annexure_BOQ_CPCL_230kV GIS- SERVICES
B	66kV GIS for CBR, CPCL at Nagapattinam, Tamil Nadu
B.1	Annexure_BOQ_CPCL_66kV GIS- MAIN & INSTRUMENTS
B.2	Annexure_BOQ_CPCL_66kV GIS- SPARE
B.3	Annexure_BOQ_CPCL_66kV GIS- SERVICES

Annexure_BOQ_230kV CPCL_MAIN & INSTRUMENTS

Sl. No.	Item Description	Unit	Qty.	Remarks
1	Supply- GIS: 230kV, 40kA for 3sec, Gas Insulated Switchgear (GIS) as per TS			
1.01	SUPPLY- GIS:230KV, 3150A, SF6 GIS LINE FEEDER BAY MODULE- INCOMING FFEDER FROM TNSEB GRID-1/2 (EXCLUDING SF6 GAS, SUPPORT STRUCTURE, HARDWARES & EARTHING ETC.)	SET	2	Please refer Section-2 along with drawing KEY SINGLE LINE DIAGRAM FOR CPP, METERING & PROTECTION SLD FOR 230KV & 66KV GIS & ELECTRICAL EQUIPMENT LAYOUT FOR 66kv MAIN DISTRIBUTION (CPP) & 230kv SUB STATIONS.
1.02	SUPPLY- GIS: 230KV, 3150A, SF6 GIS TRANSFORMER FEEDER BAY MODULE- OUTGOING FEEDER TO 220/66KV ICT (EXCLUDING SF6 GAS, SUPPORT STRUCTURE, HARDWARES & EARTHING ETC.)	SET	2	Please refer Section-2 along with drawing KEY SINGLE LINE DIAGRAM FOR CPP, METERING & PROTECTION SLD FOR 230KV & 66KV GIS & ELECTRICAL EQUIPMENT LAYOUT FOR 66kv MAIN DISTRIBUTION (CPP) & 230kv SUB STATIONS.
1.03	SUPPLY- GIS: 230KV, 3150A, SF6 GIS TRANSFORMER FEEDER BAY MODULE- SPARE BAY FOR FUTURE SIMILAR TO ICT WITH AIR TO SF6 BUSHING WITH GIB/ CABLE CONNECTION MODULE (EXCLUDING SF6 GAS, SUPPORT STRUCTURE, HARDWARES & EARTHING ETC.)	SET	1	Please refer Section-2 along with drawing KEY SINGLE LINE DIAGRAM FOR CPP, METERING & PROTECTION SLD FOR 230KV & 66KV GIS & ELECTRICAL EQUIPMENT LAYOUT FOR 66kv MAIN DISTRIBUTION (CPP) & 230kv SUB STATIONS.
1.04	SUPPLY- GIS: 230KV, 3150A, SF6 GIS BUS COUPLER FEEDER BAY MODULE (EXCLUDING SF6 GAS, SUPPORT STRUCTURE, HARDWARES & EARTHING ETC.)	SET	1	Please refer Section-2 along with drawing KEY SINGLE LINE DIAGRAM FOR CPP, METERING & PROTECTION SLD FOR 230KV & 66KV GIS & ELECTRICAL EQUIPMENT LAYOUT FOR 66kv MAIN DISTRIBUTION (CPP) & 230kv SUB STATIONS.
1.05	SUPPLY- GIS: 230KV, 3150A, SF6 GIS BUS BAR MODULE WITH BUS VT BAY & BUS EARTH SWITCH (EXCLUDING SF6 GAS, SUPPORT STRUCTURE, HARDWARES & EARTHING ETC.)	SET	2	Please refer Section-2 along with drawing KEY SINGLE LINE DIAGRAM FOR CPP, METERING & PROTECTION SLD FOR 230KV & 66KV GIS & ELECTRICAL EQUIPMENT LAYOUT FOR 66kv MAIN DISTRIBUTION (CPP) & 230kv SUB STATIONS.
1.06	SUPPLY- GIS : 230KV, 3150A, SINGLE PHASE GIB DUCT OUTSIDE GIS HALL (INCLUDING SF6 GAS, SUPPORT STRUCTURE, HARDWARES & EARTHING ETC.)	MTR	250	Gas insulated duct shall be measured from last equipment of GIS bay. Please refer Section-2 along with drawing KEY SINGLE LINE DIAGRAM FOR CPP, METERING & PROTECTION SLD FOR 230KV & 66KV GIS & ELECTRICAL EQUIPMENT LAYOUT FOR 66kv MAIN DISTRIBUTION (CPP) & 230kv SUB STATIONS.
1.07	SUPPLY- GIS : 230KV, 3150A, SINGLE PHASE SF6 TO AIR BUSHING (INCLUDING SF6 GAS, SUPPORT STRUCTURE, HARDWARES & EARTHING ETC.)	SET	12	Please refer Section-2 along with drawing KEY SINGLE LINE DIAGRAM FOR CPP, METERING & PROTECTION SLD FOR 230KV & 66KV GIS & ELECTRICAL EQUIPMENT LAYOUT FOR 66kv MAIN DISTRIBUTION (CPP) & 230kv SUB STATIONS. 1 SET= 1 NO. FOR 1 PHASE
1.08	SUPPLY- GIS: SPARES: 230kv CLASS SF6 GIS SURGE ARRESTER (INCLUDING SF6 GAS, SUPPORT STRUCTURE, HARDWARES & EARTHING)	SET	1	Please refer Section-2 along with drawing KEY SINGLE LINE DIAGRAM FOR CPP, METERING & PROTECTION SLD FOR 230KV & 66KV GIS & ELECTRICAL EQUIPMENT LAYOUT FOR 66kv MAIN DISTRIBUTION (CPP) & 230kv SUB STATIONS. This is an optional Item, to be finalized as per detailed engineering. 1 SET= 1 NO. FOR 1 PHASE
1.09	SUPPLY- GIS: SPARES: 230kv SF6 GIS VOLTAGE TRANSFORMER (INCLUDING SF6 GAS, SUPPORT STRUCTURE, HARDWARES & EARTHING)	SET	1	Please refer Section-2 along with drawing KEY SINGLE LINE DIAGRAM FOR CPP, METERING & PROTECTION SLD FOR 230KV & 66KV GIS & ELECTRICAL EQUIPMENT LAYOUT FOR 66kv MAIN DISTRIBUTION (CPP) & 230kv SUB STATIONS. This is an optional Item, to be finalized as per detailed engineering. 1 SET= 1 NO. FOR 1 PHASE
1.10	SUPPLY- GIS: SF6 GAS REQUIRED FOR PLACING GIS BAYS INTO SUCCESSFUL OPERATION (EXCLUDING REQUIREMENT OF BUS DUCT, SF6 TO AIR BUSHING, SURGE ARRESTOR & VT ETC.)	LOT	1	Please refer clause 4.5 & 9.1, Section-2 along with drawing KEY SINGLE LINE DIAGRAM FOR CPP, METERING & PROTECTION SLD FOR 230KV & 66KV GIS & ELECTRICAL EQUIPMENT LAYOUT FOR 66kv MAIN DISTRIBUTION (CPP) & 230kv SUB STATIONS.
1.11	SUPPLY- GIS: STRUCTURE MATERIAL, FOUNDATION BOLTS, EMBEDDED ITEMS, RAILS AND/ OR ANY OTHER MATERIALS ETC (EXCLUDING REQUIREMENT OF BUS DUCT, SF6 TO AIR BUSHING, SURGE ARRESTOR & VT ETC.)	LOT	1	Please refer Section-2 along with drawing KEY SINGLE LINE DIAGRAM FOR CPP, METERING & PROTECTION SLD FOR 230KV & 66KV GIS & ELECTRICAL EQUIPMENT LAYOUT FOR 66kv MAIN DISTRIBUTION (CPP) & 230kv SUB STATIONS.

Annexure_BOQ_230kV CPCL_MAIN & INSTRUMENTS

Sl. No.	Item Description	Unit	Qty.	Remarks
1.12	SUPPLY- GIS: EARTHING MATERIALS WITH HIGH FREQUENCY EARTHING, IF APPLICABLE FOR COMPLETE GIS SYSTEM (EXCLUDING REQUIREMENT OF BUS DUCT, SF6 TO AIR BUSHING, SURGE ARRESTOR & VT ETC.)	LOT	1	Please refer clause 4.15, Section-2 along with drawing KEY SINGLE LINE DIAGRAM FOR CPP, METERING & PROTECTION SLD FOR 230KV & 66KV GIS & ELECTRICAL EQUIPMENT LAYOUT FOR 66kV MAIN DISTRIBUTION (CPP) & 230kV SUB STATIONS.
1.13	SUPPLY- GIS: LOCAL CONTROL CUBICLES	SET	6	Please refer clause 7.0, Section-2 along with drawing KEY SINGLE LINE DIAGRAM FOR CPP, METERING & PROTECTION SLD FOR 230KV & 66KV GIS & ELECTRICAL EQUIPMENT LAYOUT FOR 66kV MAIN DISTRIBUTION (CPP) & 230kV SUB STATIONS.
1.14	SUPPLY- GIS: ONLINE PARTIAL DISCHARGE MONITORING (PDM) SYSTEM	LOT	1	Please refer clause 4.12, Section-2 along with drawing KEY SINGLE LINE DIAGRAM FOR CPP, METERING & PROTECTION SLD FOR 230KV & 66KV GIS & ELECTRICAL EQUIPMENT LAYOUT FOR 66kV MAIN DISTRIBUTION (CPP) & 230kV SUB STATIONS.
1.15	SUPPLY- GIS: 230kV, 3150A, SF6 GIS END PIECE/ INTERFACE MODULE FOR FUTURE GIS EXTENSION MODULE	SET	2	
1.16	SUPPLY- GIS: 230kV, 3150A, SF6 GIS BUS BAR EXTENSION MODULE	SET	1	Optional item, applicable in case of change in architectural layout of GIS building.
2	Supply- GIS: Special Tools and Testing & Maintenance Instruments as per TS			
2.01	SUPPLY- GIS: TESTING & MAINTENNACE INSTRUMENTS: Mobile SF6 gas treatment plant	NO	1	Please refer clause 9.2, section-2.
2.02	SUPPLY- GIS: TESTING & MAINTENNACE INSTRUMENTS: Two-wheel gas maintenance cart	NO	1	Please refer clause 9.3, section-2.
2.03	SUPPLY- GIS: TESTING & MAINTENNACE INSTRUMENTS: SF6 Gas maintenance cart	NO	1	Please refer clause 9.4, section-2.
2.04	SUPPLY- GIS: TESTING & MAINTENNACE INSTRUMENTS: SF6 gas leakage test equipment	NO	1	Please refer clause 9.5, section-2.
3	Supply- GIS: Special Tools & Tackles as per TS			
3.01	SUPPLY- GIS: SPECIAL TOOLS AND TACKLES: Any other special tool required for the purpose of installation, maintenance, overhauling and testing of GIS shall be provided by bidder.	LOT	1	Please refer clause 9.6, section-2.

Annexure_BOQ_230KV CPCL_MANADATORY SPARES

Sl. No.	Item Description	Unit	Qty.	Remarks
4	Spares-GIS: Mandatory Spares for 230kV, 40kA for 3sec, Gas Insulated Switchgear (GIS) as per TS			
4.01	SUPPLY- GIS: SPARES: Portable gas filling equipment/ SF6 gas cart	NO	1	
4.02	SUPPLY- GIS: SPARES: 230kV, Handle for disconnect switch drive	NO	2	
4.03	SUPPLY- GIS: SPARES: 230kV, Handle for earthing switch drive	NO	2	
4.04	SUPPLY- GIS: SPARES: 230KV, Pre selection/ mechanical key	NO	1	
4.05	SUPPLY- GIS: SPARES: 230KV, Power cable termination kit along with plug and socket (R,Y, B Phases)	SET	2	1 SET= 1 NO for each type of cable size
4.06	SUPPLY- GIS: SPARES: 230KV, Tripping coil	LOT	1	1 LOT= 20% spare of total quantity
4.07	SUPPLY- GIS: SPARES: 230KV, Closing coil	LOT	1	1 LOT= 20% spare of total quantity
4.08	SUPPLY- GIS: SPARES: 230KV, Capacitive type voltage detectors	SET	1	
4.09	SUPPLY- GIS: SPARES: 230KV, Control fuses/ MCB	SET	1	1 SET= 10 NO for each type and rating
4.10	SUPPLY- GIS: SPARES: 230KV, Density / Pressure Gauge	SET	2	1 SET= 1 NO for each type
4.11	SUPPLY- GIS: SPARES: 230KV, Indicating lamps covers	LOT	1	1 LOT= Min. 5 NO of different colours for every 5 feeders of similar group
4.12	SUPPLY- GIS: SPARES: 230KV, Indicating lamps	LOT	1	1 LOT= Min. 5 NO of different colours for every 5 feeders of similar group
4.13	SUPPLY- GIS: SPARES: 230KV, Auxiliary relays for LCC/ drive mechanism etc.	LOT	1	1 LOT= 10% or Min. 2 NO of each type
4.14	SUPPLY- GIS: SPARES: Portable SF6 gas leakage detector	NO	1	
4.15	SUPPLY- GIS: SPARES: 230KV, Ethernet Switch	SET	1	1 SET= 1 NO of each type
5	Spares- GIS: Commissioning Spares as per TS			
5.01	SUPPLY- GIS: COMMISSIONING SPARES: Commissioning Spare Parts shall be provided along with main equipment/ 230KV GIS as per OEMs recommendations. The list of such recommended commissioning spares shall be proposed by bidder.	LOT	1	
6	Spares- GIS: Recommended Spare for Normal Operation & Maintenance as TS			
6.01	SUPPLY- GIS: RECOMMENDED SPARE FOR NORMAL OPERATION & MAINTAINENCE: Two-years spares for normal operation and maintenance (over and above mandatory spares) along with unit price is to be proposed by bidder	LOT	1	

Annexure_BOQ_230KV CPCL_MANADATORY SPARES

Sl. No.	Item Description	Unit	Qty.	Remarks
7	Spares-GIS: Reference Unit Price for addition/ deletion of supply items of 230kV, 40kA for 3sec, Gas Insulated Switchgear (GIS) as per TS			
	Unit Prices of Individual Equipment included here or in mandatory spares are required for any Addition/Deletion of Equipment and replacement of damaged items. Vendor to ensure that the unit prices have a logical relationship with prices of assemblies in main items. Quoting for unit prices is mandatory and shall be considered for evaluation			
7.01	SUPPLY- GIS: SPARES: 230kV, OPERATING MECHANISM FOR CIRCUIT BREAKER	SET	1	1 SET= Operating Mechanism for 1 Pole of Circuit Breaker complete in all respect
7.02	SUPPLY- GIS: SPARES: 230kV, OPERATING MECHANISM FOR DISCONNECTOR	SET	1	1 SET= Operating Mechanism for 3 Poles of Disconnecter complete in all respect
7.03	SUPPLY- GIS: SPARES: 230kV, OPERATING MECHANISM FOR MAINTENANCE EARTHING SWITCH	SET	1	1 SET= Operating Mechanism for 3 Poles of Maintenance Earthing Switch complete in all respect
7.04	SUPPLY- GIS: SPARES: 230kV, OPERATING MECHANISM FOR FAST ACTING EARTHING SWITCH	SET	1	1 SET= Operating Mechanism for 1 Pole of High Speed Earthing Switch complete in all respect
7.05	SUPPLY- GIS: SPARES: 230kV, CIRCUIT BREAKER	SET	1	1 SET= 1 Pole complete in all respect
7.06	SUPPLY- GIS: SPARES: 230kV, DISCONNECTOR	SET	1	1 SET= 1 Pole complete in all respect
7.07	SUPPLY- GIS: SPARES: 230kV, MAINTENANCE EARTHING SWITCH	SET	1	1 SET= 1 Pole complete in all respect
7.08	SUPPLY- GIS: SPARES: 230kV, FAST ACTING EARTHING SWITCH	SET	1	1 SET= 1 Pole complete in all respect
7.09	SUPPLY- GIS: SPARES: 230kV, CURRENT TRANSFORMER	NO	1	1 SET= 1 NO each type and rating in complete in all respect
7.10	SUPPLY- GIS: SPARES: 230kV, VOLTAGE TRANSFORMER	NO	1	1 SET= 1 NO each type and rating in complete in all respect
7.11	SUPPLY- GIS: SPARES: 198kV SURGE ARRESTER	NO	1	1 SET= 1 NO complete in all respect
7.12	SUPPLY- GIS: SPARES: 230kV, SINGLE PHASE BUS BAR	MTR	1	
7.13	SUPPLY- GIS: SPARES: 230kV, GIS METALLIC ENCLOSURE	KG	50	
7.14	SUPPLY- GIS: SPARES: 230kV, EXPANSION JOINTS	SET	1	1 SET= 1 NO of each type
7.15	SUPPLY- GIS: SPARES: 230kV, BARRIER INSULATOR	SET	1	1 SET= 1 NO of each type
7.16	SUPPLY- GIS: SPARES: 230kV, NON-BARRIER INSULATOR	SET	1	1 SET= 1 NO of each type
7.17	SUPPLY- GIS: SPARES: 230kV, GAS SEALS	SET	1	1 SET= 1 NO of each type
7.18	SUPPLY- GIS: SPARES: 230kV, GAS DENSITY MONITOR SWITCH	SET	1	1 SET= 1 NO of each type
7.19	SUPPLY- GIS: SPARES: 230kV, UHF PD SENSOR	SET	1	1 SET= 1 NO of each type
7.20	SUPPLY- GIS: SPARES: 230kV, GAS PRESSURE SWITCH	SET	1	1 SET= 1 NO of each type
7.21	SUPPLY- GIS: SPARES: 230kV, TEE BEND	SET	1	1 SET= 1 NO of each type
7.22	SUPPLY- GIS: SPARES: 230kV, ANGLE BEND	SET	1	1 SET= 1 NO of each type
7.23	SUPPLY- GIS: SPARES: 230kV, L-BEND	SET	1	1 SET= 1 NO of each type

Sl. No.	Item Description	Unit	Qty.	Remarks
8	Services- GIS: 230kV, 40kA for 3sec, Gas Insulated Switchgear (GIS) as per TS			
8.01	SERVICES- GIS: SUPERVISION OF ERECTION: 230KV, SF6 GIS BAY MODULE	SET	6	Supervision of erection of GIS system, complete in all respect including LCC and other accessories. It also includes supervision of unloading & verification of materials for proper storage at site. GIS bay having GIS circuit Breaker shall be treated as Bay Module.
8.02	SERVICES- GIS: TESTING & COMMISSIONING: 230KV, SF6 GIS BAY MODULE	SET	6	Testing and commissioning of complete GIS system, is to be executed by vendor. All testing instruments, kits, T&P etc. are to be arranged by contractor on returnable basis. GIS bay having GIS circuit Breaker shall be treated Bay Module.
8.03	SERVICES- GIS : 230KV, SUPERVISION OF ERECTION OF 1 PHASE GAS INSULATED BUS DUCT	MTR	250	
8.04	SERVICES- GIS : 230KV, TESTING & COMMISSIONING OF 1 PHASE GAS INSULATED BUS DUCT	MTR	250	
8.05	SERVICES- GIS : 230KV, SUPERVISION OF ERECTION OF 1 PHASE, SF6 TO AIR BUSHING	SET	12	
8.06	SERVICES- GIS : 230KV, TESTING & COMMISSIONING OF 1 PHASE, SF6 TO AIR BUSHING	SET	12	
8.07	SERVICES- GIS: FINAL SUCCESSFUL HV/ POWER FREQUENCY TESTING OF GIS INCLUDING ARRANGING OF HV TEST KIT ALONG WITH OPERATOR	Lot	1	Carrying out successful HV/ Power Frequency Testing of complete GIS as per IEC including Arrangement of HV Test kit (on returnable basis) shall be in scope of bidder, which includes charges for HV test kit with vendor, accessories & tools required for completion of HV testing. Bays may be commissioned in phase wise manner.
8.08	SERVICES- GIS: INSULATION CO-ORDINATION & VFTO STUDIES FOR GIS SYSTEM COMPLETE	LOT	1	1 LOT= Insulation co-ordination and VFTO studies for 230kV GIS system complete
9	Services-GIS: Reference Unit Price for addition/ deletion of services items of 230kV, 40kA for 3sec, Gas Insulated Switchgear (GIS) as per TS			
9.01	SERVICES- GIS : REFERENCE UNIT PRICE OF GIS INDIVIDUAL ITEM/ EQUIPMENT - SERVICES FOR SUPERVISION OF ERECTION OF GIS	MAN-DAY	10	Charges for repetition of services - (if required due to reasons not attributed to the contractor) This item will be executed only if repetition of services is required by BHEL.
9.02	SERVICES- GIS : REFERENCE UNIT PRICE OF GIS INDIVIDUAL ITEM/ EQUIPMENT - SERVICES FOR TESTING & COMMISSIONING OF GIS	MAN-DAY	10	Charges for repetition of services - (if required due to reasons not attributed to the contractor) This item will be executed only if repetition of services is required by BHEL.
9.03	SERVICES- GIS : REFERENCE UNIT OF GIS INDIVIDUAL ITEM/ EQUIPMENT - HIRING CHARGES OF HV TEST KIT WITH OPERATOR	LOT	1	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). This item is executed only if repetition/ additional HV Test is required by BHEL i.e. post successful commissioning of GIS. (if required due to reasons not attributed to vendor)
10	Services-GIS: Training of customer/ owner Personnel as per TS			
10.01	SERVICES- GIS : Training- Training for Maintenance Engineers in batch (3 batches) for 2 Days (Max 4 Persons per batch) at Vendors works.	MAN-DAY	24	2 engineers from BHEL/TBG is also included.
10.02	SERVICES- GIS : Training- Training for Operators in batch (2 batches) for 3 days (Max 7 Persons per batch) at Site works.	MAN-DAY	42	2 engineers from BHEL/TBG is also included.

Annexure_BOQ_66kV CPCL_MAIN & INSTRUMENTS

Sl. No.	Item Description	Unit	Qty.	Remarks
1	Supply- GIS: 66kV, 40kA for 3sec, Gas Insulated Switchgear (GIS) as per TS			
1.01	SUPPLY- GIS: 66KV, 3150A, SF6 GIS LINE FEEDER BAY MODULE- INCOMING FEEDER FROM 230/66KV ICT (EXCLUDING SF6 GAS, SUPPORT STRUCTURE, HARDWARES & EARTHING ETC.)	SET	2	Please refer Section-2 along with drawing KEY SINGLE LINE DIAGRAM FOR CPP, METERING & PROTECTION SLD FOR 230KV & 66KV GIS & ELECTRICAL EQUIPMENT LAYOUT FOR 66kV MAIN DISTRIBUTION (CPP) & 230kV SUB STATIONS.
1.02	SUPPLY- GIS: 66KV, 3150A, SF6 GIS TRANSFORMER FEEDER BAY MODULE- INCOMING FEEDERS FROM GTR-1/2/3/4 (EXCLUDING SF6 GAS, SUPPORT STRUCTURE, HARDWARES & EARTHING ETC.)	SET	4	Please refer Section-2 along with drawing KEY SINGLE LINE DIAGRAM FOR CPP, METERING & PROTECTION SLD FOR 230KV & 66KV GIS & ELECTRICAL EQUIPMENT LAYOUT FOR 66kV MAIN DISTRIBUTION (CPP) & 230kV SUB STATIONS.
1.03	SUPPLY- GIS: 66KV, 3150A, SF6 GIS TRANSFORMER FEEDER BAY MODULE- SPARE INCOMING FEEDER SIMILAR TO GTR (EXCLUDING SF6 GAS, SUPPORT STRUCTURE, HARDWARES & EARTHING ETC.)	SET	1	Please refer Section-2 along with drawing KEY SINGLE LINE DIAGRAM FOR CPP, METERING & PROTECTION SLD FOR 230KV & 66KV GIS & ELECTRICAL EQUIPMENT LAYOUT FOR 66kV MAIN DISTRIBUTION (CPP) & 230kV SUB STATIONS.
1.04	SUPPLY- GIS: 66KV, 3150A, SF6 GIS TRANSFORMER FEEDER BAY MODULE- INCOMING FEEDERS FROM STR-1/2/3 (EXCLUDING SF6 GAS, SUPPORT STRUCTURE, HARDWARES & EARTHING ETC.)	SET	3	Please refer Section-2 along with drawing KEY SINGLE LINE DIAGRAM FOR CPP, METERING & PROTECTION SLD FOR 230KV & 66KV GIS & ELECTRICAL EQUIPMENT LAYOUT FOR 66kV MAIN DISTRIBUTION (CPP) & 230kV SUB STATIONS.
1.05	SUPPLY- GIS: 66KV, 3150A, SF6 GIS BUS COUPLER FEEDER BAY MODULE (EXCLUDING SF6 GAS, SUPPORT STRUCTURE, HARDWARES & EARTHING ETC.)	SET	2	Please refer Section-2 along with drawing KEY SINGLE LINE DIAGRAM FOR CPP, METERING & PROTECTION SLD FOR 230KV & 66KV GIS & ELECTRICAL EQUIPMENT LAYOUT FOR 66kV MAIN DISTRIBUTION (CPP) & 230kV SUB STATIONS.
1.06	SUPPLY- GIS: 66KV, 3150A, SF6 GIS BUS SECTIONALISER MODULE (EXCLUDING SF6 GAS, SUPPORT STRUCTURE, HARDWARES & EARTHING ETC.)	SET	2	Please refer Section-2 along with drawing KEY SINGLE LINE DIAGRAM FOR CPP, METERING & PROTECTION SLD FOR 230KV & 66KV GIS & ELECTRICAL EQUIPMENT LAYOUT FOR 66kV MAIN DISTRIBUTION (CPP) & 230kV SUB STATIONS.
1.07	SUPPLY- GIS: 66KV, 3150A, SF6 GIS TRANSFORMER FEEDER BAY MODULE- OUTGOING FEEDERS FOR LSTK CONTRACTOR (EXCLUDING SF6 GAS, SUPPORT STRUCTURE, HARDWARES & EARTHING ETC.)	SET	4	Please refer Section-2 along with drawing KEY SINGLE LINE DIAGRAM FOR CPP, METERING & PROTECTION SLD FOR 230KV & 66KV GIS & ELECTRICAL EQUIPMENT LAYOUT FOR 66kV MAIN DISTRIBUTION (CPP) & 230kV SUB STATIONS.
1.08	SUPPLY- GIS: 66KV, 3150A, SF6 GIS TRANSFORMER FEEDER BAY MODULE- OUTGOING FEEDERS FOR CUSTOMER BAYS (EXCLUDING SF6 GAS, SUPPORT STRUCTURE, HARDWARES & EARTHING ETC.)	SET	33	Please refer Section-2 along with drawing KEY SINGLE LINE DIAGRAM FOR CPP, METERING & PROTECTION SLD FOR 230KV & 66KV GIS & ELECTRICAL EQUIPMENT LAYOUT FOR 66kV MAIN DISTRIBUTION (CPP) & 230kV SUB STATIONS.
1.09	SUPPLY- GIS: 66KV, 3150A, SF6 GIS TRANSFORMER FEEDER BAY MODULE- SPARE OUTGOING FEEDERS FOR CUSTOMER (EXCLUDING SF6 GAS, SUPPORT STRUCTURE, HARDWARES & EARTHING ETC.)	SET	8	Please refer Section-2 along with drawing KEY SINGLE LINE DIAGRAM FOR CPP, METERING & PROTECTION SLD FOR 230KV & 66KV GIS & ELECTRICAL EQUIPMENT LAYOUT FOR 66kV MAIN DISTRIBUTION (CPP) & 230kV SUB STATIONS.
1.10	SUPPLY- GIS: 66KV, 3150A, SF6 GIS BUS BAR MODULE WITH BUS PT BAY & BUS EARTH SWITCH (EXCLUDING SF6 GAS, SUPPORT STRUCTURE, HARDWARES & EARTHING ETC.)	SET	4	Please refer Section-2 along with drawing KEY SINGLE LINE DIAGRAM FOR CPP, METERING & PROTECTION SLD FOR 230KV & 66KV GIS & ELECTRICAL EQUIPMENT LAYOUT FOR 66kV MAIN DISTRIBUTION (CPP) & 230kV SUB STATIONS.
1.11	SUPPLY- GIS : 66KV, 3150A, SF6 GIS CABLE CONNECTION MODULE SUITABLE UP TO 1CX1000SQMM (EXCLUDING SF6 GAS, SUPPORT STRUCTURE, HARDWARES & EARTHING ETC.)	SET	55	Please refer Section-2 along with drawing KEY SINGLE LINE DIAGRAM FOR CPP, METERING & PROTECTION SLD FOR 230KV & 66KV GIS & ELECTRICAL EQUIPMENT LAYOUT FOR 66kV MAIN DISTRIBUTION (CPP) & 230kV SUB STATIONS. 1 SET= 1 NO. FOR ALL 3 PHASES
1.12	SUPPLY- GIS: SPARES: 66kV CLASS, SF6 GIS SURGE ARRESTER (EXCLUDING SF6 GAS, SUPPORT STRUCTURE, HARDWARES & EARTHING ETC.)	SET	55	Please refer Section-2 along with drawing KEY SINGLE LINE DIAGRAM FOR CPP, METERING & PROTECTION SLD FOR 230KV & 66KV GIS & ELECTRICAL EQUIPMENT LAYOUT FOR 66kV MAIN DISTRIBUTION (CPP) & 230kV SUB STATIONS. 1 SET= 1 NO. FOR ALL 3 PHASES
1.13	SUPPLY- GIS: SPARES: 66kV, SF6 GIS VOLTAGE TRANSFORMER (EXCLUDING SF6 GAS, SUPPORT STRUCTURE, HARDWARES & EARTHING ETC.)	SET	55	Please refer Section-2 along with drawing KEY SINGLE LINE DIAGRAM FOR CPP, METERING & PROTECTION SLD FOR 230KV & 66KV GIS & ELECTRICAL EQUIPMENT LAYOUT FOR 66kV MAIN DISTRIBUTION (CPP) & 230kV SUB STATIONS. 1 SET= 1 NO. FOR ALL 3 PHASES

Annexure_BOQ_66kV CPCL_MAIN & INSTRUMENTS

Sl. No.	Item Description	Unit	Qty.	Remarks
1.14	SUPPLY- GIS: SF6 GAS REQUIRED FOR PLACING GIS BAYS INTO SUCCESSFUL OPERATION	LOT	1	Please refer Section-2 along with drawing KEY SINGLE LINE DIAGRAM FOR CPP, METERING & PROTECTION SLD FOR 230KV & 66KV GIS & ELECTRICAL EQUIPMENT LAYOUT FOR 66kV MAIN DISTRIBUTION (CPP) & 230kV SUB STATIONS.
1.15	SUPPLY- GIS: STRUCTURE MATERIALS, FOUNDATION BOLTS, EMBEDDED ITEMS, RAILS AND/ OR ANY OTHER MATERIALS ETC.	LOT	1	Please refer Section-2 along with drawing KEY SINGLE LINE DIAGRAM FOR CPP, METERING & PROTECTION SLD FOR 230KV & 66KV GIS & ELECTRICAL EQUIPMENT LAYOUT FOR 66kV MAIN DISTRIBUTION (CPP) & 230kV SUB STATIONS.
1.16	SUPPLY- GIS: EARTHING MATERIALS WITH HIGH FREQUENCY EARTHING, IF APPLICABLE FOR COMPLETE GIS SYSTEM	LOT	1	Please refer clause 4.15, section-2.
1.17	SUPPLY- GIS: LOCAL CONTROL CUBICLES	SET	59	Please refer Section-2 along with drawing KEY SINGLE LINE DIAGRAM FOR CPP, METERING & PROTECTION SLD FOR 230KV & 66KV GIS & ELECTRICAL EQUIPMENT LAYOUT FOR 66kV MAIN DISTRIBUTION (CPP) & 230kV SUB STATIONS.
1.18	SUPPLY- GIS: ONLINE PARTIAL DISCHARGE MONITORING (PDM) SYSTEM	LOT	1	Please refer clause 4.12, section-2.
1.19	SUPPLY- GIS: 66kV, 3150A, SF6 GIS END PIECE/ INTERFACE MODULE FOR FUTURE GIS EXTENSION MODULE	SET	4	
2.20	SUPPLY- GIS: 66kV, 3150A, SF6 GIS BUS BAR EXTENSION MODULE	SET	1	Optional item, applicable in case of change in architectural layout of GIS building.
2	Supply- GIS: Special Tools and Testing & Maintenance Instruments as per TS			
2.01	SUPPLY- GIS: TESTING & MAINTENNACE INSTRUMENTS: Mobile SF6 gas treatment plant	NO	1	Please refer clause 9.2, section-2.
2.02	SUPPLY- GIS: TESTING & MAINTENNACE INSTRUMENTS: Two-wheel gas maintenance cart	NO	1	Please refer clause 9.3, section-2.
2.03	SUPPLY- GIS: TESTING & MAINTENNACE INSTRUMENTS: SF6 Gas maintenance cart	NO	1	Please refer clause 9.4, section-2.
2.04	SUPPLY- GIS: TESTING & MAINTENNACE INSTRUMENTS: SF6 gas leakage test equipment	NO	1	Please refer clause 9.5, section-2.
3	Supply- GIS: Special Tools & Tackles as per TS			
3.01	SUPPLY- GIS: SPECIAL TOOLS AND TACKLES: Any other special tool required for the purpose of installation, maintenance, overhauling and testing of GIS shall be provided by bidder.	LOT	1	Please refer clause 9.6, section-2.

Annexure_BOQ_66KV CPCL_MANADATORY SPARES

Sl. No.	Item Description	Unit	Qty.	Remarks
4	Spares-GIS: Mandatory Spares for 66kV, 40kA for 3sec, Gas Insulated Switchgear (GIS) as per TS			
4.01	SUPPLY- GIS: SPARES: Portable gas filling equipment/ SF6 gas cart	NO	1	
4.02	SUPPLY- GIS: SPARES: 66kV, Handle for disconnect switch drive	NO	2	
4.03	SUPPLY- GIS: SPARES: 66kV, Handle for earthing switch drive	NO	2	
4.04	SUPPLY- GIS: SPARES: 66kV, Pre selection/ mechanical key	NO	1	
4.05	SUPPLY- GIS: SPARES: 66KV, Power cable termination kit along with plug and socket (R,Y, B Phases)	SET	2	1 SET= 1 NO for each type of cable size
4.06	SUPPLY- GIS: SPARES: 66KV, Tripping coil	LOT	1	1 LOT= 20% spare of total quantity
4.07	SUPPLY- GIS: SPARES: 66KV, Closing coil	LOT	1	1 LOT= 20% spare of total quantity
4.08	SUPPLY- GIS: SPARES: 66KV, Capacitive type voltage detectors	SET	1	
4.09	SUPPLY- GIS: SPARES: 66KV, Control fuses/ MCB	SET	1	1 SET= 10 NO for each type and rating
4.10	SUPPLY- GIS: SPARES: 66KV, Density / Pressure Gauge	SET	2	1 SET= 1 NO for each type
4.11	SUPPLY- GIS: SPARES: 66KV, Indicating lamps covers	LOT	1	1 LOT= Min. 5 NO of different colours for every 5 feeders of similar group
4.12	SUPPLY- GIS: SPARES: 66KV, Indicating lamps	LOT	1	1 LOT= Min. 5 NO of different colours for every 5 feeders of similar group
4.13	SUPPLY- GIS: SPARES: 66KV, Auxiliary relays for LCC/ drive mechanism etc.	LOT	1	1 LOT= 10% or Min. 2 NO of each type
4.14	SUPPLY- GIS: SPARES: Portable SF6 gas leakage detector	NO	1	
4.15	SUPPLY- GIS: SPARES: 66KV, Ethernet Switch	SET	1	1 SET= 1 NO of each type
5	Spares- GIS: Commissioning Spares as per TS			
5.01	SUPPLY- GIS: COMMISSIONING SPARES: Commissioning Spare Parts shall be provided along with main equipment/ 66KV GIS as per OEMs recommendations. The list of such recommended commissioning spares shall be proposed by bidder.	LOT	1	
6	Spares- GIS: Recommended Spare for Normal Operation & Maintenance as TS			
6.01	SUPPLY- GIS: RECOMMENDED SPARE FOR NORMAL OPERATION & MAINTAINENCE: Two-years spares for normal operation and maintenance (over and above mandatory spares) along with unit price is to be proposed by bidder	LOT	1	

Annexure_BOQ_66KV CPCL_MANADATORY SPARES

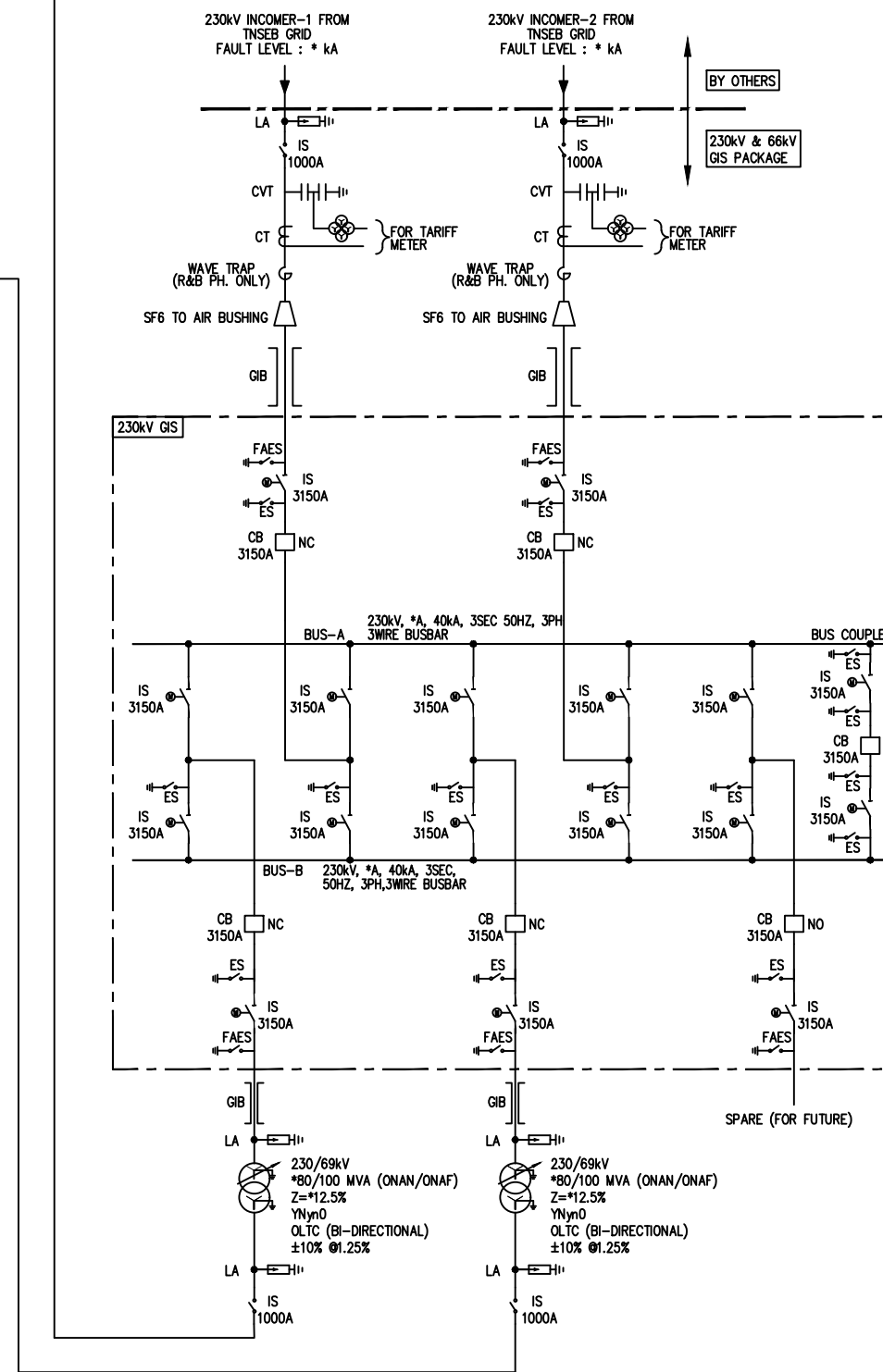
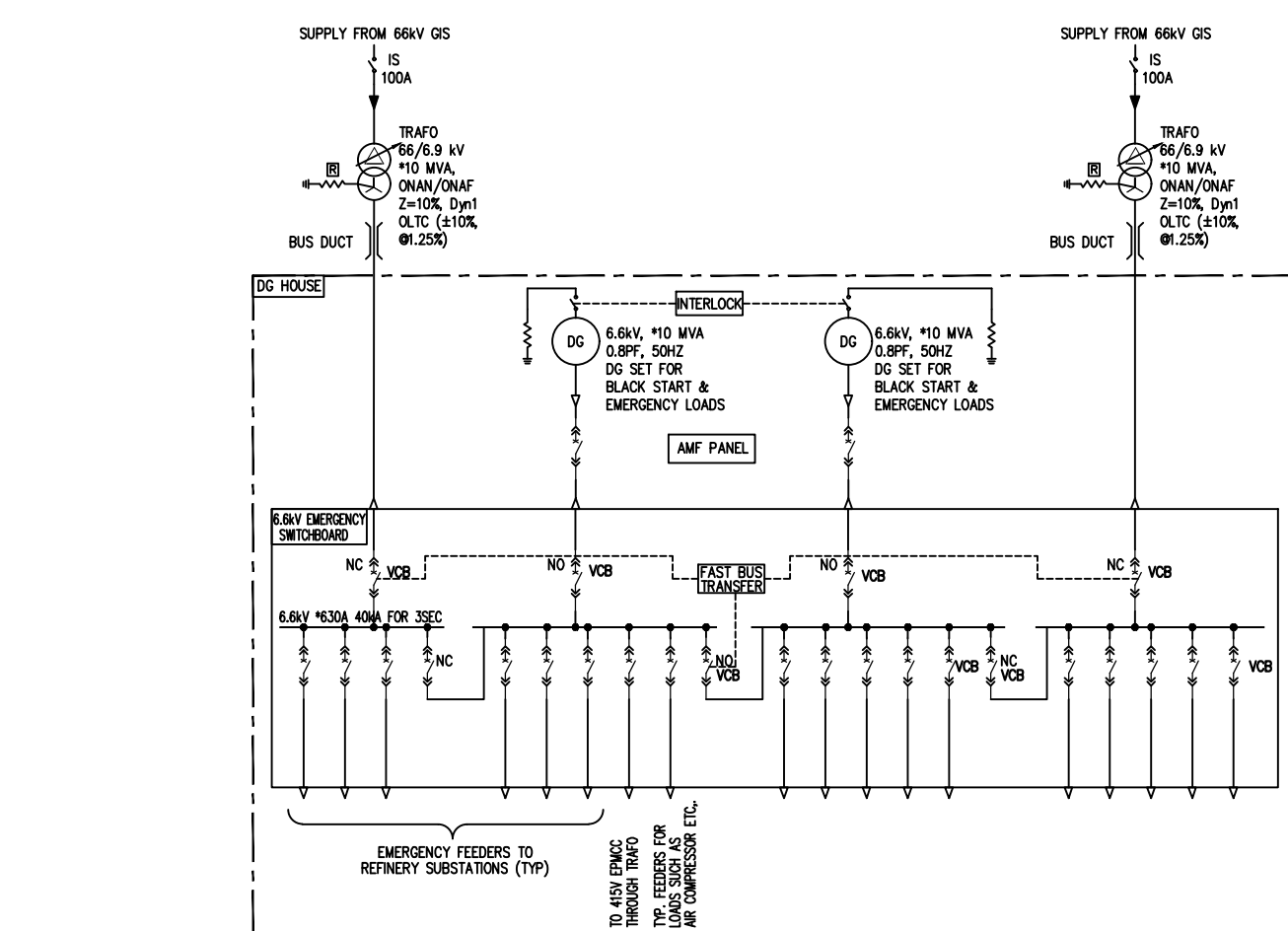
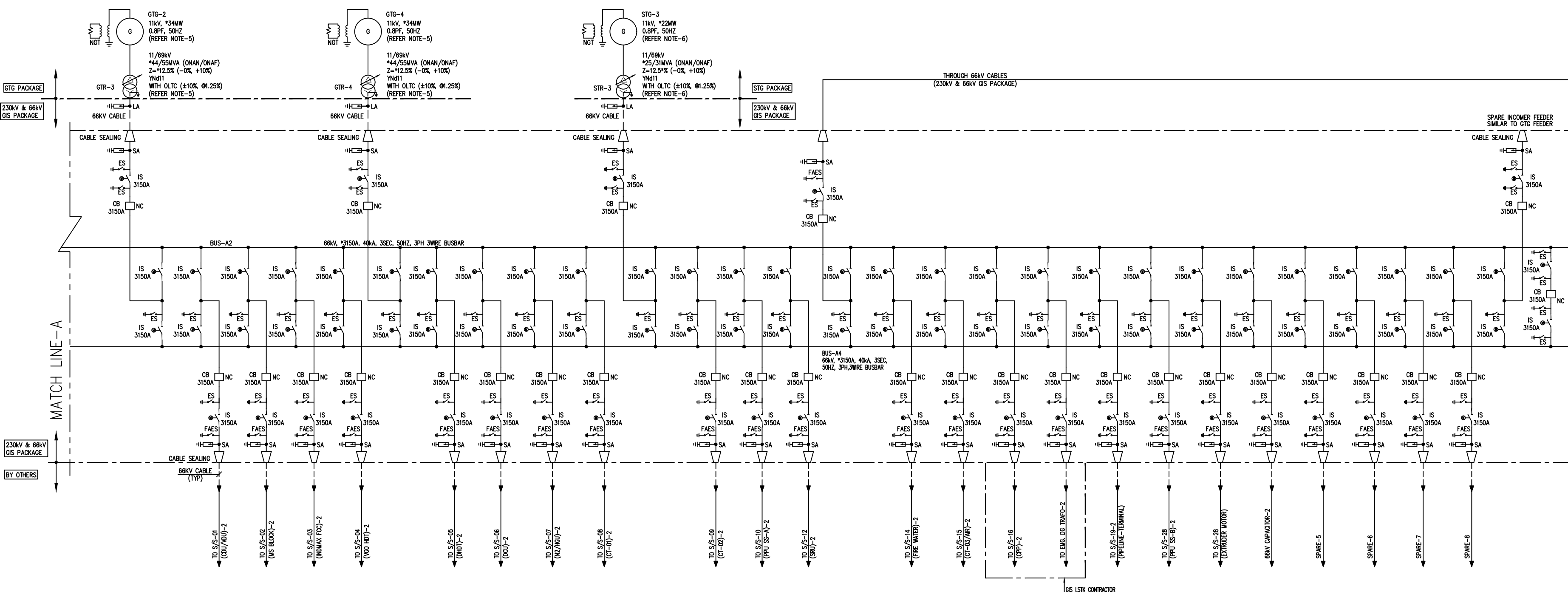
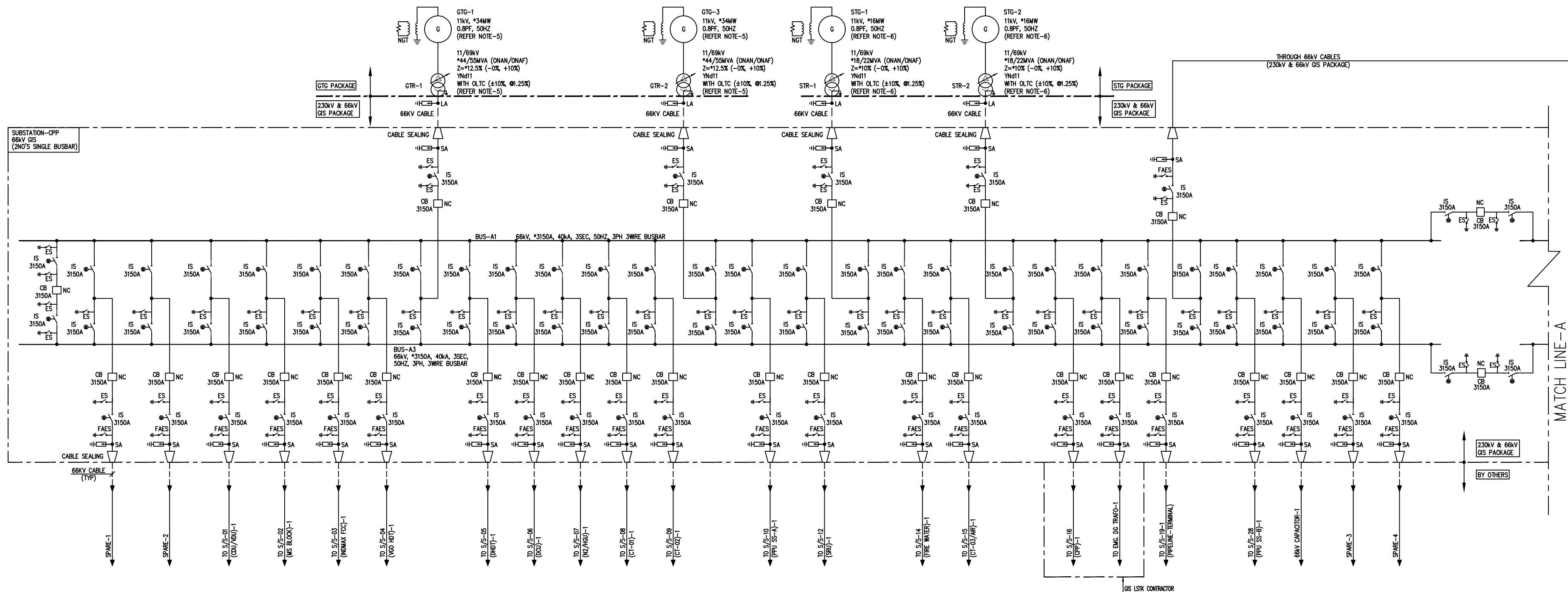
Sl. No.	Item Description	Unit	Qty.	Remarks
7	Spares-GIS: Reference Unit Price for addition/ deletion of supply items of 66kV, 40kA for 3sec, Gas Insulated Switchgear (GIS) as per TS			
	Unit Prices of Individual Equipment included here or in mandatory spares are required for any Addition/Deletion of Equipment and replacement of damaged items. Vendor to ensure that the unit prices have a logical relationship with prices of assemblies in main items. Quoting for unit prices is mandatory and shall be considered for evaluation			
7.01	SUPPLY- GIS: SPARES: 66kV, OPERATING MECHANISM FOR CIRCUIT BREAKER	SET	1	1 SET= Operating Mechanism for 3 Pole of Circuit Breaker complete in all respect
7.02	SUPPLY- GIS: SPARES: 66kV, OPERATING MECHANISM FOR DISCONNECTOR	SET	1	1 SET= Operating Mechanism for 3 Poles of Disconnecter complete in all respect
7.03	SUPPLY- GIS: SPARES: 66kV, OPERATING MECHANISM FOR MAINTENANCE EARTHING SWITCH	SET	1	1 SET= Operating Mechanism for 3 Poles of Maintenance Earthing Switch complete in all respect
7.04	SUPPLY- GIS: SPARES: 66kV, OPERATING MECHANISM FOR FAST ACTING EARTHING SWITCH	SET	1	1 SET= Operating Mechanism for 3 Pole of High Speed Earthing Switch complete in all respect
7.05	SUPPLY- GIS: SPARES: 66kV, CIRCUIT BREAKER	SET	1	1 SET= 3 PoleS complete in all respect
7.06	SUPPLY- GIS: SPARES: 66kV, DISCONNECTOR	SET	1	1 SET= 3 Pole complete in all respect
7.07	SUPPLY- GIS: SPARES: 66kV, MAINTENANCE EARTHING SWITCH	SET	1	1 SET= 3 Pole complete in all respect
7.08	SUPPLY- GIS: SPARES: 66kV, FAST ACTING EARTHING SWITCH	SET	1	1 SET= 3 Pole complete in all respect
7.09	SUPPLY- GIS: SPARES: 66kV, CURRENT TRANSFORMER	SET	1	1 SET= 1 NO comprising of 3 phases- each type and rating in complete in all respect
7.10	SUPPLY- GIS: SPARES: 66kV, VOLTAGE TRANSFORMER	SET	1	1 SET= 1 NO comprising of 3 phases- each type and rating in complete in all respect
7.11	SUPPLY- GIS: SPARES: 60kV SURGE ARRESTER	SET	1	1 SET= 1 NO comprising of 3 phases- Phases complete in all respect
7.12	SUPPLY- GIS: SPARES: 66kV, SINGLE PHASE BUS BAR	MTR	1	
7.13	SUPPLY- GIS: SPARES: 66kV, GIS METALLIC ENCLOSURE	KG	50	
7.14	SUPPLY- GIS: SPARES: 66kV, EXPANSION JOINTS	SET	1	1 SET= 1 NO of each type
7.15	SUPPLY- GIS: SPARES: 66kV, BARRIER INSULATOR	SET	1	1 SET= 1 NO of each type
7.16	SUPPLY- GIS: SPARES: 66kV, NON-BARRIER INSULATOR	SET	1	1 SET= 1 NO of each type
7.17	SUPPLY- GIS: SPARES: 66kV, GAS SEALS	SET	1	1 SET= 1 NO of each type
7.18	SUPPLY- GIS: SPARES: 66kV, GAS DENSITY MONITOR SWITCH	SET	1	1 SET= 1 NO of each type
7.19	SUPPLY- GIS: SPARES: 66kV, GAS PRESSURE SWITCH	SET	1	1 SET= 1 NO of each type
7.20	SUPPLY- GIS: SPARES: 66kV, TEE BEND	SET	1	1 SET= 1 NO of each type
7.21	SUPPLY- GIS: SPARES: 66kV, ANGLE BEND	SET	1	1 SET= 1 NO of each type
7.22	SUPPLY- GIS: SPARES: 66kV, L-BEND	SET	1	1 SET= 1 NO of each type

Annexure_BOQ_66KV CPCL_SERVICES

Sl. No.	Item Description	Unit	Qty.	Remarks
8	Services- GIS: 66kV, 40kA for 3sec, Gas Insulated Switchgear (GIS) as per TS			
8.01	SERVICES- GIS: SUPERVISION OF ERECTION: 66KV, SF6 GIS BAY MODULE	SET	59	Supervision of erection of GIS system, complete in all respect including LCC and other accessories. It also includes supervision of unloading & verification of materials for proper storage at site. GIS bay having GIS circuit Breaker shall be treated as Bay Module.
8.02	SERVICES- GIS: TESTING & COMMISSIONING: 66KV, SF6 GIS BAY MODULE	SET	59	Testing and commissioning of complete GIS system, is to be executed by vendor. All testing instruments, kits, T&P etc. are to be arranged by vendor on returnable basis. GIS bay having GIS circuit Breaker shall be treated as Bay Module.
8.03	SERVICES- GIS: FINAL SUCCESSFUL HV/ POWER FREQUENCY TESTING OF GIS INCLUDING ARRANGING OF HV TEST KIT ALONG WITH OPERATOR	LOT	1	Carrying out successful HV/ Power Frequency Testing of complete GIS as per IEC including Arrangement of HV Test kit (on returnable basis) shall be in scope of vendor, which includes charges for HV test kit with operator, accessories & tools required for completion of HV testing. Bays may be commissioned in phase wise manner.
8.04	SERVICES- GIS: INSULATION CO-ORDINATION & VFTO STUDIES FOR GIS SYSTEM COMPLETE	LOT	1	1 LOT= Insulation co-ordination and VFTO studies for 66kV GIS system complete
9	Services-GIS: Reference Unit Price for addition/ deletion of services items of 66kV, 40kA for 3sec, Gas Insulated Switchgear (GIS) as per TS			
9.01	SERVICES- GIS : REFERENCE UNIT PRICE OF GIS INDIVIDUAL ITEM/ EQUIPMENT - SERVICES FOR SUPERVISION OF ERECTION OF GIS	MAN-DAY	10	Charges for repetition of services - (if required due to reasons not attributed to vendor) This item will be executed only if repetition of services is required by BHEL.
9.02	SERVICES- GIS : REFERENCE UNIT PRICE OF GIS INDIVIDUAL ITEM/ EQUIPMENT - SERVICES FOR TESTING & COMMISSIONING OF GIS	MAN-DAY	10	Charges for repetition of services - (if required due to reasons not attributed to vendor) This item will be executed only if repetition of services is required by BHEL.
9.03	SERVICES- GIS : REFERENCE UNIT OF GIS INDIVIDUAL ITEM/ EQUIPMENT - HIRING CHARGES OF HV TEST KIT WITH OPERATOR	LOT	1	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). This item is executed only if repetition/ additional HV Test is required by BHEL i.e. post successful commissioning of GIS. (if required due to reasons not attributed to vendor)
10	Services-GIS: Training of customer/ owner Personnel as per TS			
10.01	SERVICES- GIS : Training for Maintenance Engineers in batch (3 batches) for 2 Days (Max 4 Persons per batch) at Vendors works.	MAN-DAY	24	2 engineers from BHEL/TBG is also included.
10.02	SERVICES- GIS : Training for Operators in batch (2 batches) for 3 days (Max 7 Persons per batch) at Site works.	MAN-DAY	42	2 engineers from BHEL/TBG is also included.

EXHIBIT-1

KEY SINGLE LINE DIAGRAM FOR CPP
TCE.12416A-EL-4005-AU-40001



LEGEND	
	THREE PHASE GENERATOR
	THREE PHASE TWO WINDING TRANSFORMER
	THREE PHASE TWO WINDING TRANSFORMER WITH OLTC
	THREE PHASE WINDING, DELTA CONNECTION
	THREE PHASE WINDING, STAR CONNECTION
	THREE PHASE WINDING, STAR CONNECTION WITH NEUTRAL BROUGHT OUT
	CURRENT TRANSFORMER
	CAPACITOR VOLTAGE TRANSFORMER
	LIGHTNING ARRESTOR / SURGE ARRESTOR
	NEUTRAL GROUNDING TRANSFORMER
	ISOLATOR (IS)
	CIRCUIT BREAKER
	SF6 AIR TERMINATION
	AIR CIRCUIT BREAKER (ACB) / VACUUM CIRCUIT BREAKER (VCB)
	DRAWOUT FEATURE
	MOLDED CASE CIRCUIT BREAKER (MCCB)
	GAS INSULATED BUSDUCT (GIB)
	NON SEGREGATED PHASE BUSDUCT
	CABLE
	EARTH SWITCH/EARTH ISOLATOR
	FAST ACTING EARTH SWITCH/EARTH ISOLATOR
	EARTH
	NEUTRAL GROUNDING RESISTOR
	DISCONNECTING SWITCH (DS)
	FUSE
	CONTACTOR
	BIMETALLIC RELAY
	BATTERY BANK
	RECTIFIER
	INVERTER
	STATIC SWITCH
	AC REGULATOR

ABBREVIATIONS:-	
CB	CIRCUIT BREAKER
VCB	VACUUM CIRCUIT BREAKER
IS	ISOLATOR
FAES	FAST ACTING EARTH SWITCH
ES	EARTH SWITCH
TR	TRANSFORMER
NO	NORMALLY OPEN
NC	NORMALLY CLOSED
GB	GAS INSULATED BUSDUCT
MWR	MOTOR PROTECTION RELAY

- NOTES:-
1. * - THE SAME WILL BE UPDATED AS ENGINEERING PROGRESS.
 2. CPP CONFIGURATION SHOWN IN SLD IS PRELIMINARY, NUMBER AND RATING OF EQUIPMENT SHALL BE FINALIZED AFTER RECEIPT OF DATA FROM RESPECTIVE VENDORS.
 3. CAPTIVE POWER PLANT ENGAGED IN THE REFINERY WILL BE DESIGNED TO CATER THE ENTIRE POWER REQUIREMENT OF THE REFINERY.
 4. GRID TRANSFORMER RATING OF 100MVA IS INDICATED BASED ON THE AGREEMENT LETTER SUBMITTED TO TATWANGS.
 5. GAS TURBINE GENERATOR (ALTERNATOR) RATING INDICATED IS THE MINIMUM POWER GENERATOR REQUIRED AT NORMAL SITE AMBIENT CONDITION. HOWEVER, GAS TURBINE GENERATOR (ALTERNATOR) RATING TO BE SELECTED CONSIDERING GAS TURBINE POWER GENERATION AT LOWEST SITE AMBIENT TEMPERATURE. GRID STEP-UP TRANSFORMER RATING INDICATED IS TENTATIVE AND SAME WILL BE FINALIZED CONSIDERING GAS TURBINE GENERATOR (ALTERNATOR) RATING WITH 10% ADDITIONAL DESIGN MARGIN.
 6. STEAM TURBINE GENERATOR (ALTERNATOR) RATING INDICATED IS TENTATIVE. HOWEVER, STEAM TURBINE GENERATOR (ALTERNATOR) RATING TO BE SELECTED CONSIDERING STEAM TURBINE POWER GENERATION AT VMD (VALVE WIDE OPEN) CONDITION. GRID STEP-UP TRANSFORMER RATING INDICATED IS TENTATIVE AND SAME WILL BE FINALIZED CONSIDERING STEAM TURBINE GENERATOR (ALTERNATOR) RATING WITH 10% ADDITIONAL DESIGN MARGIN.

REFERENCE DRAWING:-

1. OVERALL KEY SINGLE LINE DIAGRAM : 8145-000-10-00-000

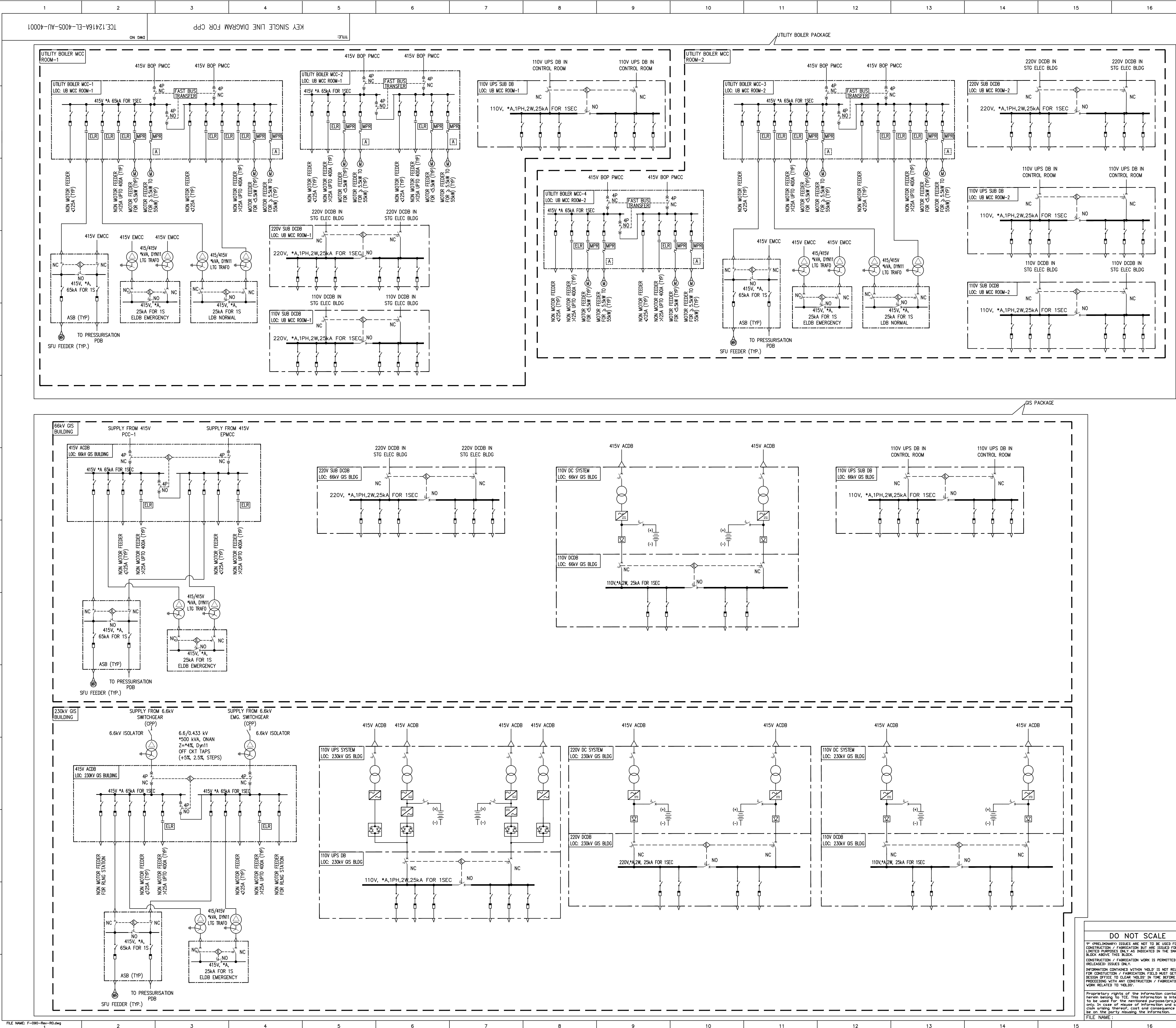
FOR APPROVAL

SIGN.	INITIALS	REVISIONS	DATE
P1	AKJ	PVR	BRS
P0	AKJ	BRS	HA
ISSUE	DRN	DSN	CHD

CHENNAI PETROLEUM CORPORATION LIMITED
POWER & UTILITIES FACILITIES OF CPCL'S SHMTPA
CAUVERY BASIN REFINERY (CBR) PROJECT AT NAGAPATTINAM, TAMILNADU.

KEY SINGLE LINE DIAGRAM FOR CPP

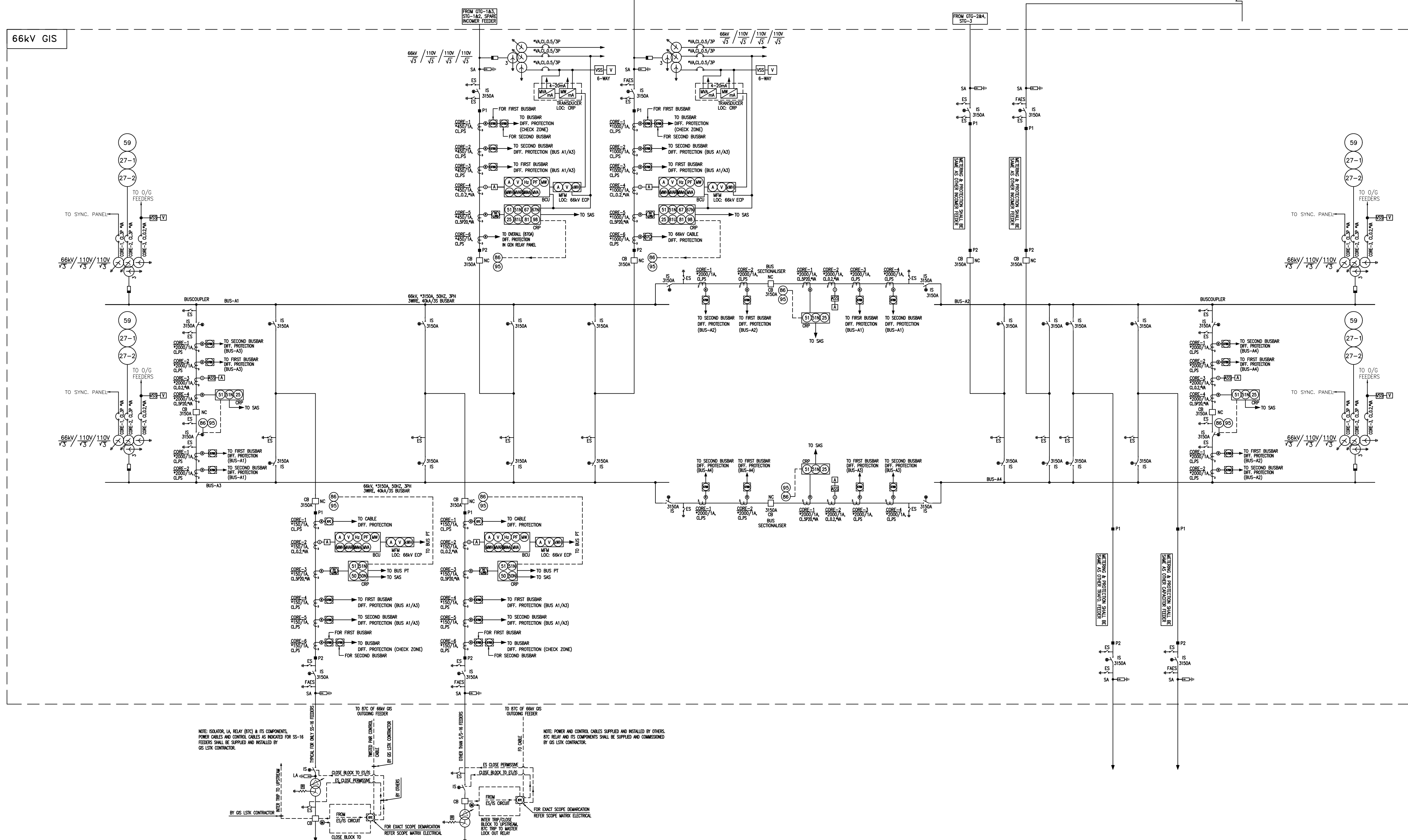
SCALE	NTS	DWG NO.	TCE.12416A-EL-4005-AU-40001	SHEET:	1 OF 4	ISSUE	P1
DC & DISC:	PBU-EL						



NOTES:
1. FOR LEGEND, ABBREVIATIONS, NOTES AND REFERENCE DRAWING REFER KEY SLD SHEET 1 OF 4.

FOR APPROVAL									
SIGN.									
INITIALS									
REVISIONS									
SIGN.									
INITIALS									
REVISIONS									
P1	INITIALS	AKJ	PVBR	BRS	HA	HA	DG	17-03-2022	
REVISIONS	REVISED AS	PER CLIENT COMMENTS							
PO	INITIALS	AKJ	BRS	HA	HA	IC	ME	16-12-2021	
ISSUE	DRN	DSN	CHD	CV	EL	IC	ME	PE/PM	APPD
CHENNAI PETROLEUM CORPORATION LIMITED POWER & UTILITIES FACILITIES OF CPCL'S 9MMTPA CAUVERY BASIN REFINERY (CBR) PROJECT AT NAGAPATTINAM, TAMILNADU.									
KEY SINGLE LINE DIAGRAM FOR CPP									
TATA CONSULTING ENGINEERS LIMITED BENGALURU									
SCALE: NTS DC & DISC: PBU-EL									
DWG NO: TCE.12416A-EL-4005-AU-40001									
SHEET: 3 OF 4									
ISSUE P1									

FOR CONTINUATION
REFER SHEET-2 OF 2



LEGEND:	
	TWO WINDING TRAF0 WITH TAP CHANGER
	CURRENT TRANSFORMER
	BURNING CURRENT TRANSFORMER
	TWO WINDING VOLTAGE TRANSFORMER
	THREE WINDING VOLTAGE TRANSFORMER
	LIGHTNING ARRESTOR/SURGE ARRESTOR
	CIRCUIT BREAKER
	DISCONNECTING SWITCH
	LINK
	DRAWOUT
	GROUNDING
	FUSE
	KW TRANSUDCER (DUAL OUTPUT)
	AMMETER
	VOLTMETER
	POWER FACTOR METER
	TRIECTION METER
	FREQUENCY METER
	REACTIVE POWER METER
	KILO VOLTAMP METER
	KILO WATT METER
	ANALOG VOLTMETER
	ANALOG AMMETER

NOTES:

1. ALL RATINGS INDICATED ARE PRELIMINARY AND THOSE WILL BE FINALIZED AS ENGINEERING PROGRESS.
2. ALL NUMERICAL RATINGS SHALL BE COMMENCEABLE OVER ISO 61800 PROTECT.
3. WVA METER IN ENV EXTERNAL POWER SUPPLY INCENDERS SHALL INCLUDE MAXIMUM DEMAND INDICATION ALSO.
4. SEPARATE WVA, WVAH, VOLTA AND WVAH METER SHALL BE PROVIDED FOR ENV EXTERNAL GRID POWER SUPPLY INCENDERS ONLY.
5. SEPARATE 3 WVA, VOLTA AND 3 WVAH METER SHALL BE PROVIDED FOR ENV EXTERNAL GRID POWER SUPPLY INCENDERS.
6. INCENDERS WITH PARAMETERS ARE SPECIFIED, THE METER SHALL BE A MULTIFUNCTION METER SUITABLE FOR DATA CONNECTIVITY WITH HMI/SCADA SYSTEM.
7. SEPARATE ANALOG METER SHALL BE PROVIDED FOR BELOW MENTIONED FEEDERS, BESIDES METERING FACILITY AVAILABLE IN NUMERICAL RELAY.
7.1. ANALOG METER SHALL BE PROVIDED FOR 11 KV SWITCHGEAR: "Y & A"
7.2. GRID INCORPOR FEEDERS: "A"
7.3. GRID INCORPOR FEEDERS: "DIGITAL MULTIFUNCTION METER"
8. PROTECTION RELAYS SHALL BE LOCATED IN THE RELAY PANEL.
9. DIGITAL METER SHALL BE LOCATED AT RESPECTIVE CDS OF 20KV & 33KV BUS.
10. RECURRENTLY OF TERTIARY WINDING FOR TWO POWER TRANSFORMERS SHALL BE CONSIDERED AS PER TAIWTRANSO REGULATIONS AND TRANSFORMER MANUFACTURER RECOMMENDATIONS.

REFERENCE DRAWINGS:
1. TCE.12416A-EL-4005-AU-40001 KEY SINGLE LINE DIAGRAM FOR CP

S.NO	FEEDER DESCRIPTION	RATED POWER	BREAKER RATING	CT RATIO	REMARKS
1	5 TO 5/2-01 (CDU/VDU)	31.5MVA	3150A	350V/1A	
2	5 TO 5/2-02 (MDU/BLD)	31.5MVA	3150A	350V/1A	
3	5 TO 5/2-03 (DHMT)	16MVA	1500A	200V/1A	
4	5 TO 5/2-04 (VGD HET)	31.5MVA	3150A	350V/1A	
5	5 TO 5/2-05 (INDT)	31.5MVA	3150A	350V/1A	
6	5 TO 5/2-06 (CDU)	25MVA	2500A	250V/1A	
7	5 TO 5/2-07 (INDT/PTU)	25MVA	2500A	250V/1A	
8	5 TO 5/2-08 (CT-01)	25MVA	2500A	250V/1A	
9	5 TO 5/2-09 (CT-02)	31.5MVA	3150A	350V/1A	
10	5 TO 5/2-10 (IPP UNIT-1)	31.5MVA	3150A	350V/1A	
11	5 TO 5/2-12 (SGU)	20MVA	2000A	200V/1A	
12	5 TO 5/2-13 (FIRE WATER)	25MVA	2500A	250V/1A	
13	5 TO 5/2-15 (CT-1/AB)	25MVA	2500A	250V/1A	
14	5 TO 5/2-16 (CPV)	31.5MVA	3150A	350V/1A	
15	15 TO 5/2-19 (PRODUCT PIPE TERMINAL)	25MVA	2500A	250V/1A	
16	5 TO 5/2-28 (PP-2)	25MVA	2500A	250V/1A	
17	5 TO CAPACITOR FEEDER-1	37MVA	3500A	400V/1A	
18	20 TO HS HOUSE-1	10MVA	1500A	150V/1A	
19	5 TO 5/2 HOUSE-2	25MVA	2500A	250V/1A	
20	5 TO 5/2-01 (CDU/VDU)	31.5MVA	3150A	350V/1A	
21	5 TO 5/2-02 (MDU/BLD)	31.5MVA	3150A	350V/1A	
22	5 TO 5/2-03 (DHMT)	16MVA	1500A	200V/1A	
23	5 TO 5/2-04 (VGD HET)	31.5MVA	3150A	350V/1A	
24	5 TO 5/2-05 (INDT)	31.5MVA	3150A	350V/1A	
25	5 TO 5/2-06 (CDU)	25MVA	2500A	250V/1A	
26	5 TO 5/2-07 (INDT/PTU)	25MVA	2500A	250V/1A	
27	5 TO 5/2-08 (CT-01)	25MVA	2500A	250V/1A	
28	5 TO 5/2-09 (CT-02)	31.5MVA	3150A	350V/1A	
29	5 TO 5/2-10 (IPP UNIT-1)	31.5MVA	3150A	350V/1A	
30	5 TO 5/2-12 (SGU)	20MVA	2000A	200V/1A	
31	5 TO 5/2-13 (FIRE WATER)	25MVA	2500A	250V/1A	
32	5 TO 5/2-15 (CT-1/AB)	25MVA	2500A	250V/1A	
33	5 TO 5/2-16 (CPV)	31.5MVA	3150A	350V/1A	
34	5 TO 5/2-19 (PRODUCT PIPE TERMINAL)	25MVA	2500A	250V/1A	
35	5 TO 5/2-28 (PP-2)	25MVA	2500A	250V/1A	
36	5 TO CAPACITOR FEEDER-2	37MVA	3500A	400V/1A	
37	5 TO 5/2-PP UNIT (EXTRUDER)	37MVA	3500A	400V/1A	
38	5 TO SPARE-1	31MVA	3150A	350V/1A	
39	5 TO SPARE-2	31MVA	3150A	350V/1A	
40	5 TO SPARE-3	31MVA	3150A	350V/1A	
41	5 TO SPARE-4	31MVA	3150A	350V/1A	
42	5 TO SPARE-5	31MVA	3150A	350V/1A	
43	5 TO SPARE-6	31MVA	3150A	350V/1A	
44	5 TO SPARE-7	31MVA	3150A	350V/1A	
45	5 TO SPARE-8	31MVA	3150A	350V/1A	
46	8 TO BUS COUPLER-1	31MVA	3150A	350V/1A	
47	8 TO BUS COUPLER-2	31MVA	3150A	350V/1A	
48	8 TO BUS SECTONALISER-1	31MVA	3150A	350V/1A	
49	8 TO BUS SECTONALISER-2	31MVA	3150A	350V/1A	

S.NO	FEEDER DESCRIPTION	RATED POWER	BREAKER RATING	CT RATIO	REMARKS
1	FROM GTG-1	34MW	315GA	500/1A	
2	FROM GTG-2	34MW	315GA	500/1A	
3	FROM GTG-3	34MW	315GA	500/1A	
4	FROM GTG-4	34MW	315GA	500/1A	
5	FROM STG-1	16MW	315GA	200/1A	
6	FROM STG-2	16MW	315GA	200/1A	
7	FROM STG-3	22MW	315GA	300/1A	
8	FROM 230KV GIS	100MVA	315GA	1000/1A	
9	FROM 230KV GIS	100MVA	315GA	1000/1A	
10	SRAB	34MW	315GA	500/1A	

ABBREVIATION:	
GT	GRID TRANSFORMER
ONAN	OIL NATURAL AIR NATURAL
ONAF	OIL NATURAL AIR FORCE
OLTC	ON LOAD TAP CHANGER
CB	CIRCUIT BREAKER
DS	DISCONNECTING SWITCH
FAES	FAST ACTING EARTH SWITCH
ES	EARTH SWITCH
IS	ISOLATOR SWITCH
MCB	MINIATURE CIRCUIT BREAKER
WTI	WINDING TEMPERATURE INDICATOR
OTI	OIL TEMPERATURE INDICATOR
LA	LIGHTNING ARRESTOR
TAM	TRI VECTOR METER
BCU	BAY CONTROL UNIT
CRP	CONTROL RELAY PANEL
SAS	SUBSTATION AUTOMATION SYSTEM

TWM METER INCLUDES FOLLOWING PARAMETERS	
SL. NO.	METER
1	AMMETER
2	VOLTMETER
3	MW METER
4	MVAR METER
5	MVA METER
6	MINI METER
7	MVARh METER
8	POWER FACTOR
9	FREQUENCY METER

DEVICE NO.	DESCRIPTION
(21)	VOLTAGE PROTECTION
(24)	DIST PER HERTZ/OVER FLUING RELAY
(25)	CHECK SYNCHRONIZING RELAY
(26)	APPARATUS THERMAL DEVICE
(27)	UNDER VOLTAGE PROTECTION WITH TIMER
(30)	ANNUNCIATOR RELAY
(50)	INSTANTANEOUS OVER CURRENT PROTECTION
(50N)	INSTANTANEOUS EARTH FAULT PROTECTION
(50NS)	LOCAL BREAKER BACKUP PROTECTION
(51)	INVERSE TIME OVER CURRENT PROTECTION
(51G)	EARTH FAULT BACKUP PROTECTION
(51N)	INVERSE TIME EARTH FAULT PROTECTION
(51NS)	STAND BY EARTH FAULT PROTECTION
(59)	OVER VOLTAGE PROTECTION
(59N)	RESIDUAL OVER VOLTAGE PROTECTION
(82)	BUCHHOLZ RELAY
(82P)	PRESSURE RELIEF DEVICE RELAY
(64R)	RESTRICTED EARTH FAULT PROTECTION
(67)	DIRECTIONAL OVER CURRENT RELAY
(67N)	DIRECTIONAL EARTH FAULT RELAY
(74)	ALARM RELAY

SPECIAL CT PARAMETERS													
S.NO	PARAMETERS	UNITS	VALUE	UNITS	VALUE	UNITS	VALUE	UNITS	VALUE	UNITS	VALUE	UNITS	
1	66kV/8KV FEEDER TRANSFORMER RATING	kVA	31.5	MVA	28	MVA	25	MVA	20	MVA	16	MVA	
2	CT RATIO FOR SECONDARY DIFFERENTIAL PROTECTION	350V/1A	A	300V/1A	A	250V/1A	A	200V/1A	A	150V/1A	A	100V/1A	
3	CLASS OF CT	PS	P5	PS	P5	PS	PS	PS	PS	PS	PS	PS	
4	CT SECONDARY WINDING RESISTANCE (Rsc=)	Ohms	2	Ohms	2	Ohms	1	Ohms	1	Ohms	1	Ohms	
5	CT CALIBRATION SCHEME	2.5	Sq.mms	2.5	Sq.mms	2.5	Sq.mms	2.5	Sq.mms	2.5	Sq.mms	2.5	Sq.mms
6	LINE FEEDING IN VOLTAGE REQUIRED	V	1250	V	1250	V	1250	V	1250	V	1250	V	
7	CT MONITORING CURRENT I _{max} AT V _R /2	mA	30	mA	30	mA	30	mA	30	mA	30	mA	

81	UNDER FREQUENCY AND dI/dt
81U	UNDER FREQUENCY RELAY
86	LOCK-OUT RELAY
87B	BUSBAR DIFFERENTIAL PROTECTION
87C	CABLE DIFFERENTIAL PROTECTION
87L	LINE DIFFERENTIAL PROTECTION
87T	GRID TRANSFORMER DIFFERENTIAL PROTECTION
95	TRIP CIRCUIT SUPERVISION RELAY FOR 86
98	DEAD BUS CHARGING RELAY

DO NOT SCALE

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CHENNAI PETROLEUM CORPORATION LIMITED
POWER & UTILITIES FACILITIES OF CPCL'S 9MMTPA
CAUVERY BASIN REFINERY (CBR) PROJECT AT NAGAPATTINAM, TAMILNADU.

TITLE: METERING & PROTECTION SLD FOR 230kV & 66kV GIS

 TATA CONSULTING ENGINEERS LIMITED
BENGALURU





NOTES: –

1. RATINGS OF EQUIPMENT SHOWN WILL BE TIME TO TIME VALIDATED THROUGH LOAD LIST
2. CONTROL SUPPLY VOLTAGE FOR CIRCUIT BREAKER AND SPRING CHARGING MOTOR SHALL BE 110V DC.
3. VOLTAGE SELECTOR SWITCH SHALL HAVE FOUR (4) POSITION METER SWITCH, HAVING POSITIONS OF "OFF", "PHASE R-Y", "PHASE Y-B" AND "PHASE B-R".
4. ALL ACDB'S SHALL BE PROVIDED WITH 20% SPARE FEEDERS FOR OUTGOING FEEDERS OF ITS TOTAL QUANTITY.
5. * - THE SAME WILL BE UPDATED BY GIS LSTK CONTRACTOR AS PER REQUIREMENT.
6. ALL METERING SHALL BE PROVIDED THROUGH NUMERICAL RELAY IN CASE RESPECTIVE SWITCHBOARD IS HAVING NUMERICAL RELAY.
7. WHEREVER MMH METERS ARE SPECIFIED, THE METER SHALL BE A MULTIFUNCTION METER SUITABLE FOR DATA CONNECTIVITY WITH SAS.

PRELIMINARY

 **Chennai Petroleum Corporation Limited**
POWER & UTILITIES FACILITIES OF CPCL'S 9MMTPA
CAUVERY BASIN REFINERY (CBR) PROJECT AT NAGAPATTINAM, TAMILNADU.

TITLE: PROTECTION & METERING SLD FOR
415V ACDB FOR 230KV GIS

	TATA CONSULTING ENGINEERS LIMITED BENGALURU	
SCALE : NTS DC & DISC: BLR & EL	DWG NO. --	SHEET: 1 OF 1 ISSUE P0

<u>ABBREVIATION:</u>	
ONAN	OIL NATURAL AIR NATURAL
OTCT	OFF CIRCUIT TAP CHANGER
MCB	MINIATURE CIRCUIT BREAKER
WTI	WINDING TEMPERATURE INDICATOR
OTI	OIL TEMPERATURE INDICATOR
FBT	FAST BUS TRANSFER
SFU	SWITCH FUSE UNIT
MPR	MOTOR PROTECTION RELAY
SG	SWITCHGEAR
EPB	EMERGENCY PUSH BUTTON
LPBS	LOCAL PUSH BUTTON STATION
ISO	ISOLATOR

DEVICE NO.	DESCRIPTION
(25)	CHECK SYNCHRONIZING RELAY
(27)	UNDER VOLTAGE PROTECTION WITH TIMER
(68B2)	BUCHHOLZ RELAY
(64R)	RESTRICTED EARTH FAULT RELAY
(51)	INVERSE TIME OVER CURRENT PROTECTION
(51N)	INVERSE TIME EARTH FAULT PROTECTION
(86)	LOCK-OUT RELAY
(95)	TRIP CIRCUIT SUPERVISION RELAY



NOTES: -

1. RATINGS OF EQUIPMENT SHOWN WILL BE TIME TO TIME VALIDATED THROUGH LOAD LIST
2. CONTROL SUPPLY VOLTAGE FOR CIRCUIT BREAKER AND SPRING CHARGING MOTOR SHALL BE 110V DC.
3. VOLTAGE SELECTOR SWITCH SHALL HAVE FOUR (4) POSITION METER SWITCH, HAVING POSITIONS OF "OFF", "PHASE R-Y", "PHASE Y-B" AND "PHASE B-R".
4. ALL ACDB'S SHALL BE PROVIDED WITH 20% SPARE FEEDERS FOR OUTGOING FEEDERS OF ITS TOTAL QUANTITY.
5. * - THE SAME WILL BE UPDATED BY GIS LSTK CONTRACTOR AS PER REQUIREMENT.
6. ALL METERING SHALL BE PROVIDED THROUGH NUMERICAL RELAY IN CASE RESPECTIVE SWITCHBOARD IS HAVING NUMERICAL RELAY.
7. WHEREVER MMH METERS ARE SPECIFIED, THE METER SHALL BE A MULTIFUNCTION METER SUITABLE FOR DATA CONNECTIVITY WITH SAS.

PRELIMINARY

 **Chennai Petroleum Corporation Limited**
POWER & UTILITIES FACILITIES OF CPCL'S 9MMTPA
CAUVERY BASIN REFINERY (CBR) PROJECT AT NAGAPATTINAM, TAMILNADU.

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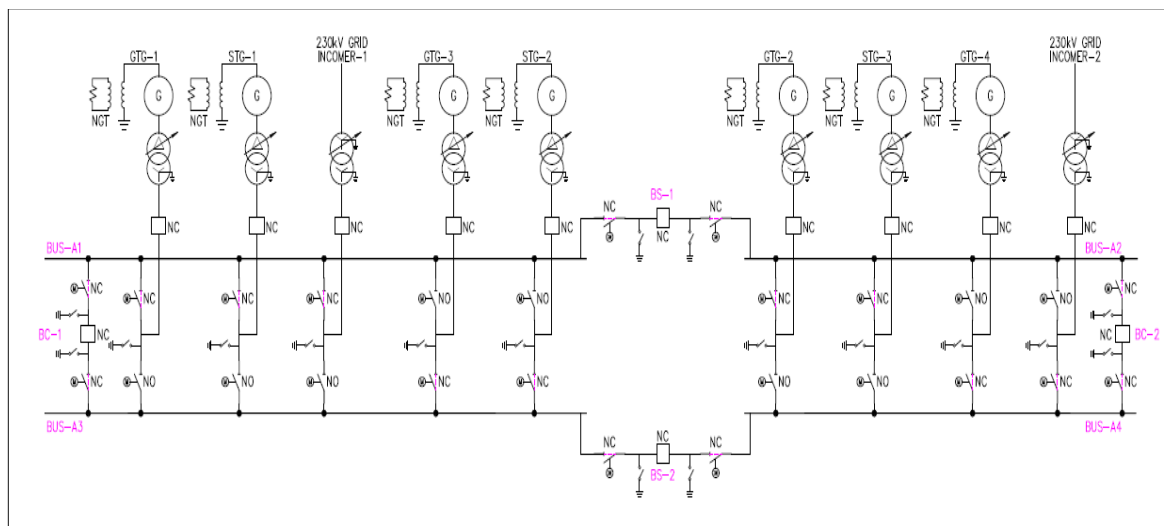
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Synchronization of Generators with TANTRANSCO Grid

Common SCAP (Synchronization Control & Annunciation Panel) is envisaged for synchronization of the CPP generators with the TANTRANSCO grid.

Common SCAP panel mentioned above will be supplied and installed by others (i.e. GTG & HRSG package supplier).

1. The following breakers in 66kV GIS are identified as synchronizing breakers and no control to be envisaged from Substation Automation System (SAS) provided by GIS package and only monitoring for these breakers is possible. Control of the synchronization breakers will be done through common SCAP panel.
 - a. 4 Nos. GTG incomer breakers (i.e. at 66kV GIS)
 - b. 3 Nos. STG incomer breakers (i.e. at 66kV GIS)
 - c. 2 Nos. Grid incomers connected at 66kV GIS through grid transformers
 - d. 2 Nos. 66kV Bus sectionalizers
 - e. 2 Nos. 66kV Bus couplers



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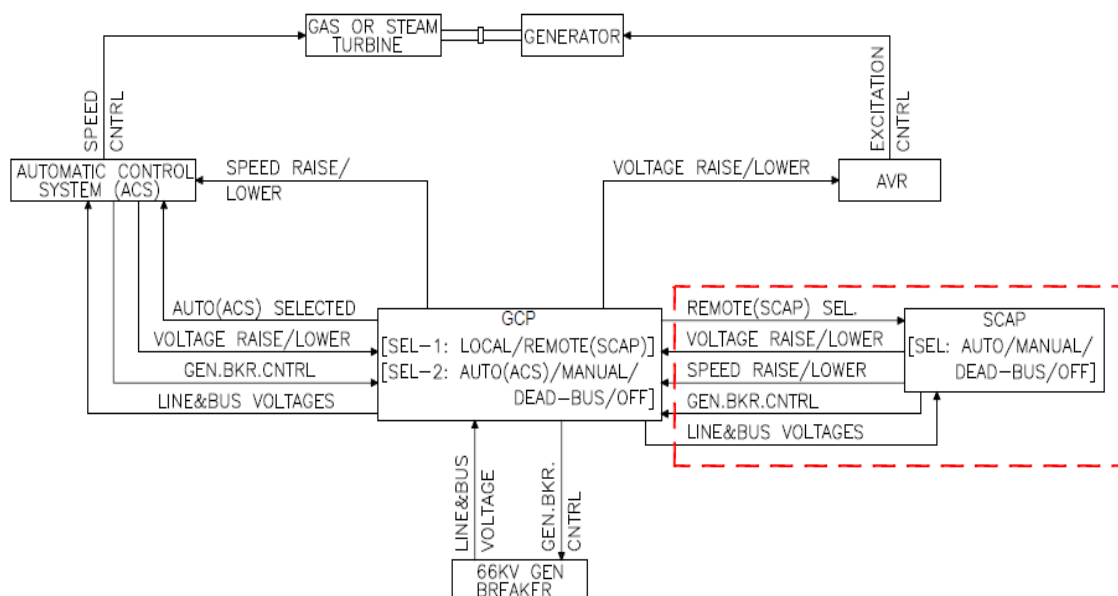
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2. The interfacing signals required between GTG or STG Generator Control Panel (GCP) and SCAP panel are described below.



BLOCK DIAGRAM FOR SYNCHRONIZATION SCHEME

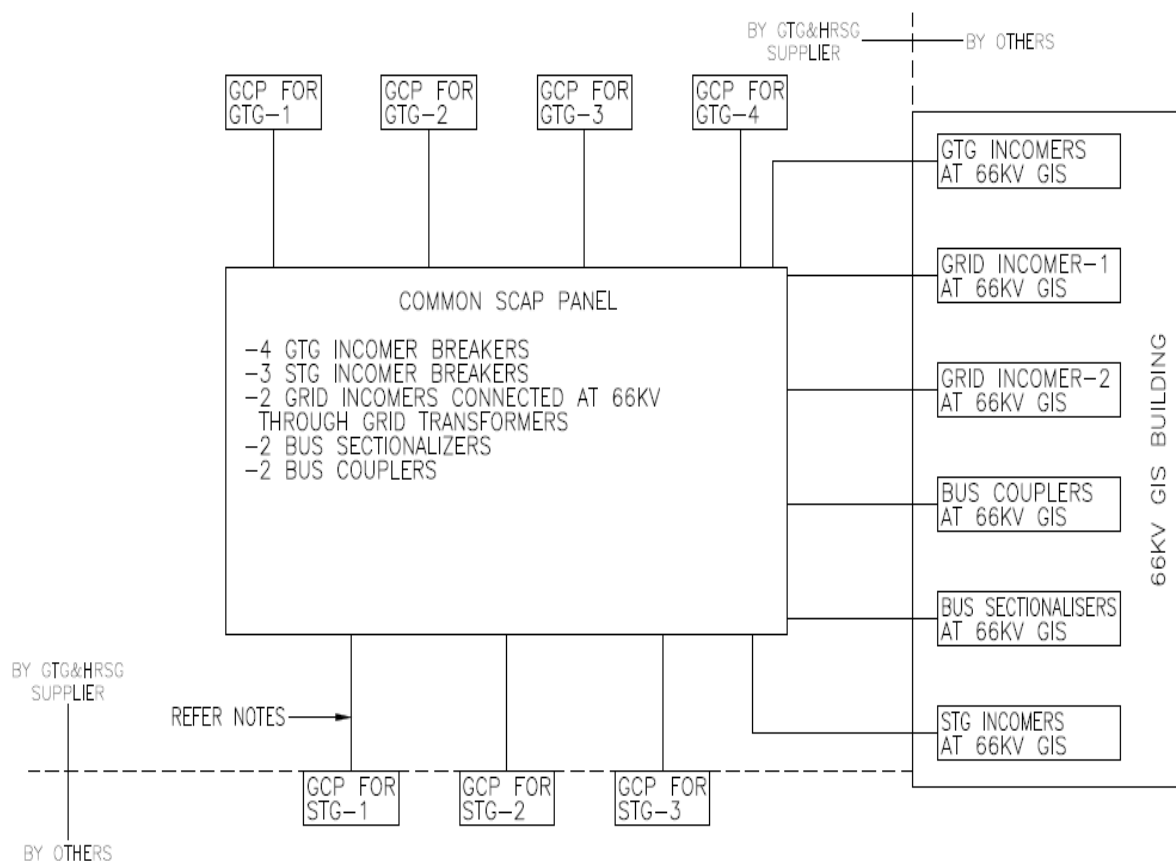
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3. Supply and installation of interconnecting cables and cable carrying system to SCAP with GCPs, GIS breakers is as follows:



NOTES:

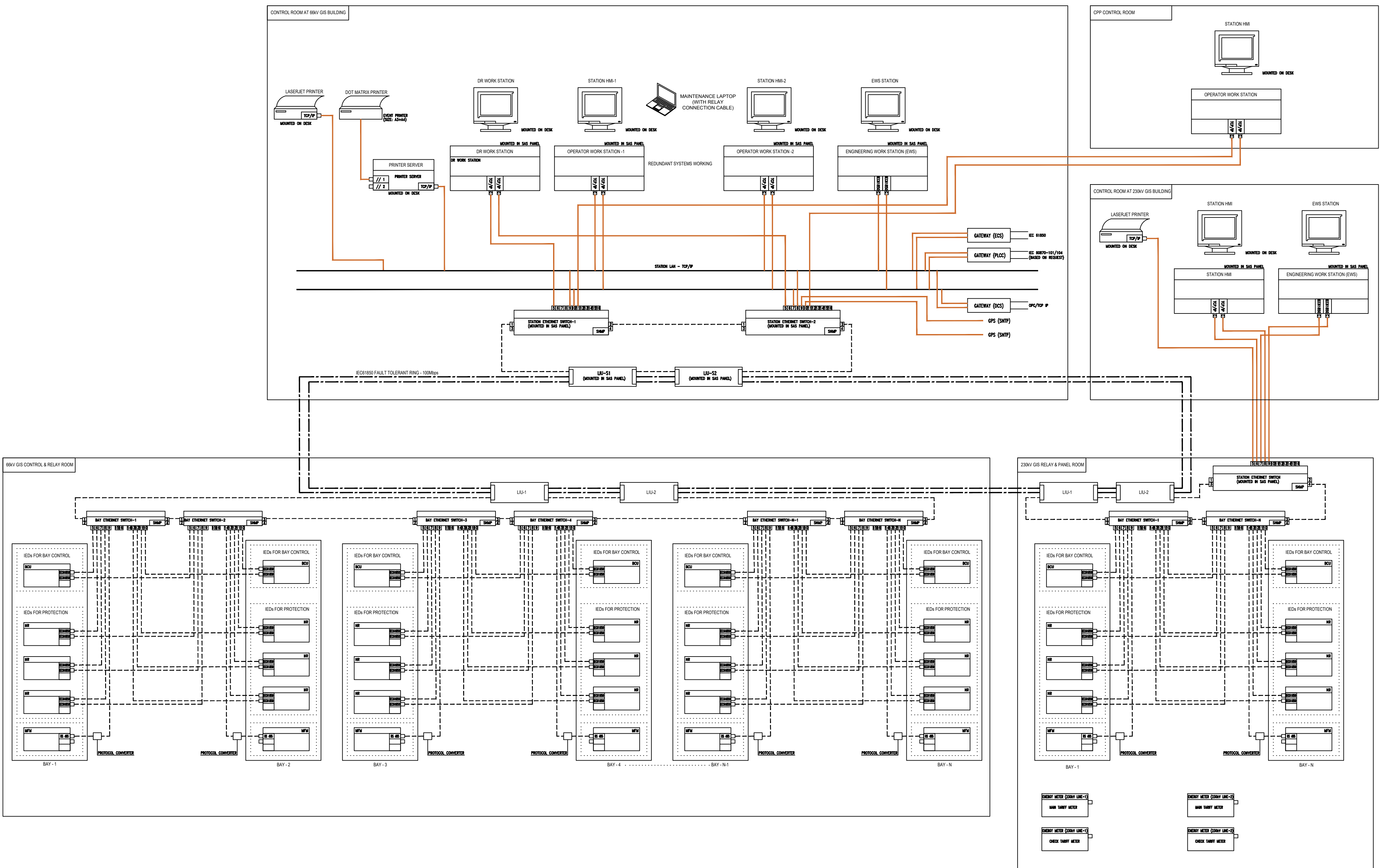
1. SUPPLY AND INSTALLATION OF CABLES WILL BE BY GTG & HRSG SUPPLIER.
2. CABLE CARRYING SYSTEMS SUCH AS CABLE TRAYS, SUPPORTS AND CONDUITS (IF REQUIRED) INSIDE GTG & HRSG BATTERY LIMIT SHALL BE BY GTG & HRSG SUPPLIER.
3. CABLE CARRYING SYSTEMS SUCH AS CABLE TRAYS, SUPPORTS AND CONDUITS (IF REQUIRED) OUTSIDE GTG & HRSG BATTERY LIMIT SHALL BE BY OTHERS.

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EXHIBIT-7



LEGEND:-

- CAT RAS CABLE
- ARMORED FO SINGLE MODE DUPLEX CABLE
- ARMORED FO SINGLE MODE 6-CORE CABLE
- LIU - MULTIMODE LIGHT INTERFERENCE UNIT
- HMI - HUMAN MACHINE INTERFACE
- SAS - SUBSTATION AUTOMATION SYSTEM
- SNTP - SIMPLE NETWORK TIME PROTOCOL
- OPC - OBJECT LINKED ENABLE PROCESS CONTROL
- BOU - BAY CONTROL UNIT
- ID - INTELLIGENT ELECTRONIC DEVICE
- OPS - GLOBAL POSITIONING SYSTEM
- DR - DISTURBANCE RECORDER
- ECS - ELECTRICAL CONTROL SYSTEM
- MMS - MAINTENANCE WORK STATION
- RSTP - RAPID SPANNING TREE PROTOCOL

NOTES:-

- SUPPLY, LAYING, SPlicing & TERMINATION OF ALL CABLES ARE IN GIS LSTR CONTRACTOR SCOPE.
- SAS ARCHITECTURE SHALL BE PROVIDED WITH IEC 61850 RSTP.
- SAS ARCHITECTURE SHOWN IS MINIMUM FUNCTIONALITY REQUIRED FOR THE SUBSTATION AND ANY ADDITIONAL COMPONENT REQUIRED SHALL BE CONSIDERED FOR THE SAFE AND SUCCESSFUL OPERATION AND INLINE WITH THE TANTRANSO GRID.
- ETHERNET SWITCHES, GATEWAYS, SERVERS SHALL BE PROVIDED WITH DUAL POWER SUPPLY UNITS.
- HARDWARE FAILURE OF ANY DEVICE SUCH AS ETHERNET SWITCHES, GATEWAYS, SERVERS, BOU, ID, FIBER OPTIC CONNECTIVITY, LAN CONNECTIVITY, COMMUNICATION FACILITY AND FAILURE OF ANY INTERNAL & EXTERNAL, AUX. POWER SUPPLIES SHALL BE ANNOUNCED IN THE STATION HMI.
- ETHERNET SWITCHES SHALL HAVE PLUGGABLE PORTS AND SHALL HAVE MINIMUM OF 2 SPARE PORTS.
- THE DIGITAL INPUTS, ANALOG INPUT SIGNALS FROM VENTILATION SYSTEM, FIRE ALARM SYSTEM, AC/DC SYSTEM, SHALL BE CONSIDERED IN THE BUS COUPLER BAY CONTROL UNIT.

HOLD LIST:-

--NIL--

NOTES:-

- TCE.12416A-EL-4005-AU-40001 KEY SINGLE LINE DIAGRAM FOR CPP.
- TCE.12416A-EL-4005-GA-40046 ELECTRICAL EQUIPMENT LAYOUT FOR 66KV MAIN DISTRIBUTION (CPP) & 230KV SUB STATIONS.

FOR INFORMATION

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1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19

CHENNAI PETROLEUM CORPORATION LIMITED
POWER & UTILITIES FACILITIES OF CPCL'S 9MMTPA
CAUVERY BASIN REFINERY (CBR) PROJECT AT NAGAPATTINAM, TAMILNADU.

TITLE:
SUBSTATION AUTOMATION SYSTEM (SAS) ARCHITECTURE
FOR 66kV & 230kV GIS

TATA CONSULTING ENGINEERS LIMITED
BENGALURU

SCALE: NTS DWG NO. TCE.12416A-EL-4019-CD-40053 SHEET 1 OF 1 ISSUE P1

SECTION-2

EQUIPMENT SPECIFICATION UNDER SCOPE OF SUPPLIES

SPEC. NO. 12416A-EL-GIS- 40101	TATA CONSULTING ENGINEERS LIMITED	SECTION: C4
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1.0 SCOPE

230kV GIS and its outdoor equipment is envisaged to receive Electrical Power from State Electricity Grid, the voltage level shall be further stepped down to 66 kV through step down transformer (230/66 kV). This power shall be connected to 66 kV GIS at CPP substation through 66 kV cable.

The scope covers design, manufacture, assembly, testing at manufacturer's works before dispatch, supply, shipping, transport, receiving at site, storage at site, erection, testing and commissioning of metal enclosed, SF6 GIS and ancillary equipment as required. The 230kV GIS shall have Two Main bus breaker as switching scheme. The GIS shall consist of the following bays/circuits.

Sl. No.	Description	No. of Bays/Circuits
1	Incomers	2Nos. from TNSEB Grid
2	Outgoing feeders	3Nos. (including 1no. spare)
3	Bus Coupler	1
	Total	6

- 1.1 Required number of 230 kV Cable to Air terminations, SF6 to 230 kV GIB terminations, SF6 to transformer etc. are included in the scope of the BIDDER.
- 1.2 RCC Building for housing the GIS, EOT crane for handling GIS sections, HVAC and other systems as indicated in Scope of work document are also included in the scope of the BIDDER. The EOT crane shall be sized to handle the heaviest section of the GIS. Space for adding two (2) numbers of bays on both the sides of GIS switchgear shall be considered in the GIS building. Adequate space for maintenance shall be provided inside the GIS building, in addition to the space required for housing the switchgear and space requirement for additional bays.
- 1.3 **SF6 gas maintenance equipment and a hand-held SF6 gas leakage monitor also shall be included in the scope of supply of the BIDDER.**
- 1.4 Notwithstanding scope of supply mentioned in this specification, if any equipment, tools or instruments are considered essential for erection, Testing & Commissioning and operation, the same shall also be supplied.
- 1.5 230 KV OUTDOOR EQUIPMENT

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Adequate number of Lightning arrestors, required quantity of ACSR conductor required for outdoor equipment inter – connections in switchyard, adequate Nos. of Bus Post Insulator, Suspension Insulator & String Insulator with its hardware fittings for supporting the overhead conductors, required number of Hot dip galvanised Gantry Towers of suitable height and width for support & termination of various equipment and required number of suitable 230 kV overhead conductor to GIB SF6 terminations.

The design, material, construction, manufacture, inspection, testing and performance of the gas insulated switchgear (GIS) and accessories, shall comply with the requirements specified in Data Sheet, all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed.

2.0 CODES AND STANDARDS

The applicable Codes and standards are specified in below table. However, for some special applications the GIS may have to confirm to some higher requirements, which will be specified in Data Sheet. In such specific cases, this specification shall take precedence over the standard requirements indicated in the applicable Industry Standards.

S. No.	Title	Standard Reference
1.	International Electro-technical Vocabulary	IEC 60050
2.	High voltage alternating current circuit breakers	IS 13118
3.	Gas-Insulated metal enclosed Switchgear for rated voltages 52kV & above	IS / IEC 62271-203
4.	High voltage test techniques	IS / IEC 60060
5.	Recommendation for heat treated aluminium alloy busbar material of the Aluminium-Magnesium Silicon type.	IEC 60114
6.	Alternating current disconnect switches and grounding switches	IEC 62271-102
7.	Bushing for alternating voltages above 1000 volts	IEC 60137

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S. No.	Title	Standard Reference
8.	Instrument transformers Part: 1 Current Transformers	IEC 61869-2
9.	Instrument transformers Part: 2 Inductive voltage transformers	IEC 61869-3
10.	Electrical Relays	IEC 60255
11.	Low Voltage Fuses	IEC 60269
12.	Specification and Acceptance of New Sulphur Hexafluoride	IEC 60376
13.	High-voltage switchgear and control gear - Alternating-current circuit-breakers	IEC 62271-100
14.	Guide for checking SF6 gas taken from Electrical Equipment	IEC 60480
15.	Artificial Pollution test on HV Insulators to be used on AC System	IEC 60507
16.	High-voltage switchgear and control gear-Direct connection between power transformers and gas-insulated metal-enclosed switchgear for rated voltages above 52 kV	IEC 62271-211
17.	Classification of degree of degree of protection provided by enclosures	IEC 60529
18.	Guide for selection of insulators in respect of polluted conditions	IEC 60815
19.	Code of Practice for Earthing	IS 3043
20.	Standard for gas insulated substations	ANSI/IEEE C37.122

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S. No.	Title	Standard Reference
21.	Quality systems – model for quality assurance in final inspection and test	ISO 9003
22.	Surge arresters-part4: metal-oxide surge arresters without gaps for ac systems	IEC 60099-4
23.	Surge arresters-part5: selection and application recommendations	IEC 60099-5
24.	Guide for partial discharge measurements in power switchgear	ANSI/IEEE 1291
25.	Paint shade	IS 5
26.	Low voltage switchgear and control gear	IEC 60947
27.	Immunity standard on electrostatic discharge	IEC 61000

3.0 COMPONENTS OF GIS ASSEMBLY

3.1 The components of switchgear assembly having compact and modular design shall essentially consist of following items and their accessories specified in subsequent clauses.

- a) Circuit breakers
- b) Disconnect Switches
- c) Ground switches (Maintenance and High-Speed types)
- d) Voltage transformers (with disconnecting link / externally operated isolation switch)
- e) Current transformers (If CT is installed in breaker gas compartment, insulation class for CT shall be class F)
- f) SF6 lightning arrestor
- g) Partial Discharge Monitoring devices
- h) Terminations - overhead line to SF6 GIB bushing and SF6 GIB bushing to Transformer oil bushing as applicable.

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i) Busbars, Bus enclosures and accessories with different bus arrangements.

j) Local control panels and operating mechanism cabinets.

k) SF6 GIS Busduct Indoor/outdoor as applicable

l) Pressure/density monitors and switches

m) GIS supporting structure

4.0 DESIGN AND CONSTRUCTIONAL FEATURES

4.1 General

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

4.1.2 Each bay shall be arranged in compact and modular design with individual equipment modules connected together to form a complete assembly for the intended GIS Bus configuration.

4.1.3 The equipment and connections within each compartment shall be arranged so as to allow removal and replacement of any section both during normal and abnormal working conditions with minimum disturbance to adjacent in-service pressurised sections.

4.1.4 The GIS Equipment shall be complete with all necessary supports, ladders, galleries, staircases, catwalks, movable platforms or walkways (for accessing the equipment above two (2) 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).

4.1.5 Minimum assembly work shall be envisaged during installation. The GIS shall be supplied as completely factory assembled switchgear bays, within shipping / transportation limits.

4.1.6 The GIS shall be installed on suitable mounting pads or supporting frames / structures with provision for levelling, including fasteners to foundation, which shall also be included in the supply. Support-structures shall be designed and fabricated to withstand the short circuit forces of the ground fault current as well as prevent excessive vibration during switching operation or faults.

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4.1.7

The GIS shall be provided with expansion joints and flexible connections, where several enclosures are connected in the longitudinal direction, such as main bus. Expansion joints provided for installation alignment shall be locked in place when alignment is complete. Expansion joints for compensation of thermal expansion and erection tolerances shall have the means to preserve mechanical integrity of the enclosure and the plug-in contacts for the conductor. Provision shall be made for expansion of GIS bus on either side of GIS.

4.1.8

All modules of the GIS switchgear and components of the same rating and construction, which may need to be replaced, shall be completely interchangeable.

4.1.9

The GIS interface points shall be carefully coordinated with other equipment such as overhead lines, transformers, etc. supplied by other manufacturers in order to ensure full compatibility. The GIS manufacturer shall also specify the dimension and mounting details, weight, etc., of the spring / bellow used between GIS busduct termination with GIS termination. The design criteria for outdoor portion of the GIS busduct leading to SF6 to air overhead line termination shall be as mentioned in clause 6.1. The surge impedance of GIS to cable or overhead line termination shall be reduced by suitable construction / arrangement of GIS module. The surge impedance values for all GIS modules shall be furnished by vendor.

4.1.10

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

4.1.11

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

4.1.12

Each module of switchgear, consisting of individual elements intended to be directly connected together, shall be constructed as a transportable assembly suitable for shipping and transportation without being dismantled. Dry nitrogen gas filling shall be used during transportation instead of SF6.

4.1.13

All new gaskets, sealants and desiccants for permanent sealing of all field joints and all access covers, removed during assembly, shall also be provided.

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4.1.14 The Bus and all current carrying parts shall be made of Aluminium alloy. In certain specific requirements electrolytic copper may be provided. All interconnecting sections of current transferring parts shall be silver-plated. Joints and couplings between dissimilar metals shall be avoided to prevent galvanic corrosion.

4.1.15 All supporting steel work shall be hot dip galvanised. All welding in GIS shall confirm the applicable codes and standards.

4.1.16 A partition separating a compartment filled with insulating gas from a neighbouring compartment such as a cable box, filled with liquid, shall not show any leakage affecting the dielectric properties of the two media.

4.1.17 All piping for SF6 gas, hydraulic and pneumatic operating mechanism including their fittings shall be made of copper, brass or stainless steel.

4.1.18 All external connectors and terminal pads shall be made of aluminium or copper with tin-plating.

4.1.19 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.

4.1.20 GIS modules shall have gas tight barrier insulator partitions such that fault in one compartment will not affect the normal operation of the adjacent compartment. The selection shall be designed:

- a) To minimize operation shutdown when the gas pressure is reduced due to leakage or for maintenance purpose.
- b) To minimize the quantity of gas that has to be evacuated and recharged before and after maintaining any item of equipment.
- c) Each section shall be provided with necessary valves to allow evacuation and refill of gas without evacuation of any other section.

4.1.21 In event of arcing in compartment the arc should not extend to neighbouring compartment. Any failure to the enclosure of compartment shall not lead to damages in neighbouring compartment. In view of this continuous busbar without gas segregation is not acceptable.

4.2 RATINGS

4.2.1 The specific ratings of the GIS equipment shall be as specified in the Data Sheet or key single line diagram attached with this specification.

4.2.2 The switchgear shall be capable of carrying the specified rated current continuously at the specified ambient conditions in Data Sheet, without

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temperature rise of various parts exceeding the limits stated in IEC 60694 or equivalent ANSI standards. The maximum temperature of the external surfaces shall be 70°C as per IEEE C37.122.

4.2.3 The switchgear and its associated apparatus shall produce minimum noise during service. The maximum noise level shall be indicated by the manufacturer and be subject to approval by the purchaser.

4.2.4 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. Any sub assembly containing components with permitted partial discharge intensity greater than 5 pC shall be considered acceptable if the discharge level does not exceed 10 pC.

4.2.5 The insulation level requirements shall be as specified in IEC 62271-203.

4.3 GIS Enclosure

4.3.1 The GIS shall be of single-phase encloser type for voltage levels of 230kV.

4.3.2 The enclosure shall be capable of sustaining without damage to all mechanical, electrical and thermal shocks that may occur in service during normal and fault conditions, including pressure effects of internal fault arc current of specified short circuit level and time. The enclosure assembly, material and design shall be such as to minimize induced electrical losses and heating effects which could occur in service under normal and fault conditions.

4.3.3 The creation of single gas zone for single phase type GIS enclosures by external piping connection between the phases is not acceptable. Also, external piping connection (with normally open valve) to create common gas zone (between same phase) in single phase type GIS is not acceptable.

4.3.4 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.

4.3.5 The enclosure shall be designed to withstand internal fault at the rated short circuit current level and consequent pressure for a period specified in Data Sheet without a burn through.

4.3.6 The GIS enclosures shall have a minimum burn-through time greater than the back-up clearance time, if rupture disc/pressure relief device is provided. The burn-through time shall be in accordance with IS/IEC 62271-203. GIS manufacturer has

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to furnish pressure rise curve in support of minimum burn-through time along with test report for internal arc withstand.

4.3.7 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.

4.3.8 The construction and thickness of the GIS enclosure shall conform to ANSI/ASME Boiler and Pressure Vessel Code and ANSI/ASME B31.1, CENELEC EN 50052 & EN 50064 or equivalent.

4.3.9 For enclosures and parts thereof, the strength of which has not been fully determined by calculation, proof tests as per the applicable standards shall be performed to demonstrate that they fulfil the requirements.

4.3.10 **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.**

4.3.11 The exterior surface finish of the enclosure shall be finalized in agreement with the Purchaser. The actual colour shade shall be based on the end user's requirement. The protective finish shall prevent deterioration due to corrosion, humidity, temperature, ageing due to weather, attack from fungus or rodents for minimum of five years.

4.3.12 SF6 Gas monitoring and service piping including all fittings and accessories shall be of copper, brass or stainless steel.

4.3.13 All steel structures above grade level required for supporting the switchgear, including SF6/Air Bushing supports and feeder bus duct supports, etc., shall be hot dip galvanized and shall be supplied as a part of switchgear package.

4.3.14 **The degree of protection for all terminal boxes, operating mechanism enclosure, control cabinets, auxiliary equipment enclosures and all accessories shall be IP 42 for Indoor application and shall be IP 55 for Outdoor application.**

4.4 GIS Gas Sections

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

4.4.2 Long bus runs shall be sectionalized into a number of gas compartments such that failure in any gas section does not affect the adjacent gas sections.

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4.4.3

The GIS module design shall be such as to minimize the quantity of gas that has to be evacuated and then recharged before and after carrying out maintenance.

4.4.4

Gas compartments shall be designed in such a way that voltage transformers can be easily removed without degassing any of the busbar compartments.

4.4.5

Compartmentalisation shall be provided for circuit breaker, Busbar, Current transformer, Voltage transformer, Surge arrester, Disconnecter along with Earthing switch and SF6 GIB to overhead line, SF6 Bus Ducts in the switchgear assembly.

4.4.6

The material shall be chosen, and the parts designed such that they retard the propagation of any flame resulting from accidental overheating in the switchgear and control gear.

4.4.7

The gas section barriers shall be capable of withstanding the differential pressure due to full vacuum on one side and 1.5 times rated gas absolute pressure on the other side.

4.5

SF6 Gas System and associated Devices

The SF6 gas shall conform to IEC 60376 and IEC 60480.

4.5.1

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.

4.5.2

The GIS shall be fully gas tight. The sealing system shall also effectively ensure against the ingress of moisture, dust and other contaminants into gas compartments. Double 'O' ring design be adopted to ensure gas tightness. All gas compartments shall contain suitable agent to absorb moisture and any other decomposition products of SF6 gas.

4.5.3

SF6 gas relative leakage rate of each gas compartment shall not exceed 0.5% per year.

4.5.4

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.

4.5.5

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

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compartments, i.e. with full vacuum drawn on one side of the barrier and 1.5 times the operating pressure on the other side.

4.5.6 **Sensors shall be provided in the GIS enclosure to detect the internal arc flash.**

4.5.7 SF6 gas in each individual compartment shall be monitored by suitable temperature-compensated pressure gauges and two stage temperature compensated pressure (gas-density continuous monitoring) switches/ relays to monitor the loss of SF6 gas. The dial of the pressure gauges shall be graduated to read pressures and coloured green, yellow and red to indicate normal, Alarm Stage I and Alarm Stage II pressure conditions.

4.5.8 Gas-density monitor shall be readable from the ground. Potential-free auxiliary contacts for two-stage alarm initiation shall be provided. These alarm contacts shall be wired to the annunciator in the respective GIS bay control panel.

4.5.9 SF6 gas density monitor switch shall be provided in each gas compartment (each phase, if phase segregated). Separate gas density monitor switch shall be provided for each equipment compartment including but not limited to Circuit Breaker, Current Transformer, Voltage Transformer, Surge Arrester, Isolator (separate monitor for bus bar and bus Isolator) & Earth Switch etc (for each compartment). Combined Gas Density monitors shall not be acceptable in any case.

4.5.10 The dial of the pressure gauges shall be graduated to read pressures to indicate normal and different alarm pressure conditions. Gas-density monitor shall be readable from the ground. Potential-free auxiliary contacts for alarm initiation shall be provided. These alarm contacts shall be wired to the annunciator in the respective GIS bay control panel.

4.5.11 For circuit breaker: The gas-density monitors shall be capable of being calibrated with the monitored equipment in service. If the gas-density monitor has a visual indicator, it shall be readable from the ground. Each relay shall be provided with two convertible (NO and NC) potential-free auxiliary contacts for two-stage alarm initiation as mentioned below. These alarm contacts shall be wired to the annunciator in the respective GIS bay control panel.

(a) "Gas Refill" Level (for all compartments)

This will be used to annunciate the need for gas refilling. Two sets of potential free contacts for remote indication/ annunciation shall be provided.

(b) "SF6 Low or Zone Trip" Level (for all compartments)

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This is the minimum gas density at which the manufacturer will guarantee the insulation rating of assembly. At this level the device contact shall trip the adjacent connected breaker. Two sets of potential free contacts for remote indication/annunciation shall be provided.

(c) "Breaker Block" Level (for CB compartments only)

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 shall block the closing and trip operations. Two sets of potential free contacts for remote indication/annunciation shall be provided.

(d) "Over pressure" alarm level (for all compartments)

This alarm level shall be provided to indicate abnormal high pressure rise in the gas compartment. Two sets of potential free contacts for remote indication/annunciation shall be provided.

4.5.12 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.

4.5.13 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.

4.5.14 It shall be possible to test and replace each pressure gauge and the density switch/relay with the GIS in service.

4.5.15 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.

4.5.16 Gas leakage detectors of an approved type shall be provided.

4.5.17 It shall be possible to test all gas monitoring relays/devices without de-energizing the primary equipment & without reducing pressure in the main section. Plugs & sockets shall be used for test purposes. It shall also damp the pressure pulsation while filling the gas in service, so that flickering of the pressure switch contacts does not take place.

4.5.18 The gas pressure of each compartment shall be able to be monitored remotely from SCADA. The system shall have the facility to pinpoint the exact gas module in the bay where gas leakage problem is there.

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4.5.19 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 equipment. Provision for disconnection of gas pipelines shall be incorporated. 100µm or smaller sintered stainless-steel particle filter disk, suitable for pressure involved, shall be installed at the gas service connection.

4.5.20 Filters shall be inserted in all the gas compartments in addition to circuit breaker compartment. Filters for gaseous arc by-products shall be installed before the bursting disc/pressure relief device, so that arcing by-products will be removed in a controlled and filtered way. SF6 gas filters shall be as follows:

- For moisture (H₂O): Desiccant material such as Al₂O₃, also called drying agent. The recommended particle size is 2-5 mm.
- For gaseous arc by-products: Molecular sieve with a pore size of 4A. Materials used for this purpose should not be regenerated.
- For particles (generally dust residues) or solid arc by products: filter to remove particles with a size larger than 1µm.

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

4.5.22 The location of gas barrier insulators shall be clearly and permanently marked on the finished external surface of the GIS enclosures.

4.5.23 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.

4.5.24 The switchgear assembly supply shall include an additional 10% supply of gas complete with containers and monitoring equipment for use during the warranty period.

4.5.25 The total design shall incorporate facilities for SF6 storage adjacent to the installed switchgear assembly.

4.6 Gas Seals

4.6.1 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

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	conditions. Double gas seals with provision to monitor the failure of first seal shall be provided. 4.6.2 The material for the seals shall be non-deteriorating. 4.7 Support Insulators 4.7.1 The support insulators and Gas section barriers/ insulators will be of solid moulded composite, epoxy resin and shall be manufactured from the highest quality material. 4.7.2 All insulators shall be free of partial discharge at a voltage, which is at least 10% greater than the maximum service voltage. A test certificate in this regard, as a proof, shall be furnished. 4.7.3 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. 4.8 Pressure Relief Device / Rupture Discs 4.8.1 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. 4.8.2 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. 4.8.3 Pressure relief devices shall be used for all gas compartment. Automatic external pressure relief devices shall be provided as a precaution against bursting of enclosure. Internal pressure relief devices shall not be acceptable. The bursting pressure of relief devices shall be effectively co-ordinated with the rated gas pressure and the pressure rise due to arcing to avoid any mal operation in normal operating conditions. All gas compartments are to be equipped with rupture diaphragms and if necessary, with gas diverter nozzles are arranged in a way that, if the rupture diaphragm burst, the gas flow is guided away in a direction not unnecessary hazardous to either personnel or equipment. 4.8.4 The pressure relief device or rupture discs shall be located away from gauges, meters, gas filling ports and gas density device calibrating point. 4.8.5 Deflectors shall be provided to direct all escaping gases, arcing products and fragments of the bursting rupture discs away from operating personnel and nearby	
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devices. The direction of the escaping gas shall so oriented so as to cause no damage to the GIS equipment.

4.9

Expansion or Flexible Connections for Enclosure

4.9.1

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

4.9.2

The arrangement of assembly offered shall provide adequate access for operation, testing and maintenance of each bay and shall be subjected to approval of Purchaser.

4.10

SF6 Gas Monitoring Devices

4.10.1

All gas compartments must have their own independent and reliable gas supervision alarm system with annunciations as per Clause 7.2.10.

4.10.2

The devices shall be temperature compensated electrically isolated and independently adjustable, dust proof and vibration resistant. Gas monitoring devices shall be capable of being checked with the high-voltage equipment in service.

4.10.3

Two potential free electrical contacts shall be provided exclusively for each of the above alarm/ trip conditions for wiring to supervisory control system. These contacts shall be in addition to those required for local indication and trip and shall be wired to the cable termination blocks in the local control panels.

4.11

Layout of GIS

4.11.1

The layout shall be such that future alterations and extensions can be undertaken in either direction without requiring major shutdown or Bus outage or adjacent bay outage. Manufacturers shall include in their bid detailed plans to describe the process of expansion.

4.11.2

The layout shall also ensure maintenance or removal of a circuit breaker or disconnect switch from a particular bay will not involve removal from service of adjacent bay disconnect switch or main bus sections.

4.11.3

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.

4.11.4

The physical layout shall ensure free movement of the SF6 Gas Cart and easy access to all components of the GIS for maintenance purposes.

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4.11.5

The inter-bay width shall be sufficient to allow access to all drive mechanisms and other termination boxes without the need of dismantling the apparatuses.

4.11.6

Sufficient clearances around bushing for cable HV AC testing shall be provided.

4.11.7

Vendor shall provide the GIS/AIR bushing and GIS/Oil bushing connection interface drawings and details.

4.11.8

GIB layout shall be designed based on the following criteria.

i)

Only two vertical layers shall be provided.

ii)

Outer to Outer (not center to center) vertical clearance between layers shall be minimum one meter.

iii)

The minimum outer to outer horizontal clearance between each GIS bus ducts shall be of minimum of 0.75 meter.

iv)

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.

v)

For the maintenance of GIB of one circuit, only that circuit shall be isolated.

4.12

Partial Discharge (PD) Monitoring system

The On-Line Partial Discharge Monitoring (PDM) System shall consisting of the following major devices:

4.12.1

Devices:

a)

Sensors/Couplers

b)

Local Data Acquisition, Monitoring and Analysis System.

c)

Communication to Remote Data Acquisition, Monitoring and Analysis System (SCADA)

d)

User Interface Data Display system

e)

LAN Cabling and associated devices

f)

Data storage/retrieving system

The PD sensors and all devices of the PD monitoring system shall meet the following minimum requirements. However, any additional requirement necessary for the satisfactory and safe performance of the system shall be deemed to be included in the scope of supply.

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- a) The PD system shall confirm to the applicable requirements of the applicable IEC specifications.
- b) The PD system shall operate on a safe DC operating voltage derived from the DC 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.
- c) The PD system sensors or couplers shall be designed not to spark over when open circuited.
- d) The PD system sensors/couplers shall be free from the Cellular/Radio signal interference and shall not record wrong signals.
- e) The PD 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.
- f) The PD sensors/couplers when installed internal to the GIS shall not cause leakage of SF6 gas.
- g) The PD 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.
- h) The Data capture resolution time shall be 1ms or less.
- i) The Data Storage system shall be capable of storing data up to 30 days.
- j) The monitoring system shall be compatible with IEC 61850 and shall be able to communicate via the Internet (TCP/IP protocol), Ethernet/ICCP link.
- k) The PD 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.

4.13 BUSBAR ASSEMBLIES

4.13.1 The busbar system shall include plug-in conductor joints and all interconnections, designed to withstand thermal expansions and carry rated normal current and withstand short circuit currents as specified in data sheet.

4.13.2 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.

4.14 Name Plate

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4.14.1 GIS and all its operating devices and main components shall be provided with nameplates, as agreed between Vendor and User. The nameplates shall be durable and clearly legible. The individual nameplates of the components can be simplified, provided common information for the GIS is stated on one nameplate. The Vendor shall give information about the total amount of SF6 contained in the GIS installation.

4.15 GIS Earthing

4.15.1 All enclosures of the GIS shall be grounded at several points and connected to ground bus. All conduits and cable sheaths shall also be connected to the ground bus available within the control cubicles and in the marshalling boxes.

4.15.2 The three enclosures of single phase GIS are required to be bonded to each other at the ends of GIS. The enclosure of the GIS shall be adequately grounded so as to limit the potential difference between individual sections within the allowable limit during faults.

4.15.3 The earthing system of GIS building must be capable to carry power frequency short circuit currents (earth fault current) and high frequency currents from switching and lightning.

4.15.4 Design of the GIS grounding system shall take into consideration of Transient Enclosure Voltage (TEV) generated due to electric breakdown of insulating gas during fault or normal operation.

4.15.5 In addition to TEV, main circuit current shall not induce excessive currents into adjacent frames, structures, reinforcing steel or shall not establish current loops via other station equipment.

4.15.6 Each marshalling box, local control cubicle, power and control cable sheaths and other noncurrent carrying metallic structures shall be connected to the grounding system of GIS via connections that are separated from GIS enclosures.

5.0 GIS SWITCHGEAR

5.1 Circuit Breakers

5.1.1 The circuit breakers shall meet the following requirements:

- Rated normal current of the Busbars and Feeders at the rated Voltage as stated in the single line diagram.
- Duration of short circuit withstand current as stated in Data Sheet.
- Capability for three pole auto-reclosing without replenishment of stored Energy as a minimum. The rated operating duty cycle sequence shall be as follows:

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O - 0.3 secs. - CO - 3 min – CO

d) The maximum interrupting time at the minimum operating SF6 pressure of the mechanism shall not exceed 3 cycles (60 ms-50 Hz systems) for Circuit Breakers up to 245 kV class.

e) The Circuit Breakers shall have a First Pole to Clear factor of 1.5.

f) The total interrupting time at all currents less than the rated short circuit interrupting current shall not exceed the rated maximum interrupting time. Restrikes shall not occur under any mode of interruption.

g) Rated small inductive current breaking: The value shall be assigned by the GIS Manufacturer having regard to the ratings and characteristics of the associated transformers/reactors and shall be supported by test reports, which shall be submitted with the bid.

h) The circuit breakers shall be of double interrupter design (2 breaks in series per pole) for 40 kAIC and can be of single interrupter design up to 40 kAIC and lower subject to satisfactory operation of the Circuit Breaker for Short Line Faults and Terminal Faults Test duties without the need of external devices.

i) 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.

j) However, Voltage grading capacitors may be used across contacts for double interrupter designs for 40kAIC Circuit Breakers.

k) The breaker shall be self-blast / auto puffer type principle and consisting of one interrupting arcing chamber. Circuit breaker must be in the independent gas compartment & no other equipment (CT/DS/ES) shall be accommodate inside CB compartment.

l) Breaker disposition must be horizontal to provide higher mechanical stability and ease in maintenance. The operating principle of breaker shall ensure minimized dynamic floor loading.

m) Single pole type circuit breakers with individual operating mechanism shall be provided with pole-discrepancy protection with time delay for tripping both trip coils (1st stage) and adjacent breakers (2nd stage) in case of discrepancy.

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n) Single pole type circuit breakers with individual operating mechanism shall have capability for 1-Phase and/or 3-phase auto-reclosing requirement to meet the operating duty cycle.

o) In addition, the circuit breaker shall comply with the following requirements as specified in IEC 62271-203, IEC 62271-100 and IEC 60694.

- i) Rated Frequency
- ii) Rated Transient Recovery Voltage (TRV) for terminal faults and Short line faults.
- iii) Rated short circuit making current (at 50 Hz)
- iv) Rated characteristics for short line faults.
- v) Rated out-of-phase breaking current.
- vi) Rated capacitive current switching.
- vii) Rated Power Frequency withstand Voltage.

5.1.2 Switching Performance Requirements

The breakers shall be capable of:

- a) Circuit breakers installed close to large generating plant or controlling very long transmission Lines will be subjected to fault currents which may have delayed or no zero crossing for a considerable number of cycles due to a high X/R ratio of the system. The GIS Manufacturer shall propose a suitable Circuit Breaker which can mitigate the high reactive component to achieve the opening of the Circuit Breaker at current zero within the normal operating time of the breaker. The methods of demonstrating satisfactory conformance to this requirement shall be mutually agreed between the Purchaser and the Contractor.
- b) Purchaser shall furnish the Network parameters for the delayed zero passage condition, if applicable to the GIS Manufacturer after award of Contract. The GIS manufacturer shall prove by calculations and by factory tests that the Circuit Breaker can safely interrupt the fault without restrikes.
- c) Switching off unloaded overhead lines.
- d) Switching unloaded transformers without exceeding specified over voltages.
- e) Cable Switching

There shall be no restrike across the main contacts when breaking capacitive or cable charging currents upto a value specified in IEC 62271-203 and IEC 60694.

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5.1.3

Interrupter Contacts

a) Main contacts shall have ample area and contact pressure for carrying the rated current and the short time rated current of the breaker without exceeding guaranteed temperature rise.

b) Positive mechanism interconnection shall be provided between interrupting contacts, resistor switches (when used), blast valve mechanism, if any, to ensure maximum operating reliability.

c) Where two breaks per pole interrupters are used, these shall be so designed that a fairly uniform voltage distribution is developed across them. Grading capacitors across contacts may be used only to have a uniform voltage gradient across the contacts.

5.1.4

Operating Mechanism

Operating mechanism shall have following features:

a) Circuit breakers shall be operated by Spring or Hydraulic-Spring or hydraulic or pneumatic mechanism. Each mechanism shall be provided with its own monitoring gauges and accessories. In addition, provision for manual operation shall also be made.

b) Operating mechanism shall normally be operated by remote electrical control. Electrical tripping shall be performed by shunt trip coils. Provision shall be made for local electrical control.

c) A local manual closing device shall also be provided for maintenance purpose. Direction of motion of handle shall be clearly and indelibly marked.

d) Circuit breakers shall have high repeatability of closing time over a wide range of parameters (ambient, temperature, hydraulic pressure, control voltages etc.). The time difference between first and last pole, for opening or closing shall be as follows:

i.

Closing: Less than 5 msecs (50Hz)

ii.

Opening: Less than 3 msecs (50Hz)

e) Operating mechanism shall be suitable for Auto reclosing. It shall be non-pumping electrically and mechanically under every method of closing (except during manual closing of a breaker for maintenance). A latch checking switch shall be provided on mechanically trip free mechanisms to prevent reclosure before the breaker latches have reset.

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f) Have two electrically independent trip coils and one close coil. The tripping mechanism shall function correctly when either one or both the trip coils are energised. The close and trip coils shall be rated for the DC voltage indicated in Data Sheet and shall operate satisfactorily at the designed temperature for voltage ranges between 85% to 110% rated voltage for closing coil and 70% to 110% for tripping coils. However, in some specific cases the trip coil may be required to operate with a different voltage range.

g) A mechanical indicator shall be provided to indicate open and closed positions at a location from where it will be visible to a person standing on the floor. An operation counter shall also be provided. Separate counter shall be provided on each phase for a segregated system.

h) The circuit breaker mechanism shall be mechanically trip free. The Circuit Breaker shall also be provided with an Anti-pumping feature.

i) Working parts of the mechanism shall be of corrosion resisting material. Bearings which require grease shall be equipped with pressure type grease fitting. Bearing pin, bolts, nuts and other parts shall be adequately pinned or locked to prevent loosening or changing of adjustment with repeated operation of the breaker.

j) Provision shall be made for attaching an operation analyser to perform CB timing tests after installation of the breakers.

k) Interlocks and/or blocking device shall be provided to prevent hunting and dangerous or undesirable operations of the circuit breaker. The interlock arrangements shall include but not be limited to the following:

5.1.6.1 Spring and Hydraulic-Spring Operated Mechanism

a) The operating mechanism shall be motor-compressed spring-operated, or hydraulic/hydraulic-spring charged. Single pole circuit breaker employing single-pole operating mechanism shall be electrically coupled for synchronous three-pole operation.

b) Motor-compressed spring-operated mechanism shall employ a motor for the rated AC/DC Voltage for spring charging. The energy storage of a motor compressed spring-operated circuit breaker shall be sufficient for an open-close-open operation without replenishing the stored energy. Means shall be provided to prevent overcharging of spring. Mechanical indication of spring(s) for both "charged" and "discharged" states shall be provided. Provision for manual spring charging shall be provided, which shall automatically cut-off the power supply to the motor during manual charging.

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c) Spring charging motors shall be suitable for operation at any voltages between 85% and 110% of rated auxiliary voltage.

d) The capacity of energy storage facilities that are integral part of the hydraulic/hydraulic-spring operating mechanism shall be sufficient to permit at least full rated duty cycle of the breaker without replenishing the stored energy. A hydraulic pressure gauge shall also be provided. Oil used in the hydraulic/hydraulic-spring mechanism shall be free of PCB shall also be provided.

e) Closing action of circuit breaker shall compress the opening spring ready for tripping.

f) When closing springs are discharged after closing a breaker, closing springs shall automatically be charged for the next operation and an indication of this shall be provided in the local control cabinet & HMI/SCADA.

g) Provisions shall be made to prevent a closing operation of the breaker when the spring is in the partial charged condition.

h) Mechanical interlocks shall be provided in the operating mechanism to prevent discharging of closing springs when the breaker is in the closed position.

5.1.6.2 Hydraulic Operated Mechanism

a) Hydraulic operated mechanism shall comprise of self- contained operating unit with power cylinder, control valves, high and low pressure reservoir, motor etc. In case of Auxiliary Power failure, provision for manual charging shall also be provided for emergency operation. The manual operation shall be interlocked with auto-operation by blocking it to ensure safety to the operator.

b) The oil pressure switch controlling the oil pump and pressure in the high-pressure reservoir shall have adequate no. of spare contacts, for continuous monitoring of low pressure, high pressure etc. at switchyard control room.

c) The Design shall be such that it shall be possible to perform at least two close-open operations after failure of AC supply to the motor.

d) The mechanism shall be capable of operating the circuit breaker correctly and performing the duty cycle specified under all conditions with the pressure of hydraulic operated fluid in the operating mechanism at the lowest permissible pressure before make up.

e) Trip lockout shall be provided to prevent operations of the circuit breaker below the minimum specified hydraulic pressure. Alarm contacts for loss of Nitrogen shall also be provided.

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f) All hydraulic joints shall have no oil leakage under the site conditions and joints shall be tested at factory against oil leakage.

5.2 DISCONNECT SWITCHES AND GROUND SWITCHES

5.2.1 The disconnect and grounding switch shall be Motorized, three (3) pole gang operated, no-load break, single stroke type, and shall generally comply with the requirements of IEC-62271-102.

5.2.2 The disconnect switch shall fully comply with the specified requirements of insulation level for the isolating distance as stated in IEC 60694.

5.2.3 The disconnect switch shall be capable of interrupting rated capacitive currents originating from switching busbars, busducts and very short lengths of cable and inductive currents as specified in the data schedule per IEC 60129.

5.2.4 The busbar side disconnect switches shall be capable of switching rated Bus-Transfer switching currents (Bus side Disconnects of each bay for Double Bus schemes) as per IEC 62271-102.

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

5.2.6 Grounding switches shall be high-speed type for all feeders and maintenance type for bay grounding. Maintenance type Bus Grounding switches shall be provided for each bus of the GIS.

5.2.7 The grounding switches shall be equipped with snap spring-operated high-speed operating mechanism with provision for manual operation.

5.2.8 Continuous current rating of the High-speed grounding switches shall be specified by the manufacturer, which can be safely injected for Bay/ Bus equipment testing.

5.2.9 The High-speed grounding switches shall be fitted with a stored energy closing system to provide fault making capacity.

5.2.10 The switches shall have inductive/ capacitive current switching capacity as per applicable standard.

5.2.11 Termination point grounding switches shall be capable of closing against the rated short circuit making current of the switchgear. All grounding switches shall have the same short time current rating as that of the switchgear.

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5.2.12

In all grounding switches, the ground connection of each phase shall be isolated from the ground connection of the other phases and from the switchgear enclosure, and brought out through an insulated bushing, rated 10kV minimum. Direct connection to ground shall be via a removable grounding strap. The current rating of the removable grounding strap shall be equal to that of the grounding switch.

5.2.13

The line grounding switches installed at each termination point of GIS shall be capable of breaking the induced capacitive and inductive currents per IEC 62271-102 (Class B) considering the transient recovery switching duty imposed on the ground switch.

5.2.14

All disconnect and grounding switches shall be equipped with local as well as remote controlled power-operated mechanism. An emergency manual operating device shall also be provided. DC power supply to the mechanism shall be automatically disconnected and local/remote electrical operation shall be prevented when manual operating device is engaged. The power to disconnect and grounding switch in the enclosure shall be transmitted via gas-sealed pressure-resistant shaft glands. Once initiated, the motor mechanism shall complete an open or close operation without requiring the initiating contact to be held closed.

5.2.15

All disconnect and grounding switches shall have mechanical position indicators for the main contact movements, directly coupled to the driving shaft and clearly visible from outside.

5.2.16

Inspection windows/endoscopy ports shall be provided in the housing of each disconnect and grounding switch to ensure isolating distance or gap by observing the position of each movable contact. The inspection viewports shall have removable covers to prevent damage of the actual viewport due to external elements. Access to viewports/endoscopy ports shall be convenient. A warning plate (green or white background with black lettering) shall be installed near each viewport/endoscopy port to warn (with words: WARNING-- DO NOT LOOK INTO THE VIEWPORT DURING SWITCHING OPERATION. ARCING MAY DAMAGE YOUR EYES) of possible danger when viewing the interior during switching operation. The area around the viewport/endoscopy port shall be painted a distinctive colour as a warning (orange or yellow).

5.2.17

Anti-condensation heaters shall be provided within the housing of each motor driven operating mechanism.

5.2.18

Interlocks

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a) Electrical and Mechanical interlocks shall be provided for absolute and positive protection against potentially harmful mal operations of the switchgear. Electrical interlocking shall be fail-safe type. Consultant or Owner's requirement shall be also taken while finalizing scheme.

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

c) Disconnect Switch shall be provided with electrical interlocking feature. This shall be in the form of bolt interlock comprising an interlock coil of latch-in type to lock the Disconnect Switch driving shaft and hence prevent Disconnect Switch operation in the latch-in condition. It shall be possible to release the latch by energising the interlock coil only when all the conditions of safe operations are satisfied. Facilities shall be provided for wiring Purchaser's external interlocks in Disconnect Switch opening and closing circuits for this purpose.

d) Crank handle insert shall prevent the operation of isolator & earth switch within the entire bay. Crank handle inserted alarm to be annunciated in local and remote.

5.2.19 Short Circuit Withstand Capacity

a) The rated peak short-circuit current or the rated short time current carried by an Disconnect Switch or Grounding switch for the rated maximum duration of short circuit shall not cause:

- i. Mechanical damage to any part of the Disconnect Switch or Grounding switch.
- ii. Separation of the contacts or contact welding.
- iii. Excessive temperature rise which is likely to damage insulation.

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

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

5.2.20 Auxiliary Switches

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a) Each circuit breaker, disconnecter and grounding switch shall be provided with mechanically direct driven auxiliary switches. These auxiliary switches shall be provided with minimum six (6) normally open (NO) and six (6) normally closed (NC) Directly driven spare auxiliary potential-free contacts and six (6) normally open (NO) and six (6) normally closed (NC) multiplied spare potential free contacts in addition to those required for the operating mechanism control and indications, protection and interlocks with other equipment. For bus side Disconnectors suitable for bus transfer duty, early make late break type contacts shall be provided for bus bar differential protection.

b) Auxiliary switches shall be rated for 10A DC 110 volts. Adequate number of Auxiliary switch contacts (Directly driven and multiplied) shall be provided.

c) Directly operated, electrically separate, reversible and adjustable type auxiliary switches shall be provided on breakers, disconnect switches and ground switches in quantities as required for the Project.

d) All tripping and interlocking schemes shall use directly driven contacts of the Circuit Breaker, Disconnect and ground switches.

e) Alarm, trip and spare contacts from operating mechanism shall be wired to the local control panels. Alarm and trip contacts to be used for Remote Control panel should be connected to terminal blocks.

f) 10 % Spare Auxiliary contacts completely wired up to the Terminal blocks in Local Control Panel shall be provided.

5.3 Instrument Transformers

5.3.1 General Requirements

a) Terminal and polarity marks shall be indelibly marked on each VT & CT on the associated terminals and these marks shall be in accordance with relevant standards and as per Owner's requirement.

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

c) Provision shall be made for primary injection testing either within CT or outside.

d) There should be facility to mount current transformer on either side of circuit breaker.

e) Secondary terminals of each voltage and current transformer shall be brought out in a weather-proof local control cabinet. Facilities shall be provided at the control cabinet for isolation and testing of CT secondaries. The design of

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isolated phase type CT's shall protect them from effects of enclosure current. Facility shall be provided for shorting and Grounding the CT secondary at the terminal box. The star point, whenever required, shall be formed at the terminal box only.

f) Voltage and current transformers shall be provided with the following accessories:

- i) Two Grounding terminals for connecting the specified size of Grounding conductor.
- ii) Terminals for Tan Delta measurement. These terminals under service conditions shall be connected to Grounding by means of links.

5.3.2 Voltage Transformers

All Voltage Transformers shall conform to IEC 60044-2 in general

- a) Voltage transformers shall be of single core type the metal enclosed gas insulated electro-magnetic mounted directly on the high voltage enclosure with plug in contacts that allow easy removal. The VTs shall be 5 limb type or 3-Single phase units in case of a common 3 phase enclosure.
- b) Minimum accuracy, burden and transient response characteristics shall be as specified in the single line diagram.
- c) In case of Grounded voltage transformers, the end of the primary winding intended to be grounded shall be brought out through a bushing and Grounding connection shall be made outside.
- d) The secondary terminal box for the voltage transformers shall also include necessary HRC fuses/ MCBs (Preferable MCBs) for protecting the secondary circuit. Further, for the purpose of fuse supervision both terminals of fuse shall be brought out to the terminal box. MCBs shall be provided with auxiliary contacts for interlocking, Trip and alarm purposes.
- e) Whenever a VT secondary winding is used for both measurement and protection application it shall have dual accuracy class of 0.5/3P, unless otherwise specified. However, for revenue class metering applications the accuracy class shall be 0.2S for that core.
- f) VT secondaries shall have extended Voltage tap wherever required for the purposes of synchronizing.
- g) The Voltage Transformer shall be so designed to avoid ferroresonance effects and shall be provided with adequate ferroresonance-suppressor (if required)

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on the secondary windings. An electrostatic shield shall be employed between the windings of VT to prevent coupling of the transients generated in the GIS high voltage conductors with the control wires.

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

i) All GIS electromagnetic Voltage Transformers shall have primary isolation device manually operated and monitored at local (LCC) and remote (control room) on the mimic diagrams.

5.3.3 Current Transformers

a) Number and location of CTs.

i) The ratio, burden, accuracy class, knee point voltage etc. shall be provided as specified in the single line diagram. CTs and PTs adequacy check shall be done based on the connected relaying and instrumentation load.

ii) The physical relative location of core in the CTs should be in accordance with the locations shown in single line diagrams enclosed with the Tender enquiry to ensure over lapping of protective zones.

b) Minimum Accuracy for Relaying Cores

All Current Transformer cores shall conform to IEC 60044-1 in general and IEC 60044-6 for Transient Protection Class CTs.

i) Accuracy Class 5P20, Class PS etc and class 0.2/0.2S for revenue metering as required shall be provided as specified in the single line diagram.

ii) Current Transformers may be single/dual/Multi Ratio type (MRCT) as specified in the Relaying and Metering Single Line diagram.

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

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

v) All CT cores shall be of low reactance type.

vi) No turns compensation shall be used in case of 'Class PS CTs. Turns compensation, if any, shall be clearly brought out in the Bid in Data Sheet.

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vii) In case of multi-ratio CTs, the minimum specified requirements in respect of VA, accuracy and Knee Point Voltage (V_{kp}) and maximum secondary resistance shall be applicable at the taps underlined in relevant drawings enclosed with the Tender.

viii) Magnetizing characteristics (extending well beyond V_{kp}) and secondary impedance values shall be furnished in Data Sheet for all protection cores.

5.4 GIS Surge Arresters

5.4.1 SF6 Insulated GIS Surge arresters shall be provided in the switchgear equipment for limiting any system transient voltages during switching and/or fault conditions in the system. The location of the surge arrester shall be in accordance to the single line diagram. The surge arresters shall fully comply with IEC-60099-4 as applicable and as noted in this specification.

5.4.2 The surge arresters shall be housed in enclosures mechanically separated from the other GIS parts by means of a gas barrier insulator. Each single-phase surge arrester and enclosure shall be treated as a single gas-monitoring zone.

5.4.3 The base plate of the enclosure shall be provided with a bushing type facility to permit leakage current measurements and the addition of discharge counters for purpose of monitoring the frequency of discharges.

5.5 SF6 to Air Bushings

5.5.1 SF6 to Air Bushings shall conform to IEC 60037 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.

5.5.2 SF6 to Air Bushings shall have minimum creepage as specified in Data Sheet. All creepage requirements shall be calculated on the basis of rated Line-to-Line Voltage.

5.5.3 Bushing shall be suitable for hot line washing and shall be provided with “water cut sheds”.

5.5.4 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.

5.5.5 All hardware used for current carrying parts shall be SS 304 and other iron parts shall be hot dip galvanized.

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5.5.6

All joints shall be airtight. Surface of the joints shall be turned up; porcelain parts by grinding and metal parts by machining. Bushing design shall be so as to ensure uniform compressive pressure on the joints.

5.5.7

All current carrying contact surfaces shall be silver faced.

5.5.8

GIS Manufacturer shall furnish details of precaution taken to prevent bimetallic corrosion wherever dissimilar materials (such as Copper, Aluminium) are used, including the following.

Aluminium conductor in the bus duct and the current carrying part in the bushing.

a)

Terminal clamp and the current carrying part in the bushing if bushing stud is not of Copper.

b)

Terminal clamp and the current carrying part in the bushing if bushing stud is not of Copper.

6.0

GIS TERMINATIONS

The following type of terminations shall be made, as applicable where SF6 Gas Bus duct directly connect the feeders provided in the GIS with the external Cables, Power Transformers etc.

6.1

SF6-to-Air Overhead Line Termination

a)

For connecting overhead lines with the GIS, SF6-to-Air outdoor bushings, mounted on suitable steel structures shall be installed. The bushings shall be wet processed porcelain or Composite (SiR) Insulator bushing and shall generally 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.

b)

The SF6-to-Air terminations shall include all necessary materials such as SF6 busduct, gas monitoring devices, busbar extensions, removable links to ensure complete termination.

c)

SF6 Gas Pressure Switch shall be provided for monitoring.

d)

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.

7.0

LOCAL CONTROL PANELS AND MECHANISM CABINETS

7.1

General

7.1.1

General features shall be as follows:

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i) Control panel shall be dead back type, sheet steel enclosed with degree of protection of IP 41 suitable for mounting close to the wall. Sheet steel used shall be cold rolled and at least 2.0 mm thick. Door shall have key locking facility or provision for padlocking.

ii) All control equipment shall be suitable for operating in an ambient temperature varying between 0°C and + 45°C. For Outdoor installations the ambient temperature variation shall be between –5°C to + 60°C with a Relative Humidity of 100%.

iii) A Ground bar for terminating the Ground wires of shielded control cables shall be located near the cable entry location.

iv) All control Panels and Marshalling Cabinets shall be provided with Ant-Condensation heaters which are thermostatically controlled. These Heaters shall operate on 1-phase, 240 V AC The thermostat controlled heaters, shall be provided complete with rotary type ON/OFF switch, HRC fuses or single pole MCB with overload and short circuit protection, link on neutral Provision for monitoring of heater failure shall be provided for all heaters.

v) A compact fluorescent lighting or LED fixture with door switch and one 6 pin 240V AC, 5/15 A Duplex receptacle shall be provided in each cabinet.

vi) The accessories and auxiliary equipment required for the correct functioning of each circuit element shall be installed in conveniently located mechanism cabinet (s).

vii) The interior shall be painted glossy white and exterior paint shade shall be 693 as per IS-5, unless specified otherwise.

viii) Terminal blocks of approved type shall be provided. The terminal blocks shall be of Phoenix make, Type OTTA-6 or Weidmuller make or equivalent. Terminal wiring shall be accessible from the front side of the panel.

7.2 Local Control Panel

7.2.1 Individual local control panels for each circuit shall be supplied to facilitate local control of circuit breakers, disconnects and Ground switches. These panels shall also house the various relays, timers etc. to realize specified interlock requirement among circuit breakers, disconnects and Ground switches. The contacts, signals and conditions originating from/ going to the switchgear, associated auxiliary, monitoring equipment and CT/VT wiring from the terminal boxes shall be wired up to the local control panels.

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7.2.2

Completely separate and isolated circuit shall be used for operating mechanism control, tripping alarms and auxiliary devices. CLOSE and TRIP circuits shall be kept isolated to their final mechanical or electrical actuators. Trip circuits shall have individual monitoring facilities.

7.2.3

Low Voltage AC/DC Switches/ MCBs

- Switches/MCBs shall be hand operated, air break, heavy duty, quick make, quick break type conforming to applicable clauses of IEC 60947-1 & 2. and IEC 60439.
- Switch handle shall have provision for locking in both fully open and fully closed positions. MCBs shall preferably be provided with suitable locking facility.
- Single throw isolating switches for complete isolation of the DC control circuits shall be provided.
- Control switches shall be of the rotary type provided with properly designated escutcheon plates clearly marked to show the operating positions. Control switches shall have momentary contacts, spring return to normal, with pistol grip handle. Selector switches shall have stay put contacts with oval handles. The local/remote selector switch shall be lockable in both positions. The number of contacts and their operation in each switch position shall be as per the requirements of the connected circuit. The switches shall be rated for minimum 10 A at 240 AC and 1 A inductive break at specified DC voltage.

7.2.4

Control & Auxiliary Power Supply

- For alarm, auxiliary devices, annunciation and indication, separate control supply feeder shall be provided by the Purchaser to each Local Control Panel.
- All control equipment shall be suitable for operation on specified DC system.
- Separate circuits with switches, fuses, etc. of adequate rating shall be provided for control of space heater, lighting and power receptacle. These shall be on 240 V, single phase AC supply, unless specified otherwise.
- AC and DC power supply shall be such that isolation of individual equipment is possible.
- AC & DC auxiliary supply to be supervised and any failure of the same to be annunciate in local & potential free contacts to be provided for remote monitoring.

7.2.5

Relays

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a) Relays for various controls, monitoring and blocking functions of particular circuit element shall be of Numerical type design installed in associated local control panel.

b) Necessary auxiliary relays for alarm, time-delay relays, voltage relays as required for control and protection shall be mounted inside the local control panel. Voltage operated relays shall have sufficient thermal capacity for continuous energisation,

c) Auxiliary relays shall be rated to operate satisfactorily between 80% and 110% of the specified rated voltage.

d) Each relay shall be provided with at least 2 NO and 2 NC potential free contacts, wired up to terminals for Customer's use.

e) Coils of all the relays shall be adequately rated to avoid spurious operation of relays on DC system ground or induced surges.

f) All relays shall be tropicalised and shall be suitable for design ambient temperature of 45 C.

g) Make and type of relay shall be subject to approval of the Purchaser.

h) Relays trip contacts connected for trip circuit shall have the making capacity of 30 amp for 0.2 seconds with an inductive load of L/R > 10 mill seconds. Bidder to submit the relay catalogue for approval.

i) Contact multiplication relays shall be provided for Gas Monitoring, Pole Discrepancy and if any alarms.

j) Electrically reset latch type trip relay shall be provided for SF6 Gas low zone trip stage. The operating time of the same shall not be more than 10 milliseconds. Provision for reset from remote to be provided.

k) Protections and metering shall be as per protection and Metering Single Line Diagram.

7.2.6 Push Buttons

All push buttons shall be of push to actuate type having 2 NO and 2 NC self-reset contacts. They shall be provided with integral escutcheon plates, engraved with functions. Push button contacts shall be rated for 10A at 240V AC and 1 A inductive breaking at specified DC voltage.

7.2.7 Indicating Lamps

Cluster LED type indicating lamps shall be provided.

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7.2.8 Internal Wiring

a) Cabinets/Panels shall be supplied completely wired ready for external connections at the terminal blocks. All wiring shall be carried out with wires of 600V grade, stranded copper conductors. The insulation shall be halogen free and flame retardant. Power circuits shall be wired with stranded copper conductors of adequate sizes to suit the rated current and the minimum size shall be 4 sq.mm. Unless otherwise specified, control alarm and indication circuits shall be wired with stranded, tinned copper conductors of sizes not smaller than 1.5 sq.mm. CT and VT circuits shall be wired with stranded copper conductor of size, not smaller than 2.5 sq.mm.

b) Engraved identification ferrules marked to correspond with the wiring diagram shall be fitted at both ends of each wire. All wiring shall be terminated on terminal blocks. Terminals shall be adequately rated for the circuit current; minimum rating shall be 10A. Control wiring shall be protected against mechanical damage.

c) CT/PT terminals shall be of disconnecting links types and all other terminals shall be of stud type. CT terminals shall have Grounding facility.

d) The wire terminations shall be made with solderless crimping type of tinned copper lugs.

e) Wiring shall be colour coded and be firmly supported, neatly installed by lacing and taping, readily accessible and connected to equipment terminals and terminal blocks. Halogen free, flame retardant plastic wiring channels/troughs with strap on covers shall be used for this purpose.

f) All control & instrument cable terminations shall have double compression type cable glands with shield grounding provision and shielded from electrostatic and electromagnetic interferences.

7.2.9 Mimic Diagrams

Mimic diagrams shall be provided on local control panels. The mimic strips shall be made of anodised aluminium and shall be screwed onto the panel. Colours of the various voltages of the mimic bus comply with relevant IEC standard. The width of mimic strip shall not be less than 5 mm. Discrepancy switches and semaphore indicator shall be provided on the mimic diagram as applicable.

7.2.10 Local Alarm/Annunciation

7.2.10.1 Window type Alarm/Annunciation shall be provided on local control panels of each bay for annunciating the specified abnormal conditions related to the bay covering

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SF6 gas pressure conditions, control supply fail as well as the hydraulic operating mechanism. The alarm windows shall have provision for differentiating cleared and uncleared faults and flashing for new faults. The Alarm/Annunciator system shall be provided with First out feature.

7.2.10.2 Alarm circuit shall not respond to faults for momentary conditions. The following minimum indications shall be generally provided in the alarm and indication circuits:

- i) Low Gas Pressure Stage-1, 2 & 3 (as applicable)
- ii) Low Operating Pressure / Spring Discharged (as applicable)
- iii) Loss of heater power
- iv) Auxiliary power supply failure (AC & DC)
- v) Pole discrepancy
- vi) Other trouble alarms for CB, DS and any others
- vii) DS/ES drive door open.

7.3 Mechanism Cabinets

7.3.1 The Circuit breaker mechanism cabinet shall consist of the following:

- a. Circuit breaker position indicator
- b. Operation counter
- c. Provision for connection of time travel recorder
- d. Operating and monitoring device associated with circuit breaker operating mechanism shall be wired to terminal blocks in circuit breaker mechanism cabinet and further to terminal blocks in local control cabinet.
- e. Monitoring and indication devices for the status of the stored energy of the circuit breaker or other status of the operating mechanism.

7.3.2 Disconnect Switch and Grounding switch mechanism cabinet.

The mechanism cabinet, in addition to other components or accessories the GIS Manufacturer considers necessary for safe and reliable operation, incorporate the following

- a. Disconnect /Grounding switch position indicator
- b. Auxiliary switches
- c. Terminal blocks

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d. Operating and monitoring device associated with Disconnect /Grounding switch operating mechanism shall be wired to terminal blocks in isolator mechanism cabinet and further to terminal blocks in local control cabinet.

e. Monitoring and indication devices for the status of the operating mechanism.

7.4 Labels and Diagram Plate

7.4.1 Every GIS equipment and devices mounted in the cabinet/ control panel shall be provided with individual labels with equipment designation/ rating. Also, the cabinet/ control panel shall be provided on the front with a non-rusting label engraved with the designation of the cabinet/control panel.

7.4.2 As built copy of a circuit diagram shall be fixed inside the door.

8.0 MISCELLANEOUS REQUIREMENTS

8.1 Grounding

8.1.1 The GIS shall be bonded to the “Main Ground Bus” for the specified short circuit current magnitude and duration.

8.1.2 It shall be the responsibility of the GIS manufacturer to provide a sufficient number of Ground connection points on the GIS which shall be suitable for interconnection.

8.1.3 Provision shall be made for future extension and/or bonding to ground bus(es) of other switchgear.

8.1.4 Every section of the SF6 switchgear equipment including all panels, cubicles, kiosks and boxes shall be solidly bonded to the Grounding system, by at least two independent leads. Two Grounding pads shall be provided at each equipment for the connection to Grounding system.

8.2 Grounding Tester

As an additional measure for the safety of personnel it shall be possible to ascertain that the particular section of the plant is de-energised before a Ground switch is closed onto the conductor. A capacitive tap shall be provided on each gas section. One loose instrument common to the complete plant, shall be supplied for connection to a capacitive tap to indicate whether the circuit is live or dead. Provision of tap to indicate status – live or dead, capacitive taps and the instrument shall be optional and quoted for separately. Required electrical interlock with VT secondary shall also be provided to ensure the feeder/bus is dead.

8.3 Welding/Casting Nuts and Bolts

8.3.1 All welding/casting shall conform to the requirements of relevant IEC standards.

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8.3.2

At least 10% of all welds/casting shall be subjected to non-destructive testing by X rays or ultrasound and all records there of shall be made available upon request.

8.3.3

All welding shall be performed with suitable submerged-arc welding machines or by fully certified welders.

8.3.4

Drawings submitted for approval shall indicate following information in respect of welds:

a. Type of weld

b. Procedure employed

c. Inspection applied

d. Applicable standard

8.3.5

Details of bolt sizes and threading shall be clearly shown on the appropriate drawings. Where self-locking type of nuts are used, they shall be of the re-usable type. Pressed type nuts are not acceptable. Fasteners used for current carrying parts shall be of Stainless Steel - 304.

8.3.6

GIS Manufacturer shall indicate the type of protection needed and precautions to be taken during GIS installation to prevent moisture or dirt entering the enclosures.

8.4

Seismic Qualification

8.4.1

The GIS shall be designed to safely withstand the seismic forces as per the codal design wherever applicable. The two seismic ground motion levels are 0.5g peak or 0.2g peak acceleration.

8.4.2

GIS Manufacturer shall submit type test certificates, if applicable to prove seismic withstand capability. If identical GIS is not tested in the past, successful GIS Manufacturers shall furnish design calculation or carry out testing to prove seismic withstand capacities without cost and time implication to the purchaser.

9.0

SPECIAL TOOLS

9.1

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.

9.2

If specified, a mobile SF6 gas treatment plant, which shall be suitable for draining, filtration/purification and refilling the equipment shall be provided. The plant shall

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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.

9.3 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.

9.4 A SF₆ Gas maintenance cart, which shall be easily moved by One 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.

9.5 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 if required. The recommended positions, exact number of detectors, type of mounting, facilities for alarm etc. shall be indicated in the Bid.

b. Each set of analyser shall comprise of:

i. SO₂ content in SF₆ gas

ii. Purity of SF₆ gas

iii. SF₆ gas moisture content

9.6 All special tools required for the purpose of installation, maintenance, overhauling and testing of GIS and also for the measurement of moisture in SF₆.

10.0 TESTING

10.1 Purchaser shall have right to carryout stage inspection and shop visit to review the manufacturing progress. However, manufacturer need not hold any of the manufacturing activity for witnessing of stage inspection by purchaser / consultant.

10.2 Routine Tests

10.2.1 The switchgear and its component circuit breakers, Disconnect Switches, Grounding switches, SF₆/oil interface bushings and instrument transformers etc. shall be fully routine tested in accordance with current edition of the relevant IEC standards.

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10.2.2

The tests may be witnessed by Purchaser's personnel. Purchaser shall be notified to witness tests at least two weeks prior to tests. Any changes in testing schedules must be communicated immediately to Purchaser.

10.2.3

All defects as a result of testing shall be repaired by GIS Manufacturer at his own expense and shall be documented and corrected prior to shipment. If, in the opinion of Purchaser, a repeat of the faulty test is required after such repairs, this shall also be done at no cost to the Purchaser.

10.2.4

Authorised representatives of Purchaser shall be allowed access to all those areas in GIS Manufacturer's shop where the equipment covered by this contract in produced at all reasonable times for the purpose of inspection and obtaining information on the progress of work.

10.2.5

Acceptance by Purchaser's representative of any equipment shall not relieve the GIS Manufacturer from any of his performance guarantees, or from any of his other obligation resulting from this contract.

10.2.6

Following tests are also required to be carried out as routine test:

- Routine partial discharge tests shall be performed on all insulators and instrument transformers. The discharge level shall be less than 5 pico Coulombs at this voltage. Purchaser may at his discretion accept alternative tests to prove the integrity of the insulators.
- Each shipping assembly shall be subjected to a one minute, 50 Hz high voltage withstand test and a partial discharge test. The extinction levels shall be taken as 5 pico Coulombs for switchgear and 3 pico Coulombs for individual insulators.
- Each enclosure & partition shall be tested to withstand twice rated internal operating pressure and test reports of the tests shall be furnished.
- Bending strength test and testing of impact strength for insulating rods shall be carried out on one sample in the presence of Purchaser's representative free of cost.
- Tests shall be carried out to verify the gas loss figures guaranteed by the GIS Manufacturer.
- Mechanical operation test including continuous operating test and timing test.
- Measurement of the resistance of the main circuit.
- Design and visual checks

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i) Tests on auxiliary circuits, equipment and interlocks in the control mechanism.

10.3 Type Tests

10.3.1 The switchgear and its component circuit breakers, Disconnect Switches, Grounding switches, SF6/oil interface and instrument transformers shall be fully type tested in accordance with IEC 62271-203, IEC 62271-100 and IEC 60694.

10.3.2 Impulsive voltage test certificates to prove withstand capabilities against both lightning and switching over voltages should have been conducted on one completely assembled bay which shall include breakers, associated disconnecting switches, grounding switches, bus ducts, instrument transformers etc. These tests shall be carried out after power frequency withstand test.

10.3.3 The type tests shall be carried out at reputed testing laboratory, the tests must have been carried out during last 5 years. Type test certificates to this effect shall be enclosed with the Bid. If not, the Type tests must be carried out and the price shall be considered in bid. Also, if specified in Section C, type test shall be carried out on the equipment.

10.4 Site Tests

10.4.1 The fully assembled equipment shall be subjected to 1 min. power frequency withstand test at 80% of the rated withstand test voltage and impulse/switching impulse voltage test at site. To test various sections of GIS, it may be necessary for some sections of GIS, to be subjected to more than one such test. All field tests as per relevant IEC standards shall be conducted. The test, the method of applying the test voltage and the requirements for conditioning shall be subjected to agreement between Purchaser and GIS Manufacturer. GIS Manufacturer shall give a detailed programme and description of site testing in the bid and standards followed.

10.4.2 Provision shall be made by GIS Manufacturer for incorporating a test bushing and other necessary testing equipment to facilitate site testing. Test bushing shall be included in GIS Manufacturer's scope, and shall be handed over to Purchaser, if so specified.

10.4.3 The GIS Manufacturer shall indicate the equipment to be made available by the Purchaser for commissioning tests at site. Special tools for erection/testing the GIS shall be supplied by the GIS Manufacturer and indicated in the bid.

10.4.4 The GIS Manufacturer shall also indicate the equipment for diagnostic/online monitoring system for the GIS as an optional item.

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ISSUE
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SPEC NO.	TATA CONSULTING ENGINEERS LIMITED 9MMTPA CBR PROJECT				SECTION: D1
12416A-EL-GIS-40101	DATA SHEET 230KV GIS AND ITS ACCESSORIES				
Sl. No.	ITEM	UNIT	PARTICULARS	BIDDER RESPONSE	REMARKS
1	General				
a	Maximum temperature of enclosure (°C)		According to IEC		
b	Color of GIS Bus and enclosures		as per painting specification		
c	Color of GIS Barrier Insulations		as per painting specification		
d	Type test reports included		Yes		
2	DISCONNECTOR				
a	Manufacturer		Bidder to Specify		
b	Type		Bidder to Specify		
	- Model No.		Bidder to Specify		
	- Country of origin		Bidder to Specify		
c	Characteristics				
	- Operating voltage (U_o/U)		133/230		
	- Rated voltage for equipment (U_r) (kV)		260		
	- Rated short time withstand current (3 s) (kA_{rms} sym)		40		
	- Rated peak withstand current (kA_p)		108		
	- Rated impulse withstand voltage at minimum operating gas pressure (U_p)		Bidder to Specify		
	- Phase to phase and phase to earth (kV_p)		1050		
	- Across the isolating distance (kV_p)		1200		
	- Switching withstand voltage at minimum operating gas pressure (U_s)				
	o Phase to earth (kV_p)		850		
	o Across the isolating distance (kV_p)		Bidder to Specify		
	- Power-frequency withstand voltage, 1 min., at minimum operating gas pressure (U_d)				
	o Phase to phase and phase to earth (kV_{rms})		460		
	o Across the isolating distance (kV_{rms})		530		
	- Rated current (I_r) (A)				
	o At 45°C		3150		
	o At 50°C		Bidder to Specify		
	- Rated frequency (Hz)		50		
	- Number of poles		3		
d	Maximum capacitive current interruption capacity (A)				
	- Opening time (s)		≤ 15		
	- Closing time (s)		≤ 15		
e	Operating mechanism		Motor & manual		
	- Motor voltage (Vd.c)		110		
	- Number of auxiliary contacts available for future customer's use		Bidder to Specify		
	- Number of mechanism for three pole operation		Bidder to Specify		

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Sl. No.	ITEM	UNIT	PARTICULARS	BIDDER RESPONSE	REMARKS
	- Hand-operating facility		Bidder to Specify		
	- Rated motor power (W)		Bidder to Specify		
	- Contact type		Bidder to Specify		
3	MAINTENANCE EARTHING SWITCH				
a	Manufacturer				
	- Type		Bidder to Specify		
	- Model No.		Bidder to Specify		
	- Country of origin		Bidder to Specify		
b	Characteristics				
	- Operating voltage (U_o /U)		133/230		
	- Rated voltage for equipment (U_r) (kV)		260		
	- Rated short time withstand current (3 s)(kArms sym)		40		
	- Rated peak withstand current (kA_p)		108		
	- Rated impulse withstand voltage at minimum operating gas pressure (U_p)				
	o Phase to phase and phase to earth (kV_p)		1050		
	o Across the isolating distance (kV_p)		1200		
	- Switching withstand voltage at minimum operating gas pressure (U_s)				
	o Phase to earth (kV_p)		Bidder to Specify		
	o Across the isolating distance (kV_p)		Bidder to Specify		
	- Power-frequency withstand voltage, 1 min., at minimum operating gas pressure (U_d)				
	o Phase to phase and phase to earth (kV_{rms})		Bidder to Specify		
	o Across the isolating distance (kV_{rms})		Bidder to Specify		
	- Rated frequency (Hz)		50		
	- Number of poles		3		
	- Opening time (s)		Bidder to Specify		
	- Closing time (s)		Bidder to Specify		
d	Operating mechanism				
	- Motor voltage (V d.c.)		110		
	- Number of auxiliary contacts available for future customer's use		Bidder to Specify		
	- Number of mechanism for three pole operation		Bidder to Specify		
	- Hand-operating facility		yes		
	- Rated motor power (W)		Bidder to Specify		
	- Contact type		Bidder to Specify		
4	HIGH SPEED EARTHING SWITCH				
a	Manufacturer				
	- Type		Bidder to Specify		
	- Model No.		Bidder to Specify		

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Sl. No.	ITEM	UNIT	PARTICULARS	BIDDER RESPONSE	REMARKS
	- Country of origin		Bidder to Specify		
b	Characteristics				
	- Operating voltage (U_o /U)		133/230		
	- Rated voltage for equipment (U_r) (kV)		260		
	- Rated short time withstand current (3 s) (kA rms sym)		40		
	- Rated peak withstand current (kA_p)		108		
	- Rated impulse withstand voltage at minimum operating gas pressure (U_p)				
	o Phase to phase and phase to earth (kV_p)		1050		
	o Across the isolating distance (kV_p)		1200		
	- Switching withstand voltage at minimum operating gas pressure (U_s)				
	o Phase to earth (kV_p)		Bidder to Specify		
	o Across the isolating distance (kV_p)		Bidder to Specify		
	- Power-frequency withstand voltage, 1 min., at minimum operating gas pressure (U_d)				
	o Phase to phase and phase to earth (kV_{rms})		Bidder to Specify		
	o Across the isolating distance (kV_{rms})		Bidder to Specify		
	- Rated frequency (Hz)		50		
	- Number of poles		3		
	- Opening time (s)		Bidder to Specify		
	- Closing time (s)		Bidder to Specify		
	- Rated inductive (electromagnetic) breaking current at 10 kV_{rms} breaking voltage (A)		Bidder to Specify		
	- Rated capacitive (electrostatic) breaking current at 20 kV_{rms} breaking voltage (A)		Bidder to Specify		
c	Operating mechanism				
	- Motor voltage (V d.c.)		110		
	- Number of auxiliary contacts available for future customer's use		Bidder to Specify		
	- Number of mechanism for three pole operation		Bidder to Specify		
	- Hand-operating facility		Bidder to Specify		
	- Rated motor power (W)		Bidder to Specify		
	- Contact type		Bidder to Specify		
5	CABLE TERMINATION BOX				

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Sl. No.	ITEM	UNIT	PARTICULARS	BIDDER RESPONSE	REMARKS
a	Manufacturer				
	- Type		Bidder to Specify		
	- Type termination (as per IEC 62271-209)		Bidder to Specify		
	- Model No.		Bidder to Specify		
	- Country of origin		Bidder to Specify		
b	Characteristics				
	- Operating voltage (Uo /U)		133/230		
	- Rated voltage for equipment (Ur) (kV)		260		
	- Rated short time withstand current (3s) (kA rms sym)		40		
	- Rated peak withstand current (kAp)		108		
	- Rated impulse withstand voltage at minimum operating gas pressure (Up) (kVp)		1050		
	- Switching withstand voltage at minimum operating gas pressure (Us) (kVp)		Bidder to Specify		
	- Power-frequency withstand voltage, 1 min., at minimum operating gas pressure (Ud) (kVrms)		460		
	- Rated current (Ir) (A)				
	At 45°C		3150		
	At 50°C		Bidder to Specify		
c	- Rated frequency (Hz)		50		
d	Construction				
	- Number of phases in one enclosure		1		
	- Mechanism design pressure (absolute) for outside of the cable terminal (MPa)		Bidder to Specify		
	- Mechanical strength of cable termination		Suitable to cable installation		
	- Fitting		As per IEC 60859		
	- Cable size range (mm ²)		As per IEC 60859		
	- Removable link between busduct and cable box		Bidder to Specify		
	- Mounting details:				
	o Bolt circle of the flange (mm)		Bidder to Specify		
	o N° of bolts		Bidder to Specify		
	o Size of bolts (mm)		Bidder to Specify		
	- Terminal:				
	o Type		Bidder to Specify		
	o Size (mm)		Bidder to Specify		
	o N° of holes (if applicable)		Bidder to Specify		
	o Outline drawing		Bidder to Specify		
	- Gas filling facilities, manometer, alarm and trip contacts for each compartment.		yes		
6	BUS DUCT				
a	Manufacturer				
	- Type		Bidder to Specify		
	- Model No.		Bidder to Specify		
	- Country of origin		Bidder to Specify		

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Sl. No.	ITEM	UNIT	PARTICULARS	BIDDER RESPONSE	REMARKS
b	Characteristics				
	- Operating voltage (U _o /U)		133/230		
	- Rated voltage for equipment (U _r) (kV)		260		
	- Rated short time withstand current (3s) (kA rms sym)		40		
	- Rated peak withstand current (kAp)		108		
	- Rated impulse withstand voltage at minimum operating gas pressure (U _p) (kV _p)		1050		
	- Switching withstand voltage at minimum operating gas pressure (U _s) (kV _p)		Bidder to Specify		
	- Power frequency withstand voltage, 1 min., at minimum operating gas pressure (U _d) (kV _{rms})		460		
	- Rated current (I _r) (A)				
	o At 45°C		3150		
	o At 50°C		Bidder to Specify		
	- Rated frequency (Hz)		50		
c	Construction				
	- Number of phases in one enclosure		1		
7	GIS MECHANISM ENCLOSURE				
a	Accessories				
	- Local/remote selector switch		yes		
	- Manual and electrical operation		yes		
	- Light, heater and service outlet in hand operated mechanism enclosure		yes		
	- MCB protected motor and control circuits		yes		
	- Motor contactor		yes		
	- Test switches (d.c.)		yes		
	- Terminal blocks		yes		
	- Enclosure degree of protection		IP 64		
	- Grounding bushing for testing of GIS insulation (10 kV isolation)				
b	Weight and dimensions				
	- Total weight, 3 poles group (kg)		yes		
	Will be submitted during detail engineering		yes		
	- Arrangement drawing (indicating dimensions) to be submitted with the bid		yes		
c	Type test reports		Bidder to Specify		
d	Quality control		ISO 9001		
e	Special requirements				
	- Manometer for SF ₆ leakage for each compartment including alarm and trip contacts and filling facility for each compartment.		yes		
	- Inspection window and mechanical indicators including locking facilities, paint color to be RAL 9010		Refer painting specification		

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Sl. No.	ITEM	UNIT	PARTICULARS	BIDDER RESPONSE	REMARKS
8	CIRCUIT BREAKER				
a	Manufacturer				
	- Type		Bidder to Specify		
	- Model No.		Bidder to Specify		
	- Country of origin		Bidder to Specify		
b	Characteristics				
	- Operating voltage (U_o /U)		133/230		
	- Rated voltage for equipment (U_r) (kV)		260		
	- Rated breaking current ($kA_{rms\ sym}$) with X_1/R_1 and X_0/R_0 ratios as type tested (ratios to be confirmed)		40		
	- Rated breaking current (kA rms sym) with a X_1/R_1 ratio of 28		Bidder to Specify		
	- Rated breaking current (kA rms sym) with a X_0/R_0 ratio of 46		Bidder to Specify		
	- Rated peak withstand current (kA_p)		108		
	- Rated impulse withstand voltage at minimum operating gas pressure (U_p)		Bidder to Specify		
	o Phase to phase and phase to earth (kV_p)		1050		
	o Across the isolating distance (kV_p)		1200		
	- Switching withstand voltage at minimum operating gas pressure (U_s)				
	o Phase to earth (kV_p)		Bidder to Specify		
	o Across the isolating distance (kV_p)		Bidder to Specify		
	- Power-frequency withstand voltage, 1 min., at minimum operating gas pressure (U_d)				
	o Phase to phase and phase to earth (kV rms)		460		
	o Across the isolating distance (kV_{rms})		530		
	- Rated current (I_r) (A)				
	o At 45°C		3150		
	o At 50°C		Bidder to Specify		
	- Rated frequency (Hz)		50		
c	Operating mechanism		Motor & Manual		
	- Motor voltage (V d.c.)		110		
	- Number of auxiliary contacts available for future customer's use		Bidder to Specify		
	- Number of mechanism for three pole operation		Bidder to Specify		
	- Hand-operating facility		yes		
d	Opening time				
	- Making (ms)		Bidder to Specify		
	- Tolerances (ms)		Bidder to Specify		
	- Chattering (ms)		Bidder to Specify		

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Sl. No.	ITEM	UNIT	PARTICULARS	BIDDER RESPONSE	REMARKS
	o Tolerances (ms)		Bidder to Specify		
	- Opening (ms)		<30		
	o Tolerances (ms)		Bidder to Specify		
	- Arcing (ms)		<25		
	o Tolerances (ms)		Bidder to Specify		
	- Break time (ms)		<50		
	o Tolerances (ms)		Bidder to Specify		
	- Dead (ms)				
	o t (ms)		≤ 300		
	o t' (min)		3		
e	Operating Data				
	- Operation duty cycle		Bidder to Specify		
	- Closing current at 110 V d.c. (A)		Bidder to Specify		
	- Tripping current at 110 V d.c. (A)		Bidder to Specify		
	- Minimum tripping voltage (V)		Bidder to Specify		
	- Minimum closing voltage (V)		Bidder to Specify		
	- Spring charging / pump motor				
	o Voltage (V)		Bidder to Specify		
	o Rated current (A)		Bidder to Specify		
	o Charging time (s)		Bidder to Specify		
	- Number of operations after which a maintenance inspection is necessary		Bidder to Specify		
	- Number of operations after which a maintenance overhaul is necessary		Bidder to Specify		
	- Number of operations at rated continuous current after which a maintenance inspection is necessary		Bidder to Specify		
	- Number of operations at rated continuous current after which a maintenance overhaul is necessary		Bidder to Specify		
	- Provide an electrical endurance curve (minimum guaranteed number of interruptions at given fault level)		Bidder to Specify		
	- Provide interlock system description		Bidder to Specify		
f	Structural Data				
	- Weight of circuit breaker (kg)		Bidder to Specify		
	- Maximum impact loading		Bidder to Specify		
	o Upward (N)		Bidder to Specify		
	o Downward (N)		Bidder to Specify		
9	CURRENT TRANSFORMER				
a	Manufacturer				
	- Type		GIS		
	- Model No.		Bidder to Specify		
	- Country of origin		Bidder to Specify		
	- Insulation		SF6		
b	Characteristics				
	- Operating voltage (U _o /U)				

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Sl. No.	ITEM	UNIT	PARTICULARS	BIDDER RESPONSE	REMARKS
	- Rated voltage for equipment (U_r) (kV)		260		
	- Rated short time withstand current (3 s) (kA rms sym)		40		
	- Rated peak withstand current (kA_p)		108		
	- Rated impulse withstand voltage at minimum operating gas pressure (U_p) (kV_p)		1050		
	- Switching withstand voltage at minimum operating gas pressure (U_s) (kV_p)		Bidder to Specify		
	- Power-frequency withstand voltage, 1 min., at minimum operating gas pressure (U_d) (kV_{rms})		460		
	- Rated frequency (Hz)		50		
	- Continuous current service factor		Bidder to Specify		
	- Temperature rise above 55°C ambient (°C)		According to IEC		
	- Transformer differential protection circuits				
	o Ratio		As per Specification		
	o Accuracy class as per IEC		PX		
	o Burden (VA)		Bidder to Specify		
	- Cable differential protection circuits				
	o Ratio		As per Specification		
	o Accuracy class as per IEC		PX		
	o Burden (VA)		Bidder to Specify		
	- Bus differential protection circuits				
	o Ratio		As per Specification		
	o Accuracy class as per IEC		PX		
	o Burden (VA)		Bidder to Specify		
	- Overcurrent (Back-up) protection circuits				
	o Ratio		As per Specification		
	o Accuracy class as per IEC		5P20		
	o Burden (VA)		Bidder to Specify		
	- Measuring circuits				
	o Ratio		As per Specification		
	o Accuracy class as per IEC		CL.0.5		
	o Burden (VA)		Bidder to Specify		
	- Main metering circuit				
	o Ratio		As per Specification		
	o Accuracy class as per IEC		CL.0.5		
	o Burden (VA)		Bidder to Specify		
	- Check metering circuit				
	o Ratio		As per Specification		
	o Accuracy class as per IEC		CL.0.5		
	o Burden (VA)		Bidder to Specify		
10	VOLTAGE TRANSFORMER				
a	Manufacturer				
	- Type				

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Sl. No.	ITEM	UNIT	PARTICULARS	BIDDER RESPONSE	REMARKS
	- Model No.		Bidder to Specify		
	- Country of origin		Bidder to Specify		
	- Insulation		Bidder to Specify		
b	Characteristics				
	- Operating voltage (U_o /U)		133/230		
	- Rated voltage for equipment (U_r) (kV)		260		
	- Rated impulse withstand voltage at minimum operating gas pressure (U_p) (kV_p)		1050		
	- Switching withstand voltage at minimum operating gas pressure (U_s) (kV_p)		Bidder to Specify		
	- Power-frequency withstand voltage, 1 min., at minimum operating gas pressure (U_d) (kV_{rms})		460		
	- Rated primary voltage (kV_{rms})		230 / $\sqrt{3}$		
	- Rated secondary voltage (V_{rms}) (Winding No 1 – No 2)		110 / $\sqrt{3}$ – 110 / $\sqrt{3}$		
	- Rated frequency (Hz)		50		
	- Winding No 1				
	o Accuracy class as per IEC		0.2/3P		
	- Winding No 2				
	o Accuracy class as per IEC		0.2/3P		
	- Continuous thermal burden		Bidder to Specify		
	- Total (VA)		Bidder to Specify		
	- Winding No 1 (VA)		Bidder to Specify		
	- Winding No 2 (VA)		Bidder to Specify		

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1.0 SCOPE

230kV GIS and its outdoor equipment is envisaged to receive Electrical Power from State Electricity Grid, the voltage level shall be further stepped down to 66 kV through step down transformer (230/66 kV). This power shall be connected to 66 kV GIS at CPP substation through 66 kV cable.

The scope covers design, manufacture, assembly, testing at manufacturer's works before dispatch, supply, shipping, transport, receiving at site, storage at site, erection, testing and commissioning of metal enclosed, SF6 GIS and ancillary equipment as required. The 66kV GIS shall have Two Main bus breaker as switching scheme. The GIS shall consist of the following bays/circuits.

Sl. No.	Description	No. of Bays/Circuits
1	Incomers	10Nos (7Nos. from Generator transformers + 2Nos. from 230kV GIS + 1No of spare)
2	Outgoing feeders	45 (including 8Nos. spares)
3	Bus-coupler	2
4	Bus Sectionalisers	2
	Total	59

1.1 Required number of 66 kV Cable to Air terminations and Cable terminations at GIS etc. are included in the scope of the BIDDER.

1.2 RCC Building for housing the GIS, EOT crane for handling GIS sections, HVAC and other systems as indicated in Scope of work document are also included in the scope of the BIDDER. The EOT crane shall be sized to handle the heaviest section of the GIS. Space for adding two (2) numbers of bays on both the sides of GIS switchgear shall be considered in the GIS building. Adequate space for maintenance shall be provided inside the GIS building, in addition to the space required for housing the switchgear and space requirement for additional bays.

1.3 SF6 gas maintenance equipment and a hand-held SF6 gas leakage monitor also shall be included in the scope of supply of the BIDDER.

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1.4 Notwithstanding scope of supply mentioned in this specification, if any equipment, tools or instruments are considered essential for erection, Testing & Commissioning and operation, the same shall also be supplied.

1.5 66 KV GIS EQUIPMENT

The design, material, construction, manufacture, inspection, testing and performance of the gas insulated switchgear (GIS) and accessories, shall comply with the requirements specified in Data Sheet, all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed.

2.0 CODES AND STANDARDS

The applicable Codes and standards are specified in below table. However, for some special applications the GIS may have to confirm to some higher requirements, which will be specified in Data Sheet. In such specific cases, this specification shall take precedence over the standard requirements indicated in the applicable Industry Standards.

S. No.	Title	Standard Reference
1.	International Electro-technical Vocabulary	IEC 60050
2.	High voltage alternating current circuit breakers	IS 13118
3.	Gas-Insulated metal enclosed Switchgear for rated voltages 52kV & above	IS / IEC 62271-203
4.	High voltage test techniques	IS / IEC 60060
5.	Recommendation for heat treated aluminium alloy busbar material of the Aluminium-Magnesium Silicon type.	IEC 60114
6.	Alternating current disconnect switches and grounding switches	IEC 62271-102
7.	Bushing for alternating voltages above 1000 volts	IEC 60137
8.	Instrument transformers Part: 1 Current Transformers	IEC 61869-2

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S. No.	Title	Standard Reference
9.	Instrument transformers Part: 2 Inductive voltage transformers	IEC 61869-3
10.	Electrical Relays	IEC 60255
11.	Low Voltage Fuses	IEC 60269
12.	Specification and Acceptance of New Sulphur Hexafluoride	IEC 60376
13.	High-voltage switchgear and control gear - Alternating-current circuit-breakers	IEC 62271-100
14.	Guide for checking SF6 gas taken from Electrical Equipment	IEC 60480
15.	Artificial Pollution test on HV Insulators to be used on AC System	IEC 60507
16.	High-voltage switchgear and control gear-Direct connection between power transformers and gas-insulated metal-enclosed switchgear for rated voltages above 52 kV	IEC 62271-211
17.	Classification of degree of degree of protection provided by enclosures	IEC 60529
18.	Guide for selection of insulators in respect of polluted conditions	IEC 60815
19.	Code of Practice for Earthing	IS 3043
20.	Standard for gas insulated substations	ANSI/IEEE C37.122
21.	Quality systems – model for quality assurance in final inspection and test	ISO 9003

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S. No.	Title	Standard Reference
22.	Surge arresters-part4: metal-oxide surge arresters without gaps for ac systems	IEC 60099-4
23.	Surge arresters-part5: selection and application recommendations	IEC 60099-5
24.	Guide for partial discharge measurements in power switchgear	ANSI/IEEE 1291
25.	Paint shade	IS 5
26.	Low voltage switchgear and control gear	IEC 60947
27.	Immunity standard on electrostatic discharge	IEC 61000

3.0 COMPONENTS OF GIS ASSEMBLY

3.1 The components of switchgear assembly having compact and modular design shall essentially consist of following items and their accessories specified in subsequent clauses.

- a) Circuit breakers
- b) Disconnect Switches
- c) Ground switches (Maintenance and High-Speed types)
- d) Voltage transformers (with disconnecting link / externally operated isolation switch)
- e) Current transformers (If CT is installed in breaker gas compartment, insulation class for CT shall be class F)
- f) SF6 lightning arrestor
- g) Partial Discharge Monitoring devices
- h) Terminations - power cable (SF6 to cable sealing end) terminations as applicable.
- i) Busbars, Bus enclosures and accessories with different bus arrangements.
- j) Local control panels and operating mechanism cabinets.

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k) SF6 GIS Busduct Indoor/outdoor as applicable

l) Pressure/density monitors and switches

m) GIS supporting structure

4.0 DESIGN AND CONSTRUCTIONAL FEATURES

4.1 General

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

4.1.2 Each bay shall be arranged in compact and modular design with individual equipment modules connected together to form a complete assembly for the intended GIS Bus configuration.

4.1.3 The equipment and connections within each compartment shall be arranged so as to allow removal and replacement of any section both during normal and abnormal working conditions with minimum disturbance to adjacent in-service pressurised sections.

4.1.4 The GIS Equipment shall be complete with all necessary supports, ladders, galleries, staircases, catwalks, movable platforms or walkways (for accessing the equipment above two (2) 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).

4.1.5 Minimum assembly work shall be envisaged during installation. The GIS shall be supplied as completely factory assembled switchgear bays, within shipping / transportation limits.

4.1.6 The GIS shall be installed on suitable mounting pads or supporting frames / structures with provision for levelling, including fasteners to foundation, which shall also be included in the supply. Support-structures shall be designed and fabricated to withstand the short circuit forces of the ground fault current as well as prevent excessive vibration during switching operation or faults.

4.1.7 The GIS shall be provided with expansion joints and flexible connections, where several enclosures are connected in the longitudinal direction, such as main bus. Expansion joints provided for installation alignment shall be locked in place when alignment is complete. Expansion joints for compensation of thermal expansion

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and erection tolerances shall have the means to preserve mechanical integrity of the enclosure and the plug-in contacts for the conductor. Provision shall be made for expansion of GIS bus on either side of GIS.

4.1.8 All modules of the GIS switchgear and components of the same rating and construction, which may need to be replaced, shall be completely interchangeable.

4.1.9 The GIS interface points shall be carefully coordinated with other equipment such as cables, capacitor banks, etc. supplied by other manufacturers in order to ensure full compatibility. The GIS manufacturer shall also specify the dimension and mounting details, weight, etc., of the spring / bellow used between GIS busduct termination with GIS termination. The surge impedance of GIS to cable termination shall be reduced by suitable construction / arrangement of GIS module. The surge impedance values for all GIS modules shall be furnished by vendor.

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

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

4.1.12 Each module of switchgear, consisting of individual elements intended to be directly connected together, shall be constructed as a transportable assembly suitable for shipping and transportation without being dismantled. Dry nitrogen gas filling shall be used during transportation instead of SF6.

4.1.13 All new gaskets, sealants and desiccants for permanent sealing of all field joints and all access covers, removed during assembly, shall also be provided.

4.1.14 The Bus and all current carrying parts shall be made of Aluminium alloy. In certain specific requirements electrolytic copper may be provided. All interconnecting sections of current transferring parts shall be silver-plated. Joints and couplings between dissimilar metals shall be avoided to prevent galvanic corrosion.

4.1.15 All supporting steel work shall be hot dip galvanised. All welding in GIS shall confirm to the applicable codes and standards.

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4.1.16

A partition separating a compartment filled with insulating gas from a neighbouring compartment such as a cable box, filled with liquid, shall not show any leakage affecting the dielectric properties of the two media.

4.1.17

All piping for SF6 gas, hydraulic and pneumatic operating mechanism including their fittings shall be made of copper, brass or stainless steel.

4.1.18

All external connectors and terminal pads shall be made of aluminium or copper with tin-plating.

4.1.19

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.

4.1.20

GIS modules shall have gas tight barrier insulator partitions such that fault in one compartment will not affect the normal operation of the adjacent compartment. The selection shall be designed:

a)

To minimize operation shutdown when the gas pressure is reduced due to leakage or for maintenance purpose.

b)

To minimize the quantity of gas that has to be evacuated and recharged before and after maintaining any item of equipment.

c)

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

4.1.21

In the event of arcing in compartment the arc should not extend to neighbouring compartment. Any failure to the enclosure of compartment shall not lead to damages in neighbouring compartment. In view of this continuous busbar without gas segregation is not acceptable.

4.2

RATINGS

4.2.1

The specific ratings of the GIS equipment shall be as specified in the Data Sheet or key single line diagram attached with this specification.

4.2.2

The switchgear shall be capable of carrying the specified rated current continuously at the specified ambient conditions in Data Sheet, without temperature rise of various parts exceeding the limits stated in IEC 60694 or equivalent ANSI standards. The maximum temperature of the external surfaces shall be 70°C as per IEEE C37.122.

4.2.3

The switchgear and its associated apparatus shall produce minimum noise during service. The maximum noise level shall be indicated by the manufacturer and be subject to approval by the purchaser.

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4.2.4

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. Any sub assembly containing components with permitted partial discharge intensity greater than 5 pC shall be considered acceptable if the discharge level does not exceed 10 pC.

4.2.5

The insulation level requirements shall be as specified in IEC 62271-203.

4.3

GIS Enclosure

4.3.1

The GIS shall be three-phase enclosure type.

4.3.2

The enclosure shall be capable of sustaining without damage to all mechanical, electrical and thermal shocks that may occur in service during normal and fault conditions, including pressure effects of internal fault arc current of specified short circuit level and time. The enclosure assembly, material and design shall be such as to minimize induced electrical losses and heating effects which could occur in service under normal and fault conditions.

4.3.3

The creation of single gas zone for single phase type GIS enclosures by external piping connection between the phases is not acceptable. Also, external piping connection (with normally open valve) to create common gas zone (between same phase) in single phase type GIS is not acceptable.

4.3.4

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.

4.3.5

The enclosure shall be designed to withstand internal fault at the rated short circuit current level and consequent pressure for a period specified in Data Sheet without a burn through.

4.3.6

The GIS enclosures shall have a minimum burn-through time greater than the back-up clearance time, if rupture disc/pressure relief device is provided. The burn-through time shall be in accordance with IS/IEC 62271-203. GIS manufacturer has to furnish pressure rise curve in support of minimum burn-through time along with test report for internal arc withstand.

4.3.7

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.

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4.3.8 The construction and thickness of the GIS enclosure shall conform to ANSI/ASME Boiler and Pressure Vessel Code and ANSI/ASME B31.1, CENELEC EN 50052 & EN 50064 or equivalent. 4.3.9 For enclosures and parts thereof, the strength of which has not been fully determined by calculation, proof tests as per the applicable standards shall be performed to demonstrate that they fulfil the requirements. 4.3.10 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. 4.3.11 The exterior surface finish of the enclosure shall be finalized in agreement with the Purchaser. The actual colour shade shall be based on the end user's requirement. The protective finish shall prevent deterioration due to corrosion, humidity, temperature, ageing due to weather, attack from fungus or rodents for minimum of five years. 4.3.12 SF6 Gas monitoring and service piping including all fittings and accessories shall be of copper, brass or stainless steel. 4.3.13 The degree of protection for all terminal boxes, operating mechanism enclosure, control cabinets, auxiliary equipment enclosures and all accessories shall be IP 42 for Indoor application. 4.4 GIS Gas Sections 4.4.1 The GIS shall be divided into compartments separated by gas barriers. The gas barriers shall be suitably identified on the outside of the GIS. 4.4.2 Long bus runs shall be sectionalized into a number of gas compartments such that failure in any gas section does not affect the adjacent gas sections. 4.4.3 The GIS module design shall be such as to minimize the quantity of gas that has to be evacuated and then recharged before and after carrying out maintenance. Cable box where cable-sealing end is installed shall have its own independent gas compartment, with gas monitoring. 4.4.4 Gas compartments shall be designed in such a way that voltage transformers can be easily removed without degassing any of the busbar compartments.		
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4.4.5 Compartmentalisation shall be provided for circuit breaker, Busbar, Current transformer, Voltage transformer, Surge arrester, Disconnecter along with Earthing switch and Cable sealing end.

4.4.6 The material shall be chosen, and the parts designed such that they retard the propagation of any flame resulting from accidental overheating in the switchgear and control gear.

4.4.7 The gas section barriers shall be capable of withstanding the differential pressure due to full vacuum on one side and 1.5 times rated gas absolute pressure on the other side.

4.5 SF6 Gas System and associated Devices

The SF6 gas shall conform to IEC 60376 and IEC 60480.

4.5.1 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.

4.5.2 The GIS shall be fully gas tight. The sealing system shall also effectively ensure against the ingress of moisture, dust and other contaminants into gas compartments. Double 'O' ring design be adopted to ensure gas tightness. All gas compartments shall contain suitable agent to absorb moisture and any other decomposition products of SF6 gas.

4.5.3 SF6 gas relative leakage rate of each gas compartment shall not exceed 0.5% per year.

4.5.4 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.

4.5.5 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.

4.5.6 Sensors shall be provided in the GIS enclosure to detect the internal arc flash.

4.5.7 SF6 gas in each individual compartment shall be monitored by suitable temperature-compensated pressure gauges and two stage temperature

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compensated pressure (gas-density continuous monitoring) switches/ relays to monitor the loss of SF6 gas. The dial of the pressure gauges shall be graduated to read pressures and coloured green, yellow and red to indicate normal, Alarm Stage I and Alarm Stage II pressure conditions.

4.5.8 Gas-density monitor shall be readable from the ground. Potential-free auxiliary contacts for two-stage alarm initiation shall be provided. These alarm contacts shall be wired to the annunciator in the respective GIS bay control panel.

4.5.9 SF6 gas density monitor switch shall be provided in each gas compartment (each phase, if phase segregated). Separate gas density monitor switch shall be provided for each equipment compartment including but not limited to Circuit Breaker, Current Transformer, Voltage Transformer, Surge Arrester, Isolator (separate monitor for bus bar and bus Isolator) & Earth Switch etc (for each compartment). Combined Gas Density monitors shall not be acceptable in any case.

4.5.10 The dial of the pressure gauges shall be graduated to read pressures to indicate normal and different alarm pressure conditions. Gas-density monitor shall be readable from the ground. Potential-free auxiliary contacts for alarm initiation shall be provided. These alarm contacts shall be wired to the annunciator in the respective GIS bay control panel.

4.5.11 For circuit breaker: The gas-density monitors shall be capable of being calibrated with the monitored equipment in service. If the gas-density monitor has a visual indicator, it shall be readable from the ground. Each relay shall be provided with two convertible (NO and NC) potential-free auxiliary contacts for two-stage alarm initiation as mentioned below. These alarm contacts shall be wired to the annunciator in the respective GIS bay control panel.

(a) "Gas Refill" Level (for all compartments)

This will be used to annunciate the need for gas refilling. Two sets of potential free contacts for remote indication/ annunciation shall be provided.

(b) "SF6 Low or Zone Trip" Level (for all compartments)

This is the minimum gas density at which the manufacturer will guarantee the insulation rating of assembly. At this level the device contact shall trip the adjacent connected breaker. Two sets of potential free contacts for remote indication/ annunciation shall be provided.

(c) "Breaker Block" Level (for CB compartments only)

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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 shall block the closing and trip operations. Two sets of potential free contacts for remote indication/ annunciation shall be provided.

(d) "Over pressure" alarm level (for all compartments)

This alarm level shall be provided to indicate abnormal high pressure rise in the gas compartment. Two sets of potential free contacts for remote indication/ annunciation shall be provided.

4.5.12 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.

4.5.13 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.

4.5.14 It shall be possible to test and replace each pressure gauge and the density switch/relay with the GIS in service.

4.5.15 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.

4.5.16 Gas leakage detectors of an approved type shall be provided.

4.5.17 It shall be possible to test all gas monitoring relays/devices without de-energizing the primary equipment & without reducing pressure in the main section. Plugs & sockets shall be used for test purposes. It shall also damp the pressure pulsation while filling the gas in service, so that flickering of the pressure switch contacts does not take place.

4.5.18 The gas pressure of each compartment shall be able to be monitored remotely from SCADA. The system shall have the facility to pinpoint the exact gas module in the bay where gas leakage problem is there.

4.5.19 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 equipment. Provision for disconnection of gas pipelines shall be incorporated. 100µm or smaller sintered stainless-steel particle

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filter disk, suitable for pressure involved, shall be installed at the gas service connection. 4.5.20 Filters shall be inserted in all the gas compartments in addition to circuit breaker compartment. Filters for gaseous arc by-products shall be installed before the bursting disc/pressure relief device, so that arcing by-products will be removed in a controlled and filtered way. SF6 gas filters shall be as follows: - For moisture (H₂O): Desiccant material such as Al₂O₃, also called drying agent. The recommended particle size is 2-5 mm. - For gaseous arc by-products: Molecular sieve with a pore size of 4A. Materials used for this purpose should not be regenerated. - For particles (generally dust residues) or solid arc by products: filter to remove particles with a size larger than 1µm. 4.5.21 A coloured diagram showing various gas compartments, piping, interconnections, valves, orifices and isolations to prevent current circulation, necessary controls and monitoring systems etc. together with normal and alarm ranges shall be provided in the drawing holder on the inside of each control cubicle for ease of supervision. 4.5.22 The location of gas barrier insulators shall be clearly and permanently marked on the finished external surface of the GIS enclosures. 4.5.23 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. 4.5.24 The switchgear assembly supply shall include an additional 10% supply of gas complete with containers and monitoring equipment for use during the warranty period. 4.5.25 The total design shall incorporate facilities for SF6 storage adjacent to the installed switchgear assembly. 4.6 Gas Seals 4.6.1 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 shall be provided. 4.6.2 The material for the seals shall be non-deteriorating. 4.7 Support Insulators		
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4.7.1 The support insulators and Gas section barriers/ insulators will be of solid moulded composite, epoxy resin and shall be manufactured from the highest quality material. 4.7.2 All insulators shall be free of partial discharge at a voltage, which is at least 10% greater than the maximum service voltage. A test certificate in this regard, as a proof, shall be furnished. 4.7.3 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. 4.8 Pressure Relief Device / Rupture Discs 4.8.1 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. 4.8.2 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. 4.8.3 Pressure relief devices shall be used for all gas compartment. Automatic external pressure relief devices shall be provided as a precaution against bursting of enclosure. Internal pressure relief devices shall not be acceptable. The bursting pressure of relief devices shall be effectively co-ordinated with the rated gas pressure and the pressure rise due to arcing to avoid any mal operation in normal operating conditions. All gas compartments are to be equipped with rupture diaphragms and if necessary, with gas diverter nozzles are arranged in a way that, if the rupture diaphragm burst, the gas flow is guided away in a direction not unnecessary hazardous to either personnel or equipment. 4.8.4 The pressure relief device or rupture discs shall be located away from gauges, meters, gas filling ports and gas density device calibrating point. 4.8.5 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. 4.9 Expansion or Flexible Connections for Enclosure 4.9.1 The number and position of expansion joints and flexible connections are to be determined by the GIS Manufacturer to ensure that the complete installation will		
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not be subjected to any expansion stresses which could lead to distortion or premature failure of any component of the GIS equipment, support structures or foundations.

4.9.2 The arrangement of assembly offered shall provide adequate access for operation, testing and maintenance of each bay and shall be subjected to approval of Purchaser.

4.10 SF6 Gas Monitoring Devices

4.10.1 All gas compartments must have their own independent and reliable gas supervision alarm system with annunciations as per Clause 7.2.10.

4.10.2 The devices shall be temperature compensated electrically isolated and independently adjustable, dust proof and vibration resistant. Gas monitoring devices shall be capable of being checked with the high-voltage equipment in service.

4.10.3 Two potential free electrical contacts shall be provided exclusively for each of the above alarm/ trip conditions for wiring to supervisory control system. These contacts shall be in addition to those required for local indication and trip and shall be wired to the cable termination blocks in the local control panels.

4.11 Layout of GIS

4.11.1 The layout shall be such that future alterations and extensions can be undertaken in either direction without requiring major shutdown or Bus outage or adjacent bay outage. Manufacturers shall include in their bid detailed plans to describe the process of expansion.

4.11.2 The layout shall also ensure maintenance or removal of a circuit breaker or disconnect switch from a particular bay will not involve removal from service of adjacent bay disconnect switch or main bus sections.

4.11.3 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.

4.11.4 The physical layout shall ensure free movement of the SF6 Gas Cart and easy access to all components of the GIS for maintenance purposes.

4.11.5 The inter-bay width shall be sufficient to allow access to all drive mechanisms and other termination boxes without the need of dismantling the apparatuses.

4.11.6 Sufficient clearances around bushing for cable HV AC testing shall be provided.

4.11.7 Provision of cable testing during fault location and identification without removal of cable/VT, VT isolator to be provided.

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4.11.8 Vendor shall provide the GIS/XLPE cable connection interface drawings and details.

4.12 Partial Discharge (PD) Monitoring system

The On-Line Partial Discharge Monitoring (PDM) System shall consisting of the following major devices:

4.12.1 Devices:

- Sensors/Couplers
- Local Data Acquisition, Monitoring and Analysis System.
- Communication to Remote Data Acquisition, Monitoring and Analysis System (SCADA)
- User Interface Data Display system
- LAN Cabling and associated devices
- Data storage/retrieving system

The PD sensors and all devices of the PD monitoring system shall meet the following minimum requirements. However, any additional requirement necessary for the satisfactory and safe performance of the system shall be deemed to be included in the scope of supply.

- The PD system shall confirm to the applicable requirements of the applicable IEC specifications.
- The PD system shall operate on a safe DC operating voltage derived from the DC 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.
- The PD system sensors or couplers shall be designed not to spark over when open circuited.
- The PD system sensors/couplers shall be free from the Cellular/Radio signal interference and shall not record wrong signals.
- The PD 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.
- The PD sensors/couplers when installed internal to the GIS shall not cause leakage of SF6 gas.

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g) The PD 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.

h) The Data capture resolution time shall be 1ms or less.

i) The Data Storage system shall be capable of storing data up to 30 days.

j) The monitoring system shall be compatible with IEC 61850 and shall be able to communicate via the Internet (TCP/IP protocol), Ethernet/ICCP link.

k) The PD 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.

4.13 BUSBAR ASSEMBLIES

4.13.1 The busbar system shall include plug-in conductor joints and all interconnections, designed to withstand thermal expansions and carry rated normal current and withstand short circuit currents as specified in data sheet.

4.13.2 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.

4.14 Name Plate

4.14.1 GIS and all its operating devices and main components shall be provided with nameplates, as agreed between Vendor and User. The nameplates shall be durable and clearly legible. The individual nameplates of the components can be simplified, provided common information for the GIS is stated on one nameplate. The Vendor shall give information about the total amount of SF6 contained in the GIS installation.

4.15 GIS Earthing

4.15.1 All enclosures of the GIS shall be grounded at several points and connected to ground bus. All conduits and cable sheaths shall also be connected to the ground bus available within the control cubicles and in the marshalling boxes.

4.15.2 The enclosure of the GIS shall be adequately grounded so as to limit the potential difference between individual sections within the allowable limit during faults.

4.15.3 **The earthing system of GIS building must be capable to carry power frequency short circuit currents (earth fault current) and high frequency currents from switching and lightning.**

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4.15.4 Design of the GIS grounding system shall take into consideration of Transient Enclosure Voltage (TEV) generated due to electric breakdown of insulating gas during fault or normal operation.

4.15.5 In addition to TEV, main circuit current shall not induce excessive currents into adjacent frames, structures, reinforcing steel or shall not establish current loops via other station equipment.

Each marshalling box, local control cubicle, power and control cable sheaths and other noncurrent carrying metallic structures shall be connected to the grounding system of GIS via connections that are separated from GIS enclosures.

5.0 GIS SWITCHGEAR

5.1 Circuit Breakers

5.1.1 The circuit breakers shall meet the following requirements:

- Rated normal current of the Busbars and Feeders at the rated Voltage as stated in the single line diagram.
- Duration of short circuit withstand current as **stated in Data Sheet.**
- Capability for three pole auto-reclosing without replenishment of stored Energy as a minimum. The rated operating duty cycle sequence shall be as follows:
O - 0.3 secs. - CO - 3 min – CO
- The maximum interrupting time at the minimum operating SF6 pressure of the mechanism shall not exceed 3 cycles (60 ms-50 Hz systems) for Circuit Breakers up to 245 kV class.**
- The Circuit Breakers shall have a First Pole to Clear factor of 1.5.**
- The total interrupting time at all currents less than the rated short circuit interrupting current shall not exceed the rated maximum interrupting time. Restrikes shall not occur under any mode of interruption.
- Rated small inductive current breaking: The value shall be assigned by the GIS Manufacturer having regard to the ratings and characteristics of the associated transformers/reactors and shall be supported by test reports, which shall be submitted with the bid.
- The circuit breakers shall be of double interrupter design (2 breaks in series per pole) for 40 kAIC and can be of single interrupter design up to 40 kAIC and lower subject to satisfactory operation of the Circuit Breaker for Short Line Faults and Terminal Faults Test duties without the need of external devices.**

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i) 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.

j) However, Voltage grading capacitors may be used across contacts for double interrupter designs for 40kAIC Circuit Breakers.

k) The breaker shall be self-blast / auto puffer type principle and consisting of one interrupting arcing chamber. Circuit breaker must be in the independent gas compartment & no other equipment (CT/DS/ES) shall be accommodate inside CB compartment.

l) Breaker disposition must be horizontal to provide higher mechanical stability and ease in maintenance. The operating principle of breaker shall ensure minimized dynamic floor loading.

m) Single pole type circuit breakers with individual operating mechanism shall be provided with pole-discrepancy protection with time delay for tripping both trip coils (1st stage) and adjacent breakers (2nd stage) in case of discrepancy.

n) Single pole type circuit breakers with individual operating mechanism shall have capability for 1-Phase and/or 3-phase auto-reclosing requirement to meet the operating duty cycle.

o) In addition, the circuit breaker shall comply with the following requirements as specified in IEC 62271-203, IEC 62271-100 and IEC 60694.

- i) Rated Frequency
- ii) Rated Transient Recovery Voltage (TRV) for terminal faults and Short line faults.
- iii) Rated short circuit making current (at 50 Hz)
- iv) Rated characteristics for short line faults.
- v) Rated out-of-phase breaking current.
- vi) Rated capacitive current switching.
- vii) Rated Power Frequency withstand Voltage.

5.1.2 Switching Performance Requirements

The breakers shall be capable of:

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a) Circuit breakers installed close to large generating plant or controlling very long transmission Lines will be subjected to fault currents which may have delayed or no zero crossing for a considerable number of cycles due to a high X/R ratio of the system. The GIS Manufacturer shall propose a suitable Circuit Breaker which can mitigate the high reactive component to achieve the opening of the Circuit Breaker at current zero within the normal operating time of the breaker. The methods of demonstrating satisfactory conformance to this requirement shall be mutually agreed between the Purchaser and the Contractor.

b) Purchaser shall furnish the Network parameters for the delayed zero passage condition, if applicable to the GIS Manufacturer after award of Contract. The GIS manufacturer shall prove by calculations and by factory tests that the Circuit Breaker can safely interrupt the fault without restrikes.

c) Switching off unloaded overhead lines.

d) Switching unloaded transformers without exceeding specified over voltages.

e) Cable Switching

There shall be no restrike across the main contacts when breaking capacitive or cable charging currents upto a value specified in IEC 62271-203 and IEC 60694.

5.1.3 Interrupter Contacts

a) Main contacts shall have ample area and contact pressure for carrying the rated current and the short time rated current of the breaker without exceeding guaranteed temperature rise.

b) Positive mechanism interconnection shall be provided between interrupting contacts, resistor switches (when used), blast valve mechanism, if any, to ensure maximum operating reliability.

c) Where two breaks per pole interrupters are used, these shall be so designed that a fairly uniform voltage distribution is developed across them. Grading capacitors across contacts may be used only to have a uniform voltage gradient across the contacts.

5.1.4 Operating Mechanism

Operating mechanism shall have following features:

a) Circuit breakers shall be operated by Spring or Hydraulic-Spring or hydraulic or pneumatic mechanism. Each mechanism shall be provided with its own monitoring gauges and accessories. In addition, provision for manual operation shall also be made.

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b) Operating mechanism shall normally be operated by remote electrical control. Electrical tripping shall be performed by shunt trip coils. Provision shall be made for local electrical control.

c) A local manual closing device shall also be provided for maintenance purpose. Direction of motion of handle shall be clearly and indelibly marked.

d) Circuit breakers shall have high repeatability of closing time over a wide range of parameters (ambient, temperature, hydraulic pressure, control voltages etc.). The time difference between first and last pole, for opening or closing shall be as follows:

i. Closing: Less than 5 msecs (50Hz)

ii. Opening: Less than 3 msecs (50Hz)

e) Operating mechanism shall be suitable for Auto reclosing. It shall be non-pumping electrically and mechanically under every method of closing (except during manual closing of a breaker for maintenance). A latch checking switch shall be provided on mechanically trip free mechanisms to prevent reclosure before the breaker latches have reset.

f) Have two electrically independent trip coils and one close coil. The tripping mechanism shall function correctly when either one or both the trip coils are energised. The close and trip coils shall be rated for the DC voltage indicated in Data Sheet and shall operate satisfactorily at the designed temperature for voltage ranges between 85% to 110% rated voltage for closing coil and 70% to 110% for tripping coils. However, in some specific cases the trip coil may be required to operate with a different voltage range.

g) A mechanical indicator shall be provided to indicate open and closed positions at a location from where it will be visible to a person standing on the floor. An operation counter shall also be provided. Separate counter shall be provided on each phase for a segregated system.

h) The circuit breaker mechanism shall be mechanically trip free. The Circuit Breaker shall also be provided with an Anti-pumping feature.

i) Working parts of the mechanism shall be of corrosion resisting material. Bearings which require grease shall be equipped with pressure type grease fitting. Bearing pin, bolts, nuts and other parts shall be adequately pinned or locked to prevent loosening or changing of adjustment with repeated operation of the breaker.

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j) Provision shall be made for attaching an operation analyser to perform CB timing tests after installation of the breakers.

k) Interlocks and/or blocking device shall be provided to prevent hunting and dangerous or undesirable operations of the circuit breaker. The interlock arrangements shall include but not be limited to the following:

5.1.6.1 Spring and Hydraulic-Spring Operated Mechanism

a) The operating mechanism shall be motor-compressed spring-operated, or hydraulic/hydraulic-spring charged. Single pole circuit breaker employing single-pole operating mechanism shall be electrically coupled for synchronous three-pole operation.

b) Motor-compressed spring-operated mechanism shall employ a motor for the rated AC/DC Voltage for spring charging. The energy storage of a motor compressed spring-operated circuit breaker shall be sufficient for an open-close-open operation without replenishing the stored energy. Means shall be provided to prevent overcharging of spring. Mechanical indication of spring(s) for both "charged" and "discharged" states shall be provided. Provision for manual spring charging shall be provided, which shall automatically cut-off the power supply to the motor during manual charging.

c) Spring charging motors shall be suitable for operation at any voltages between 85% and 110% of rated auxiliary voltage.

d) The capacity of energy storage facilities that are integral part of the hydraulic/hydraulic-spring operating mechanism shall be sufficient to permit at least full rated duty cycle of the breaker without replenishing the stored energy. A hydraulic pressure gauge shall also be provided. Oil used in the hydraulic/hydraulic-spring mechanism shall be free of PCB shall also be provided.

e) Closing action of circuit breaker shall compress the opening spring ready for tripping.

f) When closing springs are discharged after closing a breaker, closing springs shall automatically be charged for the next operation and an indication of this shall be provided in the local control cabinet & HMI/SAS.

g) Provisions shall be made to prevent a closing operation of the breaker when the spring is in the partial charged condition.

h) Mechanical interlocks shall be provided in the operating mechanism to prevent discharging of closing springs when the breaker is in the closed position.

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5.1.6.2 Hydraulic Operated Mechanism

a) Hydraulic operated mechanism shall comprise of self- contained operating unit with power cylinder, control valves, high and low pressure reservoir, motor etc. In case of Auxiliary Power failure, provision for manual charging shall also be provided for emergency operation. The manual operation shall be interlocked with auto-operation by blocking it to ensure safety to the operator.

b) The oil pressure switch controlling the oil pump and pressure in the high-pressure reservoir shall have adequate no. of spare contacts, for continuous monitoring of low pressure, high pressure etc. at switchyard control room.

c) The Design shall be such that it shall be possible to perform at least two close-open operations after failure of AC supply to the motor.

d) The mechanism shall be capable of operating the circuit breaker correctly and performing the duty cycle specified under all conditions with the pressure of hydraulic operated fluid in the operating mechanism at the lowest permissible pressure before make up.

e) Trip lockout shall be provided to prevent operations of the circuit breaker below the minimum specified hydraulic pressure. Alarm contacts for loss of Nitrogen shall also be provided.

f) All hydraulic joints shall have no oil leakage under the site conditions and joints shall be tested at factory against oil leakage.

5.2 DISCONNECT SWITCHES AND GROUND SWITCHES

5.2.1 The disconnect and grounding switch shall be Motorized, three (3) pole gang operated, no-load break, single stroke type, and shall generally comply with the requirements of IEC-62271-102.

5.2.2 The disconnect switch shall fully comply with the specified requirements of insulation level for the isolating distance as stated in IEC 60694.

5.2.3 The disconnect switch shall be capable of interrupting rated capacitive currents originating from switching busbars, busducts and very short lengths of cable and inductive currents as specified in the data schedule per IEC 60129.

5.2.4 The busbar side disconnect switches shall be capable of switching rated Bus-Transfer switching currents (Bus side Disconnects of each bay for Double Bus schemes) as per IEC 62271-102.

5.2.5 The disconnect switches shall be equipped with adjustable, self-aligning, high pressure type silver-faced copper contacts. The contacts shall be capable of

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carrying full rated and short circuit currents without over heating or welding. Contact design shall be such that no shunt current shall flow through the contact springs.

5.2.6 Grounding switches shall be high-speed type for all feeders and maintenance type for bay grounding. Maintenance type Bus Grounding switches shall be provided for each bus of the GIS.

5.2.7 The grounding switches shall be equipped with snap spring-operated high-speed operating mechanism with provision for manual operation.

5.2.8 Continuous current rating of the High-speed grounding switches shall be specified by the manufacturer, which can be safely injected for Bay/ Bus equipment testing.

5.2.9 The High-speed grounding switches shall be fitted with a stored energy closing system to provide fault making capacity.

5.2.10 The switches shall have inductive/ capacitive current switching capacity as per applicable standard.

5.2.11 Termination point grounding switches shall be capable of closing against the rated short circuit making current of the switchgear. All grounding switches shall have the same short time current rating as that of the switchgear.

5.2.12 In all grounding switches, the ground connection of each phase shall be isolated from the ground connection of the other phases and from the switchgear enclosure, and brought out through an insulated bushing, rated 10kV minimum. Direct connection to ground shall be via a removable grounding strap. The current rating of the removable grounding strap shall be equal to that of the grounding switch.

5.2.13 The line grounding switches installed at each termination point of GIS shall be capable of breaking the induced capacitive and inductive currents per IEC 62271-102 (Class B) considering the transient recovery switching duty imposed on the ground switch.

5.2.14 All disconnect and grounding switches shall be equipped with local as well as remote controlled power-operated mechanism. An emergency manual operating device shall also be provided. DC power supply to the mechanism shall be automatically disconnected and local/remote electrical operation shall be prevented when manual operating device is engaged. The power to disconnect and grounding switch in the enclosure shall be transmitted via gas-sealed pressure-resistant shaft glands. Once initiated, the motor mechanism shall

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complete an open or close operation without requiring the initiating contact to be held closed.

5.2.15 All disconnect and grounding switches shall have mechanical position indicators for the main contact movements, directly coupled to the driving shaft and clearly visible from outside.

5.2.16 Inspection windows/endoscopy ports shall be provided in the housing of each disconnect and grounding switch to ensure isolating distance or gap by observing the position of each movable contact. The inspection viewports shall have removable covers to prevent damage of the actual viewport due to external elements. Access to viewports/endoscopy ports shall be convenient. A warning plate (green or white background with black lettering) shall be installed near each viewport/endoscopy port to warn (with words: WARNING-- DO NOT LOOK INTO THE VIEWPORT DURING SWITCHING OPERATION. ARCING MAY DAMAGE YOUR EYES) of possible danger when viewing the interior during switching operation. The area around the viewport/endoscopy port shall be painted a distinctive colour as a warning (orange or yellow).

5.2.17 Anti-condensation heaters shall be provided within the housing of each motor driven operating mechanism.

5.2.18 Interlocks

- Electrical and Mechanical interlocks shall be provided for absolute and positive protection against potentially harmful mal operations of the switchgear. Electrical interlocking shall be fail-safe type. Consultant or Owner's requirement shall be also taken while finalizing scheme.
- Disconnect Switch and Grounding switch shall be mechanically interlocked such that it will not be possible to close the Grounding switch when the Disconnect Switch is closed or vice-versa.
- Disconnect Switch shall be provided with electrical interlocking feature. This shall be in the form of bolt interlock comprising an interlock coil of latch-in type to lock the Disconnect Switch driving shaft and hence prevent Disconnect Switch operation in the latch-in condition. It shall be possible to release the latch by energising the interlock coil only when all the conditions of safe operations are satisfied. Facilities shall be provided for wiring Purchaser's external interlocks in Disconnect Switch opening and closing circuits for this purpose.

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d) Crank handle insert shall prevent the operation of isolator & earth switch within the entire bay. Crank handle inserted alarm to be annunciated in local and remote.

5.2.19 Short Circuit Withstand Capacity

a) The rated peak short-circuit current or the rated short time current carried by an Disconnect Switch or **Grounding switch for the rated maximum duration of short circuit shall not cause:**

- i. Mechanical damage to any part of the Disconnect Switch or Grounding switch.
- ii. Separation of the contacts or contact welding.
- iii. Excessive temperature rise which is likely to damage insulation.

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

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

5.2.20 Auxiliary Switches

a) Each circuit breaker, disconnecter and grounding switch shall be provided with mechanically direct driven auxiliary switches. These auxiliary switches shall be provided with minimum six (6) normally open (NO) and six (6) normally closed (NC) Directly driven spare auxiliary potential-free contacts and six (6) normally open (NO) and six (6) normally closed (NC) multiplied spare potential free contacts in addition to those required for the operating mechanism control and indications, protection and interlocks with other equipment. For bus side Disconnectors suitable for bus transfer duty, early make late break type contacts shall be provided for bus bar differential protection.

b) Auxiliary switches shall be rated for 10A DC 110 volts. Adequate number of Auxiliary switch contacts (Directly driven and multiplied) shall be provided.

c) Directly operated, electrically separate, reversible and adjustable type auxiliary switches shall be provided on breakers, disconnect switches and ground switches in quantities as required for the Project.

d) All tripping and interlocking schemes shall use directly driven contacts of the Circuit Breaker, Disconnect and ground switches.

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e) Alarm, trip and spare contacts from operating mechanism shall be wired to the local control panels. Alarm and trip contacts to be used for Remote Control panel should be connected to terminal blocks.

f) 10 % Spare Auxiliary contacts completely wired up to the Terminal blocks in Local Control Panel shall be provided.

5.3 Instrument Transformers

5.3.1 General Requirements

a) Terminal and polarity marks shall be indelibly marked on each VT & CT on the associated terminals and these marks shall be in accordance with relevant standards and as per Owner's requirement.

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

c) Provision shall be made for primary injection testing either within CT or outside.

d) There should be facility to mount current transformer on either side of circuit breaker.

e) Secondary terminals of each voltage and current transformer shall be brought out in a weather-proof local control cabinet. Facilities shall be provided at the control cabinet for isolation and testing of CT secondaries. The design of isolated phase type CT's shall protect them from effects of enclosure current. Facility shall be provided for shorting and Grounding the CT secondary at the terminal box. The star point, whenever required, shall be formed at the terminal box only.

f) Voltage and current transformers shall be provided with the following accessories:

i) Two Grounding terminals for connecting the specified size of Grounding conductor.

ii) Terminals for Tan Delta measurement. These terminals under service conditions shall be connected to Grounding by means of links.

5.3.2 Voltage Transformers

All Voltage Transformers shall conform to IEC 60044-2 in general

a) Voltage transformers shall be of single core type the metal enclosed gas insulated electro-magnetic mounted directly on the high voltage enclosure with

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plug in contacts that allow easy removal. The VTs shall be 5 limb type or 3- Single phase units in case of a common 3 phase enclosure.

- b) Minimum accuracy, burden and transient response characteristics shall be as specified in the single line diagram.
- c) In case of Grounded voltage transformers, the end of the primary winding intended to be grounded shall be brought out through a bushing and Grounding connection shall be made outside.
- d) The secondary terminal box for the voltage transformers shall also include necessary HRC fuses/ MCBs (Preferable MCBs) for protecting the secondary circuit. Further, for the purpose of fuse supervision both terminals of fuse shall be brought out to the terminal box. MCBs shall be provided with auxiliary contacts for interlocking, Trip and alarm purposes.
- e) Whenever a VT secondary winding is used for both measurement and protection application it shall have dual accuracy class of 0.5/3P, unless otherwise specified. However, for revenue class metering applications the accuracy class shall be 0.2S for that core.
- f) VT secondaries shall have extended Voltage tap wherever required for the purposes of synchronizing.
- g) The Voltage Transformer shall be so designed to avoid ferroresonance effects and shall be provided with adequate ferroresonance-suppressor (if required) on the secondary windings. An electrostatic shield shall be employed between the windings of VT to prevent coupling of the transients generated in the GIS high voltage conductors with the control wires.
- h) Voltage Transformers shall not be mounted on the same compartment/Gas section as the Cable Feeder termination compartment in order to test the Cable feeder independent of the Voltage Transformer.
- i) All GIS electromagnetic Voltage Transformers shall have primary isolation device manually operated and monitored at local (LCC) and remote (control room) on the mimic diagrams.

5.3.3 Current Transformers

- a) Number and location of CTs.
 - i) The ratio, burden, accuracy class, knee point voltage etc. shall be provided as specified in the single line diagram. CTs and PTs adequacy check shall be done based on the connected relaying and instrumentation load.

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ii) The physical relative location of core in the CTs should be in accordance with the locations shown in single line diagrams enclosed with the Tender enquiry to ensure over lapping of protective zones.

b) Minimum Accuracy for Relaying Cores

All Current Transformer cores shall conform to IEC 60044-1 in general and IEC 60044-6 for Transient Protection Class CTs.

i) Accuracy Class 5P20, Class PS etc and class 0.2/0.2S for revenue metering as required shall be provided as specified in the single line diagram.

ii) Current Transformers may be single/dual/Multi Ratio type (MRCT) as specified in the Relaying and Metering Single Line diagram.

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

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

v) All CT cores shall be of low reactance type.

vi) No turns compensation shall be used in case of Class PS CTs. Turns compensation, if any, shall be clearly brought out in the Bid in Data Sheet.

vii) In case of multi-ratio CTs, the minimum specified requirements in respect of VA, accuracy and Knee Point Voltage (V_{kp}) and maximum secondary resistance shall be applicable at the taps underlined in relevant drawings enclosed with the Tender.

viii) Magnetizing characteristics (extending well beyond V_{kp}) and secondary impedance values shall be furnished in Data Sheet for all protection cores.

5.4 GIS Surge Arresters

5.4.1 SF6 Insulated GIS Surge arresters shall be provided in the switchgear equipment for limiting any system transient voltages during switching and/or fault conditions in the system. The location of the surge arrester shall be in accordance to the single line diagram. The surge arresters shall fully comply with IEC-60099-4 as applicable and as noted in this specification.

5.4.2 The surge arresters shall be housed in enclosures mechanically separated from the other GIS parts by means of a gas barrier insulator. Each single-phase surge arrester and enclosure shall be treated as a single gas-monitoring zone.

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5.4.3

The base plate of the enclosure shall be provided with a bushing type facility to permit leakage current measurements and the addition of discharge counters for purpose of monitoring the frequency of discharges.

6.0

GIS TERMINATIONS

The following type of terminations shall be made, as applicable where SF6 Gas Bus duct directly connect the feeders provided in the GIS with the external Cables, Power Transformers etc.

6.1

Sealing end box for GIS to XLPE Cable Termination

a)

Suitable SF6 gas-filled cable sealing end boxes shall be provided, where required, for accommodating XLPE or LPOF single core copper cable terminations. The boxes shall be designed to accept the cable along with its terminations cone from below. The scope shall also include necessary cable supports and cable grounding facilities.

b)

Necessary data about the power cables required for designing/supplying suitable cable terminations are as specified in Data Sheet. All cable terminations of LPOF cables shall be located outside the substation building.

c)

The cable connections shall generally comply with IEC 60859.

d)

The SF6-to-XLPE Cable at the power cable pothead termination shall allow for power cable disconnection from the gas-insulated bus through a removable link and provide means to permit High Voltage AC field testing of the cable.

e)

Effective and long-life gas-tight seals shall be provided between the cable sealing end and the cable termination enclosure. It shall be possible to accommodate high voltage cables of all types upto 1000mm² conductor cross-sections at the cable end terminations.

f)

The design of the cable termination shall allow plugging and unplugging the EHV cable without need of opening the GIS and without any gas work or minimum work.

g)

All the GIS apertures intended for future cable terminations shall be sealed with effective cover plates to safeguard against SF6 leakage.

h)

Wherever necessary the cable enclosure and support structure shall be equipped with means for isolating the cable sheath to provide cathodic protection of the cable system per IEC 60859.

i)

SF6 Gas Pressure Switch shall be provided for monitoring.

7.0

LOCAL CONTROL PANELS AND MECHANISM CABINETS

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7.1

General

7.1.1

General features shall be as follows:

a)

Control panel shall be dead back type, sheet steel enclosed with degree of protection of IP 41 suitable for mounting close to the wall. Sheet steel used shall be cold rolled and at least 2.0 mm thick. Door shall have key locking facility or provision for padlocking.

b)

All control equipment shall be suitable for operating in an ambient temperature varying between 0°C and + 45°C. For Outdoor installations the ambient temperature variation shall be between –5°C to + 60°C with a Relative Humidity of 100%.

c)

A Ground bar for terminating the Ground wires of shielded control cables shall be located near the cable entry location.

d)

All control Panels and Marshalling Cabinets shall be provided with Ant-Condensation heaters which are thermostatically controlled. These Heaters shall operate on 1-phase, 240 V AC The thermostat controlled heaters, shall be provided complete with rotary type ON/OFF switch, HRC fuses or single pole MCB with overload and short circuit protection, link on neutral Provision for monitoring of heater failure shall be provided for all heaters.

e)

A compact fluorescent lighting or LED fixture with door switch and one 6 pin 240V AC, 5/15 A Duplex receptacle shall be provided in each cabinet.

f)

The accessories and auxiliary equipment required for the correct functioning of each circuit element shall be installed in conveniently located mechanism cabinet (s).

g)

The paint shade shall be as per attached painting specification.

h)

Terminal blocks of approved type shall be provided. The terminal blocks shall be of Phoenix make, Type OTTA-6 or Weidmuller make or equivalent. Terminal wiring shall be accessible from the front side of the panel.

7.2

Local Control Panel

7.2.1

Individual local control panels for each circuit shall be supplied to facilitate local control of circuit breakers, disconnects and Ground switches. These panels shall also house the various relays, timers etc. to realize specified interlock requirement among circuit breakers, disconnects and Ground switches. The contacts, signals and conditions originating from/ going to the switchgear, associated auxiliary, monitoring equipment and CT/VT wiring from the terminal boxes shall be wired up to the local control panels.

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7.2.2

Completely separate and isolated circuit shall be used for operating mechanism control, tripping alarms and auxiliary devices. CLOSE and TRIP circuits shall be kept isolated to their final mechanical or electrical actuators. Trip circuits shall have individual monitoring facilities.

7.2.3

Low Voltage AC/DC Switches/ MCBs

- Switches/MCBs shall be hand operated, air break, heavy duty, quick make, quick break type conforming to applicable clauses of IEC 60947-1 & 2. and IEC 60439.
- Switch handle shall have provision for locking in both fully open and fully closed positions. MCBs shall preferably be provided with suitable locking facility.
- Single throw isolating switches for complete isolation of the DC control circuits shall be provided.

Control switches shall be of the rotary type provided with properly designated escutcheon plates clearly marked to show the operating positions. Control switches shall have momentary contacts, spring return to normal, with pistol grip handle. Selector switches shall have stay put contacts with oval handles. The local/remote selector switch shall be lockable in both positions. The number of contacts and their operation in each switch position shall be as per the requirements of the connected circuit. The switches shall be rated for minimum 10 A at 240 AC and 1 A inductive break at specified DC voltage.

7.2.4

Control & Auxiliary Power Supply

- For alarm, auxiliary devices, annunciation and indication, separate control supply feeder shall be provided by the Purchaser to each Local Control Panel.
- All control equipment shall be suitable for operation on specified DC system.
- Separate circuits with switches, fuses, etc. of adequate rating shall be provided for control of space heater, lighting and power receptacle. These shall be on 240 V, single phase AC supply, unless specified otherwise.
- AC and DC power supply shall be such that isolation of individual equipment is possible.
- AC & DC auxiliary supply to be supervised and any failure of the same to be annunciate in local & potential free contacts to be provided for remote monitoring.

7.2.5

Relays

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a) Relays for various controls, monitoring and blocking functions of particular circuit element shall be of Numerical type design installed in associated local control panel.

b) Necessary auxiliary relays for alarm, time-delay relays, voltage relays as required for control and protection shall be mounted inside the local control panel. Voltage operated relays shall have sufficient thermal capacity for continuous energisation,

c) Auxiliary relays shall be rated to operate satisfactorily between 80% and 110% of the specified rated voltage.

d) Each relay shall be provided with at least 2 NO and 2 NC potential free contacts, wired up to terminals for Customer's use.

e) Coils of all the relays shall be adequately rated to avoid spurious operation of relays on DC system ground or induced surges.

f) All relays shall be tropicalised and shall be suitable for design ambient temperature of 45 C.

g) Make and type of relay shall be subject to approval of the Purchaser.

h) Relays trip contacts connected for trip circuit shall have the making capacity of 30 amp for 0.2 seconds with an inductive load of L/R > 10 mill seconds. Bidder to submit the relay catalogue for approval.

i) Contact multiplication relays shall be provided for Gas Monitoring, Pole Discrepancy and if any alarms.

j) Electrically reset latch type trip relay shall be provided for SF6 Gas low zone trip stage. The operating time of the same shall not be more than 10 milliseconds. Provision for reset from remote to be provided.

k) Protections and metering shall be as per protection and Metering Single Line Diagram.

7.2.6 Push Buttons

All push buttons shall be of push to actuate type having 2 NO and 2 NC self-reset contacts. They shall be provided with integral escutcheon plates, engraved with functions. Push button contacts shall be rated for 10A at 240V AC and 1 A inductive breaking at specified DC voltage.

7.2.7 Indicating Lamps

Cluster LED type indicating lamps shall be provided.

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7.2.8 Internal Wiring

a) Cabinets/Panels shall be supplied completely wired ready for external connections at the terminal blocks. All wiring shall be carried out with wires of 600V grade, stranded copper conductors. The insulation shall be halogen free and flame retardant. Power circuits shall be wired with stranded copper conductors of adequate sizes to suit the rated current and the minimum size shall be 4 sq.mm. Unless otherwise specified, control alarm and indication circuits shall be wired with stranded, tinned copper conductors of sizes not smaller than 1.5 sq.mm. CT and VT circuits shall be wired with stranded copper conductor of size, not smaller than 2.5 sq.mm.

b) Engraved identification ferrules marked to correspond with the wiring diagram shall be fitted at both ends of each wire. All wiring shall be terminated on terminal blocks. Terminals shall be adequately rated for the circuit current; minimum rating shall be 10A. Control wiring shall be protected against mechanical damage.

c) CT/PT terminals shall be of disconnecting links types and all other terminals shall be of stud type. CT terminals shall have Grounding facility.

d) The wire terminations shall be made with solderless crimping type of tinned copper lugs.

e) Wiring shall be colour coded and be firmly supported, neatly installed by lacing and taping, readily accessible and connected to equipment terminals and terminal blocks. Halogen free, flame retardant plastic wiring channels/troughs with strap on covers shall be used for this purpose.

f) All control & instrument cable terminations shall have double compression type cable glands with shield grounding provision and shielded from electrostatic and electromagnetic interferences.

7.2.9 Mimic Diagrams

Mimic diagrams shall be provided on local control panels. The mimic strips shall be made of anodised aluminium and shall be screwed onto the panel. Colours of the various voltages of the mimic bus comply with relevant IEC standard. The width of mimic strip shall not be less than 5 mm. Discrepancy switches and semaphore indicator shall be provided on the mimic diagram as applicable.

7.2.10 Local Alarm/Annunciation

7.2.10.1 Window type Alarm/Annunciation shall be provided on local control panels of each bay for annunciating the specified abnormal conditions related to the bay covering

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SF6 gas pressure conditions, control supply fail as well as the hydraulic operating mechanism. The alarm windows shall have provision for differentiating cleared and uncleared faults and flashing for new faults. The Alarm/Annunciator system shall be provided with First out feature.

7.2.10.2 Alarm circuit shall not respond to faults for momentary conditions. The following minimum indications shall be generally provided in the alarm and indication circuits:

- i) Low Gas Pressure Stage-1, 2 & 3 (as applicable)
- ii) Low Operating Pressure / Spring Discharged (as applicable)
- iii) Loss of heater power
- iv) Auxiliary power supply failure (AC & DC)
- v) Pole discrepancy
- vi) Other trouble alarms for CB, DS and any others
- vii) DS/ES drive door open

7.3 Mechanism Cabinets

7.3.1 The Circuit breaker mechanism cabinet shall consist of the following:

- a. Circuit breaker position indicator
- b. Operation counter
- c. Provision for connection of time travel recorder
- d. Operating and monitoring device associated with circuit breaker operating mechanism shall be wired to terminal blocks in circuit breaker mechanism cabinet and further to terminal blocks in local control cabinet.
- e. Monitoring and indication devices for the status of the stored energy of the circuit breaker or other status of the operating mechanism.

7.3.2 Disconnect Switch and Grounding switch mechanism cabinet.

The mechanism cabinet, in addition to other components or accessories the GIS Manufacturer considers necessary for safe and reliable operation, incorporate the following

- a. Disconnect /Grounding switch position indicator
- b. Auxiliary switches
- c. Terminal blocks

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8.3.2

At least 10% of all welds/casting shall be subjected to non-destructive testing by X rays or ultrasound and all records there of shall be made available upon request.

8.3.3

All welding shall be performed with suitable submerged-arc welding machines or by fully certified welders.

8.3.4

Drawings submitted for approval shall indicate following information in respect of welds:

a. Type of weld

b. Procedure employed

c. Inspection applied

d. Applicable standard

8.3.5

Details of bolt sizes and threading shall be clearly shown on the appropriate drawings. Where self-locking type of nuts are used, they shall be of the re-usable type. Pressed type nuts are not acceptable. Fasteners used for current carrying parts shall be of Stainless Steel - 304.

8.3.6

GIS Manufacturer shall indicate the type of protection needed and precautions to be taken during GIS installation to prevent moisture or dirt entering the enclosures.

8.4

Seismic Qualification

8.4.1

The GIS shall be designed to safely withstand the seismic forces as per the codal design wherever applicable. The two seismic ground motion levels are 0.5g peak or 0.2g peak acceleration.

8.4.2

GIS Manufacturer shall submit type test certificates, if applicable to prove seismic withstand capability. If identical GIS is not tested in the past, successful GIS Manufacturers shall furnish design calculation or carry out testing to prove seismic withstand capacities without cost and time implication to the purchaser.

9.0

SPECIAL TOOLS

9.1

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.

9.2

If specified, a mobile SF6 gas treatment plant, which shall be suitable for draining, filtration/purification and refilling the equipment shall be provided. The plant shall

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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.

9.3 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.

9.4 A SF₆ Gas maintenance cart, which shall be easily moved by One 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.

9.5 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 if required. The recommended positions, exact number of detectors, type of mounting, facilities for alarm etc. shall be indicated in the Bid.

b. Each set of analyser shall comprise of:

i. SO₂ content in SF₆ gas

ii. Purity of SF₆ gas

iii. SF₆ gas moisture content

9.6 All special tools required for the purpose of installation, maintenance, overhauling and testing of GIS and also for the measurement of moisture in SF₆.

10.0 TESTING

10.1 Purchaser shall have right to carryout stage inspection and shop visit to review the manufacturing progress. However, manufacturer need not hold any of the manufacturing activity for witnessing of stage inspection by purchaser / consultant.

10.2 Routine Tests

10.2.1 The switchgear and its component circuit breakers, Disconnect Switches, Grounding switches, SF₆/oil interface bushings and instrument transformers etc. shall be fully routine tested in accordance with current edition of the relevant IEC standards.

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10.2.2

The tests may be witnessed by Purchaser's personnel. Purchaser shall be notified to witness tests at least two weeks prior to tests. Any changes in testing schedules must be communicated immediately to Purchaser.

10.2.3

All defects as a result of testing shall be repaired by GIS Manufacturer at his own expense and shall be documented and corrected prior to shipment. If, in the opinion of Purchaser, a repeat of the faulty test is required after such repairs, this shall also be done at no cost to the Purchaser.

10.2.4

Authorised representatives of Purchaser shall be allowed access to all those areas in GIS Manufacturer's shop where the equipment covered by this contract in produced at all reasonable times for the purpose of inspection and obtaining information on the progress of work.

10.2.5

Acceptance by Purchaser's representative of any equipment shall not relieve the GIS Manufacturer from any of his performance guarantees, or from any of his other obligation resulting from this contract.

10.2.6

Following tests are also required to be carried out as routine test:

a)

Routine partial discharge tests shall be performed on all insulators and instrument transformers. The discharge level shall be less than 5 pico Coulombs at this voltage. Purchaser may at his discretion accept alternative tests to prove the integrity of the insulators.

b)

Each shipping assembly shall be subjected to a one minute, 50 Hz high voltage withstand test and a partial discharge test. The extinction levels shall be taken as 5 pico Coulombs for switchgear and 3 pico Coulombs for individual insulators.

c)

Each enclosure & partition shall be tested to withstand twice rated internal operating pressure and test reports of the tests shall be furnished.

d)

Bending strength test and testing of impact strength for insulating rods shall be carried out on one sample in the presence of Purchaser's representative free of cost.

e)

Tests shall be carried out to verify the gas loss figures guaranteed by the GIS Manufacturer.

f)

Mechanical operation test including continuous operating test and timing test.

g)

Measurement of the resistance of the main circuit.

h)

Design and visual checks

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i)

Tests on auxiliary circuits, equipment and interlocks in the control mechanism.

10.3

Type Tests

10.3.1

The switchgear and its component circuit breakers, Disconnect Switches, Grounding switches, SF6/oil interface and instrument transformers shall be fully type tested in accordance with IEC 62271-203, IEC 62271-100 and IEC 60694.

10.3.2

Impulsive voltage test certificates to prove withstand capabilities against both lightning and switching over voltages should have been conducted on one completely assembled bay which shall include breakers, associated disconnecting switches, grounding switches, bus ducts, instrument transformers etc. These tests shall be carried out after power frequency withstand test.

10.3.3

The type tests shall be carried out at reputed testing laboratory, the tests must have been carried out during last 5 years. Type test certificates to this effect shall be enclosed with the Bid. If not, the Type tests must be carried out and the price shall be considered in bid. Also, if specified in Section C, type test shall be carried out on the equipment.

10.4

Site Tests

10.4.1

The fully assembled equipment shall be subjected to 1 min. power frequency withstand test at 80% of the rated withstand test voltage and impulse/switching impulse voltage test at site. To test various sections of GIS, it may be necessary for some sections of GIS, to be subjected to more than one such test. All field tests as per relevant IEC standards shall be conducted. The test, the method of applying the test voltage and the requirements for conditioning shall be subjected to agreement between Purchaser and GIS Manufacturer. GIS Manufacturer shall give a detailed programme and description of site testing in the bid and standards followed.

10.4.2

Provision shall be made by GIS Manufacturer for incorporating a test bushing and other necessary testing equipment to facilitate site testing. Test bushing shall be included in GIS Manufacturer's scope, and shall be handed over to Purchaser, if so specified.

10.4.3

The GIS Manufacturer shall indicate the equipment to be made available by the Purchaser for commissioning tests at site. Special tools for erection/testing the GIS shall be supplied by the GIS Manufacturer and indicated in the bid.

10.4.4

The GIS Manufacturer shall also indicate the equipment for diagnostic/online monitoring system for the GIS as an optional item.

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10.4.5 HV testing of the cable plus the plug-in connector in the GIS shall be performed via a suitably designed cable junction box together with a test cable.

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12416A-EL-GIS-40101	DATA SHEET 66KV GIS AND ITS ACCESSORIES				
Sl. No.	ITEM	UNIT	PARTICULARS	BIDDER RESPONSE	REMARKS
1	General				
a	Maximum temperature of enclosure (°C)		According to IEC		
b	Color of GIS Bus and enclosures		as per painting specification		
c	Color of GIS Barrier Insulations		as per painting specification		
d	Type test reports included		Yes		
2	DISCONNECTOR				
a	Manufacturer		Bidder to Specify		
b	Type		Bidder to Specify		
	- Model No.		Bidder to Specify		
	- Country of origin		Bidder to Specify		
c	Characteristics				
	- Operating voltage (U_o/U)		38/66		
	- Rated voltage for equipment (U_r) (kV)		75		
	- Rated short time withstand current (3 s) (kArms sym)		40		
	- Rated peak withstand current (kA _p)		108		
	- Rated impulse withstand voltage at minimum operating gas pressure (U_p)		Bidder to Specify		
	- Phase to phase and phase to earth (kV _p)		325		
	- Across the isolating distance (kV _p)		375		
	- Switching withstand voltage at minimum operating gas pressure (U_s)				
	o Phase to earth (kV _p)		Bidder to Specify		
	o Across the isolating distance (kV _p)		Bidder to Specify		
	- Power-frequency withstand voltage, 1 min., at minimum operating gas pressure (U_d)				
	o Phase to phase and phase to earth (kV _{rms})		140		
	o Across the isolating distance (kV _{rms})		160		
	- Rated current (I_r) (A)				
	o At 45°C		3150		
	o At 50°C		Bidder to Specify		
	- Rated frequency (Hz)		50		
	- Number of poles		3		
d	Maximum capacitive current interruption capacity (A)				
	- Opening time (s)		≤ 15		
	- Closing time (s)		≤ 15		
e	Operating mechanism		Motor & manual		
	- Motor voltage (Vd.c)		110		
	- Number of auxiliary contacts available for future customer's use		Bidder to Specify		
	- Number of mechanism for three pole operation		Bidder to Specify		

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Sl. No.	ITEM	UNIT	PARTICULARS	BIDDER RESPONSE	REMARKS
	- Hand-operating facility		Bidder to Specify		
	- Rated motor power (W)		Bidder to Specify		
	- Contact type		Bidder to Specify		
3	MAINTENANCE EARTHING SWITCH				
a	Manufacturer				
	- Type		Bidder to Specify		
	- Model No.		Bidder to Specify		
	- Country of origin		Bidder to Specify		
b	Characteristics				
	- Operating voltage (U_o /U)		38/66		
	- Rated voltage for equipment (U_r) (kV)		75		
	- Rated short time withstand current (3 s)(kArms sym)		40		
	- Rated peak withstand current (kA_p)		108		
	- Rated impulse withstand voltage at minimum operating gas pressure (U_p)				
	o Phase to phase and phase to earth (kV_p)		325		
	o Across the isolating distance (kV_p)		375		
	- Switching withstand voltage at minimum operating gas pressure (U_s)				
	o Phase to earth (kV_p)		Bidder to Specify		
	o Across the isolating distance (kV_p)		Bidder to Specify		
	- Power-frequency withstand voltage, 1 min., at minimum operating gas pressure (U_d)				
	o Phase to phase and phase to earth (kV_{rms})		Bidder to Specify		
	o Across the isolating distance (kV_{rms})		Bidder to Specify		
	- Rated frequency (Hz)		50		
	- Number of poles		3		
	- Opening time (s)		Bidder to Specify		
	- Closing time (s)		Bidder to Specify		
d	Operating mechanism				
	- Motor voltage (V d.c.)		110		
	- Number of auxiliary contacts available for future customer's use		Bidder to Specify		
	- Number of mechanism for three pole operation		Bidder to Specify		
	- Hand-operating facility		yes		
	- Rated motor power (W)		Bidder to Specify		
	- Contact type		Bidder to Specify		
4	HIGH SPEED EARTHING SWITCH				
a	Manufacturer				
	- Type		Bidder to Specify		
	- Model No.		Bidder to Specify		

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Sl. No.	ITEM	UNIT	PARTICULARS	BIDDER RESPONSE	REMARKS
	- Country of origin		Bidder to Specify		
b	Characteristics				
	- Operating voltage (U_o /U)		38/66		
	- Rated voltage for equipment (U_r) (kV)		75		
	- Rated short time withstand current (3 s) (kA rms sym)		40		
	- Rated peak withstand current (kA_p)		108		
	- Rated impulse withstand voltage at minimum operating gas pressure (U_p)				
	o Phase to phase and phase to earth (kV_p)		325		
	o Across the isolating distance (kV_p)		375		
	- Switching withstand voltage at minimum operating gas pressure (U_s)				
	o Phase to earth (kV_p)		Bidder to Specify		
	o Across the isolating distance (kV_p)		Bidder to Specify		
	- Power-frequency withstand voltage, 1 min., at minimum operating gas pressure (U_d)				
	o Phase to phase and phase to earth (kV_{rms})		Bidder to Specify		
	o Across the isolating distance (kV_{rms})		Bidder to Specify		
	- Rated frequency (Hz)		50		
	- Number of poles		3		
	- Opening time (s)		Bidder to Specify		
	- Closing time (s)		Bidder to Specify		
	- Rated inductive (electromagnetic) breaking current at 10 kV_{rms} breaking voltage (A)		Bidder to Specify		
	- Rated capacitive (electrostatic) breaking current at 20 kV_{rms} breaking voltage (A)		Bidder to Specify		
c	Operating mechanism				
	- Motor voltage (V d.c.)		110		
	- Number of auxiliary contacts available for future customer's use		Bidder to Specify		
	- Number of mechanism for three pole operation		Bidder to Specify		
	- Hand-operating facility		Bidder to Specify		
	- Rated motor power (W)		Bidder to Specify		
	- Contact type		Bidder to Specify		
5	CABLE TERMINATION BOX				

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Sl. No.	ITEM	UNIT	PARTICULARS	BIDDER RESPONSE	REMARKS
a	Manufacturer				
	- Type		Bidder to Specify		
	- Type termination (as per IEC 62271-209)		Bidder to Specify		
	- Model No.		Bidder to Specify		
	- Country of origin		Bidder to Specify		
b	Characteristics				
	- Operating voltage (U _o /U)		38/66		
	- Rated voltage for equipment (U _r) (kV)		75		
	- Rated short time withstand current (3s) (kA rms sym)		40		
	- Rated peak withstand current (kAp)		108		
	- Rated impulse withstand voltage at minimum operating gas pressure (U _p) (kVp)		325		
	- Switching withstand voltage at minimum operating gas pressure (U _s) (kVp)		Bidder to Specify		
	- Power-frequency withstand voltage, 1 min., at minimum operating gas pressure (U _d) (kVrms)		140		
	- Rated current (I _r) (A)				
	At 45°C		3150		
	At 50°C		Bidder to Specify		
c	- Rated frequency (Hz)		50		
d	Construction				
	- Number of phases in one enclosure		3		
	- Mechanism design pressure (absolute) for outside of the cable terminal (MPa)		Bidder to Specify		
	- Mechanical strength of cable termination		Suitable to cable installation		
	- Fitting		As per IEC 60859		
	- Cable size range (mm ²)		As per IEC 60859		
	- Removable link between busduct and cable box		Bidder to Specify		
	- Mounting details:				
	o Bolt circle of the flange (mm)		Bidder to Specify		
	o N° of bolts		Bidder to Specify		
	o Size of bolts (mm)		Bidder to Specify		
	- Terminal:				
	o Type		Bidder to Specify		
	o Size (mm)		Bidder to Specify		
	o N° of holes (if applicable)		Bidder to Specify		
	o Outline drawing		Bidder to Specify		
	- Gas filling facilities, manometer, alarm and trip contacts for each compartment.		yes		
6	BUS DUCT				
a	Manufacturer				
	- Type		Bidder to Specify		
	- Model No.		Bidder to Specify		
	- Country of origin		Bidder to Specify		

SPEC NO.	TATA CONSULTING ENGINEERS LIMITED 9MMTPA CBR PROJECT				SECTION: D2
12416A-EL-GIS-40101	DATA SHEET 66KV GIS AND ITS ACCESSORIES				
Sl. No.	ITEM	UNIT	PARTICULARS	BIDDER RESPONSE	REMARKS
b	Characteristics				
	- Operating voltage (U _o /U)		38/66		
	- Rated voltage for equipment (U _r) (kV)		75		
	- Rated short time withstand current (3s) (kA rms sym)		40		
	- Rated peak withstand current (kAp)		108		
	- Rated impulse withstand voltage at minimum operating gas pressure (U _p) (kV _p)		325		
	- Switching withstand voltage at minimum operating gas pressure (U _s) (kV _p)		Bidder to Specify		
	- Power frequency withstand voltage, 1 min., at minimum operating gas pressure (U _d) (kV _{rms})		140		
	- Rated current (I _r) (A)				
	o At 45°C		3150		
	o At 50°C		Bidder to Specify		
	- Rated frequency (Hz)		50		
c	Construction				
	- Number of phases in one enclosure		3		
7	GIS MECHANISM ENCLOSURE				
a	Accessories				
	- Local/remote selector switch		yes		
	- Manual and electrical operation		yes		
	- Light, heater and service outlet in hand operated mechanism enclosure		yes		
	- MCB protected motor and control circuits		yes		
	- Motor contactor		yes		
	- Test switches (d.c.)		yes		
	- Terminal blocks		yes		
	- Enclosure degree of protection		IP 64		
	- Grounding bushing for testing of GIS insulation (10 kV isolation)				
b	Weight and dimensions				
	- Total weight, 3 poles group (kg)		yes		
	Will be submitted during detail engineering		yes		
	- Arrangement drawing (indicating dimensions) to be submitted with the bid		yes		
c	Type test reports		Bidder to Specify		
d	Quality control		ISO 9001		
e	Special requirements				
	- Manometer for SF ₆ leakage for each compartment including alarm and trip contacts and filling facility for each compartment.		yes		
	- Inspection window and mechanical indicators including locking facilities, paint color to be RAL 9010		Refer painting specification		

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12416A-EL-GIS-40101	DATA SHEET 66KV GIS AND ITS ACCESSORIES				
Sl. No.	ITEM	UNIT	PARTICULARS	BIDDER RESPONSE	REMARKS
8	CIRCUIT BREAKER				
a	Manufacturer				
	- Type		Bidder to Specify		
	- Model No.		Bidder to Specify		
	- Country of origin		Bidder to Specify		
b	Characteristics				
	- Operating voltage (U_o /U)		38/66		
	- Rated voltage for equipment (U_r) (kV)		75		
	- Rated breaking current ($kA_{rms\ sym}$) with X_1/R_1 and X_0/R_0 ratios as type tested (ratios to be confirmed)		40		
	- Rated breaking current (kA rms sym) with a X_1/R_1 ratio of 28		Bidder to Specify		
	- Rated breaking current (kA rms sym) with a X_0/R_0 ratio of 46		Bidder to Specify		
	- Rated peak withstand current (kA_p)		108		
	- Rated impulse withstand voltage at minimum operating gas pressure (U_p)		Bidder to Specify		
	o Phase to phase and phase to earth (kV_p)		325		
	o Across the isolating distance (kV_p)		375		
	- Switching withstand voltage at minimum operating gas pressure (U_s)				
	o Phase to earth (kV_p)		Bidder to Specify		
	o Across the isolating distance (kV_p)		Bidder to Specify		
	- Power-frequency withstand voltage, 1 min., at minimum operating gas pressure (U_d)				
	o Phase to phase and phase to earth (kV rms)		140		
	o Across the isolating distance (kV_{rms})		160		
	- Rated current (I_r) (A)				
	o At 45°C		3150		
	o At 50°C		Bidder to Specify		
	- Rated frequency (Hz)		50		
	- Breaking capacitive current of 66 kV cables (A)		Bidder to Specify		
	- Breaking inductive current (A)		Bidder to Specify		
	- Switching capacitive current of 66 kV cables (kA_p)		Bidder to Specify		
	- Switching frequency of capacitive current (Hz)		Bidder to Specify		
	- First pole to clear factor		Bidder to Specify		
c	Operating mechanism		Motor & Manual		
	- Motor voltage (V d.c.)		110		
	- Number of auxiliary contacts available for future customer's use		Bidder to Specify		
	- Number of mechanism for three pole operation		Bidder to Specify		

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Sl. No.	ITEM	UNIT	PARTICULARS	BIDDER RESPONSE	REMARKS
	- Hand-operating facility		yes		
d	Opening time				
	- Making (ms)		Bidder to Specify		
	- Tolerances (ms)		Bidder to Specify		
	- Chattering (ms)		Bidder to Specify		
	o Tolerances (ms)		Bidder to Specify		
	- Opening (ms)		<30		
	o Tolerances (ms)		Bidder to Specify		
	- Arcing (ms)		<25		
	o Tolerances (ms)		Bidder to Specify		
	- Break time (ms)		<50		
	o Tolerances (ms)		Bidder to Specify		
	- Dead (ms)				
	o t (ms)		≤ 300		
	o t' (min)		3		
e	Operating Data				
	- Operation duty cycle		Bidder to Specify		
	- Closing current at 110 V d.c. (A)		Bidder to Specify		
	- Tripping current at 110 V d.c. (A)		Bidder to Specify		
	- Minimum tripping voltage (V)		Bidder to Specify		
	- Minimum closing voltage (V)		Bidder to Specify		
	- Spring charging / pump motor				
	o Voltage (V)		Bidder to Specify		
	o Rated current (A)		Bidder to Specify		
	o Charging time (s)		Bidder to Specify		
	- Number of operations after which a maintenance inspection is necessary		Bidder to Specify		
	- Number of operations after which a maintenance overhaul is necessary		Bidder to Specify		
	- Number of operations at rated continuous current after which a maintenance inspection is necessary		Bidder to Specify		
	- Number of operations at rated continuous current after which a maintenance overhaul is necessary		Bidder to Specify		
	- Provide an electrical endurance curve (minimum guaranteed number of interruptions at given fault level)		Bidder to Specify		
	- Provide interlock system description		Bidder to Specify		
f	Structural Data				
	- Weight of circuit breaker (kg)		Bidder to Specify		
	- Maximum impact loading		Bidder to Specify		
	o Upward (N)		Bidder to Specify		
	o Downward (N)		Bidder to Specify		
9	CURRENT TRANSFORMER				
a	Manufacturer				
	- Type		GIS		
	- Model No.		Bidder to Specify		

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12416A-EL-GIS-40101	DATA SHEET 66KV GIS AND ITS ACCESSORIES				
Sl. No.	ITEM	UNIT	PARTICULARS	BIDDER RESPONSE	REMARKS
	- Country of origin		Bidder to Specify		
	- Insulation		SF6		
b	Characteristics				
	- Operating voltage (U_o /U)		38/66		
	- Rated voltage for equipment (U_r) (kV)		75		
	- Rated short time withstand current (3 s) (kA rms sym)		40		
	- Rated peak withstand current (kA_p)		108		
	- Rated impulse withstand voltage at minimum operating gas pressure (U_p) (kV_p)		325		
	- Switching withstand voltage at minimum operating gas pressure (U_s) (kV_p)		Bidder to Specify		
	- Power-frequency withstand voltage, 1 min., at minimum operating gas pressure (U_d) (kV_{rms})		140		
	- Rated frequency (Hz)		50		
	- Continuous current service factor		Bidder to Specify		
	- Temperature rise above 55°C ambient (°C)		According to IEC		
	- Transformer differential protection circuits				
	o Ratio		As per Specification		
	o Accuracy class as per IEC		PX		
	o Burden (VA)		Bidder to Specify		
	- Cable differential protection circuits				
	o Ratio		As per Specification		
	o Accuracy class as per IEC		PX		
	o Burden (VA)		Bidder to Specify		
	- Bus differential protection circuits				
	o Ratio		As per Specification		
	o Accuracy class as per IEC		PX		
	o Burden (VA)		Bidder to Specify		
	- Overcurrent (Back-up) protection circuits				
	o Ratio		As per Specification		
	o Accuracy class as per IEC		5P20		
	o Burden (VA)		Bidder to Specify		
	- Measuring circuits				
	o Ratio		As per Specification		
	o Accuracy class as per IEC		CL.0.5		
	o Burden (VA)		Bidder to Specify		
	- Main metering circuit				
	o Ratio		As per Specification		
	o Accuracy class as per IEC		CL.0.5		
	o Burden (VA)		Bidder to Specify		
	- Check metering circuit				
	o Ratio		As per Specification		
	o Accuracy class as per IEC		CL.0.5		
	o Burden (VA)		Bidder to Specify		

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12416A-EL-GIS-40101	DATA SHEET 66KV GIS AND ITS ACCESSORIES				
Sl. No.	ITEM	UNIT	PARTICULARS	BIDDER RESPONSE	REMARKS
10	VOLTAGE TRANSFORMER				
a	Manufacturer				
	- Type		GIS		
	- Model No.		Bidder to Specify		
	- Country of origin		Bidder to Specify		
	- Insulation		Bidder to Specify		
b	Characteristics				
	- Operating voltage (U_o/U)		38/66		
	- Rated voltage for equipment (U_r) (kV)		75		
	- Rated impulse withstand voltage at minimum operating gas pressure (U_p) (kV_p)		325		
	- Switching withstand voltage at minimum operating gas pressure (U_s) (kV_p)		Bidder to Specify		
	- Power-frequency withstand voltage, 1 min., at minimum operating gas pressure (U_d) (kV_{rms})		140		
	- Rated primary voltage (kV_{rms})		66 / $\sqrt{3}$		
	- Rated secondary voltage (V_{rms}) (Winding No 1 – No 2)		110 / $\sqrt{3}$ – 110 / $\sqrt{3}$		
	- Rated frequency (Hz)		50		
	- Winding No 1				
	o Accuracy class as per IEC		0.2/3P		
	- Winding No 2				
	o Accuracy class as per IEC		0.2/3P		
	- Continuous thermal burden		Bidder to Specify		
	- Total (VA)		Bidder to Specify		
	- Winding No 1 (VA)		Bidder to Specify		
	- Winding No 2 (VA)		Bidder to Specify		

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 other than those furnished in the schedule of deviations.
3. Only those technical submittals which are specifically asked for in Notice Inviting Tender (NIT) to be submitted at tender stage shall be considered as part of offer. Any other submission, even if made, shall not be considered as part of 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

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