5. BIDDER QUALIFICATION CRITERIA (BQC):

5.1. EXPERIENCE CRITERIA – TECHNICAL:

The Bidder shall either be a:

- Sole bidder (Indian)
- ~~A consortium/ Joint venture of maximum 2 (two) members (both Indian)~~

The bidder shall meet the following qualification criteria:

5.1.1. The bidder (in case of sole bidder) ~~or one of the members in case of Consortium/ Joint venture~~ shall be a manufacturer of Gas Insulated switchboard with SF6 circuit breaker of rating 220kV (minimum) and shall have executed at least One (1) order for EHV indoor, double bus GIS (with single breaker/ one and half breaker/ double breaker execution) of voltage rating 220kV or above with SF6 circuit breaker having minimum bus rating of 2000A, 50 kA for 3 sec. and total 4 nos. of circuit breaker having same model of EHV GIS and SF6 circuit breaker as being offered, including design, detailed engineering, procurement, supply, fabrication, along with either installation, testing and commissioning or supervision of installation, testing and commissioning, in the last ten (10) years, reckoned from the last day of month previous to the one in which the enquiry was issued and the reference job must have completed a period of minimum one (01) year after commissioning.

5.1.2. ~~In case the sole bidder is not meeting requirement of clause 5.1.1 above, bidder can still qualify provided the bidder has executed as an EPC/LSTK contractor, a work having supply, installation, testing and commissioning of a Gas insulated switchboard with SF6 circuit breaker of rating 220kV (minimum) and the bidder engages an EHV GIS manufacturer for this job who has executed at least one (01) order for EHV indoor, double bus GIS (with single breaker/ one and half breaker/ double breaker execution) of voltage rating 220kV or above with SF6 circuit breaker having minimum bus rating of 2000A, 50kA for 3 sec. and total 4 nos. circuit breaker bays having same model of EHV GIS & SF6 circuit breaker as being offered, including design, detailed engineering, procurement, supply, fabrication, along with either testing and commissioning or supervision of testing and commissioning. The reference EPC/LSTK job and GIS manufacturer's reference job must have been completed and commissioned in the last ten (10) years, reckoned from the last day of month previous to the one in which the enquiry was issued and the reference job must have completed a period of minimum one (01) year after commissioning.~~

5.1.2.1. In such a case, the bidder, along with the bid, shall submit memorandum of understanding (MoU)/ Agreement and a clear scope/ responsibility matrix (activity wise) with the finalized GIS manufacturer based on the experiences mentioned in EHV GIS manufacturer qualifying reference, which shall be binding on the bidder and is not to be changed thereafter and shall remain in force at least for 4 years or till the defect liability period whichever is later. The minimum scope of the EHV GIS manufacturer in MoU shall include supply, installation, testing and commissioning of their EHV GIS. The minimum scope of the bidder in MoU shall include but not limited to i) overall project management, ii) Planning, monitoring, scheduling and reporting, iii) Procurement of critical hardware, iv) Participation in progress review meeting and v) commissioning.

The MOU / agreement shall be converted into definitive contract agreement between successful bidder & EHV GIS manufacturer after award of job and before signing of contract with BPCL which shall be done within one month from the date of award to EPC contractor and this agreement must remain in force for at least 4 years or till the defect liability period whichever is later.

5.1.3. 220 kV Gas Insulated Switchboard shall be supplied from the manufacturer's same unit/ works from which GIS switchboards meeting the criteria specified at 5.1.1 ~~& 5.1.2~~ above have been supplied for the referenced jobs/ past projects.

Prepared by 20/6/25 | Checked By 20/06/25 | Approved By 20.6.25

BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION BUSINESS ENGINEERING MANAGEMENT
NOIDA

DOCUMENT NO.	**TB-PBTU-BPCL BINA-220kV GIS**	**Rev 00**	**Prepared**	**Checked**	**Approved**
TYPE OF DOC.	**TECHNICAL SPECIFICATION**	**NAME**	**BY**	**DKS**	**VK**
TITLE **220kV Gas Insulated Switchgear (GIS) with its accessories** *(suitable for non-air conditioned, tropical, humid and corrosive environment)*		**SIGN**			
		DATE	20.06.2025	20.06.2025	20.06.2025
		GROUP	**TBEM**		
		WO No.			

CUSTOMER	**IOCL**
PROJECT	Pre-Bid Tie up for, 220kV GIS Package of BINA PETCHEM & REFINERY EXPANSION PROJECT (BPREP) of M/S BHARAT PETROLEUM CORPORATION LIMITED (BPCL)

Contents

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	

SECTION 1: CHECKLIST FOR TECHNICAL EVALUATION

Along with the technical offer/ bids, the bidder should submit this checklist confirming the inclusion of the enclosures as listed below,

Sl. No.	Documents to be enclosed	Bidder to confirm (Please tick "Confirmed")
1.	Supporting documents for compliance of Technical Qualifying Requirement.	Confirmed
2.	Unpriced BOQ duly mentioning "Quoted" for all the items, signed and sealed.	Confirmed
3.	Annexure-A & B duly filled, signed and sealed.	Confirmed

Note: Any bidder not meeting the above requirement is liable for non-evaluation.
The above checklist is reviewed and verified for,

NIT Reference No.:

Name of Bidder:

Name of Project:

Date: Bidder's Stamp & Signature

Contents

SECTION 1:
SCOPE, PROJECT SPECIFIC TECHNICAL REQUIREMENTS & BILL OF QUANTITIES

1. Scope

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

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

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

The specification comprises of following sections:

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

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

1. Statutory Regulations
   In particular, the latest version of the following statutory regulations, as applicable, shall be followed for system,
   - o Indian Electricity Act
   - o CEA regulations
   - o The Factory Act

- o The Petroleum Rules
- o OISD standards
- o Requirements of other statutory bodies as applicable, e.g. CEA, CCE, LPCB.

2. Section-1
3. Section-2
4. Section-3
5. Codes & Standards

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

GIS shall be designed in such a way that transfer from one bus isolator to another bus isolator shall be possible in energized condition without any break in supply to the loads.

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

The equipment is required for the following project:

Name of the Customer	:	Bharat Petroleum Corporation Limited (BPCL)
Name of Consultant	:	Engineers India Limited (EIL)
Name of Main Contractor	:	Bharat Heavy Electricals Limited (BHEL)
Name of the Project	:	220kV GIS Package of BINA PETCHEM & REFINERY EXPANSION PROJECT (BPREP) of M/S BHARAT PETROLEUM CORPORATION LIMITED (BPCL)

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

2. Codes & Standards

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

IEC 60694	Common clauses for High Voltage Switchgear & Control Gear
IEC 62271-203	Gas Insulated metal-enclosed Switchgear for rated voltages above 52kV
IEC 62271-207	Seismic Qualification for Gas-insulated Switchgear Assemblies for rated voltages above 52kV
IEC 60376	New Sulphur Hexafluoride
IEC 62271-100	High Voltage Alternating Current Circuit Breakers

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

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

3. Specific Technical Requirements

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

Sl. No.	Technical Parameters	Unit	Particulars
	Type of GIS		Indoor type, phase segregated/ phase encapsulated, Double Bus bar
	Installation		Indoor in airconditioned environment
	Meteorological data		
1.1	Design ambient temperature	^{0}C	45.0
1.2	Site ambient temperature range: min. to max.	^{0}C	1.1 (min.), 48.0 (max.)
1.3	Altitude (above MSL)	Mtrs	< 1000 Mtrs
1.4	Relative humidity	%	86
1.5	Seismic zone	Zone	As per applicable IEC
1.6	Site environment		Hot, humid and corrosive
1.7	Location of installation		Indoor
	Switchgear Design Data		
2.1	System voltage, frequency, phases	kV/ Hz/ Ø	220kV, 50 Hz, 3Ø
2.2	Voltage variation	%	±6±TP
2.3	Frequency variation	%	±3
2.4	System grounding		Solidly earthed
2.5	Fault level	kA/ sec	50/3

2.6	Maximum Service Voltage	kV	245
2.7	Rated Insulation Level		
	- at power frequency 1 min	kV	460
	- at lightning impulse (1.2/50 µs wave)	kV	1050
2.8	Rated service current (min.)		
	- Bus bar	A	2000
	- Incomer Bay	A	2000
	- Bus Coupler	A	2000
	- Bus Sectionalizer	A	2000
	- Transformer	A	1250
2.9	Rated short time withstand current (Symm.)	kA	50
	- Duration	Sec	3
2.10	Internal fault withstand time without burn Through		As per IEC-62271-203
2.11	Temperature rise at rated service current (indicative)		
	- Conductor	°C	As per IEC-60694
	- Enclosure	°C	
2.12	Rated SF6 gauge pressure at 20°C		
	- Circuit breaker		as per standard
	- Switchgear		as per standard
2.13	Enclosure design pressure		
	- Circuit breaker		as per standard
	- Switchgear		as per standard
2.14	Leakage rate of SF6 per annum for the whole substation		< 0.5 %
2.15	Maximum partial discharge level		≤ 5 pC
2.16	Painting of switchgear		
	- Paint Shade		RAL 7032
2.17	Surface protection of steel frames		Hot-dip Galvanizing with Zinc with 610gm/ square meter
2.18	Degree of Protection		IP4X

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

4. Other General Requirements

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

1. Storage shall be provided by BHEL/ its contractor. However, bidder shall provide their

tentative space requirement for covered and/ or open store area during tender stage only. In addition to this, bidder shall submit their standard storage instruction manual specifically specifying the item detailed with details of type of storage.

2. Bidder shall submit list of consumables with shelf life of less than six months and same shall be dispatched just before the erection and only after specific clearance from BHEL/Customer.
3. Project Site is located in petrochemical/ process industry, which is highly corrosive & abundance of hydrocarbon area. Hence, GIS should be compatible with above requirements during design, material selection and construction of GIS & its accessories and all equipment, accessories and wiring shall have tropical protection, involving special treatment of metal and insulation against fungus, insects and corrosion.
4. Packing of GIS & its accessories shall be suitable for long term storage without any deterioration in quality and performance (minimum 1 years, if required).
5. Bidder shall offer their latest type tested compact model to accommodate the specified & allocated space as per attached layout drawing of GIS. Bidder to note that if bidder fails to meet above requirement, its technical offer is liable for non-evaluation.
6. Bidder shall conduct insulation co-ordination studies in line with IEC:60071 for establishing surge arrester rating, quantity and any other requirement for successful operation of GIS.
7. Bidder shall be required to submit 3D OGA Drawing compatible with Primtech for complete GIS & its accessories.
8. Bidder shall check and ensure adequacy of system protection for successful operation of GIS. After checking of system by bidder, GIS shall be installed and if any failure, malfunction of any part occurs after/ during commissioning, same shall be replaced immediately without any extra cost.
9. The 220kVGIS building shall comprise an EOT (Electric overhead travel) crane as per GIS OEM/ bidder recommendation, for lifting of any components of GIS switchgear. However, EOT crane for GIS is not envisaged in bidder's scope but bidder shall provide all the calculations basis for sizing of EOT crane during tender stage only. EOT cranes for GIS hall shall be provided for erection & maintenance of largest GIS component/assembly. The crane shall consist of all special requirements & lifting assemblies for erection & maintenance of GIS equipment.

1. CT/ VT parameters mentioned in CT VT parameter document is indicative only. Bidder has to ensure correctness of CT/VT sizing for GIS during contact stage / detailed Engineering stage.
2. Any change in bay pitch (distance between bays) as per civil requirement for during detailed engineering stage shall be incorporated by the bidder without any cost and delivery implication to BHEL.
3. Bidder shall include painting and marking of all buses, individual incomers, all outgoing feeders etc. with details such as tag no., feeder rating, sending end source reference etc. for all switchboards.
4. The GIS shall be designed in such a way that suitable walkways are provided all around the switchgears so that the operators will be able to have free access to all the operating mechanism.
5. The GIS Equipment shall be complete with all necessary supports, ladders, galleries, staircases, catwalks, movable platforms or walkways (for accessing the equipment above two meters for maintenance and operation), mechanism cabinets, internal cable raceways etc for each bay and it shall be of modular construction and extendable design. All structures, galleries, staircases and walkways shall conform to the relevant Occupational Safety and Health Administration (OSHA).

6. Special tools & tackles for installation and testing kits for testing & commissioning shall be in bidder's scope, however, it shall be brought at site on returnable basis only.
7. Bidder shall provide list of general tools, tackles, slings, spanners, gauges and other lifting devices, drills, instruments, testing kits and appliances necessary for the complete assembly, installation, gas filling, maintenance, site testing of the GIS, however, the same shall be arranged by BHEL.

5. Earthing of GIS

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

6. Modular Design & Future extensions

1. The GIS switch gear shall be of modular design offering high degree of flexibility. Each module shall be complete with SF6 gas circuit breaker, disconnectors, Maintenance Grounding switches, fast Earthing switches, voltage transformers, Current transformers, bus & elbow sections, Gas Insulated Bus-duct, local control cubicle and all necessary components required for safe & reliable operation and maintenance.
2. The GIS shall be of either single-phase enclosure type or three-phase enclosure type for voltage levels of 220kV.
3. In those design where bus bar is continuous, provision is to be made available for isolation of individual bay without disturbing adjacent bay.
4. The switchgear shall be of the freestanding, self-supporting dead-front design, with all high-voltage equipment installed inside gas-insulated, metallic grounded enclosures, and suitably sub-divided into individual arc and gas proof compartments, preferably for:
   (1) Bus bars
   (2) Intermediate compartment
   (3) Circuit breakers
   (4) Line dis-connectors
   (5) Voltage transformers
   (6) Gas Insulated bus duct section between GIS and,
   (7) Gas insulated bus section between GIS and oil filled transformer.
   (8) Current Transformers.
5. The bus enclosure shall be sectionalized in a manner that maintenance work on any bus disconnector (when bus and bus disconnector are enclosed in a single enclosure) can be carried out by isolating and evacuating the small effected section and not the entire bus.
6. Arc faults caused by external reasons shall be positively confined to the originating compartment and shall not spread to other parts of the switchgear. In case of any internal arc fault in a busbar, busbar disconnector or circuit breaker, of double bus system, repair works must be possible without shutting down complete substation and at least one busbar and the undisturbed bays must remain in operation.
7. The busbar system shall be sectionalized for each bay and contained in individual SF6 gas tight bus compartments to prevent contamination of the gas of the whole bus bar due to fault in

one bay zone and refill lesser quantity of SF6 gas.

8. Where bus Coupler is specified and in case of any internal arc fault in a busbar, busbar disconnector or sectionaliser, repair work must be possible without shutting down the complete substation and at least one half of the substation must remain in operation.
9. Documents indicating sequence of repair work steps and description of necessary restrictions during work shall be submitted with the technical manual during as built drawing submission.
10. Each bay module should be equipped with suitable arrangement for easy dismantling and refitting during maintenance without disturbing other units.
11. Bus duct lengths shall be taken from the end of bay equipment (VT, LA etc.) to end equipment (SF6 to air bushing, SF6 to oil bushing/ connection etc.)
12. Material clearance certificate shall be issued after demonstration of the functionality of maintenance equipment.
13. Structure Materials for support of GIS, Bus Ducts, SF6 to oil bushing/ connection and SF6 to air bushing/ connection including Foundation Bolts, Embedded Items, Rails and/ or other items structural items required. All steel structure members shall be hot-dip galvanized after fabrication. Unless otherwise specified, minimum mass of zinc coating for Galvanizing shall be 610 gm/square meter. All field assembly joints shall be bolted. Field welding shall not be acceptable. Noncorrosive metal or plated steel shall be used for bolts and nuts throughout the work. Manufacturer shall provide suitable foundation channels and anchor bolts to support the switchgear assemblies. All mounting bolts, nuts and washers shall be provided to fasten the switchgear base frames to the foundation channels.

7. Maintenance and Repair of Circuit Breaker

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

8. Interchangeability & Future Extension

1. As much as possible, all the parts shall be of standard manufacturer with similar parts and assemblies being interchangeable.
2. The GIS system shall be suitable for future extension on either end by the addition of extra feeders, bus couplers, bus-bars, circuit breakers, dis-connectors, and other switch gear

components. The arrangement of gas sections or compartments shall be such as to facilitate future extension without any drilling, cutting or welding on the existing equipment. To add equipment, it shall not be necessary to move or dislocate the existing switchgear bays

3. The layout shall ensure that GIS bus link section is provided for future extension of the GIS buses to avoid de-gassing and modification of the existing bus.
4. The physical layout shall ensure free movement of the SF6 Gas Cart and easy access to all components of the GIS for maintenance purposes.

9. Online Partial Discharge (PD) monitoring system for GIS, if applicable

The equipment shall be used for detecting different types of defects in Gas Insulated Switchgear (GIS) such as Particles, Loose shields and Partial Discharges as well as for detection of Partial discharges in other types of equipment such as Cable Joints, CTs and PTs.

It shall be capable for measuring PD in charged GIS environment as EHV which shall have bandwidth in order of 100 MHz–2GHz with possibility to select a wide range of intermediate bandwidths for best measurement results. The principle of operation shall be based on UHF principle of detection. The instrument should also be able to detect partial discharges in cable joints and terminations.

Detection and measurement of PD and bouncing particles shall be displayed on provided HMI for the system and the measurement shall be stored in the PC for further analysis to locate actual source of PD such as free conducting particles, floating components, voids in spacers, particle on spacer surfaces etc. Software for display and diagnosis of PD signals and an expert software system for accurate interpretation of cause of PD shall also, be supplied and installed on the provided HMI by the contractor.

Measurement shall be possible in the charged substation/ switchyard in the presence of EMI/EMC

10. Bill of Quantities

Quantities for supply and services for 220kV GIS with LCC & its Accessories shall be as per Annexure- BOQ_BPCL.

11. Drawings / Documents required for Engineering Manufacturing Clearance

The drawings/ documents, as follows shall be used for providing technical clearance for manufacturing of GIS and furthermore, it shall be used for delay analysis, if any, from bidder. The 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
1	220KV GIS- Gas Schematics with Single Line Diagram (Including CT VT Parameters)
2	220KV GIS- Guaranteed Technical Particulars (Including all GIS equipment
3	220KV GIS- Layout Plan & Section
4	220KV GIS- Interfacing Drawings for Cable Connection Module, SF6 to Air Bushing, SF6 to Oil Module with Guaranteed Technical Particulars
5	220KV GIS- Equipment Layout with Earthing philosophy

6	220KV GIS- Type Test Reports (Including all GIS equipment)
7	220KV GIS- Secondary Engineering Base Design
8	220KV GIS- Control Schematics for GIS and Local Control Cabinet
9	220KV GIS- Maintenance Equipment Catalogue with Guaranteed Technical Particulars
10	220KV GIS- Quality Assurance Plan & Inspection Test Schedule
11	220KV GIS- Civil Design Specification with Foundation Loading Diagram (Including interfacing details)
12	220KV GIS- Quantification for main Items, Spares, Consumables

12. Type Testing

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

Type test certificates shall not be more than fifteen (15) years old as on original scheduled date of technical bid opening. In those cases, where type test certificates are more than fifteen (15) years old from original scheduled date of technical bid opening, OEM/ bidder shall carry out the type tests at at any ISO/IEC accredited laboratories prior to dispatch of equipment with no commercial implication to BHEL/Customer.

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

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

1. Tests to verify the insulation level (Lightning impulse, switching impulse and ac withstand test with PD) test on each GIS device (CB, Disconnector, bus, etc).
2. Dielectric tests on auxiliary circuits.
3. Tests to prove the radio interference voltage (RIV) level.
4. Tests to prove the temperature rise of any part of the equipment and measurement of the resistance of the main circuit.
5. Tests to prove the ability of the main and earthing circuits to carry the rated peak and the rated short time withstand current.
6. Tests to verify the making and breaking capacity of the included switching devices.
7. Tests to prove the satisfactory operation of the included switching devices.
8. Tests to prove the strength of enclosures.
9. Verification of the degree of protection of the enclosure.
10. Gas tightness tests
11. Electromagnetic compatibility tests (EMC).
12. Additional tests on auxiliary and control circuits.
13. Tests on partitions.

14. Tests to prove the satisfactory operation at limit temperatures.
15. Tests to prove performance under thermal cycling and gas tightness tests on insulators.
16. Corrosion test on earthing connections (if applicable).
17. Tests to assess the effects of arcing due to an internal fault.
18. Tests on solid dielectric components (operating rods, spacers, etc)
19. Seismic test
20. Test on Auxiliary switches (Electrical & Mechanical Endurance, Heat run, IR & HV test)

13. Quality Plan

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

Superior quality control system shall be adopted to assure high product quality. Raw materials of the best commercial grade quality and high reliability shall be used in the manufacture of GIS. High reliability of materials shall be ensured so as to keep maintenance work to a minimum. All materials shall be procured, manufactured, inspected and tested by vendor/ sub-vendor as per approved quality plan. The supplier shall perform all tests necessary to ensure that the material and workmanship conform to the relevant standards and comply with the requirements of the specification. Charges for all these tests for all the equipment & components shall be deemed to be included in bidder's scope.

14. Inspection & Testing

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

15. Field Testing & Commissioning

1. Bidder shall carry out the ~~supervision of~~ installation, field testing and commissioning of 220kV GIS with LCC & its Accessories. Further appropriate test and commissioning reports and as-built documentation as necessary be submitted.
2. Field testing and commissioning of 220kV GIS with LCC & its Accessories shall be done by Bidder/OEM only.
3. Bidder shall also submit site acceptance testing (SAT) procedures and get them approved from BHEL/ Customer before carrying out the site testing at site.

4. All switchboard protection shall be subject to primary injection test before commissioning.
5. Bidder/ OEM shall coordinate with manufacturers of other equipment wherever required and shall freely and readily supply all technical information for this purpose as and when called for.
6. All electrical equipment shall be said to be installed and mechanically complete after circuit testing, primary and secondary injection testing and loop simulation is complete. Due care and consideration shall be given to the installation of 220kV GIS with LCC & its Accessories.

16. Makes of Equipment/ Components

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

17. 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 SF6 equipment shall be shipped in the largest factory assembled units within transport and loading limitations and considering handling facilities on site to reduce the erection and installation work on site to a minimum. Where possible all items of equipment or factory assembled units shall be boxed in substantial crates or containers to facilitate handling in a safe and secure manner.
3. Each individual piece to be shipped, whether crate, container or large unit, shall be marked special notations such as 'Fragile', 'This side up', 'Centre of gravity', 'Weight', 'Owner's particulars', 'PO no.' etc., and other details as per purchase order.
4. The equipment may be stored outdoors for long periods before installation. The packing shall be completely suitable for outdoor storage in areas with heavy rains and high ambient temperature.
5. Special precautions shall be taken to protect any parts containing electrical insulation against the ingress of moisture. This applies particularly to the equipment of which each gas section shall be sealed and pressurized prior to shipping. Either dry nitrogen/air or dry SF6 gas shall be used and the pressure shall be such as to ensure that, allowing for reasonable leakage, it will always be greater than the atmospheric pressure for all variations in ambient temperature and the atmospheric pressure encountered during shipment to site and calculating the pressure to which the sections shall be filled to ensure positive pressure at all times during shipment.
6. All blanking plates, caps, seals, etc., necessary for sealing the gas sections during shipment to site shall be provided. Any seals, gaskets, `0' 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.

18. Abbreviations Used

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

GIS:	Gas Insulated Switchgear
LCC:	Local Control Centre
CT:	Current Transformer
DC:	Direct Current
HV:	High Voltage
EHV:	Extra High Voltage
kV:	Kilovolt
Hz:	Hertz
IP:	Ingress Protection
SAT:	Site Acceptance Testing
CCOE:	Chief Controller of Explosives
OEM:	Original Equipment Manufacturer
ANSI:	American National Standards Institute
ASTM:	American Society for Testing and Materials
BIS:	Bureau of Indian Standards
BS:	British Standard
IEC:	International Electro Technical Commission
IEEE:	Institute of Electrical & Electronics Engineers
IS:	Indian Standards
NEMA:	National Electrical Manufactures Association
CEA:	Central Electricity Authority
DIN:	Deutsches Institiut fur Normung
CCE:	Continuous and Comprehensive Evaluation
LPCB:	Loss Prevention Certification Board
BHEL:	Bharat Heavy Electricals Limited
OISD:	Oil Industry Safety Directorate
BPCL:	Bharat Petroleum Corporation Limited
LSTK:	Lump sum Turnkey
QAP:	Quality Assurance Plan
BOQ:	Bill of Quantities

19. Definitions Used

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

2. Bid/Bidding Documents: The totality of the documents comprising the Bidding Document for the notice inviting tender.

3. Contract: The totality of agreement between Customer/ Purchaser/ Owner/BPCL and the Contractor/ LSTK Contractor/ BHEL as derived from the contract documents.

4. Contractor/ LSTK contractor: The bidder selected by the Customer/ Purchaser/ Owner/BPCL for the performance of the work and supply of materials. In this case, it is BHEL.

5. Customer/ Purchaser/ Owner: Indian Oil Corporation Limited.

6. Consultant: Any person(s)/ Firm nominated/ assigned by the Contractor/ LSTK Contractor/ BHEL for providing the engineering consultant services. In this case, it is CB&I INDIA PRIVATE LIMITED.

7. Bidder/ vendor: The bidder selected for this intended work shall be known as vendor.

20. List of Documents/ Drawings

Following drawing/ documents are attached for information purpose,

1. Single Line Diagram
2. Layout Plan
3. Architectural Drawing of Building

SCOPE OF WORK & JOB SPECIFICATION

(ELECTRICAL)

FOR

220kV GIS PACKAGE

(TENDER NO. B957-000-16-50-EB-T-0020)

PROJECT : MPMC AND PMC/EPCM SERVICES FOR ETHYLENE CRACKER UNIT AND UTILITIES & OFFSITES RELATED TO BINA PETCHEM & REFINERY EXPANSION PROJECT (BPREP)

OWNER : M/s BHARAT PETROLEUM CORPORATION LTD.

EPCM : ENGINEERS INDIA LTD.

JOB NO. : B957

Rev. No	Date	Purpose	Prepared by	Checked by	Approved by
A	20.11.2024	ISSUED WITH TENDER	SK	RSR	RSR

CONTENTS

1 GENERAL

1.1 INTRODUCTION

I. This section defines the electrical scope of work and job specification for 220 kV Gas Insulated Substation Package for BPREP Project of BPCL – Bina Refinery. This specification along with design basis, design philosophy, equipment datasheets, equipment specifications, drawings/ documents and other codes/ standards attached or referred shall form the basis for detailed design and engineering, manufacturing, supply, erection, testing, pre-commissioning, commissioning of the electrics covered in this tender of 220 kV Gas Insulated Substation Package for BPREP Project of BPCL – Bina Refinery.

II. The work shall be carried out to the best workmanship, in conformity with the specifications, approved drawings/ construction drawings and the instructions of the owner or Engineer-in-Charge from time to time.

III. The contract shall include clearing of temporary constructions, waste materials and loose earth, which might get collected in and nearby the work site during execution of work and after final completion.

1.2 STANDARDS

I. The work / equipment shall also comply with the requirements of latest revision of codes & standards attached or referred with the tender document. In case of any conflict between the various documents, the most stringent one shall be followed and Owner's/ EIL decision in this regard shall be final and binding. It is the responsibility of the Contractor to highlight any contradictions between various documents at the bid stage itself.

II. In case of imported equipment, codes and standards of the country of origin may be followed, if these standards are equivalent or stringent than the applicable Indian standards and meet the statutory regulations of approving Indian statutory bodies.

III. In addition, the work shall also conform to the requirements of latest editions/ amendments of the following:

- The CEA guidelines and rules framed there under.
- The fire insurance Regulations.
- Indian Petroleum Rules.
- The regulations laid down by Electrical Inspectorate (CEA).
- The regulations laid down by the Factory Inspectorate
- The regulations laid down by the Chief Controller of Explosives.
- The regulations laid down by Oil Industries Safety Directorate (OISD).
- Any other regulations laid down by the Central, State or Local Authorities from time to time during the execution of this contract.

1.3 GUARANTEE

I. The contractor shall guarantee the installation for satisfactory operation against any defects of workmanship and materials (supplied by the contractor) for a period as specified elsewhere. Any damage or defect connected with the erection of materials, equipments or fittings supplied by the contractor that may be discovered at the time of issue of the completion certificate, or arise or come to light thereafter, shall be rectified or replaced by the contractor at his own expense as deemed necessary and as per the instruction of Owner or Engineer-in-Charge within the time limit specified by the Owner or Engineer-in-Charge.

II. The above guarantee shall be applicable for the quality of the work executed as well as for all equipment/ cables/ fixtures/ fittings/ other materials supplied by the contractor.

1.4 SITE CONDITION

For site conditions refer the clause 5.1 of Electrical Design Basis document B857-999-16-50-EDB-1001 enclosed with the package.

1.5 UTILIZATION VOLTAGE

For details of the utilization voltage refer the electrical design basis document B857-999-16-50-EDB-1001 enclosed with the package.

For the works to be executed in existing refinery area, utilisation voltage for control supplies i.e. 110V DC OR 110V AC UPS, shall be finalised during detailed engineering.

1.6 ENGINEERING AND JOB SPECIFIC REQUIREMENTS

I. Various equipment (to be supplied by contractor) covered in this tender, shall be in compliance with the requirements defined in design philosophy, equipment datasheets and specifications attached/ referred. Besides these, the requirements as defined in respective clauses for individual equipment, referred elsewhere in this document shall also be considered/ complied with.

II. Contractor shall ensure that all electrical equipment shall comply with the site and system conditions, ratings and other technical requirement specified elsewhere with the documents attached with the tender.

III. CONTRACTOR shall use this specification, datasheet, design philosophy document and OWNER/ Consultant's standard specifications for various equipments. For equipments, where OWNER/Consultant standard specifications are not available, have not been attached, CONTRACTOR/ SUPPLIER shall use their own specification, developed based on project specific requirement and good engineering practices prevalent in petroleum industry, so as to ensure satisfactory operation and maintenance conditions. CONTRACTOR to however check from OWNER/ EIL with respect to availability of EIL standard/ specification, before use of their own specification

IV. CONTRACTOR shall note that data sheets for some of the equipment are not enclosed separately. Equipment data sheets for such equipments shall be prepared by the CONTRACTOR/ SUPPLIER based on relevant codes and specifications and the data sheet shall contain all technical data and information which is essential for the purpose of review and technical acceptability, detailed engineering, installation, testing, repair and maintenance, replacement, etc. of the equipments. CONTRACTOR to however check from OWNER/ EIL with respect to availability of standard datasheet, before use of their own datasheet

V. The CONTRACTOR shall also prepare data sheets mentioned in OWNER/ Consultant standard specifications, but not enclosed with the package.

VI. The equipment shall in general conform to latest revision of statutory regulations, Indian Standards, IEC/ Other international standards applicable for the country of origin of the equipment

VII. All equipment shall be subjected to routine and acceptance tests as per applicable specifications.

VIII. CONTRACTOR shall clearly specify in their purchase specifications, the requirement of conducting other special tests/ type tests, envisaged for various electrical equipment. Same shall be conducted without any time/ cost implication to OWNER/ Consultant.

2 POWER SYSTEM DESCRIPTION

To meet the power requirement of Petrochemical complex in BPREP Project in BPCL Bina Refinery, power will be received at 220kV from state electricity board through double circuit

overhead line at 220kV. These lines shall be terminated on the outdoor gantry located in existing refinery area near MRS along with outdoor type 220kV GIS bays and further connection will be made to the 220kV GIS for this Project though single core copper cables.

Once this power is received at the 220kV GIS, same shall be then stepped down to 66kV using 220/69kV power transformers. These power transformers in turn will be connected to 66kV GIS through 66kV Gas insulated bus duct (GIBD).

Primary distribution in the plant shall be done at 66kV using the 66kV GIS located in Main Receiving Substation (MRS-100). 66kV transformer feeders from MRS-100, each rated for 100% load, will supply power to downstream substations. Power will be received at 66kV GIS Isolating breaker panels (IBP) (located indoor in respective downstream substations via 66kV (Earthed grade) cables, outgoing cabling from IBP to 66/6.9kV power transformers (located outdoor) via 66 kV (Earthed grade) cables. The stepdown power at 6.6 kV shall be fed to 6.6 kV switchboard having two incomers & two bus sections interconnected by means of a bus coupler set (one normal bus coupler & one dummy bus coupler). This 6.6kV board shall cater to all 6.6 kV loads. All HV motors rated above 132kW shall be at 6.6 kV fed from 6.6 kV switchboard. Power shall be stepped down to 415 V using 6.6 kV / 0.433 kV distribution transformers for feeding 415V loads and miscellaneous loads like welding receptacles, power panels etc. through power cum motor control centres.

MV motors up to 132 kW will be fed from PMCC. Auto/Manual changeover facility shall be provided in PMCC & EPMCC while mechanical interlock shall be provided in incomers for LDB & ELDB.

220kV, 66 kV and 415 V systems are solidly earthed, whereas, 6.6 kV system is resistance earthed.

A separate EPMC has been envisaged for feeding plant emergency loads. 1 incomer of EPMC shall be fed directly from PMCC and second incomer will be fed through 1 no. 6.6/0.433 kV distribution transformer backed through DG to provide reliability in the system.

EPMC will have two sections interconnected by a normally open buscoupler. EPMC shall be provided with auto transfer facility.

Plant normal lighting loads will be fed through normal lighting distribution board having two incoming supplies one incomer fed directly from PMCC and another incomer through 415V/415V lighting transformers fed from each bus section of normal PMCC.

25% of plant lighting will be on emergency. Emergency lighting load will be fed through an emergency lighting distribution board having both incoming supplies fed through 415V/415V lighting transformers from each bus section of emergency PMCC.

230V AC UPS shall be provided in the substation for feeding control supply for ECS Panels, LAN, HMIs, etc., in substation.

110V DC battery and chargers shall be provided to feed critical DC lighting, and 110V DC system for switchgear protection and control circuits which will be located in the substation building.

ECS system shall be procured by Owner. All equipments shall be connected to ECS for monitoring and control as per ECS IO list.

Refer key single line diagram and scope demarcation drawing for typical power distribution scheme and broad scope demarcation.

3 SCOPE OF WORK (ELECTRICAL)

3.1 GENERAL

The electrical scope of work under this tender shall include but not be limited to basic and detailed engineering, manufacturing, supply, transportation to site, storage at site, inspection at manufacturer's work, erection, testing, commissioning of all equipments, supply of all mandatory spares, commissioning spares, special tools and tackles, cabling, earthing, lighting, fire alarm, plant communication works as defined in the scope document, drawings, installation standards, equipment datasheets, standard specifications, etc. attached or referred with the tender document.

3.2 SCOPE OF BASIC AND DETAILED ENGINEERING

The scope of basic and detailed engineering includes sizing and selection of electrical equipment, cables, earthing, lighting, fire alarm system, and preparation of layouts and other items covered in the scope of CONTRACTOR. This shall include but not be limited to the following

I. Basic and detail engineering activities for design of MRSS-100 substation building and co-ordination with Civil, Mechanical for cut-outs, cable trays, trenches, designing of air conditioning system, EOT crane, etc.

II. Design and engineering of electrical system for air conditioning system, EOT crane, etc.

III. Design and engineering of grid connected rooftop solar photovoltaic system comprising of array layout, SLD, mounting structure design, shadow analysis, etc., on the roof of substation building (MRSS-100).

IV. Basic engineering calculations i.e. load analysis, load flow, short circuit, for selection of electrical equipments.

V. Design, engineering, sizing and selection of equipment and facilities comprising of switchboards, NIFPS, HV water spray system, DC system, UPS system, Fiber Optic transmission system, lighting transformer, etc. and submission of sizing calculation report for OWNER/ PMC review.

VI. Overall single line diagram and protection & metering SLDs for individual switchboards, DC systems, UPS system, and auxiliary power supply system in CONTRACTOR's scope.

VII. Cable sizing, illumination level calculation and preparation of power supply distribution scheme for normal, emergency and critical lighting, design calculation for earthing system (as per IEEE-80 in support of step and touch potential) and lightning protection system (as per IEC 62305) for the 220 kV GIS substation MRSS-100.

VIII. Preparation of equipment layouts, lighting layouts, cabling layouts, earthing layouts, lightning protection layout, NIFPS piping layout, plant communication layouts, fire alarm layouts, telephone layouts, LAN system layout for 220 kV GIS substation (MRSS-100).

IX. Preparation of bill of materials for cabling, lighting, earthing and lightning protection, , plant communication, fire alarm, telephone system, LAN and miscellaneous items.

X. Preparation of system architecture drawings for Substation automation system.

XI. Insulation co-ordination studies for the 220 kV GIS substation package to finalize location and quantity of surge arrestors required in addition to those shown in SLD.

XII. Calculation of requirement of IOs for ECS Interface Panels (transducer panel, Dummy panel, Interposing relay panel) and ECS RTU Panels etc. for interface of 220 kV GIS substation package with client's ECS System. ECS interface panel shall be free issued by owner at MRSS-100. Installation of the same is in scope of contractor.

XIII. Relay Co-ordination studies including protection coordination charts, relay setting calculations; relay parameterization for complete PETCHEM complex including MRS-100 is in scope of CONTRACTOR. ETAP Project files (i.e. *.oti file) for the new system along with coordinated

relay setting shall be provided by contractor. ETAP project files for downstream relay coordination shall be provided by EIL/Owner during detail engineering. Contractor to verify and co-ordinate the relay settings with upstream MPPTCL grid feeder and downstream PETCHEM complex substations and hand over the updated ETAP project file (OTI file) to Owner/ EIL.

XIV. Preparation of miscellaneous engineering document such as electrical equipment list, lighting/ power panel schedule, cable schedule, interconnection drawing, ECS interface document, etc.

XV. 3D Modelling shall be done for substation buildings consisting of all the equipment like FA system, HVAC/VAM (including ducts), equipment layout (panels and transformers), etc. to avoid fouling of various systems and subsequent re-work. Also, cable tray and cable trench design in cable cellar of substation shall be reviewed in 3D model.

XVI. Preparation of specification for procurement of electrical equipment in CONTRACTOR's scope of supply, review of sub vendor drawings and then submission of electrical equipment drawing for review/ information, preparation of site executable (AFC) engineering drawings and details for installation work, wherever applicable.

XVII. Collection of data from Site/ Owner as required for carrying out detailed engineering.

XVIII. Shop inspection and testing procedures and QA schedule.

XIX. Field testing and commissioning procedures.

XX. Preparation of as-built drawings on completion of the project for final records.

XXI. Preparation of operation and maintenance schedule/manuals.

XXII. Preparation of all drawings and documents required for obtaining the approvals from MPPTCL for the 220 kV system interface.

XXIII. The CONTRACTOR while performing design and engineering activities shall adhere to following guidelines:

3.2.XXIII.1 CONTRACTOR, if not stated but required shall prepare any additional specifications for equipment or bulk material. CONTRACTOR shall follow current national & international standards/specifications for the equipment that are not covered by OWNER/ EIL's specifications.

3.2.XXIII.2 The drawings attached with tender define the basic system design and distribution philosophy for the package and are for guidance purpose only. CONTRACTOR shall develop detailed drawings and submit for EIL/owner review.

3.2.XXIII.3 Contractor to note that equipment ratings and quantity, wherever specified in the bid package shall be considered as minimum rating & quantity. Contractor shall be responsible to verify the same and provide equipment with higher rating & quantity subject to minimum rating as per bid package requirements. Compliance to the same shall be without any extra cost and time implications to owner.

XXIV. Interface engineering and drawing, as required for the completeness of erection, testing and commissioning of electrical system.

XXV. Any other work/activity which is not listed above, but however found necessary for completeness and satisfactory operation of the electrical system.

XXVI. Fire Protection system for the building to be designed in line with the EWS-Design Basis (doc. No. B857-000-17-43-BD-1001) / applicable codes / statutory requirements attached in tender.

3.3 SCOPE OF SUPPLY, ERECTION, TESTING AND COMMISSIONING

The electrical scope covered under this package includes but shall not be limited to supply erection, testing and commissioning of the following (**Equipment rating and specifications mentioned here are preliminary and approval has to be taken from EIL/owner before finalizing the rating and placing order**):

I. 220 kV Outdoor switchyard complete with substation cum control room building, incoming gantry, lightning arrestor, motorized isolators with earth switch, EHV outdoor CT & PT, AAAC/ ACSR conductors, clamps & connectors, lighting, earthing, lightning protection, etc. for receiving power from double circuit 220kV overhead line. Minimum rating/type of various equipments is as listed below:

- 2000 Amps, Double Break Center Rotating, Motorized type Isolator with Earth Switch
- 220kV/√3 / 110V/√3 Single phase potential transformer for metering with 3 cores (minimum) as per MPPTCL standard design philosophy.
- Single phase Current Transformer for metering with 2 cores (minimum) as per MPPTCL standard design philosophy.
- 220kV/√3 / 110V/√3 Single phase CVTs for wave trap & communication with cores as per MPPTCL standard design philosophy.
- PLCC system with wave traps & 48V DC System for both sending & receiving end shall be procured as part of this tender. Installation, testing and commissioning of sending end equipments MPPTCL substation is also in the scope of CONTRACTOR. Make/model/design of same shall be as per MPPTCL standard design philosophy.
- OPGW/FOTE system including all control panels and other equipment for both sending & receiving end shall be procured as part of this tender. Installation, testing and commissioning of sending end equipments MPPTCL substation is also in the scope of CONTRACTOR. Make/model/design of same shall be as per MPPTCL standard design philosophy.
- Lightning Arrestor for 198kV, 10KA, Zinc Oxide type with discharge counter, insulating base and other accessories
- Tri-vector meter for tariff metering as per MPPTCL standard design philosophy including features and provisions for Open Access metering purpose
- Conductor within the gantry area shall be free issued by MPPTCL. However, installation, testing & commissioning of conductor including supply of related connectors, clamps etc shall be in the scope of CONTRACTOR.
- Main I & main II schemes shall be in the form of Numerical Distance relays having built in back up differential protection, different make, preferably based on different fault detection algorithms shall be supplied by CONTRACTOR.
  Both distance protection relay shall have parallel redundant port for communication on IEC 61850 Protocol.
  Relays type LBB, NDR, DTOC have been considered built in the DPR.
- Supply, Installation, Testing and commissioning: at both end, i.e. MPPTCL end and within battery limit is by CONTRACTOR. At MPPTCL end, these relays shall be installed in a separate relay and control panel.
- Bus post insulators as required
- Gantry as required
- All other items as required for outdoor switchyard.

II. 220 kV, 2000 Amps, 50 kA (3 Sec), Double Bus Gas Insulated Switchgear with Local Control Cubicle and Separate control and relay panel complete with numerical relay, metering, protection and synchronization panel at MRSS-100. Control and relay panel for GIS shall be simplex type.

III. Communicable type power quality meter along with HMI shall be provided at all 220kV incomer feeders of 220kV switchboard envisaged at MRSS-100 for monitoring of various current & voltage harmonics at 220kV level. Communication protocol of this meter shall be selected by contractor so that same can be hooked up with 220kV SAS for centralised monitoring at ECS.

IV. SCAP panel for 220kV GIS system shall be provided in MRSS-100.

V. 3 Number of 220/66 kV, 160/200 MVA, ONAN/ ONAF, YNyn0, Z= 12.5% (-0% to +10%), Oil filled transformer with OLTC and RTCC and suitable for bidirectional power flow as per enclosed

specification and datasheets. Power transformer shall be provided with Nitrogen Injection Fire Protection System (NIFPS) along with HVWS based fire fighting system. RTCC Panel shall be with dual redundant AVR facility.

VI. 66kV, 2000A, 40kA (3 sec.), SF6 Gas Insulated, single phase, 3 phase enclosure or single-phase enclosure busduct with all bends and flexibles comprising of the Gas monitoring devices, barriers, pressure switches, UHF PD sensors etc.

VII. 66 kV, 3150 Amps, 40 kA (3 Sec), Double Bus Gas Insulated Switchgear with Local Control Cubicle and Separate control and relay panel complete with numerical relay, metering, protection and synchronization panel. Control and relay panel for GIS shall be simplex type.

VIII. 20 Nos. of 66 kV, 630 Amps, 40 kA (3 Sec), Gas insulated Isolating Breaker Panel with SF6 circuit breaker complete with disconnector, earth switch, power cable termination kits, surge arrestor, numerical relay, metering and protection as per enclosed specification and datasheet. This panels shall also include supply of transformer differential relays for both ends. Note that Internal Arc Classification (IAC) rating of switchboard shall be 40 kA for 3 sec.

IX. 2 Nos. of 33 kV, 800 Amps, 40 kA (1 Sec), Gas insulated Isolating Breaker Panel with SF6 circuit breaker complete with power cable termination kits, numerical relay, metering and protection as per enclosed specification and datasheet for installation in CT-02 substation (SS-109) in Petchem area. Note that Internal Arc Classification (IAC) rating of switchboard shall be 40 kA for 1 sec.

X. 1 No 6.6 kV, 800 Amps, 40 kA (1 Sec), Isolating breaker panel with earthing truck, lifting truck (wherever applicable) complete with numerical relay, metering and protection as per enclosed specification and datasheet. Note that Internal Arc Classification (IAC) rating of switchboard shall be 40 kA for 1 sec.

XI. 2 nos. 66/ 6.9 kV, min. 16/20 MVA, Z=10% (-0% to +10%), Dyn1, ONAN/ONAF transformer with OLTC and RTCC as per attached data sheet. Power transformer shall be provided with HVWS based fire fighting system. RTCC Panel shall be with dual redundant AVR facility.

XII. 2 nos. neutral grounding resistor (3.81kV, 600A for 10 sec.) as per attached data sheet& EIL specification, 6-51-0043.

XIII. 2 sets of 6.6 kV, 2500A, 40kA for 1sec. air insulated segregated phase bus duct as per enclosed datasheet. Drawing of MRSS-100 is attached with tender based on which length of bus duct shall be estimated by contractor.

XIV. 1 no. 6.6kV, 2500Amps, 40kA (1sec.), AIS switchboard as per attached data sheet & feeder list for feeding package loads including owner's loads:

Note: Supply, laying & termination of 6.6kV power & control cable from outgoing terminal of owner's feeders shall be taken care by owner. Cable route within battery limit shall be provided by contractor. Also the receiving end unit of feeder differential protection (87F) shall be free issued by contractor for installation at the downstream 6.6kV switchboard by the respective package contractor.

XV. 2 Numbers, 6.6/0.433 kV, 1600 KVA (minimum), Off Circuit tap changer, Dyn11, oil filled distribution transformer with min. Energy Efficiency Level 3 as per IS 1180 (Part-1) / GOI notification dtd. 08-Dec-2023, BEE star rating 3 including amendments, for feeding substation normal loads.

XVI. 1 Number, 6.6/0.433 kV, 500 KVA (minimum), Off Circuit tap changer, Dyn11, oil filled distribution transformer with min. Energy Efficiency Level 3 as per IS 1180 (Part-1) / GOI notification dtd. 08-Dec-2023, BEE star rating 3 including amendments, for feeding substation emergency loads.

XVII. 415 V, 2500 Amps (minimum), 65 kA (1 Sec) TPN Bus duct for connection between Transformer and Switchboard.

XVIII. 1 no. 415 V, 2500 Amps (minimum), 65 kA (1 Sec) and draw out type TPN switchboard (Power and Motor control center – PMCC) complete with numerical relay, metering and protection as per enclosed specification and datasheet. PMCC shall have two incomer from transformers and one incomer from rooftop solar photovoltaic system and bus coupler with auto changeover facility. Outgoing feeders shall be sufficient to cater CONTRACTOR load, Owner's load and spare feeders as per spare philosophy.

XIX. 1 no. 415 V, 800 Amps (minimum), 65 kA (1 Sec) and draw out type TPN switchboard (Emergency Power and Motor control center – EPMCC) complete with numerical relay, metering and protection as per enclosed specification and datasheet. EPMCC shall have one incomer from PMCC and second incomer from owner's substation SS-109 (CT-2) through 6.6kV IBP, 6.6/0.433kV transformer and bus coupler with auto changeover facility. Outgoing feeders shall be sufficient to cater CONTRACTOR load, Owner's load and spare feeders as per spare philosophy.

XX. 415 V, 250 Amps (Minimum), 25 kA for 1 Sec (Minimum) and draw out type TPN lighting distribution board (LDB) as per enclosed specification and datasheet for all the normal lighting including those for owner's use. LDB shall have two incomer and one bus coupler. Quantity and rating/ type of outgoing feeders shall be sufficient to cater CONTRACTOR load, Owner's load and spare feeders as per spare philosophy.

XXI. 415 V, 250 Amps (Minimum), 25 kA for 1 Sec (Minimum) and draw out type TPN Emergency lighting distribution board (ELDB) as per enclosed specification and datasheet for all the emergency lighting including those for owner's use. ELDB shall have two incomer and one bus coupler. Quantity and rating/ type of outgoing feeders shall be sufficient to cater CONTRACTOR load, Owner's load and spare feeders as per spare philosophy.

XXII. Substation Automation System (SAS) is in the scope of supply of CONTRACTOR. Hardware for Substation Automation system includes all cables, Ethernet switches, gateway, FO cable, HMI, industrial grade laptop for interfacing with Numerical relays over IEC-61850 etc. Provision of hook-up of soft electrical control, monitoring and status signals to ECS system, SCAP system of MRSS-100 shall be provided in SAS. Software for all interfacing & control for Numerical Relays and other system components shall be installed in HMI and Laptop. All hardwired signals shall be connected upto the ECS interface panels by CONTACTOR.

Separate SAS shall be provided each for 220 kV GIS and 66kV GIS system at MRSS-100. Further common SAS shall be provided for 6.6kV & 415V system at MRSS-100.

Interface between Contractor's SAS & owner's DCS is not envisaged. However, for other connectivity of contractor supplied equipment, refer instrumentation part of tender.

Integration with MPPTCL is also required for meters/ switchgear for implementation of load trimming scheme, availability-based tariff metering and SCADA interface for real time data visibility. All hardware and components, as required by MPPTCL for establishing communication shall be in scope of CONTRACTOR. All details of existing system, as required shall be obtained from MPPTCL, by CONTRACTOR.

XXIII. ECS of MRSS-100 is new & included in owner's scope (supply, testing & commissioning). However, installation of owner's supplied ECS panels i.e. interface panels (transducer panel, dummy panel, interposing relay panel) & RTU panel at MRSS-100 is kept in contractor's scope.

XXIV. 110V DC supply system comprising parallel redundant battery chargers, 2 x 100% Nickel Cadmium battery, DCDB, cell booster, for switchgear protection & control including spare feeders and feeders for Owner's use as required.

XXV. 110V DC supply system comprising parallel redundant battery chargers, 1 x 100% Nickel Cadmium battery, DCDB, cell booster for critical lighting including spare feeders and feeders for Owner's use as required.

XXVI. 230V, Parallel Redundant UPS with Bypass (2+1 Design) and Ni-Cd battery backup (2 X 100%) with ACDB, Cell Booster and self-powered disturbance recorder with internal battery backup

shall be provided for providing for control supply to ECS Panels, LAN, SAS HMIs, etc., installed in substation

XXVII. 2 nos. 415V/415V, Off Circuit, Dyn1, dry type lighting transformer for feeding normal & emergency lighting loads of substation buildings & outdoor switchyards. Note that minimum rating of lighting transformers shall be considered as 100KVA (normal lighting) & 50KVA (emergency lighting) at MRSS-100.

XXVIII. IP Telephone system for 220 kV GIS package including supply of telephone distribution JB, and wiring from JB upto telephone sockets in substation building as per specifications enclosed in tender. However, min. 2 nos. telephones per switchgear floor shall be provided in substation.

XXIX. LAN system for 220 kV GIS package complete with LAN wiring, UTP jacks, rack panels, LIUs and associated power sockets is included in CONTRACTOR scope. Connection with existing refinery LAN system shall be done by others.

XXX. MV Motors, as required. All safe area MV motors shall be energy efficient IE4 type as per IS 12615.

XXXI. Local control stations/ push button stations for motors/ transformers, lighting control, etc. as required. Lighting panel/ power panel/ Welding receptacles/ convenience sockets/ junction boxes/ marshalling panel, as required, industrial grade, suitable for installation in safe area.

XXXII. Flameproof and corrosion proof, certified for gas group IIC classified locations equipment (Lighting fixture, exhaust fan, etc.) suitable for installation in battery room.

XXXIII. Design, supply, laying, termination (including termination kit), testing & commissioning of 220kV (E) copper conductor cable with aluminium corrugated sheath (1Rx1Cx630 sq.mm. min.) from outdoor gantry to incoming of 220kV GIS switchboard in MRSS-100 and outgoing 220kV GIS to primary cable box of 160/200MVA (min.), 220/66kV transformer envisaged at MRSS-100 shall be supplied, laid & terminated by contractor. In this regard, contractor to follow the EIL standard specification, 6-51-0067 & data sheet.

Additionally, Contractor to provide 1 extra run of cable per line laid (which should be able to connect to any of the phase R/Y/B) and should be made ready to connect including termination kits at both ends. This extra run should be safe guarded and sealed for environmental protection as practiced in other outdoor substations.

XXXIV. Design, supply, laying, termination (including termination kit), testing & commissioning of 66kV (E) copper conductor cable with aluminium corrugated sheath (1Rx1Cx240 sqmm. Min.) from outgoing terminal of 66kV GIS switchboard of MRSS-100 to primary cable box of 16/20MVA (min.), 66/6.9kV transformer envisaged at MRSS-100 shall be supplied, laid & terminated by contractor. In this regard, contractor to follow the EIL standard specification, 6-51-0067 & data sheet.

XXXV. Design, supply & laying of 66kV (E) cable from outgoing terminal of contractor supplied GIS switchboard to downstream individual package unit shall be done by others. However, 66 kV termination kits required at contractor supplied 66kV GIS at MRSS-100 shall be supplied by contractor.

XXXVI. 66kV & 33kV Termination kits for 66kV & 33kV Isolation breaker panels (IBP) for both incoming and outgoing shall be supplied by Contractor.

XXXVII. Design, supply, laying, termination (including termination kit), testing & commissioning of 6.6kV (UE) cable shall be supplied, laid & terminated by contractor. Contractor to follow the cable data sheet & applicable EIL standard specification, 6-51-0051. Laying & termination of 6.6kV cable (except the owner's feeders and incomer of IBP) for contractor supplied equipment including termination kit is in scope of contractor.

XXXVIII. 2 nos. adequate rated indoor panel mounted capacitor bank each rated 50% of total rating with APFC relay at 6.6kV level for maintaining power factor at input of 66/6.9kV power transformer as 0.95 (lag). Each bank shall have vacuum contactor for ON/OFF control.

XXXIX. Contractor shall provide controlled switching device/synchronous switching device in each of the 220kV outgoing transformer feeders (including at all spare feeders) at 220kV GIS substation (MRSS-100) to limit voltage dip during closing of transformer incomer breaker. Details of CSD along with reference list of past executed projects & filed proven test record shall be furnished by the contractor for review/approval of EIL/owner. Contractor shall carry out transformer inrush current study for all EHV transformer under various operating conditions & shall submit the report to EIL/owner for review/approval.

XL. All incoming and outgoing, XLPE Insulated, armoured, FRLS type outer sheath MV cables for power, control and space heater complete with laying and termination accessories for equipment supplied by contractor.

XLI. All fibre optic cables (Single mode type only) required for communication between various equipment supplied &installed by contractor, shall be supplied, laid and terminated by the contractor including all accessories (termination kits, pig tails, LIUs, patch cords, etc.) as required.

XLII. All cabling accessories i.e. straight through joints, end termination kits, GI pipes, GI cable trays complete with structural supports, top and bottom tray covers, cable glands and lugs, cable markers, HDPE ducts for laying FO cables, etc. as required for the complete package inside substation building including cables being supplied and laid by owner/others.

XLIII. Complete earthing and lightning protection system comprising of earth pit with electrode, earth grid, earth plates, GI earth strips for earth connection between equipment and earth plates, lightning arrestors, earthing conductor, etc. as required for earthing and lightning protection of the various equipment.

XLIV. Normal and Emergency lighting system comprising of lighting panels, LED type lighting fixtures with clamps/ connectors/ adaptors, for indoor and outdoor lighting, DC critical lighting, plug, socket, etc. as per design basis for the complete 220 kV GIS substation.

XLV. Free standing floor mounted type PDB for space heater outgoing supply to various switchboards/ bus duct/ other equipment, with 415 V, TPN incomer and 240 V SPN outgoing feeders as required.

XLVI. Solar rooftop photovoltaic system consists of SPV array, Module Mounting Structure, Power Conditioning Unit (PCU), etc. suitable for installation on roof of substation building of MRSS-100.

XLVII. Electrics for various mechanical systems like EOT cranes, Air conditioning, etc. as applicable.

XLVIII. Fire-proof sealing system and fire protection coating system to prevent spreading of fire from one zone to another through the openings in wall / floor, along cables laid in trays / racks and through openings below floor-mounted Electrical Switchgear, PMCC, Distribution Boards, Junction boxes, Cabinets and Panels.

XLIX. Canopies complete with fixing arrangement and hardware for all outdoor electrical equipment in scope of the CONTRACTOR.

L. Distribution boards for various DC & AC supplies.

LI. One set of special tools and tackles, erection hardware and touch up paint as required, Start-up & commissioning spares, as required during commissioning.

LII. Mandatory spares as per the spares listed elsewhere in the tender.

LIII. List of recommended spares for 2 years of normal operation and maintenance of all electrical equipments, along with unit rates and quantity.

LIV. All Civil works required for installation of electrical equipment, supports for cables/ cable trays, equipment foundations, etc., for completion of electrical works in substation.

LV. CONTRACTOR shall include painting and marking of all buses, individual incomers, all outgoing feeders etc. with details such as tag no., feeder rating, CT details, sending end source reference etc. for all switchboards. Painting and marking of important parameters of all other indoor and outdoor equipments, lighting and FA devices, earth pits, etc. (supplied and/ or installed by CONTRACTOR) is also included in CONTRACOTR's scope.

LVI. Inspection and Factory Acceptance Tests including type tests for electrical equipment. Contractor shall also furnish factory acceptance and site acceptance testing procedures from manufacturers for OWNER/EIL approval. Site acceptance testing shall be included for equipment's such as numerical relays, substation automation system, etc. The equipment manufacturer shall carry out these tests at site only. Site testing procedures shall be got approved from OWNER/EIL before performing these tests at Site

LVII. For the following equipment, CONTRACTOR shall ensure that installation, testing and commissioning of the equipment at site shall be done by the respective equipment manufacturer (OEM):

- 220 kV Double bus GIS and associated LCC
- Control and Relay panel for 220 kV Double Bus GIS (Testing & Commissioning only)
- 66 kV Double bus GIS and associated LCC
- Control and Relay panel for 66 kV Double Bus GIS (Testing & Commissioning only)
- 66 kV GIS Isolating Breaker Panel (Testing and Commissioning only)
- 33 kV GIS Isolating Breaker Panel (Testing and Commissioning only)
- Grid transformer including NIFPS
- Power transformer
- 6.6 kV switchboard & 6.6kV Isolating Breaker Panel (Testing and Commissioning only)
- Numerical relays and Substation Automation System (Testing and Commissioning only)
- MV switchboards (Testing and Commissioning only)
- Complete DC System & AC UPS (Testing and Commissioning only)
- Solar rooftop photovoltaic system.

However, for other equipment's, contractor shall ensure services of manufacturer's representative as required during testing and commissioning.

LVIII. Contractor shall carry out the installation, field testing and commissioning of all electrical equipment supplied as part of this package, including installation, assistance in field testing and commissioning of free issue items, provision of appropriate test and commissioning reports and as-built documentation as necessary for all but not limited to equipment and systems specified above.

LIX. The contractor shall obtain approvals from the concerned electrical inspectorate (e.g. CEA, State Authority etc.) for installation drawings and engineering of the electrical system and equipment covered under the contractor's scope. Any modification or additional requirements of the electrical inspectorate shall have to be carried out by the contractor at his own cost without affecting time schedule. Any additional testing, if required, shall be carried out by the contractor without affecting project time schedule at no extra cost to owner.

LX. Providing training for TEN number OWNERS' s Engineers for a period of at least three days for each item at Site for the following equipment's is included in the Contractor's scope:

- 220 kV Double bus GIS and associated LCC
- Partial Discharge Monitoring of 220 kV GIS
- Control and Relay panel for 220 kV Double Bus GIS
- 66 kV Double bus GIS and associated LCC
- Partial Discharge Monitoring of 66 kV GIS
- Control and Relay panel for 66 kV Double Bus GIS
- NIFPS of Power transformer
- 66 kV GIS Isolating Breaker Panel

- 33 kV GIS Isolating Breaker Panel
- 6.6kV Isolating breaker panel
- 6.6kV HV switchboard
- Numerical relays and Substation Automation System
- Complete DC System & UPS
- Solar rooftop photovoltaic system.

LXI. All other electrical equipment materials and work not explicitly mentioned but nevertheless required to fulfil the following minimum requirements shall deemed to be included in the scope of the CONTRACTOR with no additional cost and time implication to the owner/ EIL.

3.3.LXI.1 To meet equipment and personnel safety.

3.3.LXI.2 To suit site facilities and environmental conditions.

3.3.LXI.3 To meet the requirements of statutory approving authorities.

3.3.LXI.4 To coordinate with other contractors and agencies involved at site for other activities and site work.

3.4 FREE ISSUE EQUIPMENTS/ ITEMS

Following equipment/ items shall be free-issued by the owner to the contractor for Engineering/ Installation/ testing and commissioning as per scope of work defined:

I. Fire Alarm devices for 220 kV GIS kV GIS package substation building (MRSS-100) shall be supplied (free issued) by Owner. Preparation of fire alarm layout, block diagram and installation of fire alarm devices in MRSS-100 substation building as per approved layout including FA system cabling is in scope of CONTRACTOR. Testing and commissioning of Fire alarm devices shall be done by others.

II. Plant communication equipment for 220 kV GIS package substation building (MRSS-100) shall be supplied (free issued) by Owner. Preparation of PA layout, block diagram, speech diagram and installation of Plant communication devices in MRSS-100 substation building as per approved layout including PA system cabling is in scope of CONTRACTOR. Testing and commissioning of plant communication devices shall be done by others.

III. ECS System in 220 kV GIS substation (MRSS-100) shall be supplied, installed, tested and commissioned by others. MV power and control cables from CONTRACTOR's equipment to ECS Panels shall be supplied, laid and terminated by CONTRACTOR. Space for ECS panels shall be provided in the GIS building as specified elsewhere.

IV. Receiving end unit of Feeder Differential relay for installation in 6.6 kV Isolating breaker panel will be free issued to the CONTRACTOR. Installation of relay shall be in scope of CONTRACTOR. Testing and commissioning of relay shall be by others.

3.5 INTERFACE WITH OWNER'S SYSTEM

Following interfaces with other plant system shall be in scope of CONTRACTOR. Contractor to also refer Interface drawing for detail.

I. Incoming 6.6kV cable up to 6.6kV IBPs shall be supplied and laid by others. However, termination of 6.6kV cable in IBPs shall be in scope of CONTRACTOR.

II. CONTRACTOR to supply Transformer + Feeder Differential Relay (87T+F) for installation in downstream switchboards outside package battery limit for each outgoing 66 kV transformer feeder. Relay shall be provided with redundant ports for OFC communication. Same OFC with multiple fibers shall be used for redundant communication between these ports on relays at both ends.FO cable (single mode type only) and HDPE conduit for these differential relays shall be supplied Owner/EIL.

III. Receiving end unit of 87F relay in 6.6 kV IBP will be free issued to the CONTRACTOR. Installation of relay and connection to Ethernet switch on RJ45/ FO shall be in scope of this tender. Testing and commissioning of relay shall be by others. CT and end termination accessories of FO cable for 87F shall be in scope of this tender.

IV. Cabling from CONTRACTOR's equipments (i.e. DC System, AC Supply, Space Heater supply, etc.) to Owner's DGFAP, ECS Panels, EPABX gateway etc., shall be supplied, laid and terminated at both ends by CONTRACTOR. Control cable (If any) from CONTRACTOR's equipments to Owner's DGFAP, ECS Panels, etc., shall be supplied, laid and terminated at both ends by CONTRACTOR.

V. Earthing of Owner's equipments installed in 220 kV GIS substation (MRSS-100) shall be in scope of CONTRACTOR. However, provision of earthing grid/ earth plates, including clean earth, if required, for ECS, shall be in scope of CONTRACTOR.

VI. ECS system shall be in scope of OWNER. However, MV power and control cables from CONTRACTOR's equipment to ECS Panels shall be supplied, laid and terminated in ECS panels by CONTRACTOR. Connection of SAS to ECS shall be by ECS vendor. CONTRACTOR to provide redundant FO Port for connection with ECS.PA Junction Box and Telephone Junction box shall be supplied by CONTRACTOR. Incoming PA and Telephone cables shall be supplied and laid by OWNER. However, termination of these cables in PAJB and TJB shall be by CONTRACTOR.

4 EQUIPMENT SIZING AND SELECTION CRITERIA

4.1 ELECTRICAL DESIGN BASIS

I. Engineering design basis for electrical (B857-999-16-50-EDB-1001) & standard design philosophy for electrical facilities (6-51-0099) along with details indicates in this specification shall form the basis for basic design and developing detailed design and engineering for electrical facilities including electrical power system, electrical equipment and electrical installation etc.

4.2 EQUIPMENT SIZING

I. The fault level for various voltage levels of Electrical system for this complex shall be limited and provided as under. Accordingly, the associated electrical equipment shall be selected suitable for same:

i). 50 kA (RMS) (3 Sec)/ 135 kA (Peak) for 220 kV System.
ii). 40 kA (RMS) (3 Sec)/ 100 kA (Peak) for 66 kV System.
iii). 40 kA (RMS) (1sec.) / 100kA (Peak) for 33 kV systems.
iv). 40 kA (RMS) (1sec.) / 100kA (Peak) for 6.6 kV systems.
v). 65 kA (RMS) (1sec.) / 143kA (Peak) for 415 V System.
vi). 25kA (RMS) (1 sec.) / 62.5 kA (Peak) for 415V System for LDB/ ELDB

II. CONTRACTOR to note that during sizing and selection of the equipment (i.e. oil filled and dry type transformers, DC system, UPS System, 415V switchboard, Ethernet switches, etc.), 20% spare feeders and 20% spare capacity shall be provided. This shall be over and above design margin.

III. CONTRACTOR to consider maximum cable de-rating factor of 0.5 for sizing of cables on ground rating at 30 degree specified in cable catalogue. This shall be considered for all underground cables.

IV. CONTRACTOR to consider sizing factor for normal, standby and intermittent loads as per EIL Spec. 6-51-0099. Contractor to consider 10% design margin and 20% spare capacity for future.

V. CONTRACTOR to note that each switchboard/ transformer shall be loaded upto maximum 80% of its bus bar/ transformer capacity.

VI. Lightning protection of building shall be designed for LPS level as per IS/IEC-62305 based on the geographical location of the package. Lightning strip size shall be minimum 25 x 3 mm.

VII. Earth Resistivity Value shall be measured by CONTRACTOR before earthing system design calculation. For earthing conductor sizing, duration of earth fault current duration to be considered, shall be minimum one (1) second.

VIII. For lighting system design, overall maintenance factor shall not be more than 0.63

4.3 SUBSTATION BUILDING

I. Design, engineering and construction of Main substation building MRSS-100 is included in the scope of CONTRACTOR. For detailed scope refer Civil/ Structural scope of work. Main Substation building MRSS-100 shall have cable cellar and battery room on ground floor and GIS Hall of double height, Switchgear Hall, ECS Hall, UPS Room on first floor. Refer indicative architectural layout for detail wherein the **minimum** substation sizing requirements are indicated. Final substation building layout shall be developed and submitted by Contractor for review/ approval by EIL/Owner, based on final equipment dimensions and gas duct layout drawings etc. GIS hall size shall be finalized after approval of GAS SLD.

II. Cut-outs shall be provided along the complete length of switchgear hall. Beams in between cut-outs shall be provided with PVC sleeves of 150 mm dia. Opening of 200 x 100 mm shall be provided in all under slab beams of switchgear hall slab for FA cable laying. Cut-out of 1200 x 200 mm shall be provided in slab along columns on switchgear floor for cabling to wall mounted panels. Base frame work for all switchgear hall cut-outs is in scope of Contractor. All unused cut-outs shall be covered with 6 mm thick chequered plate after installation of all equipment. Cut outs provided for switchboards shall be covered with 6mm thick chequered plate during construction to prevent falling of people through cut outs.

III. All door/ gates in substation shall be provided with facility to padlocking the doors. Monorail shall be provided for equipment loading/ unloading.

IV. All switchboards shall be installed considering provision for installation of two future panels on each side of switchboard.

V. CONTRACTOR to keep space for installation of Owner's ECS System panels in the switchgear hall. Approx. area of ECS Panel Room and ECS Operator Room is indicated in the architectural layout. Exact dimension of both the rooms shall be finalized during detailed engineering.

VI. Structural support for Owner's supplied panels is also in the scope of CONTRACTOR. In addition to the base frame of panel, additional framework base channels for embedding in the concrete/ welding to the insert plates on concrete surface shall be supplied and erected by the CONTRACTOR. Supporting structure for 220 kV & 66 kV Cables from cable cellar to GIS structure shall also be provided by CONTRACTOR.

VII. Power transformers shall be provided with a RCC oil soak pit below the transformer. Following guidelines shall be followed in this regard:

4.3.VII.1 The RCC oil soak pit shall be dimensioned such that the clearance between the pit extension and the transformer body shall be 20% of the height of the transformer (highest point) or minimum 800 mm beyond transformer body (Tank and Radiator) all around.

4.3.VII.2 For the transformers, which are having their soak pits connected to a common waste oil pit, the individual soak pit shall be sized to hold one third of the oil content of the particular transformer (Tank, Cooler, Conservator, OLTC and Cable Box) plus volume of water due to HV water spray system and a margin of approximately 20% for rain water.

4.3.VII.3 However, the transformers with oil capacity more than 2000 litres, but not connected to waste oil pit, soak pit shall be sized to take the whole of the oil of the transformer plus 30% design margin.

4.3.VII.4 The pit shall be filled with 40 mm size gravel and a porosity factor of 40% shall be considered for sizing of the pit.

4.3.VII.5 Total pit volume shall also account for the transformer foundation or any other foundation in the pit.

4.3.VII.6 Pit shall be raised at least 150 mm above the external level.

VIII. In addition, provision shall also be made to drain away the oil from individual soak pit to a separate waste oil tank/ pit, where use of more than 9,000 liters of oil in any oil tank/ pit or chamber is involved. This tank/pit shall be connected by a suitable Hume/ HDPE drain pipe of not less than 200 mm diameter to each soak pit. Waste oil tank/ pit shall be located away from the transformer, in the lowest part of the switchyard to assist drainage. The tank/ pit shall be of sufficient capacity to receive, without overflowing, the contents of the largest transformer plus the water of any fixed fire-fighting system and a certain quantity of rain water collected form all tanks/ pits. No other drain shall lead to the tank/pit. This pit shall be provided with an air vent large enough to avoid over pressure during operation. The whole internal surface shall be impermeable.

IX. This pit shall not have stone filling. Suitable manhole with ladder shall be provided for the waste oil pit. For taking out the oil from the waste oil pit, a portable pump of suitable rating as per OISD-173 shall be provided.

X. Rail track/ Channel shall be provided for the movement of the main transformers. Same shall be extended on the main approach road. Mooring post shall be provided at a suitable location. Necessary arrangement along with suitable foundation shall be provided for jacking pad, wherever it is required to change the direction of transformer wheels.

XI. Wherever cables cross the rail-track/ foundation, suitable size ducts in Concrete block shall be provided.

XII. Main gate for power transformers and Maintenance Gates for routine operation & maintenance shall be provided in transformer bay. Transformer bays to be covered with concrete roof at double height.

XIII. Each transformer bay shall be provided with 1 Nos. 100 Amps outlet for oil filtration and other maintenance activities.

XIV. Fire wall between two adjacent transformers shall be extended at least 1 meter above the top most point of the Transformers. Fire wall shall also be designed to withstand the explosion of transformer bushing. Firewall thickness shall be minimum 355 mm in case of brick construction or 230 mm in case of RCC construction.

XV. Battery room shall be well ventilated along with necessary exhaust system and water connection with sink. Battery room shall be provided with minimum two exhaust fans and louvered opening in the opposite wall/door. Floor of the battery room and walls up to 1.5 M height shall have acid/alkaline (as applicable) resistant protective material coating. Maintenance platform and wash basin/sink shall be provided in the battery room. Neutralization pit for battery room shall be considered, which shall be connected to plant drain.

XVI. Switchgear/ control room shall have fire-fighting equipment, first aid boxes, insulating floor mats all around the switchboards, hand-gloves and other safety equipment as per statutory requirements. Flooring of switchgear hall shall be painted with insulation paint.

XVII. Epoxy based insulation coating with breakdown voltage as per IS, suitable for installation on concrete flooring shall be applied on switchgear hall and GIS Hall of substation in air-conditioned/ non-air-conditioned area. Rubber mats shall also be provided around switchboards as per CEA safety regulations.

XVIII. The fire-proof sealing system and fire protection coating system are required to prevent the spreading of fire from one place to another (or one zone to another) through the openings in wall / floor, along cables laid in trays / racks and through openings below floor-mounted Electrical

Switchgear, PMCC, Distribution Boards, Junction boxes, Cabinets and Panels. The systems shall be installed in the specified locations in consultation with the purchaser's engineer after all cables have been laid and terminated.

XIX. Emergency escape route is mandatory to be maintained and marked from all locations in the cable cellar of substation.

XX. Contractor shall note that 220kV & 66kV EHV cables inside cable cellar of MRSS-100 shall be laid in RCC trenches. Accordingly, required facility for the same shall be considered by contractor.

4.4 SINGLE LINE DIAGRAM

It is the responsibility of the contractor to provide number of outgoing feeders in each switchboard as per actual loads, other electrical system requirements plus spare feeders in each switchboard in line with engineering design basis.

Contractor shall prepare Single line diagram for complete package and submit the same to Owner/ Consultant for approval. Equipment s as required, as per the bid package to cater the load demand of package and owner's load shall be supplied without any price and time impact to Owner/Consultant.

5 EQUIPMENT SPECIFICATIONS

5.1 GRID TRANSFORMER (220kV primary)

I. Tag Number for various transformers is as per table below:

Tag Number	Rating	Impedance	Cable Termination	
100-TR-21	220/66 kV, 160/200 MVA, ONAN/ ONAF, YNyn0, OLTC -17.5% to +12.5 % (In step of ± 1.25%)	Z = 12.5% (-0% to +10% tolerance)	**At 220 kV Side** 245 kV (E), 1 Run/ phase, 1C x 630 Sq.mm, Cu Conductor, XLPE Insulated, Armoured, Corrugated Aluminium, PVC Outer sheath Cable	**At 66 kV Side** GIBD
100-TR-22				
100-TR-23				
100-TR-24				

II. 220kV grid transformer shall be as per the enclosed transformer datasheets and EIL standard specification 6-51-0068 attached with the tender. In addition to the requirements specified in 6-51-0068, following clauses shall also be complied.

a)	Lighting Impulse Withstand	:	1050 kV_p
b)	Power Frequency Withstand	:	460 kV_{rms}
c)	Conservator for Cable Box	:	Separate from main tank conservator
d)	Conservator for OLTC	:	Common/ Separate, as per vendor design
e)	Air Cell Puncture Detection Relay	:	Not Required
f)	Sudden/ Rapid Pressure Rise Relay	:	Required
g)	Automatic Regenerative Breather	:	Not Required
h)	Remote Indication for pressure relief devices	:	Through separate measuring system
i)	NIFPS System	:	Required separately for tank and 220 kV cable box

j)	HV Water Spray System	:	Required
k)	Rollers	:	Flat type
l)	220 kV Termination	:	Oil insulated phase separated cable box with oil/ oil bushings
m)	66 kV Termination	:	Phase separated cable chambers suitable for Gas Insulated Busduct termination
n)	Dissolve Gas Analyser	:	Required (Offline Type)
o)	Gases to be monitored	:	H_2, CH_4, C_2H_4, C_2H_6, C_2H_2, CO, CO_2
p)	Online Moisture Removal System	:	Required (Refer doc. –SP-0023)
q)	OLTC	:	Bi-directional
r)	Microprocessor bases AVR Interface for communication	:	FO Port on IEC 61850. LIU shall be provided to terminate armoured cable.
s)	Impact Recorders	:	Required
t)	Type tests to be conducted on offered transformers, even if type test reports are available:		
i.	Temperature Rise	:	Required (One transformer of each rating)
ii.	Loss Measurement	:	Required
iii.	Short Circuit	:	Not Required
iv.	Dielectric Test (As per IS 2026 Part 3) For both transformer and cable box	:	Not Required
v.	Dissolved Gas Analysis of transformer Oil	:	Required
vi.	Frequency Response Analysis	:	Required (At works and at site)
vii.	Measurement of the harmonics of the no load current	:	Not Required
viii.	Fault current withstand capacity test of 220 kV oil filled cable box.	:	Not Required
ix.	Pressure Test	:	Required (On each tank size) & Cable box
x.	Vacuum Test	:	Required (On each tank size) & Cable box
xi.	Parallel operation	:	Yes
xii.	SFRA test	:	To be done on all 220kV EHV Grid transformer at factory (before dispatch) & at site as part of pre-commissioning procedure.

5.1.II.1 Neutral point at 220 kV side shall be provided by means of the outdoor type bushing with minimum continuous voltage rating of 33 kV.

5.1.II.2 Contractor to ensure that valid type test certificates for offered design of transformer are available for heat run test, short circuit test, impulse test and other tests as specified in tender. The same shall also be furnished for Owner's review/approval during detail engineering. Type test certificates for EHV bushings and other transformer components shall also be furnished. Type test of transformer shall only be acceptable provided the offered transformer have been manufactured from the same plant /works from where type tested transformer was manufactured. In case the valid type test certificates are not available, contractor shall carryout the type tests without any additional cost and time implication to Owner/EIl.

In case of non-availability of short circuit test reports, manufacturer certified comparative statement in line with IS: 2026 Part-5/IEC-60076 Part-5 shall be furnished along with calculations & other supporting documents

For 220/66kV Grid transformers, in case of non-availability of short circuit test certificate for similar transformer or nonavailability of comparative analysis for all the 9 parameters as defined in Annexure-B of IS-2026 Part-5/IEC-60076 Part-5, vendor shall demonstrate ability of transformer to withstand the short circuit for both thermal ability as well as ability to withstand dynamic effects of short circuit by detailed calculations and design & manufacture considerations as per IS:2026 Part-5/IEC-60076 Part-5.

Guidelines as mentioned in Cl. 4 and Annexure-A of IS: 2026 Part-5 and CIGRE 'Guidelines for Conducting Design Review', 204, SC WG12.22 shall be followed for design review. Format for design review parameters as mentioned in Appendix-VI of CBIP manual for Transformer (publication 317) shall be also referred.

The design review shall be concluded before commencement of manufacturing of transformers. The design calculations & design review documents shall be verified & vetted by a competent third party (to be appointed by package contractor) having experience in conducting such design reviews & the package contractor. These documents shall be submitted to EIL/owner for review/ approval.

5.1.II.3 The transformer cable chambers shall be provided with disconnecting arrangement for 220kV terminations to facilitate testing of cables and/or transformers independently. It shall also facilitate removal of the transformer without disturbing cables. The disconnecting arrangement can consist of links in the cable chamber or in a separate disconnecting chamber. The disconnecting arrangement shall be suitably insulated with provision of vermin proof breathing arrangement where applicable.

5.1.II.4 The clearances between the cable terminals and transformer bushings shall be adequate to subject each cable or transformer separately to high voltage tests. The cable box and the disconnecting arrangement shall be capable of withstanding both at the time of the first test on cables and at any subsequent time as required.

5.1.II.5 Supply of termination kits for entry of 220 kV cables in the oil filled chambers is in CONTRACTOR's scope.

5.1.II.6 For each cable chamber of 220 kV cable terminal box, separate PRV shall be provided along with prismatic level gauges on both the legs of the cable chamber i.e. cable end and transformer end.

5.1.II.7 Separate conservator provided for 3-phase cable chambers shall be provided with a flexible oil resistance air bag and shall also be supplied with following accessories as a minimum:

- Buchholz relay (double float type) with separate normally open trip and alarm contacts for each cable chamber connection
- Prismatic level gauge
- De-hydrating breather
- Air release Device
- Oil filling hole with cover
- Oil Level indicator with alarm contact
- Pressure relief valve shall be provided (with alarm contact).
- Sampling valve
- Conservator drain valve
- Top oil filter valve
- Drain cum bottom filter valve
- NIFPS System

III. Supporting arrangement for raising the power cable to transformer end termination shall be provided.

IV. Grid transformers shall be provided with OLTC and shall have RTCC facility.

V. Grid transformers shall be used for bi-directional flow of rated power. Tap changer shall be suitable for bidirectional power flow. The tap changer rating shall be more than maximum rated current of transformer at selected tap position and at ONAF rating.

VI. CT for 51G and 64R shall be provided at both sides of transformer. CT for 51G shall be class 5P10 and CT for 64R shall be class PS for all the transformers. Technical details of class PS CT (CT Ratio, Vk, Imag and RCT) shall be submitted by contractor for EIL/owner review.

VII. Grid transformer shall be transported with transformer tank/ OLTC/ terminal box/ etc. filled with dry air or nitrogen at positive pressure to ensure that no ingress of moisture, humidity or contamination takes place. Necessary arrangement shall be ensured by the contractor to take care of pressure drop of dry air or nitrogen during transit and storage till completion of oil filling during erection. A dry air or nitrogen pressure testing valve with necessary pressure gauge and adaptor valve shall be provided.

VIII. Transformer shall be fitted with sufficient number of electronic impact recorders (on returnable basis) during transportation to measure the magnitude and duration of the impact in all three directions. The acceptance criteria and limits of impact in all three directions which can be withstood by the equipment during transportation and handling shall be submitted by the contractor during detailed engineering. The recording shall commence in the factory and must continue till the units reach site. The data of electronic impact recorders shall be downloaded at site and a soft copy of it shall be handed over to Engineer – in –charge.

IX. GA of transformer shall be planned in such a manner, that it is possible to pull transformer tank outside the bay without withdrawing the radiators/ any other accessories of transformer.

X. Grid transformers shall be provided with Dissolved Gas Analyser (DGA) kit. Provision shall be provided on tank and cable box for connecting the supplied DGA kit for online analysis.

XI. 220kV EHV grid transformers shall be provided with Nitrogen Injection Fire Protection System (NIFPS) along with HVWS based fire fighting system. NIFPS shall be as per EIL specification attached with tender. NIFPS system shall be separate for cable box. Contractor to furnish PTR of NIFPS supplier before finalization of vendor.

XII. The Maximum Limit of value of tan delta shall be 1% for windings, 0.5% for bushings and 0.2 % for oil.

XIII. All the instruments, meters, etc., used for testing shall be duly calibrated at NABL laboratory and necessary calibration certificate shall be made available during inspection.

XIV. All transformers shall have WTI/ OTI transducer for interfacing with SCAP/ ECS. Duplicate set of terminals shall be provided for interface with SCAP and ECS. All contacts including “spare contacts” and “contacts for owner’s interface” shall be duly wired and terminated upto the terminal block.

XV. All signals as per ECS IO List shall be provided for interface with the Electrical control system.

XVI. All internal wiring inside RTCC Marshalling Box etc. shall be with FRLS insulation.

XVII. Transformers shall be provided with emergency trip pushbutton station in the transformer bay. Push button station shall have Dual pushbutton with logic to press both for transformer trip.

XVIII. As per Ministry of Environment, Forest and Climate Change (MoEF&CC), Regulation of Polychlorinated Biphenyls Order, 2016, manufacture and import of the Polychlorinated Biphenyls (PCBs) and PCBs containing equipment is banned and hence compliance of same in transformer oil shall be ensured.

XIX. Contractor to ensure that valid type test certificates for offered design of transformer are available for heat run test, short circuit test and impulse test. The same shall also be furnished for Owner's review/approval during detail engineering. In case the valid type test certificates are not available, contractor shall carryout the type tests without any additional cost and time implication to Owner/EIL. In case of non-availability of short circuit test reports, manufacturer certified comparative statement in line with IEC-60076 part 7 / IS 2026 part 5 shall be furnished.

XX. CONTRACTOR to also ensure the following:

5.1.XX.1TRANSFORMER CORE

Core material type shall be low loss, non-ageing, high permeability PRIME GRADE, CRGO M4 Grade or better. Design of the core shall fulfil the requirements as listed below.

- It shall be perfectly insulated and clamped to minimize noise and vibrations
- Lower thickness material grades shall be used. Prime grade Cold rolled grain oriented M4 grade or better (Hi-B Grain Oriented Steel grades (HG-OS)) shall be used.
- Lap joints for core shall be of Step type.
- Yoke for the core shall be of boltless.
- The derived building factor shall range from 1.05 to 1.15.
- Certified Mill Test Report for core material shall be submitted.

5.1.XX.2DESIGN CRITERIA

Following vendor data shall also be submitted for scrutiny after design finalization post order.

Yoke Lamination, Type of Core Joint, Number of Lamination/ Lay, Overlap length, Angle of Overlap, Gaps at Joint, Operational Flux density, Proportion of corner weight, X0/ R0, X/R, Z variation at ± 10% Tap position (@ ONAF) on Maximum, Normal and Minimum Tapping.

5.1.XX.3OVER-EXCITATION TEST REPORTS

Over excitation conditions and test reports for the following level and duration of supply voltage shall be submitted post order for review by Client/ EIL.

- 110% continuous
- 125% for 1 min
- 140% for 5 sec
- 150% for 1 sec.

Over excitation graphs meeting the requirements specified above may also be accepted.

5.1.XX.4CORE LAMINATIONS ASSEMBLY

Core lamination assembly shall be done while taking care of following points

- Shall be done appropriately (preferably using automatic pressure bed) to ensure that no air pockets are trapped within the laminations.
- Stage inspections of material during fabrication of the Laminations shall be carried out to ensure that only Prime material is being used.

5.1.XX.5ACCREDITED LABS

Labs where heat run, loss measurements tests can be carried out shall either be CPRI Bhopal /Bangalore or any other NABL accredited labs under supervision of CPRI.

5.2 POWER TRANSFORMER (66kV primary)

I. Tag nos. of power transformer are as follows:

Tag Number	Rating	Impedance	Cable Termination	
100-TR-31	66kV/ 6.9kV min. 16/20 MVA, Dyn1, ONAN/ONAF	Z=10% (-0% to +10%),	**At 66 kV Side** 1 Run/ phase, 1C x 240 Sq.mm (min.), Cu Conductor, XLPE Insulated, Armoured, Corrugated Aluminium, PVC Outer sheath Cable	**At 6.9kV** Busduct (phase segregated)
100-TR-32	66kV/ 6.9kV min. 16/20 MVA, Dyn1, ONAN/ONAF			

II. 66kV power transformer shall be as per the enclosed transformer datasheets and EIL standard specification 6-51-0068 attached with the tender. In addition to the requirements specified in 6-51-0068, following clauses shall also be complied.

a) Lighting Impulse Withstand : 325 kV_p
b) Power Frequency Withstand : 140 kV_{rms}
c) Conservator for OLTC : Common/ Separate, as per vendor design
d) Air Cell Puncture Detection Relay : Not Required
e) Sudden/ Rapid Pressure Rise Relay : Required
f) Automatic Regenerative Breather : Not Required
g) Remote Indication for pressure relief devices : Through separate measuring system
h) HV Water Spray System : Required
i) Rollers : Flat type
j) 66 kV Termination : Phase separated cable chambers suitable for Gas Insulated Busduct termination
k) Online Moisture Removal System : Required (Refer doc. –SP-0023)
l) OLTC : Uni-directional
m) Type tests to be conducted on offered transformers, even if type test reports are available:
   i. Temperature Rise : Required (One transformer of each rating)
   ii. Loss Measurement : Required
   iii. Short Circuit : Not Required
   iv. Dielectric Test (As per IS 2026 Part 3) For both transformer and cable box : Not Required
   v. Measurement of the harmonics of the no load current : Not Required
   vi. Pressure Test : Required (On each tank size) & Cable box
   vii. Vacuum Test : Required (On each tank size) & Cable box
   viii. Parallel operation : Yes

5.2.II.1 Contractor to ensure that valid type test certificates of offered design of transformer are available for Heat run test, short circuit test, IP test of panels, dielectric test, etc. as per type tests listed

in IS:2026. In case of non-availability of short circuit test reports, dielectric test reports, IP test reports, impulse test reports, etc. same shall be conducted without any cost and time implication to Owner/ EIL. Type test certificates for bushings and other transformer components shall also be furnished. Type test of transformer shall only be acceptable provided the offered transformer have been manufactured from the same plant/works from where type tested transformer was manufactured.

5.2.II.2 The transformer cable chambers shall be provided with disconnecting arrangement for 66kV terminations to facilitate testing of cables and/or transformers independently. It shall also facilitate removal of the transformer without disturbing cables. The disconnecting arrangement can consist of links in the cable chamber or in a separate disconnecting chamber. The disconnecting arrangement shall be suitably insulated with provision of vermin proof breathing arrangement where applicable.

5.2.II.3 The clearances between the cable terminals and transformer bushings shall be adequate to subject each cable or transformer separately to high voltage tests. The cable box and the disconnecting arrangement shall be capable of withstanding both at the time of the first test on cables and at any subsequent time as required.

5.2.II.4 Separate conservator provided for 3-phase cable chambers shall be provided with a flexible oil resistance air bag and shall also be supplied with following accessories as a minimum:

- Buchholz relay (double float type) with separate normally open trip and alarm contacts for each cable chamber connection
- Prismatic level gauge
- De-hydrating breather
- Air release Device
- Oil filling hole with cover
- Oil Level indicator with alarm contact
- Pressure relief valve shall be provided (with alarm contact).
- Sampling valve
- Conservator drain valve
- Top oil filter valve
- Drain cum bottom filter valve

III. Supporting arrangement for raising the power cable to transformer end termination shall be provided.

IV. Power transformers shall be provided with OLTC and shall have RTCC facility.

V. Power transformers shall be used for uni-directional flow of rated power. Tap changer shall be suitable for bidirectional power flow. The tap changer rating shall be more than maximum rated current of transformer at selected tap position and at ONAF rating.

VI. CT for 51G and 64R shall be provided at both sides of transformer. CT for 51G shall be class 5P10 and CT for 64R shall be class PS for all the transformers. Technical details of class PS CT (CT Ratio, Vk, Imag and RCT) shall be submitted by contractor for EIL/owner review.

VII. Power transformer shall be transported with transformer tank/ OLTC/ terminal box/ etc. filled with dry air or nitrogen at positive pressure to ensure that no ingress of moisture, humidity or contamination takes place. Necessary arrangement shall be ensured by the contractor to take care of pressure drop of dry air or nitrogen during transit and storage till completion of oil filling during erection. A dry air or nitrogen pressure testing valve with necessary pressure gauge and adaptor valve shall be provided.

VIII. GA of transformer shall be planned in such a manner, that it is possible to pull transformer tank outside the bay without withdrawing the radiators/ any other accessories of transformer.

IX. The Maximum Limit of value of tan delta shall be 1% for windings, 0.5% for bushings and 0.2 % for oil.

X. All the instruments, meters, etc., used for testing shall be duly calibrated at NABL laboratory and necessary calibration certificate shall be made available during inspection.

XI. All transformers shall have WTI/ OTI transducer for interfacing with SCAP/ ECS. Duplicate set of terminals shall be provided for interface with SCAP and ECS. All contacts including "spare contacts" and "contacts for owner's interface" shall be duly wired and terminated upto the terminal block.

XII. All signals as per ECS IO List shall be provided for interface with the Electrical control system.

XIII. All internal wiring inside RTCC Marshalling Box etc. shall be with FRLS insulation.

XIV. Transformers shall be provided with emergency trip pushbutton station in the transformer bay. Push button station shall have Dual pushbutton with logic to press both for transformer trip.

XV. As per Ministry of Environment, Forest and Climate Change (MoEF&CC), Regulation of Polychlorinated Biphenyls Order, 2016, manufacture and import of the Polychlorinated Biphenyls (PCBs) and PCBs containing equipment is banned and hence compliance of same in transformer oil shall be ensured.

XVI. Contractor to ensure that valid type test certificates for offered design of transformer are available for heat run test, short circuit test and impulse test. The same shall also be furnished for Owner's review/approval during detail engineering. In case the valid type test certificates are not available, contractor shall carryout the type tests without any additional cost and time implication to Owner/EIL. In case of non-availability of short circuit test reports, manufacturer certified comparative statement in line with IEC-60076 part 7 / IS 2026 part 5 shall be furnished.

XVII. CONTRACTOR to also ensure the following:

5.2.XVII.1 TRANSFORMER CORE

Core material type shall be low loss, non-ageing, high permeability PRIME GRADE, CRGO M4 Grade or better. Design of the core shall fulfil the requirements as listed below.

- It shall be perfectly insulated and clamped to minimize noise and vibrations
- Lower thickness material grades shall be used. Prime grade Cold rolled grain oriented M4 grade or better (Hi-B Grain Oriented Steel grades (HG-OS)) shall be used.
- Lap joints for core shall be of Step type.
- Yoke for the core shall be of boltless.
- The derived building factor shall range from 1.05 to 1.15.
- Certified Mill Test Report for core material shall be submitted.

5.2.XVII.2 DESIGN CRITERIA

Following vendor data shall also be submitted for scrutiny after design finalization post order.

Yoke Lamination, Type of Core Joint, Number of Lamination/ Lay, Overlap length, Angle of Overlap, Gaps at Joint, Operational Flux density, Proportion of corner weight, X0/ R0, X/R, Z variation at ± 10% Tap position (@ ONAF) on Maximum, Normal and Minimum Tapping.

5.2.XVII.3 OVER-EXCITATION TEST REPORTS

Over excitation conditions and test reports for the following level and duration of supply voltage shall be submitted post order for review by Client/ EIL.

- 110% continuous
- 125% for 1 min
- 140% for 5 sec
- 150% for 1 sec.

Over excitation graphs meeting the requirements specified above may also be accepted.

5.2.XVII.4 CORE LAMINATIONS ASSEMBLY

Core lamination assembly shall be done while taking care of following points

- Shall be done appropriately (preferably using automatic pressure bed) to ensure that no air pockets are trapped within the laminations.
- Stage inspections of material during fabrication of the Laminations shall be carried out to ensure that only Prime material is being used.

5.2.XVII.5 ACCREDITED LABS

Labs where heat run, loss measurements tests can be carried out shall either be CPRI Bhopal /Bangalore or any other NABL accredited labs under supervision of CPRI.

5.3 DISTRIBUTION TRANSFORMER

I. Maximum rating of distribution transformer shall be limited to 2500kVA however the transformer rating shall be finalized based on load analysis, considering 10% design margin and 20% capacity for future load. Each transformer shall be sized to feed the complete load independently

II. Transformers shall be provided with emergency trip pushbutton station in the transformer bay. Push button station shall have Dual pushbutton with logic to press both for transformer trip.

III. The transformers impedances shall be chosen to suit switchgear fault withstand capabilities and large motor start-up (if any).

IV. Distribution transformer rated upto 2500kVA shall comply to latest IS-1180 (Part-1): 2014 and its amendments including but not limited to amendment-4 and latest Gazette of India Order. Accordingly, efficiency of transformer at 50% and 100% load shall be considered with total losses at 50% and 100% loading not exceeding maximum losses values specified in Table-6 of IS-1180 (Part-1) /IS-1180 (Part-3): (including amendments) for Energy Efficiency Level 3/ Table-3 of GOI Notification dt. 08 Dec 2023, BEE Star Rating 3 (including latest GOI Notifications).

V. The transformer shall bear standard mark of Bureau of Indian Standards in line with Gazette of India. Copy of license obtained from Bureau of Indian Standards in compliance with IS 1180(Part-1) shall be furnished by the contractor along with transformer vendor drawings post order.

VI. The overall dimensions of the transformers shall be limited in accordance with 7-51-0337 enclosed with the package.

VII. Fire fighting system is generally not envisaged for distribution transformers, accordingly, oil quantity for distribution transformer shall be restricted up to 2000 liters. In case, oil quantity is more than 2000 litre, HVWS system shall be provided by contractor.

VIII. CT for 51G shall be class 5P10 and CT for 64R shall be class PS for all the transformers. Technical details of class PS CT (Vk, Imag and RCT) shall be submitted by contractor for EIL review.

IX. All transformers shall have WTI/ OTI transducer for interfacing with ECS.

X. All contacts including “spare contacts” and “contacts for owner’s interface” shall be duly wired and terminated upto the terminal block.

XI. Contractor to ensure that valid type test certificates for offered design of transformer are available for heat run test, short circuit test and impulse test. The same shall also be furnished for Owner’s review/approval during detail engineering. In case the valid type test certificates are not available, contractor shall carryout the type tests without any additional cost and time implication to Owner/EIL. In case of non-availability of short circuit test reports, manufacturer certified comparative statement in line with IEC-60076 part 5 / IS 2026 part 5 shall be furnished.

XII. Heat run test shall be done on one distribution transformer of each rating, even if type test report for same is available with the vendor. Pressure test and vacuum test shall be done on one transformer tank of each size.

XIII. All signals as per ECS IO List shall be provided for interface with the Electrical control system.

XIV. As per Ministry of Environment, Forest and Climate Change (MoEF & CC), Regulation of Polychlorinated Biphenyls Order, 2016, manufacture and import of the Polychlorinated Biphenyls (PCBs) and PCBs containing equipment is banned and hence compliance of same in transformer oil shall be ensured.

XV. Transformers with 80% loading shall be equal to Peak Demand (including 10% design margin) & does not include 20% spare capacity for future.

5.4 EHV GAS INSULATED BUSDUCT (GIB) FOR 66kV

I. Maximum weight of gas in gas tight section of GIB shall not exceed 250kg.

II. GIS bus ducts of each circuit shall be arranged in preferably horizontal formation and the clearance (outer to outer) between nearest bus ducts of two adjacent circuits shall be minimum one meter.

III. GIB shall be generally in only one horizontal layer. However, in exceptional circumstance two horizontal GIB layers can be provided with the approval of owner/EIL and the vertical clearance between layers shall be minimum one meter in such case.

IV. The minimum outer to outer horizontal clearance between each GIS bus duct shall be 0.5 meter.

V. The minimum vertical ground clearance of GIB at road crossing shall be 5.5 meters.

VI. The horizontal clearance between GIB and GIS building /any other building wall shall be minimum three meters for GIB running parallel to the building/wall.

VII. The GIB route inside the GIS Hall shall not obstruct easy access to GIS and control room buildings and shall not obstruct movement of crane, equipment including HV test equipment for maintenance works.

VIII. The GIB height outside the GIS hall in switchyard area shall not obstruct easy access to GIB, movement of crane for maintenance work.

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

X. Contractor shall finalise the make of 66kV GIBD meeting the criteria indicated in attached Datasheet-Experience Record Proforma (ERP), doc. No. B957-000-16-50-DS-0021. Completely filled in ERP sheet along with all supporting documents shall be furnished along with bid.

5.5 HV & MV BUSDUCT

I. Bus duct shall be provided for connection between the transformer and switchboards where the board rating is more than 1250A.

II. Bus-duct layout drawings shall be prepared by the CONTRACTOR based on substation equipment layout and Structural and Architectural drawings of substation and transformer drawings at the time of detail engineering.

III. It is CONTRACTOR's responsibility to close the gap between the bus-duct and the cut-out left for bus-duct routing. Closing of gap shall be done with material suitable for minimum 2 hours fire rating.

IV. All other requirements for HV & MV Bus duct shall be as per EIL Specification 6-51-0054 and HV & MV bus duct datasheet attached with the tender.

V. All the offered HV, MV bus duct shall be type tested. CONTRACTOR to ensure at the time of order placement that copies of valid type test certificates for the following tests conducted on identical design of offered bus ducts are available.

- Short time current withstand test
- Power frequency & lightning impulse voltage withstand capacity
- Heat run test.
- Ingress Protection test.

VI. CONTRACTOR to conduct heat run test on each rating of HV & MV bus duct at vendor's works as part of scope of this tender and no extra payment for the same shall be provided.

VII. The busduct bus bar material shall be same as that used for switchgear busbar. In case different material are provided for busbar of switchboards/transformers and busduct, bimetallic washer/plates shall be provided.

5.6 GENERAL REQUIREMENT FOR ALL EHV, HV & MV SWITCHGEAR

I. Selection, sizing and suitability of all components shall be the CONTRACTOR's responsibility. The equipment as required for safe and satisfactory operation shall be considered included in CONTRACTOR's scope even if not specifically mentioned.

II. Hardware data sheet for feeders include only the major relays, meters and control switches. Any auxiliary relays, timers, switches, etc., as required, while developing the control schematics and for safe operation, even if these are not specifically mentioned, shall be supplied by the CONTRACTOR without any price and time implication. All logic shall be implemented in the relay itself and not externally. Provision of adequate I/O count in the relays shall be ensured.

III. The CONTRACTOR shall be solely responsible to coordinate the relay characteristics with relay supplier for the proper selection of all CTs with special care to select class PS CTs. The VA burden, knee-point voltage, CT resistance and magnetizing current shall be calculated by the vendor for Owner/ EIL's review before proceeding with manufacturing.

IV. Following sizing calculation for Class PS CT's shall be submitted by CONTRACTOR's during drawing review stage.

- Knee point voltage Vk
- Metrosil
- Stabilizing resistor.

V. CT ratios/ details, load details, cable sizes, feeder nos., name plate details etc., for all feeders at switchboards shall be finalized at the time of review of vendor drawings which shall be taken care by the CONTRACTOR without any impact on cost and time to Owner.

VI. The size of bus-bar from horizontal bus to breaker and breaker to outgoing shall be designed based on breaker rating and not on CT/feeder rating.

VII. Relay Setting

5.6.VII.1 Relay settings for other outgoing feeders in CONTRACTOR's scope shall be undertaken by the CONTRACTOR/ Vendor and CONTRACTOR/ Vendor shall furnish the relay setting chart and relay coordination curves. During drawing review stage, vendor shall furnish numerical relay selection chart showing complete model no. of numerical relay and various functionalities offered meeting all requirements specified in tender.

5.6.VII.2 Any other data required for relay setting to be done by the CONTRACTOR's shall be provided during engineering stage.

5.6.VII.3 Design calculations for selection of relay setting and relay parameterization, relay coordination, providing relay-setting table & relay parameterization, etc. for all feeders is included in the CONTRACTOR's scope. Relay parameterization for all relays shall be provided and implemented by vendor.

VIII. Dummy panels and rear extensions, as required, to avoid fouling with beam/ column, adequacy of space for cable terminations, bus trunking, mounting of relays, meters, control components etc. shall be supplied as required without time & cost implication to owner.

IX. Breaker rating as specified in the data sheet is 'in-panel' rating at design ambient. CONTRACTOR may select higher rating of breaker if there is de-rating factor for 'in-panel' rating and due to design ambient. No force cooling shall be accepted.

X. Breaker control switches shall be hardwired type. All TNC and Trip Switch shall be lockable type.

XI. Spring charging motors shall be suitable for 110V DC supply.

XII. All feeders/switchboards shall have provision for LOTO implementation. Photographs of LOTO provision in each type of panels shall be submitted during drawing review for approval.

XIII. All transformer incipient faults signals shall be wired through interposing contactors in the panel to avoid nuisance tripping.

XIV. 4-Pole MCB shall be considered in all the PT panels. 4th pole contact of the MCB shall be used for blocking under voltage protection function. Bi-stable relays shall be considered in PT panels for multiplication of the contact for under voltage blocking function in each feeder.

XV. In Control logics / schemes, contacts of vacuum/ SF6 circuit breaker shall be utilized. In case, same is not available, then Bi-stable relays shall be considered for multiplication of Circuit breaker contacts.

XVI. Wherever failsafe contact concept is used, it shall use mechanical contacts. In case mechanical contacts cannot be provided, failsafe concept shall not be used.

XVII. The details of all Instrument transformers comprising their full name plate and connection diagram shall be displayed with stickers at an easily accessible location (In addition to Instrument transformer itself), during normal operation.

XVIII. All the CT& PT connection should be through ring type reliable connection/terminations only.

XIX. Terminal connectors of all other control terminals shall be screwed type only. Separate terminal block shall be provided for further wiring to ECS/ upstream breaker/ Transformer, etc. for tripping/ interlock/ annunciation, etc.

XX. All the NO, NC contacts of breaker, Relay DI/DO, RTD inputs, etc. shall be wired upto terminal block, even if the contacts are not used in the scheme.

XXI. Terminal multiplication to be done, wherever double control cable termination is done, i.e. only one control cable wire shall be connected to one terminal.

XXII. Additional 2 set of spare CT and PT terminals shall be provided for tapping CT and PT supply for future purpose in Incomers/ bus couplers/ Line PT and Bus PT of all switchboards.

XXIII. It is required to interface EHV, HV and MV switchgears with the ECS Panel for control, monitoring and annunciation purpose. For ECS Interface, typical ECS IO list is attached.

XXIV. In addition to above, terminals as required for interface with upstream and downstream switchgear needs to be provided to fulfil the operational requirements.

XXV. Hardware, as required, including selector switches, auxiliary relays, etc. during detail engineering to meet the operation requirement shall be supplied by vendor without any time and cost implication.

XXVI. Vendor to note that the control cables used shall be 2.5 sq. mm. twisted pair shielded cables.

XXVII. All signals as per ECS IO List shall be provided for interface with the Electrical control system.

XXVIII. Terminals for DCS & ECS, input & output shall be segregated & separate terminal block shall be provided. While wiring these signals from respective feeder module to marshalling, it shall be ensured that separate cables are used for status & commands & same shall be segregated.

XXIX. Current rating for interface contacts shall be 2A, 220V DC or 240V AC.

XXX. For the DC Control supply to the various breaker panels in EHV GIS, HV IBPS & 415V Switchboards, there shall be one common control switch for all control supply to the panel. Separate fuses for following branch circuit shall be provided:

5.6.XXX.1 Spring charging circuit

5.6.XXX.2 Closing circuit

5.6.XXX.3 Tripping, contact multiplier & digital input circuit

5.6.XXX.4 Indication circuit

5.6.XXX.5 Each Numerical relay supply (incoming of numerical relay supply fuse shall be tapped before the control supply switch)

XXXI. Separate control supply switch shall be provided for differential protection relays.

XXXII. Bus differential scheme shall have dedicated supply from the same bus section.

XXXIII. CT Bypassing relay shall be latched type.

XXXIV. Bus differential multiplier relay shall be VAJH type only.

XXXV. Common lock key shall be provided for breakers in place of individual lock key for each breaker.

XXXVI. Requirements For Online Temperature Monitoring System For HV & MV Switchboards:

5.6.XXXVI.1 Online Temperature Monitoring System (OTMS) for HV Switchboards at all critical point mentioned below shall be provided for each switchboard and isolating breaker panels. In each vertical, wireless sensors shall be located as per the following:

a. Each horizontal bus bar terminal/tap-off connection in busbar compartment.

b. Each cable /bus duct connection points in cable compartment.

c. One sensor per phase of cable connection points shall be considered irrespective of number of runs of cable.

5.6.XXXVI.2 Online Temperature Monitoring System (OTMS) for MV Switchboards shall conform to the following: In each vertical panel, sensors shall be located as per the following :

i. For MV Switchboard (PCC/PMCC/EPMC) having Air circuit breaker panels:

a. Each horizontal bus bar terminal/tap-off connection in busbar compartment.

b. Each bus duct/cable connection points in cable compartment.

c. One sensor per phase of cable connection points shall be considered irrespective of number of runs of cable

ii. OTMS is not required for MCC, ASB, LDB & ELDB.

5.6.XXXVI.3 The temperature sensors installed shall be suitable for wireless, with direct contact to hot point, operating range from -10°C to 125 °C. The accuracy shall be as per the following: ± 3°C accuracy for 0°C to 80 °C range. ± 4°C accuracy for full range (-10°C to 0°C and 80°C to 125 °C)

5.6.XXXVI.4 The system shall allow at least 1 configurable threshold (alarm).

5.6.XXXVI.5 OTMS system shall have the provision to send complete data to SAS/ Owner's ECS for monitoring and investigation. The system shall be online to immediately provide an abnormal temperature alarm (with identification/location of the abnormal temperature) to the owner's operator system.

5.6.XXXVI.6 Complete data of OTMS shall be accessible in the SAS (through switchboard level Ethernet switches) & associated SAS Laptop/ HMI. The protocol for communication shall be either IEC 61850 or MODBUS TCP/IP or MODBUS RTU or other open protocol and shall be decided by CONTRACTOR. Accordingly, protocol convertors/gateways at suitable locations as required shall be provided by CONTRACTOR for data integration on IEC 61850 protocol from Master Ethernet switch to Owner's ECS system.

5.6.XXXVI.7 Online temperature monitoring data shall be available in both owner's ECS as well as Substation Automation System (SAS). OTMS shall be integrated with owner's ECS.

5.7 220 kV & 66kV GAS INSULATED SWITCHGEAR

I. 220 kV, 2000 Amps, 50 kA (3 Sec) Double Bus Bar GIS Panel & 66kV, 3150A, 40kA (3 Sec) Double Bus Bar GIS Panel shall be as per EIL standard specification 6-51-0066, complete with metering and protection as per datasheet attached with tender. LCC and separate CRP shall be supplied for each bay. Tag number of various equipment shall be as follows:

Tag Number	Item
100-EHV-201GIS	220kV GIS Switchgear
100-LCCEV-201	LCC of 220kV GIS Switchgear
100-CRPEV-201	Control & Relay Panel of 220kV GIS Switchgear
100-HV-201GIS	66kV GIS Switchgear
100-LCCHV-201	LCC of 66kV GIS Switchgear
100-CRPHV-201	Control & Relay Panel of 66kV GIS Switchgear

II. The equipment shall be designed for operation in applicable seismic zone for earthquake resistance. The seismic loads are due to the horizontal and vertical acceleration which may be assumed to act on concurrently. Seismic Qualification requirements shall be as per IEC 62271-207 for the design of equipment. To prevent the movement of GIS sub-assemblies i.e. various bay modules during the earthquake, suitable devices shall be provided for fixing the sub-assemblies to the foundation. The contractor shall supply necessary bolts for embedding in the concrete foundation. The fixing of GIS sub-assemblies to the foundation shall be designed to withstand the seismic events. It will also be ensured that the special devices as well as bolts shall not be over stressed. The details of the devices used and the calculations for establishing the adequacy shall be furnished by the supplier and shall be subject to Owner's/ EIL approval.

III. For feeder details and power cable termination kits, refer SLD & feeder detail datasheets attached with tender. Sequence/position of various feeder as shown in the SLD is indicative and same shall be finalised during detailed engineering without any cost and time implication to Owner/EIL.

IV. The offered GIS equipment and components shall conform to the type tests as per IEC 62271-203. CONTRACTOR to ensure at the time of order placement that copies of valid type test certificates for tests conducted on identical design of offered equipment is available. In case of non-availability of type test certificates, same shall be conducted without any cost and time implication to Owner/ EIL. Validity of type test certificate applicable for 220kV, 66kV GIS switchboard & 66kV GIBD shall be considered as 'Till Design Change'. Type test certificate of parent company is also acceptable subject to meeting the tender & statutory requirement.

V. GIS shall be designed in such a way that transfer from one bus isolator to another bus isolator shall be possible in energised condition without any break in supply to the loads.

VI. Transformer differential relay (87T) of same make/ model as installed in the GIS CRP for 66 kV IBP's, for installation in client's/other downstream 6.6kV incomer panel shall be supplied loose

(free issued by contractor) under scope of this tender. Testing and commissioning of loose supply relay is also included in scope of CONTRACTOR.

VII. In addition to the requirements specified in 6-51-0066, following clauses shall also be complied:

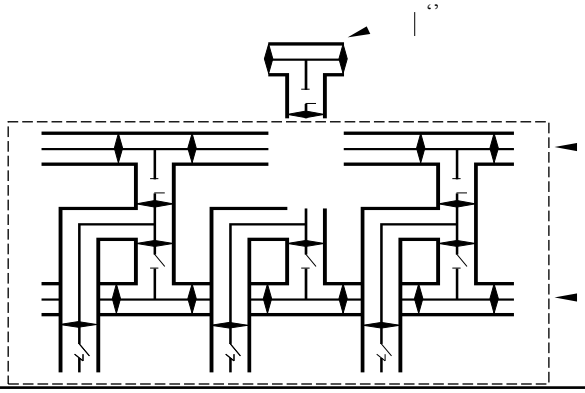
5.7.VII.1 The GIS assembly shall consist of separate modular compartments e.g. Circuit Breaker compartment, Bus bar compartment filled with SF6 gas & separated by gas tight partitions so as to minimize risk to human life, allow ease of maintenance and limits the effects of gas leaks failure and internal arcs, etc. These compartments shall be such that maintenance, repair, extension on one feeder may be performed without de-energising the adjacent feeders. These compartments shall be designed to minimize the risk of damage to adjacent sections and protection of personnel in the event of a failure occurring within the compartments. Rupture diaphragms with suitable deflectors shall be provided to prevent uncontrolled bursting pressures developing within the enclosures under worst operating conditions, thus providing controlled pressure relief in the affected compartment.

5.7.VII.2 The switchgear shall be of modular design and shall have complete phase segregation for the active components (i.e. Isolators, breakers, earth switch, etc.). The conductors and the live parts shall be mounted on high grade epoxy resin insulators. These insulators shall be designed to have high structural strength and electrical dielectric properties and shall be free of any voids and free of partial discharge at a voltage recommended by IEC. These shall be shaped so as to provide uniform field distribution and to minimize the effects of particle deposition either from migration of foreign particles within the enclosures or from the by-products of SF6 breakdown under arcing conditions.

5.7.VII.3 Gas barrier insulators shall be provided so as to divide the GIS into separate compartments. These shall be suitably located in order to minimize disturbance in case of leakage or dismantling. They shall be designed to withstand any internal fault thereby keeping an internal arc inside the faulty compartment. Due to safety requirement for working on this pressurized equipment, whenever the pressure of the adjacent gas compartment is reduced during maintenance, this compartment shall be designed so that it shall remain in service to perform its intended duty. The gas tight barriers shall be clearly marked on the outside of the enclosures.

5.7.VII.4 The bus enclosure should be sectionalized in a manner that maintenance, repair or extension work on any bus disconnector (when bus and bus disconnector are enclosed in a single/ three phase enclosure) can be carried out by isolating and evacuating the small effected section and not the entire bus. The design of 220 kV GIS shall be such that in case a circuit breaker/ any other module of a feeder is removed for maintenance, both bus bars shall remain in service. For achieving the above requirements, adequate mechanical support and number of intermediate gas tight compartments as required, shall be provided to ensure equipment and operating personnel's safety.

5.7.VII.5 Adequate nos. of gas sectionalizer shall be provided in 220kV GIS & 66kV GIS for ensuring safety, ease of maintenance/repair& lower gas handling requirements during bus faults, regular maintenance/repair activities or extension work. Gas partitions shall be provided in GIS switchboard (220kV & 66kV) as per Fig: F.6 of IEC-62271-203 as a minimum. Typical sketch is as below:



LINE-3	TRANSFO-2	LINE-4
FEEDER IN SERVICE	FEEDER OUT OF SERVICE	FEEDER IN SERVICE

5.7.VII.6 The material and thickness of the enclosures shall be such as to withstand an internal flash over for a period of 300 mill second at rated short time withstand current.

5.7.VII.7 Each pressure filled enclosure shall be designed and fabricated to comply with the requirements of the applicable pressure vessel codes to which it is subjected in service (ASME/ CENELEC code for pressure vessel) and based on the design temperature and design pressures as defined in IEC-62271-203.

5.7.VII.8 The bursting strength of Aluminium castings has to be at least 5 times the design pressure. A bursting pressure test shall be carried out at 5 times the design pressure as a type test on each type of enclosure. Each enclosure has to be tested as a routine test at 1.5 times the design pressure for one minute.

5.7.VII.9 The thermal rating of all current carrying parts shall be minimum for three second for the rated symmetrical short-circuit current.

5.7.VII.10 The ladders and walkways shall be provided wherever necessary for access to the equipment. The enclosure and support structure shall be designed that a person of 1780 mm in height and 80 kg in weight is able to climb on the equipment for maintenance.

5.7.VII.11 In general the contours of energized metal parts of the GIS and any other accessory shall be such, so as to eliminate areas or points of high electrostatic flux concentrations. The surfaces shall be smooth with no projection or irregularities which may cause visible corona. No corona shall be visible in complete darkness when the equipment is subjected to specified test voltage. There shall be no radio interference from the energized switchgear at rated voltage.

5.7.VII.12 The GIS shall be designed, so as to take care of the Very Fast Transients (VFT) over voltages generated as a result of pre-strikes and re-strikes during isolator operation. Maximum VFT over voltages peak shall not be higher than rated lightning impulse withstand voltage of the equipment. Necessary measures shall be under taken by GIS manufacturer to restrict maximum VFT over voltages lower than the lightning impulse withstand voltage. Manufacturer shall submit the study report of VFTO generated for GIS installation.

5.7.VII.13 The enclosure shall be of continuous design and shall meet the requirement as specified in clause no. 10 (special considerations for GIS) of IEEE- 80, Year- 2000.The enclosure shall be sized for carrying induced current equal to the rated current of the Bus. The conductor and the enclosure shall form the concentric pair with effective shielding of the field internal to the enclosure.

5.7.VII.14 The enclosure shall be designed to practically eliminate the external electromagnetic field and thereby electro-dynamic stresses even under short circuit conditions. The average intensity of electromagnetic field shall not be more than 50 micro –Tesla on the surface of the enclosure. The contractor shall furnish all calculations and documents in support of the above during detailed engineering.

5.7.VII.15 Alarm circuit shall not respond to faults for momentary conditions. The following indications including those specified elsewhere in the specifications shall be provided in the alarm and indication circuits.

Gas Insulating System

- Loss of Gas Density.
- Loss of Heater power (if required)
- Any other alarm necessary to indicate deterioration of the gas insulating system.

Operating System

- Low operating pressure.

- Loss of Heater power.
- Loss of operating power.
- Loss of control supply.
- Pole Discordance

5.7.VII.16 Metallic bellows for permitting the movement during expansion and contraction may be of following types:

- Lateral / Vertical mounting units
- Axial compensators
- Parallel compensators
- Tolerance compensators
- Vibration compensators

5.7.VII.17 The contractor shall provide suitable measure to mitigate transient enclosure voltage caused by high frequency currents caused by lightning strikes, operation of surge arrestor, phase to earth fault and discharges between contacts during switching operation. The earthing system shall ensure safe touch & step voltages in all the enclosures.

5.7.VII.18 In order to ensure the security of personnel, equipotential earth mat shall be provided, where the enclosures and fixed accessories are accessible for the floor and manual operation of apparatus or locking system is located.

5.7.VII.19 Contractor shall provide adequate number of UHF sensors in the offered GIS for detection of Partial discharge (of 5 pC and above) as per IEC 60270 through Partial Discharge (PD) monitoring system and the number and location of these sensors shall be subject to approval of Owner/ EIL. Further UHF sensors shall necessarily be provided in close proximity to VT compartments.

5.7.VII.20 However, adequacy of number of sensors and their location shall be verified at site by the contractor as per recommendations of CIGRE task force TF 15/33.03.05 (Task force on Partial discharge detection system for GIS: Sensitivity verification for the UHF method and the acoustic method). In case during site testing additional UHF sensors are required, the same shall also be supplied & installed to complete the technical requirement without cost and time implication to purchaser.

5.7.VII.21 The arrangement of gas sections or compartments shall be such as to facilitate future extension of any make without any drilling, cutting or welding on the existing equipment. To add equipment, it shall not be necessary to move or dislocate the existing switchgear bays. Contractor shall make available during detailed engineering stage, the complete design detail of interface module such as cross section, enclosure material, enclosure dimensions (inner & outer), Flange diameter (inner & outer), conductor connection arrangement, bolt spacing & dimension, rated gas pressure, etc. GIS manufacturer shall furnish all the required details in addition to those mentioned above necessary for design and successful implementation of an interface module during later stage while extending GIS by any other GIS make, without any help of GIS manufacturer who has supplied the GIS equipment in present scope.

5.7.VII.22 Isolating/removable link shall be provided on both side of each busbar so that future extension can be done. Also, dedicated gas compartment shall be provided at both ends. However, connecting complete busbar is permitted for shut down for safety purpose.

5.7.VII.23 Dedicated gas compartment shall be provided in between two adjacent bays.

5.7.VII.24 In case of outage of feeder (incoming/outgoing), adjacent feeder shall not be affected & shall remain in operation without compromising the safety, reliability**.**

5.7.VII.25 **Refer clause 5.5.4 of 6-51-0066**, Note that metallic bellows shall be provided for lateral and vertical alignment based on calculation.

5.7.VII.26 **Refer clause 5.6 of 6-51-0066, following shall also be complied**

i. The corona rings/ stress shields for the control of electrical field in the vicinity of the isolation gap shall be provided by the GIS manufacturer.

ii. The opening for access shall be provided in each phase terminal enclosures as necessary to permit removal of connectors to isolate the XLPE cables to allow carrying out the insulation tests.

iii. Type test reports of radio interference voltage (RIV) level shall be submitted for approval

5.7.VII.27 **Refer clause 5.14.3 (a) and (d) of 6-51-0066,** Note that manual closing and opening of dis-connector is not allowed.

5.7.VII.28 **Refer clause 6.1.1 of 6-51-0066, following shall also be complied**

The circuit breaker shall be capable of

i. Interrupting the steady and transient magnetizing current for transformers upto 200 MVA.

ii. Interrupting line/ cable charging current as per IEC without re-strikes and without use of opening resistors. The breaker shall be able to interrupt the rated line charging current as per IEC-62271-100 with test voltage immediately before opening equal to the product of U/√3 and 1.4.

iii. Breaking 25% the rated fault current at twice the rated voltage under phase opposition condition.

iv. The breaker shall satisfactorily withstand the high stresses imposed on them during fault clearing, load rejection and re-energization of shunt reactor and/or series capacitor compensated lines with trapped charges.

v. Withstanding all dielectric stresses imposed on it in open condition at lock out pressure continuously (i.e. shall be designed for 2 p.u. across the breaker continuously, for validation of which a power frequency withstand test conducted for a duration of at least 15 minutes is acceptable).

vi. Circuit breakers shall be able to switch in and out the shunt reactor of rating upto 100 Ampere with maximum rise of overvoltage limited upto 2.3 p.u.

vii. **Total Break Time**: The total break time shall not be exceeded under any of the following duties:

- Test duties T10, T30, T60, T100 (with TRV as per IEC- 62271-100)
- Short line fault L90, L75 (with TRV as per IEC-62271-100)

The total break time of the breaker shall not be exceeded under any duty conditions specified such as with the combined variation of the trip coil voltage (70-110%), pneumatic/ hydraulic pressure and SF6 gas pressure etc. While furnishing the proof for the total break time of complete circuit breaker, the contractor may specifically bring out the effect of non-simultaneity between poles and show how it is covered in the total break time.

The values guaranteed shall be supported with the type test reports.

5.7.VII.29 **Refer clause 6.1.5 of 6-51-0066, following shall also be complied**

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

ii. Provisions shall be made for attaching an operational analyser to record travel, speed and making measurement of operating timings etc. after installation at site. The contractor shall supply three set of transducer for substation covered under the scope.

5.7.VII.30 **Refer clause 6.1.6 (b) (viii) of 6-51-0066, clause shall be read as**

Densimeter contacts and pressure switch contacts shall be suitable for direct use as permissive in closing and tripping circuits. Separate contacts have to be used for each of tripping and closing circuits.

5.7.VII.31 **Refer clause 6.1.6 (e) of 6-51-0066, following shall also be complied**

i. As long as power is available to the motor, a continuous sequence of the closing and opening operations shall be possible. The motor shall have adequate thermal rating for this duty.

ii. After failure of power supply to the motor one close open operation shall be possible with the energy contained in the operating mechanism.

iii. Breaker operation shall be independent of the motor which shall be used solely for compressing the closing spring. Facility for manual charging of the closing spring shall also be provided. The motor rating shall be such that it requires preferably not more than 90 seconds for full charging of the closing spring.

5.7.VII.32 **Refer clause 6.1.6 (c) of 6-51-0066, following shall also be complied**

i. The hydraulic oil used shall be fully compatible for the temperature range to be encountered during operation.

ii. 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.

iii. The mechanism shall be suitable for at-least two close open operations after failure of AC supply to the motor starting at pressure equal to the lowest pressure of auto reclose duty plus pressure drop for one close open operation.

iv. 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.

v. 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.

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

5.7.VII.33 **Refer clause 6.2.1 of 6-51-0066, following shall also be complied**

i. The signalling of the closed position of the Disconnector shall not take place unless it is certain that the movable contacts will reach a position in which the rated normal current, peak withstand current and short-time withstand current can be carried safely.

ii. The signalling of the open position of the Disconnector shall not take place unless the movable contacts have reached such a position that the clearance between the contacts is at least 80 percent of the rated isolating distance.

iii. Continuous current rating of the Safety earthing switch and high speed make proof earthing switches (not less than 100A) shall be specified by the manufacturer, which can be safely injected for Bay/ Bus equipment testing.

5.7.VII.34 **Refer clause 6.2.4 of 6-51-0066, following shall also be complied**

All portions of the earthing switch and operating mechanism required for earthing shall be connected together utilizing flexible copper conductors having a minimum cross-sectional area of 100 sq. mm.

5.7.VII.35 **Refer clause 6.2.5 of 6-51-0066, following shall also be complied**

Earthing switches located at the beginning of the line/ transformer feeder bay modules shall be of the high speed, make proof type and will be used to discharge the respective charging currents, trapped charge in addition to their safety earthing function. These earthing switches shall be capable of interrupting the inductive and capacitive currents and to withstand the associated TRV. These shall confirm to class B and electrical endurance class E1 as per annexure – C of IEC: 62271-102

5.7.VII.36 **Refer clause 6.3 of 6-51-0066, following shall also be complied**

i. Surge arrestor for GIS shall be installed within the GIS enclosure. Outdoor type surge arrestor are not permitted.

ii. The contractor shall be fully responsible for complete insulation co-ordination of substation including GIS. Contractor shall carry out detailed studies and design calculations to evolve the required parameter locations, energy capability etc. of surge arrestors such that adequate protective margin is available between peak impulse, surge and power frequency discharge voltages and BIL of the protected equipment. The locations of surge arrestors shown in single line diagram is indicative only. If at some more locations the surge arrestors are required to be provided the same should also be deemed included in the scope of work.

iii. The contractor shall perform all necessary studies and the report shall detail the limits of all equipment parameters which could affect the insulation co-ordination. The report shall also detail the characteristics of the surge arrestor and shall demonstrate that the selected arrestor's protective and withstand levels, discharge and coordinating currents and arrestor ratings to comply with the requirement of specification.

iv. The contractor shall also consider in the studies the open circuit breaker condition, fast transients generated by slow operation of disconnecting switches. The study report and design calculations shall be submitted for Owner's approval.

v. 245 kV class arrester shall be capable of discharging energy equivalent to class 3 of IEC for 245 kV system on two successive operations.

vi. The reference current of the arresters shall be high enough to eliminate the influence of grading and stray capacitance on the measured reference voltage.

vii. Each arrestor shall be fitted with an online continuous resistive leakage current monitoring system. The system shall be provided with an interface to integrate with the substation automation system.

5.7.VII.37 **Refer clause 6.4.2 of 6-51-0066,** Note that LCC shall be powder coated.

5.7.VII.38 **Refer clause 6.6 of 6-51-0066, following shall also be complied**

i. Current transformer, characteristics shall be such as to provide satisfactory performance of burdens ranging from 25% to 100% of rated burden over a range of 5% to 120% (or specified rated extended current whichever is higher) of rated current in case of metering CTs and up to the accuracy limit factor/ knee point voltage in case of relaying CTs.

ii. The instrument security factor at all ratios shall be less than five (5) for metering core. If any auxiliary CTs/reactor are used in the current transformers then all parameters specified shall have to be met treating auxiliary CTs as an integral part of the current transformer. The auxiliary CTs/reactor shall preferably built-in construction of the CTs.

iii. Provisions shall be made for primary injection testing.

iv. Note that 1.1 kV bushing mentioned in 6.6.4 for taking CT connections to terminal box is not mandatory.

5.7.VII.39 **Refer clause 6.7 of 6-51-0066, following shall also be complied**

i. VT's for GIS shall be installed within the GIS enclosure. Outdoor type VTs are not permitted.

ii. The supplier shall ensure that there is no risk of Ferro resonance in inductive type voltage transformers, due to the capacitance of the GIS.

5.7.VII.40 **Refer clause 6.9.4 of 6-51-0066, following shall also be complied**

For SF6 gas site tests for moisture, air content, flash point and dielectric strength to be done during commissioning of GIS. Gas bottles should be tested for leakage during receipt at site. The contractor shall indicate diagnostic test methods for checking the quality of gas in the various sections during service. The method proposed shall, as a minimum check the moisture content & the percentage of purity of the gas on annual basis. The contractor shall also indicate clearly the precise procedure to be adopted by maintenance personnel for handling equipment that are exposed to the products of arcing in SF6 Gas so as to ensure that they are not affected by possible irritants of the skin and respiratory system. Recommendations shall be submitted for suitable protective clothing, method of disposal of cleaning utensils and other relevant matters. The contractor shall also indicate the details and type of filters used in various gas sections, and should also submit the operating experience with such filters.

5.7.VII.41 **Refer clause 6.10.2 of 6-51-0066, following shall also be complied**

For “Compartments except Circuit Breaker” and for “Circuit Breaker” compartment, SF6 low level shall be used to annunciate the need for urgent gas filling. Zone trip level shall also be provided for circuit breaker compartment.

5.7.VII.42 **Refer clause 6.10 of 6-51-0066, following shall also be complied**

The contractor should furnish temperature v/s pressure curves for each setting of density monitor along with details of the monitoring device.

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.

In case gas leakage under specified conditions is found to be greater than 0.5% after one year of commissioning, the manufacturer will give additional warranty for FIVE years.

VIII. It is required to interface the GIS switchboards, LCC and CRP with the ECS Panel for control, monitoring and annunciation purpose. For ECS Interface, typical ECS IO list is attached. All the Bus PTs shall have four stages of under-frequency & df/ dt protection and separate contact for each stage shall be provided for ECS interface. In addition to above, terminals as required for interface with upstream and downstream switchgear needs to be provided to fulfil the operational requirements.

IX. For control of GIS switchboards through ECS, One Local/ Remote (L/R) selector switch shall be provided in each individual panel of GIS. Where Local means Operation from panel itself and Remote means ECS.

- When L/ R selector switch is in Local mode, all controls are transferred to GIS switchboard. Following operations shall be possible from the GIS
  - Closing of all incomers and bus coupler breakers in test position only.
  - Closing of all outgoing breakers in test and service position.
  - Tripping of all breakers, irrespective of position of Local/ Remote selector switch.

X. Manufacturer shall furnish the following information for Owner’s/ EIL review

5.7.X.1 Details regarding the loosely distributed metallic particles within the GIS encapsulation and calculations of critical field strength for specific particles of defined mass and geometry.

5.7.X.2 Study report of VFTO generated for GIS installation.

5.7.X.3 The methodology and all the equipment for electrical partial discharge (PD) detection.

5.7.X.4 The calculations and documents in support of the average intensity of electromagnetic field on the surface of the enclosure during detailed engineering.

5.7.X.5 The detailed criteria/ design regarding location of pressure relief devices/rupture diaphragms

5.7.X.6 Calculations to show that there is no Ferro resonance due to capacitance of GIS for the voltage transformers

5.7.X.7 Design calculation for simulated parameters for Seismic level as applicable

5.7.X.8 Insulation Coordination studies including studies to recommend for additional surge arrestor

5.7.X.9 Calculation in support of touch & step voltages in all enclosures and earthing of complete GIS installation.

5.7.X.10 Equipotential earth mat drawings along with design calculations.

5.7.X.11 Measures to mitigate transient enclosure voltage by high frequency currents.

XI. All transport packages containing critical units viz. Circuit breakers and Voltage transformers shall be provided with sufficient number of electronic impact recorders (on returnable basis) during transportation to measure the magnitude and duration of the impact in all three directions. The acceptance criteria and limits of impact in all three directions which can be withstood by the equipment during transportation and handling shall be submitted by the contractor during detailed engineering. The recording shall commence in the factory and must continue till the units reach site. The data of electronic impact recorders shall be downloaded at site and a soft copy of it shall be handed over to Engineer – in –charge.

XII. Special precautions shall be taken to protect any parts containing electrical insulation against the ingress of moisture. Either dry nitrogen/ air or dry SF6 gas shall be used and the pressure shall be such as to ensure that, allowing for reasonable leakage, it will always be greater than the atmospheric pressure for all variations in ambient temperature and the atmospheric pressure encountered during shipment to site and calculating the pressure to which the sections shall be filled to ensure positive pressure at all times during shipment. The type of gas, the maximum pressure to which sections will be filled prior to shipment and the minimum allowable pressure during shipment shall be advised prior to dispatch. Necessary arrangement shall be ensured by the contractor to take care of pressure drop of dry air or nitrogen during transit and storage till completion of erection.

XIII. Following equipments shall be supplied along with GIS (These equipments shall be supplied as Mandatory spare, defined in EDB-1001 & SL-0020 attached with tender/technical amendment)

5.7.XIII.1 SF6 Gas leakage detector

The detector shall be portable, battery operated with built in battery charger, hand held type and having a minimum SF6 gas leakage sensitivity of 5gm/year. The test kit shall be compatible for EMI/EMC environment as per IEC 1000. The equipment shall have on/off switch & suitable indicating lamps/LEDs, variable pitch audible signal for leakage indication, and a head phone jack. The equipment shall have automatic zeroing of background signals suitable for detecting SF6 gas leakage in charged substation.

5.7.XIII.2 Gas filling and evacuating cart

i. This shall include all the necessary gas cylinders for temporarily storing the evacuated SF6 gas. The capacity of the temporary storage facilities shall be at least be sufficient for storing the maximum quantity of gas that could be removed from at least one phase of one complete Bay (switchgear and associated equipment) or continuous bus section (whichever is higher).

ii. The minimum capacity of cart will be as under:

- Vacuum Pump: 60 M^3/Hour (Nominal suction pressure)

- Compressor: 15 M^3/Hour (Delivery).

5.7.XIII.3 SF6 gas analyser

The SF6 gas analyser should be of portable type and instruments shall have following features

i. In-built calibration facility.

ii. Sensitivity of the equipment shall not be affected by any atmospheric conditions like dust, humidity, heat, wind etc.

iii. Equipment shall work on zero gas loss principle i.e. gas should be pumped back to the compartment after measurement without any exposure to the atmosphere.

iv. Equipment shall be supplied with suitable regulator which can be used to connect SF6 cylinder if required.

v. Following acidic/impurities products should be detected as per IEC 60480 and IEC 60376

- SF6 purity – Range: 0-100% & Accuracy: +/- 0.5 %
- Dew point - Range: -60 to +20 °C & Accuracy: +/- 0.5 °C
- SO2 - Range: 0-150 ppm & Accuracy: +/- 2 %
- CF4 – Range: 0-60% volume & Accuracy: +/- 1 %
- HF - Range: 0-200 ppm & Accuracy: +/- 5 %

vi. Instrument should work on AC source as well as on rechargeable battery

vii. Input pressure: upto 10 bar

viii. It should be housed in a robust IP67 case with wheels

5.7.XIII.4 Online Partial Discharge (PD) monitoring system for both indoor & outdoor GIS

i. The equipment shall be used for detecting different types of defects in Gas Insulated Stations (GIS) such as Particles, Loose shields and Partial Discharges as well as for detection of Partial discharges in other types of equipment such as Cable Joints, CTs and PTs.

ii. It shall be capable for measuring PD in charged GIS environment as EHV which shall have bandwidth in order of 100 MHz–2GHz with possibility to select a wide range of intermediate bandwidths for best measurement results. The principle of operation shall be based on UHF principle of detection. The instrument should also be able to detect partial discharges in cable joints and terminations.

iii. Detection and measurement of PD and bouncing particles shall be displayed on provided HMI for the system and the measurement shall be stored in the PC for further analysis to locate actual source of PD such as free conducting particles, floating components, voids in spacers, particle on spacer surfaces etc. Software for display and diagnosis of PD signals and an expert software system for accurate interpretation of cause of PD shall also be supplied and installed on the provided HMI by the contractor.

iv. The equipment shall meet the following requirements

- Measurement shall be possible in noisy environment.
- Stable reading shall be possible in presence of vibrations within complex GIS assemblies, which can produce signals similar to PD.
- Equipment should have necessary synchronizing circuits to obtain PD correlation with power cycle and power frequency.
- The equipment shall be battery operated with built-in-battery charger. It shall also be suitable for 230V AC/ 50 Hz input.
- Measurement shall be possible in the charged substation/ switchyard in the presence of EMI/EMC. Supplier should have supplied similar detector for GIS application to other utilities. Performance certificate and the list of users shall be furnished for evaluation during detail engineering.

- Instrument shall be supplied with standard accessories i.e., re-locatable sensors with mounting arrangements, connecting cables (duly screened) to sensors, Laptop PC, diagnostic and expert interpretation software, carrying case, rechargeable battery pack with charger suitable for 230V AC, 50Hz supply connecting cables (duly screened) to view in storage.

v. The function of software shall be covering the following:

- Data recording, storage and retrieval in computer
- Data base analysis
- Template analysis for easy location of fault inside the GIS
- Evaluation of PD measurement i.e. Amplitude, Phase Synchronization etc.
- Evaluation of bouncing/loose particles with flight time and estimation on size of particle.
- Expert software system for accurate interpretation of cause of PD.
- Report generation.

vi. To prove the suitability in charged switchyard condition, practical demonstration shall be conducted before acceptance.

vii. Necessary training may be accorded to personnel to make use of the kit for locating PD sources inside the GIS

viii. Calibration: The UHF Couplers have to be first calibrated as per CIGRE procedure TF 15/330305 as part of factory acceptance tests to guarantee detection sensitivity of 5pC or better. The GIS of same design shall be used as test specimen during the coupler calibration. The pulse injection level determined through above factory calibration tests shall only be used as reference for site sensitivity checks during commissioning of PDM system. The data sheet/ frequency response characteristics shall be submitted for reference.

ix. Pulse generator for UHF sensor sensitivity test shall also be supplied as a standard accessory.

5.7.XIII.5 SF6 topping system.

SF6 topping system shall be provided for 220 kV GIS for filling/ topping up SF6 gas to panel under energized condition manually.

XIV. DC Control supply change over scheme for the EHV GIS shall be as per hardware datasheet B957-000-16-50-1835 attached with the tender document.

XV. Contractor shall finalise the make of 66kV GIS switchboard meeting the criteria indicated in attached Experience Record Proforma (ERP), B957-000-16-50-DS-0020. Completely filled in ERP sheet along with all supporting documents shall be furnished along with bid.

XVI. At all 220kV & 66kV feeders (incomer & outgoing) including spares, local breaker back up protection (LBB) shall be considered. Control logic shall be prepared accordingly.

XVII. Regarding the busbar differential protection envisaged in 220kV GIS & 66kV GIS, contractor shall note the following:

a. Redundant & completely independent scheme shall be provided for main & check zone low impedance distributed differential protection with complete redundancy at both central as well as feeder CT input level for each of the main & check zone protection scheme. Redundancy of bus differential scheme to be ensured with two independent sets central unit each having independent main & check zone protection along with dedicated independent CT input modules for each feeder.

b. Bus differential scheme shall have dedicated power supply from same bus section.

5.8 HV ISOLATING BREAKER PANELS

I. 6.6 kV, 800 Amps, 40 kA (1 Sec) AIS Isolating Breaker Panel (1 no.) shall be as per EIL standard specification 6-51-0001.The switchboard shall be complete with metering, protection & control facility as per data sheet attached with tender. Tag number of various equipment shall be as follows.

Tag Number	Item	Hardware Datasheet
100-MV-202	6.6 kV, 800 Amps, 40 kA (1 Sec) Isolating Breaker Panel	B957-000-16-50-0128

II. The switchgear shall be qualified as classification IAC for rated fault current for 1 sec. for 6.6kV, according to IEC 62271-200 with regard to its mechanical strength in the event of an internal arc. The test performance shall be in conformity with accessibility type AFLR. The test shall be executed for all separate compartments within the functional unit containing HV equipment, i.e., bus-bar compartment, circuit breaker compartment and cable compartment.

5.8.2.1 In case contractor has considered pressure relief flap/gas duct above switchboard for release of gases due to internal arc, suitable absorbers in the switchboard shall be provided to prevent the release of harmful gases in the switchgear hall. Alternatively, duct including all accessories/supporting arrangement/sealing material/bends/ installation material etc. shall be provided for taking the gas outside of substation to a safe location. Substation equipment layout shall be furnished during detailed engineering stage by contractor indicating duct location. This requirement is applicable for 6.6kV switchboard & all isolating breaker panels (6.6kV).

III. Vendor to note that all HV switchboards shall have Loss of service continuity category as LSC2B with partition class PM as per IEC-62271-200.

IV. Separate earthing carriage/ truck shall be supplied for the IBPs. One set of earthing truck for incoming and outgoing cable side earthing shall be provided for IBPs. Two numbers of Lifting trucks and accessories (if applicable) shall be provided for IBPs for withdrawal of cassette mounted circuit breakers.

V. The validity requirements for the type test reports for HV switchboards, breakers etc. shall be as below:-

S. No	Type Test	Equipment	Validity
1	Short Circuit Withstand Capacity	Panel	Up to 5 years from the final bid opening date or design change which is earlier
2	Temperature Rise	Panel and breaker	Up to 5 years from the final bid opening date or design change which is earlier
3	Impulse and power frequency withstand	Panel	Till any design change
4	Internal Arc Fault	Panel	Till any design change
5	Degree of protection for panels	Panel	Till any design change
6	Breaker short circuit duty cycle test	Breaker	Till any design change

VI. In case the valid type tests on the offered design of Equipment is not available, all type tests shall be conducted by the successful vendor on the offered design after order finalization without any extra cost and delivery impact

VII. Surge arrestor shall be provided at both incoming and outgoing of Isolating Breaker Panels. Sizing calculation of surge arrestors shall be furnished during drawing review stage.

VIII. IBPs shall be with single tier circuit breaker arrangement and shall be provided with online temperature monitoring system.

IX. IBPs outgoing and incoming cabling compartment shall be provided with unique castle key rear door interlock such that breaker gets tripped/ does not gets closed, if rear door (through rear door limit switch) of that IBP is opened. In addition to that IBP rear door shall be interlocked with upstream switchboard breaker off contact, so that it shall not be possible to open the rear door, until upstream switchboard breaker is off. Rear door can be opened only when the breaker is switched off and racked out

X. Electrical interlock shall be provided for rear door of IBPs. Further, a mechanical interlock such as a trapped key interlock mechanism that does not permit opening of back cover until cable side earthing of outgoing breakers has been done.

XI. Pressure relief ducts above switchboard for release of gases due to internal arc duct shall be considered as per manufacturer's recommendation and type tested design. In case pressure relief ducts are terminated inside switchgear hall, these shall be directed away/ upwards from person standing in the vicinity and shall be provided with absorber at both ends.

XII. In each VCB panel, vendor shall ensure that two separate shutters have been provided, one for bus-side and one for cable side.

XIII. Vendor to note that an indication that defines 'ON', 'OFF', and 'in service position' shall be provided at the back side of all Isolating Breaker panel. Further, additionally, R-, Y-, B- Phase healthy indication shall also be provided.

XIV. Incoming and outgoing power cables to and from isolating breaker panels shall be as follows:

- **For 6.6kV IBP**: 1 Run 3C x 240 Sq.mm (min.). 6.6 kV (UE), XLPE Insulated, Armoured, and FRLS Aluminium Cables separately for incoming from upstream feeder and to downstream 6.6/0.433kV distribution transformer.

XV. The 6.6kV IBP will receive power from upstream 6.6 kV switchboard. Receiving end 87F relay for upstream switchboard end this IBP shall be free issued to CONTRACTOR as part of this tender. Optical fiber cable along with HDPE duct (Green conduit with white strip) shall be provided by others, however end termination of OFC including all accessories for receiving end shall be in the scope of this tender.

5.9 HV SWITCHBOARD

I. All requirements shall be considered while sizing the switchboards and feeders, as required, including feeder for free-issues material based on final approved single line diagram, shall be provided with no cost and time implication to owner. 20% spare capacity shall be considered for sizing of Switchboard.

II. HV Switchboard shall be provided with two incomers and two bus coupler. Second bus coupler shall be without any kind of numerical relay and shall be provided with Electro-mechanical type Trip circuit supervision relay. Status of second bus coupler shall be used in interlock of Auto changeover logic, which shall be implemented in the first bus coupler with numerical relay. There shall not be any feeder in between two bus couplers.

III. All HV Switchgear shall be provided with online wireless temperature monitoring facility. The passive sensor should be wireless, battery less, dielectrically safe, robust to high voltage, high electromagnetic field, and harsh environment. It should take direct measurement on critical point. This facility shall be interfaced with ECS.

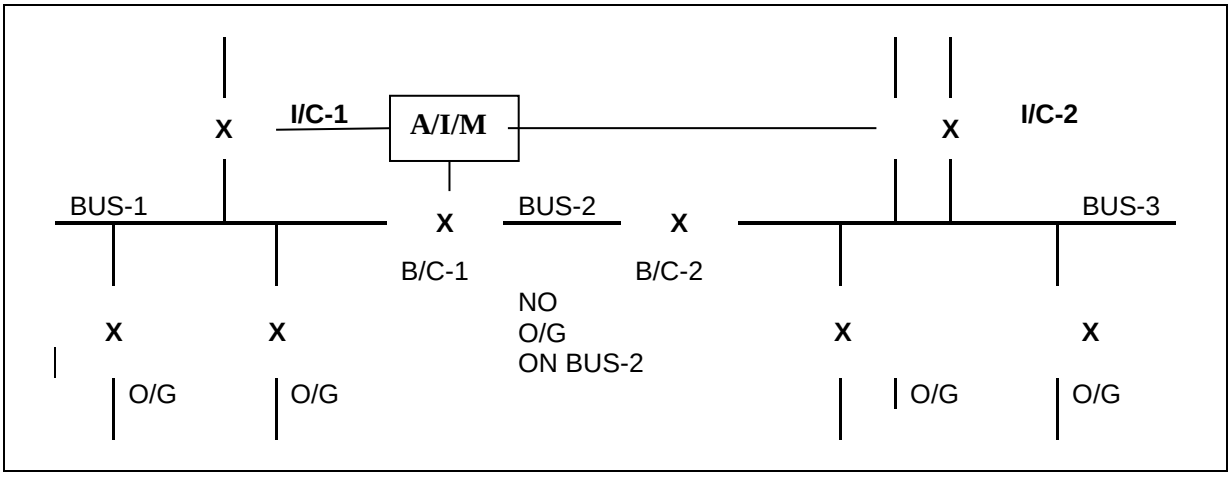
IV. CONTRACTOR shall supply (loose supply) Feeder differential relay (87F) of same make/ model as installed in the 6.6kV Outgoing plant feeder for Owner's use for installation and wiring in downstream 6.6kV Switchboard incomer panels. Installation, Testing and commissioning of loose supply relays shall be done by others.

V. Auto changeover between incomers and bus coupler for 6.6 kV system shall be provided. Additionally manual change over through synchro-check relay with momentary paralleling shall also be provided. All necessary hardware shall be included to achieve auto, independent and manual operation of incomers and bus coupler.

VI. Only major relays, meters and controls are indicated in the hardware data sheets. Any auxiliary relays, timers, switches, etc, as required while developing the control schematic and felt necessary for safe operation, even if these are not specifically included, shall be supplied by the CONTRACTOR. All logic shall be implemented in the relay itself and not externally. Provision of adequate I/O count in the relays shall be ensured.

VII. All relays, metering and control components shall be mounted on the panel front only. Dummy panel and rear extension, as required, for bus trunking / cable terminations shall be provided.

VIII. Auto/Manual Changeover scheme for switchboard with two incomers and Two bus-coupler breakers shall comply with the logic described briefly as follows. Safety interlocks as deemed necessary shall however be considered during detailed engineering.



Auto Changeover:

(a) Auto changeover between the two incomers and bus-coupler-1 shall be in such a way those two-incomer breakers are 'ON' at a time and bus-coupler breaker-1 is normally open & bus-coupler breaker-2 is normally closed.

(b) Bus-coupler breaker-1 is made 'ON' automatically in case the incoming supply at incomer breaker no. 1 or 2 fails and the respective breaker trips on under voltage.

(c) Blocking of auto transfer (i.e., closing of bus-coupler) if any incomer breaker trips due to a fault. Trip due to 51G, 64R, 63TX & 87T shall allow the transfer.

(d) Tripping of incomer on under voltage shall be blocked, if both the incomers simultaneously experience an under voltage.

Manual Changeover:

From Bus-coupler-1

(a) Incomer no. 1 and 2 breakers are 'ON'. Bus-coupler breaker-1 is 'OFF' & Bus-coupler breaker-2 is 'ON'. Manual closing of bus-coupler-1 breaker with momentary paralleling (interlocked with check synchronizing relay) of the incoming supplies to facilitate taking out any of the incomer breakers for maintenance.

(b) Trip incomer 1 or 2 (pre-selected) after closing of Incomer 1 or 2 or coupler to avoid continuous paralleling of incomers.

Initiation of auto changeover:

(a) When the incoming supply to the I/C breaker no. 1 or I/C breaker no. 2 fails, the respective incomer is tripped through under voltage relays and a timer. The time delay is in the range of 0.5 to 5 sec. Breaker trip on under voltage is blocked in case of power failure on both the incomers.

(b) The voltage on healthy bus section has been above the set value of normal voltage for a specified duration (settable through an off-delay timer 0.5-5 sec) and the incomer breaker of healthy bus is closed in service position.

(c) Bus-coupler-1 is open and in-service position & Bus-coupler-2 is closed.

(d) Auto/ Manual switch at B/C-1 is set for 'AUTO' operation.

Closing of bus coupler-1 breaker under auto operation:

(a) One of the incomer breakers has tripped on under voltage.

(b) The residual voltage on the bus that has lost supply is less than 40% of normal voltage.

(c) Incoming voltage of healthy incomer has been above 80% of normal voltage for a specific duration. (Through timer 0.5 sec - 5.0 sec)

(d) Auto/ Manual switch is set for 'AUTO' operation.

Manual transfer after auto changeover:

(a) When supply is again available at incomer breaker after auto changeover has already taken place, it is possible to restore the system to normal operating condition by operating selector switch (meant for tripping incomer no. 1 or 2 or bus-coupler-1) and by setting auto/ manual switch in 'Manual' mode.

In manual transfer the closing circuit shall be interlocked through check synchronizing relay.

Manual transfer for taking Bus-couplers in Maintenance.

For Bus-coupler-1

(a) Incomer no. 1 and 2 breakers are 'ON'. Bus-coupler breaker-1 is 'OFF' & Bus-coupler breaker-2 is 'ON'.

(b) Bus-coupler-2 breaker is made 'OFF' and I/C-1 breaker is made off. Bus-1 & 2 are now dead buses hence the Bus-coupler-1 can be taken out for maintenance.

For Bus-coupler-2

(c) Incomer no. 1 and 2 breakers are 'ON'. Bus-coupler breaker-1 is 'OFF' & Bus-coupler breaker-2 is 'ON'.

(d) Bus-coupler-2 breaker is made 'OFF' and I/C-2 breaker is made off. Bus-2 & 3 are now dead buses hence the Bus-coupler-2 can be taken out for maintenance.

IX. CT and PT burden mentioned in data sheets are indicative. CONTRACTOR shall provide the same as required including the burden for transducers provided at transducer panel. CONTRACTOR may consider 1.5 VA per phase per transducer for CT burden and 1.5 VA per phase per transducer for PT burden for analogue input for ECS interface.

X. DC and AC control supply scheme for HV switchboards shall be in line with hardware data sheet attached for HV switchboards.

XI. All HV motor feeder schematics shall have provision for auto start and auto re-acceleration with feature to inhibit irrespective of process/licensor's requirement.

XII. All HV switchboards shall have provision for positive LOTO implementation. Photographs of LOTO provision in each type of panels shall be submitted during drawing review for approval.

XIII. All requirements as specified above including ECS interface, shall be applicable for switchboard. Line PT and protection & metering requirements shall be as per Design data sheets and 6.6 kV hardware data sheets as applicable.

XIV. For interfacing with DCS system, Hardwired signals (with minimum requirement specified below) from various feeders of a bus section required for DCS interface shall be wired and terminated.

i) Breaker/Contactor 'ON' indication

ii) Breaker/Contactor 'OFF' indication

iii) Local/Remote selection indication

iv) Process Trip indication

v) Process Start command

vi) Process Stop command

vii) Process Start permissive command

viii) Ammeter (4-20mA)

ix) Ready to Start signal from feeder

XV. Terminals for DCS input & DCS output shall be segregated & separate terminal block shall be provided. While wiring these signals from respective feeder module to marshalling, it shall be ensured that separate cables are used for status & commands & same shall be segregated.

XVI. Current rating for interface contacts shall be 2A, 110V DC.

XVII. All the signals available in Numerical relays shall be made available in Laptop & HMI through serial communication.

XVIII. All signals as per ECS data sheet shall be provided for interface with the Electrical control system.

XIX. Number of analogue / digital IOs shall be worked out by the CONTRACTOR as per the ECS I/Os list attached with the bid package

XX. All trip contact should be preferably "NO" contact. Separate NO contact of each such trip should be routed to relay also for event logging or redundant tripping.

XXI. All the CT connection should be through ring type reliable connection/terminations only.

XXII. There shall be one common control supply switch for all control supply of feeder. Separate fuses for following branch circuit shall be provided:

- Spring charging circuit
- Closing circuit
- Tripping circuit and contactor multiplier circuit & digital input circuit
- Indication circuit
- Numerical relay supply (incoming of numerical relay supply fuse shall be tapped before the "control supply switch".

XXIII. Separate control supply switch shall be provided for differential protection relays.

XXIV. Control supply of each BUS PT of HV switchboard shall have independent control supply switch and sets of fuses tapped from Main DC bus.

XXV. Installation of surge arrestors to be done after the CTs towards cable termination side.

XXVI. Hard contacts of the breaker shall be used for providing interlocks in the schemes mainly for auto change over, tripping, feedback, closing and process interlocks. In the absence of sufficient hard contacts, latched contactors/ relays to be used for contact multiplication.

XXVII. Critical contacts used for providing process interlocks should be direct hard contacts and these shall not be taken from the multiplying contactors / auxiliary relays, if feasible.

XXVIII. Wherever two NO contacts available in Emergency push button & LCS STOP PB of all breaker fed HV Motors, one NO contact shall be wired to trip breaker directly & other shall be wired to binary input of numerical motor protection relay.

XXIX. All rear panel doors of HV panels shall have handle for ease of maintenance.

XXX. The validity requirements for the type test reports for HV switchboards, breakers etc. shall be as below:-

S. No	Type Test	Equipment	Validity
1	Short Circuit Withstand Capacity	Panel	Up to 5 years from the final bid opening date or design change which is earlier
2	Temperature Rise	Panel and breaker	Up to 5 years from the final bid opening date or design change which is earlier
3	Impulse and power frequency withstand	Panel	Till any design change
4	Internal Arc Fault	Panel	Till any design change
5	Degree of protection for panels	Panel	Till any design change
6	Breaker short circuit duty cycle test	Breaker	Till any design change

In case the valid type tests on the offered design of Equipment is not available, all type tests shall be conducted by the successful vendor on the offered design after order finalization without any extra cost and delivery impact.

XXXI. Contractor shall furnish details of type test certificate in attached format for Type test certificates during detailed engineering for review.

XXXII. For owner supplied items, feeders at 6.6kV shall be provided by the CONTRACTOR in the HV (6.6kV) switchboard supplied by them. Number of feeders required for Owner's use are listed below.

S. No.	Description	Rating of feeder	Nos. of feeders	Total Load*
1.	ETP package	1250A	2	2 MW
2.	Butene-1 Unit	1250A	2	2 MW
3.	Petchem MCR+Lab+FWPH	1250A	2	2 MW
4.	Steam Block	1250A	2	2 MW
5.	Polymer warehouse & Gantry	1250A	2	2 MW

* Total Load of 10 MW of owner's load shall be considered by contractor in Power transformer sizing.

5.9.36 SLD of HT board shall be painted behind the HT board indicating the bus bar arrangement.

5.10 NEUTRAL GROUNDING RESISTOR

I. Neutral grounding resistor shall be supplied as per the EIL specification, 6-51-0043 & attached data sheet.

5.11 EHV CABLE (220kV & 66KV)

I. 220kV & 66kV cables shall be supplied as per the EIL specification, 6-51-0067 & attached data sheet. Bonding scheme & associated hardware, jointing kit, termination kit, earthing cable etc. as required shall be decided & supplied by contractor.

II. Termination of owner's supplied & laid 66kV cable at outgoing terminal of 66kV GIS switchboard at MRSS-100 is included in contractor's scope. Accordingly, termination kit shall be supplied & commissioned by contractor.

III. Supply, laying & termination of 66kV cable on primary side of 66/6.9kV transformer to be supplied by contractor is included in contractor's scope.

5.12 HV CAPACITOR BANK

5.12.1 HV Capacitor shall be as per the enclosed HV capacitor datasheet and EIL standard specification 6-51-0020 attached with the tender.

5.12.2 Capacitor banks along with APFCR shall be indoor panel mounted type, installed in switchgear hall. Dry type series reactor, RVT installed inside panel shall be provided with the capacitor banks.

5.12.3 Capacitor bank and associated equipment shall be sized to maintain min. 0.95 power factor at the primary of 66/6.9kV transformers.

5.13 MV (415V) SWITCHBOARD

I. Refer enclosed hardware data sheets for the details of relay and metering facilities to be provided for each feeder. Only major relays, meters and controls are indicated in the data sheets. Any auxiliary relays, timers, switches, etc., as required while developing the control schematic and felt necessary for safe operation, even if these are not specifically included, shall be supplied by the contractor. All relays, metering and control components shall be mounted on the panel front only. All logic shall be implemented in the relay itself and not externally. Adequate I/O count shall be ensured.

II. The Contractor shall be solely responsible to coordinate the relay characteristics with relay supplier for the proper selection of all CTs with special care to select class PS CTs. The VA burden, knee-point voltage, CT resistance and magnetizing current shall be calculated by the contractor for Owner/ Consultant's review before proceeding with manufacturing.

III. Dummy panels and rear extensions, as required, for cable terminations, mounting of relays, meters, control components etc. shall be supplied as required and dummy/adopter panel for beam shall be considered for as per site requirements. Rear cable chamber provided for the switchboard shall be of height similar to other vertical panels.

IV. All MV switchboards in contractor scope shall be of the same make.

V. Limiting maximum rating of PMCC/EPMCC shall be 4000A and fault level limited to 65kA for 1 sec.

VI. All Incomers, Bus couplers and ACB power/motor feeders in MV Switchgear (PMCC/EPMCC) shall be provided with online wireless temperature monitoring facility. The passive sensor should be wireless, battery less, dielectrically safe, robust to high voltage, high electromagnetic field, and harsh environment. It should take direct measurement on critical point. This facility shall be interfaced with ECS.

VII. For PMCC/EPMCC internal arc protection system shall be provided to sense internal arc and to isolate the fault.

VIII. For MV Switchboards rated up to 4000A, forced cooling for any of the components e.g. bus bars, air circuit breakers etc. is not acceptable. To achieve the continuous current rating under site conditions at design ambient temperature inside the panel / cubicle, the required de-rating as / if applicable shall be considered by switchboard vendor.

IX. MV switchboards shall be provided with facility to conduct test & disconnected operations with door closed position only.

X. All switchboards (PMCC/EPMCC) shall be provided with two incomer and Two bus coupler. However, PMCC shall have third incomer for integrating solar photovoltaic system. No. of outgoing feeders shall be decided based on system requirement, spare feeders and feeders for Owner's use as defined elsewhere. However, feeders, as required, based on final approved single line diagram, shall be provided with no cost and time implication to owner. 20% spare outgoing feeder or minimum one of each type, whichever is higher shall be provided in each switchboard.

XI. Air circuit breaker/Isolator provided in incomers of PMCC /EPMCC/ LDB /ELDB shall be of 4-pole type. Isolating links shall be provided in the neutral circuit of all the TPN outgoing feeders

XII. All the switchgears shall have rating at least equal to the maximum demand plus a provision for 10% future load growth and 20% spare capacity (i.e. Max. Demand x 1.1 x 1.2). Incomers of switchgear shall be designed to cater to the complete load including 10% margin for future load growth and 20% spare capacity as specified above. Service breaking capacities for all breakers shall be equal to or higher than the maximum value of the short circuit at the point of installation.

XIII. **Changeover scheme for three incomers and Two bus-coupler**

PMCC shall be provided with Auto/ Manual Changeover facility. Auto/Manual Changeover scheme for switchboard with two incomers and Two bus-coupler breakers shall comply with the logic described briefly as follows. Third Incomer of PMCC (i.e. Incomer from Solar PV system) shall be connected to the bus having emergency supply. Safety interlocks as deemed necessary shall however be considered during detailed engineering.

Buscoupler-1 shall be with protections and shall be used in changeover logic, whereas Bus coupler-2 shall be used as an isolator without any protections.

5.13.XIII.1 **Auto *Changeover***

i) Auto changeover between the two incomers and two bus-coupler shall be in such a way that the two-incomer breakers are 'ON' at a time and bus-coupler breaker is normally open.

ii) Bus-coupler breaker is made 'ON' automatically in case the incoming supply at either of the incomer breaker fails and the respective breaker trips on under voltage.

iii) Blocking of auto transfer (i.e., closing of bus-coupler) if any incomer breaker trips due to a faultor in case of standby earth fault (51G). Trip due to 64R, 63TX shall allow the transfer.

iv) Tripping of incomer on under voltage shall be blocked, if both the incomers simultaneously experience an under voltage.

5.13.XIII.2 ***Manual Changeover***

i) Both the Incomer breakers are 'ON'. Bus-coupler breaker is 'OFF' Manual closing of bus-coupler with momentary paralleling (interlocked with check synchronizing relay) of the incoming supplies to facilitate taking out any of the incomer breakers for maintenance.

ii) Trip any of the incomer breakers (pre-selected) after closing of any of the Incomer or coupler to avoid continuous paralleling of incomers.

5.13.XIII.3 ***Initiation of auto changeover:***

i) When the incoming supply to any of the breakers fails, the respective incomer is tripped through under voltage relays and a timer. The time delay is in the range of 0.5 to 5 sec. Breaker trip on under voltage is blocked in case of power failure on both the incomers.

ii) The voltage on healthy bus section has been above the set value of normal voltage for a specified duration (settable through an off-delay timer of range 0.5 to 5 sec) and the incomer breaker of healthy bus is closed in service position.

iii) Bus-coupler is open and in-service position.

iv) Auto / Manual switch is set for 'AUTO' operation.

5.13.XIII.4 ***Closing of bus coupler breaker under auto operation:***

i) One of the incomer breakers has tripped on under voltage.

ii) The residual voltage on the bus that has lost supply is less than 40% of normal voltage.

iii) Incoming voltage of healthy incomer has been above 80% of normal voltage for a specific duration (Through timer 0.5 sec to 5.0 sec)

iv) Auto/ Manual switch is set for 'AUTO' operation.

5.13.XIII.5 ***Manual transfer after auto changeover:***

i) When supply is again available at incomer breaker after auto changeover has already taken place, it is possible to restore the system to normal operating condition by operating selector switch (meant for tripping incomer no. 1 or 2 or bus-coupler) and by setting auto/ manual switch in 'Manual' mode.

ii) In manual transfer the closing circuit shall be interlocked through check synchronizing relay.

XIV. For interfacing with OWNER system, separate Standalone Marshalling panel shall be provided in Substation. Hardwired signals (with minimum requirement specified below) from various feeders required for ECS / DCS interface shall be wired and terminated in the standalone marshalling panel.

i) Breaker/Contactor ‘ON’ indication

ii) Breaker/Contactor ‘OFF’ indication

iii) Local/Remote selection indication

iv) Process Trip indication

v) Process Start command

vi) Process Stop command

vii) Process Start permissive command

viii) Ammeter (0-1A/4-20mA)

ix) Ready to Start signal from feeder

XV. Number of analogue / digital IOs shall be worked out by the Contractor as per the ECS I/Os list attached with the tender.

XVI. Terminals for DCS& ECS, input & output shall be segregated & separate terminal block shall be provided. While wiring these signals from respective feeder module to marshalling, it shall be ensured that separate cables are used for status & commands & same shall be segregated

XVII. Current rating for interface contacts shall be 2A, 110V DC or 240V AC.

XVIII. Indicating lamps shall employ LEDs. LEDs provided for indication shall be cluster type with adequate brightness and minimum 2Nos LEDs chips per light. LEDs shall be connected in parallel and each LED chip having diameter not less than 3mm.

XIX. All feeders shall have physical lock out provision to facilitate the “lock out tag out” (LOTO) procedure for ensuring safe operation

XX. Two numbers ACB breaker handling trolleys shall be provided for the substation.

XXI. Earth fault relay operated through CBCT provided in PMCC & LDB feeders shall be mounted on draw-out part of the switchboard and shall be suitable for operation at 110V DC or 240V AC supply as available in the respective switchboard.

XXII. Timer provided in LDB shall be astronomical type smart timer i.e. to take care of weather condition & shall be programmable for full year.

XXIII. For motor feeder rated up to 45kW, following shall be provided:

- R-C circuit shall be provided across the power contactor for all DOL motor starter feeders in PMCC.
- Low burden auxiliary contactors shall be provided in all DOL motor starter feeders for receiving start/ stop commands from field.

XXIV. All trip contact should be preferably “NO” contact. Separate NO contact of each such trip should be routed to relay also for event logging or redundant tripping.

XXV. All the CT connection should be through ring type reliable connection/terminations only.

XXVI. There shall be one common control supply switch for all control supply of feeder. Separate fuses for following branch circuit shall be provided:

- Spring charging circuit
- Closing circuit
- Tripping circuit, contactor multiplier circuit& digital input circuit
- Indication circuit
- Numerical relay supply (incoming of numerical relay supply fuse shall be tapped before the “control supply switch).

XXVII. Separate control supply switch shall be provided for differential protection relays.

XXVIII. Control supply of each BUS PT of PMCC/EPMCC shall have independent control supply switch and sets of fuses tapped from Main DC bus.

XXIX. Hard contacts of the breaker shall be used for providing interlocks in the schemes mainly for auto change over, tripping, feedback, closing and process interlocks. In the absence of sufficient hard contacts, latched contactors/ relays to be used for contact multiplication.

XXX. Critical contacts used for providing process interlocks should be direct hard contacts and these shall not be taken from the multiplying contactors / auxiliary relays, if feasible.

XXXI. Wherever two NO contacts available in Emergency push button & LCS STOP PB of all breaker fed MV Motors, one NO contact shall be wired to trip breaker directly & other shall be wired to binary input of numeric motor protection relay.

XXXII. All rear panel doors of MV panels shall have handle for ease of maintenance

XXXIII. Rear cable chamber provided for the switchboard shall be of height similar to other vertical panels and shall have handle for ease of maintenance.

XXXIV. All the offered switchboards and breakers shall be type tested. Copies of valid type test certificates for the following tests conducted on identical design of offered equipments required as per data sheets attached with tender specifications shall be furnished post order. The validity requirements for the type test reports for MV switchboards, breakers etc. shall be as below:-

S. No	Type Test	Equipment	Validity
1	Short Circuit Withstand Capacity	Panel and breaker	Up to 5 years from the final bid opening date or design change which is earlier
2	Temperature Rise	Panel and breaker	Up to 5 years from the final bid opening date or design change which is earlier

S. No	Type Test	Equipment	Validity
3	Internal Arc Fault	Panel	Till any design change
4	Degree of protection for panels	Panel	Till any design change
5	Breaker short circuit duty cycle test	Breaker	Till any design change

XXXV. CONTRACTOR to conduct heat run test on each rating of MV switchboard at vendor's works as part of scope of this tender and no extra payment for the same shall be provided.

XXXVI. For owner supplied items, feeders at 415 V shall be provided by the CONTRACTOR in the PMCC switchboard supplied by them. Number of feeders required for Owner's use are listed below.

S. No.	Description	PMCC	EPMCC	LDB	ELDB	Total Load*
1	FVNR 30	4	2			PMCC- 60KVA EPMCC – 30KVA
2	FVNR 100	3	2			PMCC- 125KVA EPMCC – 90KVA
3.	SFU – 250 Amps with CBCT and ELR, Contactor	2	-			PMCC- 200kVA
6.	SFU – 1 x 160 Amps + 4 x 63 Amps with CBCT and ELR, Contactor & timer			2 + 2 (Indoor+ Outdoor)	2 + 2 (Indoor+ Outdoor)	LDB- 25KVA ELDB- 10KVA

* Total Load of 410 KVA of owner's load shall be considered in Normal distribution transformer sizing. Total load of 130KVA of Owner's load shall be considered by Contractor for emergency distribution transformer sizing.

5.13.38 INTELLIGENT MOTOR PROTECTION RELAY(IMPR) FOR MOTOR UPTO 45KW

a. All intelligent motor protection relays shall be of latest advanced version.

b. Intelligent motor protection relay shall provide current based protection only. However, provision shall be provided to add on voltage & frequency-based protection in the IMPR. Further, display unit either as part of IMPR or additional module shall be provide for each IMPR as per cl. no. 5.13.38.e below

c. It shall suitably distinguish between starting and running condition and provides appropriate protection at the right time.

d. All relays shall be communicable type.

e. Display unit is not part of IMPR shall be provided additionally for each intelligent motor protection relay. Minimum following shall be provided in display unit:

i. ON Indication,

ii. OFF Indication,

iii. TRIP Indications &

iv. 3-Phase Current Display.

f. All disturbances/events in numerical relay shall be displayed with time stamp.

g. Vendor to furnish Intelligent Motor protection datasheet doc. no. B957-000-16-50-DS-5512 attached with tender during drawing review stage.

h. Intelligent communicable type motor protection relay shall offer a wide range of selectable protective functions. Enhanced capabilities shall be available in the intelligent motor protection relay allow following facilities to the user:
- Get warnings of developing problems before a trip occurs
- Gather dynamic load information
- Select the response of the protective device
- Know why the device tripped

i. Intelligent relay shall have following minimum benefits for maintenance purpose:
- Provides real time, dynamic motor and load data to facilitate Predictive motor and load maintenance.
- Includes enhanced monitoring and protective functions
- Allows selected responses to monitored motor or load conditions
- Alert the user to an impending problem and prevent unwanted shutdowns
- Alerts the user as to the cause of a trip or warning, simplifying maintenance
-

j. All relays shall have conformal coating as per as per IEC-60271-3-3 class 3C3 & type test certificates of IMPR batch supplied for the project shall be furnished during detail engineering.

k. Intelligent Protection relay shall have following minimum protection elements:

S.No.	Protective Function	√- Required X – Not Required	Operating time/Range/Setting (To be filled by Vendor Post order)
1.	Overcurrent / Overload	√	
2.	Current Imbalance	√	
3.	Under Current	√	
4.	Over Current	√	
5.	Earth leakage Protection	√	
6.	Time Delayed Phase Overcurrent	√	
7.	Time Delayed Neutral Overcurrent	X	
8.	Ground Fault-51G	√	
9.	Stalled rotor-48	√	
10.	Jam	√	
11.	Loss of Load	√	
12.	Starts/Hour Limit	√	
13.	Under Voltage	X	
14.	Over Voltage	X	
15.	Voltage Unbalance	X	
16.	Under Frequency	X	
17.	Over Frequency	X	
18.	Warnings	√	

19.	Power Factor	√	
20.	Voltage Monitoring	√	
21.	kW monitoring	√	
22.	Phase Fail/Phase unbalance-47P	√	
23.	Reverse Phase	√	
24.	Negative Phase sequence	√	

l. Vendor to furnish operation & setting manual for the relay.

m. Minimum 6DI & 4DO shall be provided in Intelligent motor protection relay. However, additional DIs & DOs if required shall be provided to fulfil control scheme requirements as specified in PR.

n. Intelligent relays shall be used only for Protection and Monitoring. It shall not be used for control logic.

o. All intelligent motor protection relay shall be of same make.

5.14 RELAY AND CONTROL PANEL

I. Relay and control panel shall be as per EIL specification for Relay and control panels/desks, single line diagram and data sheets.

II. Panel shall be free standing, floor mounting, simplex panel with swing frame and protective full glass door in front.

III. Relay and Control panel shall be fed from separate dedicated 415V AC supply feeders, from PMCC/EPMCC.

IV. Closing and tripping coil of each breaker shall have a dedicated DC feeder.

V. The measuring instruments for Import/ Export purpose shall be taut-band type.

VI. The captions to be engraved for various feeders / annunciators shall be finalised during detail engineering. Same shall meet the technical specification of C&R Panels as per MPPTCL.

VII. Semaphore indicator shall be used for isolator and earth switch, while for breakers, Discrepancy switches shall be used.

VIII. Testing facility for meters and relays shall be provided. For this purpose, necessary test blocks and test plugs shall be provided.

IX. A digital clock suitable for DC supply shall be provided in a suitable position on the complete relay panel assembly.

X. Requirement of ICTs, stabilizing resistance and metrosil shall be decided by the contractor. Calculations to be furnished. For transformer feeders, stabilizing resistor shall be provided in residual earth fault connections to avoid spurious tripping during charging of transformer.

XI. Synchronizing panel shall be provided as part of Relay and control panel. Synchronizing facility shall be provided to carry out the synchronizing for the 220 kV & 66kV GIS Incomers, Bus couplers, Bus-sectionalizer. Synchronization shall be from ECS as well as from this panel. Following operations shall be possible from Synchronization panel:

5.14.XI.1 Closing of all incomer breakers, bus couplers, bus Sectionalizer breakers, tie breakers (in service position) on dead bus condition (bus coupler/ bus sectionalising breakers dead bus closing to be checked on either side of the breaker).

5.14.XI.2 Synchronizing and closing of selected incomer breakers (in service position) and bus couplers/ bus sectionalising breakers/tie breaker (in service position) through check synchronizing.

5.14.XI.3 Required interlocks for safe operation shall be provided.

XII. All signals as per ECS data sheet shall be provided for interface with the Electrical control system.

XIII. Number of analogue / digital IOs shall be worked out by the Contractor as per the ECS I/Os list attached with the bid package

XIV. Power quality meter, disturbance recorder & event logger, Main and back up distance relay, fibre optic transmission system for voice and data communication, cyber security requirements, etc. shall be complied as per requirement of CEA guidelines for grid connectivity and CEA guidelines for communication system. Specific requirement of MPPTCL for power quality meters and other equipment listed above shall also be complied by the CONTRACTOR.

XV. CONTRACTOR to note that relays, meters and other instruments used in MPPTCL feeders shall be as per MPPTCL specifications & requirements.

5.15 NUMERICAL RELAYS AND SUBSTATION AUTOMATION SYSTEM

I. Numerical relays shall be used in 220 kV GIS, 66k kV GIS, 33kV GIS, 6.6 kV and 415 V switchgear.

II. All numerical relays shall be digital (microprocessor based) & communicable type as per EIL Standard Specification 6-51-0055 and datasheet for Numerical relay attached with tender.

III. All relays to the extent possible shall be sourced from same make. All the numerical relays of each switchboard shall be suitable for communication on IEC-61850 protocol and shall be connected serially/LAN topology to Ethernet Switches.

IV. All protective relays and meters shall be provided with test terminal blocks for secondary injection testing.

V. All numerical relays shall comply with the prevalent emission and immunity levels.

VI. All relays, metering and control components shall be mounted on the panel front only. All panels, relays and components shall be suitable for use in corrosive, humid, sulphurous environment. All relays shall be suitable for flush mounting, and fitted with dust-tight covers. The relay shall have a provision for testing using an external power supply without disconnecting the permanent wiring.

VII. Hardwired lockout relay (86), Hand reset (VAJH) type shall be provided. PQ8 relay is not acceptable.

VIII. Differential relays (87), restricted E/F (64R) relay as asked for in the data sheet shall be separate relay and shall not be combined with the main protection relay.

IX. The requirement of numerical relays and integration shall be in compliance with the requirement given in attached data sheet, and specification. Even though data sheets define the requirement in terms of discreet relays (electromechanical type) but numerical relay comprising all required functions shall be provided. Under voltage and Overvoltage relay along with associated timers shall be part of the numerical relay.

X. Numerical relays provided for motor feeders shall use in-built under voltage relay and timer for delayed tripping on bus under voltage.

XI. Minimum 4 nos. inputs (DI) and 4 nos. outputs (DO) as spare shall be provided in each numerical relay.

XII. Provision of manual bypass of 87B shall be provided in Numerical relays

XIII. Relay logic shall be ensured to not provide trip in case of DC failure & restoration

XIV. Scheme of switchboard shall be engineered to achieve the control logic, as required, through relay logic.

XV. All relays shall be integrated to ECS for monitoring and control. Provision shall be provided for monitoring & control at HMI also. The relays shall be integrated based on basic system architecture attached with the tender.

XVI. Conformal coating shall be done for all electronic equipments as per grade 3C3 (Harsh environment) of IEC 60721-3-3. Alternatively, it shall comply with ANSI/ ISA S71.04 class G3 or IEC 60068-2-60 for mixed flow gas test or ASTM B845. Certification for batch of supplied items shall be submitted by vendor for the same.

XVII. All relays shall have communication port for direct access of data through laptop. One laptop common for all relays shall be provided for the following purposes:

5.15.XVII.1 Retrieving data from numerical relays.

5.15.XVII.2 Uploading settings & I/O configuration.

5.15.XVII.3 Retrieving & viewing disturbance recorder data

XVIII. The Numerical relays shall be provided with suitable hardware, software and communication ports for communication with minimum three different client sources simultaneously.

XIX. The redundancy in communication hardware shall be provided as per the data sheet attached. In ring topology, the communication shall have no disruption due to loop open circuit or failure of communication port. Also the switch off of DC supply to any or more relay should not affect the communication to rest of the relay. Moreover, the ring should not be shared between the switchboards. For LAN where star couplers are used, the communication from star coupler to Ethernet switches shall be dual redundant. Relays of different switchboard should not be connected to the same star coupler. Similar to ring architecture, the failure of one star coupler or failure of communication port or processor should not affect the communication of other star coupler to Ethernet switches.

XX. **Refer Specification for Numerical Relays (Doc no. 6-51-0055),** 20% spare ports shall be provided in each Ethernet switch provided in switchboard and in SAS.

XXI. All the data as available in the relay including the status of DI should be considered to be communicated to HMI. The data required for final configuration shall be finalized during engineering. Similarly, whether specified or not, serial interface shall have no limitation for data transfer to ECS. However, data as required for ECS interface shall be decided during engineering.

XXII. GPS antenna and hardware shall be provided for time synchronization. The resolution of time synchronization shall be ±1 millisecond or better throughout the entire system. Suitable ports shall be provided in the GPS for hook up of Owner's switchboard numerical relays for future use.

XXIII. Substation Automation System for switchgears shall be provided. It shall include Ethernet switches, laptop, HMI (Engineering cum operator workstation) and software to be installed for interfacing with Numerical relays over IEC-61850. Following substation automation system shall be in the scope of contractor.

SAS Tag Number	For Equipment	Remarks
100-SAS-921	220 kV GIS	
	66 kV GIS	
	6.6 kV IBP and 415V Switchboard	Separate Ethernet Switch in each IBP and MV switchboards shall be provided

XXIV. Redundant upper level Ethernet switch shall be provided for each SAS system in wall mounted cabinet.

XXV. Supply, laying and termination of all interconnecting cables from switch boards to Ethernet switches including cable termination kits and accessories in each substation is in CONTRACTOR's scope. FO cable for connection between switchgear and Ethernet switch shall be supplied and laid in HDPE duct (HDPE ducts shall be black conduit with blue strip for Relay LAN) which is also to be supplied and installed by CONTRACTOR.

XXVI. DC System, UPS etc. shall be interfaced with SAS (Substation Automation System) on MODBUS TCP/IP.

XXVII. One common Laptop is envisaged for the EHV, HV & MV switchboards in the project hence software as required for interface with Numerical relays of EHV switchboard and HV/MV switchboard shall be loaded by the switchboard Vendors in the Laptop provided. Following Laptops shall be in the scope of contractor.

5.15.XXVII.1 Laptop for 220 kV GIS, 66kV GIS, 33kV GIS-IBP, 6.6kV IBP, 6.6kV and 415V switchboards. Software required for interface with numerical relay and software if required for interface with GIS SF6 Analyser, PD Monitoring system, etc. shall be loaded in the Laptop provided

XXVIII. Laptop with Windows-11 or latest tested & compatible windows version and other required licensed software, hardware, accessories (serial data cables, VGA Cables, HDMI Cables, and USB Cables etc.) and materials shall be supplied as defined in the tender. The communication port on laptop shall match as that provided on the front of numerical relay. System configuration shall be latest proven model and upgradable. The minimum configuration for this project shall be Intel i7 processor, 1 TB HDD, 4 GB RAM, DVD R/W Multi Drive, 15" LED screen, 4 nos. USB Ports (minimum), Ethernet Port, RS-232 Serial Ports, HDMI Port, etc. Further, laptop shall have compatible ports and compatible hardware for interfacing with transformer gas analysis, GIS SG6 analyser, PD Monitoring, etc. systems.

XXIX. Laptop provided with SAS shall have functionalities specified under clause 6.4.1, 6.4.5 and 6.4.6 of 6-51-0055 attached with tender.

XXX. HMI with Windows-11 or latest tested & compatible windows version and other required licensed software, hardware, accessories (serial data cables, VGA Cables, HDMI Cables, and USB Cables etc.) and materials shall be supplied as defined in the tender. System configuration shall be latest proven model and upgradable. The minimum configuration for this project shall be Intel i7 processor, 1 TB HDD, 4 GB RAM, DVD R/W Multi Drive, 21" LED screen, 4 nos. USB Ports (minimum), Ethernet Port, RS-232 Serial Ports, HDMI Port, etc.

XXXI. Laser printer shall be provided configured for line by line printing.

XXXII. Software for substation automation along with integrating hardware as required shall be supplied as a part of Laptop. Functionality minimum but not limited to the following shall be carried out. Customized software for substation application shall be supplied in non-returnable CD/DVD/USB Drive. Contractor to submit function design specification and screenshots of the various screen for Owner's review.

- Relay parameterization
- Control
- Disturbance record
- Data logging
- Annunciation
- Event/ status monitoring (including DI& DO of relays)
- Feeder status monitoring
- Event recording, motor starting transients, fault analysis etc.
- Analogue signal monitoring and metering
- Self-supervision
- Single Line Diagram
- View of historical data and generating trends

- Preparation of maintenance schedule

XXXIII. HMI shall be provided for disturbance recorder and power quality analyzer. The Power quality meter shall share the recorded data with the electricity regulatory commission. Power quality meters shall have facility to measure and meter the harmonics complying with provision of IEC 61000-3-4 Class A. In addition to harmonics, power quality meter shall have provision to monitor voltage sag, swell, flicker, disruptions, etc. Facility for waveform analysis shall also be provided.

XXXIV. **FACTORY ACCEPTANCE TEST**

FAT shall be conducted for project simulation. FAT procedure shall be prepared and submitted for Owner's review. The methodology shall be mutually agreed to verify the system simulation and intended specification of tender document. All graphics and navigation between different pages shall be configured to Owner's satisfaction and successful commissioning.

XXXV. **SITE ACCEPTANCE TEST**

SAT shall be conduct to verify the actual simulation and shall be verified for required functionality and the scan time. Any modification as required to meet the tender document requirement and customization modification due to Owner's site engineer in charge shall be carried out with no commercial implication.

XXXVI. For system architecture, refer system architecture drawing attached with tender.

5.16 DC SYSTEM

I. The DC system shall be as per EIL standard specification 6-51-0019 and DC System datasheet attached with tender. Battery shall be Medium Discharge type. Minimum temperature for battery sizing shall be 10°C.

II. DC system configuration shall be as per sketch attached with the Design Basis.

III. 110V DC system complete with Ni - Cd battery bank, battery charger & DCDB supplied for Switchgear protection and control shall be provided with 2 x 100% battery banks.

IV. 110V DC system complete with Ni - Cd battery bank, battery charger & DCDB supplied for critical lighting shall be provided with 1 x 100% battery banks.

V. 25% spare capacity shall be considered while sizing the battery and battery charger. 20% spare feeders of each type and rating shall be provided in DCDB.

VI. 3 Pole switch shall be provided for battery isolation purpose. Battery Isolator shall not be located inside battery room.

VII. Battery charger shall be Thyristor/SMPS based.

VIII. Busbar to be provided on TOP in DCDB.

IX. ECS Interface for each DC System shall be provided as per ECS I/O list.

X. Battery charger output interlocking system shall not be MCCB based.

XI. All inter-cell & inter row links shall be of copper with lead coating. Aluminium links are not acceptable.

XII. Chargers shall be provided with voltage dropping diodes with bypass facility to maintain terminal voltage at level to suit instrument requirement at field. Annunciation for failure of the dropping diode shall be given.

XIII. All battery chargers shall be designed to have Online battery load testing facility. All chargers shall have inbuilt load test provision.

XIV. For the following loads, completely independent redundant feeders from different bus sections of the DCDB shall be provided to the respective loads as minimum:

5.16.XIV.1 220kV GIS / CRP

5.16.XIV.2 66kV GIS / CRP

5.16.XIV.3 6.6kV switchboard

5.16.XIV.4 Electrical control system (ECS)

5.16.XIV.5 415V PMCC/EPMCC

5.16.XIV.6 Substation Automation System Panels

5.16.XIV.7 Nitrogen Injection Fire Protection System panel

5.16.XIV.8 Any other equipment based on reliability point of view & client requirement.

XV. Battery charger for DC System shall be installed in Air-Conditioned area but it shall be suitable for operation in non-air-conditioned area also. Battery backup time shall be 120 minutes for both DC system.

XVI. Both DC system shall be kept in Substation switchgear hall. Ni-Cd Batteries for DC system shall be installed in a separate battery room. Both the DC system shall be of same make.

XVII. Diode droppers for battery charger shall be provided to limit the load voltage to nominal voltage.

XVIII. Battery stand shall be in Double row double tier execution.

XIX. All cable glands and lugs are in scope of vendor.

XX. Current feedback of each battery bank shall be provided to both the rectifiers so that in case of failure of one rectifier, another rectifier can control/ regulate the charging current of both battery banks.

XXI. The height of DCDB panel shall be same as that of battery charger.

XXII. Clearance between gland plates to terminating point shall be minimum 300mm in all the electrical equipment

XXIII. Each of battery banks is to be located in a common battery room. CONTRACTOR to furnish number of air changes required to make the battery room safe i.e. non-hazardous. CONTRACTOR to furnish the proposed layout of battery rack in battery room maintaining 750 mm minimum clearance on all sides of battery rack.

XXIV. All electrical equipment installed in battery room must be flameproof type suitable for gas group IIC. Heat detectors installed in battery room shall be of intrinsically safe type with zener barrier.

XXV. Acid resistant apron, face shield and gloves shall be provided in each battery room.

XXVI. Battery room shall be provided with min. 2 nos. flameproof exhaust fans. No switches shall be provided inside battery room.

XXVII. **Following clause-wise modifications / additions to standard specifications shall be applicable on Specification for Battery Charger (EIL Spec. 6-51-0019):**

5.16.XXVII.1 Note-2 on Page 14 & 15 of specification

Addition: “Battery isolator (MCCB/Switch Fuse) shall be provided with three pole version to ensure positive isolation of all the three connections of battery”.

5.16.XXVII.2 Cl. no. 5.2.1.8 Battery Charger:

Addition: “Perforated sheet/Wire Mesh shall not be provided at the bottom of the charger as over a period of time these gets corroded / damaged resulting in easy access of vermin’s. Heat transfer system inside the charger shall be designed considering this aspect”

5.16.XXVII.3 Cl. no. 5.2.2.7 Printed Circuit Board:

Addition: “Battery charger PCB electronic cards shall have conformal coating as per grade 3C3 (harsh environment) of IEC 60721-3-3 and certification for batch of supplied items shall be submitted by vendor for the same.

5.16.XXVII.4 Cl. no. 5.3.1 Construction of Chargers / Distribution Board

Modification: "Each Battery Charger and DC distribution board shall be housed in a separate free-standing cubicle with minimum IP-41 degree of protection, with common items for charger-1 & 2 housed in a separate vertical panel….."

5.17 UPS SYSTEM

I. UPS system shall be as per EIL Specification 6-51-0017 and UPS system datasheet attached with the tender.

II. UPS system configuration shall be Parallel redundant with Individual bypass as per sketch attached with the Design Basis. Bypass shall have static voltage regulator only.

III. 230V AC UPS system complete with 2 x 100% Ni - Cd battery bank & ACDB shall be provided for Control supply of Thyristor Control Panel, VFD, ECS, LAN system etc.

IV. 20% spare capacity shall be considered while sizing the battery and UPS. 20% spare feeders of each type and rating shall be provided in ACDB.

V. 3 Pole switch shall be provided for battery isolation purpose. Battery Isolator shall not be located inside battery room.

VI. UPS system shall be provided with additional separate earth bus for earthing of Isolation transformer. This earth bus shall be separate from earth bus provided for body earthing.

VII. ECS Interface for each UPS System shall be provided as per ECS I/O list.

VIII. Outgoing feeders with isolation transformer shall be provided with HRC type switch fuse on primary side and semi-conducting type fuse along with switch on secondary side. Outgoing feeders without isolation transformer shall be provided with semi-conducting type fuse.

IX. Wherever, isolation transformers are required to be earthed to maintain output voltage in grounded condition, earth bus shall have punched holes for earthing of isolation transformers.

X. DC to DC convertor between UPS charger and battery bank is not acceptable i.e. battery bank float voltage shall be equal to charger float voltage.

XI. All inter-cell & inter row links shall be of copper with lead coating. Aluminum links are not acceptable.

XII. Disturbance recorder shall have at least two analogue channels with sampling rate of 1ms or better for monitoring of both UPS output at one place. Disturbance recorder shall have minimum features:

- Capacity to record at least 5 disturbances of 3 second each -
- Disturbances shall triggered based on settable under voltage level. -
- Option of settable pre - & post time
- Shall have facility to take the data to laptop through USB/ suitable communication port.
- Disturbance should be stored in "first in first out" mode without any manual intervention.

Separate disturbance recorder is not required in case features mentioned at above for disturbance recorder are provided as part of FDU/UPS HMI based controller or voltage monitoring relays on the UPS output is provided with the disturbance recording features. Regarding requirement of two analogue channels mentioned under "Disturbance Recorder" please note that the same is meant for monitoring the dual redundant UPS output voltages.

XIII. Busbar to be provided on TOP in ACDB.

XIV. For the following loads, completely independent redundant feeders from different bus sections of the ACDB shall be provided to the respective loads:

5.17.XIV.1 LAN System Racks

5.17.XIV.2 Substation Automation System Panels

5.17.XIV.3 ECS System Panels

5.17.XIV.4 Any other equipment based on reliability point of view & client requirement.

XV. FEEDER REQUIREMENTS FOR UPS ACDB:

UPS System	Rating of each outgoing feeders	Number of Outgoing feeders
For ECS System	Upto 5kVA	10 Feeders

This feeder requirement is over and above the requirement of feeders for items free issued by owner and does not include any spare feeders. Same to be located in Main GIS Substation MRSS-100.

5.18 FIRE DETECTION AND ALARM SYSTEM

I. Fire alarm system shall be engineered in line with the specifications attached with the bid document for all areas within battery limit including buildings.

II. Fire Alarm devices (i.e. DGFAP, detectors, MCP, hooters, HAB, exit sign, input module/ control module) shall be supplied by Owner as free issue items (FIM) and quantities of same are as mentioned elsewhere in the tender. In case quantity required by CONTRACTOR is more than the indicated FIM, contractor shall supply the additional quantity without any time & cost implication. The make of these additional equipment/devices shall be of identical make, type & model no. as that of the free-issued equipment/devices.

III. Fire alarm system as required for unit/area including buildings within package battery limit shall be engineered by CONTRACTOR. CONTRACTOR will prepare the fire alarm layout for the building. Owner will free issue the FA devices as per the final approved layout within the limits as mentioned elsewhere in the tender.

IV. Installation of all Free Issued Materials for Fire Alarm System and cabling including supply & laying of cables up to DGFAP for all field equipment in line with approved calculations shall be done by contractor. Installation shall be carried out as per installation details/ instruction details/ precautions provided by FA system manufacturer, approved Fire Alarm layouts, specification attached, approved sizing calculations and block diagram.

V. Interface cabling with air-conditioning system, NIFPS, HVWS and other systems shall be provided by contractor as applicable.

VI. Testing and commissioning, of the Owner supplied fire alarm system will be done by others (Fire Alarm Vendor). However, contractor shall extend all necessary help and manpower to Fire Alarm vendor for executing works such as cable connection, disconnection and reconnection, detector removal, re-installation required during testing and commissioning of the system.

VII. FAJB (Metallic), as required shall be in scope of CONTRACTOR. Fire alarm cabling inside building shall be done using armoured cables. Unarmoured cable will be used as a special case in concealed conduits only subject to Owner's approval.

VIII. Tinned copper cable lugs for termination of 1.5 sq.mm. multi stranded fire alarm cables in all indoor and outdoor equipments including panels, detectors, BGU, hooters, relay modules, exit signs, JB's, etc. shall be considered by CONTRACTOR. Cable glands with PVC shrouds for all indoor and outdoor equipments including panels, detectors, BGU, hooters, relay modules, exit signs, JB's, etc. shall also be considered by the CONTRACTOR.

IX. All hardware used for installation and cable tags shall be of SS 304 grade.

X. CONTRACTOR to furnish the details of control voltage of various systems like NIFPS system & HVAC system for designing of tripping contact by FA system manufacturer. CONTRACTOR to furnish tripping philosophy for HVAC system including tripping of VAM package and AHU package during engineering stage.

XI. Maximum number of Fire Alarm system equipments considered in OWNER's scope of supply for installation in MRSS-100 by contractor, shall be as listed below. Any requirement over and above the listed quantities shall be in contractor's scope. The make of these additional equipment/devices shall be of identical make, type & model no. as that of the free-issued equipment/devices. Make & model no. of free-issued fire alarm equipment and fire alarm cable sizes shall be informed to the Contractor during detail engineering

- Data gathering cum fire alarm panel (DGFAP) – 1 no.
- Intelligent addressable multi sensor detector – 285 Nos.
- Response Indicator – 120 Nos.
- Intrinsic safe intelligent addressable heat detector – 05 Nos.
- Linear Beam detectors – 10 Nos.
- Manual call point (MCP) safe area type – 12 Nos.
- Electronic hooters addressable – 7 Nos.
- Exit signs addressable (Single faced) – 8 Nos.
- Exit signs addressable (Double faced) – 4 Nos.
- Hooter Acknowledgement Box – 4 Nos.
- Relay Module – 6 Nos.
- Input module – 16 Nos.
- Fault Isolator Module – 25 Nos.

5.19 PLANT COMMUNICATION SYSTEM

I. Plant communication system shall be engineered in line with the specifications attached with the bid document for all areas within battery limit including buildings.

II. Plant communication devices (i.e. Master call station, Operator Call station, Field Call Station, Loudspeaker, beacon lamp, etc.) shall be supplied by Owner as free issue items (FIM) and quantities of same are as mentioned elsewhere in the tender. In case quantity required by CONTRACTOR is more than the indicated FIM, contractor shall supply the additional quantity without any time & cost implication. The make of these additional equipment/devices shall be of identical make, type & model no. as that of the free-issued equipment/devices.

III. Plant communication system as required for unit/area including buildings within package battery limit shall be engineered by CONTRACTOR. CONTRACTOR will prepare the plant communication layout for the building. Owner will free issue the devices as per the final approved layout within the limits as mentioned elsewhere in the tender

IV. Installation of all Free Issued Materials for Plant Communication System, PAJB and cabling including supply of PAJB and supply & laying of cables up to PAJB for all field equipment in line with approved layouts shall be done by contractor. Installation shall be carried out as per installation details/ instruction details/ precautions provided by Plant Communication system manufacturer, approved layouts, specification attached, approved sizing calculations and block diagram.

V. Testing and commissioning of the Plant Communication system will be done by Owner/others (Plant Communication Vendor). However, contractor shall extend all necessary help and manpower to Plant communication vendor for executing works such as cable connection, disconnection and reconnection required during testing and commissioning of the system.

VI. Weatherproof Junction box (Metallic), shall be considered in 220 kV GIS substation building suitable for 1 runs of 50P cable, for receiving incoming cable from Owner's PA System Exchange. Termination and glanding of incoming cable in PAJB is in scope of CONTRACTOR. Contractor to note that minimum 5P cable shall be considered for each FCS and OCS/MCS.

VII. Plant Communication cabling from PAJB onwards to the MCS, OCS, FCS, amplifier, loudspeaker, etc. shall be done by CONTRACTOR. Cabling inside building shall be done in concealed conduits using un-armored cables. Tinned copper cable lugs shall be considered for

termination of multi stranded cables in all equipments. Cable glands with PVC shrouds for all equipments shall also be considered by the CONTRACTOR

VIII. All hardware used for installation and cable tags shall be of SS 304 grade.

IX. Maximum number of Communication system equipments considered in OWNER's scope of supply shall be as listed below. Any additional requirement over and above the listed quantities shall be in contractor's scope. The make of these additional equipment's shall be of identical make, type & model no. as that of the free-issued equipment's. Make & model no. of free-issued plant communication equipment's and PA communication cable size shall be informed to the Contractor during detail engineering.

- Master Call Station – 1 Nos.
- Operator Call Station – 2 Nos.
- Field call station & weatherproof loudspeakers 25W (FCS + Ext loudspeaker) – 6 Nos.

5.20 LAN SYSTEM

I. CONTRACTOR scope includes supply, installation, testing and commissioning of LAN system comprising of CAT 6A modular UTP jack including all connected material (i.e. face plate, surface mounted box, patch cord, etc.), circuit wiring from Ethernet switch rack to CAT 6A UTP Jack using CAT 6A LSZH UTP cables, CAT 6A modular patch cord.

II. CONTRACTOR to note that minimum three 5A convenience outlets with switch shall be provided along with each LAN UTP Jack.

III. CONTRACTOR to note that connection of LAN system with refinery LAN shall be done by others

5.21 MOTORS

I. MV Motors, if required, shall be energy efficient IE4 type as per IS 12615 and shall meet the requirements as per EIL standard specification 6-51-0064 and datasheet for MV motors attached with tender.

II. Motors installed outdoors shall have FRP canopy for additional weather protection.

III. The cable entries of all Terminal Boxes of motors, before dispatch from motor manufacturer works, shall be fitted with suitably sized IP-55 Metallic Sealing Plugs to prevent water entry/ingress in motor windings through openings meant for cable entry in terminal boxes at construction site till the time motors are erected and cable terminations are done. Weatherproof nickel plated brass cable glands shall be supplied loose.

IV. In addition to packing requirements specified in EIL standard specification of motors, Vendor to do plastic wrapping for shipping from works to site.

V. All motors shall have provision for double earthing.

VI. All glands supplied with motors shall be of thread type 'ET'.

5.22 LOCAL CONTROL STATION

I. Weatherproof control stations (IP-65) for all motors, emergency stop push buttons for transformers, motors and emergency push buttons as required for plant operation and safety etc. shall be provided by the contractor.

II. Following minimum electrical facilities shall be provided by Vendor on Local Control Station (LCS):

a) Start

b) Stop (Stop Push button shall have provision of putting LOTO locks and padlocks.)

c) Field ammeter suitable for 4-20mA signal. Ammeter provided at push-button station shall be 240 degree taut band moving coil type

d) Selector switch (L-O-R) shall be provided, as required, as per P&ID & operational requirements

The interlocking between the switchboard/MCC feeder and field equipment shall be arranged in Local Control Station by the Vendor.

III. Dual pushbutton to be provided in the transformer bay shall be wired in series and connected to the trip circuit of the upstream breaker such that pressing of both simultaneous shall trip the transformer circuit breaker. All contact of these push buttons shall be used as close permissive for the transformer circuit breaker. Additionally push buttons shall also be provided with covers and pushbutton shall be stay put type.

IV. Each pushbutton provided in LCS shall have two elements / contacts.

V. Local control stations installed in outdoor area shall have FRP canopy for additional weather protection.

VI. Local Push Button station at each entry of substation floor shall be provided and same shall be wired to LDB for control of normal lighting of switchgear/GIS hall & cable cellar.

5.23 CABLING

I. All HV & MV Power cables shall comply with the EIL standard specification 6-51-0051 and datasheet attached with tender.

II. Power cables used shall be with 3.5/ 4 cores, except for motors, which shall be 3C. The conductor size shall be minimum 4mm2. Colour of outer sheath of cables shall be BLACK.

III. The conductor material for MV power cables shall be copper up to 16 mm2 / Aluminium above 16 mm2.

IV. All MV control cables, plant communication cables, telephone system cables and fire alarm cables shall comply with the EIL standard specification 6-51-0052 and datasheet attached with tender. Control cables shall be 2.5 mm², multi stranded copper conductor, twisted pair and overall shielded, XLPE insulated type. Note that type of core insulation for these cables shall be Type A as per IS 5831 and material of Inner sheath shall be ST1.

V. All cable tags used for cable identification shall be of stainless steel grade SS 304.

VI. For fire alarm system, power cables shall be 2.5 mm², copper conductor, XLPE Insulated armoured with FRLS outer sheath and cables for connecting various fire alarm devices shall be 1.5 mm², copper conductor, twisted pair XLPE Insulated, armoured with FRLS outer sheath. Fire alarm cables shall be multi-stranded type. Colour of outer sheath of fire alarm cables shall be RED. However, power cables for fire alarm shall be BLACK in colour.

VII. For plant communication system, 0.9 mm dia twisted pair solid copper conductor XLPE insulated cables for interconnections between MCS / OCS / FCS & exchange and 1.5 sq. mm twisted pair multi stranded copper cable for connection to the loudspeakers shall be provided. Colour of outer sheath of plant communication cables shall be GREY.

VIII. All cables shall be supplied in non-returnable steel drums.

IX. **FIBRE OPTIC CABLES**

5.23.IX.1 Fibre optic cable shall be supplied along with HDPE duct.

5.23.IX.2 The fibre-optic cable shall be of single mode type only with a minimum of 2 spare fibers in each cable. Procedure of data transmission, error control and recovery shall be as per acceptable standards.

5.23.IX.3 All lengths shall be joint free single continuous lengths. Coating and the colour of the fiber shall not react with the surrounding jelly. Outer sheath shall be flame retardant low smoke (FRLS) type.

5.23.IX.4 Fiber-optic data cable shall be suitable for water-submergence duty and high temperature withstand as per the routing requirements in the plant. All lengths shall be joint-free continuous lengths.

5.23.IX.5 Optical fibers shall be coated with UV cured double acrylate resin. It should not have any reaction with cladding or core material.

5.23.IX.6 The coatings shall be in various colours in order to facilitate fiber identification. Fiber colours shall correspond to latest revision of IEC publication 60793-2 and 60304. The colours shall correspond reasonably with standard colours and shall readily be identifiable and shall be durable. The colours should have good colour fast properties also in the presence of other materials during the lifetime of cable. The coating and the colour shall not react with the surrounding jelly.

5.23.IX.7 The fiber optic cable shall be protected against damages from termite, rodent, fire, chemicals (such as oil & natural gas, LPG and other petroleum/ petrochemical products), moisture and water over the life time of the cable.

5.23.IX.8 Moisture barrier – Polymer coated aluminium tape placed longitudinally over the cable core. The tape shall form a close fit around the cable core with a sealed overlap of 6mm minimum. The thickness of each polymer layer shall be 0.04 mm minimum. The thickness of fully annealed aluminium foil shall be 0.15 mm minimum.

5.23.IX.9 The armouring of the optical fiber cable shall be of corrugated steel (electrolytically chrome plated low carbon steel) tape both side coated with ethylene acrylic copolymer, applied longitudinally with minimum overlap of 6mm. The thickness of the steel tape shall be 0.15 mm minimum. The thickness of each polymer layer shall be minimum 0.04 mm minimum.

5.23.IX.10 The cable shall have sufficient strength to withstand a load of value T = 9.81×W newton, where W = mass of 1 km in kg. The load shall not produce total strain exceeding 0.25% in the fiber.

5.23.IX.11 The termination enclosures of the optical fiber cable should be dust tight (No dust ingress) and protected against immersion in water (suitable for continuous immersion in water) and should be complete with all accessories including splice cassettes splice protection and all other accessories including accessories for electrical continuity of metallic layers of optical fiber cable and OFC preparation kit along with instruction sheet.

5.23.IX.12 All fibres (including spare fibers) of a cable shall be terminated in the termination enclosure by pigtails. Subsequent connection shall be by patch chords. Supply and erection of termination enclosure, pigtail, patch chord etc. is in vendor's scope. OTDR analysis/report shall form part of the testing activities of the OFC network.

5.23.IX.13 Vendor shall furnish past track record for the selected make of the fiber optic cable, preferably for the past EIL projects during drawing review stage.

5.23.IX.14 HDPE duct shall be permanently solid lubricated/ with spiral groove, UV-protected, fire retardant (Class V2 as per UL-94 and with limited oxygen index of 21 or higher as per ASTM D2863), of 40 mm outer diameter (+5.0/-0.0 mm) minimum thickness 3.7 mm, suitable to withstand load of 6 kg/m2.

5.23.IX.15 All HDPE ducts shall be supplied along with accessories such as push fit coupler, bend and elbow, end plug, simple plug, sonic head, etc. required for blowing cable into HDPE duct by compressed air technology.

5.24 CABLING SYSTEM

I. Cable tray support along with cable trays inside substation cable cellars shall be provided by CONTRACTOR. Cable tray shall be provided on both side of vertical supports in multi-tier arrangement with minimum 6 cable trays uniformly spaced at 300 mm, on each vertical support along the complete length of substation. Vertical support shall be provided for complete height of cable cellar, fixed at cable cellar floor and roof. Span between two consecutive supports shall not exceed 3000 mm.

II. Dedicated cable route shall be provided for 220 kV & 66kV cables. Only 1 trefoil of 220 kV and 2 trefoil of 66kV cable is permitted in each tray. Sufficient space, minimum 500 mm for 220kV cables and 400mm for 66kV cable shall be provided between various tiers for laying cables. For 220 kV&66kV Cables, trays and supports shall be provided to withstand minimum 250 kg/ meter of uniform weight for cables laid in trefoil arrangement. Sufficient space shall be provided between trays for laying of cables.

III. Supporting structure shall be provided for raising cable trays from cable cellar to switchgear hall for termination in GIS. Cutout provided for raising 220 kV& 66kV cables in switchgear hall for termination shall be closed by chequered plates.

IV. Cable tray supports shall be suitable for 750 mm wide cable trays. Engineering for sizing of cable trays based on number and size of cables shall be done by CONTRACTOR.

V. All cable trays as required as per CONTRACTOR scope, shall be GI type with SS hardware and shall be provided by CONTRACTOR. Coupling and connection hardware of cable trays shall be of stainless steel grade SS 304.

VI. GI pipes for cable protection above ground, floor sleeves, supports wherever necessary, cable markers, identification tags, GI saddles, saddle bars and associated accessories, all other galvanized hardware like nuts, bolts, washers, grouting bolts as necessary, shall also be provided

VII. Modification in requirements specified above, to suit site condition shall be finalized during detail engineering, which shall be taken care by the contractor without any impact on cost and time to Owner/ EIL

VIII. Wherever trenches/trays within battery limit have interface with the trays and trenches outside battery limit, the details shall be finalized during detailed engineering. Trenches and trays shall be provided up to the battery limits as per the final approved layouts without any impact on cost and time to owner

IX. It shall be CONTRACTOR's responsibility to co-ordinate the cable trench/ tray routing from the package battery limit area, control room and substation building etc. with other agencies involved. Trenches and trays shall be provided up to the battery limits as per the final approved layouts without any impact on cost and time to owner.

X. In cable trays/trenches 20% spare space shall be provided. 40% spare shall be considered in Electrical Road Crossings.

XI. Lugs to be supplied by the CONTRACTOR shall meet the following requirements for all terminations for the equipments in the scope of CONTRACTOR.

- Aluminum conductor cable termination on Aluminum bus bar/ terminals (like switchboards) - Aluminum lugs
- Aluminum conductor cable termination on Copper bus bar/ terminals (like motor) - Bimetallic lugs having Al barrel & tinned Cu palm
- Copper conductor cable termination on Aluminum bus bar - Bimetallic lugs having tinned Cu barrel & Al palm
- Copper conductor cable termination on copper bus bar/ terminals - Tinned copper lugs.
- Lugs provided for termination of HV & MV cables at switchgear end shall be of long barrel type.

XII. Glands to be supplied by the CONTRACTOR shall be of nickel-plated brass for all cabling & termination for the equipment in the scope of CONTRACTOR. The cable glands shall be single compression type for indoor equipments & double compression type for outdoor equipments.

XIII. MV Control cable shall be of Multi-stranded conductor, twisted pair individual & overall shielded, XLPE insulated type.

XIV. The Cable outer sheath Color for various twisted pair cables shall be as follows:

MV Control Cables	Black base color
MV Communication Cables	Gray base color
MV Fire Alarm Cables	Red base color
MV Fire Safe Cables	White base color

5.25 EARTHING AND LIGHTNING PROTECTION

I. Earthing system of the entire package shall be designed to meet the statutory requirements and shall be included in contractor's scope including interconnection with owner's earth grid and earthing of all equipment.

II. Earth Resistivity Value shall be measured by CONTRACTOR at minimum five locations before earthing system design calculation.

III. Contractor shall measure the earth resistivity of soil as per Wenner's four electrode method. For determining the earth resistivity, five test locations shall be chosen to cover the whole site as per the site-Engineer-in-charge. This number shall be increased if the test results obtained shows a significant difference. The tests shall be conducted during the dry season

IV. Earthing system shall conform to following standards:

5.25.IV.1 IEEE-80 Guide for safety in AC substation grounding.

5.25.IV.2 IS-3043, Code of practice for earthing.

5.25.IV.3 CBIP Tech. report for Earthing System for HV, EHV and UHV Substations.

5.25.IV.4 CEA Regulations as amended from time to time and the relevant regulations of the Electricity Supply Authority concerned.

5.25.IV.5 The earthing work shall also conform to EIL specification for Installation of earthing system.

V. Lightning protection shall comply with the requirements of IS/ IEC 62305. Contractor to furnish calculation for lightning protection of building. Lightning protection of building and switchyard area shall be separate and shall be designed for LPS 2 as a minimum. Lightning strip size shall be minimum 25 x 3 mm.

VI. Cross-section of earthing conductor shall be designed to prevent fusing of conductor and deterioration of joint under most adverse conditions of fault. The same shall be determined as per IS: 3043, and to meet the regulations of CEA Regulations. MS rod shall be used for the buried earth grid in outdoor switchyard. For earthing conductor sizing, duration of earth fault current duration to be considered, shall be minimum one second.

VII. The entire installation shall be done in accordance with standards mentioned herein. The contractor shall carry out any changes desired by the electrical inspector or the owner, in order to make the installation conform to CEA Regulations at no extra cost.

VIII. Earthing system shall be designed to have a low impedance to ground and a current carrying capacity consistent with the fault current. The earth loop impedance to ground shall not be in excess of 1.0 Ω. The main earth loop shall be laid at a depth of minimum 500 mm below grade level. Earth resistance of individual electrode to general mass of earth shall not exceed requirements given in OISD-STD-137.

IX. Test disconnect facilities shall be provided for the earth pits to check their earth resistance periodically.

X. The method of earthing has to be considered from the view point of touch and step potentials in the area extended 1 meter outside the substation battery limit and in outdoor switchyard area,

so as to ensure that the area in the vicinity of the substation and the switchyard equipments is safe from the viewpoint of touch potential under fault conditions.

XI. The attainable and permissible values of the step and touch potential in the design of the earthing grid in substation shall be calculated as per IEEE 80, and it shall be ensured that the attainable step and touch potential are less than permissible step and touch potential. For step and touch potential, current distribution factor shall be considered as 1 and duration of rated fault current shall be 1 second.

XII. Contractor shall provide earth grid up to battery limit of the package including provision of earth plate near the battery limit for interconnection of the unit earth grid with the Owner's main plant grid. CONTRACTOR shall extend & connect the plant earthing grid to main earthing grid, at minimum two points.

XIII. All earthing hardware (i.e. nut, bolts, etc.) for earth pits, earth plate connection cable trays earthing, etc. shall be of stainless steel grade SS 304.

XIV. Contractor to note that separate dedicated earth electrodes shall be provided for lightning protection.

XV. **Equipotential Earth mat**.

5.25.XV.1 When a fault current flows through the earthing connections into the soil, the enclosures, linked to the earthing circuits, will be at the same potential as the earthing mat conductors but this potential is generally different from that on the soil surface.

5.25.XV.2 In order to ensure the security of personnel, it is necessary to install an equipotential mat linked to the general earthing mat in the zones where metal enclosures and fixed accessories are accessible from the floor.

5.25.XV.3 It is also necessary to provide an equipotential earthing mat in the zones where an emergency mechanical operation or a locking system is accessible from the floor. It is therefore possible to extend the equipotential mat to allow the operator to carry out his maneuvers.

5.25.XV.4 In order to ensure a good equipotential surface, each element of the equipotential mat must be connected to the general earthing network by the manufacturer.

5.25.XV.5 This mat will be placed on the floor, all around the switchgears. It is not required in front of the control cubicles.

5.25.XV.6 If it is an oxidizing material, it should be hot dip galvanized.

5.25.XV.7 The manufacturer must design, specify, and provide this equipotential earth mat. The location of the equipotential mat should be defined by the supplier for all the GIS and at places where:

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

5.25.XV.8 Equipotential earth mat drawings along with design calculations shall be submitted for approval by the CONTRACTOR along with general arrangement drawings.

XVI. All earth pits for earthing and lightning protection shall be maintenance free chemical earth pit with Cu bonded high tensile low carbon steel core electrode.

XVII. Earth connections shall be welded at joints, anti-corrosive paint or bitumen and jute covering shall be applied for welded portion.

XVIII. Separate clean earth system shall be provided for Numerical relays, SAS & ECS in Substation.

XIX. Material of connection of equipments to earth plate shall be as per the equipment earthing schedule enclosed with the tender document.

XX. Minimum size of the main earth grid shall be 100 x 12 for Substation. However, Earthing sizing calculation shall be furnished by Contractor for the final GI earth strip selected.

XXI. Adequate number of earth plates for taking branch connections shall be provided.

XXII. Earth pits shall be painted as per standard for e.g. earth pit for equipment earthing, body earthing etc. shall be green, transformer neutral earthing shall be black and lightening arrestors shall be blue.

XXIII. Earthpit number shall be marked on each earth pit.

XXIV. Earthpit cover size shall be min. 650 mm x 650 mm.

XXV. Earthpit cover chamber shall be flushed with FFL for paved area. For unpaved areas it shall be elevated.

5.26 LIGHTING SYSTEM

I. Normal lighting, Emergency lighting and DC Critical lighting shall be provided as per Electrical Design Philosophy.

II. All lighting fixtures shall be LED type, supplied complete with associated LED lamp and driver

III. 25% of total fixtures shall be fed from emergency lighting panel for illumination, in case of failure of normal power supply.

IV. During normal operation, both emergency and normal lighting shall be fed by normal power source. On failure of normal supply, emergency lighting load shall be transferred to emergency power supply source. Critical (DC) lighting shall be normally kept 'OFF' and during failure of AC power; DC system shall feed the critical lighting system.

V. All lighting fixtures shall be suitable for the area in which they are installed. All hardware of the lighting fixtures like nuts, bolts, mounting brackets for ceiling & column mounting and adaptors for installation on poles shall be with MOC of SS304.

VI. For fixture mounted on pole dedicated standalone junction box shall be provided at bottom for loop-in loop-out.

VII. Lighting & Power panels shall be standardized to have 6, 12 or 18 single phase outgoing feeders. The panel shall be provided with 30% spare out goings

VIII. All lighting poles shall be hot dipped galvanized type with SS hardware.

IX. DC critical lighting shall be provided at exit, escape route inside the building/plant area and other strategic locations in package battery limit.

X. All lighting fixtures shall also have independent earth terminal outside the enclosure.

XI. Cable from lighting panel onwards to the outdoor lighting fixtures shall be 3Cx2.5mm2, Copper conductor, and armored FRLS cable.

XII. It is vendor's responsibility to ensure that adequate lighting is maintained within package battery limit with minimum lux level specified as per clause 7.4.12 of 6-51-0099. The same will be measured and demonstrated at site. In case additional lighting fixtures and associated circuit/cabling is required, the same will be provided by vendor without any time/cost implication to owner.

XIII. 415/ 415V Dry type lighting transformer shall be supplied with vector group as Dyn1

5.27 SPECIAL REQUIREMENTS FOR LEDs FIXTURES

I. MISCELLANEOUS REQUIREMENTS

5.27.I.1 For LED fixture, integral junction box shall be provided with 3 nos. cable entries for loop-in, loop-out and associated wiring to fixture. Alternatively, 2 nos. cable entries for loop-in and loop-out shall be provided with internal wiring for driver and lamp.

5.27.I.2 All lighting fixtures shall be supplied complete with associated LED lamp and driver.

5.27.I.3 All lighting fixtures shall be supplied with fixture mounting nuts and bolts of stainless steel SS-304. Fixture mounting bolts & nuts for mounting the light fittings on already installed clamps/brackets. However, Clamps/brackets mounting bolts & nuts are excluded from vendor's scope.

5.27.I.4 Flameproof LED type lighting fixtures shall fulfill the following requirements:

- LED lamps and Drivers shall be provided with min. 5 years warranty period.
- Lighting fixtures reserved for use in 240 Volt AC Emergency Circuit shall have additional RED Circular ring marking for identification purpose for hazardous area identification. This detail shall be furnished to successful vendor during detailed engineering.
- Vendor shall indicate the following parameters as a minimum in fixture drawings:
  - Fixture Wattage and LED Wattage
  - Actual Consumption of Fixture
  - Driver Consumption
  - Fixture Life time
  - Luminous Efficacy of fixture
  - Lumen Output of Fixture
  - Tolerance for Voltage and wattage rating
  - Power factor of Fixture
  - Beam Angle of Lighting Fixture
  - Weight of Fixture
  - LED LAMP and Driver Warranty Period
  - Driver Surge Protection
  - Compliance to IEC-61347-2-13 for LED Driver
  - BIS Certification no. for Driver
  - Driver Make and Model No.
  - LED Make and Model no.
  - LED type i.e. COB (Chip on Board) or Multichip etc.
  - Quantity of Fixtures
  - No. of Cable entries for Fixture along with quantity of FLP Cable glands and FLP Stopper plug.
  - PESO/CIMFR/BIS License certificates numbers along with dates.
- IES files of all LED lighting fixtures finalized during detail engineering shall be furnished for owner/EIL records.

5.28 FIXED TYPE SPACE HEATER PDB

I. PDB shall be installed in safe area and shall be suitable for safe area. Ingress protection shall be IP-41.

II. PDB shall be single front, and fixed type, free standing floor mounted type. PDB shall be minimum 415V, 200 Amp, 50Hz, TPN, 25 kA (1 sec.) with two number MCCB incomers mechanically interlocked with each other.

III. The switchboard shall be non-compartmentalized type instead of compartmentalized specified in 6-51-0012. However, other requirements of 6-51-0012 shall be complied with.

IV. The number of outgoing 240V AC, SPN feeders in the PDB for Owner's use shall be as follows:

Rating	Nos
16A Double Pole MCB	6

32A Double Pole MCB	6
63A Double Pole MCB	6

V. Incomer feeder shall be provided with voltmeter and ammeter. All indicating lamps shall be LED type.

VI. Terminals for outgoing feeder's upto 16A shall be suitable for 10 Sq.mm. cable. Terminals for upto 32A and 63A feeders shall be suitable for 25 mm² cable. Supply of lugs and nickel-plated brass cable glands for all cabling & termination in the scope of vendor inclusive of cable glands for incoming cable to PDB. The cable glands shall be single compression type.

5.29 SOLAR ROOFTOP PHOTO VOLTAIC SYSTEM

I. Contractor shall provide grid connected solar power plant units at roof top of main substation MRSS-100 on substation switchgear room and transformer bays and feed the generated solar power to the electrical system of the complex. The solar power shall be generated at 415V, TPN, 50 Hz which can support loads at 0.8 pf.

II. The scope of work for contractor includes design, manufacture, supply, erection, testing and commissioning of grid connect interactive solar PV power plants without batteries on substation building roof. Solar power unit shall be connected to the nearest 415V MV switchboard for export of solar power. The solar power systems shall remain synchronized with the grid supply for generation of solar power.

III. Each photovoltaic solar panel shall be divided into small sub arrays to feed into Power Conditioning Units (PCU). The series parallel connection of sub arrays shall be done through panel junction boxes, Array junction boxes and main junction boxes. The AC output of the PCUs shall be collected at the MV switchboard. The detailed scheme for power evacuation shall be worked out by the contractor.

IV. PV panels shall be installed on the complete building terrace area which includes roof top of substation switchgear room and transformer & capacitor bays except for personnel movement area and area for other facilities installed on the roof top. Minimum 1 KWp solar panels shall be located in each 12 m2 area.

V. The minimum guaranteed supply of energy from the solar power systems shall be 1400 KWh/year for 1 KWp PV panel. The contractor/manufacturer shall furnish the undertaking for guaranteed supply of energy for the solar power systems provided by them.

VI. Contractor shall engage the services of a separate specialist agency/manufacturer for execution of solar power plants including design, engineering, sizing, selection & procurement of equipment/material, installation, testing and commissioning of solar power plants. The agency shall be an established manufacturer/supplier of complete SPV power system and shall have adequate experience for carrying out similar SPV based solar power plants. The agency should have designed, supplied, installed and commissioned SPV power plants of cumulative installed capacity of 250 kWP or above, out of which at least one plant should be of 100 kWP capacity operating satisfactorily for more than one year. The agency shall be approved by PMC/Owner during detail engineering based on details furnished by contractor.

VII. The PV solar panels shall be located on roof tops of substation switchgear room and transformer & capacitor bays away from the shadow area. The direction of solar panels shall be as per manufacturer recommendation. The PCU shall be located within the building in Air-conditioned room.

VIII. Complete cabling including supply, laying and termination of cables, cable trays, material, hardware etc. within SPV power plant units and from power plant units to MV switchboards for export of solar power is in contractor scope.

IX. For further requirements/details refer std. Specification for Solar PV System (doc. No. 6-51-00022) attached with the tender.

5.30 REQUIREMENT FOR AIR CONDITIONING

I. Vendor scope shall include sizing, design, engineering, manufacturing, supply, installation, testing and commissioning, packing and delivery at site of all the electrical equipments including supply of all commissioning spares, special tools and tackles as per the specifications and the datasheets attached or referred. The major electrical equipments for the package includes

5.30.I.1 All MV motors

5.30.I.2 Power distribution board - PDB (As per EIL specification 6-51-0012) for all motors and other load of the package, separate for each building (PDB shall be installed in AC Plant/ Package room, AHU room, as required).

5.30.I.3 Supply, laying and termination of all power and control cabling for all package loads.

5.30.I.4 Cable trays, as required for laying the cables for the motors/ loads.

5.30.I.5 Local control panels/ local push button stations (as required).

5.30.I.6 Earthing material as required for earthing for package equipments.

5.30.I.7 Any other equipment not specifically mentioned above but required for normal operation of the package equipments.

II. PDB shall be single front, compartmentalized, and fixed type. PDB shall be suitable for 415V, 50Hz, TPN, 50 kA (1 sec.) with single bus, two MCCB incomers (4 Pole) provided with manual transfer facility and mechanical interlocking between incomers.

III. The number of feeders in the PDB shall be as per the electrical loads of the respective building, where PDB is located. PDB for AC Plant room in shall also include feeders for downstream PDBs located in each AHU Room

IV. All PDBs shall be suitable for TOP Cable entry. Minimum clear space of 1000mm shall be maintained in front of PDBs.

V. Incomer feeder shall be provided with voltmeter and ammeter. Incomer MCCB shall be 4 Pole type. All motor& other feeders shall be provided with hardware as per the respective datasheets for same attached with the tender, however same shall be in fixed execution. Field ammeter shall be provided in LCS for all motors.

VI. Providing required interlocking between main PDB & sub PDB of A/C system of a particular building shall be in vendor scope.

VII. For Air-conditioning, all blowers shall trip and all “Fire Dampers” shall automatically close on receipt of “Fail-safe FIRE signal” i.e. normally closed but open on Fire condition contact. CONTRACTOR shall take care of this contact in fire alarm system of building. Further distribution of fire signal to each vendor’s sub PDB in AHU room (for air-conditioning system) shall be in vendor’s scope.

VIII. All indicating lamps shall be LED type. LED for Space heater ‘ON’ indication shall be provided for all feeders.

IX. 20% spare outgoing feeder or minimum one of each type, whichever is higher shall be provided for each PDB

X. Control transformer shall be provided for each outgoing feeder module.

XI. Required number of earth plate shall be provided within AC room, AHU room, and pressurization room. Further connection of individual equipments with earthing system shall be done by contractor. For earthing of various equipments upto earth plate, earthing schedule attached with the tender shall be followed

XII. All the Electrical work of this package shall be carried-out as per EIL Standard Spec no. 6-51-0093 for package units.

XIII. Co-ordination required for lighting and fire alarm installation works for areas with false ceiling and/ or air-conditioning ducts is in scope of vendor.

5.31 REQUIREMENT FOR EOT CRANE

I. One EOT Crane for GIS hall of suitable capacity shall be provided for erection & maintenance of largest GIS component/assembly. The crane shall consist of all special requirements & lifting assemblies for erection & maintenance of GIS equipment.

II. The capacity of the crane shall be sized to lift the heaviest GIS switchgear component.

III. The Crane shall be used for the erection and maintenance of the GIS switchgear component and all parts installed in the GIS switchgear room. On completion of erection of the switchgear, the CONTRACTOR shall completely service the crane before the handing over to client.

IV. For detailed specifications of EOT crane, refer elsewhere in the tender document.

5.32 FIRE PROOFING SYSTEM

I. The fire-proof sealing system and fire protection coating system are required to prevent the spreading of fire from one place to another (or one zone to another) through the openings in wall / floor, along cables laid in trays / racks and through openings below floor-mounted Electrical Switchgear, MCC, Distribution Boards, Junction boxes, Cabinets and Panels. The systems shall be installed in the specified locations in consultation with the purchaser's engineer after all cables have been laid and terminated.

II. DESIGN CRITERIA

5.32.II.1 The fire stop system, in case of fire, shall prevent spreading of fire in cables / systems beyond the fire stops

5.32.II.2 The fire rating shall not be less than two hours and the system shall be stable after application of water jet in the exposed side in order to extinguish fire

5.32.II.3 The system shall be suitable for a site condition of 50°C ambient temperature and 100% humidity

5.32.II.4 The design shall be capable of withstanding vibrations, drop-loads, foot traffics, mechanical loads, etc

5.32.II.5 The system shall be of retrofit design to accommodate not less than 20% more addition of cables, without disturbance / wastage of existing material

5.32.II.6 The system should be equally effective in horizontal and vertical formations

5.32.II.7 Under normal load, short circuit and fire conditions, the cable / cable trays will be subject to movement, expansion and vibration. The system shall be designed to withstand and perform satisfactorily under these conditions

III. MATERIAL SPECIFICATION

The material / components used for Fire stop system shall be provided to meet the following requirements.

5.32.III.1 Life expectancy should not be less than 40 years from the date of installation

5.32.III.2 It shall be free from shrinkage or cracking, should not have asbestos in composition and should achieve smoke and gas tightness during fire.

5.32.III.3 It shall not generate toxic gas and shall be harmless to the personnel handling the system.

5.32.III.4 The system shall not emit any corrosive or toxic fumes/smoke on the unexposed face of the barrier.

5.32.III.5 It shall not contain volatile solvents after the setting period of system.

5.32.III.6 It must be Repellent to pests, rodents and termite.

5.32.III.7 It should not affect the current carrying capacity of the cables.

5.32.III.8 The material shall be non-hygroscopic and non-inflammable and shall not get affected over a period of time due to water immersion.

5.32.III.9 It shall not react with cable sheaths, galvanized and painted steel materials etc.

5.32.III.10 It should be easy to apply / install using conventional methods.

5.32.III.11 The material shall have adequate shelf life to suit the storage and installation period.

IV. **INSTALLATION OF FIRE STOP SYSTEM**

5.32.IV.1 The various openings in the cable vault, vertical / horizontal raceways of cables penetrating walls / floors, etc. shall be provided with fire stop systems as directed by the purchaser's engineer.

5.32.IV.2 The bidder shall prepare drawings for each seal after verifying the actual installation of cables at site. The requirement of the sealing material shall be quantified accordingly and the approval of the purchaser's site engineer shall be obtained. The estimate of material shall be based on the net area to be sealed, wastage, thickness, density and other parameters as per the type test report.

5.32.IV.3 The fire stops are required to be installed in the openings where power, control cables and instrumentation cables have already been laid. Cables shall not be damaged. The Cable trays and supports shall not be disturbed.

5.32.IV.4 Welding work is not permitted in the areas such as cable vaults, hydrogen Generation area, highly combustible area, etc. In case of unavoidable circumstances, the specific approval from purchaser's engineer shall be taken before starting of any welding work.

5.32.IV.5 Any work like drilling / welding to building steel, chipping or breaking of existing structures like wall, floor or fabrications and any civil work shall be taken up with prior approval from the purchaser's engineer.

5.32.IV.6 The system shall be mechanically secured to the masonry work / concrete work to resist dislocation.

5.32.IV.7 Any wastage of the material during the process of mixing / processing / application shall be to the bidder's account.

5.32.IV.8 For foam type of systems, only the foam shall provide the specified fire rating. The damming boards shall be removed after curing of the foam.

5.32.IV.9 All work shall be carried out in accordance with the approved Field quality plan and drawings to be submitted by the bidder. The Field quality plan shall specify the thickness of fire-sealing material, minimum cured density and other parameters achieved in the approved type tests.

5.32.IV.10 The work shall be subject to the approval of the purchaser's site engineer and the owner.

V. **ROUTINE AND ACCEPTANCE TESTS ON FIRE-PROOF SEALING SYSTEM (FIRE STOP)**

5.32.V.1 Routine and Acceptance tests shall be decided based on the type of sealing material offered. The list of tests shall be mutually agreed before award of contract.

5.32.V.2 Charges for Routine and Acceptance tests shall be deemed to be included in the equipment price.

VI. **TYPE TESTS ON FIRE-PROOF SEALING SYSTEM (FIRE STOP)**

5.32.VI.1 Following Type test reports as per the setup and procedures given in subsequent clauses for the Fire proof sealing system shall be submitted

a) Accelerated ageing test
b) Water absorption test
c) Fire rating test
d) Hose stream test
e) Vibration test followed by fire rating test

5.32.VI.2 Tests specified above (5.27.5.1 a) to e)) should have been carried out on the same test sample sequentially one after the other without any touch up / repair / modification in accordance with the Test procedures specified later on in the document. The sample should be assembled as specified later on the document.

5.32.VI.3 Tests should have been carried out on a separate sample.

5.32.VI.4 Physical, chemical and mechanical properties of various components / ingredients used should also have been tested as a part of type tests.

5.32.VI.5 Test reports shall contain the following information:

a) Type of sealing material tested
b) Details of various components / ingredients used, along with their catalogue
c) Physical, chemical and mechanical properties of various components / ingredients used
d) Description of the various test assemblies tested

e) Details of method of conditioning

f) The observations as called for, in BS:476 Part-20 and technical specification

VII. **ASSEMBLY OF TEST SPECIMEN FOR TYPE TESTS**

5.32.VII.1 The test specimen shall resemble a typical Fire-proof sealing System for a floor/ wall crossing.

5.32.VII.2 The test specimen shall be designed to seal an opening of adequate size in a concrete slab of 200mm thickness.

5.32.VII.3 Two lengths of 300 / 600mm wide ladder type cable tray shall be assembled with required layer of XLPE / PVC insulated, PVC sheathed unarmoured cables in touching formation.

5.32.VII.4 Cables shall be adequately clamped with tray at both the sides of the penetration. However, for penetration system with blocks which require staggered arrangement, cables can be clamped at an adequate distance from the penetration and the tray need not pass through the penetration seal.

VIII. **TYPE TEST PROCEDURES**

5.32.VIII.1 Accelerated ageing test: The intention of accelerated aging test is to ascertain whether the artificial aging of the systems and components thereof results into change in the mechanical properties or in the form The test specimen (with damming board removed) shall be subjected to accelerated ageing test by storing in an air furnace where the temperature of the inside air is maintained at 85 ºC for 168 hours. The temperature controlled furnace should have approximately 7 air changes per hour.

5.32.VIII.2 Water absorption test: The test specimen shall be immersed in fresh clean water at a temperature of 20 ºC ±2 ºC. The test specimen must be separated from the bottom and sides of the soak tank by at least 10mm and it shall be covered by approximately 25mm of water. At the end of the 24 hour soak period, the specimen shall be removed from the water and mopped up with a damp cloth.

5.32.VIII.3 Fire rating test: This test (carried out after accelerated ageing test and water absorption test) shall prove the guaranteed power rating duration of the system in respect of stability, integrity and insulation characteristics of the complete system

a) The test specimen shall be subjected to fire rating test as per BS: 476 Part - 20.

b) Oil / Gas fired furnace shall be used for healing. The furnace shall have achieved standard time / temperature characteristics for fire tests as per BS: 476 Part - 20.

c) The pressure inside the furnace at the time of test shall be within 1.5 ± 0.5mm water gauge.

d) The cables in the test specimen shall be anchored on the hot side to a structure independent of the barrier. This is to ensure that any differential movement between the sealing system and the cable that could occur during a fire is produced in the type tests and the reliability of the integrity of the system is checked.

e) The cables shall be protruding between 1 and 2 metre from the barrier face on the unexposed side and protruding into the furnace as far as it is practicable with a minimum length 750 mm.

f) The ends of the cables shall be capped on the unexposed face to prevent gases and fumes escaping from the furnace during the fire.

g) The test specimen shall be subjected to fire test with the surface exposed to controlled fire in the furnace conforming t0 time / temperature characteristics specified in BS: 476 part-20

h) During the test the temperatures of both the faces of the fire stop, i.e. one which is exposed to fire and the other which is unexposed shall be measured by calibrated thermo-couples at regular intervals of 5 minutes.

i) At least 3 thermo-couples shall be provided for temperature measurement of each face. Thermocouples on the unexposed side shall be at a distance of 25mm from the unexposed surface.

5.32.VIII.4 Interpretation of results of Fire rating test: During the test, the test specimen shall meet all criteria simultaneously

a) The system is deemed to have failed to maintain stability if there is a total collapse of the fire proof seal

b) In case cracks are seen on the face of the fire stop or there are cracks through which the flame or hot gas can pass, the system is deemed to have failed to maintain integrity. The development of a crack is characterised by the appearance of black soot on cotton wool held near the seal on the unexposed surface at a distance of about 100mm

c) Failure shall be deemed to have occurred when the mean temperature of the unexposed surface of the specimen assembly increases by more than 140 ºC above the initial temperature or if the

temperature of the unexposed surface is increased at any point by more than 180 ºC above the initial temperature.

5.32.VIII.5 Hose stream test: The intention of the hose stream test is to ascertain whether the penetration seal assembly maintains its stability on application of water jet after withstanding the fire for the guaranteed fire rating duration.

a) A hose stream test shall be conducted on the test specimen immediately following a fire resistance test on that assembly. The specimen must first be removed from the furnace since the hose stream is to be applied to the exposed face. This must be done quickly since it is the intention of the test that the stream be applied to the specimen whilst it is hot.

b) The hose stream shall be long range narrow angle, (20º - 90º set at 30º included angle). High velocity water spray is provided from a 28mm hose discharging through an appropriate nozzle. The water pressure shall be 5bar calculated at the base of the nozzle and the minimum flow rate shall be 4.7 litres per second. The stream shall be supplied perpendicularly to the exposed face of the test specimen with nozzle 3m from the exposed face.

IX. Application shall be for a minimum of two and a half minutes per 9 sq. m. of the test specimen including the barrier.

5.33 SYNCHRONISATION, CONTROL AND ANNUNCIATION PANEL (SCAP)

I. For the 220kV system covered under the scope of this tender hard wired control, metering and annunciation shall be provided on SCAP which shall be located in Main Substation MRSS-100 and same shall be of mosaic panel type. SCAP shall carry out the control, monitoring and annunciation functions including those of future incomers, which shall include but not be limited to the following

5.33.I.1 Control functions

- Control of all breakers (incomers, bus couplers, outgoings).
- Tap changer control of Grid transformers
- Auto/Manual synchronization of all incomers and bus couplers.
- ON/OFF control of all incomers, outgoing feeders and bus couplers including outdoor IBPs in outdoor switchyard.
- Manual Synchronization subsystem complete with running and incoming voltmeters, frequency meters, ON/OFF switch, check synchronizing and guard relays, switches, lamps and any other hardware as required.
- Manual Changeover of incomers & bus couplers.

5.33.I.2 Monitoring functions

- Voltage of incomers and buses.
- Current of each phase of incomers and bus couplers/section breakers
- Frequency of each incomer
- Power factor of each incomer
- MW, MVAR & MVA of each incomer and outgoing feeder.
- MWH, MVARH of each incomer
- Voltage and frequency recorder for each bus.
- Any other function, which is not mentioned but is essential for operation and safety of equipment and personnel.

5.33.I.3 Audio-visual annunciation Functions

Audio-visual annunciation shall be provided for monitoring the equipment, transformers, switchboard and other electrical equipment as a minimum, but shall not be limited to the following:

- Annunciation of Fault status of Breakers

- Operating and fault status of all protective relays and trip alarm of incomers, bus couplers, etc.
- Complete trip and non-trip alarm annunciation for all transformers including alarm of OLTC.
- Annunciation of all protective relays and trip alarms of all major electrical equipment in the substation
- Hooter and clock.

5.33.I.4 Status on mimic diagram

- ON/OFF/TRIP indications of all breakers
- Semaphore indicators for all circuit breakers, isolators and earth switches

5.33.I.5 Control And Operation Philosophy

a) Switchboard shall have one local/remote control selector switch. When the switch is selected in local mode, the control will be done from GIS control cubicle.

- It shall be possible to close any incomer and bus coupler/section breaker of GIS in test condition.
- It shall be possible to close any of the outgoing breakers of GIS in service condition.
- When selector switch is selected in remote mode, control shall be transferred to hard wired synchronizing panel (SCAP).

b) Hard wired synchronizing panel (SCAP) shall be provided with the following selector switches for operation and control:

SW-1 3-position selector switch (SCAP/ OFF/ECS)

SW-2 4 position selector switches for each breaker to be synchronised (OFF/Dead bus/Manual synchronizing/Auto synchronizing)

- Incomers selector switches shall be provided on SCAP for selecting the incomers to be sync checked and closed.
- Contractor, based on the requirements of synchronizing scheme finalized shall decide quantities of these selector switches.
- Following operations shall be possible from SCAP:
  - Closing of all incomer breakers (in service position) and bus couplers/section breakers (in service position) on dead bus condition (bus coupler/ section breakers dead bus closing to be checked on either side).
  - Synchronizing and closing of selected incomer breakers (in service position) and bus couplers/ section breakers (in service position) through check synchronizing & auto synchroniser.
- Required interlocks for safe operation shall be provided.

5.34 ECS INTERFACE

I. All signals as per ECS IO List sheet attached elsewhere shall be provided in respective equipment for interface with the Electrical control system.

II. Number of analogue / digital IOs for ECS interface shall be worked out by the CONTRACTOR as per the ECS I/O's list attached.

III. CONTRACTOR to note that:

5.34.III.1 Acquisition of input/output (I/O) signals as hardwired or software:

- All numerical relays shall be connected to a substation automation system. ECS shall communicate with the substation automation system to acquire relay and metering status I/O signals of the relays. These I/O signals have been indicated as “relay and metering LAN” in the typical I/O list.
- All other I/O’s shall be acquired hardwired and have been indicated as “hardwired” in the typical I/O list.
- In case any of these data cannot be acquired over the relay LAN, these signals have to be provided as hardwired. For requirement of numerical relays, refer Electrical part of contract document.

5.34.III.2 The I/O list is indicative only. Any other I/O required to meet the contract requirements shall be identified and provided by CONTRACTOR

5.34.III.3 Guidelines for ECS I/O Interface Design

Analogue Input Signals	Signal transducers for hard-wired analogue inputs shall have accuracy class 0.1 for the range 0-120%. All transducers shall be externally-powered types. External power supply shall be 230V AC UPS. For all measurements for I, V, MW, MVAR, Hz, obtained on the relay and metering LAN, maximum possible accuracy shall be ensured
Digital Input Signals	
Alarm (D)	Alarm is a signal which requires operator to be alerted such as VT circuit MCB (closed, open), relays 86 & 95 (operated, reset), auto-changeover (blocked, not blocked), DC control supply (healthy, failed), line voltage (unhealthy, healthy), bus voltage (unhealthy, healthy), motor trip from process, under-voltage trip. This shall be hardwired / on relay LAN as specified. For hardwired signal, potential free contacts of rating 1 A, 110V DC or 240 V AC, make to alarm (NO) preferred. CONTRACTOR shall specifically indicate if NC contact is being provided in place of NO contact. Generally a hardwired alarm point is put under "sequence of event" monitoring
Status (S)	For hardwired signal, potential free contacts of rating 1 A, 110V DC or 240 V AC, make to alarm (NO) required
Digital Output Signals	
Command (C)	Hardwired through potential free changeover type contact of interposing relay, contact rating 5 A, 240 V AC and/or 4 A, 110V DC. Coil rating shall be 24 V DC

6 MISCELLANEOUS REQUIREMENTS

6.1 Equipment numbering scheme for equipment located in Substation shall be as per Design Basis document. Numbering scheme for other equipments shall be decided during detailed engineering.

6.2 Power system study shall be carried out in latest version of ETAP software. Contractor shall furnish the native file of ETAP after carrying out the preliminary study (stage-1), intermediate study (stage-2) & final study (stage-3). Following study shall be done by contractor & report shall be submitted to EIL/owner for review/approval:

a. Load flow
b. Short circuit
c. Motor startup studies (Largest HV and MV motor shall be intimated during detail engineering.

d. Transient stability
e. Arc flash study
f. Harmonic study
g. Relay co-ordination
h. Insulation co-ordination (*)
i. Transformer inrush current (*)

(*) If the study is not part of ETAP, contractor shall utilize other reputed industry proven software to conduct these studies. Operating & contingency conditions for carrying out power system study shall be informed during detailed engineering.

6.3 Wherever switchboards are provided with online temperature monitoring system, thermography window in cable chamber is not required.

6.4 CONTRACTOR shall furnish complete relay coordination and relay settings for the complete package including coordination with other EPCC CONTRACTOR/owner, relay settings for the upstream feeders.

6.5 Paint shade for indoor electrical equipment shall be RAL 7032, & for outdoor electrical equipment shall be RAL 7031.

6.6 Suitability of cable terminal boxes/chambers for the respective cables sizes / runs as per the approved cable schedule shall be ensured by the CONTRACTOR.

6.7 All nuts, bolts, washers, spring washers, grouting bolts, anchor fasteners, etc. necessary for completion of job wherever used shall be of stainless steel SS304. External hardware for lighting fixture, junction boxes, 230V receptacles, and lighting panel shall be of stainless steel grade SS304.

6.8 All lugs to be supplied shall be heavy duty, long barrel, crimping type and made of tinned copper. Sector shaped/circular barrel lugs shall be provided for making connections for cables having sector shaped/circular geometry of conductors respectively.

6.9 Cable tag shall be stainless steel with cable tag engraved. All spare holes at feeder end shall be sealed using metallic plate and GI hardware.

6.10 Cable glands shall be of nickel-plated brass. Cable glands shall be single compression type for indoor equipments & double compression type for outdoor equipments.

6.11 CONTRACTOR to note that 3D modelling of substation building and equipments shall be done by contractor in line modelling specification attached with tender. PDF/ Hard Copy of GA drawings of Owner's equipments to be installed in the substation shall be provided to CONTRACTOR during detail engineering

6.12 Wherever single core cables are to be terminated in switchboard, aluminum gland plates shall be provided.

6.13 All Emergency Stop/Stop pushbuttons on LCS/LCP/Switchboard shall be provided with protective covers to avoid accidental operation.

6.14 Contractor shall include painting and marking of all buses, individual incomers, all outgoing feeders etc. with detail such as Tag no., feeder rating, sending end source reference etc. for all switchboards.

6.15 All switchboards, panels, etc. shall be provided with LED indications and adequate no. of LEDs shall be provided to give required illumination.

6.16 All ACB fed motor feeders (>45kW), schematics shall have provision for auto start and auto re-acceleration with feature to inhibit irrespective of process/licensor's requirement. Reacceleration scheme for contactor fed motors (<=45kW) shall be provided by Contractor for all those drives requiring reacceleration as per Process requirements.

6.17 For owner supplied items, feeders at 415V/230V AC/ 110V DC/ 230V AC UPS voltage shall be provided by the contractor in the respective switchboard supplied by them. The details for same shall be provided during detailed engineering.

6.18 All the critical inputs must be wired in SAS/ECS for proper monitoring.

6.19 Armoured cables with double compression glands shall be used inside Battery Rooms along with FLP fittings/equipments.

6.20 Contractor / vendor shall comply with the requirements as per Ministry of Power (GoI)'s various orders regarding testing of all equipment, components & parts imported for use in the power supply system for cyber security to check for any kind of embedded malware/Trojans/cyber threat and for adherence to Indian Standards. Necessary testing of their equipment/ components at designated labs & obtaining test certificates in line with MOP orders shall be done by contractor/vendor

6.21 Color of HDPE duct for various application shall be as under :

Sr. No.	Application	Colour
1.	Fire Alarm System Data highway OFC cables	Fire Red
2.	Substation Automation system	Black with blue strips
3.	ECS System OFC Cables	Black with red strip for main data highway. Black with blue strip for redundant data highway.
4.	HDPE conduit for LAN line OFC	YELLOW conduit with BLACK strip
5.	HDPE conduit for Feeder differential protection System	GREEN conduit with WHITE strip

6.22 All the modules shall have stickers (Yellow background with black letters) or letter painting indicating KW, cable size, FLC at front and back of HT and front for LT. A bigger size sticker having list of motor tag nos. and module no. shall be pasted on both side of the panel end covers.

6.23 All spare cut outs in sub-station floor shall be properly marked and flushed with floor level.

6.24 SLD of HT board shall be painted behind the HT board indicating the bus bar arrangement.

6.25 Spare entries in panels, gland plates shall be blocked to avoid dust and vermin ingress.

6.26 Sufficient sub-station furniture and lockable storage cupboards/shelves shall be provided for maintenance purpose.

6.27 **ADDITIONS / DELETIONS / MODIFICATIONS TO STANDARD SPECIFICATION**

I. Specification for Battery Charger (6-51-0019 Rev. 6)

6.27.I.1 The following is added at the end of Note-2 on Page 14 & 15 of specification:

"Battery isolator (MCCB/Switch Fuse) shall be provided with three pole version to ensure positive isolation of all the three connections of battery".

6.28 CONTRACTOR shall provide separate RCBO & MCB or separate ELCB & MCB for each lighting outgoing circuit at local lighting distribution panel. Common RCBO/ELCB + MCB unit is not acceptable. ELCB/RCBO shall be rated for 30mA in field and 300mA in indoors.

6.29 For wiring just above the false ceiling, METSEC channel shall be used. For wiring on true ceiling black enamelled surface conduits shall be used.

6.30 All Copper Control cables shall be twisted paired (individual shielded and overall shielded) only. Minimum 10% spare pair or minimum 1 spare pair shall be provided.

6.31 All Multi-Function Meter (MFM) in HV & MV switchboards shall be communicable type. Complete data of MFM shall be accessible in the SAS (through switchboard level Ethernet switches) & associated SAS Laptop/ HMI. The protocol for communication shall be over RS-485 or fibre optic cable, preferably with IEC protocol. Accordingly, protocol convertors/gateways at suitable locations as required shall be provided by CONTRACTOR for data integration on IEC 61850 protocol from Master Ethernet switch to Owner's ECS system.

7 SPARES

7.1 Commissioning spares for all electrical equipments are included in Package Contractor's scope of supply and shall be included in the base price.

7.2 Mandatory spares shall be as per cl. No. 6.1 of EDB (Engineering Design Basis) B857-999-16-50-EDB-1001 attached with tender.

7.3 Unit rates for two years recommended O&M spares along with list of recommended spares for each equipment provided as a part of this package, shall be provided by CONTRACTOR along with offer

7.4 Recommended list of maintenance spares for two years operation shall include the following as a minimum for motors. Vendor shall ensure to quote for the same.

- Bearing for DE/NDE-one set
- Terminal box cover with screws
- Fan
- Terminal block

8 COMPREHENSIVE POST WARRANTY ANNUAL MAINTENANCE CONTRACT (CPWAMC)

8.1 Vendor shall propose 5 year's comprehensive post warranty annual maintenance contract for UPS, DC chargers, SAS etc. and shall mention the service to be provided, methodology, scope of work and Vendor's responsibility with year wise break up. Placement of this comprehensive AMC will be done after expiry of the guarantee period. In the event of any malfunction of the system hardware / system software, experienced service engineer shall be made available at site within 24 hours on the receipt of such information from Owner.

8.2 The contract shall include supply of maintenance spares, tools & tackles as required. Travel, boarding & lodging of service engineer shall be by Vendor. The quote shall be made year wise up to 5 Years. Contract shall include on site stock & shall give cost of each item after expiry of 5 Years CPWAMC.

8.3 The service under Comprehensive Post Warranty Annual Maintenance Contract including supply of spare parts and services shall broadly encompass:

I. Preventive maintenance
II. Periodic maintenance
III. Emergency service
IV. Software support

8.4 **Periodic maintenance:** Once in a year, involving complete overhaul of the Electrical Equipments, inspection of hardware and software, fault prediction, inspection of power supply quality, environmental and operating condition checks, calibration checks, major repairs/replacements and detailed reporting. This visit is in addition to visit required for periodic maintenance.

8.5 **Periodic maintenance:** Site visits, minimum four to six times in a year, inspection of general healthiness of the system, study and advice on daily maintenance, inspection of hardwares and softwares of Electrical Equipments. If any problem is reported, running of test programs, on-line servicing and solving reported problems. Checks shall be conducted on running system i.e.

I. On-line sub-systems
II. Power supply checks
III. Others Vendor to mention

8.6 **Software maintenance:** Maintain existing software to improve and utilize existing application and improve performance of the system. Minor software modifications shall also be covered under this scope.

8.7 **Emergency service:** Any failure shall be on system suppliers' account. In the event of any malfunction of the Electrical Equipment, system hardware/ software during this period, Service Engineer must report at site within 24 hrs. of report of failure with necessary spares. The Electrical Equipment must be brought back within 24 hours after reporting at site.

Notes:

1. Vendor to note that while carrying out the Comprehensive Post Warranty Maintenance Contract activities Owner's engineers may associate with system engineers. On job training of these associated engineers shall be covered under this scope.

2. All financial aspects of the Post Warranty Maintenance Contract must be listed clearly by the Vendor

9 INSTALLATION, FIELD TESTING & COMMISSIONING AT SITE

9.1 Contractor shall carry out the installation, field testing and commissioning of all items including installation in field, testing and commissioning of free issue items in accordance with Consultant installation standard & standard specification attached with tender.

9.2 Contractor 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.

9.3 Contractor shall comply with the requirements of Mechanical Completion as described in relevant section of Bid document.

9.4 Obtaining clearance for energizing the complete electrical facilities covered under this tender and approval of installation / drawings from central electrical inspector and any other concerned approving authority e.g. CCOE (PESO), OISD etc. shall be in the scope of the contractor.

9.5 Contractor shall also avail OEM (Original Equipment Manufacturer) services for testing and commissioning of equipment as listed elsewhere in the tender. However for other equipment, contractor shall ensure services of manufacturers' representatives for supervision of installation, testing and commissioning.

9.6 Testing and commissioning of all free issue relays for installation in Owner's sending/receiving end switchboard feeders, relay setting for all these feeders at site including supply, installation and testing of application software as required for numerical relays and Owner's laptop/ HMI (of 220 kV, 66kV and 33kV / 6.6 kV / 415V) are included in the scope of vendor. Relay manufacturer shall be solely responsible for numerical relays integration, relay setting etc. for the complete switchboards.

9.7 Splicing of FO cable and taking over from cable laying contractor and glanding of same shall be in the scope of CONTRACTOR. OTDR test shall be done mandatorily after taking over from cable laying contractor.

9.8 Structural steel support shall be fabricated of rolled MS sections after shot blasting, welding, bolting, riveting, supply of necessary anchor bolts and grouting etc. including supply of paint and applying one coat of anti-rust primer and two finished coats of approved synthetic enamel paint (suitable for highly corrosive environment) as per painting specification attached with tender.

9.9 Cable support structure below the GIS shall NOT be fixed to the floor/ wall, instead shall be connected to GIS structure, to avoid this structure coming off the fixing during the short circuit.

9.10 Chequered plate shall be painted in accordance with painting specification 6-79-0020 enclosed elsewhere in the bid package.

9.11 HV cables wherever being free issued by owner shall be made available at OWNER's warehouse. Transportation of cables from warehouse to site, laying and termination of cables including supply of all cable laying accessories, cable joints, cable termination kits, etc. is in scope of contractor.

9.12 Painting/ marking/ numbering of all buses of switchboards and each incoming/ outgoing feeder with details of tag number, feeder rating in front and rear of panel and all other equipments viz. transformers, lighting fixtures, FA devices, junction boxes, motors, welding receptacles,

convenience receptacles, local control stations, etc. shall be done as per requirement of Engineer-in-charge at site.

10 INSPECTION AND TESTING AT MANUFACTURER'S WORKS

10.1 All major electrical equipment and material shall be subject to inspection by owner/ Consultant or authorized representative at manufacturers' works. Contractor/Vendor/ Sub-Vendor shall furnish all necessary information concerning the supply to owner/ Consultant.

10.2 During fabrication, all the equipment shall be subject to inspection by owner/Consultant or by an agency authorized by the owner to assess the progress of work as well as to ascertain that only quality raw material is used.

10.3 Type, routine and acceptance tests to be conducted on all equipment shall include all tests as specified in standard specifications & data sheets enclosed with the package.

10.4 Contractor shall ensure that the electrical equipment procured have type test certificates.

10.5 All routine and acceptance tests as specified by the applicable standards shall be carried out by the contractor/vendor/sub-vendor and these tests shall be witnessed by owner/ Consultant or an agency authorized by owner/ Consultant Any other test and quality assurance requirements as defined elsewhere in the package shall also be complied.

10.6 All the equipment offered shall have valid type test certificates of recognized testing house such as CPRI, CMRI, PTB, BASEEFA, UL or equivalent.

10.7 Wherever, EIL Inspection and test plan is not available for electrical equipments e.g. Solar rooftop photovoltaic system, etc., CONTRACTOR/ Supplier shall develop QAPs using the specific requirements of Inspection and testing as covered in the tender. The QAPs are required to be reviewed and approved by EIL/Owner.

11 STATUTORY APPROVAL OF WORKS

11.1 The contractor shall obtain approvals from the concerned electrical inspectorate for installation drawings and engineering of the electrical system and equipment covered under the contractor's scope. Any modification or additional requirements of the electrical inspectorate shall have to be carried out by the contractor at his own cost without affecting time schedule. Arranging for any other approvals required for the complex, from agencies such as CCOE, CEA etc. are included in the contractor's scope. For electrical equipment to be installed in hazardous area, statutory approval certificates shall be furnished by the contractor. Any additional testing, if required, shall be carried out by the contractor without affecting project time schedule at no extra cost to Owner.

11.2 The inspection and acceptance of the work as above shall not absolve the Contractor from any of his responsibilities under this package. Obtaining clearance for energizing the complete electrical facilities covered under this tender, and approval of installation and drawings from the Chief Electrical Inspectorate/CEA/MPPTCL/Power Supply Company shall be the responsibility of the contractor.

12 MAKES OF EQUIPMENT AND COMPONENTS

12.1 List of approved vendors for Electrical equipment/components is as mentioned elsewhere in the Master Vendor List, attached with the tender.

12.2 All electrical equipment shall be brand new with state of art technology and proven track record. No prototype shall be offered. The make and type of equipment, if not specified in this bid document, shall be subject to approval of owner/ Consultant.

12.3 Additional makes of imported items shall be subject to Owner/Consultant's approval during detailed engineering.

12.4 Vendor may procure material from any of the listed vendors. However current validity and range of approval as per Consultant enlistment letter, workload, stability and solvency need to be verified by the vendor before placement of order.

12.5 Vendor shall ensure the availability of spare parts and maintenance support services for the offered equipment at least for 10 years from the date of supply. Vendor/ sub-vendor shall give a notice of at least one year to the end user of equipment and PMC before phasing out the products/spares to enable the end user for placement of order for spares and services.

ENGINEERING DESIGN BASIS
ELECTRICAL

JOB NO: **B857**

PROJECT: **EPCM Services for Site Enabling for Bina Petrochemical and Refinery Expansion Project**

CLIENT: **BPCL - BINA REFINERY**

EIL SIGNATURE: 17/01/25

CLIENT SIGNATURE: Amit Kr Jha 18/01/2025 — M. SATISH BABU 18/01/2025 — R H PANCHAL 18/01/2025

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R H PANCHAL
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GENERAL MANAGER (U&O) - OFREP
भारत पेट्रोलियम कॉर्पोरेशन लिमिटेड
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1	17/Jan/2025	Revised & Issued For Implementation	KANUGUTTA SUMITH	RASHMI SINGH RATHAUR	HARISH KUMAR
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Legend: ***Bold italic*** text denotes change with respect to previous revision.

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1.0 SCOPE

This electrical design basis defines the design requirements agreed by owner/clients in addition to EIL standard design philosophy for electrical facilities no. 6-51-0099 Rev no. 7.
In case of any conflict between statutory requirements, this design basis and standard design philosophy, the most stringent requirement shall govern.

2.0 ABBREVIATIONS, CODES & STANDARDS / PUBLICATIONS

2.1 ABBREVIATIONS

Code	Description
AC	Alternating Current
ACB	Air Circuit Breaker
ACSR	Aluminium Conductor Steel Reinforced
AN	Air Natural
APFC	Automatic Power Factor Correction
ASB	Auxiliary Service Board
ATS	Auto Transfer Scheme
CB	Circuit Breaker
CBCT	Core Balance Current Transformer
CEA	Central Electricity Authority
CT	Current Transformer
DC	Direct Current
DCP	Data Concentrator Panel
DG	Diesel Generator
DGMS	Director General Mines Safety
DOL	Direct On Line
EHV	Extra High Voltage
ELCB	Earth Leakage Circuit Breaker
ELR	Earth Leakage Relay
EMPR	Electronic Motor Protection Relay
EPCC	Emergency Power Control Center
EPMCC	Emergency Power cum Motor Control Center
FBT	Fast Bus Transfer
FRLS	Flame Retardent Low Smoke
FS	Fire Survival
GI	Galvanised Iron
GIBD	Gas Insulated Bus Duct
GIS	Gas Insulated Switchgear
GTG	Gas Turbine Generator
HMI	Human Machine Interface
HV	High Voltage
IEC	International Electro-Technical Commission
IS	Indian Standard
LDB	Lighting Distribution Board
LV	Low Voltage
MCC	Motor Control Centre
MCCB	Moulded Case Circuit Breaker
MI	Mineral Insulated
MOV	Motor Operated Valve
MPCB	Motor Protection Circuit Breaker
MPR	Motor Protection Relay

Code	Description
MV	Medium Voltage
NA	Not Applicable
NGR	Neutral Grounding Resistor
NGT	Neutral Grounding Transformer
NIFPS	Nitrogen Injection Fire Protection System
OFAF	Oil Forced Air Forced
OLTC	On Load Tap Changer
ONAF	Oil Natural Air Forced
ONAN	Oil Natural Air Natural
PCC	Power Control Centre
PESO	Petroleum & Explosive Safety Organisation
PL	Power Limiting
PLC	Programmable Logic Control
PMCC	Power Cum Motor Control Centre
PRP	Parallel Redundancy Protocol
PVC	Polyvinyl Chloride
RCC	Reinforce Cement Concrete
RSTP	Rapid Spanning Tree Protocol
SAS	Substation Automation System
SFU	Switch Fuse Unit
SPN	Single Phase & Neutral
SPV	Solar Photovoltaic
SR	Self Regulating
STG	Steam Turbine Generator
TP	Three Phase
TPN	Three Phase & Neutral
UPS	Uninterrupted Power Supply
VCB	Vacuum Circuit Breaker
VFD	Variable Frequency Drive
VT	Voltage Transformer
XLPE	Cross Link Poly Ethylene
TCP	***Thyristor Control panel***
SVR	***Static Voltage Regulator***

2.2 CODES & STANDARDS / PUBLICATIONS

The main codes and standards, considered as minimum requirements, as applicable, are as follows -

S.No.	Description	Standards / Codes	Edition
1	IEEE recommended practice and requirements for harmonic control in electric power systems	IEEE-519	
2	Code of Practice for Electrical Wiring Installations	IS 732	
3	Outdoor type oil immersed distribution transformers up to and including 2 500 KVA,33kV - specification part 1 mineral oil immersed	IS-1180	
4	Code of practice for the fire safety of buildings - Electrical Installations.	IS-1646	

S.No.	Description	Standards / Codes	Edition
5	Code of practice for selection: installation and maintenance of automatic fire detection and alarm system.	IS-2189	
6	Code of practice for fire safety of industrial buildings - Electrical generating and distributing stations.	IS-3034	
7	Code of practice for Earthing.	IS-3043	
8	Code of practice for Interior Illumination: Part 1 General requirements and recommendations for welding interiors	IS-3646	
9	Application guide for Insulation Coordination.	IS-3716	
11	Guide for safety procedures and practices in electrical work	IS-5216	
12	Classification of hazardous areas (other than mines) having flammable gases and vapours for electrical installations.	IS-5572	
13	Code of practice for Industrial Lighting.	IS-6665	
14	Guide for Control of undesirable static electricity.	IS-7689	
15	Guide for improvement of power factor - consumer's installations.	IS-7752	
16	Application guide for on load tap changers.	IS-8478	
17	Reference ambient temperature for electrical equipment	IS-9676	
18	Code of practice for selection, installation and maintenance of transformer.	IS-10028	
19	Code of practice for selection, installation and maintenance for switchgear and control gear.	IS-10118	
20	Voltage bands for electrical installations including preferred voltages and frequencies.	IS-12360	
21	Energy efficient induction motors-three phase squirrel cage	IS-12615	
22	Guide for short circuit calculations in three phase AC systems.	IS-13234	
23	Electrical apparatus for explosive gas atmospheres - General requirements.	IS/IEC 60079-0	
24	Equipment protection flameproof enclosures "d"	IS/IEC 60079-1	
25	Explosive atmospheres - Part 2: Equipment protection by pressurized enclosure "p"	IS/IEC 60079 : PART 2	

S.No.	Description	Standards / Codes	Edition
26	Electrical Apparatus for explosive gas atmospheres - Powder filling 'q'	IS/IEC 60079 : PART 5	
27	Electrical apparatus for explosive gas atmospheres - Oil immersion "o"	IS/IEC 60079 : PART 6	
28	Electrical apparatus for explosive gas atmospheres Increased safety type "e"	IS/IEC 60079 : PART 7	
29	Explosive Atmospheres Part 10 Classification of Areas Section 2 Combustible dust atmospheres	IS/IEC 60079 : PART10-2	
30	Explosive atmospheres: Part 11 equipment protection by intrinsic safety "i"	IS/IEC 60079 : PART 11	
31	Explosive Atmospheres: Electrical Installations Design, Selection and Erection	IS-16724/ IEC 60079 : PART 14	
32	Electrical apparatus for explosive gas atmosphere -Part-15 Construction, test and marking of type of protection "n" electrical apparatus	IS/IEC 60079 : PART 15	
33	Explosive atmospheres: Part 18 equipment protection by encapsulation "m"	IS/IEC 60079 : PART 18	
36	Explosive atmospheres: Part 31 equipment dust ignition protection by enclosure "t"	IS/IEC 60079 : PART 31	
37	Code of practice for the protection of buildings and allied structures against lightning.	IS/IEC- 62305	
38	Recommended practices on static electricity	OISD-RP-110	
39	Classification of Area for electrical installation at Hydrocarbon Processing and handling facilities	OISD STD-113	
40	Inspection and safe practices during electrical installation	OISD-RP-147	
41	Design aspects for safety in electrical systems	OISD-RP-149	
42	Fire Protection System for Electrical Installations	OISD STD 173	
43	Lightning Protection	OISD-GDN-180	
44	National Electrical Code (NEC) - BIS Publication.	SP-30	
45	Rotating Electrical Machines - Efficiency classes of line operated AC motors	IS/IEC 60034-30-1	
46	Electrical apparatus for use in the presence of combustible dust: Selection and installation	IS/IEC 61241-14	
47	Electrical apparatus for use in the presence of combustible dust: Type of protection "pD".	IS/IEC 61241-4	

S.No.	Description	Standards / Codes	Edition
48	Recommended Practice for Lightning Protection of Aboveground Storage Tanks for Flammable or Combustible Liquids	API-RP-545	

3.0 GENERAL / DESIGN CONSIDERATIONS

S.No.	Project Philosophy
1	LV - Low Voltage. The voltage which does not normally exceed 250 V.
2	MV - Medium Voltage. The voltage which normally exceeds 250 V and does not exceed 650 V.
3	HV - High Voltage. The voltage which normally exceeds 650 V but does not exceed 33 kV.
4	EHV - Extra High Voltage. The voltage which exceeds 33 kV under normal condition.
5	FRP Canopy shall be provided for all outdoor equipment except transformers and Capacitor Banks.
6	Circuit breaker provided for PCC/ EPCC/ MCC/ ASB/ LDB/ ELDB incomer shall be 4 Pole type.

4.0 SPECIFIC DESIGN REQUIREMENTS

S.No.	Project Philosophy
1.0	***Equipment numbering philosophy for electrical equipment in this petchem project shall be as listed below (@@@- denotes substation number):*** ***220/69kV Power Trafo.: @@@-TR-011*** ***66/6.9kV Power Trafo.: @@@-TR-021*** ***33/6.9kV Power Trafo.: @@@-TR-031*** ***6.6/0.433kV Dist. Trafo.: @@@-TR-041*** ***415/415V Normal/Emergency Ltg. Trafo.: @@@-TR-061*** ***220kV GIS switchboard: @@@-EHV-101*** ***66kV GIS Isolator: @@@-HV-111*** ***66kV GIS: @@@-HV-102*** ***33kV GIS Isolator: @@@-HV-121*** ***6.6kV Isolator: @@@-HV-211*** ***6.6kV Switchboard: @@@-HV-201*** ***415V Normal/Emg. Power PCC: @@@-PCC-301*** ***415V Normal/Emg. Power MCC: @@@-MCC-311*** ***415V Normal/Emg. Lighting: @@@-LB-331*** ***415V Aux. Power: @@@-ASB-351*** ***Normal lighting panels: @@@-LP-501*** ***Emg. Lighting panels: @@@-ELP-531*** ***Power panels: @@@-PP-601*** ***Space heater panels: @@@-SHP-631*** ***Power panels for Instrumentation: @@@-PPI-661*** ***110V DCDB: @@@-DCDB-701*** ***110V UPS-ACDB: @@@-ACDB-711*** ***ECS panels: @@@-IFP/IRP/RTU-901*** ***Marshalling panels: @@@-DCSMB/ECSMB-911*** ***Tag number indicated above is for the first equipment in the series of that type.***

S.No.	Project Philosophy
2	***5 years comprehensive AMC charges for UPS, DC chargers, SAS, ECS (including EMS), VFDs/Soft starters (except air fin coolers), TCP and Nitrogen Injection Fire protection systems (NIFPS) shall be taken into account while evaluating the offer. Placement of this comprehensive AMC will be done after expiry of the guarantee period.***
3	Miscellaneous Requirements
3.1	All push button stations shall be provided with 2 nos. earthing lugs/studs.
3.2	***Sufficient no. of 240 volts flame proof plug points along with 240/24 volts flame proof transformer units shall be provided in the plant for shutdown purpose. In the column near each man way minimum TWO no. 240 volts flame proof plug point along with one no. 240/24 volts flame proof transformer unit to be provided. Transformer unit shall be suitable for connecting two nos. flame proof hand lamps. Also sufficient no. of 3 phase 4 wire FLP welding receptacles shall be provided at suitable location near each columns and heaters, at least ONE 3 Phase Welding receptacles near each column & heater.***
3.3	Paint Shade for Electrical equipment"s shall be as below: a) RAL-7032 (for Indoor Equipment) b) 632 as per IS-5/RAL-7031 (for Outdoor Equipment) c) Paint shade of the motor shall be grass green shade No. 218.
3.4	All the MCCs shall be intelligent type with intelligent motor protection relays for all the motors having rating less than 55 KW. All the PLC and DCS signals shall be through relay logic. The iMCCs shall be fully integrated with DCS through Modbus, Ethernet communication.
3.5	***Motor having 1.2 MW or above capacity shall have differential protection. In case the motor is having provision for both VFD and direct on line, necessary provision shall be considered so that differential CT circuit gets by-passed whenever the motor is running in VFD mode.***
3.6	***VFD (critical), failure of which, causes tripping of plant shall have 100% hot standby facility with redundant PLC (with individual signals from field/control room to respective PLC)***
3.7	Shroud shall be provided on the stop push button of LCP/LCS
3.8	Cable trays used shall be GI coated of 100 micron thickness. All the hardware used for joining the cable trays shall be of SS-316 material. However for cooling tower area and CWPH, FRP trays shall be used.
3.9	All cables shall be supplied in metallic drums as specified in the data sheet. Each drum shall have the BPCL PO no., BPCL Project Electrical & BPCL Project Name mentioned on both sides of the drum. The cable shall have BPCL Project Name-Electrical printed on the cable outer sheath at regular intervals.
3.10	Cable tray earthing shall be done by laying GI strip or earthing cable along the cable tray and earthing the tray at every 25m interval.
3.11	Wherever welding has been done on the cable tray, an anti-rust zinc coating shall be provided for preventing rusting of cable tray.
3.12	LIGHTNING PROTECTION: Risk assessment against Lightning strike on plant structure, buildings (including Control room, SRR, Substation), Pump house sheds and tanks etc. shall be carried out as per OISD-GDN-180, IS/IEC 62305 and API-RP-545. Based on risk level assessment mitigation arrangement required to lower the risk less than tolerable limit shall be carried out. In buildings where solar panels have been provided, lightning protection shall be taken care accordingly.
3.13	For temporary electrical installation, requirement of Cl. no. 7 of OISD-147 shall be followed.
3.14	***For maintenance 3 phase (415V 3P + N + E), 125A Power sockets shall be provided so as to ensure complete coverage of the plant through 50 meter radius.***

S.No.	Project Philosophy
3.15	Convenience outlets (240V) 15/5 A shall be provided so as to ensure complete coverage of the plant through 20 meter radius. Near the manholes of the vessels 24V transformer unit shall be fixed type and shall be provided with single hand lamp at each man hole. Design of the sockets shall be such that 240V and 24V plugs are not interchangeable.
3.16	***The following minimum standard equipment shall be supplied in each substation:*** ***Fire extinguishers (type Co2 and Dry chemical powder), 1 pcs framed key diagram of electrical system(SLD), Discharge earthing rod-2 sets, first aid kit & Breaker trolley (1 no. suitable for each type)***
3.17	Solar power fencing system shall be provided for new boundary wall.
3.18	Independent LCS with ammeters shall be provided for all the auxiliary motors of HVAC system i.e. cooling water pump motors, condensate pump motors, chiller pump motors etc. These LCS shall have LOTO facility.
3.19	***LOTO system facility (Box, lock & Key, HASP,Wire etc.) shall be provided in each substation.***
3.20	***In every manned generating station, sub-station or switching station of voltage exceeding 650 V, an artificial respirator shall be provided and kept in good*** ***working condition.***
4.0	Following clause-wise modifications / additions to Design Philosophy (6-51-0099 Rev.7) shall be applicable:
4.1	Clause 4.1 System Design Philosophy First line to be modified as Safety to personnel and equipment both during Installation, testing, commissioning, operation and maintenance.
4.2	Clause 4.6.2 Note-c) Voltage Drops The subject note shall be read as "For MV motors, the voltage available at the motor terminals must not be less than 80% of rated voltage during start up and reacceleration. However, motor shall be able to start up at 75% of the rated voltage available at the motor terminals."
4.3	Clause 4.10.3 Protection and metering schemes The subject clause gets modified as "Metering shall be provided to keep a record of power and cumulative energy consumption and supervision of all concerned parameters....."
4.4	Clause 4.17.6 Electrical Surface Heating System Add a new clause as "For Electrical Heat Tracing system, temperature sensing device shall be RTD. Controllers with all requisite status and control signals shall be provided accordingly. These signals shall be also wired upto control room including supply of cables by vendor."
4.5	***Clause 4.12 Emergency Power supply system for UPS and DC system shall be as below:*** ***a) For UPS system – UPS-1 incomer shall be fed from EPMC/EPCC, whereas UPS-2 & SVR (bypass) shall be fed from PMCC/PCC.*** ***b) For DC system (switchgear control & critical lighting) – charger-1 shall be fed from EPMC and charger-2 shall be fed from PMCC/PCC.***
4.6	Clause 4.15.2 Plant Communication System The subject clause gets modified as "Each exchange shall be designed to have at least 20% spare capacity"
4.7	Clause 4.15.4 Plant Communication System Add a new clause as "Call station shall have min 4 keys. One for master, one for slave to slave and two spare."
4.8	Clause 4.16.4 Fire Detection and Alarm System The subject gets modified as "Each panel and each loop / zone shall have at least 20% spare capacity.
4.9	Clause 4.16.7 Fire Detection and Alarm System Add a new clause as "Manual fire call point as per OISD requirement."
4.10	***DELETED***
4.11	***DELETED***

S.No.	Project Philosophy
4.12	Clause 5.3.7 Switchgear In the subject clauses Future load growth of 20% shall be considered instead of 10%.
4.13	Clause 5.3.9 Switchgear The subject clause gets modified as "Circuit breaker / contactors controlling motor feeders shall have a rating of at least 150% of the maximum continuous rating instead of 125% of the connected load."
4.14	Clause 5.3.12 Switchgear Add at the end of the clause "Breaker rating shall be in-panel rating"
4.15	Clause 5.3.14 Switchgear Add at the end of the clause "Motors 55KW and above shall be provided with air circuit breaker having DC control supply for closing and tripping purpose."
4.16	***Clause 5.3.15 Switchgear Add at the end of the clause "1 no. PCC at each substation shall be provided with one 800A feeder on each side to feed construction power supply. The construction power supply module shall be equipped with numerical relay having all necessary protections, energy meter and CBCT with sensitive earth fault protection along with other protection. However, these feeders shall not be considered in transformer sizing."***
4.17	Clause 5.3.16 Switchgear The subject clause gets modified as "For ALL motors, CT in Y phase shall be provided in switchboard for remote metering."
4.18	Clause 5.3.17 Switchgear Add at the end of the clause " ACBs/MCCBs/Switches of I/Cs & B/C of MCC, ASB, LDB & ELDB shall have 4 poles".
4.19	Clause 5.3.19 Switchgear Add a new clause "In HV switchgear, horizontal bus bar size in the complete board shall be of same size. Similarly size of the bus bar from horizontal bus to breaker and breaker to outgoing shall be designed based on breaker rating and not on CT/feeder rating."
4.20	Clause 5.3.20 Switchgear Add a new clause "Bus bar material for PCC & MCC shall be Electrolytic grade Aluminium / Copper and Neutral bus bar size shall be same as phase bus bar size."
4.21	Clause 5.4 Bus Duct Add at the end of the clause "Bus bar material shall be Electrolytic grade Aluminium / Copper and Neutral bus bar size shall be same as phase bus bar size."
4.22	Clause 5.7.1 DC Power Supply System The subject gets modified as " ------- DC distribution board. Charger shall be dual redundant type with separate battery set (2 sets with 100% capacity for switchgear protection and control & 1 set with 100% capacity for DC Emergency Lighting) for each charger."
4.23	Clause 5.7.3 DC Power Supply System In the subject clause 20% spare capacity for future load growth shall be considered instead of 10%.
4.24	Clause 5.7.5 DC Power Supply System In the subject clause 20% Spare feeders for future use shall be considered instead of 10%
4.25	Clause 5.8.4 Uninterrupted Power Supply System In the subject clause 20% Spare feeders for future feeders shall be considered instead of 10%.
4.26	Clause 5.8.3 Uninterrupted Power Supply System In the subject clause 20% Spare capacity for future load growth shall be considered instead of 10%
4.27	Clause 5.8.6 Uninterrupted Power Supply System Add a new clause "ACDB shall have current and voltage transducer to give signal to DCS for total current & voltage. Same to be connected to DCS also apart from other UPS alarm."
4.28	Clause 5.11.7 Emergency Generator Add a new clause "The Emergency generator shall have brushless excitation system with PMG & Pilot excitor or rotating diodes."
4.29	Clause 5.11.8 Emergency Generator Add a new clause "In house breaker shall be provided near Emergency generator set for positive isolation.
4.30	Clause 5.11.9 Emergency Generator Add a new clause "Emergency Generator shall have auto/ manual synchronizing facility for trial/ going on load/ offload."
4.31	Clause 5.13.3 and 5.13.4 Cables and Wires In the subject clause XLPE insulated cables shall be considered instead of PVC insulated cables.

S.No.	Project Philosophy
4.32	Clause 5.13.8 Cables and Wires In the subject clause considering 20% future load growth, all incoming cables to switchgear/UPS/DC system/ DB's and other equipment shall be sized instead of 10%. Cable for capacitor banks shall be sized for 135 % of the rated capacitor current.
4.33	Clause 5.13.9 Cables and Wires The subject clause gets modified as "The incoming cable for heat tracing power distribution panel and lighting distribution board shall be with four cores....."
4.34	Clause 5.13.12 Cables and Wires Add a new clause "Outer sheath shall be FRLS for all the cables and wires."
4.35	***Clause 5.13.13 Cables and Wires Add a new clause "For LAN and electronic data transfer, only fiber optic cables shall be used."***
4.36	Clause 5.15.3 Convenience Receptacles The last line of the subject clause gets modified as "..... In hazardous areas as well as in safe areas flameproof hand lamps shall only be rated for 24V & shall be LED based"
4.37	***Clause 5.16.3 Actuators for Motor Operated Valve Add new clause "MOVs shall be installed away from the heat source (radiated heat) so as to avoid failure of electronic cards due to the heat or MOV control shall be away from the heat source. If this is not possible, feasibility of having control unit located at suitable location shall be explored during detailed engineering".***
4.38	***Clause 5.20 Add a new clause "Conformal coating shall be done for all PCB, electronic equipment as per min. Class 3C2 (Harsh environment) of IEC 60721-3-3. Alternatively, it shall comply with ANSI/ ISA S71.04 class G3 or IEC 60068-2-60 for mixed flow gas test or ASTM B845. Supporting documents shall be provided for the same"***
4.39	Clause 6.5 Substation / MCC Room Design Philosophy In the subject clause instead of rolling shutter door MS door in two parts shall be provided.
4.40	Clause 6.8 Substation / MCC Room Design Philosophy The subject clause gets modified as "------ Light fittings in this room shall be flameproof LED type. -------The battery room shall be provided with minimum two nos. flameproof exhaust fans..... No switches shall be provided inside the battery room."
4.41	Clause 6.9 Substation / MCC Room Design Philosophy Add at the end of the clause "Excitation panel, Digital voltage regulator panels & PLC based thyristor control panel shall also be located in air conditioned room."
4.42	Clause 6.11 Substation / MCC Room Design Philosophy The last line of clause gets modified as "Fire protection for transformers and switchgear room shall be provided to comply with the requirements of OISD-STD-116,117, 173 and as per latest CEA rules."
4.43	Clause 7.1 Installation Design Philosophy The 2nd line of the subject clause gets modified as ".... Shall generally conform to EIL/BPCL standard specifications and installation standards".
4.44	***Clause 7.2.1 Cabling System at the end of the clause following shall be added "Preferably, total cable route connected to fire water pump/motors starting from receiving substation to Fire water pump house shall be through a built-in RCC cable trench"***
4.45	Clause 7.2.2 Cabling System In the 2nd line of the subject clause instead of sand, trenches in hazardous areas shall be filled up with stone dust.
4.46	***Clause 7.2.5 Cabling System In the 1st line of the subject clause instead of 10%, 20% space for future cables shall be considered on cable trays, racks and trenches.***
4.47	***Clause 7.3.6 Earthing System Add new bullet point, All values shall comply to latest revision of OISD Std. – 137.***

S.No.	Project Philosophy
4.48	Clause 7.3.12 Earthing System Add a new clause "If required/ suggested by the original equipment manufacturer of electronic equipment"s like UPS, Excitation voltage regulator, Numerical Relays, LCP etc. dedicated clean earth shall be provided by having dedicated earth pits."
4.49	Clause 7.4.5 Lighting System The 3rd last line of the subject clause gets modified as "Adequate number of self contained flameproof portable hand lamps and battery operated....."
4.50	***Clause 7.4.8 Lighting System The subject clause gets modified as ".....Tall structure shall have aviation obstruction LED based lighting as per statutory requirements."***
4.51	***Clause 5.16.4 Actuators for Motor Operated Valve Add new clause "All MOV actuators shall be non-intrusive type."***
4.52	***Clause 5.16.5 Actuators for Motor Operated Valve Add new clause " Fire safe Electric Actuators shall be provided with Intumescent paint for fire proofing and same shall be suitable for 30 minutes. Fire Proofing shall be ensured as per UL-1709 for hydrocarbon fire."***
4.53	Clause 5.3.8 Switchgear : The subject clause gets modified as "Spare outgoing feeders shall be provided in all switchgear. For HV switchboards, the number of spares shall be as indicated in SLD. For other switchboards (and where not specifically indicated in SLD), at least one number of each type of outgoing feeder or 20% of each type of outgoing feeder, whichever is more, shall be provided as spare in the switchboard."
4.54	Clause 5.13.4 Cables and Wires : The subject clause gets modified as "The control cables shall be twisted pair, copper conductor, XLPE insulated, armoured, extruded FRLS PVC outer sheathed and individual & overall shielded. Control cables with twisted pair and shielding shall also be provided for specialized applications i.e. for CT secondary current, differential protection, restricted earth fault protection, etc."
4.55	***Clause 5.13.10 Cables and Wires : The subject clause gets modified as "All control cables shall have minimum 10% spare pairs, except that control cables having up to seven pair shall have one pair as spare."***
4.56	Clause 4.16.1 Fire Detection and Alarm System Add at the end of the clause "The system shall be connected to nearest control room and fire station control room through redundant fibre optic network. FA panel shall have Modbus connectivity features for interfacing with DCS system in lieu of repeater panel".
4.57	Clause 5.3.17 Switchgear In the subject clauses maximum rating of bus-bars 800A for ASB/LDB/ELDB shall be considered instead of 1250A.
4.58	Clause 5.14.4 Control station Add a new clause as "Stop Push button shall have provision of putting LOTO locks and padlocks."
4.59	Clause 5.10.1 HV Capacitor Banks Add at the end of the clause "Dry type series reactor shall be used for capacitor banks. Dry type series reactor shall not be integrated with capacitor cubicle and shall be separate standalone panel."
4.60	***Clause 5.14.1 Control station Add at the end of the clause "For air cooler motors, Emergency stop push button station shall have ammeter and stop push button at grade level."***
4.61	Clause 5.16.6 Actuators for Motor Operated Valve Add new clause "MOVs shall be explosion proof and suitably fire rated of 1100 deg. C for 30 min duration."
4.62	Clause 6.15.j The subject gets modified as "Battery rack to wall clearance for Single row, single/double tier & Double row, single tier as 750mm instead of 100mm.

S.No.	Project Philosophy
4.63	***Clause 4.1 System Design Philosophy, Add at the end of the clause " "All motors efficiency class shall be IE3 (for Hazardous area) / IE4 (safe area). Distribution transformer upto 2500 kVA shall be minimum energy efficiency level 2 / Table-3 of GOI notification dtd 08 Dec 2023, BEE star rating 2 (including latest GOI notifications). All lighting fixtures shall be LED type. Intelligent MCC (i-MCC) shall be considered for MV switchboards (draw-out type).***
4.64	***Clause 4.4.1 Capacity of Electrical system, Add at the end of the clause "Electrical system shall be designed to suit single feeder operation. However in case of three incomers any two incomers shall be able to take full load of the system."***
4.65	Clause 4.10.1 Protection and Metering Schemes, Add sr. no. "d) Type 2 coordination for LV system shall be ensured"
4.66	Clause 4.11.1 DC Power Supply, Add at the end of the clause "Critical Lube oil pumps of generators/ critical equipment or as specified by OEM/Process Licensor."
4.67	cl. no. 4.19: Add the following: For Existing refinery revamp - New ECS & EMS system shall be considered of same make as existing system. OEM basis. For Petchem - Separate new ECS & EMS system shall be considered. The same need not be on OEM basis.
4.68	Clause 4.6.1 (Note-2) shall be replaced with the following "In case of difficulty in achieving specified voltage drops in cables up to lighting panel, total 5% drop from Auxiliary switchboard/ LDB up to lighting points may be permitted".
4.69	New cl. no. 5.3.19: Add "LOTO facility shall be provided in switchgear."
4.70	cl. no. 4.15: Add the following: For Existing refinery revamp - New Plant communication system shall be considered of same make as existing system. OEM basis. For Petchem - Separate new Plant communication system shall be considered. The same need not be on OEM basis.
4.71	cl. no. 4.16: Add the following: For Existing refinery revamp - New Fire alarm system shall be considered of same make as existing system. OEM basis. For Petchem - Separate new Fire alarm system shall be considered. The same need not be on OEM basis.
4.72	cl. no. 5.7.1: Add the following "DC system for switchgear control: refer attached sketch (option-II), however the battery bank shall be 2x100%. DC system for Lighting: Refer attached sketch (option-II), with 1x100% battery bank."
4.73	cl. no. 5.8.1: Add the following "UPS system shall be as per attached sketch (option-III), however the battery bank shall be 2x100%"
4.74	cl. no. 5.11.5: replace the following "The Emergency generator set shall have at least 20% spare capacity for meeting future requirements"
4.75	cl. no. 6.15: Add sl. no. o as "Spacing between the two LT panels where the breakers are mounted shall be minimum 2 meters."
4.76	New cl. no. 6.22: Add "SLD of HT board shall be painted behind the HT board indicating the bus bar arrangement."
4.77	New cl. no. 6.23: Add "All the modules shall have stickers (Yellow background with black letters) or letter painting indicating KW, cable size, FLC at front and back for HT and front for LT. A bigger size sticker having list of motor tag nos. and module no. shall be pasted on both side of the panel end covers"

S.No.	Project Philosophy
4.78	New cl. no. 6.24: Add "All spare cut outs in sub-station floor shall be properly marked and flushed with floor level"
4.79	New cl. no. 6.25: Add "Spare entries in panels, gland plates shall be blocked to avoid dust and vermin ingress."
4.80	New cl. no. 6.26: Add "Insulation paint (epoxy coating) shall be applied in substations as per the highest system voltage in respective substations subject to market availability."
4.81	New cl. no. 6.27: Add "All HT tools, First aid Box etc. shall be provided and located at an earmarked place in sub-station and labelled."
4.82	New cl. no. 6.28: Add "Two nos. (min.)gas masks shall be provided conspicuously and installed and maintained at accessible places for use in the event of fire or smoke."
4.83	New cl. no. 6.29: Add "Fire buckets filled with clean dry sand and ready for immediate use for extinguishing fires in addition to fire extinguishers suitable for dealing with fires, shall be conspicuously marked and kept in all generating stations, enclosed sub- stations and switching-stations in convenient location."
4.84	New cl. no. 6.30: Add "In every manned generating station, sub-station or switching station of voltage exceeding 650 V, an artificial respirator shall be provided and kept in good working condition"
4.85	New cl. no. 6.31: Add "Instructions, in English or Hindi and the local language of the District and where Hindi is the local language, in English and Hindi for the resuscitation of persons suffering from electric shock, shall be affixed; in a conspicuous place in every generating station, enclosed sub-station, enclosed switching station"
4.86	***New cl. no. 6.32: Add "415V, 400A DB (FLP) total 4 nos. shall be provided at suitable locations in each process unit of petchem in consultation with BPCL. It is proposed to take the supply source for this DB from the ASB/EPCC of same substation having DG backup."***
4.87	New cl. no. 6.33: Add "10/20 Pairs telephone cable shall be laid from nearest existing telephone JB to the plant end (for Hazardous area - analogue telephones)"
4.88	New cl. no. 6.34: Add "All new substations shall be connected to MRS through fibre optic cable network. FO cable laying can be planned along with Power cable from MRS. All interfacing shall be through OFC cables such as differential protection, inter-tripping & ECS connectivity etc."
4.89	New cl. no. 6.35: Add "Fire proofing of all substation entries for cable / bus duct shall be done."
4.90	cl. no. 7.2.3: In the statement "30 m" shall be read as "15 m"
4.91	cl. no. 7.2.14: Add the following after the statement "GI cover shall be considered for top most cable tray and bottom of the lowest cable trays shall also be covered with GI sheet. GI type sheet shall be selected based on the type of cable trays. Tray cover shall be provided for the outermost trays of vertical droppers."
4.92	cl. no. 7.4.12: The statement shall be read as "Lighting system design shall be based on minimum illumination levels as specified in latest PNGRB guidelines"

5.0 OWNER / CLIENT SPECIFIC REQUIREMENTS

5.1 SITE CONDITIONS

S.No.	Description	Selected Option	Available Options
1	Equipment design temperature	45 DEG C	a)40 DEG C b)45 DEG C c)50 DEG C d)Any other
2	Relative humidity	86%	

S.No.	Description	Selected Option	Available Options
3	Soil Resistivity	As per soil investigation report	
4	Minimum temperature. for battery sizing	10 DEG C	a)10 DEG C b)20 DEG C c)Any other
5	Minimum temperature For Electric heat tracing	1.1 DEG C	
6	Altitude above mean sea level	Less than 1000m above MSL	a)Less than 1000m above MSL b)Any Other
7	Maximum temp	48 DEG C	
8	Minimum temp	1.1 DEG C	
9	Pollution level for outdoor equipment	Heavy	a)Light b)Medium c)Heavy d)Very heavy

5.2 POWER SOURCE DETAILS

S.No.	Description	Selected Option	Available Options
1	Power System	220kV system (Independent system) For Petchem. 33kV System for BINA Refinery.	a)Grid Supply b)In house CPP c)Grid supply with CPP d)Existing electrical system
2	Grid Supply	220kV from MPSEB for PETCHEM.	a)Yes b)No (Below Clause is not applicable)
2.1	Name of sub station	***400kV MPPTCL substation Bina***	
2.2	Number of feeders	***2 circuits (DCDS)***	
2.3	Length of feeder	***21 KM***	
2.4	Type /size of conductor/ cable size	* __ sqmm	
2.5	Voltage	220 kV ± 10%	
2.6	Frequency	***50 Hz ± 5%***	
2.7	Maximum fault level		*
2.7.1	3 Phase fault	***12615.04 MVA***	
2.7.2	1 Phase fault	***10739.69 MVA***	
2.7.3	X/R Ratio	*	
2.8	Minimum fault level	* kA, sec.	
2.9	Design fault level	50 kA for 3 sec.	
2.10	Basic Insulation Level	460 kV / 1050 kV	
2.11	System neutral Earthing	Solid Grounded	
2.12	Parallel operation of incomers	Yes*	a)YES b)NO
2.14	PLCC requirement	Yes	a)YES b)NO
3	CPP and its configuration		
3.1	Type of Generator	STG	a)STG b)GTG
3.1.1	Number of Generators	REFER CPP DESIGN BASIS	

S.No.	Description	Selected Option	Available Options
3.1.2	Rating of Generator/Voltage/P.f	REFER CPP DESIGN BASIS	
3.1.3	Requirement of Generator Circuit Breaker	No	a)YES b)NO
3.2	Parallel operation with grid	Yes*	a)YES b)NO
3.3	Black Start DG Envisaged	As per CPP Design Basis	a)YES b)NO
3.4	Electricity duty metering	*	a)YES b)NO
4	Existing System	220kV Grid with Internal Generation	
4.1	Name of Substation	Existing Substation	
4.2	Voltage rating	33 kV	
4.3	Maximum fault level	*	
4.4	Design fault level	40 kA for 1 sec.	
4.5	System neutral earthing	Solid earthed	
4.6	NGR rating (if applicable)	Not Applicable	
5	Emergency generator	Centralised (REFER NOTE-1)	a)Centralised b)Distributed
5.1	Generator Voltage	6.6kV	a)6.6KV b)415V c)Any Other
5.2	Parallel operation with other sources	Momentary Paralleling However during load trial, continuously paralleling with grid is also envisaged.	a)Momentary Paralleling b)Continuously Paralleling
5.3	Auto Starting	Yes	a)YES b)NO
5.4	Type of Emergency Generator	*	a)Diesel b)Gas
6	Solar Power System		
6.1	Solar PV System	Provided	a)Provided b)Not provided
6.2	Buildings on which solar power system to be mounted	Non Plant Building, Admin Building. Further Sub-station, Control Room & Warehouse not associated with Process Units	
6.3	Technology	Silicon Crystalline (Mono/Poly)	a)Silicon Crystalline Mono b)Silicon Crystalline Poly c)Silicon Crystalline (Mono/Poly)
6.4	Battery	Not Provided	a)Provided b)Not Provided
6.5	Connectivity	Local Switchboard	
6.6	Monitoring System	Data logger based connection to SAS	a)Data logger based connection to SAS b)Internet web based with HMI

**** - New Power System selection option shall be finalised after detailed study by MPPPTCL.***

Note:-

1. The rating and Qty. of emergency Generator sets shall be finalized during detailed engineering.The emergency Generator set for the plant shall cater to emergency loads of various units,utility and offsite areas.

2. Based on Process Licensor/ Flare Loading, the emergency generator option (distributed / centralized) shall be selected during detail engineering. However, preferred option shall be centralized Emergency generator with black start facility.

3. For Bina refinery power distribution is 33KV & 6.6 KV level from Existing substation. For new refinery unit loads, Power distribution will be 33KV & 6.6 KV.

4. Power factor correction with APFC control shall be at 6.6kV bus. Exact value of Power factor at load centre & grid connection shall be ascertained during detail engineering.

5. Location of solar inverter: Installed in switchgear hall either floor or wall mounted as per site condition as suggested by PMC/EPCM.

6. Power distribution for the new petchem complex shall be as below:
a) Normal power - through 220kV Grid
b) Emergency power - through Diesel generator (DG)
c) Critical/Most Essential power - Being fed from existing CPP having existing grid backup.

5.3 POWER SUPPLY DISTRIBUTION SYSTEM

5.3.1 VOLTAGE AND FREQUENCY VARIATION

S.No.	Description	Selected Option	Available Options
1	AC System		
1.1	Voltage	For Bina Refinery 33kV/6.6kV/415V ± 10% For Petchem 220kV/66kV/6.6kV/415V ± 10%	a) 11kV/6.6kV/415V ± 10% b) 33kV/6.6kV/415V ± 10% c) 66kV/6.6kV/415V ± 10% d) 66kV/11kV/415V ± 10% e) Other
1.2	Frequency	***50 Hz ± 5%***	a)50 Hz ± 3% b)60 Hz ± 3%
2	DC System		
2.1	Electrical protection and Control system	110V ± 10%	a)220V ± 10% b)110V ± 10%

S.No.	Description	Selected Option	Available Options
2.2	DC critical Lighting system	110V ± 10%	a)220V ± 10% b)110V ± 10%
2.3	Instrumentation Power Supplies	Refer Instrumentation Design Basis	

Note:
1.0 Refer section 5.6.10 of this document for design voltage/frequency variation for motors.

2.0 110 V DC control supply shall be considered for 220 KV GIS substation at Petchem and for all other substations.

5.3.2 UTILISATION VOLTAGE

S.No.	Description	Selected Option	Available Options
1	Primary EHV/HV distribution voltage	33kV (For Bina Refinery) 66kV (For Petchem)	a)33kV b)66kV c)11kV d)Any other
2	Secondary HV distribution voltage	6.6kV	a)11kV b)6.6kV c)3.3kV d)Any Other
3	Primary EHV/HV distribution system neutral Earthing	Solidly Earthed	a)Solidly Earthed b)NGR c)Unearthed
4	Secondary HV distribution system Neutral Earthing	NGR	
5	HV motor voltage for DOL	6.6kV (For motors rating > 132kW)	
6	MV motor voltage	415 V AC (DOL)(For motors rating 0.18<=kW<=132)	
7	AC Motors	240V AC (except MOVs) (For motors rating < 0.18kW)	
8	DC Motor	110V DC (if required)	
9	Motor operated valves	415V AC, TP	
10	Battery chargers incoming power supply	415V AC,TPN	
11	UPS System incoming power supply	415V AC,TPN	
12	AC Lighting/Power Panels	415V AC,TPN (incoming power supply)	
13	Auxiliary Boards incoming power supply	415V AC,TPN	
14	Welding Receptacles	415V AC,TPN	
15	Electrical heaters	415V AC, TP	
16	Normal Lighting/Emergency Lighting	240V AC,SPN	
17	LAN UPS Output Voltage	***230V AC,SPN***	

1. Utilisation Voltage for Convenience outlets shall be 240 VAC, SPN.

2. For higher rated motors such as MAB, WGC etc.(in ECU) & Extruder (in PPU/LLDPE) etc, input supply shall be provided at 66kV level respectively which will be step-down to suitable voltage level for feeding respective motors.

3. Contactor shall close satisfactorily at any value between 85 % and 110 % of their rated control supply voltage. The limits between which contactors shall drop out and open fully shall be between 75 % to 20 % for a.c. The drop off voltage shall be governed by following criteria and same shall be finalized during detailed engineering:-Process critical motors/Electrical system stability.

4) The above S. no. 5 & 6 are related to DOL motors. For VFD fed motors refer Cl. no. 5.6.15.

5) following new subclauses for utilisation voltage shall be added as:
a) Rim seal UPS : 230V AC, SPN
b) Weigh bridge: 230V AC, SPN

5.3.3 UTILISATION VOLTAGE FOR CRITICAL SUPPLIES

S.No.	Description	Selected Option	Available Options
1	Switchgear protection control power supply	110V DC (Note-1)	a)220V DC b)110V DC
2	Critical lighting power supply	110V DC	a)220V DC b)110V DC
3	Input power supply for Plant communication system	240V AC SPN (With Dedicated battery back up)	a)240V AC SPN (With Dedicated battery back up) b)110V AC UPS
4	Input power supply Fire alarm system	240V AC SPN (With Dedicated battery back up)	a)240V AC SPN (With Dedicated battery back up) b)110V AC UPS
5	Power supply for electrical annunciation panel	Not Applicable	a)220V DC b)110V DC
6	Control supply for VFD/ Soft-Starter/ Thyristor Panel	230V AC UPS	a)110V DC b)220V DC c)110V AC UPS d)230V AC UPS
7	Normal Instrumentation power supply	Refer Instrumentation design basis	
8	Critical instrumentation power supply	Refer Instrumentation design basis	
9	Instrumentation Shut-down system power supply	Refer Instrumentation design basis	
10	DC system for lighting and switchgear control	Separate	a)Separate b)Common

Notes: 1.
110 V DC control supply shall be considered for 220 KV GIS substation at Petchem and for all other substations.

5.3.4 SYSTEM NEUTRAL EARTHING

S.No.	Description	Selected Option	Available Options
1	EHV System	Solid earthed	a)Solid earthed b)Resistance earthed
2	HV System	6.6kV (Resistance earthed) 33kV (Solid earthed)	a)Solid earthed b)Resistance earthed c)Unearthed
3	415V System	Solid earthed	a)Solid earthed b)Resistance earthed
4	GT/ST Generator with generator transformer	NGT	a)NGT b)NGR c)Solid earthed d)Unearthed
5	GT/ST Generator without generator transformer	Not Applicable	a)NGT b)NGR c)Solid earthed
6	Emergency Generator-HV System	NGR	a)NGT b)NGR c)Solid earthed
7	Emergency Generator-415V System	Solid earthed	a)Solid earthed b)Resistance earthed
8	NGR rating- HV System	___A	
9	NGR rating- 415V System	___A	

5.3.5 OPERATING PHILOSOPHY

S.No.	Description	Selected Option	Remarks
1	Auto/Manual transfer at primary distribution voltage bus with momentary paralleling	YES (continuous parallel operation)	a)NA b)YES c)NO
2	Auto/Manual transfer at secondary distribution voltage bus with momentary paralleling	Yes (Continuous parallel operation)	a)YES b)NO
2.1	Bus transfer scheme	Normal	a)Fast b)Normal c)NA
3	Auto /Manual transfer at MV with momentary paralleling		
3.1	At PCC/EPC/EPMCC Level	Yes (Note-1)	a)YES b)NO c)OTHER
3.2	At MCC Level (In case ACB incomers and Bus couplers)	Not Applicable (Note-2)	a)YES b)NO c)OTHER
3.3	At ASB/ LDB Level	No (including MCC level)	a)YES b)NO c)OTHER
4	Continuous Parallel operation of Incomers		
4.1	Primary EHV/HV voltage	Yes for 220kV & 66 kV GIS switchboards at Petchem & 33kV GIS switchboards at Bina Refinery.	a)YES b)NO

S.No.	Description	Selected Option	Remarks
4.2	Secondary HV voltage	Yes	a)YES b)NO
4.3	PCC/PMCC	No	a)YES b)NO
5	Power Factor Correction	Required	
5.1	Power factor improvement capacitors- location	6.6kV bus with APFC	a)6.6kV bus b)415V c)Both 6.6kV & 415V d)Any other
5.2	Minimum P.F. to be maintained at Power Transformer Primary at respective sub-station	***Refer Note-4 below***	a)0.95 b)0.90
5.3	Monitoring at Power Transformer Primary at respective sub-station	Yes	a)YES b)NO
6	Load shedding	Yes (Note-3)	a)YES b)NO
6.1	Voltage level for Load Shedding	For Bina refinery 33kV, 6.6kV For Petchem 66kV, 6.6kV	a) 66kV b) 33kV c) 11kV d) 6.6kV e) 0.415kV - PCC/PMCC incomer f) Any Other

Notes:-
1. Auto changeover logic/ABT is not envisaged in normal (GRID power) EHV, HV, MV, LV switchboards. However, for Emergency DG switchboard (EPCC/EPMCC etc.) shall have the facility of auto changeover/ABT.

2. Manual Transfer shall be considered for MCC switchboards.

3. Voltage level for Load Shedding shall be 66KV,33 KV,415V). Load shedding at 415V-PCC/EPCC level shall be 415V switchboard (I/C-ACB, B/C-ACB and outgoing ACB feeders).

4. Power factor 0.99 (min.) - at Grid transformer primary
Power factor 0.995 (min.) - at 6.6kV switchboard

5.4 CONTROL-PROTECTION - METERING

5.4.1 CONTROL PHILOSOPHY

S.No.	Description	Selected Option	Available Options
1	Location of Relays for Generator	Separate Relay and Control Panel	
2	Location of Relays for Outdoor Switchyard	Not Applicable	
3	Location of Protection relays for EHV/HV switchgear		

S.No.	Description	Selected Option	Available Options
3.1	Primary voltage EHV/HV switch gear	***On switchgear (33kV at Bina refinery switchboards)*** ***Bay controller and separate Relay & control panel for 220kV GIS & 66kV GIS in Petchem***	a)On switchgear b)Separate relay and control panel
3.2	Secondary Voltage HV switchgear	On 6.6kV switchgear	a)On switchgear b)Separate relay and control panel
4	EHV/HV Switchgear control		
4.1	Generator	Control Relay Panel	a)Control Relay Panel b)SCAP c)ECS
4.2	Outdoor Switchyard	Not Applicable	a)Control Relay Panel b)SCAP c)ECS (for breaker)
4.3	Primary voltage EHV/HV switch gear	***On switchgear (for 33kV at Bina Refinery switchboards)*** ***Separate Relay & control panel (for 220kV GIS & 66kV GIS in Petchem Project)***	a)On switchgear b)SCAP (for breaker) c)Separate relay and control panel
4.4	Secondary Voltage HV switchgear	On 6.6kV switchgear	a)On switchgear b)Separate relay and control panel c)ECS
5	Numerical Protection/Monitoring system for		
5.1	Generators	Yes	a)YES b)NO
5.2	EHV system	Yes	a)YES b)NO
5.3	HV Switchboard	Yes	a)YES b)NO
5.4	PMCC/PCC	Yes	a)YES b)NO
5.5	MCC (for incomer and bus coupler having ACB)	Yes & IMPR relay for motor feeders upto 45kW.	a)YES b)NO
6	Control and logic through numerical relays	Yes (Note-3)	a)YES b)NO
7	Hardwired synchronization control panel-SCAP	Yes	a)YES b)NO
7.1	Synchronizing trolley required	Yes	a)YES b)NO
7.2	Type of Panel	*	a)Mosaic b)Simplex
7.3	Extent of Coverage on SCAP	*	
8	Type of annunciation panel	Not Applicable	a)HMI b)Part of SCAP

S.No.	Description	Selected Option	Available Options
9	Load shedding panel	Yes (Part of ECS with RTU)(Note-5)	a)Part of ECS b)Separate PLC c)Hardwired
10	Method of motor starting		
10.1	HV Motors	DOL (above 132kW). VFD controlled soft starter shall be considered. if required depending upon motor rating (Note-1)	a)Direct on line (Note-1) b)Auto transformer c)Voltage Controlled Soft starter d)V/F Soft starter e)Dedicated transformer 2 MW and above
10.2	MV Motors	DOL upto 132 kW motor rating (Note-1)	a)Direct on line b)V/F Soft starter c)Voltage Controlled Soft starter
11	Starting MVA limitation conditions for Motors		
11.1	HV Motors	***Starting current 500% (inclusive of positive tolerance) of full load current (Note-2)***	
11.2	MV Motors	As per IS-12615-2018/IEC 60034-30	

**** To be decided during detail engineering.***

Notes:

1. V/F controlled soft starter shall be considered for starting large HV motors if essential/unavoidable as per system design requirement/equipment design limitation based on power system study.

2. Lower starting current shall be specified if required based on motor start-up study.

3. STOP signals shall be directly hardwired. However, start and DCS permissive signals shall be routed through numerical relay for time stamping & monitoring. this will also reduce wiring within the switchboards. All status signals to DCS shall be through ECS on Modbus TCP IP protocol except critical process signals used in interlocking which shall be hardwired and to be decided during detail engineering.

4. Separate On, Off, Spring Charged, Trip Circuit Healthy, Process Trip, Breaker in Test, Breaker in Service indication lamps required.

5. Voltage level for Load Shedding shall be 66KV,33 KV,415V). Load shedding at 415V-PCC/EPCC level shall be 415V switchboard (I/C-ACB, B/C-ACB and outgoing ACB feeders).

6. In case of VFD/Soft starter, starting current shall be limited to 100% of FLC.

5.4.2 POWER ISOLATION FOR TRANSFORMERS LOCATED REMOTELY AWAY FROM EHV/HV SUBSTATION

S.No.	Description	Selected Option	Available Options
1	Push button in transformer bay for tripping remote breaker	Yes (Break glass type)	a)YES b)NO
2	Local Primary isolating breaker	Standalone breaker (Indoor type) in respective substation.	a)YES b)NO
3	Protection relay required	Only feeder differential at receiving end.	a)YES b)NO

5.4.3 RELAY PROTECTION SYSTEM

5.4.3.1 PROTECTION DEVICES FOR POWER DISTRIBUTION SYSTEM

Protection devices for power distribution system shall be as indicated below -
(Figure inside bracket refers to note below)
(YES - Applicable)

S.No.	Relay Description	Relay No.	HV Transformer Feeder - Sec. Winding Volt=>3.3kv	HV Transformer Feeder - Sec. Winding Volt<=0.433kv	HV Motor Feeder	Outgoing Breaker Feeder - HV Plant Feeder	Outgoing Breaker Feeder - MV PCC/PMCC	Incomer - EHV/HV	Incomer - MV PCC/PMCC
1	IDMTL over-current relay	51	YES	YES	-	YES	YES	YES (1)	YES
2	IDMTL earth-fault relay	51N	YES(2)	YES	-	YES	YES	YES (1)	YES
3	51G backup earth-fault relay (Earthed neutral)	51G(11)	YES(23)	YES(23)	-	-	-	-	-
4	Motor protection relay with (50, 50N,46, 49, 50L/R,86,95)	99	-	-	YES(3)	-	YES(3)	-	-
5	Instantaneous restricted earth-fault relay (Earthed side)	64R(11)	-	-	-	-	-	YES(24)	YES(24)
6	Instantaneous over-current relay	50	YES	YES	-	-	-	-	-
7	Instantaneous earth-fault relay	50N	YES(4)	YES	-	-	-	-	-
8	Differential protection relay	87	YES(5)(16)	YES(16)	YES(6)(16)	YES(7)(16)	-	YES(16)	-

S.No.	Relay Description	Relay No.	HV Transformer Feeder - Sec. Winding Volt=>3.3kv	HV Transformer Feeder - Sec. Winding Volt<=0.433kv	HV Motor Feeder	Outgoing Breaker Feeder - HV Plant Feeder	Outgoing Breaker Feeder - MV PCC/PMCC	Incomer - EHV/HV	Incomer - MV PCC/PMCC
9	High speed tripping relay	86(20)	YES	YES	YES	YES	YES	YES	YES
10	Trip circuit supervision relay	95(20)	YES	YES	YES	YES	YES	YES	YES
11	Transformer auxiliary relay	63	YES	YES	-	-	-	-	-
12	Under-voltage relay with timer	27/2	-	-	YES	-	-	YES(9)	YES(9)
13	Check synchronisation relay	25	-	-	-	-	-	YES(10)	YES(10)

5.4.3.2 POWER GENERATION AND EXTERNAL POWER SUPPLY

Minimum protection relays for Synchronous generator (GTG/STG), generator transformer Grid power supply incomer and Synchronous motors shall be as follows:
(YES - Applicable)

S.No.	Relay Description	NEMA Code	Generator	Generator Transformer	EHV Incomer	EHV Transformer	Syn. Motor
1	Distance protection	21	YES		YES		
2	Synchronous check	25	YES(27)	YES	YES		
3	Under voltage with timer	27	YES		YES		YES
4	Reverse power	32	YES				YES
5	Low power flow	37	YES				
6	Loss of excitation	40	YES				YES
7	Negative sequence	46	YES				YES
8	Over current	50				YES	YES

S.No.	Relay Description	NEMA Code	Generator	Generator Transformer	EHV Incomer	EHV Transformer	Syn. Motor
9	Earth fault relay	50N				YES	YES
10	Over current	51			YES	YES	
11	Voltage restrained	51V	YES	YES			
12	Earth Fault back up	51G	YES	YES		YES	
13	Over current E/F	51N		YES	YES	YES	
14	Over voltage with timer	59	YES		YES		YES
15	VT failure	60	YES				YES
16	Auxiliary relay for transformer	63TX		YES		YES	
17	Transformer Restricted Earth Fault	64R	YES(26)	YES		YES	
18	Stator back up earth fault	64G	YES				
19	Generator Rotor Earth fault	64R	YES				YES
20	Directional O/C	67			YES		
21	Directional E/F	67N			YES		
22	Under frequency and df/dt	81	YES		YES		YES
23	Tripping relay	86	YES	YES	YES	YES	YES
24	Gen differential	87G	YES				
25	Gen and Transformer differential	87GT		YES			
26	Transformer differential	87T		YES		YES	
27	Feeder differential	87F				YES	
28	Bus bar differential and check	87B/ 87CH		YES			
29	Trip circuit supervision	95	YES	YES	YES	YES	

S.No.	Relay Description	NEMA Code	Generator	Generator Transformer	EHV Incomer	EHV Transformer	Syn. Motor
30	Dead bus charging relay	98	YES(27)	YES	YES		
31	Over fluxing	99	YES	YES(28)			
32	Out of step	78	YES				YES
33	Thermal overload relay	49G	YES				
34	Local breaker backup protection	50LBB	YES				

5.4.3.3 RELAY PROTECTION PHILOSOPHY

S.No.	Project Philosophy
1	In case of HV switchboards with continuous parallel operation of incomers, following additional relays shall be provided: a. One set of 87B (Bus differential) and 95 B (Bus wire supervision) for each bus section. b. 67 and 67N (Directional IDMTL over current and earth fault) relays for the incomers.
2	Instantaneous earth fault (50N) shall be provided only for transformer with delta primary.
3	For breaker fed motor feeders. Relay 50 shall not be provided for contactor controlled feeders.
4	Directional IDMTL earth fault (67N) shall be provided for transformer with star primary.
5	For transformers rated 5 MVA and above.
6	***For motors rated 1200 kW and above, excluding VFD fed motors.***
7	For critical/long feeders and plant feeders connected to main power generation and distribution bus. A plant feeder implies outgoing feeders from one switchboard to another switchboard of same voltage level.
8	***Trip circuit supervision relay 95 shall be provided separately and NOT as part of the numerical relay for HV/ MV feeders wherever numerical relays are provided.***
9	Wherever auto-transfer feature is provided
10	For switchgears where continuous or momentary paralleling of Incomers is envisaged, check synchronising relay shall be provided.
11	51G and 64R relays for input transformer of VFD system shall be decided by VFD Manufacturer.
12	The bus tie feeders in HV switchboards shall be provided with 51, 51N, 86 and 95 relays.
13	HV capacitor bank feeders shall be provided with 51, 51N, 59 (over voltage), 60 (Neutral displacement), 86 and 95 relays.

S.No.	Project Philosophy
14	The following feeders shall be provided with timers for delayed tripping on bus under voltage while the under voltage relay shall be common for the bus a. HV and MV capacitor feeders b. HV and MV breaker controlled motor feeders c. Contactor controlled motor feeders with DC control supply. Numerical relays & iMPR where ever provided for motor and capacitor feeders shall use in built under voltage relay and timer for delayed tripping on bus under voltage.
15	One no. DC supply supervision relay (80) shall be provided for each incoming DC supply to the switchboard.
16	One set of bus differential relays (87B) and bus wire supervision relay (95 B) for each bus section shall be provided for HV switchboards connected directly to generation buses.
17	In case of numerical relays, all relays shall be comprehensive units including all protection, metering and control having communication protocol of IEC 61850.
18	Under voltage and over voltage function along with associated timer shall be part of the numerical relays.
19	***Auto changeover logic/ABT is not envisaged in normal (GRID power) EHV, HV, MV, LV switchboards.*** ***However, for Emergency DG switchboard (EPCC/EPMCC etc.)shall have the facility of auto changeover/ABT.***
20	Tripping relays (86) & Trip Circuit supervision relay (95) shall NOT be part of numerical relay.
21	1 No. of 86 relay and 1 no. Auxiliary relay (VAA type) shall be considered for HV and MV motor rated 55KW and above and it shall be separate and not part of Numerical relays wherever provided. This is required to facilitate quick starting of the motor in case of tripping due to process/instrument interlock. VAA relay for process trip shall be auto reset but flag shall be hand reset type only.
22	Breaker control switch shall be hardwired type.
23	Stand by earth fault relay 51G shall be provided in the outgoing HV transformer feeder.
24	Restricted earth fault relay 64R shall be provided for transformer rating >= 2 MVA in the incomer of switchboard fed from transformers.
25	Relay 51V voltage controlled over current relay shall be provided on specific requirement considering the rating of the outgoing feeders with respect to the Incomer rating. Generally this relay shall be provided wherever CT primary current of outgoing feeders is exceeding 40% of the CT primary current of the Incomer.
26	415V DG set shall be provided with protection but not limited to 51V,51G,40,46,86,95,80,64R etc for generator rated above 500KVA and Generator rated less than 500KVA shall have 51V,51G,40,46,86,95,80 unless otherwise agreed with the owner.
27	For directly connected generator.
28	For large transformer as per manufacturer's standard.
29	Relay 87 and 64R shall be numerical relay and shall not be part of main comprehensive numerical relay. CT for 87 and 64R can be clubbed, as two core of single CT.
30	Stabilizing resistor shall be provided in residual earth fault connection for all motors and transformers even in case of numerical relay to avoid spurious tripping during start up.
31	Feeder differential relay shall be connected with optical fibre cable for communication between two relays.

S.No.	Project Philosophy
32	For transformer feeder, WTI/OTI/Buchholz relay alarm to be connected to hooter so that other can come to know on actuation of these alarms
33	Check zone scheme for bus-differential protection shall be provided wherever bus differential scheme is provided.
34	Process Trip indication on the LV motor feeders with rating less than 55KW with manual reset facility shall be considered. Also, the process trip contactor shall not be dependent on the Reset PB. The logic of process trip shall be independent of Reset PB and Process Trip Indication lamp.
35	Numerical relays shall be used for logic build-up in addition to protection & monitoring provided induced voltage phenomenon is taken care to prevent maloperation of digital inputs(DIs).
36	Interposing relays for all the DI signals from DCS/ PLC in VFD"s/ soft starters shall be considered.
37	***Low impedance-based busbar differential protection scheme shall be considered in 220kV & 66kV GIS***

5.4.4 METERING

5.4.4.1 METERING DEVICES IN EHV, HV AND MV SWITCHBOARDS

The metering devices in EHV, HV and MV switchboards shall be as below:
Type of metering : Analogue/As part of the Numerical relay

(Figure inside bracket refers to note below) (YES - Applicable)

S.No.	Feeder Type	A	V	Hz	PF	MW	MWH	HM	MVAR	MVAH	MVA
1	Grid Incomers	YES	YES	YES	YES	YES(2)	YES	-	YES(2)	YES(2)	YES(1,2)
2	Grid Bus Tie	YES									
3	Grid Transformer	YES				YES	YES				
4	Grid Bus P.T.		YES								
5	EHV/HV Incomer	YES	YES	YES	YES	YES	YES	-	YES	YES	YES
6	EHV/HV Bus Tie	YES	-	-	-	-	-	-	-	-	-
7	EHV/HV Transformer	YES	-	-	-	YES	YES	-	-	-	-
8	EHV/HV Bus P.T.	-	YES	-	-	-	-	-	-	-	-

S.No.	Feeder Type	A	V	Hz	PF	MW	MWH	HM	MVAR	MVAH	MVA
9	EHV/HV Plant Feeder	YES	-	-	-	-	YES	-	-	-	-
10	EHV/HV Motor	YES	-	-	-	-	YES(kWh)	YES	-	-	-
11	EHV/HV Capacitor	YES	YES	-	-	-	-	-	YES	-	-
12	PCC/PMCC Incomer	YES	YES	-	YES	-	YES(kWH)	-	-	-	-
13	PCC/PMCC Bus Tie	YES	-	-	-	-	-	-	-	-	-
14	PCC Bus P.T.	-	YES	-	-	-	-	-	-	-	-
15	ACB Outgoing (Non motor)	YES	-	-	-	-	YES(kWh)	-	-	-	-
16	MV Motor (>55kW)	YES	-	-	-	-	-	-	-	-	-
17	MCC/ASB Incomer	YES	YES	-	-	-	-	-	-	-	-
18	MCCB/SFU O/G(250A)	YES	-	-	-	-	YES(kWh)	-	-	-	-
19	LDB Incomer	YES	YES	-	-	-	YES(kWh)	-	-	-	-
20	DG Set-MV	YES	YES	YES	YES	YES(kW)	YES(kWh)	YES	-	-	-

Notes:

1. MVA meter in EHV external power supply Incomers shall include maximum demand indication also.

2. Separate MW, MVAR, MVA and MVAH meters shall be provided for EHV external power supply Incomers only.

3. Seperate 3 nos. voltmeter and 3 nos. ammeter shall be provided for EHV external power supply incomers.

4. In addition to conventional metering, all metering shall be provided through numerical relay in case respective switchboard is having numerical relay.

5. Field ammeters are to be provided for all motors.

6. Motor feeder shall be provided with 4-20mA current/ voltage/ power dual output transducers (as required) for feedback to DCS.

7. CT has to be 0.2s, burden 15 VA. PT has to be 0.2, burden 50 VA. Main and check energy meter shall be availability based tariff meter, 0.2s class accuracy, with feature of every 15 minutes recording of all the readings. The above is applicable for Petchem, open access power measurement.

8. Communicable Multifunction Meter (MFM) shall be used for metering purpose as per table above for all feeders.

9. Conventional ammeter, voltmeters and communicable multifunction meter shall be considered for all incomers of switchboards (HV/MV/PCC/EPMC/MCC/ASB/LDB).

10. Communicable Multi function meters (MFM) shall be considered with interconnectivity to existing ECS system for Bina Refinery and new ECS system for Petchem.
11. Metering for generator shall be provided as minimum as specified above but not be limited to the same.
12. Ammeter provided at push-button station shall be 240 degree taut band moving coil type. However for smaller rating motor (less than 1 HP), this ammeter can be normal moving iron type.
13. Harmonic meter shall be considered in the incomers of 220kV, 66kV, 33kV, 22kV, 11kV & 6.6kV switchboards/Isolator breaker panels.
14. Metering facility for space heater current of transformer and bus duct shall be provided on Space hater distribution board (DB).
15. Metering facility shall be provided on switchboard panels(Motor Feeder > 22 KW) for Space heater current.

5.4.4.2 METERING FOR GENERATOR AND GENERATOR TRANSFORMER

S.No.	Meter	HV Generator	Generator transformer
1	Ammeter (3 nos.)	YES	YES
2	Voltmeter (3 nos.)	YES	YES
3	MW meter	YES	YES
4	MVAR meter	YES	
5	MVA meter	YES	
6	MWH meter	YES	YES
7	MVARH meter	YES	
8	Power factor	YES	YES
9	Frequency meter	YES	

5.5 SUBSTATION DESIGN

5.5.1 SUBSTATION AUTOMATION SYSTEM

S.No.	Description	Selected Option	Available Options
1	Substation Automation System (SAS)	Required	
2	Communication protocol for relay network	IEC 61850	a)IEC 61850 b)open protocol
3	System architecture	IEC 61850 RSTP	a)IEC 61850 RSTP b)IEC 61850 PRP c)Redundant architecture for other open protocols
4	Data concentrator for SAS	***Not required.***	a)Required b)Not Required
5	Communication with other devices		
5.1	Communication with ECS	Yes	
5.1.1	Protocol for communication with ECS	IEC 61850	a)IEC 61850 b)Modbus
5.2	Communication with DCS	Part of ECS RTU	a)Part of data concentrator b)Part of ECS RTU c)No d)Part of ethernet switch
5.2.1	Communication with DCS-HV Switchboard	Part of ECS RTU	a)Part of data concentrator b)Part of ECS RTU c)No d)Part of ethernet switch
5.2.2	Communication with DCS-PCC/PMCC	Part of ECS RTU	a)Part of data concentrator b)Part of ECS RTU c)No d)Part of ethernet switch
5.2.3	Communication with DCS-Conventional MCC	***Not Applicable***	a)Part of data concentrator b)Part of ECS RTU c)No d)Part of ethernet switch

S.No.	Description	Selected Option	Available Options
5.2.4	Communication with DCS-Intelligent MCC	Part of ECS RTU	a)Part of data concentrator b)Part of ECS RTU c)No d)Part of ethernet switch
5.2.5	Protocol for communication with DCS	Modbus TCP/IP	
5.3	Communication with VFD & UPS	Part of ECS RTU	a)Part of data concentrator b)Part of ECS RTU c)No d)Part of ethernet switch
5.3.1	Protocol for communication with VFD & UPS	Modbus TCP/IP	
6	HMI for SAS	Operator Cum Engineering Workstation	a)not required b)operator cum engineering workstation c)1 operator & 1 engineering workstation
7	Laptop	Common laptop for EHV, HV & MV for each substation with all necessary software.	a)not required b)common for HV & MV for each substation c)seperate for HV & MV for each substation
8	Local storage of data	part of HMI	a)not required (part of ECS) b)part of HMI c)part of data concentrator
9	Relay parameterization	Through numerical relays / laptop & SAS HMI	a)SAS HMI b)ECS HMI

Notes:
1. Dual redundant gateway shall be provided for control/ communication with DCS/ PLC for i-MCC.
2. Communicable multi function meters installed on panels shall have communication facility with open protocol. Energy meter/MFM on panel shall have accuracy class min 0.2.
3. Parameterization and fault record downloading facility shall be provided from Engg. Station.

5.5.2 EHV OUTDOOR SWITCHYARD

S.No.	Description	Selected Option	Available Options
1	Type	220kV EHV GIS substation at Petchem	
2	Type of bus	Double bus bar system	a)String bus b)Tubular bus
3	Structure for outdoor	Not applicable	a)Galvanised b)Painted c)Not applicable
4	Bus material	As per type test design	a)ACSR b)Aluminium

EHV Switchyard shall be read as EHV GIS SUBSTATION

5.5.3 SUBSTATION FEATURES

S.No.	Description	EHV	HV	MV	MCC/Elec. Room
1	Elevated with trays in cable cellar	YES	YES	Yes	***NO***
2	Raised with internal trenches	NO	NO	NO	***YES***
3	All top cable entry with trays below ceiling	NO	NO	NO	NO
4	Pressurisation against ingress of dust	NO	NO	NO	NO
5	Roof slab for				
5.1	Generator Transformer/ Tie transformer	NO	NO	NA	NA
5.2	Power transformer	***YES***	***YES***	***YES***	NO
5.3	Distribution transformer	YES	YES	YES	-
6	Air conditioning with false ceiling of switchgear hall	YES (Note-3)	YES	YES	***YES***
7	EOT Crane in EHV GIS area	YES (Note-2)	NA	NA	NA
8	Lift for substation having 2 Switchgear room floors	YES	YES	YES	NA
9	Electrical maintenance room	YES	YES	NO	NA
10	Electrical store room	YES	YES	NO	NO
11	Separate room for Instrumentation RIO panels	NO	***YES***	***YES***	***YES***
12	Exhaust fans/Ventilation fans for Switchgear room	NO	NO	NO	***NO***

Note :

1. Column HV is defined as Sub-station having full fledged EHV/ HV switchboard.
2. EOT Crane is not envisaged for isolator breaker panels located inside substation building.
3. False ceiling is not envisaged for areas where EHV GIS panels are located.
4. For 33 KV and above rated switchboards, Gas Insulated Switchgear (GIS) with double bus-bar shall be provided. GIS switch board shall have bus tie on each bus and bus-coupler between buses (In all 4 section i.e. Bus 1A / 1B and 2A / 2B).
5. DELETED.
6. Annunciation for tripping of HVAC system shall be provided in DCS.
7. Exhaust fans shall be provided in cable cellar at feasible location.
8. Each substation shall be provided with a toilet and maintenance room outside

switchgear hall (with split AC) which shall have facility for workmen to keep their tools.
9. 20A single phase DP MCB with industrial socket shall be provided at every 20 mtr interval in the switchgear hall.
10. MCC/Electrical room shall be without any power/distribution transformer. Any building with power/distribution transformer shall be considered as substation.

5.5.4 SPECIFIC EQUIPMENT LOCATIONS

S.No.	Description	Selected Option	Available Options
1	Batteries in substation and control Rooms	Separate room	
2	Battery charger in substation	Air conditioned room	a)Air conditioned room b)Non air conditioned room
3	Battery charger in control room	Air conditioned room	a)Air conditioned room b)Non air conditioned room
4	Variable speed drive panels	Air-conditioned room in substation	a)Air-conditioned room in substation b)SRR
5	Thyristor controlled panels	Air-conditioned room in substation	a)Air-conditioned room in substation b)SRR
6	UPS System	Air conditioned room in control room & substation	
7	Lead-Acid and Nickel-Cadmium	Separate room	a)Separate room b)Common room
8	Location of VRLA battery	Air conditioned room	
9	Annunciation panel	Not applicable (Note-6)	
10	Lighting Transformers	Switchgear room	a)Switchgear room b)Separate transformer room
11	Neutralisation pit with drain from flooded battery room	Required	a) Required b) Not required

Notes:-

1. Battery room shall be preferably located in corner side at Ground floor of the sub-station building.
2. Battery charger for Instrumentation shall be placed in air-conditioned UPS room in control room.
3. Electrical equipment installed in battery room such as exhaust fan, lighting, receptacles shall be of flameproof construction and certified for gas group II-C classified locations. Heat detectors installed in battery room shall be of intrinsically safe type with zener barrier. Battery Circuit Breaker shall be located outside battery room.
4. Battery rooms shall be provided with wash basin, eye washer and safety shower. Acid resistant apron, face shield and gloves shall be provided in each battery room.
5. Exhaust fans and flameproof light fittings in battery rooms shall be installed in such a way that they can be accessed using suitable ladders without removing the batteries.
6. Annunciation is part of ECS & separate annunciation panel in not required. However, provision of annunciation with hooter shall be considered as part of HV AIS switchboards. IRF status of numerical relay and Fault alarm status for VFD/excitation

system/FA/PA system shall also be provided.
7. Separate air conditioning system/ split air conditioning system shall be considered for UPS battery room in control room if battery type is VRLA.

5.6 EQUIPMENT DESIGN

5.6.1 EHV DESIGN

5.6.1.1 EHV OUTDOOR SWITCHYARD

S.No.	Description	Selected Option	Available Options
1	Bus bar system	***Not Applicable (Part of EHV GIS)***	a) Single Bus b) Double Bus c) Main and Transfer Bus
2	Circuit breaker type	Not Applicable	
3	Isolator type	***Centre rotating (For gantry Isolator)***	a)Pantograph b)Semi Pantograph c)Centre rotating d)Centre break

5.6.1.2 EHV SWITCHBOARD

S.No.	Description	Selected Option	Available Options
1	Type of Switchgear	Gas Insulated	
2	Busbar	Double	a)Single b)Double
3	Circuit Breaker Type	SF6	
4	Local Control Cabinet	***Separate free standing (for 220kV GIS) & Mounted on GIS (for 66kV GIS) (refer Note-2)***	a)Mounted on GIS b)Separate free standing c)As per vendor drawing

Note:
1. Short Circuit rating & duration : 50kA for 3 sec. (for 220kV GIS) & 40kA for 3 sec. (for 66kV GIS).
2. Local control cabinet for 220kV GIS shall be mounted in GIS hall.
3. Two relays of different make shall be used for Petchem 220 KV LILO incomer line side protection.
4. GIS switchboard shall have bus tie on each bus and bus-coupler between buses (In all 4 section i.e. Bus 1A / 1B and 2A / 2B).
5. Following equipment shall be supplied along with GIS of 220kV, 66kV and 66kV IBPs (for IBP's 1 set for each substation) :
a) SF6 Gas Leakage Detector
b) Online SF6 gas Filling and Evacuation Cart
c) SF6 Gas Analyser
d) Portable Partial Discharge (PD) Monitoring System

5.6.2 HV SWITCHBOARD

S.No.	Description	Selected Option	Available Options
1	Execution	Drawout (AIS) Fixed (GIS)	a)Drawout b)Fixed

S.No.	Description	Selected Option	Available Options
2	Type of switchgear	Air Insulated & Gas insulated	a)Air insulated b)Gas insulated
3	Bus bar	Single bus & Double bus	a)Single bus b)Double bus
4	Circuit breaker type	VCB	a)SF6 b)VCB
5	Motor Control	Breaker	a)Breaker b)Vacuum contactor
6	Marshalling Cabinet	Part of HV Switchboard	a)Part of HV Switchboard b)Separate c)Not Applicable
7	Internal Arc Classification		
7.1	Short Circuit Current (kA)	40	a)40 b)25 c)Any Other
7.2	Duration (Second)	1	a) 0.1 b) 0.2 c) 0.5 d) 1.0 e) Other
8	No. of bus-coupler	Two	a)One b)Two c)Other
9	Thermography window	No	a)No b)Yes
10	Online temperature monitoring system	Yes	a)No b)Yes

Notes:
1. Short Circuit Rating and duration:
i) DELETED.
ii) 33kV HV (GIS) at Bina Refinery location - 40kA for 1sec.
iii) 6.6kV HV (AIS) at Bina Refinery & at Petchem location - 40kA for 1Sec.
2. LOTO facility shall be provided for each module.
3. ON/OFF indication shall also be provided on rear side of panel.
4. Auto tripping of HT circuit breaker upon opening rear side cover shall be provided.
5. All the numerical relays used in a particular substation shall be time synchronized with GPS.
6. 6.6 KV and above rating HV switch boards shall have two bus couplers.
7. For HV switchboards, the number of spares shall be as indicated in SLD.
8. The back side cable compartment cover of HV switchboard shall not be able to open while the feeder is electrically connected. Breaker shall trip if any person opens the back side cover preferably by mechanical interlock otherwise on electrical interlock. Back side cover shall have on / off LED indication lamp.
9. Breaker operated direct contacts to be used to the maximum extent for DCS / interlock. If it is not possible than same to be given through bi-stable relays.
10. HT off load isolator shall not be used, in its place normal VCB panel shall be used.
11. Instrumentation remote IO panels are envisaged in substation for command interface. whereas all status signals to DCS shall be through ECS on Modbus TCP IP protocol except critical process signals used in interlocking through PLC which shall be hardwired and to be decided during detail engineering.
12. GIS Isolating breaker panels (for 33kV & 66kV) shall be single bus type.

5.6.3 CURRENT TRANSFORMER (CT)/POTENTIAL TRANSFORMER (PT)

S.No.	Description	Selected Option	Available Options
1	CT Secondary		
1.1	General Protection	1A	
1.2	Special protection(87,64R ,51G etc)	1A	
1.3	Metering	1A for conventional and remote metering	
2	VT Secondary	110V AC	

5.6.4 TRANSFORMERS (POWER/DISTRIBUTION)

S.No.	Transformer	Voltage Ratio	Vector Group	Tap Changer	Cooling
1	Grid power transformer	220/66kV	YnYn0	OLTC	ONAN/ONAF or ONAN/ONAF/OFAF
2	Generator transformer	11/66kV	YNd 11	Off-circuit	ONAN or ONAN/ONAF
3	Tie Transformer	During detail engg.	During detail engg.	Off-circuit	ONAN/ONAF
4	Generator auxiliary transformer	During detail engg.	During detail engg.	Off-circuit	ONAN/ONAF
5	Intermediate power transformer	33/6.9kV for Bina Refinery 66/6.9kV for Petchem	Dyn 11	OLTC	ONAN/ONAF
6	Dedicated (e.g. for VFD)	As per OEM	As Reqd.	Off-circuit	Dry type
7	Distribution transformer (<= 3150 KVA)	6.6/0.433kV	Dyn 11	Off-circuit	ONAN

Note:
1) Provision of Oil Soak Pit & Oil Collection Pit for transformers shall be as follows:
a) Oil quantity <= 2000L: Not Required
b) 2000L < Oil Quantity <= 9000L: Soak Pit
c) Oil Quantity > 9000L: Soak Pit + Collection Pit
2) DELETED.
3) Automatic fixed Fire fighting system of Nitrogen Injection Fire Protection System (NIFPS) type shall be provided for transformers rated 10MVA and above or Oil quantity greater than 2000 litres.
4) Lighting transformer and dedicated transformer for VFD shall be dry type.
5) Flexible oil resistant air bag shall be provided for conservator for transformer rated above 750KVA.
6) All the power and distribution transformers shall be high efficiency. Distribution Transformer rated upto 2500 kVA shall be minimum Energy efficiency level-2 as per IS:1180 (Part-1) table-6/Table-3 of GOI notification dtd. 08 Dec 2023, BEE star rating 2 (including latest GOI notifications).
7) Emergency stop PB station shall be provided for tripping of transformer. The emergency trip PB station shall be located outside the transformer yard and shall have on / off indication & protective shroud for avoiding inadvertent operation.

8) In case of space constraint, dry type transformers shall be considered with rating up to 2MVA and temperature rise shall not be more than 95 deg. C over and above ambient temperature.
9) Transformer terminal box shall be properly approachable and platform shall be provided for primary and secondary terminal box inspection for cover opening / maintenance purpose wherever feasible.

5.6.5 MV SWITCHBOARD

S.No.	Description	Selected Option	Available Options
1	PCC / PMCC		
1.1	Breaker panels	Drawout Single front	
1.2	Contactor feeders	Drawout Double front	a)Drawout Single Front b)Drawout Double front c)Fixed Single front
2	MCC	Drawout Double front iMCC (Intelligent MCC)	a)Drawout Single Front b)Drawout Double front c)Fixed Single front
3	ASB	Drawout Double front	a)Drawout Single Front b)Drawout Double front c)Fixed Single front
4	LDB	Drawout Double front	a)Drawout Single Front b)Drawout Double front c)Fixed Single front
5	Motors		
5.1	PMCC	FVNR feeder with iMPR for motors rating upto 45kW. ACB motor feeder with NR for motors rated 55 kW and above	
5.2	MCC	FVNR Feeder with iMPR for Motors rating upto 45KW.	
6	Switchboard for small package (AC system, Pressurisation system ,Bagging plant etc)		
6.1	Type	***Compartmentalised Fixed type, single front***	a)Compartmentalised Fixed type b)Drawout type
6.2	Configuration	Two incomers without Bus coupler	a)Single incomers b)Two incomers without Bus coupler c)Two incomers with Bus coupler
7	Marshalling Cabinet	Separate (Note-11)	a)Part of MV Switchboard b)Separate c)Not Applicable
8	Internal Arc Classification		
8.1	Short Circuit Current (kA)	65 kA	a)65 kA b)50 kA c)35 kA d)25 kA e)Any other

S.No.	Description	Selected Option	Available Options
8.2	Duration (Second)	0.1	a)0.1 b)0.2 c)0.5 d)1.0 e)Any other
9	Bus-bar material	Aluminium	a)Aluminium b)Copper c)Any other
10	Closed door operation required	No	a)Yes b)No
11	Type of cooling for switchboard (Note-2)	Natural	a)Natural b)Forced
12	Incomer & bus-coupler for MCC & ASB	ACB	a)ACB b)Heavy duty switch
13	Incomer & bus-coupler for LDB	MCCB	a)MCCB b)Heavy duty switch

Notes:

1. MCC shall be limited to 1250A and ASB shall be limited to 800A.
2. Up to 4000A rating, forced cooling shall not be provided.
3. Power Panel and Lighting Panel shall be wall mounted fixed type.
4. IP plate of LV MCC shall have control on/ off switch & on / off / trip indication lamp in case same cannot be accommodated in relay LED.
5. LOTO facility shall be provided for each module.
6. Breaker operated direct contacts to be used to the maximum extent for DCS / interlock. If not possible same to be given through bi-stable relays.
7. Separate control switch & control fuse for isolation of control supply in all the motor feeders shall be provided. Separate control supply facility from space heater bus for checking module healthiness in TEST position shall not be provided.
8.All the numerical relays & iMPR used in a particular substation shall be time synchronized with GPS.
9. iMPR & Numerical relays shall also be used for for control logic except Start/ Stop command. For iMPR, PLC and DCS signals shall be through relay logic provided timing shall be less than 50ms as per instrument/ process requirement.
10. DELETED.
11. Marshalling Cabinet for MV Switchboard shall be standalone type (not part of MV switchboard panel). However, separate marshalling panel not required wherever remote I/O panels are located in substation.
12. Instrumentation remote IO panels are envisaged in substation for command interface. whereas all status signals to DCS shall be through ECS on Modbus TCP IP protocol except critical process signals used in interlocking which shall be hardwired and to be decided during detail engineering.
13. MV switchboard (PCC/EPCC) shall be provided with 2 bus couplers.
14. All the MV switchboards (PCC/PMCC/EPC/EPMCC/MCC) shall be provided with online temperature monitoring system.
15. Floor mounted fixed type non-compartmentalised space heater DB (SHDB) with 2 incomers shall be considered for space heater power supply in substations for EHV,HV,MV,LV switchboards.

5.6.6 MEDIUM VOLTAGE MOTOR STARTER TYPE

S.No.	Description	Selected Option	Available Options

S.No.	Description	Selected Option	Available Options
1	Contactor and switch fuse with overload relay	Not Applicable	
2	Contactor, switch fuse and overload relay with CBCT & ELR	Not Applicable	
3	Contactor and switch fuse with communicable motor protection relay	Not Applicable	
4	Air circuit breaker with numerical motor protection relay	***55kW and above***	
5	Contactor and MPCB with overload relay	Not applicable	
6	Contactor, MCCB with CBCT & ELR	Not Applicable	
7	MCCB with contactor and communicable Motor Protection Relay	< 37kW (Note-1)	
8	Contactor and MCCB with overload relay with CBCT & ELR	37kW & 45kW (Note-1)	
9	Contactor, MCCB with O/L Relay	Not applicable	

Note-

1. Instead of overload relay, all motor feeders upto 45kW shall be provided with iMPR (intelligent motor protection relay) for Draw-out type switchboards, whereas for Fixed type switchboards (in HVAC pkg, Lift/elevator etc.) it shall be with non-communicable DMPR (Digital motor protection relay).
2. Double Break MCCB with LOTO facility shall be provided in MV switchboard panels.
3. R-C Circuit across power contactor and low-burden auxiliary contactor for receiving start/ stop command from field shall be provided in all DOL starter feeders.

5.6.7 MEDIUM VOLTAGE OUTGOING FEEDER TYPE

S.No.	Description	Selected Option	Available Options
1	MCCB and CBCT with ELR	Not Applicable	a)___A and up to ___A b)Not Applicable
2	Switch fuse	Not applicable	
3	Switch fuse with Contactor and CBCT & ELR	Not applicable	
4	MCCB with Contactor and CBCT & ELR	***250A & upto 400A (refer Note-2). 32A/63A for Aux. heater feeders.***	a)___A and up to ___A b)Not Applicable
5	***MCCB with E/F release***	***below 250A***	a)___A and up to ___A b)Not Applicable

Note-

1. All MCCBs shall be provided with shunt trip coil and shall be microprocessor based.
2. CBCT+ ELR & contactor shall be provided for all MCCB feeder for E/F protection for 250A and above rated feeders.

5.6.8 MOTOR CONTROLS (AS PER PROCESS PACKAGE & OPERATING PHILOSOPHY)

S.No.	Description	Selected Option	Available Options
1	Auto/OFF/Manual switch	***In LCS near motor***	a)Near motor b)Switchgear c)Control room
2	Local/OFF/Remote switch	***Switchgear (Local/remote)***	a)Near motor b)Switchgear c)Control room
3	Process interlock (Note-1)	PLC	a)PLC b)Switchgear
4	Reacceleration equipment	Switchgear	a)PLC b)Switchgear

Notes;
1. To be made available at switchgear as per Instrumentation philosophy.

5.6.9 CONTROL SUPPLY VOLTAGE

S.No.	Description	Selected Option	Available Options
1	Breaker control	110V DC	a)220V DC b)110V DC
2	Breaker spring charging	110V DC	a)240V AC b)220V DC c)110V DC d)230V AC UPS
3	Contactor feeder	240V AC	a)240V AC b)220V DC c)110V DC d)230V AC UPS
4	Control supply for earth fault relay in contactor feeder	***110V DC (iMPR – for Drawout swbd) / 240V AC (DMPR – for fixed type swbd)***	a)240V AC b)220V DC c)110V DC d)230V AC UPS
5	Control supply for contactor motor starter and contactor feeder	***Tapping P-N of Respective Feeder***	a)Control Transformer common for each bus b)Tapping P-N of Respective Feeder c)Control transformer in individual DOL starter d)NA
6	MCCB/ MPCB shunt trip voltage	240V AC	a)220V DC b)110V DC c)240V AC

Notes:
1) DELETED.
2) DC control supply to MCC is applicable for main substation where DC power supply is available.
3) Control supply of VFDs and exciter panel supply shall be from UPS. Dual redundant battery banks shall be provided for each UPS.
4) All modules in LT shall have isolate, test and service position

5.6.10 MOTORS

S.No.	Motors	High voltage	415 volts
1	Enclosure		
1.1	Indoor	IP55	IP55
1.2	Outdoor	IP55	IP55
2	Insulation class	F (Temp. Rise limited to B)	F (Temp. Rise limited to B)
3	Anti-condensation heater	Yes	30 kW and Above
4	Additional canopy (outdoor motors)	Yes	Yes
5	Design voltage variation	±10%	±10%
6	Design frequency variation	***±5%***	***±5%***
7	Combined voltage / frequency variation (Design)	±10 % Any combination of above	±10 % Any combination of above
8	Energy efficient IE motors	NA	Yes (Refer Note-2)

Notes:

1. MOV Actuators:
1.1. Motors for MOV actuator shall have F class of insulation with temperature rise limited to class-B.
1.2. MOVs shall not change their status during voltage drop/power outages. The control supply for MOV shall be tapped internally from the 415V, 3ph supply to MOV. No separate DC/UPS control supply provision shall be made by the Owner.
1.3. Actuator of MOV shall have provision for Partial Stroke Test (PST). Actuator of MOVs shall be commissioned by OEM.
2. Motor Efficiency class shall be IE3 (for Hazardous area) / IE4 (for Safe area) as per latest IS 12615 /IEC 60034-30.
3. Permanent arrangement for monsoon protection for AFC motors shall be provided. Necessary arrangement shall be provided so that water ingress through the shaft in the motors can be avoided.
4. Thermistors shall be provided in VFD driven motors and the provision for tripping the motor in case of excess temperature shall be considered.
5. DELETED.
6. Motor antifriction bearings on DE & NDE shall have greasing facility to lubricate the bearings at site.
7. There shall be proper provision for carrying out the greasing of NDE/DE side of AFC/Vertical HT motor from ground floor. Longer length of grease pipe shall be made available for AFC/vertical HT motors with grease nipple at bottom of the pipe for ease of greasing.

5.6.11 UPS SYSTEM

S.No.	Description	Selected Option	Available Options
1	Redundancy	100%	a)50% b)100%
2	Type of redundancy	Parallel redundant (Note-10)	a)Parallel redundant b)Hot standby c)Dual redundant
3	Back-up time	60 minutes	a)30 minutes b)60 minutes c)120 minutes

S.No.	Description	Selected Option	Available Options
5	Separate fault diagnostic unit (Note 1)	No	a)YES b)NO
6	Battery type	Ni-Cd	a)Ni-Cd b)Lead acid c)VRLA
7	Battery configuration	(2 x 100% configuration)	a)(2 x 50% configuration) b)(2 x 100% configuration) c)(1 x 100% configuration)
8	UPS Output Supply	Single Phase	a)Single Phase b)Triple Phase
9	UPS Output Voltage	110V AC (Final voltage shall be as per Instrumentation Design Basis)	
10	ACDB outgoing feeder type	Switch fuse unit	a) Switch fuse unit b) MCCB c) MCB

Note-

1. Separate Fault Diagnostic Unit (FDU) is not required.
2. UPS for CFAP of FA system, PA system, Rim Seal fire protection system & Weigh bridge shall be non redundant with bypass type with VRLA/SMF battery.
3. By pass supply shall be through SVR (static voltage regulator) only.
4. UPS & ACDB shall be as below:
a) Output of UPS-1 & 2 along with SVR output shall be paralleled.
b) ACDB shall be provided with 2 incomers (incomer-1 from UPS-1/SVR, incomer-2 from UPS-2/SVR). Both incomer and bus coupler shall always be NC (normally closed).
5. All outgoing feeders in UPS ACDB which are going to the field shall be provided through isolating transformers as per instrumentation requirement.
6. Outgoing feeders with isolation transformer shall be provided with HRC type switch fuse on primary side and semi-conducting type fuse along with switch on secondary side.
7. Outgoing feeders without isolation transformer shall be provided with semi-conducting type fuse along with switch.
8. DELETED.
9. DC to DC convertor between UPS charger and battery bank is not acceptable i.e. battery bank float voltage shall be equal to charger float voltage.
10. UPS shall be designed with 100% isolation with UPS-1 and 2.
11. Type of switchboard for DCDB, UPS ACDB, PDB, MDB, weatherproof/flameproof (as per hazardous area classification) outdoor type switchboards: Compartmentalized Fixed type, single front.
12. UPS for VFDs/soft starter, ECS, sub-station Automation system (SAS) HMI, Thyristor control panel shall be parallel redundant type with Ni-cd battery (2 x 100%)". LAN UPS Power requirement (substation/MCC, SRR/CR etc.) shall also be fed from this UPS through isolation transformer. In case of UPS for LAN system is required for remote buildings where substation UPS is not available, the same shall be with non-redundant with bypass type with VRLA battery.
13. 230V AC LAN Power requirement for substation, MCC room, SRR & CR shall be fed from respective UPS of the buildings.

5.6.12 COMMUNICATION SYSTEM

S.No.	Description	Selected Option	Available Options
1	Plant Communication System	Yes	a)YES b)NO
2	Telephone System	***IP based (Refer Instrumentation EDB & Note-1 below)***	a)YES b)NO c)Separate
3	Telephone system and plant Communication system	Separate	a)Separate b)Integrated
4	Interface of Communication system		
4.1	With fire alarm system	Yes	a)YES b)NO
4.2	With telephone system	Yes	a)YES b)NO
5	FLP Telephone for process units	Yes (Note-2)	a)YES b)NO
6	Telephone cable type (Outdoor)	***Non Jelly filled (copper) for Analogue telephones only. for IP telephones refer Instrumentation EDB.***	a)Non Jelly filled b)Jelly filled

Notes:
1) At least 2 phones per switchgear floor, shall be provided in the substation.
2) FLP telephones shall be provided for process units, and process plant lifts also.

5.6.13 FIRE DETECTION AND ALARM SYSTEM

S.No.	Description	Selected Option	Available Options
1	Type	Digital addressable	a)Conventional b)Analogue addressable
2	Name of buildings to be provided with Detectors	Control room, sub-station, SRR, Administration building/office, other buildings as required.	
3	Detection System	Break Glass, Multi sensor detection, heat detector, Linear heat sensing cables (if required), Linear beam detector (if required)	
4	Type of manual call point	Without call back facility	a)With call back facility b)Without call back facility
5	Qty of Siren and location	***1 no. at each substation and Petchem MCR***	
6	Power supply for Siren	***415V AC (Emergency)***	a) 415V AC b) 110V AC UPS c) 240VAC
7	Siren range	8 Km(Diametrically)	a)5 Km(Diametrically) b)8 Km(Diametrically)
8	Response indicator for rooms and concealed area for Addressable Fire alarm system	Yes	a)YES b)NO c)Not Applicable

S.No.	Description	Selected Option	Available Options
9	Detector type for battery room	Intrinsically safe-IIC	a)Flameproof b)Intrinsically safe-IIC

Notes:
1. All the FA system shall have the facility to communicate with DCS and it shall be compatible with DCS protocol and existing central FA panel at BPCL fire station in case of Bina Refinery.
2. FA Interface with DCS shall be Modbus Communication only.

5.6.14 DC SYSTEM

S.No.	Description	Selected Option	Available Options
1	Battery type		
1.1	Switchgear Protection Control and critical lighting	Ni-cd	a)Lead acid b)Ni-Cd c)VRLA
1.2	Instrumentation System	Not Applicable	a)Lead acid b)Ni-Cd c)VRLA
1.3	Diesel Engine Starting	Lead Acid	
1.4	DC Motors	Not Applicable	a)Lead acid b)Ni-Cd c)VRLA
1.5	Fire alarm system	***VRLA/SMF***	
1.6	Telephone system	***As per Instrumentation EDB***	
1.7	End Cell Voltage		
1.7.1	Lead Acid Battery	1.85 VOLT	
1.7.2	VRLA Battery	1.75 VOLT	
1.7.3	Ni-Cd Battery	1.0 VOLT	
2	Battery backup time		
2.1	Switchgear Protection and Control	120 minutes	a)30 minutes b)60 minutes c)120 minutes
2.2	DC Critical lighting	120 minutes	a)30 minutes b)60 minutes c)120 minutes
2.3	Instrumentation	60 minutes	a)30 minutes b)60 minutes c)120 minutes
2.4	Diesel Engine Starting	10 starts (FW pumps) & 6 starts (others)	
2.5	DC Motors	As per equipment manufacturer's recommendation	
3	Battery Configuration	2X100% (for substation control) 1x100% (for DC critical lighting)	a)2X50% b)1X100%
4	DCDB outgoing feeder type	Switch fuse unit	a)Switch fuse unit b)MCCB c)MCB

Notes:
1. Battery for Plant communication system shall be VRLA/SMF type.
2. All intercell & inter row links shall be of copper with lead coating. Al links are Not acceptable.
3. Chargers shall be provided with voltage dropping diodes with bypass facility to maintain terminal voltage at level to suit instrument requirement at field. Annunciation for failure of the dropping diode shall be given.
4. All the battery chargers shall be designed to have on-line battery load testing facility.
5. The battery charger for switchgear control and critical lighting shall be Thyristor based.
6. All the chargers shall have inbuilt load test provision.
7. Common cell booster suitable for largest battery rating shall be provided in each substation building for similar battery systems.

5.6.15 VARIABLE FREQUENCY DRIVE

S.No.	Description	Selected Option	Available Options
1	By pass feature required	Yes(Note-1)	a)YES b)NO
2	VFD rated output voltage(in case bypass is not provided)		
2.1	MV Inverter	i) Motor kW rating upto 315kW at 415V without bypass (Note-3) ii) Motor kW rating above 315kW & up to 700kW at voltage up to 690V without bypass (Note-4)	
2.2	HV Inverter	>1100V for Motor rating more than 750kW (Note-5)	

Notes:
1. Bypass for VFD shall be provided as a standard practice unless not recommended from Process or driven equipment operation point of view.
2. VFD control supply shall be from 230V AC UPS.
3. 415 V – For VFD fed motor with bypass facility with rating less than or equal to 132 KW.
4. 6.6kV – For VFD fed motor with bypass facility with rating above 132kW and upto 750KW.
5. For motors > 750kW, 6.6 KV voltage shall be used. For higher rated motors such as MAB, WGC etc.(in ECU) & Extruder (in PPU & LDDPE), input supply shall be provided at 66kV level respectively which will be step-down to suitable voltage level for feeding respective motors

5.6.16 CABLE SIZES

The power and control cables shall have the following minimum cross sectional areas

S.No.	Description	Selected Option	Available Options

S.No.	Description	Selected Option	Available Options
1	Medium voltage power cable	25mm^2(Aluminium)/2.5 mm^2 to 16 mm^2(Copper)	a)Above 16 sqmm (Aluminium) b)2.5 sqmm to 16 sqmm (Copper)
2	Control cables	2.5 mm^2 (Copper) twisted pair, multi strand, flexible, shielded (individual pair shielded & overall shielded)	
3	Lighting	2.5 sqmm (Copper), multistrand, flexible	
4	Communication system	0.63 sq.mm i.e. 0.9 mm dia (Copper) for telephone and FO cables for Electrical network PLC system	
5	Telephone System	0.63 mm dia.(Copper) Non Jelly Filled cable	
6	Fire alarm system	1.5 sqmm (Copper)twisted pair	

Notes:

1. For lighting inside the building, minimum 2.5 sqmm. Copper conductor, PVC insulated FRLS wire shall be used in conduit system (for circuit and point wiring), with proper color coding.
2. Cable sizes are indicative only and these shall be finalised as per the recommendations of the equipment manufacturer.
3. Special cable type and size shall be decided on specific requirement.
4. All power cables 2.5 sqmm upto 16 sqmm shall be with copper conductor and above 16 sqmm shall be aluminium/copper conductor.
5. Control cable shall be twisted pair shielded (individual pair shielded & overall shielded type).
6. Outer PVC sheath of all cables shall be flame retardant type. Cables shall have low smoke properties i.e. FRLS type with 60% (Max) smoke density.
7. Earthing cable shall have multi strand copper conductor & overall insulation above the conductor.
8. All control cables, Fire alarm cable and Plant communication cables shall be XLPE insulated.
9. Medium voltage power cable for motors shall be minimum 4 sq.mm (Copper).

5.6.17 BUS DUCT

S.No.	Description	Selected Option	Available Options
1	HV Bus Duct (Phase segregated type)	Conventional	a)Conventional b)Sandwich type c)Cast resin type
2	MV Bus Duct (Non-phase segregated type)	Conventional	a)Conventional b)Sandwich type c)Cast resin type

5.6.18 CAPACITOR BANK

S.No.	Description	Selected Option	Available Options

S.No.	Description	Selected Option	Available Options
1	Voltage Level (kV)	6.6KV	a)0.415KV b)6.6KV c)11KV d)Other
2	Location	Indoor (Panel mounted)	a)Outdoor b)Indoor
3	Type of series reactor	Dry type (panel mounted)	a)Oil filled b)Dry Type
4	APFC Panel	Required (Indoor)	a)Required (Indoor) b)Not Required c)Other

5.7 CABLING SYSTEM

5.7.1 CABLE DETAILS

S.No.	Design Criteria	EHV	HV	415 volts
1	Loads located beyond 1 km	1 core cable	Cable	Cable
2	Loads located 200-1000 m	1 core cable	1-core cable/ 3-core cable	1-core / 3 1/2-core cable
3	Loads located upto 200 m	1 core cable	Cable	Cable
4	Loads beyond 1250A rating and located near the transformer	GIBD/ 1 core cable	Bus duct /1 core cable	Bus duct /1 /3.5 core cable
5	Recommended limiting size of multi-core cable (sqmm)	NA	300	300
6	Short-circuit withstand time (seconds)	1.Incomer from transformer:1 2.Incomer from other switchboard:0.6 3.Plant feeder:0.6 4.Transformer feeder:0.2	1.Incomer from transformer:1 2.Incomer from other switchboard:0.6 3.Plant feeder:0.6 4.Motor/Transformer feeder:0.2 5.Capacitor feeder:0.4	Not Applicable
7	Insulation voltage grade	Earthed	Unearthed for 6.6kV cable. Earthed for 66kV cable in Petchem & 33kV cable in Bina refinery	Earthed
8	Type of cable insulation	XLPE	XLPE	XLPE
9	Fire survival (Resistant) cable for Fire proof MOV and NIFPS	NA	NA	Yes
10	Power Cable for Motors/MOV	NA	3 core	3 core
11	Cable Conductor	***Copper***	Copper/ Aluminium	Refer Cl. 5.6.16

S.No.	Design Criteria	EHV	HV	415 volts
12	Armouring	Unarmoured or Armoured	Power cable Armoured Earthing cable un-armoured	Power cable Armoured Earthing cable un-armoured
13	Type of Moisture barrier	***Corrugated Aluminium***	NA	NA
14	Termination Type	Cold Shrink/ Hot Shrink/ Premoulded	Cold Shrink/ Hot Shrink	NA
15	Screen Bonding arrangement for single core cables	Single point or Cross bonding	Single point or Cross bonding	NA

Notes:
1. EHV GIBD shall be phase separated SF6 insulated type.
2. Following color code shall be used for power cables:
220kV: Black
66kV: Violet
33kV: Pink
6.6kV: Yellow
1.1kV: Black
FS (Fire survival cables for MOV power & control): White
PA: Grey
FA: Red
Control: Black

5.7.2 CABLE LUGS MATERIAL

S.No.	Description	Selected Option	Available Options
1	Copper conductor cable & copper bus bar/ terminals	Tinned Copper	a)Tinned Copper
2	Copper conductor cable & Aluminium bus bar/ terminals	Tinned Copper	a)Tinned Copper b)Bi-metallic (Aluminium palm with Copper barrel)
3	Aluminium conductor cable & Copper bus bar/ terminals	Bi-metallic (Aluminium barrel with Tinned Copper palm)	a)Bi-metallic (Aluminium barrel with Tinned Copper palm) b)Tinned Copper
4	Aluminium conductor cable & Aluminium bus bar/ terminals	Aluminium	a)Aluminium b)Tinned Copper

5.7.3 CABLE LAYING PHILOSOPHY

S.No.	Description	Selected Option	Remarks
1	Process area where pipe-rack/sleeper is available	Above ground cable tray	a)Above ground cable tray b)RCC Trench
2	Process area where pipe-racks/ sleeper is not available	***Overhead cable tray/RCC trench sand filled without racks (localised), wherever overhead cable tray route is not possible***	a)Overhead cable tray b)RCC trench, sand filled without racks

S.No.	Description	Selected Option	Remarks
3	Offsite paved area where pipe-rack / sleeper is available	Above Ground cable tray	a)Above Ground cable tray b)Overhead rack c)RCC trench d)Other
4	Offsite paved area where pipe-rack / sleeper is not available	RCC trench, sand dust filled without racks	a)Above ground cable tray b)Overhead rack c)RCC trench, sand filled without racks d)RCC trench,without sand filling with racks
5	Offside unpaved area where pipe-rack/ sleeper is available	Above Ground cable tray	a)Above Ground cable tray b)Overhead rack c)RCC trench d)Other
6	Offside unpaved area where pipe-rack/ sleeper is not available	Directly buried/RCC trench as per site conditions	a)RCC Trench b)Directly buried
7	Type of cable trays	Galvanized prefabricated FRP type for CT & CWPH	a)Galvanized prefabricated b)Site fabricated and Painted c)FRP type
8	Road Crossings for underground cables	***Cable culvert/ERC***	a)PVC Pipes b)Cable culvert
9	Road Crossings for Above ground cables	Overhead cable bridge / culvert	a)Overhead cable bridge b)Culvert
10	Walkway, handrail and ladder for overhead cable trays	Required	a)Required b)Not Required
11	Cable entry into Blast resistant CR/SRR	Through MCT	a)Through MCT b)Without MCT through trench c)Without MCT through sleeves below ground
12	Cable entry into Sub-station	Underground through trench	a)Underground through trench b)Overhead through trays

Notes:-

1. Plant communication, fire alarm and telephone cables shall be laid in instrumentation overhead cable duct / instrumentation trenches as far possible. In case these are not available. Cable shall be laid in electrical routes along berm of the roads.
2. FO Cable shall be laid through HDPE / GI conduit.
3. All hardware used for joining cable trays shall be of SS material.
4. Cables shall not pass through area where high temperature lines, steam vents / drains etc are provided. Adequate precautions shall be taken in un-avoidable cases.
5. Signal cables i.e. Instrument, communication, fire alarm, LAN and data highway, etc. shall preferably not be laid in the same trench / tray along with electrical cables. In case they are laid in the same trench / tray, a clearance of minimum 300 mm from electrical cables shall be provided. The overall cable layouts shall be designed for minimum interference between signal and power cables.
6. Cable entry to CR/SRR - Through MCT.
7(a). Walkway, handrail and ladder for overhead cable tray - Required.
7(b). No cable joints in overhead cable trays is permitted in Process unit/Hazardous

area.
8. EHV (220kV) cables shall be laid in RCC Trench, filled with stone dust without racks.
9. Cable laying philosophy
a) Cables in general shall be laid in overhead cable trays in the unit area & in overhead cable trays/cable trenches in offsite paved and unpaved areas.
b) Lighting cables in unit area shall be laid overhead in cable trays
c) For Offsite unpaved area, cable may be buried underground built-in cable trench depending on number and criticality of cables which may accordingly be decided during detailed engineering.
d) Cable shall cross the road through cable culvert or ERC. For ERC details, refer structural design basis.
e) FO cables shall be laid in HDPE / GI conduit.
f) No process pipe shall pass through cable trench. If unavoidable, minimum 300mm clearance to be provided between pipe and cables. In this case, either pipe or cables shall be taken through RCC congregate.
g) Ensure no hydrocarbon or water seepage into the cable trench.
h) All cables shall be provided with Fire proofing coating upto 1.0m from termination point as per OISD requirement.
10) All new substations shall be connected to MRS through fibre optic cable network. FO cable laying can be planned along with Power cable from MRS. All interfacing shall be through OFC cables such as differential protection, inter-tripping & ECS connectivity etc.
11) Fire proofing of all substation entries for cable / bus duct shall be done.
12) In case of direct burial, cable route markers shall be installed at 15 m interval all along the cable routes and where the direction of cable trench changes.
13) All cables shall have cable lead marker wrapped on cables for easy identification indicating Tag No., Size, voltage grade & source. These lead markers shall be put at each 15m interval, at all bend and at places from where cables come out from ground.
14) In case when cable is laid underground in normal soil (not in trench) then a layer of stone dust up to 150 mm shall be provided over laid cables, over the stone dust a single layer of bricks shall be provided and then the area shall be filled with loose soil. A PCC shall be made over these type of cable trenches which shall be of min. 100mm thickness. A red colour marking shall be done over the PCC for easy identification.

5.8 EARTHING SYSTEM

S.No.	Description	Selected Option	Available Options
1	Earth electrode	***Chemical earth electrode***	
2	Main earth loop material	GI main earth grid upto Earth plate. Earth plate to Equipment by Copper cable	
3	Substation earth loop	Combination of GI strip and CU cable	
4	EHV switchyard earth grid	YES for EHV GIS	

Notes:
1. Earth pits shall be painted as per standard for e.g. earth pit for equipment earthing, body earthing etc. shall be green, transformer neutral earthing shall be black and lightening arrestors shall be blue.
2. Earth pit number shall be marked on each earth pit.
3. Earth pit cover size shall be min 650 X 650 mm.
4. Earth pit chamber covers shall be flushed with FFL for paved area. For unpaved area, it

should be elevated.

5.9 LIGHTING SYSTEM

5.9.1 SUPPLY SYSTEM

S.No.	Description	Selected Option	Available Options
1	Centralised with Lighting distribution board-LDB	***NO***	a)YES b)NO
2	LDB at each substation	Yes	a)YES b)NO
3	Lighting transformer required	Yes	a)YES b)NO
4	100% Standby transformer for normal lighting system	***Yes***	a)YES b)NO
5	100% Standby transformer for emergency lighting system	***Yes***	a)YES b)NO
6	Lighting transformer voltage ratio	415V/415V with tapping (Note-1)	a)415V/415V b)415V/400V c)Other

1) Off circuit tap changer shall be with voltage variation in steps of +/- 2.5% with tap range +10% and -5%.
2) Following philosophy shall be followed for lighting system:
a) The Lighting distribution board (LDBs) shall have outgoing feeders to feed Indoor & Outdoor lighting panels of each unit and U&O. 240V convenience sockets in plant area shall be fed through power panel which in turn will get feeder from ASB.
b) LDBs shall be provided with Astronomical type digital timer with programming over full year for outdoor/plant lighting auto control.
c) The outdoor lighting in unit shall be done using multi-way FLP lighting panels.
d) DC critical lighting is required in Plant / Substation / SRR / Control room through separate 110 V DC battery charger so that fault in lighting circuit will not affect substation charger. DC critical lighting shall be 110V LED type.
e) For LED fixture, integral junction box shall be provided with 3 nos. cable entries for loop-in, loop out and associated wiring to fixture. Alternatively 2 nos. cable entries for loop-in and loop-out shall be provided with internal wiring for driver and lamp.
f) For emergency lighting in the plant, there shall be separate Emergency Lighting distribution board (ELDBs). Distribution to emergency light fitting shall be similar to normal light fitting i.e. from ELDB to flameproof multiway lighting panel & from this to individual light fitting.
g) For platform mounted poles, bottom of light fitting shall be 2 metre from floor/platform. All platform mounted poles shall be of GI type with all SS mounting hardware including SS U clamps & SS platform mounting lock nuts.
h) For light fitting, 4 core cables shall be used. 4 core cable for lighting shall be stranded type. Cables shall be connected at terminals with use of lugs.
i) Final LUX level study shall be carried out after mechanical completion of project activities.
j) LDB & ELDB shall have different compartments as per project datasheet to feed lighting supply for different areas either in auto/manual mode. Each LDB & ELDB board for auto circuit shall be provided with one common astronomical type digital timer to control outdoor plant lighting. Also one unwired additional astronomical timer shall be provided in the timer compartment of LDBs & ELDBs.
k) LED light/latest energy efficient light fittings shall be provided for plant area lighting, street lighting, transformer bay lighting, substation, control room and office lighting. All these fittings shall be covered under 5 year warrantee. Flameproof well

glass type LED fitting shall be provided for plant area lighting. Wire Guard of FLP light fittings shall be made up of SS304 material (min. 4mm thickness). However, flameproof focus LED lights need not be well glass type.
l) Surge suppressor for LED fitting shall be suitable for 10KV. LED fitting driver shall take care of neutral opening for long sustained cases.
m) Goose neck poles mounted light fittings to be used wherever gratings are there e.g. on the columns, heaters, stair case etc. The bottom of light fitting from the grating shall be 2 metre. Goose neck pipes shall be installed on the railings and orientation shall be parallel to the railing and shall not obstruct the walkway. On the grating area where goose neck pole cannot be installed, lighting fittings can be installed on the structure in such a way that fitting height is 2 metre. Goose neck poles shall be of GI with coating of 100 microns.
n) The lighting fittings on ground floor shall be approachable by max 12 feet ladder and on upper floors wherever solid concrete surface is available the lighting fittings shall be approachable by max 8 feet ladder.
o) All lighting fittings and junction boxes shall be properly approachable. For e.g. location of lighting fitting should not be above any equipment motor/pump/panel etc.).
p) All hardware such as Nuts, Bolts & washers used for light fittings, JBs, goose neck pole etc shall be of SS304 material.

5.9.2 CONTROL PHILOSOPHY

S.No.	Description	Selected Option	Available Options
1	Outdoor yard	Auto	a)Auto b)Manual c)Centralised d)Local
2	Street lighting	Auto/Manual/centralised	a)Auto b)Manual c)Centralised d)Local
3	Outdoor process area	Auto/manual; centralised/local	a)Auto b)Manual c)Centralised d)Local
4	Process building	Auto/manual/Local	a)Auto b)Manual c)Centralised d)Local
5	Auto control	Astronomical timer with programming over full year	a)Synchronous timer b)Photocell c)ECS
6	Lamp type for all types of lighting fixtures.	LED	
7	ELCB in outgoing of LDB/ ASB feeding Lighting/ Power Panels	Yes sensitivity of 300mA*	a)YES b)NO
8	ON /OFF Push button at substation entry	Yes	a)YES b)NO
9	ELCB (30mA) in each circuit of LP/PP	Yes (2-pole)*	a)YES b)NO

Notes:
1) ELCB indicated in the above clause shall be referred as "RCCB".

2) Substation lighting control switch shall be provided outside the substation room (both side doors) for switching ON and OFF the substation lighting (normal) from outside.

5.9.3 AC EMERGENCY LIGHTING

S.No.	Description	Selected Option	Available Options
1	Name of process plants	All process areas (as per operation requirement)	
2	Name of buildings	Substation, Control room, Fire Water Pump House, Admin Building, Lab., Workshop, Canteen, Warehouse (Office Area) etc.	
3	Power supply source	Diesel generator	

5.9.4 DC CRITICAL LIGHTING FOR ESCAPE

S.No.	Description	Selected Option	Available Options
1	Name of process units	Required (as per OISD)	
2	Name of building	Substation, control room, SRR, Administration building, FWPH, Fire Station, Emg. generator shed, First Aid Center	
3	DC lighting for remote buildings	Lighting fixture with built in battery	

5.9.5 WIRING TYPE

S.No.	Description	Selected Option	Available Options
1	Process plant / Building / Shed	Armoured cable	
2	Large service building	Surface conduit	
3	Buildings with false ceiling	METSEC/Surface conduit above false ceiling	a) Surface conduit above false ceiling except in switchgear room, concealed conduit below false ceiling b) Cables c) Perforated cable tray
4	Substation (Switchgear Room)	METSEC channel/Concealed conduit	a)METSEC channel b)Concealed conduit
5	Substation (Cable Cellar)	Surface Conduit	a)Surface Conduit b)Armoured cable c)METSEC channel d)Concealed conduit
6	Other buildings in safe area	Surface conduit/cable (armoured)	

5.9.6 SPECIFIC LIGHTING REQUIREMENTS

S.No.	Description	Selected Option	Available Options
1	Aviation warning lighting	Yes, LED based Flashing	a)YES b)NO

S.No.	Description	Selected Option	Available Options
2	Security lighting for peripheral road boundary wall	Required for Petchem	a)Required b)Not Required
3	Type of high mast flood light	30 meters Telescopic tubular with LED lamps (Note-3)	a)30 meters Telescopic tubular b)Lattice structural mast
4	Overall general lighting	High Mast	a)High Mast b)Street Lighting c)High mast with street lighting d)Photovoltaic solar hybrid street light e)Other

Notes:
1. Type of Fitting for indoor and outdoor lighting : LED Lamp
2. 30m High mast control panel and motor shall be FLP type for Hazardous area.
3. The high mast shall be smart enabled consisting of dimmable type lighting fixtures, along with dimmable drivers, dimming controller, smart high mast feeder pillar panel, associated cabling between drivers & controllers, controller & smart high mast feeder pillar panel etc.
4. Adequate number of street lighting poles shall be provided along the peripheral roads of the unit. The supply to street light shall be taken through plant lighting DB at substation. Street lighting poles shall be octagonal type, hot dip galvanised to 100 micron.
5. Lighting mast provided in the plant area during construction time shall have flame proof motor and flame proof starter with 24 nos. of LED lighting fitting/fixture(400W). The LUX level shall be minimum 5 LUX at 80 m radius of lighting mast. Height of the lighting mast shall be 30 meter. Lighting mast shall be installed during construction stage in such a way that same can be used after commissioning of the plant. Light Fittings on top of the mast shall be LED based with individual fuse for protection.

5.10 ELECTRIC HEAT TRACING SYSTEM

S.No.	Description	Selected Option	Available Options
1	Maximum sheath temperature of Tracer	Product classification approach for SR	a) Product classification approach for SR b) System approach for PL/ MI
2	Skin effect heat tracing	Not required	a)Required b)Not Required
3	Circuit Temperature Control	RTD	a)RTD b)Thermostat
4	Central Monitoring System	Yes (Note-2)	a)Yes b)No

Note:
1. Skin Effect Heat tracing system shall be provided for long length pipeline application based on requirement.
2. Corresponding central monitoring units of respective Electrical heat tracing system shall be located in SRR/MCR for which exact location shall be decided during detail engineering.

5.11 ELECTRICAL EQUIPMENT FOR HAZARDOUS AREAS

The electrical equipment for hazardous areas both for flammable gas & vapour areas and for explosive dust areas shall be selected as per IS-16724, OISD-149 and Petroleum rules. The Gas/ Dust group and Temperature class shall be selected based on the hazardous area classification. The minimum requirement is summarised below (for flammable gas and vapour areas):

S.No.	Equipment	Zone-1	Zone-2
1	MV Motors	Ex-d	Ex-d
2	HV Motors	Ex-d / Ex-p (Note-2.8)	Ex-d / Ex-p (Note-2.8)
3	Push Button Station	Ex-d	Ex-d
4	Motor Starters	Ex-d	Ex-d
5	Plug & Socket	Ex-d	Ex-d
6	Welding Receptacle	Ex-d	Ex-d
7	Lighting fitting	Ex-d	Ex-d
8	Junction Boxes	Ex-d	Ex-d
9	Transformer Unit	Ex-d	Ex-d
10	Plug & Socket	Ex-d	Ex-d
11	Break Glass Unit (Fire Alarm System)	Ex-d	Ex-d
12	Lighting Panel/Power Panel	Ex-d	Ex-d
13	Transformers	Hermetically sealed with surface temperature not exceeding 200 DEG C	Hermetically sealed with surface temperature not exceeding 200 DEG C
14	Plant communication system	Ex-d / Intrinsically safe	Ex-d / Intrinsically safe
15	Plant Lift	Ex-d	Ex-d
16	Aviation lighting fitting	Ex-d	Ex-d

For additional Hazardous Area requirements, refer notes below -

5.11.1 NOTES

S.No.	Notes
1	The electrical equipment for hazardous areas shall generally be suitable for gas group IIB and temp classification T3 as applicable to the selected type of explosion protection. In case of hydrogen or hydrocarbon mixtures having more than 30% hydrogen, the gas group to be considered shall be IIC.
2	As additional safety features, the following requirements for electrical equipment shall be followed.
2.1	The electric motors for agitators/mixers, metering pumps and canned pumps handling flammable material shall be flameproof type irrespective of the area being classified as zone 2 or zone 1.
2.2	All electric motors for vertical sump pumps handling flammable material shall be flameproof type. (Ex-d)
2.3	Irrespective of the area classification (whether zone 1 or zone 2), all lighting fixtures within the storage areas shall be flameproof type. (Ex-d)
2.4	Irrespective of the area classification (whether zone 1 or zone 2), all motors and lighting fixtures within the pump house/pump station/ compressor house associated with offsite tank farm, within the loading/unloading gantries shall be of flameproof type. (Ex-d)
2.5	The emergency/critical lighting fixtures and associated junction boxes in hazardous areas (whether zone-1 or zone-2) shall be flameproof type. (Ex-d)
2.6	Even though fired heaters in process units are not considered for area classification, all electrical equipments associated with fired heaters in process units shall as a minimum be suitable for installation in Zone-2 area.

S.No.	Notes
2.7	Building such as Compressor sheds inside the process area shall be designed to allow adequate ventilation to allow area classification as Zone-2. Lighting equipment, EOT crane etc. in the shed shall be flameproof type. All other electrical equipment shall be suitable for Zone-1 or Zone-2 area depending on extent of hazard.
2.8	The motors for hazardous area Zone-1 shall preferably be flameproof type. Pressurised motors may be provided in exceptional cases, when flame proof motors are not available.
2.9	In zone-1 areas, Ex-de motor i.e. Ex-d motor with Ex-e terminal box is acceptable provided the motor has been tested/ certified by CIMFR or equivalent testing agency and approved by PESO
3	Statutory Approval 1. Statutory Authority for Electrical Installation: State Electrical Inspectorate/CEA 2. Statutory authority for hazardous area: DGMS:For mining area PESO:For area other than mines

5.12 ELECTRICAL CONTROL SYSTEM-ECS

S.No.	Description	Selected Option	Available Options
1	Extent of coverage	APPLICABLE FOR PETCHEM LOCATION	
1.1	No of substations	All	
1.2	Monitoring		
1.2.1	EHV/HV switchboard	Yes	a)YES b)NO
1.2.2	415V switchboard (I/C, B/C & outgoing breaker feeders)	Yes	a)YES b)NO
1.2.3	Emergency DG set	Yes	a)YES b)NO
1.3	Control		
1.3.1	EHV/HV switchboard	Yes	a)YES b)NO
1.3.2	415V switchboard (I/C, B/C & outgoing breaker feeders)	No	a)YES b)NO
1.3.3	Emergency DG set	No	a)YES b)NO
2	Base ECS functionalities		
2.1	Breaker control in CPP & Switchyard	OFF control for motor feeders, ON/OFF for all other breakers	
2.2	Breaker control in other substations	ON/OFF Control for Capacitor feeder. OFF control for all feeders	
2.3	Area lighting	ON/OFF control	
2.4	Electrical plant data acquisition and display	Yes	a)YES b)NO
2.5	Routine log report generation and energy balance report	Yes	a)YES b)NO
2.6	Detection and reporting of alarms	Yes	a)YES b)NO
2.7	Sequence of event recording	Yes	a)YES b)NO

S.No.	Description	Selected Option	Available Options
3	Advanced ECS functionalities		
3.1	Load shedding including maximum demand limit control	YES (Note-1)	a)YES b)NO
3.2	Synchronization	YES	a)YES b)NO
3.3	Capacitor feeder control for power factor improvement	No	a)YES b)NO
3.4	Active & Reactive power control	YES	a)YES b)NO
3.5	Frequency & load control of all generators except DG	YES	a)YES b)NO
3.6	Excitation control of synchronous motors	NO	a)YES b)NO
3.7	Grid transformer OLTC control	YES	a)YES b)NO
4	Communication with other systems	Refer communication requirements in SAS	

Notes: 1.
Dedicated load shedding scheme shall be provided for Petchem Project.

6.0 SPARE PARTS

6.1 MANDATORY SPARES

Mandatory spares shall be procured along with the main equipment. Such spares for each equipment shall be as per the below table. These spares include only those spares, which are critical for equipment.

S.No.	Part Description	Description
1	Generator	One set of spare for each Generator
1.1	Generator relay	One set (each type & make)
1.2	DVR - all control card	One each type
1.3	Control fuses / MCB	10 Nos. of each rating & type
1.4	Exciter Diodes and fuses	1 set
1.5	Control and Selector switches	1 No. of each type and make
1.6	Aux. contactors	20% of each type and make OR 1 No.(min) of each type and make, whichever is more
2	66kV / 33kV Gas Insulated Switchboard (GIS)	One set of spare for each switchboard (Refer Note-7 & 10)
2.1	Portable gas filling equipment/SF6 gas cart	1 No.
2.2	Handle for disconnector switch drive	4 Nos.
2.3	Handle for earthing switch drive	4 Nos.
2.4	Pre selection / Mechanical key	1 No.
2.5	Power cable termination kit along with plug and socket (R,Y,B Phases)	2 Sets
2.6	Tripping coil	2 No.
2.7	Closing coil	2 No.
2.8	Capacitive type voltage detectors	1 Set
2.9	Control fuses / MCB	10 Nos. of each rating & type

S.No.	Part Description	Description
2.10	Density monitoring device	2 Nos of each type
2.11	Indicating lamps covers	5 nos. of each colour
2.12	Indicating lamps	20% or 3 nos. (min.), whichever is more
2.13	Portable SF6 Gas Leakage Detector	1 Nos.
2.14	Ethernet Switch	1 no. of each type (Refer Note-10)
2.15	Pressure Gauge	2 Nos of each type
3	Power Transformer	One set of spare for each power transformer
3.1	Complete set of gaskets	1 set
3.2	Sealing / Gauge glass of Conservator	2 Nos of each rating & type.
3.3	Control fuses / MCB for MB cubicles	20% for each rating OR 1 No. (min.) of each rating, whichever is more
3.4	HV bushings	One set of each type and rating
3.5	OTI	1 no.
3.6	WTI	1 no.
3.7	Buchholz relay	1 no.
3.8	OLTC Diverter switch along with transition Resistance	1 set
3.9	OLTC fixed & moving contacts along with transition resistance	1 set
4	Distribution Transformer	One set of spare for each transformer
4.1	Complete set of gaskets	1 set
4.2	Sealing / Gauge glass of Conservator	2 Nos. of each rating & type.
4.3	Control fuses / MCB for MB cubicles	20% for each rating OR 1 No. (min.) of each rating, whichever is more
4.4	HV & MV bushings	One set of each type and rating
4.5	OTI	1 no.
4.6	WTI	1 no.
4.7	Buchholz relay	1 no.
5	HV Air Insulated Switchboard (AIS)	One set of spare for each switchboard (Refer Note-7 & 10)
5.1	Closing coil	1 No. of each rating & type
5.2	Shunt trip coil	1 No. of each rating & type
5.3	Control fuses / MCB (all type & rating)	10 Nos. of each rating & type
5.4	Breaker Finger jaws	1 set for each rating and type
5.5	Indicating lamps covers	5 Nos. of each colour
5.6	Indicating lamps	20% or 3 Nos. (min.), whichever is more
5.7	Ethernet Switch	1 no. of each type (Refer Note-10)
5.8	Spring Charging Motor	1 no. each type
5.9	Numerical Protection relays	1 no. each type
6	415V MV Switchboard & iMCC (Intelligent MCC)	One set of spare for each switchboard (refer Note-9 & 10)
6.1	Closing coil	1 No. of each rating & type
6.2	Shunt trip coil	1 No. of each rating & type
6.3	Control fuses / MCB	10 Nos. each rating & type
6.4	Indicating lamps covers	5 Nos. of each colour
6.5	Indicating lamps	20% or 3 Nos. (min.), whichever is more
6.6	Breaker finger jaws	1 set for each rating and type
6.7	Contactor contacts	1 set for each rating and type
6.8	Ethernet Switch	1 no. of each type (Refer Note-10)

S.No.	Part Description	Description
6.9	Electronic modules of iMCC (Intelligent MCC)	20% electronic modules of each type
6.10	Spring Charging Motor	1 no. of each type
6.11	Numerical Protection relays	1 no. of each type
6.12	Contactors(Beyond 400 Amps)	1 No. of each rating
7	Variable Frequency Drive (one set of spare for each VFD) and Soft Starter	Quantity is per VFD and Soft Starter
7.1	IGBT / Thyristor /IGCT/ Other Power Semiconductor devices	3 No. of each type & rating
7.2	Control cards	1 No of each type
7.3	Power supply cards	1 No of each rating & type
7.4	Power fuses	20% for each rating OR 1 no. (min.) of each rating, whichever is more
7.5	Drive Unit	1 No. of each type
7.6	Contactors	10% of each type OR 1 no. (min) of each type, whichever is more
7.7	Indicating lamps	20% OR 1 nos. (min.), whichever is more
7.8	Indicating lamps covers	2 nos of each colour
7.9	Blocker Diode	2 nos. of each rating & type
7.10	Control power supply module	1 No of each rating & type
7.11	Power module	3 No of each rating & type
7.12	Inverter Cell for Drive (Only HV)	1 No of each rating & type
8	Substation Automation System (SAS) / HMI / Data Concentrator	One set of spare for each SAS / HMI / Data Concentrator
8.1	All cards such as input & output cards, power supply cards, processor cards etc.	1 No. of each type
8.2	Ethernet switches	1 No. of each type
8.3	Control fuses / MCB	10 Nos. of each rating & type
9	Relays for GIS/ Switchboard / Relay control Panel	One set of spare for each GIS/ Switchboard (Refer Note-8) /Relay control Panel
9.1	Protection Relays	1 No. of each type
9.2	Auxiliary Relays	10% or minimum 2 Nos. of each type
10	UPS System	One set of spare for each UPS system
10.1	Power Thyristors / Transistors / IGBT / IGCT	1 No. of each rating & type
10.2	Control cards	1 No. of each type
10.3	Power supply cards	1 No. of each rating and type
10.4	Power fuses	20% for each rating OR 1 no. (min.) of each rating, whichever is more
10.5	Control fuses / MCB	10 Nos. of each rating & type
10.6	Indicating lamps	10% OR 3 nos. (min.), whichever is more
10.7	Indicating lamps covers	2 Nos. of each colour
10.8	Blocker Diode	2 Nos. of each rating & type
11	DC System	One set of spare for each DC System
11.1	Power Thyristors / Transistors / IGBT / IGCT	1 No. of each rating & type
11.2	Control cards	1 No. of each type
11.3	Power supply cards	1 No. of each rating and type
11.4	Power fuses	20% for each rating OR 1 no. (min.) of each rating, whichever is more
11.5	Control fuses / MCB	10 Nos. of each rating & type

S.No.	Part Description	Description
11.6	Indicating lamps	10% OR 3 nos. (min.), whichever is more
11.7	Indicating lamps covers	2 Nos. of each colour
11.8	Blocker Diode	2 Nos. of each rating & type
11.9	Thyristors/Transistors/ IGBT/ IGCT	3 Nos. of each rating & type
11.10	Power fuses	3 Nos. of each rating & type
12	Synchronous motors	One set of spare for each rating & type
12.1	Power fuses	20% for each rating OR 1 no. (min.) of each rating, whichever is more
12.2	Control fuses / MCB	10 Nos. of each rating & type
12.3	Bearing (DE & NDE)	1 set
12.4	Control cards	1 No. of each type
12.5	Terminal studs/bushing assembly	1 set each
12.6	Exciter Diodes and fuses	1 set
13	HV induction motors	One set of spare for each rating & type
13.1	Bearing (DE & NDE)	1 set
13.4	Purge panel	Complete 1 Panel (for Ex """"P"""" motor)
13.2	Terminal studs/bushing assembly	1 set each
13.3	speed switch	1 set each type
14	MV induction motors 37 kW & above	One set of spare for each rating & type
14.1	Bearing (DE & NDE)	1 set
14.3	Speed switch	1 set each type
14.2	Terminal studs/bushing assembly	1 set each
15	Fire alarm system	
15.1	All cards	1 No. of each type
15.2	Power fuses	20% for each rating OR 1 no. (min.) of each rating, whichever is more
15.3	Control fuses / MCB	10 Nos. of each rating & type
15.4	Terminal blocks	20 Nos
15.5	Smoke/Multisensor/Heat Detectors	1% of total installed capacity of each type OR 1 no.(min.) of each type, whichever is more
15.6	Glass for Break Glass Boxes/ Manual call point	5 % of each type OR 1 No. (min.) of each type, whichever is more
15.7	Ethernet Switch	1 No. of each type
16	Paging system / Plant Communication System	
16.1	All cards	1 No of each type
16.2	Power fuses	20% for each rating OR 1 no. (min.) of each rating, whichever is more
16.3	Control fuses / MCB	10 Nos. each rating & type
16.4	Ethernet Switch	1 No. of each type
17	Thyristor control panel for heaters	
17.1	Rectifier control module (Control card fully assembled)	1 No. of each type
17.2	Power supply card	1 No. of each type
17.3	Control cards	1 No of each type
17.4	Power fuses	2 Nos. min. of each rating and type
17.5	Control fuses / MCB	10 Nos. each rating & type

S.No.	Part Description	Description
17.6	Contactors	10% of each type OR one no (min) of each type, whichever is more
17.7	Indicating lamps	20% OR 1 nos. (min.), whichever is more
17.8	Indicating lamps covers	2 nos. of each colour
17.9	Blocker Diode	2 nos. of each rating & type
17.10	Power Module	1 No. of each rating and type
17.11	Thyristors	6 Nos. each rating
17.12	Transducer,Signal Isolator /Multiplier	1 No. each rating
18	Electrical Control System (ECS)	
18.1	Interposing relays (As applicable)	5 Nos. of each type
18.2	Power supply & control cards	1 No. of each type
18.3	Transducers	20% of estimated quantity of each type and make OR 1 no (min) of each type and make, whichever is more
18.4	Function generator cum counter	1 No.
18.5	4-20mA signal injection set	1 No.
18.6	Isolation transformer	1 No.
18.7	Ethernet Switch	1 No. of each type
19	Electrical Heat Tracing System	
19.1	RTD/Thermostat	1 no. of each type
19.2	Control fuses/ MCB/ELCB	5 Nos. each rating & type
19.3	Indicating lamps	10% or 2 nos. (min.) whichever is more
19.4	Indicating lamps covers	5 nos. of each colour
19.5	Contactor contacts	1 set for each rating and type
20	APFC panels for Capacitor Bank	One set of spare for total APFC panels
20.1	Control cards	One no. of each type
20.2	Power supply cards	One No of each rating & type
20.3	Power fuses	20% for each rating or one no. (min.) of each rating, whichever is more
20.4	Control fuses/ MCB	10 Nos. of each rating & type
20.5	Auxiliary Contactors	10% of each type or 1 no. (min.) of each type, whichever is more
20.6	Numerical Relays	One no. of each type
20.7	Indicating lamp covers	2 nos. of each colour
20.8	Indicating lamps	20% or 1 no. (min.), whichever is more
21	Solar Photovoltaic System	One set of spare for each system
21.1	Power Thyristor / Transistors / IGBT / IGCT	1 No. of each rating & type
21.2	Control cards	1 No. of each type
21.3	Power supply cards	1 No. of each rating and type
21.4	Cable connectors	10% or minimum 2 Nos. of each type
22	Lift	
22.1	Control Card	1 No. of each type
22.2	PLC/VFD	1 No. of each type
22.3	Floor Level indicator	1 no. of each type
22.4	Limit switches	1 no. of each type
22.5	Brake assembly	1 no. of each type
22.6	Complete Gear box Assembly	1 No. of each type
22.7	Relays & contactors	1 no. of each type
23	220kV GIS for Petchem Project	One set of spare for each GIS
23.1	SF6 Gas Leakage Detector	1 nos.

S.No.	Part Description	Description
23.2	Portable Gas filling and evacuating cart	1 nos.
23.3	SF6 Gas Analyzer	1 nos.
23.4	Portable Partial Discharge Monitoring System	1 nos.
23.5	SF6 Gas topping system	1 nos.
23.6	Handle for Disconnector switch drive (If applicable as per standard design)	4 nos.
23.7	Handle for earthing switch drive (If applicable as per standard design)	4 nos.
23.8	Tripping coil	2 nos.
23.9	Closing coil	2 nos.
23.10	Density monitoring device	2 Nos. of each type
23.11	Pressure Gauge	2 Nos. of each type
23.12	Ethernet Switch	1 Nos. of each type
23.13	Capacitive type voltage detectors	1 set
24	Excitation system for motors	
24.1	Transistors/IGBT/IGCT	3 Nos. of each rating & type
24.2	Controls cards	1 No. of each type
24.3	Power supply Cards	1 No. of each type
24.4	Power Fuses	3 Nos. of each rating & type
24.5	Contactors	no. of each rating and type (for rating > 400A)
25	Igniters	
25.1	Ignition transformer	1 No. of each rating & type
25.2	Control Card	1 No. of each rating & type
25.3	Ignition tip	1 No. of each type
26	Desalter	
26.1	Entrace Bushing	3 Nos. of each rating
26.2	Transformer Bushing	3 nos. of each rating
26.3	Insulators	3 Nos. of each rating
27	Flameproof Light Fitting	5% LED drivers for each type of FLP light fitting.

NOTES:

1. The word 'TYPE' means the Make, Model no., Type, Range, Size/ Length, Rating, Material as applicable.
2. Wherever % age is identified, Contractor shall supply next rounded figure.
3. The terminology used under 'Part Description' is the commonly used name of the part and may vary from manufacturer to manufacturer.
4. Mandatory spares as indicated above do not cover commissioning spares.
5. Mandatory spares as indicated above do not cover two year O&M spares.
6. Mandatory spares shall be applicable for electrical items of motors / sub-packages as per mandatory spares philosophy specified elsewhere in the bid document.
7. For Isolation breaker panel (GIS or AIS) one set of "Tripping Coil (1 No.), Closing coil (1 No.) and Control fuse/MCB (10 Nos. of each rating and type)" shall be considered as mandatory spares for each Isolation breaker panel (GIS or AIS).
8. For Isolation breaker panel (GIS or AIS) one set of "Auxiliary relays (1 no. of each type)" shall be considered as mandatory spares for Relays for Isolation breaker panel (GIS or AIS).
9. MV Switchboard shall include fixed and drawout type of switchboards such as PCC, MCC, PMCC, EPCC, EPMCC, ASB, LDB, ELDB, package switchboards etc.
10. 1 no. Ethernet switch of each type shall be provided for all switchboards put together.

6.2 COMMISSIONING SPARES

Commissioning Spare Parts shall be procured along with the main equipment as per equipment manufacturer's recommendations. The list of such recommended spares shall be obtained along with the offer.

Minimum 2 nos. Breaker handling trolley, 5 nos. each Breaker racking / rack out handle, Breaker spring charging handle and Fuse puller shall be procured for each type of switchboard.

6.3 RECOMMENDED SPARE FOR NORMAL OPERATION & MAINTAINENCE

Quotation for two-years spares for normal operation and maintenance (over and above mandatory spares) along with unit price shall be obtained with the proposal for Client to order the same separately.

6.4 SPECIAL TOOLS AND TACKLES

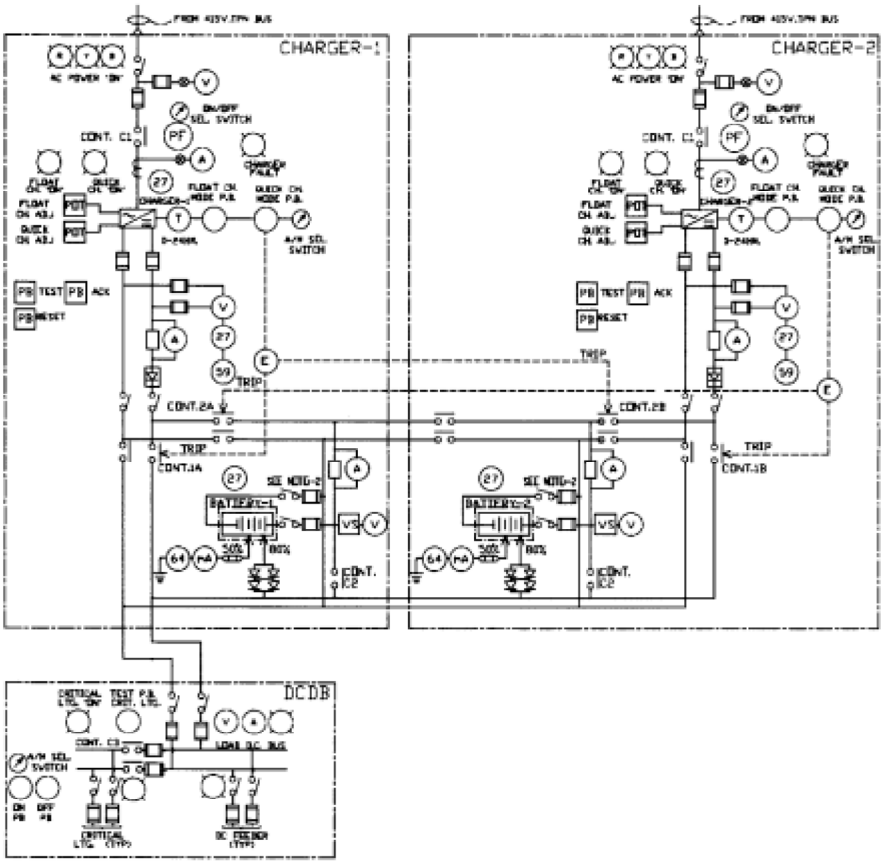
Required Special Tools and Tackles shall be procured along with the main equipment as per equipment manufacturer's recommendations. The list of such recommended special tools/tackles shall be obtained along with the offer.

7.0 VENDOR DATA REQUIREMENT

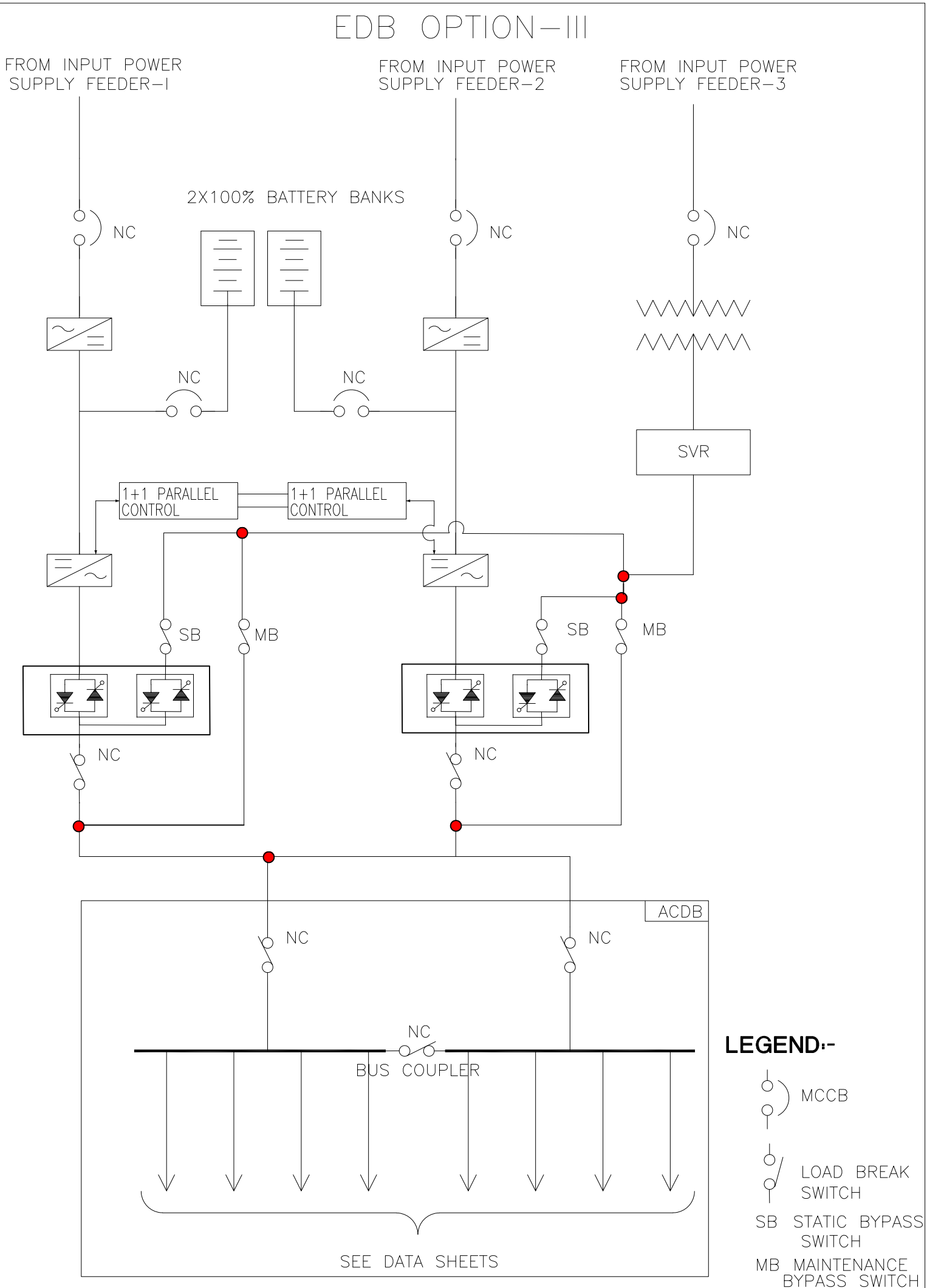
Vendor Data Requirement as indicated in the respective equipment Material Requisitions shall be followed.

EDB Annexure-1

OPTION–II



1. a) THE DC CONTACTORS SHALL HAVE A TESTED/ PUBLISHED DC RATING EQUAL TO OR EXCEEDING THE MOST STRINGENT CURRENT CARRYING AND BREAKING REQUIREMENTS CONSIDERING ADEQUATE DESIGN MARGINS.
   b) PUSH BUTTONS ARE NOT ACCEPTABLE IN PLACE OF SELECTOR SWITCHES FOR THE ON/OFF SWITCHING OPERATIONS OF THE CONTACTORS.
   c) THE DC CONTACTORS SHALL BE OPERATED WITH A DC CONTROL SUPPLY.
2. SUITABLY RATED DC MCCB CAN BE ACCEPTED IN PLACE OF SWITCH FUSE UNIT AT BATTERY OUTPUT.
3. BATTERY CONFIGURATION SHALL BE 2X50% AH CAPACITY UNLESS SPECIFIED OTHERWISE IN DATASHEET/ JOB SPECIFICATION


EDB OPTION–III
FROM INPUT POWER SUPPLY FEEDER–1
FROM INPUT POWER SUPPLY FEEDER–2
FROM INPUT POWER SUPPLY FEEDER–3
2X100% BATTERY BANKS
NC
NC
NC
NC
NC
SVR
1+1 PARALLEL CONTROL
1+1 PARALLEL CONTROL
SB
MB
SB
MB
NC
NC
ACDB
NC
NC
NC
BUS COUPLER
SEE DATA SHEETS
LEGEND:-
MCCB
LOAD BREAK SWITCH
SB STATIC BYPASS SWITCH
MB MAINTENANCE BYPASS SWITCH

DRAWINGS
(STRUCTURAL)

220 KV SWITCHYARD & GIS PACKAGE

TENDER NO. – B957-000-16-50-EB-T-0020

PROJECT: MPMC AND PMC/EPCM SERVICES FOR ETHYLENE CRACKER UNIT AND UTILITIES & OFFSITES RELATED TO BINA PETCHEM & REFINERY EXPANSION PROJECT (BPREP)

UNIT : 000

OWNER : BHARAT PETROLEUM CORPORATION LIMITED (BPCL)

PMC : ENGINEERS INDIA LTD.

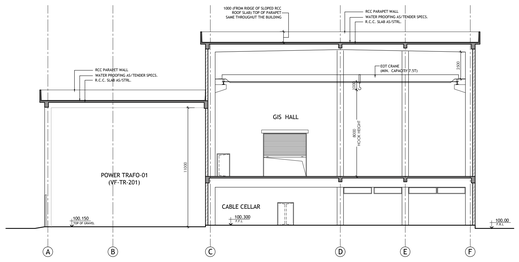
JOB NO. : B957

Rev. No	Date	Purpose	Prepared by	Checked by	Approved by
0	06.11.2024	ISSUED FOR BIDS	IF	PU	SP

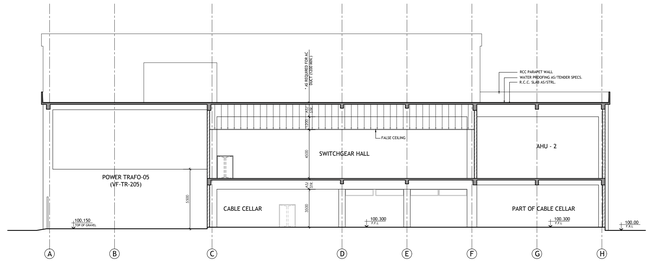
LIST OF DRAWINGS

NIL

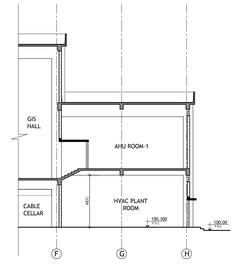
B957-710-81-46-02471



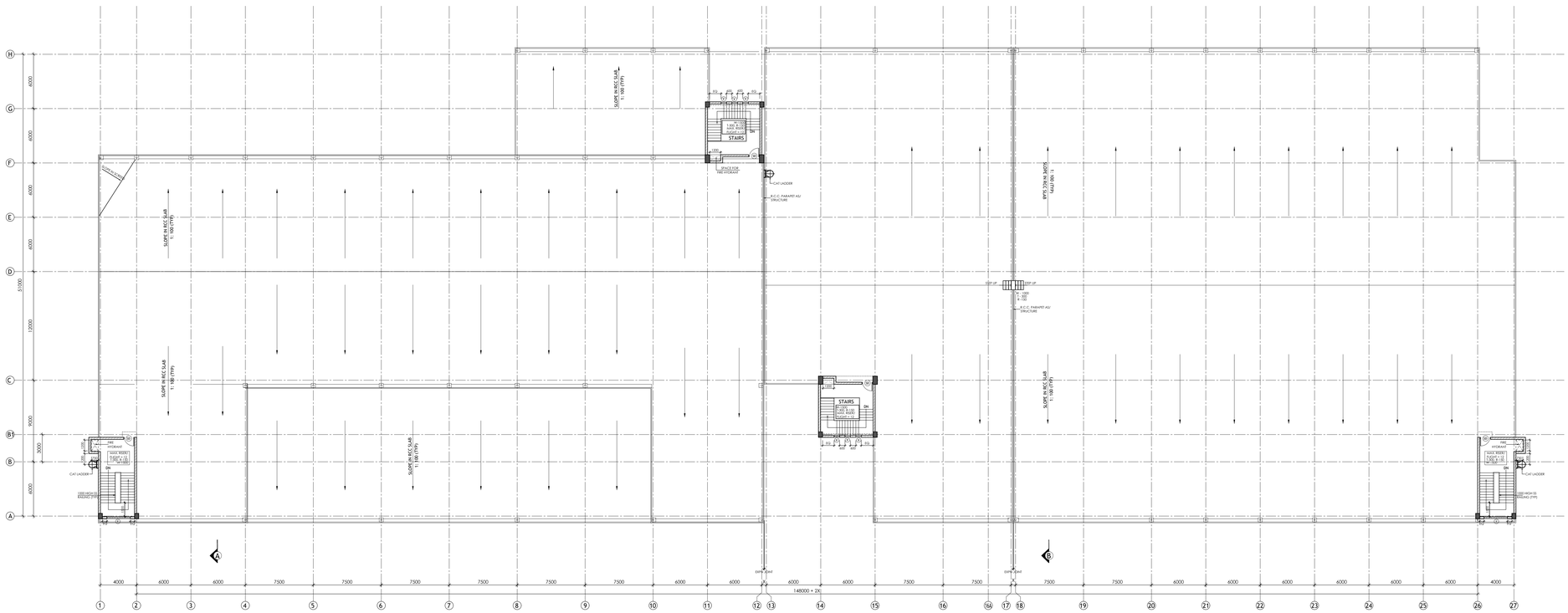
SECTION A-A



SECTION B-B



SECTION C-C



TERRACE PLAN

REF. DWG. NO.	REFERENCE DRAWING TITLE
B957-710-81-46-02470	GROUND FLOOR & FIRST FLOOR PLAN

NOTES:

THIS DRAWING IS GUIDE DRAWING IN NATURE AND IS INDICATIVE OF BROAD REQUIREMENT SUCH AS SPACE REQUIREMENT, SIZE AND LAYOUT.

THE CONTRATOR SHALL MAKE DESIGN IMPROVEMENTS OR REDESIGN THE BUILDING COMPLYING WITH BID REQUIREMENT.

HOWEVER TOTAL BUILDING AREA OF THIS DRG SHALL BE MAINTAINED AS MINIMUM REQUIREMENT.

CONTRACTOR TO PROVIDE A SUITABLE ARRANGEMENT TO MINIMIZE THE GAP BETWEEN SWITCHGEAR HALL AND DOOR/ SHUTTER DURING CLOSED CONDITION SO THAT THE LEAKAGE OF COLD AIR THROUGH THIS GAP WILL BE NEGLIGIBLE/ MINIMUM.

CUT-OUTS/ OPENINGS IN WALLS FOR HVAC SYSTEM SHALL BE FINALIZED BY CONTRACTOR DURING DETAILED ENGINEERING BASED ON HVAC VENDOR DRAWINGS/ DUCT LAYOUTS APPROVED BY PMC/ OWNER.

LEGEND :-

A.R.L. - TOP OF APPROACH ROAD LEVEL
F.F.L. - FINISHED FLOOR LEVEL

AC = AIR CONDITIONED
FC = FALSE CEILING

= 345 THK BRICK WALL AROUND TRANSFORMER AREA
= 230 THK BRICK WALL
= 115 THK BRICK WALL

RS - MOTORISED ROLLING SHUTTER
FD - 2 HRS FIRE RATED DOOR
ALD - ALUMINIUM DOOR
ALW - ALUMINIUM WINDOW
V - ALUMINIUM VENTILATOR
SD - STEEL DOOR
WD - WOODEN DOOR

REV.	DATE	DESCRIPTION	BY	CHKD	APPD	PM
D	30.10.24	RE-ISSUED FOR TENDER	BK	PD	AG	
C	17.10.24	ISSUED FOR TENDER	BS	PD	AG	
B	15.10.24	REVISED & RE-ISSUED FOR COMMENTS	BS	AG	AK	
A	10.10.24	ISSUED FOR COMMENTS	BK	AG	AK	

इंजीनियर्स इंडिया लिमिटेड (भारत सरकार का उपक्रम) ENGINEERS INDIA LIMITED (A Govt. of India Undertaking)

BHARAT PETROLEUM

BHARAT PETROLEUM CORP. LTD.

बीना पैट्रोकेमिकल एवं रिफाईनरी एक्सपैन्शन परियोजना

BINA PETROCHEMICAL & REFINERY EXPANSION PROJECT (BPREP)

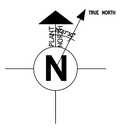
SUBSTATION - MRS 100

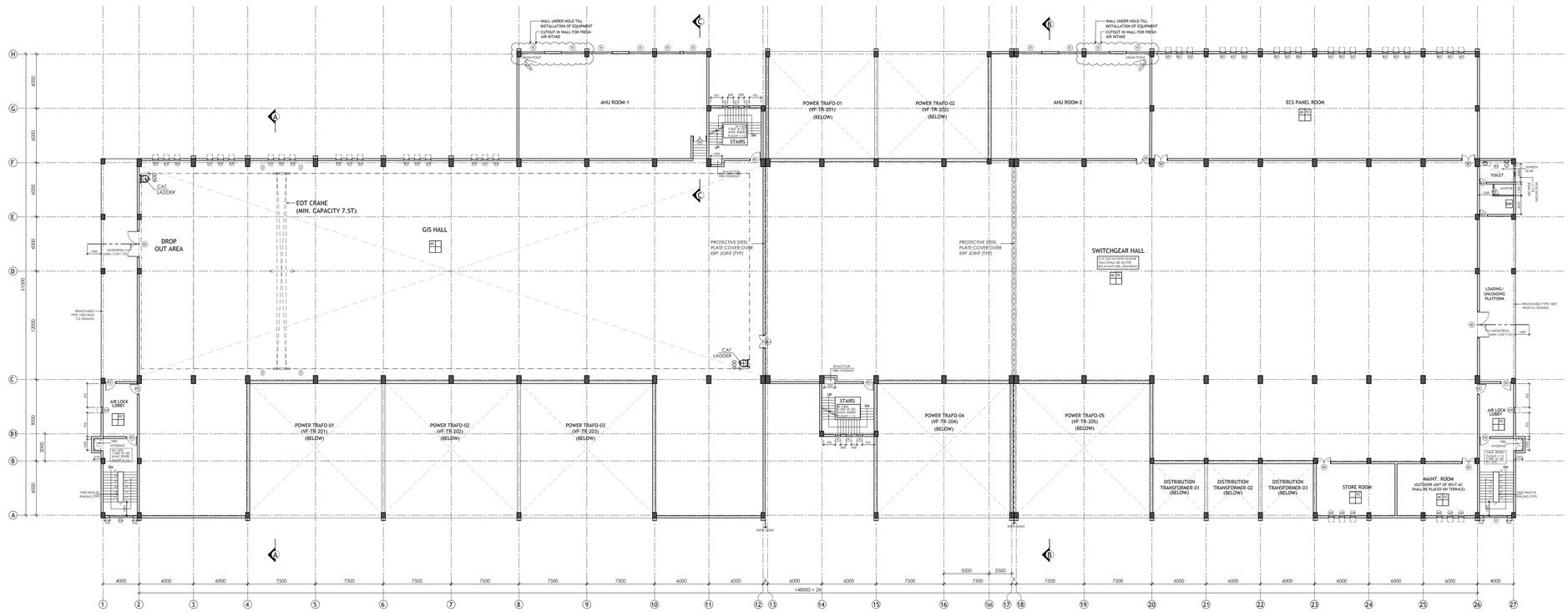
TERRACE PLAN & SECTIONS

SCALE	JOB NO.	UNIT	DIVN.	DEPT.	DWG. NO.	REV.
1:200	B957	710	81	46	02471	D

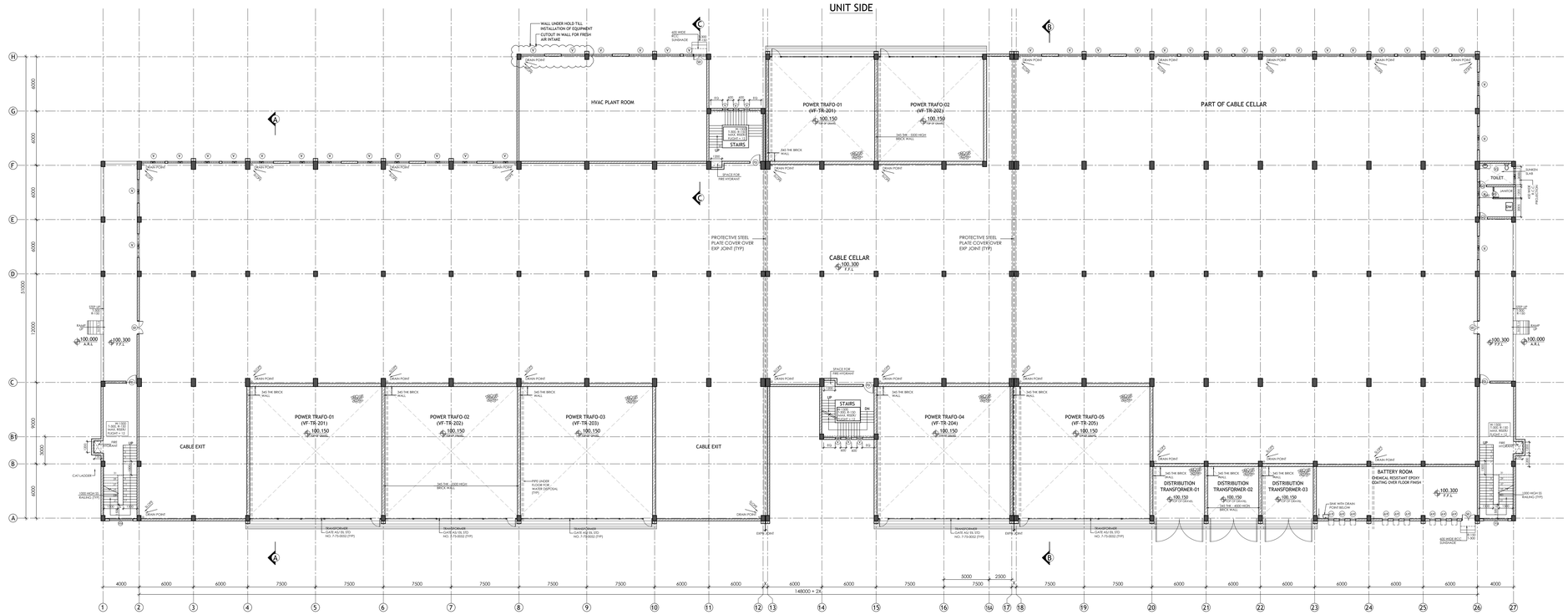
3-1641-0500 REV.4 / 06.03.2024 A0-1189 x 841

B957-710-81-46-02470





FIRST FLOOR PLAN



GROUND FLOOR PLAN

REF. DWG. NO.	REFERENCE DRAWING TITLE
B957-710-81-46-02471	TERRACE PLAN & SECTIONS

NOTES:

THIS DRAWING IS GUIDE DRAWING IN NATURE AND IS INDICATIVE OF BROAD REQUIREMENT SUCH AS SPACE REQUIREMENT, SIZE AND LAYOUT.

THE CONTRATOR SHALL MAKE DESIGN IMPROVEMENTS OR REDESIGN THE BUILDING COMPLYING WITH BID REQUIREMENT.

HOWEVER TOTAL BUILDING AREA OF THIS DRG SHALL BE MAINTAINED AS MINIMUM REQUIREMENT.

CONTRACTOR TO PROVIDE A SUITABLE ARRANGEMENT TO MINIMIZE THE GAP BETWEEN SWITCHGEAR HALL AND DOOR/ SHUTTER DURING CLOSED CONDITION SO THAT THE LEAKAGE OF COLD AIR THROUGH THIS GAP WILL BE NEGLIGIBLE/ MINIMUM.

CUT-OUTS/ OPENINGS IN WALLS FOR HVAC SYSTEM SHALL BE FINALIZED BY CONTRACTOR DURING DETAILED ENGINEERING BASED ON HVAC VENDOR DRAWINGS/ DUCT LAYOUTS APPROVED BY PMC/ OWNER.

ARCHITECTURAL FINISHES SCHEDULE

ROOM	FLOORING	WALL FINISH	CEILING
CABLE CELLAR	CEMENT CONCRETE FLOORING	CEMENT PLASTER & ACRYLIC DISTEMPER	CEMENT PLASTER & ACRYLIC DISTEMPER
BATTERY ROOM	CHEMICAL/ ABRASION RESISTANT EPOXY COATING OVER CEMENT CONCRETE FLOOR FINISH	CHEMICAL RESISTANT EPOXY COATING OVER CEMENT PLASTER UP TO 2500MM HEIGHT AND CEMENT PLASTER, POP PUNNING & PLASTIC EMULSION PAINT ABOVE 2500MM HEIGHT	CEMENT PLASTER & ACRYLIC DISTEMPER
HVAC PLANT ROOM , AHU	HEAVY DUTY FLOORING	CEMENT PLASTER & ACRYLIC DISTEMPER	CEMENT PLASTER & ACRYLIC DISTEMPER
SWITCHGEAR HALL	EPOXY COATING OVER HEAVY DUTY CEMENT CONCRETE FLOORING	CEMENT PLASTER & ACRYLIC DISTEMPER	ALUMINIUM PANEL FALSE CEILING
GIS HALL	EPOXY COATING OVER HEAVY DUTY CEMENT CONCRETE FLOORING	CEMENT PLASTER & ACRYLIC DISTEMPER	CEMENT PLASTER & ACRYLIC DISTEMPER
AIR LOCK LOBBY	VITRIFIED TILES FLOORING	CEMENT PLASTER, POP PUNNING & PLASTIC EMULSION PAINT	COMBINATION OF GYPSUM BOARD & MINERAL FIBER TILE FALSE CEILING AT 3000 MM FROM FFL
STORE ROOM, MAINTENANCE ROOM, ECS PANEL ROOM	VITRIFIED TILES FLOORING	CEMENT PLASTER, POP PUNNING & PLASTIC EMULSION PAINT	COMBINATION OF GYPSUM BOARD & MINERAL FIBER TILE FALSE CEILING
TOILET/ D/W AREA	NON-SLIP VITRIFIED TILE FLOORING	CERAMIC TILE DADO UP TO 2100 MM AND CEMENT PLASTER, POP PUNNING & PLASTIC EMULSION PAINT ABOVE	MOISTURE RESISTANT GYPSUM BOARD FALSE CEILING AT 3000 MM FROM FFL
LOADING/ UNLOADING PLATFORM	HEAVY DUTY CEMENT CONCRETE FLOORING	CEMENT PLASTER & ACRYLIC DISTEMPER	CEMENT PLASTER & ACRYLIC DISTEMPER
TRANSFORMERS	GRAVEL FILLING	CEMENT PLASTER, EXTERIOR ACRYLIC PAINT	CEMENT PLASTER & ACRYLIC DISTEMPER
STAIRCASE /STEPS	KOTA STONE	CEMENT PLASTER & ACRYLIC DISTEMPER	CEMENT PLASTER & ACRYLIC DISTEMPER
EXTERNAL WALL	PLAIN CEMENT PLASTER AND EXTERIOR ACRYLIC PAINT		
ROOF	OVERDECK INSULATION CUM WATER PROOFING SYSTEM		

LEGEND :-

A.R.L. - TOP OF APPROACH ROAD LEVEL
F.F.L. - FINISHED FLOOR LEVEL

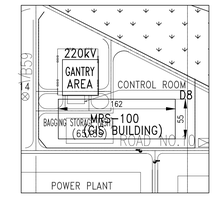
AC = AIR CONDITIONED
FC = FALSE CEILING

= 345 THK BRICK WALL AROUND TRANSFORMER AREA
= 230 THK BRICK WALL
= 115 THK BRICK WALL

RS - MOTORISED ROLLING SHUTTER
FD - 2 HRS FIRE RATED DOOR
ALD - ALUMINIUM DOOR
ALW - ALUMINIUM WINDOW
V - ALUMINIUM VENTILATOR
SD - STEEL DOOR
WD - WOODEN DOOR

BUILDING AREA:

BUILDING AREA	=	5750 SQM
TRANSFORMERS (PART OF BUILDING)	=	1510 SQM
TOTAL AREA	=	**7260 SQM**



KEY PLAN

REV.	DATE	DESCRIPTION	BY	CHKD	APPD	PM
E	30.10.24	RE-ISSUED FOR TENDER	BK	PD	AG	
D	30.10.24	RE-ISSUED FOR TENDER	BK	PD	AG	
C	17.10.24	ISSUED FOR TENDER	BS	PD	AG	
B	15.10.24	REVISED & RE-ISSUED FOR COMMENTS	BS	AG	AK	
A	10.10.24	ISSUED FOR COMMENTS	BK	AG	AK	

इंजीनियर्स इंडिया लिमिटेड ENGINEERS INDIA LIMITED (A Govt. of India Undertaking)

BHARAT PETROLEUM

BHARAT PETROLEUM CORP. LTD.

बीना पैट्रोकेमिकल एवं रिफाईनरी एक्सपैन्शन परियोजना

BINA PETROCHEMICAL & REFINERY EXPANSION PROJECT (BPREP)

SUBSTATION - MRS 100

GROUND FLOOR & FIRST FLOOR PLAN

SCALE	JOB NO.	UNIT	DIVN.	DEPT.	DWG. NO.	REV.
1:200	B957	710	81	46	02470	E

3-1641-0500 REV.4 / 06.03.2024 A0-1189 x 841

LIST OF DRAWINGS
(ARCHITECTURAL)

220 KV SWITCHYARD & GIS PACKAGE

PROJECT : **BINA PETROCHEMICAL & REFINERY EXPANSION PROJECT (BPREP), MADHYA PRADESH**

UNIT : **000**

OWNER : **M/s BHARAT PETROLEUM COOPERATION LIMITED (BPCL)**

PMC : **ENGINEERS INDIA LIMITED**

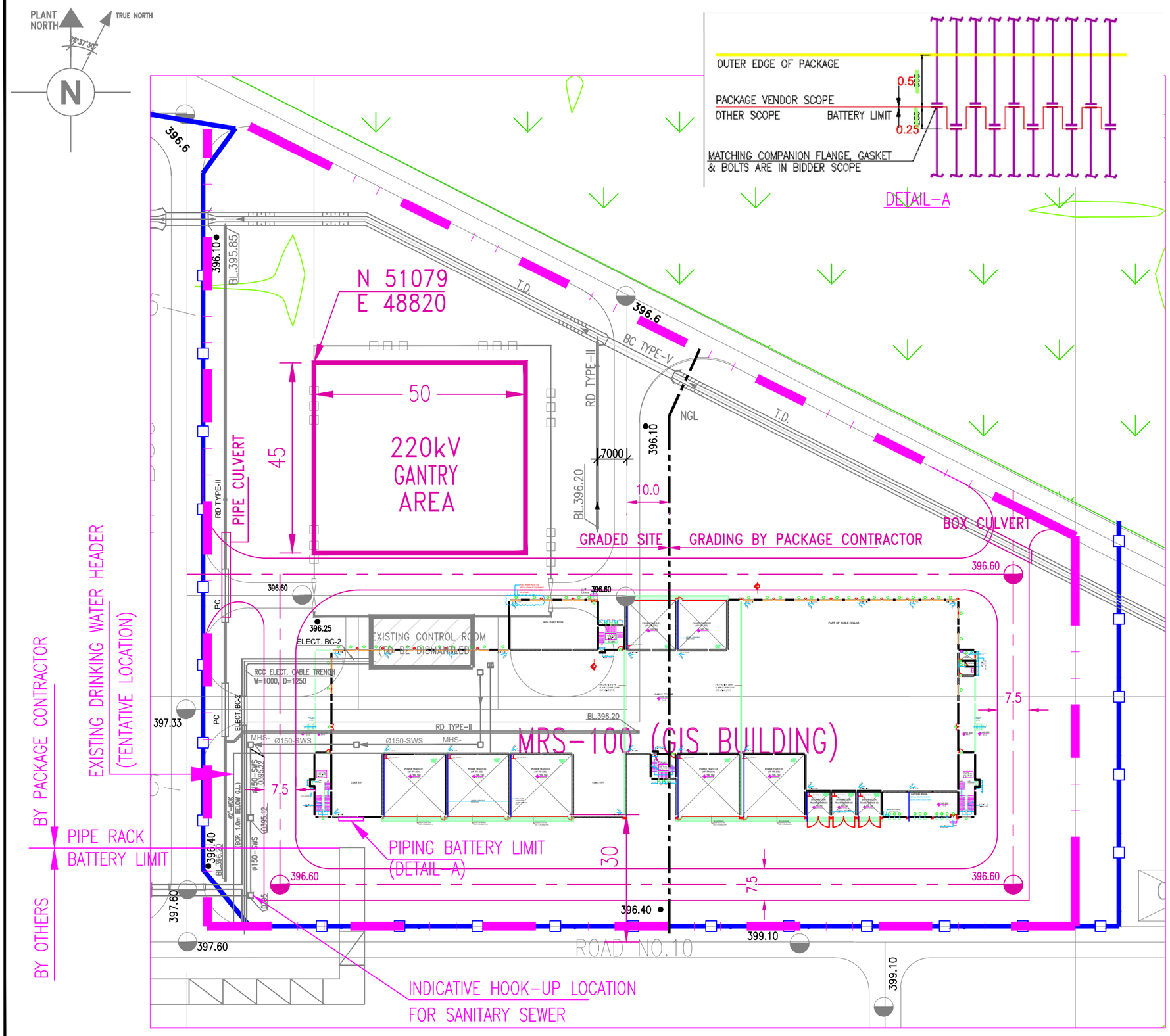
JOB NO. : **B957**

TENDER NO. : **B957-000-16-50-EB-T-0020**

Rev. No	Date	Purpose	Prepared by	Checked by	Approved by
A	11.11.2024	ISSUED FOR BIDS	PC	AG	AK

LIST OF DRAWINGS
(ARCHITECTURAL)

S.NO	TITLE	DRAWING NO.
1	Sub-Station MRS-100, Ground floor & First Floor plan	B957-710-81-46-02470
2	Sub-Station MRS-100, Terrace floor plan & Sections	B957-710-81-46-02471



NOTES:-

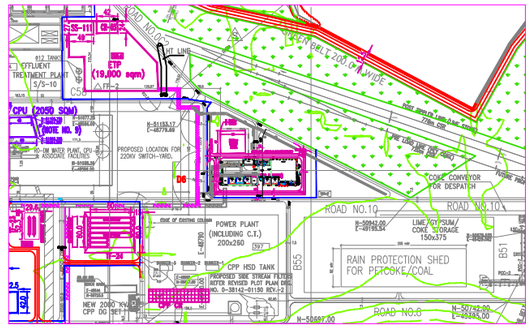
1. All dimensions, levels and co-ordinates are in metre.
2. This drawing shall be read in conjunction with scope of work, specifications etc.
3. Partly graded site shall be handed over to package contractor as per the indicated levels. The contractor shall carry out the grading of the balance area in the scope limit of the package contractor to match with the existing levels of graded area. Also, micro grading with in the scope limit shall be carried out by the package contractor.
4. Approach roads including road crossing such as Pipe Culverts, Box culverts, ERC, IRC's etc. are in scope of Package Contractor.
5. All temporary approaches etc. required for erection purpose is in the scope of package contractor.
6. Storm water drainage for gantry area of GIS is in the scope of package contractor including connecting the same to nearest offsite drain as shown.
7. This drawing indicates scope outside Substation building & 220 kv Gantry area. For scope inside substation building refer elsewhere in the bid document.
8. The existing building (Existing Control Room) in the plot shall be dismantled by others.
9. Package Contractor shall provide the roads all around the MRS building.
10. For scope of Fire Protection, refer documents given elsewhere in the tender document.
11. Package Contractor shall provide RCC paved area for transformer maintenance/ placement within his Scope limit as per the requirement.
12. All Electrical Trenches within the scope limit shall be in the scope of Package contractor.
13. The pipes shall be provided at the Piping Battery limit and further piping within the package scope area shall be in the scope of Package Contractor.
    - 13.1. All high point vent & low point drain coming in the package shall be provided by the contractor.
    - 13.2. All valves, instrument connections etc. inside the package shal be accessible & platform to be provided for operation & maintenance.
    - 13.3. Supports for lines inside the Package to be supported by contractor including supply of all materials.
    - 13.4. Flanges shall be staggered at Battery limit interface.
    - 13.5. Details as shown in the drawing are indicative only to show battery limit piping in staggered manner. The contractor shall develop & submit the detailed battery limit drawings showing total number of lines, sequence, elevation etc.
14. The location of existing Sanitary sewer & drinking water is tentative & the shall be verified by the package contractor at the site.

LEGENDS:

SCOPE LIMIT FOR PACKAGE CONTRACTOR

FACILITIES BY OTHERS

CHAIN LINK FENCING (BY OTHERS)



KEY PLAN

D	11-11-2024	REVISED & ISSUED FOR TENDER	ANIL	NS	AK		
C	08-11-2024	ISSUED FOR TENDER	ANIL	NS	AK		
B	05-11-2024	REVISED & ISSUED FOR COMMENTS	ANIL	NS	AK		
A	05-11-2024	ISSUED FOR COMMENTS	ANIL	NS	AK		
REV.	DATE	DESCRIPTION	BY	CHK	APPROVED	APPROVED	

ENGINEERS INDIA LIMITED
NEW DELHI

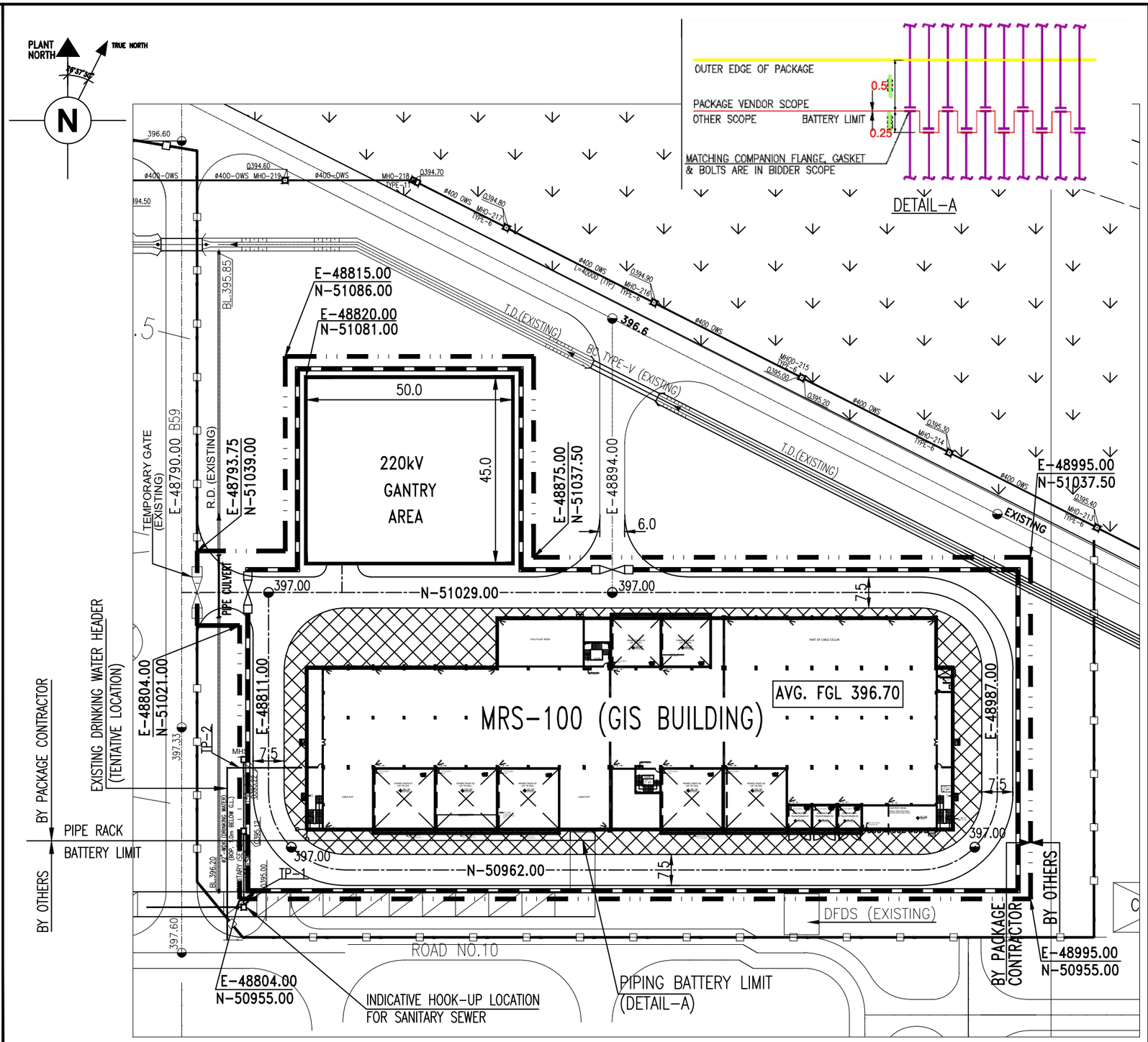
BHARAT_PETROLEUM_CORP._LTD.
BINA_PETROCHEMICAL_&
REFINERY_EXPANSION
PROJECT_(BPREP)

SCOPE DRAWING
220 KV SWITCHYARD & GIS PACKAGE

DRAWING NO.	REV.
B957-000-81-45-30571	D

1-1641-0503 REV.1 A3-420x297

TA01

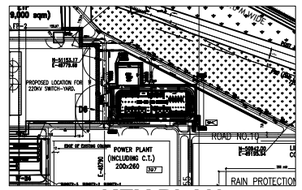


NOTES:-

1. All dimensions, levels and co-ordinates are in metre.
2. This drawing shall be read in conjunction with scope of work, specifications etc.
3. Graded site shall be handed over to package contractor as per the indicated levels. Micro grading with in the scope limit shall be carried out by the package contractor.
4. Approach roads including road crossing such as Pipe Culverts, Box culverts, ERC, IRC's etc. are in scope of Package Contractor.
5. All temporary approaches etc. required for erection purpose is in the scope of package contractor.
6. Storm water drainage for gantry area of GIS is in the scope of package contractor including connecting the same to nearest offsite drain.
7. This drawing indicates scope outside Substation building & 220 kv Gantry area. For scope inside substation building refer elsewhere in the bid document.
8. Package Contractor shall provide the roads all around the MRS building.
9. For scope of Fire Protection, refer documents given elsewhere in the tender document.
10. Package Contractor shall provide RCC paved area for transformer maintenance/ placement within his Scope limit as per the requirement.
11. All Electrical Trenches/trays including structural supports (if applicable) within the package battery limit shall be in the scope of Package contractor.
12. The pipes shall be provided at the Piping Battery limit and further piping within the package scope area shall be in the scope of Package Contractor.
    - 12.1. All high point vent & low point drain coming in the package shall be provided by the contractor.
    - 12.2. All valves, instrument connections etc. inside the package shal be accessible & platform to be provided for operation & maintenance.
    - 12.3. Supports for lines inside the Package to be supported by contractor including supply of all materials.
    - 12.4. Flanges shall be staggered at Battery limit interface.
    - 12.5. Details as shown in the drawing are indicative only to show battery limit piping in staggered manner. The contractor shall develop & submit the detailed battery limit drawings showing total number of lines, sequence, elevation etc.
13. The location of existing Sanitary sewer & drinking water is tentative & the shall be verified by the package contractor at the site.
14. The extent of rcc pavement marked is tentative. Contractor to provide pavement as per tender requirement.
15. Any damage to the existing facilities shall be corrected to original shape by the contractor without any cost implication.
16. Boundary wall location shown here is indicative and shall be finalized during detailed engineering.

LEGENDS:

- SCOPE LIMIT FOR PACKAGE CONTRACTOR
- BOUNDARY WALL (2.0M HIGH)
- GATE
- EXISTING FACILITIES (BY OTHERS)
- CHAIN LINK FENCING (BY OTHERS)
- RCC PAVEMENT TYPE-I (MINIMUM)
- ROAD TOP LEVEL (RTL)
- FINISHED GRADE LEVEL (FGL)
- TP-1 TAPPING POINT (SANITARY)
- TP-2 TAPPING POINT (DRINKING WATER)



KEY PLAN

ENGINEERS INDIA LIMITED, NEW DELHI	BHARAT_PETROLEUM_CORP._LTD. BINA_PETROCHEMICAL_& REFINERY_EXPANSION PROJECT_(BPREP)					
	E	04.03.2025	REVISED & ISSUED FOR TENDER	ANIL	UF/NS	AK
	D	11-11-2024	REVISED & ISSUED FOR TENDER	ANIL	NS	AK
	C	08-11-2024	ISSUED FOR TENDER	ANIL	NS	AK
	B	05-11-2024	REVISED & ISSUED FOR COMMENTS	ANIL	NS	AK
	A	05-11-2024	ISSUED FOR COMMENTS	ANIL	NS	AK
	REV.	DATE	DESCRIPTION	BY	CHK	APPROVED / APPROVED

SCOPE DRAWING 220 KV SWITCHYARD & GIS PACKAGE

DRAWING NO.	REV.
B957-000-81-45-30571	E

1-1641-0503 REV.1 A3-420x297

B957-000-16-50-0011

OUTDOOR SWITCHYARD

220KV LINE-1 FROM SEB

220KV LINE-2 FROM SEB

LA 198KV, 10KA

CVT 220kV / 110V 3 CORES

METERING PT 220kV / 110V 3 CORES

METERING CT 2000/1A 2 CORES

GANTRY / WT

ISOLATOR WITH E/S 2000A CR TYPE

BY OWNER/OTHERS ←→ BY CONTRACTOR

LOC : MRS SUBSTATION(SS-100)

220KV (E) CABLES

100-EHV-101 GIS

220 KV, 50 KA (3sec.) TP BUS 2000 A

220 KV, 50 KA (3sec.) TP BUS, 2000 A

100-TR-011 220/66kV 160/200 MVA ONAN/ONAF, YNYn0 OLTC +10% TO -10% IN STEPS OF 1.25% (TYP.)

100-TR-012 220/66kV 160/200 MVA ONAN/ONAF, YNYn0 OLTC +10% TO -10% IN STEPS OF 1.25% (TYP.)

100-TR-013 220/66kV 160/200 MVA ONAN/ONAF, YNYn0 OLTC +10% TO -10% IN STEPS OF 1.25% (TYP.)

100-BD-01 GIBO

100-BD-02 GIBO

100-BD-03 GIBO

100-HV-102

66 KV, 3150A, 40 KA (3sec.) TP BUS, 3150 A

66 KV, 40 KA (3sec.) TP BUS, 3150 A

TRAFO FEEDER 100-TR-021

PLANT FEEDER-4 100-HV-111 EOI SS-101

PLANT FEEDER-4 100-HV-112 EOI SS-102

PLANT FEEDER-4 100-HV-111 LLDPE/HDPE SS-103

PLANT FEEDER-4 100-HV-112 LLDPE/HDPE SS-104

PLANT FEEDER-4 100-HV-111 PPU SS-105

PLANT FEEDER-4 100-HV-111 CT-02 SS-106

PLANT FEEDER-4 100-HV-112 CT-02 SS-107

PLANT FEEDER-4 100-HV-112 RMPP+HDPE SS-108

PLANT FEEDER-4 100-HV-115 LLDPE/HDPE SS-109

SPARE TRAFO FEEDER

SPARE PLANT FEEDER-1 (3 NOS.)

PLANT FEEDER-1 100-HV-117 LLDPE/HDPE SS-110

PLANT FEEDER-4 100-HV-113 CT-02 SS-108

PLANT FEEDER-4 100-HV-113 CT-02 SS-109

TRAFO FEEDER 100-TR-022

PLANT FEEDER-4 100-HV-122 EOI SS-101

PLANT FEEDER-4 100-HV-122 EOI SS-102

PLANT FEEDER-4 100-HV-112 LLDPE/HDPE SS-103

PLANT FEEDER-4 100-HV-114 LLDPE/HDPE SS-104

PLANT FEEDER-4 100-HV-115 PPU SS-105

PLANT FEEDER-4 100-HV-118 CT-02 SS-106

PLANT FEEDER-4 100-HV-117 LLDPE/HDPE SS-110

PLANT FEEDER-2 100-HV-122 PP EXTRUDER

PLANT FEEDER-4 100-HV-118 RMPP+HDPE SS-110

PLANT FEEDER-4 100-HV-118 LLDPE/HDPE SS-109

SPARE PLANT FEEDER-4 (2 NOS.)

PLANT FEEDER-1 100-HV-118 LLDPE/HDPE SS-110

PLANT FEEDER-4 100-HV-118 CT-01 SS-106

PLANT FEEDER-4 100-HV-119 CT-02 SS-109

66/6.9 KV * MVA Dyn1, Z= *% ONAN/ONAF,OLTC +10% TO -10% IN STEPS OF 1.25% (TYP.)

100-TR-021

100-TR-022

100-BD-04

100-BD-05

100-MV-201

MRS AUX SWBD.

6.6 kV, *A, 40 KA (1 sec.) TP BUS

MANUAL TRANSFER

APFC

CAPACITOR

SPARE FEEDER

FEEDERS FOR OWNER'S USE (REFER NOTE-8)

6.6/0.433 KV * MVA Z= *, Dyn11 OLTC +/-5 % 2.5 % STEPS

100-PCC-301

PMCC

415 V, * A, 50Hz, 65 KA (1 Sec.), TPN

MOTOR FEEDERS (RATING >37KW) (TYP.)

MOTOR FEEDERS (RATING >=3.7KW & <=37KW) (UPTO 45kA TYP.)

MOTOR FEEDERS (RATING >=3.7KW & <=37KW) (UPTO 45kA TYP.)

MCCB+CONTACTOR OUTGOING>=250A (TYP.)

MCCB OUTGOING FEEDER (TYP.)

OUTGOING BREAKER FEEDER (TYP.)

NORMAL LTG. TRAFO. 415V/415V * kVA Z= *, Dyn1

100-LB-331 LDB

100-ELB-332 ELDB

E/M INTERLOCK

415V, *A, 25kA(1Sec.), 50Hz, TPN

INDOOR LP/ELP (TYP.)

OUTDOOR LP/ELP (TYP.)

FROM EMG. HV SWBD (SS-109)

100-MV-211 6.6 kV ISOLATING BREAKER PANEL

6.6/0.433 KV * MVA Z= *, Dyn11 OLTC +/-5 % 2.5 % STEPS

FROM 100-PCC-301 (PMCC)

100-EPC-302

EPMCC

A/M TRANSFER

415 V, * A, 50Hz., 65 KA (1 Sec.), TPN

EMG. LTG. TRAFO. 415V/415V * kVA Z= *, Dyn1

FROM EPMCC 100-EPC-302

FROM PMCC 100-PCC-301

FROM PMCC 100-PCC-301

2x150Ah BATTERY BANKS

230V AC UPS SYSTEM LOC: SS-100

LDB PANEL CONTROL

ELDB PANEL CONTROL

LDB

ELDB

LEGEND-

MCCB

LOAD BREAK SWITCH

3P STATIC BYPASS SWITCH

MC MAINTENANCE BYPASS SWITCH

OUTGOING FEEDERS FOR VFD, THYRISTOR PANEL, ECS, LAN ETC.

FROM PMCC FROM EPMCC

110V DC SYSTEM LOC.: SS-100

2x150Ah

110V DCDB

DC LOADS FOR SWGR. CONTROL INCLUDING SPARE FEEDERS

1x150Ah

DC LOADS CRITICAL LIGHTING INCLUDING SPARE FEEDERS

FROM PMCC FROM PMCC

PDB-01, (MRS S/S AIR CONDITIONING) (BY PACKAGE VENDOR)

INTERLOCK

*A

NC NO

415V,*A, 50HZ, *KA (1 Sec.), AL.

LOAD DISTRIBUTION

- S/S AIRCONDITIONING PACKAGE

REF. DWG. NO.	REFERENCE DRAWING TITLE

NOTES :-

1. THIS SINGLE LINE DIAGRAM IS INDICATIVE ONLY. IT IS INTENDED TO HIGHLIGHT THE POWER DISTRIBUTION PHILOSOPHY AND BROADLY DEFINE THE MAJOR ELECTRICAL EQUIPMENTS. THE EXACT DETAILS OF EQUIPMENT SHALL BE FINALISED DURING DETAILED ENGINEERING AS PER PROJECT SPECIFICATIONS.
2. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO DEVELOP THE SINGLE LINE DIAGRAM INTO DETAILED DIAGRAM BASED ON BID PACKAGE REQUIREMENTS.
3. THE RATING & QUANTITY OF ELECTRICAL EQUIPMENT SHOWN IN THE SINGLE LINE DIAGRAM ARE INDICATIVE. THE QUANTITIES & RATING OF THESE EQUIPMENTS SHALL BE DECIDED & FINALISED DURING DETAIL ENGINEERING MEETING AS PER BID PACKAGE REQUIREMENT WITH NO COST AND TIME IMPLICATION.
4. TYPICAL OUTGOING FEEDERS ARE SHOWN IN FOR ALL SWITCHBOARDS. REQUIRED NUMBER OF OUTGOING FEEDERS INCLUDING SPARES AS PER ENGINEERING DESIGN BASIS AND JOB SPECIFICATION SHALL BE PROVIDED BY THE CONTRACTOR IN LINE WITH BID DOCUMENT.
5. RELAYS, METERS AND OTHER COMPONENTS SHALL BE PROVIDED FOR FEEDERS AS PER FEEDER DATASHEETS, RESPECTIVE FEEDER HARDWARE DATASHEETS, ENGINEERING DESIGN BASIS & JOB SPECIFICATION ENCLOSED WITH THE BID DOCUMENT.
6. ANY OTHER EQUIPMENT AS REQUIRED FOR MEETING STATUTORY REQUIREMENT SHALL BE PROVIDED BY CONTRACTOR.
7. SCOPE LINE MARKED ON THE KEY SLD IS INDICATIVE AND DOES NOT DEFINE TOTAL ELECTRICAL SCOPE OF CONTRACTOR FOR THE PACKAGE. FOR DETAILED SCOPE, REFER BID DOCUMENT AND OTHER DRAWINGS.
8. FOLLOWING FEEDERS SHALL BE PROVIDED IN 6.6KV SWITCHBOARD FOR OWNER PURPOSE:
   A. 2 NOS., 1250A FEEDERS FOR ETP
   B. 2 NOS., 1250A FEEDERS FOR BUTENE-1
   C. 2 NOS., 1250A FEEDERS FOR PETCHEM MCR, LAB & FWPH
   D. 2 NOS., 1250A FEEDERS FOR STEAM BLOCK
   E. 2 NOS., 1250A FEEDERS FOR POLYMER WAREHOUSE & GANTRY
9. 6.6KV SWITCHBOARD & 415V PMCC/EPMCC SHALL BE PROVIDED WITH TWO BUS COUPLERS. HOWEVER SECOND BUS COUPLER SHALL BE WITHOUT ANY NUMERICAL RELAY AND SHALL BE PROVIDED WITH ELECTROMECHANICAL TYPE TRIP CIRCUIT SUPERVISION RELAY.

LEGENDS

- EHV/HV CIRCUIT BREAKER
- AIR CIRCUIT BREAKER
- NEUTRAL GROUNDING RESISTOR
- TRANSFORMER
- GAS/AIR INSULATED BUSDUCT
- BUSBAR
- FUSE
- ON LOAD ISOLATOR/ HEAVY DUTY SWITCH
- MINIATURE CIRCUIT BREAKER
- RESIDUAL CURRENT CIRCUIT BREAKER
- I/L INTERLOCK
- A/M AUTO/MANUAL
- PUSH BUTTON STATION WITH AMMETER
- PUSH BUTTON STATION
- POTENTIAL TRANSFORMER
- CAPACITOR BANK
- TRANSFORMER TRIP PB (BREAK GLASS TYPE)
- CURRENT TRANSFORMER
- MFM MULTI FUNCTION METER
- CBCT
- ELR EARTH LEAKAGE RELAY
- 3 POSITION MOTORISED ISOLATOR FOR GIS
- 2 POSITION MOTORISED ISOLATOR FOR GIS
- HIGH SPEED EARTH SWITCH
- MOTOR
- RECTIFIER/CHARGER
- INVERTER
- SS STATIC SWITCH
- BATTERIES
- CONTACTOR
- DRAWOUT FEATURE
- CABLE GLAND TERMINATION
- MPR MOTOR PROTECTION RELAY
- T SYNCHRONOUS TIMER

REV.	DATE	REVISIONS	BY	CHKD	APPD	PEMPC
D	28.04.25	REVISED & ISSUED WITH TA-2	SK	RSR	HK	
C	18.03.25	REVISED & ISSUED WITH TA-1	SK	RSR	HK	
B	18.10.24	REVISED & ISSUED WITH BID PACKAGE	SK	RSR	HK	
A	10.10.24	ISSUED WITH BID PACKAGE	SK	RSR	HK	

इंजीनियर्स इंडिया लिमिटेड (भारत सरकार का उपक्रम) ENGINEERS INDIA LIMITED (A Govt. of India Undertaking)

CLIENT: BHARAT PETROLEUM CORP. LTD.

BINA PETROCHEMICAL & REFINERY EXPANSION PROJECT (BPREP)

KEY SINGLE LINE DIAGRAM
220KV GIS PACKAGE (SS-100)

SCALE	JOB NO.	UNIT	DIVN.	DEPT.	DWG. NO.	REV.
NTS	B957	000	16	50	000011	D

3-1641-0500 REV.2 A0-1189 x 841

ANNEXURE: BOQ 220kV GIS SUPPLY BPCL Bina
REV No: 0.0
DATE: 20.06.2025

Sl. No.	Item Description	Unit	Qty.	Remarks
1.0	**SUPPLY- GIS: 220KV, 50KA FOR 3S, GAS INSULATED SWITCHGEAR (GIS) AS PER TS (Two/ Double bus scheme)**			
1.01	GIS SUPPLY: 220KV, 2000A, 50kA, SF6 GIS BUS BAR MODULE (INCLUDING SF6 GAS, STRUCTURE, HARDWARES & EARTHING MATERIALS) AS PER TS	SET	4	
1.02	GIS SUPPLY: 220KV, 50kA, SF6 BUS PT/ VT BAY MODULE WITH BUS EARTH SWITCH (INCLUDING SF6 GAS, STRUCTURE, HARDWARES & EARTHING MATERIALS) AS PER TS	SET	4	220kV PT/ VT BAY MODULE shall include following but not limited to, (a) 1 SET- 1 NO x3 phase Disconnector with Maintenance Grounding Switch, complete with operating mechanism. (b) 1 SET- 1 NO x3 phase High Speed make proof Earthing Switch, complete with operating mechanism. (c) 3 NO- 1 phase multi winding Voltage Transformer with residual Current Circuit Breaker arrangement In addition to above, Gas device, UHF sensors, Pressure Switches, Expansion joints/ Flexible connections, Insulators etc. as applicable shall be included, however, Online PD Monitoring System, Local Control Cubicle and End Terminations, if applicable shall be covered separately. GIS shall be complete with all necessary terminal boxes, inspection windows, SF6 gas, grounding connection, pipings for gas monitoring system, trays, support structures with mounting hardwares, walkways, interconnecting cables with glands, ferrules, lugs etc. Please refer section-2 (TS for EHV GIS)- Technical Specification.
1.03	GIS BAY SUPPLY: 220kV, 2000A, 50 kA, SF6 INCOMING GIS LINE FEEDER BAY MODULE (INCLUDING SF6 GAS, STRUCTURE, HARDWARES & EARTHING MATERIALS) AS PER TS	SET	2	220kV INCOMING GIS LINE FEEDER BAY MODULE shall include following but not limited to, (a) 1 SET- 1 NO x3 phase Circuit Breaker, compatible for Controlled Switching Facility (if applicable), complete with operating mechanism (b) 2 SET- 1 NO x3 phase Disconnector with Maintenance Grounding Switch, complete with operating mechanism. (c) 1 SET- 1 NO x3 phase Disconnector without Maintenance Grounding Switch, complete with operating mechanism. (d) 1 SET- 1 NO x3 phase High Speed make proof Earthing Switch, complete with operating mechanism. (e) 6 NO- 1 phase multi ratio Current Transformer. (f) 6 NO- Cable connection module suitable upto 2Rx1600sqmm XLPE Cable. (additional requirement, if any shall be payable as per other line item) In addition to above, Gas device, UHF sensors, Pressure Switches, Expansion joints/ Flexible connections, Insulators etc. as applicable, however, Controlled Switching Device (CSD), Online PD Monitoring System, Local Control Cubicle and End Terminations, if applicable shall be covered separately. GIS shall be complete with all necessary terminal boxes, inspection windows, SF6 gas, grounding connection, pipings for gas monitoring system, trays, support structures with mounting hardwares, walkways, interconnecting cables with glands, ferrules, lugs etc. Please refer section-2 (TS for EHV GIS)- Technical Specification.
1.04	GIS BAY SUPPLY: 220kV, 2000A, 50kA, SF6 GIS BUS COUPLER BAY MODULE (INCLUDING SF6 GAS, STRUCTURE, HARDWARES & EARTHING MATERIALS) AS PER TS	SET	2	220kV GIS BUS COUPLER BAY MODULE shall include following but not limited to, (a) 1 SET- 1 NO x3 phase Circuit Breaker, compatible for Controlled Switching Facility (if applicable), complete with operating mechanism (b) 2 SET- 1 NO x3 phase Disconnector with Maintenance Grounding Switch, complete with operating mechanism. (c) 6 NO- 1 phase multi ratio Current Transformer. In addition to above, Gas device, UHF sensors, Pressure Switches, Expansion joints/ Flexible connections, Insulators etc. as applicable, however, Controlled Switching Device (CSD), Online PD Monitoring System (OPMS), Local Control Cubicle (LCC) and End Terminations, if applicable shall be covered separately. GIS shall be complete with all necessary terminal boxes, inspection windows, SF6 gas, grounding connection, pipings for gas monitoring system, trays, support structures with mounting hardwares, walkways, interconnecting cables with glands, ferrules, lugs etc. Please refer section-2 (TS for EHV GIS)- Technical Specification.
1.05	GIS BAY SUPPLY: 220kV, 2000A, 50kA, SF6 GIS BUS SECTIONALISER BAY MODULE (INCLUDING SF6 GAS, STRUCTURE, HARDWARES & EARTHING MATERIALS) AS PER TS	SET	2	220kV GIS BUS SECTIONALIZAER BAY MODULE shall include following but not limited to, (a) 1 SET- 1 NO x3 phase Circuit Breaker, compatible for Controlled Switching Facility (if applicable), complete with operating mechanism (b) 2 SET- 1 NO x3 phase Disconnector with Maintenance Grounding Switch, complete with operating mechanism. (c) 6 NO- 1 phase multi ratio Current Transformer. In addition to above, Gas device, UHF sensors, Pressure Switches, Expansion joints/ Flexible connections, Insulators etc. as applicable, however, Controlled Switching Device (CSD), Online PD Monitoring System (OPMS), Local Control Cubicle (LCC) and End Terminations, if applicable shall be covered separately. GIS shall be complete with all necessary terminal boxes, inspection windows, SF6 gas, grounding connection, pipings for gas monitoring system, trays, support structures with mounting hardwares, walkways, interconnecting cables with glands, ferrules, lugs etc. Please refer section-2 (TS for EHV GIS)- Technical Specification.
1.06	GIS BAY SUPPLY: 220kV, 2000A, 50 kA, SF6 OUTGOING GIS TRANSFORMER FEEDER BAY MODULE (INCLUDING SF6 GAS, STRUCTURE, HARDWARES & EARTHING MATERIALS) AS PER TS	SET	3	220kV GIS TRANSFORMER FEEDER BAY MODULE shall include following but not limited to, (a) 1 SET- 1 NO x3 phase Circuit Breaker, compatible for Controlled Switching Facility (if applicable), complete with operating mechanism (b) 2 SET- 1 NO x3 phase Disconnector with Maintenance Grounding Switch, complete with operating mechanism. (c) 1 SET- 1 NO x3 phase Disconnector without Maintenance Grounding Switch, complete with operating mechanism. (d) 1 SET- 1 NO x3 phase High Speed make proof Earthing Switch, complete with operating mechanism. (e) 6 NO- 1 phase multi ratio Current Transformer. (f) 6 NO- Cable connection module suitable upto 2Rx1600sqmm XLPE Cable. (additional requirement, if any shall be payable as per other line item) In addition to above, Gas device, UHF sensors, Pressure Switches, Expansion joints/ Flexible connections, Insulators etc. as applicable, however, Controlled Switching Device (CSD), Online PD Monitoring System, Local Control Cubicle and End Terminations, if applicable shall be covered separately. GIS shall be complete with all necessary terminal boxes, inspection windows, SF6 gas, grounding connection, pipings for gas monitoring system, trays, support structures with mounting hardwares, walkways, interconnecting cables with glands, ferrules, lugs etc. Please refer section-2 (TS for EHV GIS)- Technical Specification.

ANNEXURE: BOQ 220kV GIS SUPPLY BPCL Bina
REV No: 0.0
DATE: 20.06.2025

Sl. No.	Item Description	Unit	Qty.	Remarks
1.07	GIS BAY SUPPLY: 220kV, 2000A, 50kA, SF6 OUTGOING GIS SPARE TRANSFORMER FEEDER BAY (FULLY EQUIPPED) MODULE (INCLUDING SF6 GAS, STRUCTURE, HARDWARES & EARTHING MATERIALS) AS PER TS	SET	1	220kV OUTGOING GIS SPARE FEEDER BAY MODULE shall include following but not limited to, (a) 1 SET- 1 NO x3 phase Circuit Breaker, compatible for Controlled Switching Facility (if applicable), complete with operating mechanism (b) 2 SET- 1 NO x3 phase Disconnector with Maintenance Grounding Switch, complete with operating mechanism. (c) 1 SET- 1 NO x3 phase Disconnector without Maintenance Grounding Switch, complete with operating mechanism. (d) 1 SET- 1 NO x3 phase High Speed make proof Earthing Switch, complete with operating mechanism. (e) 6 NO- 1 phase multi ratio Current Transformer. (f) 6 NO- Cable connection module suitable upto 2Rx1600sqmm XLPE Cable. (additional requirement, if any shall be payable as per other line item) In addition to above, Gas device, UHF sensors, Pressure Switches, Expansion joints/ Flexible connections, Insulators etc. as applicable, however, Controlled Switching Device (CSD), Online PD Monitoring System, Local Control Cubicle and End Terminations, if applicable shall be covered separately. GIS shall be complete with all necessary terminal boxes, inspection windows, SF6 gas, grounding connection, pipings for gas monitoring system, trays, support structures with mounting hardwares, walkways, interconnecting cables with glands, ferrules, lugs etc. Please refer section-2 (TS for 220kV GIS)- Technical Specification.
1.08	GIS SUPPLY: 220KV, 1 PHASE SURGE ARRESTER WITH SURGE COUNTER (INCLUDING SF6 GAS, STRUCTURE, HARDWARES & EARTHING MATERIALS)	NO	30	Please refer section-2 (TS for 220kV GIS)- Technical Specification. It is considered for INCOMING BAYS, BUS BAR MODULE, OUTGOING BAYS (INCLUDING SPARE BAY) only.
1.09	GIS SUPPLY: 220KV, 1 PHASE CABLE CONNECTION MODULE (INCLUDING SF6 GAS, STRUCTURE, HARDWARES & EARTHING MATERIALS)	NO	1	Please refer section-2 (TS for 220kV GIS)- Technical Specification. This is an optional item and shall be used, as per requirement. Cable connection module shall be suitable upto 1Rx1600sqmm XLPE Cable.
1.10	GIS SUPPLY: 220KV, 1 PHASE VOLTAGE TRASNFORMER (INCLUDING SF6 GAS, STRUCTURE, HARDWARES & EARTHING MATERIALS)	NO	1	Please refer section-2 (TS for 220kV GIS)- Technical Specification. This is an optional item and shall be used, as per requirement.
1.11	GIS SUPPLY: LOCAL CONTROL CUBICLES	SET	10	Please refer section-2 (TS for 220kV GIS)- Technical Specification. It is considered for ALL BAYS only.
1.12	GIS SUPPLY: 220KV, CONTROLLED SWITCHING DEVICE (CSD) FOR 220KV, 3- PH CIRCUIT BREAKER	SET	2	Please refer section-2 (TS for 220kV GIS)- Technical Specification. It is considered for LINE BAYS only.
2.0	**SUPPLY- GIS: SPECIAL TOOLS AND TESTING & MAINTENANCE INSTRUMENTS AS PER TS**			
2.01	GIS SUPPLY: PORTABLE SF6 GAS LEAKAGE DETECTOR	NO	1	Please refer section-2 (TS for 220kV GIS)- Technical Specification.
2.02	GIS SUPPLY: ONLINE PORTABLE SF6 GAS FILLING AND	NO	1	Please refer section-2 (TS for 220kV GIS)- Technical Specification.
2.03	GIS SUPPLY: SF6 GAS ANALYSER	NO	1	Please refer section-2 (TS for 220kV GIS)- Technical Specification.
2.04	GIS SUPPLY: PORTABLE PARTIAL DISCHARGE (PD)	NO	1	Please refer section-2 (TS for 220kV GIS)- Technical Specification.
2.05	GIS SUPPLY: HANDLE FOR DISCONNECTOR SWITCH	NO	4	Please refer section-2 (TS for 220kV GIS)- Technical Specification.
2.06	GIS SUPPLY: HANDLE FOR EARTHING SWITCH DRIVE, IF	NO	4	Please refer section-2 (TS for 220kV GIS)- Technical Specification.
2.07	GIS SUPPLY: TRIPPING COIL	NO	2	Please refer section-2 (TS for 220kV GIS)- Technical Specification.
2.08	GIS SUPPLY: CLOSING COIL	NO	2	Please refer section-2 (TS for 220kV GIS)- Technical Specification.
2.09	GIS SUPPLY: DENSITY MONITORING DEVICE (1 SET= 2 NO	SET	1	Please refer section-2 (TS for 220kV GIS)- Technical Specification.
2.10	GIS SUPPLY: PRESSURE GAUGE (1 SET= 2 NO OF EACH	SET	1	Please refer section-2 (TS for 220kV GIS)- Technical Specification.
2.11	GIS SUPPLY: ETHERNET SWITCH (1 SET= 1 NO OF EACH	SET	1	Please refer section-2 (TS for 220kV GIS)- Technical Specification.
3.0	**SPARES- GIS: 220KV, 50KA FOR 3S, GAS INSULATED SWITCHGEAR (GIS) AS PER TS**			
3.01	GIS SPARES: RECOMMENDED SPARES FOR 2 YEARS OF NORMAL OPERATION AND MAINTENANCE	SET	1	
4.0	**SUPPLY- GIS: <u>REFERENCE UNIT PRICE FOR ADDITION/ DELETION</u> OF SUPPLY ITEMS** (Unit Prices of Individual Equipment included here or in manadatory spares are required for any Addition/Deletion of Equipment and replacement of damaged items. Bidder 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)			
4.01	SUPPLY- GIS: SPARES: 220KV, OPERATING MECHANISM FOR CIRCUIT BREAKER COMPLETE IN ALL RESPECT	SET	1	
4.02	SUPPLY- GIS: SPARES: 220KV, OPERATING MECHANISM FOR DISCONNECTOR COMPLETE IN ALL RESPECT	SET	1	
4.03	SUPPLY- GIS: SPARES: 220KV, OPERATING MECHANISM FOR MAINTENANCE EARTHING SWITCH COMPLETE IN ALL	SET	1	
4.04	SUPPLY- GIS: SPARES: 220KV, OPERATING MECHANISM FOR FAST ACTING/ HIGH SPEED GROUNDING SWITCH	SET	1	
4.05	SUPPLY- GIS: SPARES: 220KV, MAINTENANCE EARTHING SWITCH COMPLETE IN ALL RESPECT	SET	1	
4.06	SUPPLY- GIS: SPARES: 220KV, FAST ACTING/ HIGH SPEED GROUNDING SWITCH COMPLETE IN ALL RESPECT	SET	1	
4.07	SUPPLY- GIS: SPARES: 220KV, SINGLE PHASE BUS BAR	MTRS	1	Complete in all respect.
4.08	SUPPLY- GIS: SPARES: 220KV, GIS METALLIC ENCLOSURE	KGS	50	
4.09	SUPPLY- GIS: SPARES: 220KV, EXPANSION JOINTS	SET	1	1set= 1 nos. of each type and each rating.
4.10	SUPPLY- GIS: SPARES: 220KV, FLEXIBLE CONNECTIONS	SET	1	1set= 1 nos. of each type and each rating.
4.11	SUPPLY- GIS: SPARES: 220KV, BARRIER INSULATOR	SET	1	1set= 1 nos. of each type and each rating.
4.12	SUPPLY- GIS: SPARES: 220KV, NON-BARRIER INSULATOR	SET	1	1set= 1 nos. of each type and each rating.
4.13	SUPPLY- GIS: SPARES: 220KV, GAS SEALS	SET	1	1set= 1 nos. of each type and each rating.
4.14	SUPPLY- GIS: SPARES: 220KV, GAS DENSITY MONITOR	SET	1	1set= 1 nos. of each type and each rating.
4.15	SUPPLY- GIS: SPARES: 220KV, GAS PRESSURE SWITCH	SET	1	1set= 1 nos. of each type and each rating.
4.16	SUPPLY- GIS: SPARES: 220KV, TEE BEND	SET	1	1set= 1 nos. of each type and each rating.
4.17	SUPPLY- GIS: SPARES: 220KV, ANGLE BEND	SET	1	1set= 1 nos. of each type and each rating.

ANNEXURE: BOQ 220kV GIS SUPPLY BPCL Bina
REV No: 0.0
DATE: 20.06.2025

Sl. No.	Item Description	Unit	Qty.	Remarks
4.18	SUPPLY- GIS: SPARES: 220KV, L-BEND	SET	1	1set= 1 nos. of each type and each rating.

ANNEXURE BOQ_220kV GIS_SERVICE_BPCL Bina
REV No: 0.0
DATE: 20.06.2025

Sl. No.	Description	Unit	Quantity	Remarks
5.0	**SERVICES- GIS : 220KV, 50KA FOR 3S, GAS INSULATED SWITCHGEAR (GIS) AS PER TS**			
5.01	SERVICES- 220kV GIS: ERECTION OF GIS	Bays	10	Erection of GIS with main bus including BUS VT Bays, complete as per TS in all respect including LCC and its accessories. It also includes verification of materials for proper storage at site for final storage. Earthing, SF6 Gas Filing works, Internal Cabling from GIS to LCC, including Structure Works are covered under this item. Surge Arrester, Voltage Transformer, Cable Connection Module are not covered in this BOQ item.
5.02	SERVICES- 220kV GIS: ERECTION OF 1 PHASE SURGE ARRESTER WITH SURGE COUNTER	SET	30	Erection of Surge Arrester complete as per TS in all respect. Earthing, SF6 Gas Filing works, Internal Cabling with tray work, including Structure Works are covered under this item.
5.03	SERVICES- 220kV GIS: ERECTION OF 1 PHASE CABLE CONNECTION MODULE	NO	36	Erection of Additional Cable Connection Module complete as per TS in all respect. Earthing, SF6 Gas Filing works, Internal Cabling with tray work, including Structure Works are covered under this item.
5.04	SERVICES- 220kV GIS: ERECTION OF 1 PHASE VOLTAGE TRANSFORMER	SET	1	Erection of Voltage Transformer complete as per TS in all respect. Earthing, SF6 Gas Filing works, Internal Cabling with tray work, including Structure Works are covered under this item.
5.05	SERVICES- 220kV GIS: TESTING & COMMISSIONING OF GIS	Bays	10	Testing and commissioning of complete GIS system including main bus, LCC and associated system (LA, VT, CSD, Cable Connection Module etc.) is to be executed by bidder. All the special testing instruments, kits, T&P etc. are to be arranged by bidder on returnable basis. Please refer relevant section of technical specification for details.
5.06	SERVICES- 220kV GIS : FINAL SUCCESSFUL HV/ POWER FREQUENCY TESTING OF GIS INCLUDING ARRANGING OF HV TEST KIT ALONG WITH OPERATOR	Bays	10	Carrying out successful HV/ Power Frequency Testing of GIS as per IEC including Arrangement of HV Test kit with operator (on returnable basis) shall be in scope of bidder, which includes charges of HV test kit with operator, accessories & tools required for completion of HV testing. The quoted price shall include GIS bays including Main Bus, GIB, SAB/SOB and other common items as per TS complete in all respect. In this BOQ item, mobilization and demobilization for HV test kit is considered for once. In case of more, for reasons not attributable to bidder, same shall be paid extra as per BOQ Item.
5.07	SERVICES- 220kV GIS : 3D MODEL FOR 220KV GIS	LOT	1	Please refer TS.
5.08	SERVICES- 220kV GIS : INSULATION CO-ORDINATION STUDIES FOR GIS SYSTEM	LOT	1	1 Lot means Complete study report as per technical specification, Including VFTO report.
5.09	SERVICES- 220kV GIS : TRAINING FOR GIS AT SITE (GIS/ ONLINE PARTIAL DISCHARGE MONITORING SYSTEM)	DAY	7	Training of ten OWNER's personnel & two BHEL's personnel for a period of at least Seven days at site
5.10	SERVICES- 220kV GIS : TRAINING FOR GIS AT MANUFACTURER WORKS	DAY	7	Training of two OWNER's personnel & two BHEL's personnel for a period of at least Seven days at manufacturer's works

6.0	**SERVICES- GIS : REFERENCE UNIT PRICE FOR ADDITION / DELETION OF SERVICES:** (UNIT PRICES OF INDIVIDUAL SERVICES INCLUDED HERE 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)			
6.01	SERVICES- 220kV GIS: REF. UNIT PRICE OF GIS INDIVIDUAL ITEM/ EQUIPMENT- SERVICES FOR ERECTION OF GIS	MANDAY	10	Charges for repetition of services - (if required due to reasons not attributed to the bidder) This item will be executed only if repetition of services is required by BHEL.
6.02	SERVICES- 220kV GIS: REF. UNIT PRICE OF GIS INDIVIDUAL ITEM/ EQUIPMENT - SERVICES FOR TESTING & COMMISSIONING OF GIS	MANDAY	10	Charges for repetition of services - (if required due to reasons not attributed to the bidder) This item will be executed only if repetition of services is required by BHEL.
	DEMOBILIZATION AND REMOBILIZATION CHARGES			
6.03	SERVICES- 220kV GIS: DEMOBILIZATION AND REMOBILIZATION CHARGES FOR GIS ERECTION TEAM	Set	2	THIS BOQ ITEM SHALL BE PAYABLE IF REQUIRED FOR REASONS NOT ATTRIBUTABLE TO BIDDER.

ANNEXURE BOQ 220kV GIS SERVICE BPCL Bina
REV No: 0.0
DATE: 20.06.2025

Sl. No.	Description	Unit	Quantity	Remarks
6.04	SERVICES- 220kV GIS: DEMOBILIZATION AND REMOBILIZATION CHARGES FOR GIS TESTING & COMMISSIONING TEAM	Set	2	BOQ ITEM SHALL BE PAYABLE IF REQUIRED FOR REASONS NOT ATTRIBUTE TO BIDDER. HV TESTING IS NOT PART OF THIS ITEM.
6.05	SERVICES- 220kV GIS: DEMOBILIZATION & REMOBILIZATION CHARGES OF HV TEST KIT ALONG WITH OPERATOR	Lot	1	In this BOQ item, mobilization and demobilization chages for HV test kit is considered for second time or more , for reasons not attributable to bidder. HV testing charges shall be paid per bay basis as per main HV testing charge.

अतिरिक्त उच्च वोल्टेज वाले गैस रोधित स्विचगियर के लिए विनिर्देश

SPECIFICATION FOR EXTRA HIGH VOLTAGE GAS INSULATED SWITCHGEAR

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
1	29.03.2019	REVISED & ISSUED AS STANDARD SPECIFICATION	AS	PG	BRB	RKT
0	30 01 2014	ISSUED AS STANDARD SPECIFICATION	AS	PG	UAP	SC

Abbreviations:

A	:	Ampere	ICT	:	Interposing Current Transformer
AC	:	Alternating Current	IEC	:	International Electro technical Commission
AL	:	Aluminium	IEEE	:	Institute of Electrical & Electronics Engineers
ASME	:	The American Society of Mechanical Engineers	IP	:	Ingress Protection
BCU	:	Bay Control Unit	IS	:	Indian Standards
BIL	:	Basic Insulation Level	kV	:	Kilo Volt
BIS	:	Bureau of Indian Standards	kW	:	Kilo Watt
BS	:	British Standards	kWh	:	Kilo Watt Hour
CB	:	Circuit Breaker	LCC	:	Local Control Cabinet
CEA	:	Central Electricity Authority	LED	:	Light Emitting Diode
CENELEC	:	Comité Européen de Normalisation Électrotechnique	MCB	:	Miniature Circuit Breaker
CIGRE	:	Conseil International des Grands Réseaux Électriques	NEMA	:	National Electrical Manufacturers Association
CNT	:	Close-Neutral-Trip	NC	:	Normally Close
CO	:	Close Open	NO	:	Normally Open
CRCA	:	Cold Rolled Cold Annealed	O	:	Open
CRP	:	Control Relay Panel	PO	:	Purchase Order
CT	:	Current Transformer	p.u	:	per unit
Cu	:	Copper	RAL	:	Reichs-Ausschuss fur Lieferbedingungen
DC	:	Direct Current	RIP	:	Resin Impregnated Paper
EHV	:	Extra High Voltage	SF_6	:	Sulphur Hexafluoride
EIL	:	Engineers India Limited	SS	:	Stainless Steel
EPDM	:	Ethylene Propylene Diene Monomer	TRV	:	Transient Recovery Voltage
FRLS	:	Flame Retardant Low Smoke	VDE	:	Verband Deutscher Elektrotechniker
GIS	:	Gas Insulated Switchgear	VT	:	Voltage Transformer
GIBD	:	Gas Insulated Bus Duct	XLPE	:	Cross Linked Poly Ethylene
HV	:	High Voltage			
Hz	:	Hertz			

Electrical Standards Committee

Convenor: Mr. B.R. Bhogal

Members:
Ms. S. Anand
Mr. Parag Gupta
Mr. M.K. Sahu
Ms. N.S. Bhattacharya
Ms. N.P. Guha (Project)
Mr. Saeed Akhtar (Inspection)

CONTENTS

1.0 SCOPE

This specification covers the design, engineering, manufacture, testing, packing and supply of Extra High Voltage Gas Insulated Switchgear (GIS) & Gas insulated Bus duct (GIBD) for working voltages from 66 kV up to and including 400 kV complete with Local Control Cabinet (LCC), Control Relay Panel (CRP) and interconnecting cabling amongst GIS, LCC & CRP.

2.0 CODES AND STANDARDS

2.1 The GIS equipments / components used shall comply with the requirements of latest revision of the following standards and also the other Indian and International Standards as applicable, unless otherwise specified:

IS 1248	Direct acting indicating analogue electrical measuring instruments and their accessories
IS 2705	Current Transformers
IS 3156	Voltage Transformers
IS 4379	Identification of contents of industrial gas cylinders
IS 5082	Material data for aluminium bus bars
IS 5578	Guide for marking of insulated conductors
IS 11353	Guide for uniform system of marking and identification of conductors & apparatus terminals
IS 13703	Low voltage fuses for voltages not exceeding 1000V AC or 1500V DC
IEC 60059	IEC Standard Current Rating
IS/IEC 60060	High Voltage test techniques
IEC 60099 -4	Metal-oxide surge arresters without gaps for a.c. systems
IEC 60114	Recommendation for heat treated aluminium alloy bus bar material of Aluminium-Magnesium-Silicon type
IEC 60137	Bushings for alternating voltages above 1000 V
IEC 60255	Electrical Relays
IS/IEC 60270	High-voltage test techniques - Partial discharge measurements
IEC 60376	Specification of technical grade sulphur hexafluoride (SF_6) for use in electrical equipment
IEC 60480	Guidelines for the checking and treatment of sulphur hexafluoride (SF_6) taken from electrical equipment and specification for its re-use
IS/IEC 60529	Degrees of protection provided by enclosures (IP Code)
IEC 60694	Common specifications for high-voltage switchgear and controlgear standards
IEC 61243-1	Live working Voltage detectors: Capacitive type to be used for voltages exceeding 1 kV A.C.
IEC 61639	Direct connection between Power Transformers and gas insulated metal enclosed switchgear for rated voltage 72.5 kV and above
IEC 61869-1	Instrument transformers – General requirements
IEC 61869-2	Additional requirements for current transformers
IEC 61869-3	Additional requirements for inductive voltage transformers
IS/IEC 62271-1	High – Voltage Switchgear and Controlgear: Common specifications
IEC 62271-4	Handling procedures for sulphur hexafluoride (SF_6) and its mixtures
IS/IEC 62271-100	Alternating current circuit-breakers
IS/IEC 62271-102	Alternating current disconnectors (isolators) and earthing switches
IEC 62271-104	Alternating current switches for rated voltages of 52 kV and above
IEC 62271-110	High-voltage switchgear and controlgear - Inductive load switching
IEC 62271-203	Gas Insulated metal-enclosed switchgear for rated Voltages above 52 kV
IEC 62271-209	Cable connections for gas-insulated metal-enclosed switchgear for

	rated voltages above 52 kV-Fluid filled and extruded insulation cables-Fluid filled and dry type cable terminations
IEC 62271-303	Use and handling of Sulphur hexafluoride (SF_6)
IEEE 80	IEEE Guide for safety in AC substation grounding

2.2 In case of imported equipment, standards of the country of origin shall be applicable, if these standards are equivalent or stringent than the applicable Indian standards.

2.3 The equipment shall also conform to the provisions of CEA regulations with latest amendments and other statutory regulations currently in force in the country.

2.4 In case Indian standards are not available for any equipment, standards issued by IEC/BS/VDE/IEEE/NEMA or equivalent agency shall be applicable.

2.5 In case of any contradiction between various referred standard/ specification/ data sheet and statutory regulation, most stringent requirements shall prevail. However, Owner's decision in this regard will be final and binding.

3.0 GENERAL REQUIREMENT

3.1 The offered equipment shall be brand new with state of art technology and proven field track record. No prototype equipment shall be offered.

3.2 Vendor shall ensure availability of spare parts and maintenance support services for the offered equipment for at least 10 years from the date of supply.

3.3 Vendor shall give a notice of at least one year to the end user of equipment and EIL before phasing out the product/spares to enable the end user for placement of order for spares and services.

4.0 SITE CONDITIONS

4.1 The EHV GIS, GIBD & accessories shall be suitable for installation and satisfactory operation in a pressurised substation or in a substation with restricted natural air ventilation in a tropical, humid and corrosive atmosphere.

4.2 The switchgear shall be designed to operate under site conditions as specified in the data sheets. If not specifically mentioned therein, a design ambient temperature of 40°C and an altitude not exceeding 1000 metres above mean sea level shall be considered.

4.3 All equipments are intended for continuous duty operation, as per nameplate rating under the specified ambient conditions, unless indicated otherwise.

5.0 DESIGN AND FABRICATION REQUIREMENTS

5.1 Enclosure and Protection

5.1.1 The switchgear shall be an indoor gas-insulated, metal enclosed design, assembled to form free standing, self supporting dead front structure. The degree of protection shall be at least IP4X for low voltage and drive mechanism compartments as specified in IS/IEC-60529. All openings, covers and doors shall be provided with suitable Neoprene / XLPE/ EPDM gaskets around the perimeter to make the switchgear dust and vermin proof.

5.1.2 LCC, drive mechanism, CRP frame shall be fabricated using 2 mm CRCA sheet steel while doors and covers shall be made from 1.6 mm thick CRCA sheet steel.

5.1.3 The switchgear assembly shall consist of completely separate, SF_6 gas filled pressurized sections housing various switchgear components. The switchgear gas enclosures shall be sectionalised, with gastight barriers between sections / compartments. Gas enclosures shall be designed and fabricated to comply with the requirements of the applicable pressure vessel codes to which it is subjected in service (ASME/ CENELEC code for pressure vessel).

5.1.4 Each gas-filled compartment shall be equipped with static filters (e.g. molecular sieve or activated alumina or other absorbent), pressure switches, filling & draining valve with automatic shut off and safety diaphragm. The filters shall be capable of absorbing any water vapour which may penetrate into the enclosures as well as the by-products of SF_6 created during interruption. Each gas compartment shall be fitted with separate non-return valve connectors for evacuating & filling the gas and checking the gas pressure etc.

5.1.5 The enclosures may be three phase enclosure or single phase enclosure as per the standard type tested design of the vendor.

5.1.6 The switchgear shall be of modular design and capable of extension in future by the addition of extra feeders without necessarily dismantling, moving or dislocating any major parts of existing switchgear bays. Design details for future extension shall be provided.

5.1.7 The enclosure for the SF_6 gas and associated circuit elements of enclosure shall be made from non magnetic material e.g. AL/AL alloy. Enclosures of the same phase shall be electrically interconnected, and shall be earthed at appropriate places. At appropriate points single phase enclosures should be connected to other phases, thus ensuring a return current path.

5.1.8 The enclosure shall be designed to practically eliminate the external electromagnetic field and thereby electro-dynamic stresses even under short circuit conditions.

5.1.9 It should be impossible to unwillingly touch live parts of the switchgear or to perform operations that lead to arcing faults without the use of tools or brute force.

5.1.10 All interlocks that prevent potentially dangerous mal-operations shall be constructed such that they cannot be operated easily, i.e. the operator shall use tools or brute force to over-ride them.

5.1.11 The switchgear earth buses shall have provision for connection to the plant earth grid running in the vicinity of the equipment.

5.1.12 The ladders, walkways and platforms with handrail shall be provided wherever necessary for access to the equipment. A portable ladder with adjustable height shall also be supplied for access to the equipment during operation & maintenance.

5.1.13 Any paints or other coatings that may be used shall be such that they will not deteriorate when exposed to the SF_6 gas and other vapours, arc products, etc. that may be present in the enclosures. They shall also not contain any substances which could contaminate the enclosed SF_6 gas or affect its insulating properties over a period of time.

5.2 Accessibility & Maintenance

5.2.1 Checking and removal of components shall be possible without disturbing adjacent equipment. All equipments shall be easily accessible. It shall be possible to set all measuring relays and instruments in-situ without de-energising the switchgear. All mounted equipment shall have identification tags of self sticking tapes at the rear also. In addition, identification numbers shall be painted on the panel wall to give a permanent identification mark.

5.2.2 All terminals shall be shrouded with plastic covers to prevent accidental contact.

5.2.3 GIS components shall be installed and arranged to facilitate realistic access for maintenance and removal of equipment, with a minimum amount of disturbance to other equipment meeting service continuity requirements.

5.2.4 It shall be generally possible to remove a circuit element (breaker, disconnect switch etc), without removing another element.

5.2.5 For routine inspection and possible repairs, all elements shall be accessible without removing support structures.

5.2.6 All special tools & tackles required for erection & maintenance of GIS & GIBD shall be provided by the vendor.

5.3 Service Continuity

5.3.1 The service continuity for GIS shall be ensured by appropriate sequence & location of feeders and by providing suitable gas compartment partitioning, additional gas buffer compartment, additional isolating links etc.

5.3.2 Following minimum requirements for service continuity shall be met:

a) During a fault in any circuit breaker compartment, no bus bar is permitted to be out of service during maintenance, repair and replacement.

b) The bus bar enclosure shall be sectionalised in a manner that maintenance work in any section of bus bar can be carried out by isolating and evacuating that small section and not the entire bus. For fault in one bus bar & disconnector compartment, at the maximum the adjacent feeders are permitted to be out of service during maintenance and repair. However the complete healthy bus / other bus shall remain operational for double bus GIS.

c) During a fault in any compartment other than circuit breaker or bus bar & disconnector compartment, maximum affected feeder is permitted out of service during maintenance and repair.

5.4 Bus Bar

5.4.1 EHV GIS Bus configuration (Single Bus or Double Bus or One and half breaker scheme) shall be provided as specified in the data sheets/ Job specification.

5.4.2 Bus bars shall be of high conductivity electrolytic aluminium or copper.

5.4.3 The 3-phase bus bars shall be either housed in single phase enclosures or 3-phase enclosure as per vendor's design. All phase bus bars shall be of uniform cross-section and shall be sized to carry continuously the rated current specified in data sheet.

5.4.4 Bus bars and the supports shall be adequately sized and braced to withstand the specified short-circuit current without any permanent deformation. All bus supports shall be of non-hygroscopic, non-inflammable, non-carbonising material, resistant to acids and alkalies.

5.4.5 Bus bar earthing facilities for each section of the bus bars, completely interlocked with associated disconnectors & CBs of that section of bus bars including bus coupler / bus sectionaliser shall be provided.

5.5 Expansion and Flexible Connection for Enclosure/ Conductors

5.5.1 Expansion joints / flexible connections shall be provided in each metal enclosure and conductors to absorb the actual or relative thermal expansion and contraction of the bus bar &equipments as well as structures resulting from variations of temperature of the switchgear equipment.

5.5.2 The number and position of the expansion joints / flexible connections shall be decided by the vendor to ensure that complete installation is not subjected to any expansion stresses which could lead to failure of any piece of the GIS equipment, supporting structures.

5.5.3 The electrical connections for the conductor expansion joints / flexible connections shall be made by means of multiple contact connectors preferably same as that provided at the joints between the separate gas compartments.

5.5.4 In addition, metallic bellows (preferably of stainless steel) shall be provided for lateral and vertical alignment.

5.6 Cable Termination

5.6.1 The SF_6 GIS to XLPE cable terminations shall conform to IEC-62271-209.

5.6.2 All power cables and control cables will be connected from below through cut-outs in the floor or through cable trench. Plug in terminations (including plugs, sockets) and all accessories shall be provided for power cables for all feeders including spare feeders by vendor.

5.6.3 Isolating links shall be provided in cable termination module for disconnection between GIS and cable during cable testing. Further suitable arrangements of test plug / socket shall be provided which will permit full dielectric testing for outgoing cable of all cable feeders including primary current injection test for current transformers. The voltage rating of test plug / socket shall be as specified in data sheet / job specification.

5.6.4 Unless otherwise specified, all control cables shall enter from the bottom. Supporting facilities shall be provided for clamping of control cables.

5.6.5 Single compression nickel plated brass cable glands & tinned copper lugs shall be provided by vendor for all cables to GIS assembly, LCC & CRP.

5.7 Pressure Relief Device

5.7.1 Pressure relief devices shall be provided in the each gas sections/ compartment to protect the main gas enclosures from damage or distortion during the occurrence of abnormal pressure increase or shock waves generated by internal electrical fault arcs. Pressure relief shall be achieved either by means of diaphragms or plugs venting directly into the atmosphere in a controlled direction. If the pressure relief devices vent directly into the atmosphere, suitable guards and deflectors shall be provided to prevent pieces of the diaphragm or plug from flying out or any dangerous SF_6 arc product gases escaping, in a manner that could endanger personnel present there.

5.7.2 Pressure relief shall be provided for all EHV compartments including SF_6 gas & air insulated enclosures. Relief into cable cellar/ trench shall not be provided.

5.7.3 The set points for the pressure relief device shall be lower than pressure withstanding capability of the enclosure with sufficient margin.

5.8 Indication & Verification of Circuit Breaker, Disconnector & Earth Switch Position

5.8.1 Mechanical indicators mounted external to the equipment shall be provided on all circuit breakers, disconnectors and earth-switches, which shall clearly show whether the earth switches/ CBs / disconnectors etc. are open or closed. The indicators shall be mechanically coupled directly to the main contact operating drive rod or linkages and shall be mounted in a position where they are clearly visible from the floor or the platform in the vicinity of the equipment.

5.8.2 Viewing windows shall be provided for all disconnectors and earth switches so that the switch contact positions can be verified by direct visual inspection. Viewing windows shall be of type, whereby the open / close position can be checked without any danger to the eyes even when a flashover occurs at that time. Wherever the inspection windows are not accessible, sight glass endoscope shall be provided.

5.9 Foundation Channels &Supporting Frame Works

5.9.1 The panels shall be suitable for installation on base frame supplied by vendor along with foundation bolts. Amply dimensioned oblong holes shall be provided at the bottom of the panels for their installation on the base frame. The panels shall be suitable for tack welding and bolting directly to the base frame. The panels with base frame shall be suitable for installation on panel supporting frame through tack welding.

5.9.2 All supporting steel structures above grade level for switchgear bays and all panels including SF_6/Air Bushing support, GIBD support, inspection platform etc. shall be provided by vendor.

5.9.3 Details of suitable embedment in the foundation floor as required for supporting the switchgear assembly and panels, necessary supporting framework, levelling screws, inspection platforms etc. to fasten the switchgear base frames to the embedments in foundation floor shall be provided by vendor. Vendor shall provide drawing showing all details of the embedded parts and installation details required on the floor.

5.10 Nameplates

5.10.1 Engraved nameplates shall preferably be of 3-ply (Black-White-Black) lamicoid sheets or anodised aluminium. However back engraved perspex sheet nameplates are also acceptable. Nameplates shall be fastened by screws and not by adhesives. A weather proof and corrosion proof name plate shall be provided and shall conform to applicable standards.

5.10.2 A nameplate with the switchgear designation shall be fixed at the top of the central panel. A separate nameplate giving details of each feeder compartment of all panels shall be provided. Danger plate (Red) shall be provided at the front and rear for each panel.

5.10.3 Blank nameplates shall be provided for all spare feeders.

5.10.4 Each of the equipment devices including CB, Disconnector switch, Earthing switch, CT, VT and busbars etc. mounted inside the switchgear shall be provided with proper nameplate and rating plate. All information as per the latest edition of relevant IEC standards shall be included. Special warning plates shall be provided on removable covers or doors giving access to cable terminals and bus bars.

5.10.5 Special warning labels shall be provided inside the switchgear also, wherever considered necessary. Identification tags shall be provided inside the panels matching with those shown on the circuit diagram.

5.11 Painting, Protective Finish / Corrosion Protection of Surfaces

5.11.1 The switchgear shall be treated and protected to withstand continuous operation under site conditions without sustaining corrosion or attacks from fungus or rodents. The protective finish shall prevent deterioration due to corrosion, humidity, temperature, ageing and weather etc. under site conditions.

5.11.2 All metal surfaces shall be thoroughly cleaned & degreased to remove mill scale, rust, grease and dirt. All exterior surfaces shall be cleaned and epoxy painted before leaving the factory with one coat of approved primer and two coats of approved equipment finish paint. Fabricated structures shall be pickled and then rinsed to remove any trace of acid. The under surface shall be prepared by applying a coat of phosphate paint and a coat of yellow zinc chromate primer. Alternately, vendor's standard paint procedure for manufacturing is also acceptable. The underside of all surfaces bearing upon the concrete foundation shall be given two coats of approved primer. The under surface shall be made free from all imperfections before undertaking the finishing coat.

5.11.3 The exterior surface finish of switchgear paint shade shall be RAL-7032 unless specified otherwise.

5.11.4 The finished panels shall be dried in stoving ovens in dust free atmosphere. Panel finish shall be free from imperfections like pinholes, orange peels, runoff paint etc. Vendor shall supply final paint (1 litre per switchboard) in non-returnable container for final touch up at site.

5.11.5 Supporting frame work shall be hot dip galvanised after fabrication.

5.11.6 All unpainted steel parts shall be Zinc passivated or suitably treated to prevent rust formation. If these parts are moving elements then they shall be greased.

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

5.11.8 Electrolytic corrosion shall be avoided in joints of different metals. Before the metal enclosed sections are joined together and charged with the SF_6 gas, they shall be thoroughly cleaned.

5.12 Auxiliary Cabling, Wiring and Terminals

5.12.1 Owner interface for remote control, metering, indication, alarm etc. of complete GIS equipment shall be at CRP only. Further external AC & DC control & auxiliary power supplies interface for complete GIS equipment shall be at designated LCC only.

5.12.2 All cables required amongst various components of GIS i.e. circuit breaker, disconnectors, earth switches, CT, VT, LCC, CRP etc. along with the cable glands & lugs shall be provided by the vendor. The cables shall be Cu conductor, FRLS, armoured type. These shall be suitable for directly laying in cable trays/ lined RCC trenches. Maximum distance between GIS/LCC and corresponding CRP shall be considered as 150 meters unless otherwise specified. Exact distances shall be informed during vendor drawing review based on the final locations of GIS/LCC and CRP.

5.12.3 Inside the cubicles, the wiring for control, signalling, protection and instrument circuits shall be done with FRLS type, copper conductor wire. The insulation grade shall be 660V. The wiring shall preferably be enclosed in plastic channels or neatly bunched together. Flexible conduits shall be provided for routing wiring between various compartments.

5.12.4 A minimum of 10% spare terminals shall be provided on each terminal block. Conductors shall be terminated with adequately sized compression-type lugs for connection to equipment terminals and strips. Stranded conductors shall be soldered at the ends before connections are made to the

terminals. Sufficient terminals shall be provided on each terminal block to ensure that not more than one outgoing wire is connected per terminal. Terminal strips shall preferably be separated from power circuits by metal barriers or enclosures. All spare contacts of CB, switches, auxiliary relays etc shall be wired up to the terminals.

5.12.5 Each wire shall be identified at both ends by correctly sized ferrules. The CT terminal blocks shall have shorting, isolation and injection test facilities whereas VT terminals shall have isolation and injection test facilities.

5.12.6 Copper conductor of cross section 1.5 mm^2 may normally be used for control fuse rating 10 amps or less. For 16 amps control fuse circuit, 2.5 mm^2 copper conductors shall be used. CT Circuit wiring shall be done with 2.5 mm^2 copper conductors.

5.12.7 All inter-panel control wiring within each shipping section shall be done at vendor works. The inter-panel wiring shall be taken through sleeves or suitable grommets. For inter-panel wiring between the shipping sections, wires in rolls of the required length, connected at one point, shall be supplied with the panel by vendor for connection at site.

5.13 Earthing

5.13.1 The earthing system shall be designed and provided as per IEEE-80 and CIGRE- 44 to protect operating staff against any hazardous touch voltages and electro-magnetic interferences. The earthing system shall ensure safe touch & step voltages in all the enclosures.

5.13.2 Vendor shall provide copper earth buses and copper earth conductors & associated hardware material for connecting all GIS equipment, earthing switches, surge arrestors, VT neutral, CT leg, enclosures, cabinets, boxes, supporting structure, platforms & hand rails, operating handles of disconnector & earth switches etc. to the earth buses of GIS.

5.13.3 The GIS enclosures shall be of continuous design and shall meet the requirements as specified in clause no. 10 (special considerations for GIS) of IEEE- 80. The GIS shall be earthed at several points so that there shall be earthed cage around all the live parts. Wherever earth continuity is not maintained by GIS inherent design, each enclosure shall be effectively interconnected with 2 nos. Cu bonds of suitable size to bridge the flanges.

5.13.4 LCC, CRP, power and control cable sheaths and other noncurrent carrying metallic structures shall be connected to the earthing grid. At least two earthing paths shall be provided to connect each point to the GIS earth bus.

5.13.5 Minimum earth bus size of 300 mm^2 copper for earthing of GIS equipment shall be provided.

5.13.6 All flexible earthing leads shall be of copper.

5.13.7 The earthing of Surge arrestor shall be provided with green PVC coated Cu braided cable up to the main earth grid. The size of the conductor shall be such that all the energy is dissipated to the earth without getting overheated.

5.14 Interlocks

5.14.1 The interlock system shall positively prevent an Operator from reaching or creating unintentionally a dangerous or potentially dangerous condition.

5.14.2 All interlocks required between circuit breakers, disconnectors and earth switches shall be provided.

5.14.3 Specifically the following conditions shall be impossible to reach:

a) Electrically and manually closing or opening of the disconnector / earthing switch while the circuit breaker is closed.

b) Electrical closing of disconnector/ circuit breaker, while the earthing switch at the remote end is closed.

c) Electrical closing of earthing switch while the remote end disconnector/circuit breaker is in closed position.

d) Electrical & manually closing of bus bar disconnectors of any circuit while the bus bar earthing switch is closed.

5.14.4 When the manual emergency cranks are used, it shall be impossible to control the devices electrically.

5.14.5 Bus VT Miniature Circuit Breaker (MCB) ON auxiliary contacts and under voltage relay contacts shall be monitored in the interlocking scheme to confirm the dead bus condition.

5.14.6 Bus-bar disconnectors of any circuit shall not close electrically or manually while a Bus-bar Earthing Switch is closed.

5.15 Space Heaters

5.15.1 CRP, LCC & drive mechanism box shall be provided with space heaters to prevent moisture condensation and maintain cubicle temperature 5°C above the ambient. The space heaters shall be controlled through a double pole MCB and thermostat. Space heaters shall be supplied from 240V AC auxiliary supply.

6.0 SWITCHGEAR COMPONENTS

6.1 Circuit Breakers

6.1.1 General

a) The circuit breakers shall be in 3 phase enclosure or single phase enclosure as per vendor standard design. They shall be electrically, mechanically, hydraulically trip free as applicable and anti-pumping with both of the trip circuits connected.

b) Pole discrepancy tripping shall be provided which shall detect discrepancy in opening of contacts. Local electrical operation shall be provided from the local control cabinet. An emergency manual trip device & mechanical operation counter shall be provided in the breaker kiosk. The breaker enclosure shall have provision for easy withdrawal of the interrupter assemblies.

6.1.2 Duty Cycle (Operating Mechanism)

a) Circuit breaker shall be C2 - M2 class as per IEC 62271-100.

b) Circuit breaker shall meet the duty requirements for any type of fault or fault location &also for line charging and dropping as applicable and perform make and break operations as per the stipulated duty cycles satisfactorily.

c) The CB shall be suitable for carrying out the duty cycle of O-0.3 seconds-CO-3.0 minutes – CO.

6.1.3 Pre-Insertion Resistor (applicable for 400 kV GIS)

The circuit breakers for transmission line bay shall be provided with single step pre insertion closing resistors/Controlled switching devices to limit the switching surges to a value of less than 2.3 p.u. The value of the pre-insertion resistor and the duration of pre-insertion time shall be as designed by vendor.

6.1.4 Construction Features

a) The circuit breakers shall be SF_6 type. The circuit breakers shall be of single pressure type / self blast type and shall utilise puffer cylinder for arc interruption. Each SF6 CB pole shall preferably be with single interrupting chamber. Each SF_6 circuit breaker pole shall be provided with its own self-contained gas system.

b) The service connections for gas handling shall be located on each pole tank to facilitate servicing. The breaker shall be designed to ensure that condensation of moisture is controlled by proper selection of organic insulating materials having low moisture absorbing characteristics, complete drying of container and breaker, selection of 'O' ring, etc.

c) Materials such as activated alumina or molecular sieve shall be provided at appropriate locations as moisture absorbents. Also suitable absorbents for removing SF6 arc products shall be employed.

d) Breakers shall be so designed that when operated within their specified rating, the temperature of each part will be limited to values consistent with a long life for the material used. The temperature rise shall not exceed that indicated in IEC-62271-100 under specified ambient conditions.

6.1.5 Breaker Contacts

a) Main contacts shall be of copper with silver plating and have ample area & contact pressure for carrying the rated current and the short time rated current of the breaker without excessive temperature rise which may cause pitting or welding. Contacts shall have a minimum of movable parts and adjustments to accomplish these results. Main contacts shall be the first to open and the last to close so that there will be little contact burning and wear.

b) Arcing contacts, if provided, shall be the first to close and the last to open and shall be easily accessible for inspection and replacement. Tips of arcing and main contacts shall be silver faced or have tungsten alloy tipping. Provision shall be made for rapid dissipation of heat generated by the arc on opening.

c) If multi-break interrupters are used, they shall be so designed and augmented that a fairly uniform voltage distribution is developed across them.

6.1.6 Operating Mechanism

a) General Requirements

i. Circuit breaker shall be operated by spring charged mechanism or electro hydraulic mechanism or a combination of these.

ii. Main poles shall operate simultaneously. The design of the circuit breaker shall be such that contacts will not close automatically upon loss of gas / hydraulic pressure.

iii. The mechanism shall be such that the failure of any auxiliary spring will not prevent tripping and will not cause trip or closing operation of the power operating devices.

b) Operating Mechanism Control

i. The close and trip circuits shall be designed to permit use of momentary-contact switches and push buttons.

ii. Two (2) independent tripping circuits, valves, pressure switches, and coils shall be provided for each operating mechanism.

iii. For all HV Variable frequency drive feeders, breaker shall be additionally provided with under voltage release. However, in case it is not possible to provide under voltage release in the standard design, as an alternative, one shunt trip coil shall be suitable for DC control supply while second shunt trip coil shall be suitable for external AC control supply. The control supply voltage level shall be as specified in datasheet.

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

v. Electrical tripping shall be performed by shunt trip coils. Provisions shall be made for electrical control from LCC & CRP.

vi. The trip coils shall be suitable for trip circuit supervision during both open and close position of breaker.

vii. Breaker tripping, closing and spring charging devices shall be fed with DC control power supply. Closing coil and associated circuits shall operate correctly at all values of control voltage between 85% and 110% of the rated voltage. Shunt trip and associated circuits shall operate correctly under all operating conditions of the circuit breaker up to the rated breaking capacity of the circuit breaker at all values of supply voltage between 70% and 110% of rated voltage.

viii. Pressure switch contacts shall be suitable for direct use as permissive in closing and tripping circuits. Separate contacts shall be used for each of tripping and closing circuits.

ix. The auxiliary switch of the breaker shall be positively driven by the breaker operating rod.

x. The breakers shall have at least 6 normally open (NO) and 6 normally closed (NC) spare auxiliary contacts for Owner's use. If these are not available, auxiliary relays shall be used to multiply the auxiliary contacts of the breakers.

c) Hydraulic Operated Mechanism

i. Hydraulic operated mechanism shall comprise self contained operating unit with power cylinder, control valves, high and low pressure reservoir, pressure gauge, necessary piping, compressor and motor, etc. A hand pump set shall also be provided for emergency operation.

ii. The piping shall be seamless type and of non-corrodible material such as SS or Brass. The joints shall be welded except at the equipment terminal ends.

iii. Oil required for initial filling including make up of usual losses during commissioning and leakages shall be supplied by vendor.

d) Hydraulic Monitoring Device:

i. Hydraulic pressure system shall be monitored as follows:

- "Hydraulic first level": this gives an alarm if, after a predetermined time interval, the hydraulic pressure is not returned to its nominal setting. Pressure switch contact to open for alarm.
- "Hydraulic second level": this will give an alarm indication if the pressure drops below the minimum operable pressure, i.e. mechanism locks out.
- Hydraulic motor Excessive start: alarm to be provided.
- Hydraulic motor: excessive running of motor alarm to be provided.

ii. 'Motor on overload' condition shall be tripped and 'trip' and 'supply failure' conditions shall be annunciated. In the event that non bio-degradable fluids are used, containment trays shall be provided to prevent a spillage.

e) Spring operated Mechanism

i. Spring operated mechanism shall be complete with motor. Opening spring and closing spring with limit switch for automatic charging and other necessary accessories to make the mechanism a complete operating unit shall also be provided.

ii. Breaker operation shall be independent of the motor which shall be used solely for compressing the closing spring. Facility for manual charging of the closing spring shall also be provided.

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

iv. 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 LCC.

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

vi. A mechanical indicator shall be provided to indicate the status of the spring. The indication shall be visible with the doors of the mechanism cabinet closed.

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

viii. The spring operating mechanism shall have adequate energy stored in the operating spring to close and latch the circuit breaker against the rated making current and also to provide the required energy for the tripping mechanism in case the tripping energy is derived from the operating mechanism.

6.2 Disconnectors &Earthing Switches

6.2.1 General

a) Disconnectors and Earthing switches shall be of single-pole, group operated type, installed in the switchgear to provide electrical isolation with one motor operated mechanism per three poles. The disconnectors and earth switches shall conform to IEC- 62271-102.

b) Disconnector shall also be able to make and break rated bus transfer current at rated bus transfer voltage which appears during transfer between bus bars in accordance with Annexure –B of IEC: 62271-102.

c) The disconnector shall be M1 class operated.

d) High speed make proof earthing switches shall be E1 class operated. Safety earthing switches shall be E0 class operated.

e) Electric motor shall be suitable for DC control supply and shall be equipped with a manual operating mechanism for emergency use. The motor shall be protected against over current and short circuit. The associated circuits shall operate correctly under all values of supply voltage between 85% and 110% of rated voltage.

f) Disconnectors shall be suitable to make and break the charging currents during their opening and closing. The contact shielding shall also be designed to prevent restrikes and high local stresses caused by transient recovery voltages when these currents are interrupted.

6.2.2 Constructional Features

a) The disconnector shall be provided with high current carrying contact surfaces of silver faced copper/silver faced aluminium.

b) Arrangement shall be provided to permit manual operation of the disconnectors & earthing switches. Whenever the manual handle is inserted into the drive mechanism, it shall not be possible to control the device electrically. Manual operating handle shall be provided with pad lock. The contacts shall be both mechanically and electrically disconnected during the manual operation.

c) The disconnectors shall be arranged in such a way that all the three phases operate simultaneously. All the parts of the operating mechanism shall be able to withstand starting torque of the motor mechanism without damage until the motor overload protection operates.

d) The disconnectors and safety earthing switches shall have a mechanical key (pad locking key) and electrical inter-locks to prevent closing of the earthing switches when disconnectors are in the closed position and to prevent closing of the disconnector when the earthing switches are in the closed position.

e) The disconnectors & earth switches shall be capable of being padlocked in both fully open and fully closed positions with the operating motor automatically disengaged. The padlock shall be visible and directly lock the final output shaft of the operating mechanism.

f) One man shall be able to operate the disconnector /earthing switch (when manually operated) without undue effort.

6.2.3 Operating Mechanism Control

a) Disconnectors and earthing switches shall be motor operated, with limit switches and controlled from the LCC and CRP. Connections, interlocking requirements and auxiliary switches shall be provided as per the requirements.

b) The disconnector operations shall be inter-locked electrically with the associated circuit breakers in such a way that the disconnector control is inoperative if the circuit breaker is closed.

c) Each disconnector, earth switch shall have at least 4 normally open (NO) and 4 normally closed (NC) spare auxiliary contacts for Owner's use.

6.2.4 Additional Requirements for Safety Earthing Switches

a) Earthing switch, whenever possible can form an integral part of each pole of the disconnector. Two independent earthing pads each with flexible copper braids and suitable connectors for the specified size of earth conductor lead shall be provided at the hinge end of the earthing switch.

b) Interlocks shall be provided so that manual operation of the earthing switches or insertion of the manual operating device will disable the electrical control circuits.

6.2.5 **Additional Requirements for High Speed Make Proof Earthing Switches**

a) High speed make proof earthing switch shall have make proof contacts and high speed stored energy operating mechanism to enable them suitable to close on to a fault.

b) High speed earth switches shall be motor driven stored energy operated. After removal of the earthing initiated by a fault making earth switch, it shall be possible to re-energize the system without first carrying out the maintenance.

c) The short circuit making current rating of each earthing switch shall be at least equal to its peak withstand current rating as applicable. The switches shall have inductive/ capacitive current switching capacity as per IEC62271-102.

d) All portions of the earthing switches and operating mechanism required for connection to earth shall be connected together utilizing copper conductor.

e) The main earthing connection on earthing switch shall be rated to carry the peak withstand current rating of the switch for 1 sec. and shall be equipped with a silver plated terminal connector suitable for steel strap of adequate design for connection to the earthing grid.

6.3 Surge Arrestors

6.3.1 The surge arrestors shall conform in general to IEC 60099-4.

6.3.2 The surge arrester shall be of heavy duty station class and gapless (Metal oxide) type without any series or shunt gaps.

6.3.3 The surge arresters shall be capable of discharging over-voltages occurring during switching, lightning impulse etc.

6.3.4 The surge arresters shall be provided with a discharge counter located at an accessible position.

6.3.5 The nonlinear blocks shall be of sintered metal oxide material. These shall be provided in such a way so as to obtain robust construction, with excellent mechanical and electrical properties even after repeated operations.

6.4 Local Control Cabinet

6.4.1 Local Control Cabinet (LCC) for each bay shall be supplied. LCCs shall be either separate free-standing floor mounted type panel or mounted on GIS assembly as per vendor's standard design. If separate LCCs are provided, these will be located next to GIS.

6.4.2 LCC shall be in dust and vermin proof hot dipped galvanised sheet steel construction. Hinged doors giving access to the components shall be provided.

6.4.3 Local control of all CBs, disconnectors & earthing switches shall be possible from LCC through control switches & selector switches with all associated interlocks. Local/ off / Remote selector switch shall be provided in LCC panel. LCC panels shall house alarms and facia annunciation etc. of GIS including GIS gas pressure system. The LCC shall also be used for termination of CT and PT cables from GIS bay.

6.4.4 Two (2) numbers of 415V, TPN, 50 Hz, power supply feeders will be provided by Owner at one location in the LCC for complete switchgear. Further power supply distribution for each LCC and to CRP shall be done by vendor.

6.4.5 Two (2) numbers of DC supply feeders will be provided by Owner at one location in the LCC for complete switchgear. Further DC power supply to each LCC and to each CRP shall be done by vendor.

6.4.6 The incoming external control supplies (AC & DC) shall be monitored continuously and alarm shall be given on failure. Vendor shall supply all necessary equipment and control for automatic change over from one source of control supply to the other in the event of failure of one source / contactor drop out.

6.4.7 An isolating switch for disconnection of power supply, open/close push buttons, magnetic contactor with thermal overload relays and HRC link type fuses for short circuit protection shall be provided in LCC for each individual motor of CB, disconnector and earth switch.

6.4.8 **Local Alarm &Annunciation**

a) Alarm contacts shall be provided for monitoring of all vital systems of each circuit breaker and SF_6 gas system.

b) Window type alarm annunciation shall be provided on LCC of each bay for the various abnormal conditions.

c) Potential free electrical contacts shall be provided for remote alarm / indication of all alarm condition. These contacts shall be in addition to those required for local indication. These shall be wired to the terminal blocks in the LCC.

d) The following minimum number of abnormal conditions shall be annunciated.

i. Gas refill level for each gas compartment of the bay. (low gas pressure)

ii. Breaker Block level for each gas compartment of the bay. (low low gas pressure)

iii. Zone isolation level for each gas compartment of the bay.

iv. Over pressure for each gas compartment of the bay.

e) In addition to the minimum abnormal conditions listed above, any other abnormal condition as per the vendor shall also be annunciated.

f) Mimic diagram preferably shall be provided.

6.4.9 All current transformer leads shall be terminated on shorting type terminal blocks in the LCC and shall be accessible at all times. All voltage transformer leads shall be terminated and protected by MCB.

6.4.10 All other devices shall be wired to terminal blocks provided in the LCC. The terminal blocks shall have minimum 10% spare terminals per cabinet.

6.5 Control Relay Panels

6.5.1 Separate Control Relay Panel (CRP) for each bay shall be supplied to facilitate control of circuit breakers, disconnectors, earth switches and metering, protection etc.

6.5.2 CRP shall be free-standing floor mounted type panel and shall be located either in GIS hall or in a separate room from GIS. CRP shall be in dust and vermin proof hot dipped galvanised sheet steel construction preferably modular swing rack type.

6.5.3 A mimic diagram shall be provided on the front of the panel with control switches and position indicators for CB, disconnector and earth switches. The panel shall be dead front type with front

door having clear glass cut-out of adequate size so that mimic diagram, annunciator windows, indicating lamps are clearly visible from outside.

6.5.4 CRP shall house bay control units (BCUs) and protection relays. These panels shall also house the various selector switches, auxiliary relays, timers, local indications, alarms and facia annunciation window etc. to realise various interlocks as per requirement among circuit breakers, disconnectors and earth switches and for breaker pole discrepancy, anti-pumping etc. It shall include the following as minimum:

a) Local / remote selection switch
b) CNT control switch for breaker
c) Breaker ON, OFF, Trip-1, Trip-2, Trip circuit healthy indications
d) Disconnector & earth switches ON, OFF control switches & indications
e) Upstream breaker ON, OFF indication (for incomers)
f) DC supply healthy indication
g) Spring charging devices status
h) Aux. relays / other devices as required by the design.

6.5.5 Completely separate and isolated circuits shall be used for each operating mechanism control, trip-1, trip-2, close, alarms and auxiliary devices. Close and trip circuits shall be kept isolated to their final mechanical or electrical actuators from the CRP terminals.

6.5.6 Trip circuit-1 & trip circuit-2 shall be individually monitored for continuity under open and closed condition of breaker. Closing circuit shall be monitored under open condition of breaker.

6.5.7 The contacts and signals originating from/going to the GIS, associated auxiliary and monitoring equipment shall be wired up to the CRP for external use.

6.5.8 **Measuring Instruments**

Meters shall be of electronic or induction- disk type, flush-mounted on the cubicle door. All analogue instruments shall be of square pattern, 96 x 96 mm, flush-mounted type. Measuring instruments, shunts, transducers, CTs, VTs, etc, shall be provided as specified in data sheet. The accuracy class for all instruments shall be 1.0 unless otherwise specified.
Digital meters shall also be acceptable, provided specific approval of EIL/Owner for make and model is obtained. All digital meters shall be highly reliable, accurate, and compact and self powered. Digital meter data shall be saved in case of power failure. Field programming from front of the meter shall be possible and shall have RS232/485 port in case specified in the job specification / data sheet.

a) Ammeters and Voltmeters

Analogue meters shall be of moving-iron type. The range shall be indicated on the drawings.

b) kW / kWh Meters

The kW / kWh meters shall be suitable to measure unbalanced loads on a 3-phase, 3-wire system. The kW meters shall operate on a VT secondary voltage of 110 V.

c) Frequency Meters

These shall be of direct-reading or digital type and shall operate on a VT secondary voltage of 110V. The standard range shall be 45-50-55 Hz.

d) Power Factor Meters

Power factor meters shall operate on a VT secondary voltage of 110 V. The standard range shall be 0.5 lead-1.0-0.5 lag.

6.5.9 **Relays**

a) Type of relay i.e. electromechanical, static or numerical / bay control unit shall be as defined in datasheet / job specification.

b) All electromechanical protective relays shall be back-connected, of drawout type, suitable for flush mounting, and fitted with dust-tight covers. Alternatively, "plug-in" type relays will also be acceptable. Auxiliary relays are acceptable in fixed execution.

c) The protective relay cases shall have a provision for insertion of a test plug at the front for testing and calibration using an external power supply without disconnecting the permanent wiring. The insertions of the test plug shall automatically short circuit the CTs and permit extension of external power supply to the relay.

d) All protective relays shall have hand reset facility and clear operating indication, e.g. flags for electro-mechanical type relays or light emitting diodes for static/numerical type relays. It shall be possible to reset the flag without opening the relay case.

e) All tripping relays shall be of lockout type with hand-reset contacts, and shall be suitable to operate on the specified voltage. These relays shall have self coil cut off contacts, and shall be provided with hand-reset operation indicators. Tripping relays will be acceptable in non-drawout cases.

f) The tripping relay shall be suitable for satisfactory operation from 50% to 110% of the specified control supply voltage.

g) Numerical relays /bay control unit shall be equipped with communication port to work as an integrated part of the substation automation system. Multifunctional device (bay control and protection unit) shall be with control, indication, metering, protection, mimic, communication/ interface functions.

h) Stabilizing resistors shall be provided along with relays, wherever required, to limit the secondary voltage of current transformer to safe level during maximum internal fault condition. Further Stabilizing resistors shall be provided with relays including numerical relays in residual earth fault connections to prevent any spurious tripping during starting.

6.5.10 **Alarm & Annunciation**

a) Potential free electrical contacts shall be provided for remote alarm / indication of all alarm/trip condition. These contacts shall be in addition to those required for local indication at LCC. These shall be wired to the terminal blocks in the CRP.

b) The following minimum no. of abnormal conditions shall be annunciated.

i. Hydraulic motor overload / circuit trouble

ii. Hydraulic first level (low hydraulic pressure)

iii. Hydraulic second level (Low-Low Hydraulic pressure)

iv. Disconnector/ earth switch motor overload (one per each bay)

v. Circuit breaker motor overload (one per each bay)

vi. DC control supply failure

vii. Common gas alarm for the bay

c) In addition to the minimum abnormal conditions listed above, any other abnormal condition as per the vendor shall also be annunciated.

6.5.11 Clustered LED type indicating light with minimum 8mm diameter size shall be provided for indications. The LED shall have a low glow voltage protection and shall not glow on voltage leakage.

6.5.12 All other devices shall be wired to terminal blocks provided in the CRP. The terminal blocks shall have not less than 10% spare terminals per panel.

6.6 Current Transformers

6.6.1 The current transformers and accessories shall conform to IEC: 61869-1&2 and other relevant standards.

6.6.2 The CT short time rating shall be equal to that of the switchgear. The CT ratings shall be as shown in the data sheet. Protective CTs shall have an accuracy class of 5P and an accuracy limit factor greater than 10. CTs for instruments shall have an accuracy class of 1.0 and an accuracy limit factor less than 5.0. For numerical relays having protection and metering functions, dual rated CT shall be provided suitable for protection class and metering class. One leg of CTs shall be earthed.

6.6.3 The current transformers shall be of metal- enclosed and shall be given tropicalised treatment for satisfactory operation in hot and humid climate. The current transformers shall have effective electromagnetic shields to protect against high frequency transients.

6.6.4 The CT secondary terminals shall be brought outside the EHV enclosures through a bushing of 1.1 kV class and mounted in accessible terminal box. All secondary leads shall be wired to shorting type terminals on the terminal strip in the local control cabinet of each breaker bay. All terminals shall be shrouded with plastic covers to prevent accidental contact.

6.6.5 All CTs shall be star connected. Interposing CT (ICT) shall be provided (if required) for differential protection of transformers having star-delta connection.

6.6.6 The polarity of the primary and secondary windings of each current transformer shall clearly be indicated.

6.7 Voltage Transformers

6.7.1 The voltage transformers shall conform to IEC 61869-1&3.

6.7.2 The voltage transformers shall be of inductive type, non-resistant and shall be contained in their own compartment. The voltage transformers shall be effectively shielded against high frequency electromagnetic transients.

6.7.3 Voltage transformer secondary shall be protected by 4 pole MCB for all the windings. The secondary terminals of the VT's shall be terminated to the stud type non-disconnecting terminal blocks in the secondary boxes.

6.7.4 The terminals of the secondary winding shall be brought out of the enclosure through 1.1 kV class bushing. Secondary terminals of each phase shall be located in accessible earthed terminal box on the VT enclosure itself. Neutral side of HV winding shall be brought out through a bushing rated for at least 1.1 kV class and located in a terminal box.

6.8 Auxiliary equipment

6.8.1 Auxiliary Relays and Contactors

a) Auxiliary relays and contactors shall generally be used for inter-locking and multiplying contacts. Auxiliary contacts shall be capable of carrying the maximum anticipated current.

6.8.2 **Control Switches**

a) All control switches shall be rotary type, having a cam-operated contact mechanism. Circuit breaker control switches shall be 3-position CNT, spring return to neutral from both Close and Trip positions. They shall have pistol-grip handles.

b) The Local/off/remote switch shall be three positions type, lockable, key free in remote positions only with the following functions:

i. Local position (the breaker, disconnector and earthing switches can only be operated locally by its control switches).

ii. Off position (the breaker, disconnector and earthing switches cannot be operated electrically).

iii. Remote position (the breaker and disconnector can only be operated from Remote).

c) Ammeter selector switches shall have a make-before-break feature on its contacts. The selector switch shall generally have four positions, three positions for reading 3-phase currents and the fourth position for OFF. The voltmeter selector switch shall also have four positions, three positions shall be used to measure phase-to-phase voltages and the fourth position shall be for OFF.

6.9 SF_6 Gas

6.9.1 SF_6 gas shall comply with the requirements of IEC 60376, 60376A & 60376B as a minimum & should be suitable in all respects for use in the switchgear under all operating conditions. The high pressure cylinders in which SF6 gas is supplied & stored at site shall comply with the requirements of IS:4379. The cylinders shall also meet the Indian Boilers Regulations.

6.9.2 SF_6 gas necessary for initial filling (including entire losses, if any, during HV testing, Pre-commissioning / commissioning) and make-up gas for leakages of the complete switchgear shall be supplied by vendor.

6.9.3 The initial gas pressure or density at the time of charging the equipment shall provide a 10% margin above the allowable operating pressure for the plant to be safely operated for a reasonably long period before recharging is necessary.

6.9.4 SF_6 gas shall be tested for purity, dew point, air, hydrolysable fluorides and water contents as per IS 13072/IEC 60376, 60376A & 60376B and test certificates shall be furnished indicating all test results as per IEC standards for each lot of SF_6 gas.

6.9.5 In addition 10% of total gas requirement shall be supplied in separate non-returnable cylinders as spare requirement by vendor.

6.10 SF_6 Gas Monitoring Devices and Alarm Circuits

6.10.1 All gas compartments shall have their own independent gas supervision and alarm systems. There shall not be any interconnection between different gas compartments for the purpose of gas monitoring.

6.10.2 Individual temperature compensated gas pressure gauge(s)/ density device(s) shall be provided in each of the gas compartments which will continuously & automatically monitor and indicate the state of gas density as follows:

a) Compartments except circuit breaker

i. 'Gas Refill' level
This will be used to annunciate on the LCC and CRP the need for the gas refilling.

ii. 'Zone Trip' level
This is the minimum level at which the vendor will guarantee the insulation rating of the assembly (i.e. one minute power frequency voltage, BIL specified). At this pressure level it will be annunciated on the LCC/ CRP so that manual tripping of the circuit should be done.

b) Circuit Breaker

i. 'Gas Refill' level
This will be used to annunciate on the LCC and CRP the need for the gas refilling.

ii. 'Breaker Block' level
This is the minimum gas density at which the vendor will guarantee the rated fault interrupting capability of the breaker. Beyond this level the device contacts lock out the breaker (trip and close operation) circuits and annunciate the condition on the LCC & CRP for the need of manual zone tripping.

c) High pressure interlock and monitoring device shall be provided.

d) Necessary contacts for remote annunciation shall be provided.

6.10.3 Vendor shall provide an independent pressure switch for isolation of the particular zone. This alarm level shall be provided to indicate abnormal pressure rise in the gas compartment.

6.10.4 Pressure switches and pressure gauges / density devices shall be located at accessible location suitable for viewing.

6.10.5 It shall be possible to test all gas monitoring devices without de-energising the primary equipment and without reducing pressure in the main section.

6.10.6 **Gas Leakage Loss**

a) Maximum guaranteed gas leakage loss of the switchgear shall be in no case be more than 0.5% per year over the life time of the switchgear. Initial filling of equipment shall guarantee gas service period of not less than 10 years.

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

6.11 SF_6 Gas Handling Unit / Service Cart

6.11.1 Portable SF_6 gas handling & processing unit suitable for evacuating, liquefying, evaporating, filling, drying and purifying SF_6 gas during the initial installation, subsequent maintenance and future extension of GIS shall be provided. The cart shall be equipped with rubber wheels and shall be easily manoeuvrable within the building.

6.11.2 The unit shall be self-contained suitable for 415 V AC, 3-phase, 50 Hz power supply and fully equipped with an electric vacuum pump, gas compressor, gas drier, gas filter, refrigeration unit, evaporator, gas storage tank, full instrumentation for measuring vacuum, compressor inlet

temperature, tank pressure and temperature, valving and piping to perform the following operations as a minimum requirement:

- Evacuation from a gas filled compartment using the vacuum pump,
- Transfer of SF_6 gas from a system at some positive or negative pressure to the storage tank via the gas drier and filter,
- Recirculation of SF_6 gas in the storage tank through the drier,
- Recirculation of SF_6 gas in any Switchgear or bus duct compartment through the drier and filter,
- Evaporating and filling SF_6 gas,
- Drawing off and liquefying SF_6 gas,
- A combination operation of filling SF_6 gas into a gas system and evacuating a second, gas system using the vacuum pump.

6.11.3 The unit shall be complete with all necessary instrumentation and control which may include instruments such as decomposition tester, hygrometer, and test unit for the density monitors, precision pressure / density gauge and vacuum gauge.

6.11.4 The unit shall include necessary gas cylinders for replenishment and for temporary storage of the evacuated SF_6 gas. The capacity of the storage facilities shall at least be sufficient for storing the maximum quantity of gas that could be removed from the largest compartment of GIS + 10% extra SF_6 gas when carrying out maintenance or repair work on the switchgear and associated equipment.

6.11.5 Adequate length of hoses shall be provided for filling of SF_6 gas in any of the gas compartment with the help of service cart.

6.12 Insulators & Gas Seals

6.12.1 The support insulators and section barriers/ insulators shall be of solid moulded composite epoxy resin. They shall be free from all voids and with smooth surface and the design shall be such so as to reduce the electrical stresses in the insulators to a minimum.

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

6.12.3 All gas seals shall be designed to ensure that leakage rates are kept to specified minimum under all pressure, temperature, electrical load and fault conditions.

6.13 Voltage Detectors (applicable for 220 kV and above)

Each outgoing & incoming bays and main bus bars shall include capacitive type voltage detectors for each phase to indicate phases "ALIVE". The unit shall also be suitable for interlocking of earthing switches (voltage free condition).

6.14 Outdoor SF_6 – Air Bushings

6.14.1 Outdoor SF_6 – Air bushings, for the connection of conventional external conductors to the GIS shall generally be in accordance with the requirements of IEC 60137 as applicable.

6.14.2 Bushing type shall be any of the following:

a) Condenser type bushings, liquid filled with liquid level gauges clearly visible from ground level, preferably of the direct reading prismatic type or the magnetic type. Other types of liquid level gauges will be accepted if specifically approved.

b) The bushings with composite insulators (Silicone rubber) or with porcelain insulators with all surfaces free from imperfections. The internal insulation of the bushings shall be resin impregnated paper winding (RIP body) or compressed SF_6 gas. The internal and external electrical field of the bushings shall be controlled by a capacitive grading body /grading shields. The RIP body shall consist of resin impregnated paper insulation with concentric aluminium layers. The space between the RIP body and the insulator shall be filled with insulating foam compound or compressed SF_6 gas. Air bushings shall comply with the relevant IEC standards.

6.14.3 Bushings shall be designed to have ample mechanical strength and rigidity for the conditions under which they will be used. Outdoor bushings shall be capable of withstanding a cantilever force applied to the terminal.

6.14.4 All current carrying parts shall be of Copper. Hardware used for current carrying parts (such as nuts, bolts etc.) shall be SS304 Grade or brass. All current carrying contact surfaces shall be silver faced.

6.14.5 The flange shall be made of weather resistant, corrosion proof material. Suitable arrangement for connection of flange to earth shall be provided. If required, corona ring shall be provided which will be of Copper / Brass.

6.14.6 Porcelain shall be homogeneous, free from laminations, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified, tough and impervious to moisture. Glazing of the porcelain shall be of uniform brown colour free from blisters, burns and similar other defects.

6.14.7 The parameters characterising the SF_6- Air bushing profile shall be such that it is suitable for "Very heavy" pollution level (salt contamination) prevailing at the site and also suitable for fixed type hot line washing. The creepage distance over the external surface of outdoor bushings shall not be less than 31 mm/kV.

6.14.8 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 / erosion or injury to conductors, insulators or supports by the formation of substances produced by chemical action.

6.14.9 All joints shall be air-tight. Surface of the joints shall be trued-up; porcelain parts by grinding and metal parts by machining. Bushing design shall be so as to ensure uniform compressive pressure on the joints.

6.15 Gas Insulated Bus Duct

6.15.1 The Gas insulated bus duct shall be 3-phase enclosure or single phase enclosure as per vendor standard design comprising of straight lengths, bends, elbows, gas seals and accessories such as flanges, gaskets, fixing hardware etc.

6.15.2 Bus bars shall be of high conductivity electrolytic aluminium or copper.

6.15.3 The enclosure for the bus duct shall be made from non-magnetic material e.g., AL/AL Alloy.

6.15.4 The bus duct shall be capable to withstand the mechanical and thermal stresses due to short circuit currents, as well as thermal expansion and contraction created by temperature cycling.

6.15.5 The bus duct shall be suitable for outdoor installation.

6.15.6 The bus duct shall not be supported from the wall when crossing from indoor to outdoor. Necessary accessories supports etc. including wall frame assemblies shall form part of supply. Necessary bellows (if required) with sealing arrangements shall be provided.

7.0 INSPECTION, TESTING AND ACCEPTANCE

7.1 Vendor shall have valid type test certificates to verify the making and breaking capacity of the switching devices & other primary components and other test certificates as per relevant IEC standards.

7.2 During fabrication, the switchgear shall be subjected to inspection by EIL / Owner or by an agency authorised by the Owner, to assess the progress of work, as well as to ascertain that only quality raw material is used. The vendor shall furnish all necessary information concerning the supply to EIL / Owner's inspectors.

7.3 All switchgear components (CBs, disconnector, earthing switches etc) shall be tested in accordance with the latest relevant standards. Test certificates for each switchgear component shall be submitted prior to delivery.

7.4 Type test certificates / reports shall be considered acceptable if they are in compliance with the latest applicable relevant Standards and conducted at recognized laboratory. If the type test reports submitted are not in accordance with the above requirements, Owner/EIL reserves the right to ask for the type tests to be repeated in the vendor's premises or other recognized place. The recognized laboratory shall issue the relevant type test certificates upon successful testing.

7.5 Switchgears and their components shall be subjected to routine tests as per the relevant IEC standards. Routine test certificates shall be submitted for EIL/Owner's review and approval before shipment of the switchgear components. The routine tests for the switchgear shall also include the functional tests for the associated LCC & CRP.

7.6 For testing requirements, refer Inspection & Test Plan Spec no. 6-81-1066.

8.0 PACKING AND DESPATCH

8.1 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.

8.2 The SF_6 equipment shall be shipped in the largest factory assembled units within transport and loading limitations and considering handling facilities on site to reduce the erection and installation work on site to a minimum. Where possible all items of equipment or factory assembled units shall be boxed in substantial crates or containers to facilitate handling in a safe and secure manner. Should the units be considered too large for packing in crates, they shall be suitably lagged and protected to prevent damage to any part, particularly small projections, during transport and handling. Special lugs or protective supports shall be provided for lifting to prevent slings and other lifting equipment from causing damage. Each crate, container or shipping unit shall be marked clearly on the outside to show where the weight is bearing and the correct position for the slings.

8.3 Each individual piece to be shipped, whether crate, container or large unit, shall be marked special notations such as 'Fragile', 'This side up', 'Center of gravity', 'Weight', 'Owner's particulars', 'PO no.' etc., and other details as per purchase order.

8.4 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. In order to prevent movement of equipment within the crates, proper packing supports shall be provided.

8.5 Special precautions shall be taken to protect any parts containing electrical insulation against the ingress of moisture. This applies particularly to the equipment of which each gas section shall be sealed and pressurized prior to shipping. Either dry nitrogen/air or dry SF_6 gas shall be used and the pressure shall be such as to ensure that, allowing for reasonable leakage, it will always be greater than the atmospheric pressure for all variations in ambient temperature and the atmospheric pressure encountered during shipment to site and calculating the pressure to which the sections shall be filled to ensure positive pressure at all times during shipment.

8.6 All blanking plates, caps, seals, etc., necessary for sealing the gas sections during shipment to site shall be provided. All parts liable to rust shall receive a coat of anti rusting composition and shall be suitably protected. Any seals, gaskets, 'O' rings, etc. that will be used as part of the arrangement for sealing off gas sections for shipment to site shall not be used in the final installation of equipment at site. Vendor to provide quantity of components accordingly considering permanent installation.

8.7 Valves and other gas couplings associated with the switchgear gas systems shall be adequately protected against damage from any bumps or physical blows. They shall also be capped to prevent ingress of dirt or moisture or damage to any coupling, pipes, threads or special fittings.

8.8 A set of instruction manuals for erection, testing and commissioning, a set of operating & maintenance manuals and a set of final drawings shall be enclosed in a waterproof cover and supplied along with the shipment.

Project	Overall Project Management as MPMC and PMC/EPCM Services for Ethylene Cracker Unit and U&O for BPREP	**Client**	BPCL		
Unit	Bulk Procurement	**Location**	Bina, Madhya Pradesh	**Job No.**	B957	**Unit No.**	000

PURCHASER'S DATA

A	**Site Conditions**		
1	Maximum Ambient Temperature	°C	48
2	Minimum Ambient Temperature	°C	1.1
3	Design Ambient Temperature	°C	45
4	Relative Humidity	%	86
5	Altitude Above MSL	m	<1000
6	Environment		Hot, humid & corrosive
B	**Operating Conditions**		
1	System Voltage		220 +/- 10% kV ± TP %
2	Frequency		50 Hz ± 5 %
3	Number of Phases		Three
4	System Fault Level	kA(for 1 sec)	50KA for 3 Sec
5	System Earthing		Solidly Earthed
6	Auxilliary Power Suppy		
i.	- for space heaters,cubicle lamps etc		240 V AC TPN 10 %
ii	- for protection metering and control		110 V DC- -10/+ 10 %
iii	- circuit breaker spring charging motor		110 V DC- 10/+ 10 %
iv	- Motor drive for disconnectors and earth switches		110 V DC- 10/+ 10 %
v	- high speed earth switch spring charging motor		110 V DC- 10/+ 10 %
vi	- gas handling and filling unit / cart		415 V AC TPN ± 10%
7	Installation		
i.	GIS		Airconditioned
ii	LCC		Airconditioned
iii	CRP		Airconditioned
C	**Electrical Data**		
1	Bus Bar System		Double
2	Bus bar rated current	A	2000
3	1 sec short circuit withstand capacity	kA	50
4	Rated peak withstand current	kA	135
5	Internal arc rating		50 kA for 0.3
6	Circuit Breaker		
i	Type of circuit breaker		SF6
ii	Duty cycle of Circuit Breaker		0-3 min-co-3 min-co
iii	Breaking capacity	kA	50
iv	Making capacity	kA	135
v	CB Operating Mechanism		Spring Charged or Electro Hydraulic 6-51-0066
vi	Shunt trip coil-1	V DC	110V DC
	Shunt trip coil -2 (see note-1)	V AC UPS	230V AC (UPS)
vii	Mechanical indicator for breaker status		Required
viii	Pre-insertion resistor		Not Required
7	Dissconnector & Earthing Switch		
i	Operating Machanism		Motorised
ii	Mechanical indicator for disconnector & earthswitch status		Required
iii	Viewing windows for disconnector and earthswitch		Required
iv	Mechanical interlock for disconnector & earthswitch		Required
v	Electrical interlock with associated circuit breaker		Required
8	High speed make-proof Earthing switch		

Rev. No.	Date	Purpose	Prepared By	Reviewed By	Approved By
C	30-APR-2025	ISSUED WITH MR/TENDER	KANUGUTTA SUMITH	RASHMI SINGH RATHAUR	RASHMI SINGH RATHAUR
B	30-JAN-2025	ISSUED WITH MR	SONALI KANU	KANUGUTTA SUMITH	RASHMI SINGH RATHAUR
A	19-NOV-2024	ISSUED WITH MR	KANUGUTTA SUMITH	RASHMI SINGH RATHAUR	RASHMI SINGH RATHAUR

Project	Overall Project Management as MPMC and PMC/EPCM Services for Ethylene Cracker Unit and U&O for BPREP			**Client**	BPCL
Unit	Bulk Procurement	**Location**	Bina, Madhya Pradesh	**Job No.**	B957

Unit No. 000

i	Operating Machanism		Motorised
ii	Mechanical indicator for High speed earthswitch status		Required
iii	Electrical interlock with associated circuit breaker		Required
D	**Miscellaneous**		
1	Paint Shade		RAL-7032
2	Interface with ECS		Required
3	SF6 Gas monitoring system		Required
4	SF6 Gas Handling /filling unit		Required
5	Spare SF6 gas		Required
6	Quality of spare gas	%	10% of total gas as per 6.9.4 of 6-51-0066
7	Mimic on LV compartment		Required
8	Voltage Detectors		Not Required

MANUFACTURER'S DATA

A	**General**		
1	Name of manufacture		
2	Place of manufacture		
3	Type designation		
4	LCC		
5	Degree of protection		
i	Gas compartment		
ii	LCC		
iii	CRP		
6	Enclosure		
7	Enclosure material		
i	Gas compartment		
ii	LCC		
iii	CRP		
9	Rated Voltage	kV	
10	1 min. power frequency withstand (rms)	kV	
11	Lighting impulse withstand voltage	kV	
12	Switching impulse withstand voltage		
13	Rated current		
i	Busbar	A	
ii	Incomers and outgoing feeders	A	
14	1 sec short ckt. withstand capacity	kA	
15	Peak dynamic withstand capacity	kA	
16	Bus bar material		
17	Main Busbar size		
18.	Bus bar size for incomers and outgoing feeders	sqmm	
19	Insulating material (busbar support)		
20	Eath busbar material / size	sqmm	
B	**SF6 Gas**		
1	Average leakage rate of SF6 gas	% / year	
2	Gas monitoring devices (density guages/pressure switch		
3	Gas handling and filling arrangement /cart		
	- maximum power requirement	kW	
4	Whether GIS are dispatched filled with SF6 gas		

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Unit	Bulk Procurement	**Location**	Bina, Madhya Pradesh	**Job No.**	B957

Unit No. 000

5	SF6 gas pressure for each gas compartment		
i	Design Pressure		
ii	Operating Pressure		
iii	Alarm Pressure		
iv	Lockout Pressure		
6	Pressure of relief device		
7	Spare gas (no. of cylinders,volume/pressure of cylinder)		
C	**Circuit Breaker**		
1	Type of circuit breaker		SF6
2	Make		
3	Place of manufacture		
4	Type designation		
5	Encloser		
6	Number of poles per phase		
7	Number of interrupting chambers per pole		
8	Number of trip coils		
9	Rated continuous current for I/C and O/G fdrs		
10	Duty cycle		
11	CB Operating mechanism		
12	Short circuit withstand capacity	kA	
13	Breaking capacity	kA	
14.	Peak making capacity	kA	
15	% DC component		
16	First pole to clear factor		
17	Power required for opening	W	
18	Power required for closing	W	
19	Power required for spring charging motor	W	
20	Closing time	sec	
21	Opening time	sec	
22	Provision of manual spring charging		
23	Manual trip device		
24	Mechanical ON/OFF indicator for breaker		
25	Mechanical indication for spring status		
26	Operation counter		
27	Number of auxiliary contacts and their rating		
28	Breaker is trip free		
D	**Disconnector / Earthing switch**		
1	Make		
2	Place of manufacture		
3	Type designation		
4	Rated continuous current of dissconnector/earth switch for I/C and O/G fdr		
5	Short circuit withstand capacity		
6	Short circuit making capacity of high speed earth switch		
7	Operating mechanism		
8	Type of motor drive		

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Project	Overall Project Management as MPMC and PMC/EPCM Services for Ethylene Cracker Unit and U&O for BPREP	Client	BPCL		
Unit	Bulk Procurement	Location	Bina, Madhya Pradesh	Job No.	B957	Unit No.	000

9	Number of auxiliary contacts and their rating		
10	Mechanical ON/OFF indicator		
11	Manual operation handle		
12	Manual spring charging		
13	Power required for spring charging motor		
E	**Instrument Transformers**		
1	Current Transformer		
i	Make		
ii	Place of manufacture		
iii	Type designation		
iv	CT ratio,accuracy & VA burden		
v	Knee point voltage / secondary voltage,accuracy & VA burden		
2	Voltage Transformer		
i	Make		
ii	Place of manufacture		
iii	Type designation		
iv	Primary Voltage / Secondary Voltage ,accuracy & VA burden		
F	**Surge Arrestors**		
1	Make		
2	Type designation		
3	Place of manufacture		
4	Rated Voltage	kV	
5	MCOV(Max. Continuous voltage, accuracy & VA burden	kV	
6	Line discharge class	kA	
7	Nominal discharge current	kA	
8	High current withstand capacity	kA	
9	Temporary overvoltage for 1 sec		
10	Temporary overvoltage for 10 sec		
G	**Mechanical**		
1	Feeder / Bay		
	Max. overall weight		
	overall Dimensions(Width X Depth X Height)		
2	LCC		
	overall Dimensions(Width X Depth X Height)		
3	CRP		
	overall Dimensions(Width X Depth X Height)		
4.	Largest shipping section		
	Max overall weight		
	overall Dimensions(Width X Depth X Height)		
5	Gas handling & filling plant / service cart		
	Overall dimensions(Width X Depth X Height)		
6	Recommended clearances		
	GIS (Front / rear / above)	mm	
	LCC (Front / rear / above)	mm	
	CRP (Front / rear / above)	mm	

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Project	Overall Project Management as MPMC and PMC/EPCM Services for Ethylene Cracker Unit and U&O for BPREP			**Client**	BPCL
Unit	Bulk Procurement	**Location**	Bina, Madhya Pradesh	**Job No.**	B957

Unit No. 000

7	Shock loading on foundation	
8	Requirement of EOT crane for GIS	
9	Capacity of EOT crane required	
10	Clear height recommended for EOT crane	
11	Dispatch for each feeder / bay	
H	**Copies of following test certificates enclo**	
	For each type of offered feeder/bay with circuit breaker, dissconnector and earthswitch	
1	Short circuit tests(peak and 1 sec withstand)	
2	Making and breaking tests	
3	Temperature rise test	
4	Internal arc test	
5.	Dielectric tests	
6	Operation and mechanical endurance tests	

Notes

1 Disconnector class shall be M2

2 Rated line charging interrupting current of breaker shall be as per IEC on 21 kM of transmission Over-head Line.

3 SF6 gas handling/filling unit mentioned in D.4 of purchaser data is already covered as part of mandatory spares as defined elsewhere.

4 Although the equipment shall be installed in Air Conditioned GIS/ Switchgear hall, but same shall be suitable for installation and satisfactory operation in a non air conditioned, tropical, humid and corrosive environment

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Rev. No.	Date	Purpose	Prepared By	Reviewed By	Approved By

इंजीनियर्स इंडिया लिमिटेड (भारत सरकार का उपक्रम) ENGINEERS INDIA LIMITED (A Govt. of India Undertaking)	220 kV GIS FEEDER DETAIL DATASHEET (HV-100103)	Data sheet No. B957-000-16-50-DS-6602 Rev.No. A

Rev.	Date	Purpose	Prepared	Checked	Approved
A	11.11.2024	ISSUED WITH TENDER	SK	RSR	RSR

Project	BPREP Project	**Unit**	SUBSTATION	**Client**	BPCL-BINA
Switchgear No.	100-EHV-201GIS	**Location**	Substation-100 (MRSS)	**Auto/ Manual Xfr.**	Not Applicable
Voltage	220 kV	**Curent**	2000 Amps	**Fault Level**	50 kA (3 Sec)
Bus Differential	Required	**Bus Diff. CT Ratio**	2000/1		

S.No.	Feeder Nameplate Inscription				Bus Section			Breaker Rating/ Feeder Designation	CT Primary Rating (A)*				Cable Details			Reference Datasheet		Remarks
										Protection								
	Panel No. @	Feeder No. #	Feeder Description	Rating (MVA)#	Left	Mid	Right		Metering	O/C,S/C, E/F	Trafo/ Feeder Differential	REF Protection	Run	Core	Size	EIL Hardware Datasheet B957-000-16-50-	Vendor Scheme No.@	
1			Incomer from 220kV OH Line (With Line PT)		1			2000	2000	2000	2000	-	3	1	630	6604		Note-4
2			Incomer from 220kV OH Line (With Line PT)				1	2000	2000	2000	2000	-	3	1	630	6604		Note-4
3			Bus Coupler 1A-2A		1			2000	2000	2000	-	-	-	-	-	6605		
4			Bus Coupler 1B-2B				1	2000	2000	2000	-	-	-	-	-	6605		
5			Bus Sectionalizer 1A-1B			1		2000	2000	2000	-	-	-	-	-	6605		
6			Bus Sectionalizer 2A-2B			1		2000	2000	2000	-	-	-	-	-	6605		
7			Bus PT 1A		1			-	-	-	-	-	-	-	-	6606		Note-7
8			Bus PT 1B		1			-	-	-	-	-	-	-	-	6606		Note-7
9			Bus PT 2A				1	-	-	-	-	-	-	-	-	6606		Note-7
10			Bus PT 2B				1	-	-	-	-	-	-	-	-	6606		Note-7
11			Transformer Feeder (100-TR-21)	160/200	1			1250A	600	600	600	600	3	1	630	6607		Note-4
12			Transformer Feeder (100-TR-22)	160/200			1	1250A	600	600	600	600	3	1	630	6607		Note-4
13			Transformer Feeder (100-TR-23)	160/200			1	1250A	600	600	600	600	3	1	630	6607		Note-4
14			Transformer Feeder (Spare)	160/200	1			1250A	600	600	600	600	3	1	630	6607		Note-4

Notes : Format No: EIL 1650-3001A Rev.2

Rev.	Date	Purpose	Prepared	Checked	Approved
A	11.11.2024	ISSUED WITH TENDER	SK	RSR	RSR

Project	BPREP Project	**Unit**	SUBSTATION	**Client**	BPCL-BINA
Switchgear No.	100-EHV-201GIS	**Location**	Substation-100 (MRSS)	**Auto/ Manual Xfr.**	Not Applicable
Voltage	220 kV	**Curent**	2000 Amps	**Fault Level**	50 kA (3 Sec)
Bus Differential	Required	**Bus Diff. CT Ratio**	2000/1		

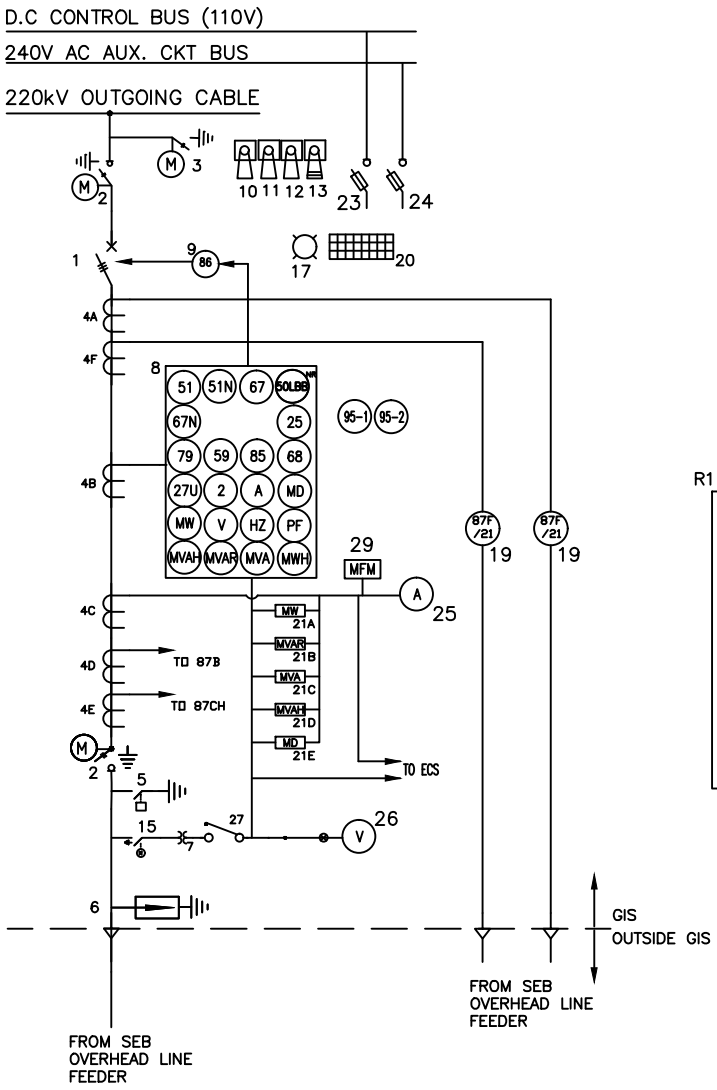
S.No.	Feeder Nameplate Inscription				Bus Section			Breaker Rating/ Feeder Designation	CT Primary Rating (A)*				Cable Details			Reference Datasheet		Remarks
	Panel No. @	Feeder No. #	Feeder Description	Rating (MVA)#	Left	Mid	Right		Metering	Protection			Run	Core	Size	EIL Hardware Datasheet B957-000-16-50-	Vendor Scheme No.@	
										O/C,S/C, E/F	Trafo/ Feeder Differential	REF Protection						

1 `*' CT primary current ratings indicated are tentative and shall be finalised during drawing approval stage without any cost implication. CT secondary shall be 1 Amps for all.
2 `#' These shall be finalised during drawing approval stage and shall not have any cost implication.
3 '@' Data to be furnished by Vendor.
4 Total number of runs collectively for R,Y and B phase are indicated. Cable runs and cable sizes are indicative and actual cable size shall be informed during review of documents post order without any time or cost implication.
5 Gas Insulated surge arrestor shall be provided in incomers and all outgoing feeders. Line PT and Bus PT shall also be Gas Insulated Type.
6 Bus differential protection and Bus wire check supervision shall be provided for the switchboard including corresponding CTs.
7 Independent Bus PT panel shall be provided for all the four buses of the Double Bus GIS switchboard.

PROJECT: BPREP PROJECT

CLIENT: M/S BPCL, BINA

REV	DATE	PURPOSE	BY	CHKD	APPRV
B	25.04.25	REVISED&ISSUED WITH TENDER	SK	RSR	RSR
A	11.11.24	ISSUED WITH TENDER	SK	RSR	RSR



R1 ▭ PART OF NUMERICAL RELAY-1
R2 ▭ PART OF NUMERICAL RELAY-2

NOTES:
1. ANTIPUMPING RELAY USED, IF ANY, SHALL BE CONSIDERED AS PART OF BREAKER MECHANISM.
2. THE ONE LINE DIAGRAM SHOWN ABOVE IS ONLY INDICATIVE. ALL THE ITEMS SPECIFIED UNDER "EQUIPMENT DATA" AND IN JOB SPECIFICATION SHALL BE IN VENDOR'S SCOPE.
3. ALL PROTECTIVE RELAYS SHALL BE NUMERICAL TYPE OF APPROVED MAKES. METERING SHALL BE A PART OF NUMERICAL RELAY. SEPARTE ANALOGUE METERING DEVICES SHALL ALSO BE PROVIDED AS INDICATED.
4. VA BURDEN OF CT & PT SHALL BE DECIDED BY THE SWITCHGEAR VENDOR CONSIDERING VA BURDEN REQUIREMENTS FOR OWNER'S EQUIPMENTS AS WELL..
5. MIMIC DIAGRAM FOR OPERATION AND STATUS INDICATION OF CIRCUIT BREAKER AND ASSOCIATED DISCONNECTORS & EARTH SWITCH SHALL BE PROVIDED ON LCC. FOR CRP MIMIC SHALL BE PROVIDED IN RELAY/BCU.
6. THE COMPONENTS & EQUIPMENTS TO BE LOCATED ON GIS, LCC & CRP RESPECTIVELY SHALL BE AS SPECIFIED IN THE TENDER DOCUMENT.
7. THREE CORE PT SHALL BE PROVIDED. PT WITH ACCURACY CLASS 1.0 SHALL BE USED FOR MEASURING, PT WITH ACCURACY CLASS 3P SHALL BE USED FOR PROTECTION & OPEN DELTA PT SHALL BE USED FOR DETECTING EARTH FAULT AND PREVENTION OF FERRO RESONANCE.
8. 87F/21 RELAY OF SAME MAKE/ MODEL SHALL BE LOOSE SUPPLIED AND INSTALLED IN SEB SWITCHYARD CRP BY VENDOR.
9. INTERCONNECTING CABLING BETWEEN GIS, LCC AND CRP SHALL BE SUPPLIED BY VENDOR AND SHALL BE ARMOURED CABLE.
10. 220 KV CABLE TERMINATION KITS ARE ALSO INCLUDED IN SCOPE OF VENDOR.

EQUIPMENT DATA

	ITEM NO.	NEMA NO.	QTY	DESCRIPTION
	1	52	1	SF6 CIRCUIT BREAKER (TWO TRIP COILS)
	2	--	2	3 POSN. DISCONNECTOR SWITCH WITH MOTORIZED/MANUAL OPERATION & MECHANICAL POSITION INDICATOR -ON/ISOLATED/EARTHED ONE FOR BUS SIDE ONE FOR LINE SIDE
	3	--	1	2 POSN. DISCONNECTOR SWITCH WITH MOTORIZED/MANUAL OPERATION & MECHANICAL POSITION INDICATOR -ISOLATED/EARTHER
	4A	--	3	CT FOR 87F/21 CLASS PS
	4B	--	3	CT CLASS-5P10
	4C	--	3	CT CLASS-1 (MIN. 10VA)
	4D	--	3	CT FOR 87B CLASS PS
	4E	--	3	CT FOR 87CH CLASS PS
	4F	--	3	CT FOR 87F/21 CLASS PS
	5	--	1	HIGH SPEED MAKE PROOF EARTHING SWITCH
	6	--	1	SURGE ARRESTOR
	7	--	1	PT 220/√3/110/√3, WITH 4 POLE MCB (REFER NOTE-07)
R1	8	67	2	DIRECTIONAL IDMTL O/C RELAY
		51N		IDMTL E/F RELAY (10-40%)
		25		SYNCHRONISING CHECK RELAY
		50LBB		LOCAL BREAKER BACKUP
		59		OVERVOLTAGE RELAY
		27		UNDERVOLTAGE RELAY
		79		AUTO RECLOSE FUNCTION
		85		CARRIER AIDED INTER TRIP
		68		BLOCKING RELAY
		2		TIMER
		67N		DIRECTIONAL IDMTL E/F RELAY
		51V		VOLTAGE RESTRAINED OVERCURRENT RELAY
		51		IDMTL O/C RELAY (50-200%)
		95-1/2		TRIP CIRCUIT SUPERVISION RELAY
	9	86	1	TRIPPING RELAY - CONVENTIONAL TYPE
	10	--	1	UPSTREAM BREAKER TRIP SWITCH (2 POSITION)(STAYPUT & LOCKABLE)
	11	--	6	CONTROL SWITCH FOR DISCONNECTORS & EARTH SWITCHES
	12	--	1	LOCAL/OFF/REMOTE SELECTOR SWITCH
	13	52C/S	1	BREAKER CONTROL SWITCH (TNC) (LOCKABLE WITH SPRING RETURN TO NEUTRAL)
	14	--	1	SOCKET AT PANEL BACK FOR CABLE TESTING,CURRENT & VOLTAGE INJECTION
	15	--	1	3 POSN. DISCONNECTOR SWITCH WITH MOTORIZED/MANUAL OPERATION & MECHANICAL POSITION INDICATOR -ON/ISOLATED/EARTHED
	16	--	AS REQD	SF6 GAS MONITORING, ALARMS AND INDICATIONS
	17	--	AS REQD	CLUSTER LED TYPE INDICATION LAMP
	18	--	AS REQD	AUXILARY RELAY
R2	19	87F/21	4	FEEDER DIFFERENTIAL PROTECTION RELAY OR DISTANCE PROTECTION RELAY (EACH OF TWO DIFFERENT MAKES) (REFER NOTE-8)
	20	--	AS REQD	WINDOW ALARM ANNUNCIATIONS
	21A	--	1	MW METER
	21B	--	1	MVAR METER
	21C	--	1	MVA METER
	21D	--	1	MVAH METER
	21E	--	1	MAXIMUM DEMAND METER
	22	--	2 SET	CUBICLE LAMP WITH MCB, DOOR SWITCH, PANEL SPACE HEATER & 3 PIN SOCKET WITH TOGGLE SWITCH FOR LCC & CRP
	23	--	2	DP SWITCH 10A WITH FUSE FOR DC CONTROL SUPPLY FOR LCC & CRP
	24	--	2	LV POWER SUPPLY SWITCH FUSE FOR LCC & CRP
	25	--	3	AMMETER
	26	--	3	VOLTMETER
	27	--	3	4 POLE MCB, 10A, (FOR EACH PT CORE)
	28	--	1	3 POSN. DISCONNECTOR SWITCH WITH MOTORIZED/MANUAL OPERATION & MECHANICAL POSITION INDICATOR -ON/ISOLATED/EARTHED
	29	MFM	1	MULTI FUNCTION METER

ENGINEERS INDIA LIMITED
NEW DELHI

220KV GIS DATA SHEET

HARDWARE DATASHEET FOR INCOMER FROM OVERHEAD LINE

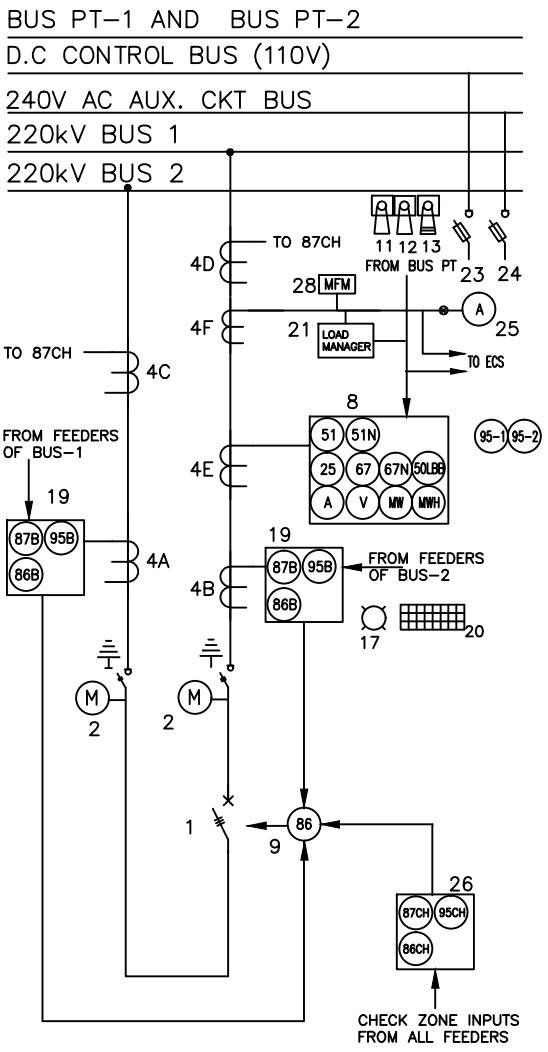
DATA SHEET

B957-000-16-50-DS-6604

Sht.1 OF 1

REV B

PROJECT: BPREP PROJECT CLIENT: M/S BPCL, BINA	REV	DATE	PURPOSE	BY	CHKD	APPRV
	A	11.11.24	ISSUED WITH TENDER	SK	RSR	RSR



R1 ☐ PART OF NUMERICAL RELAY-1

R2 ☐ PART OF NUMERICAL RELAY-2

R3 ☐ PART OF NUMERICAL RELAY-3

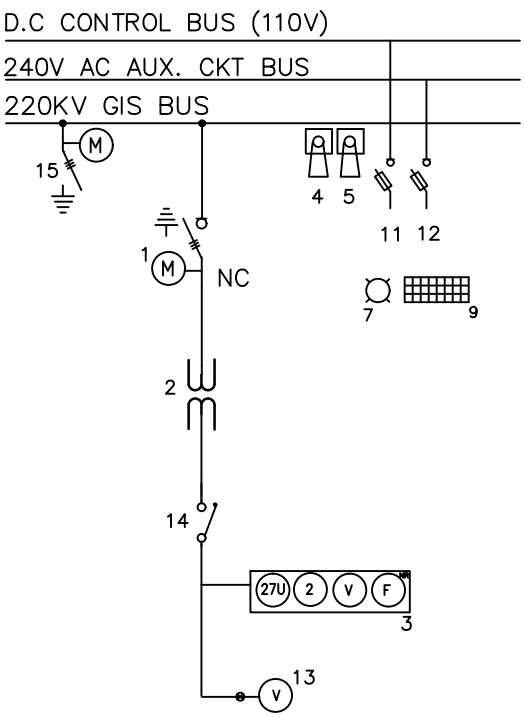
EQUIPMENT DATA

	ITEM NO.	NEMA NO.	QTY	DESCRIPTION
	1	52	1	SF6 CIRCUIT BREAKER (TWO TRIP COIL)
	2	--	2	3 POSN. DISCONNECTOR SWITCH WITH MOTORIZED/MANUAL OPERATION & MECHANICAL POSITION INDICATOR -ON/ISOLATED/EARTHED
	3	--	--	DELETED
	4A	--	3	CT FOR 87B CLASS PS
	4B	--	3	CT FOR 87B CLASS PS
	4C	--	3	CT FOR 87CH CLASS PS
	4D	--	3	CT FOR 87CH CLASS PS
	4E	--	3	CT CLASS-5P10
	4F	--	3	CT CLASS-1 (MIN. 10VA)
	5	--	--	DELETED
	6	--	--	DELETED
	7	--	--	DELETED
R1	8	67	1	DIRECTIONAL IDMTL O/C RELAY
R1		51N		IDMTL E/F RELAY (10-40%)
R1		25		SYNCHRONISING CHECK RELAY
R1		50LBB		LOCAL BREAKER BACKUP
R1		67N		DIRECTIONAL IDMTL E/F RELAY
R1		51		IDMTL O/C RELAY (50-200%)
R1		95-1/2		TRIP CIRCUIT SUPERVISION RELAY
	9	86	1	TRIPPING RELAY - CONVENTIONAL VAJH TYPE
	10	--		DELETED
	11	--	4	CONTROL SWITCH FOR DISCONNECTORS & EARTH SWITCHES
	12	--	1	LOCAL/OFF/REMOTE SELECTOR SWITCH
	13	52C/S	1	BREAKER CONTROL SWITCH (TNC) (LOCKABLE WITH SPRING RETURN TO NEUTRAL)
	14	--	1	SOCKET AT PANEL BACK FOR CABLE TESTING,CURRENT & VOLTAGE INJECTION
	15	--		DELETED
	16	--	AS REQD	SF6 GAS MONITORING, ALARMS AND INDICATIONS
	17	--	AS REQD	CLUSTER LED TYPE INDICATION LAMP
	18	--	AS REQD	AUXILARY RELAY
R2	19	87B	2	BUSBAR DIFFERENTIAL PROTECTION RELAY LOW IMPEDANCE TYPE WITH MANUAL BYPASS
R2		95B		CT SUPERVISION RELAY
	20	--	AS REQD	WINDOW ALARM ANNUNCIATIONS
	21	--	1	LOAD MANAGER
	22	--	2 SET	CUBICLE LAMP WITH MCB, DOOR SWITCH, PANEL SPACE HEATER & 3 PIN SOCKET WITH TOGGLE SWITCH FOR LCC & CRP
	23	--	2	DP SWITCH 10A WITH FUSE FOR DC CONTROL SUPPLY FOR LCC & CRP
	24	--	2	LV POWER SUPPLY SWITCH FUSE FOR LCC & CRP
	25	--	1	AMMETER WITH 4 WAY A-S-S
R3	26	87CH	1	BUSBAR DIFFERENTIAL PROTECTION RELAY LOW IMPEDANCE TYPE WITH MANUAL BYPASS
R3		95CH		CT SUPERVISION RELAY
	28	MFM	1	MULTI FUNCTION METER

NOTES:
1. ANTIPUMPING RELAY USED, IF ANY, SHALL BE CONSIDERED AS PART OF BREAKER MECHANISM.
2. THE ONE LINE DIAGRAM SHOWN ABOVE IS ONLY INDICATIVE. ALL THE ITEMS SPECIFIED UNDER "EQUIPMENT DATA" AND IN JOB SPECIFICATION SHALL BE IN VENDOR'S SCOPE.
3. ALL PROTECTIVE RELAYS SHALL BE NUMERICAL TYPE OF APPROVED MAKES. METERING SHALL BE A PART OF NUMERICAL RELAY. SEPARTAE ANALOGUE METERING DEVICES SHALL ALSO BE PROVIDED AS INDICATED.
4. VA BURDEN OF CT & PT SHALL BE DECIDED BY THE SWITCHBOARD VENDOR CONSIDERING VA BURDEN REQUIREMENTS FOR OWNER'S EQUIPMENTS AS WELL.
5. MIMIC DIAGRAM FOR OPERATION AND STATUS INDICATION OF CIRCUIT BREAKER AND ASSOCIATED DISCONNECTORS & EARTH SWITCH SHALL BE PROVIDED ON LCC. FOR CRP MIMIC SHALL BE PROVIDED IN RELAY/BCU.
6. THE COMPONENTS & EQUIPMENTS TO BE LOCATED ON GIS, LCC & CRP RESPECTIVELY SHALL BE AS SPECIFIED IN THE SPECIFICATION.

ENGINEERS INDIA LIMITED NEW DELHI	220KV GIS DATA SHEET HARDWARE DATASHEET FOR BUS COUPLER/ BUS SECTIONALIZER	DATA SHEET	REV
		B957-000-16-50-DS-6605 Sht.1 OF 1	A

PROJECT: BPREP PROJECT CLIENT: M/S BPCL, BINA	REV	DATE	PURPOSE	BY	CHKD	APPRV
	A	11.11.24	ISSUED WITH TENDER	SK	RSR	RSR



EQUIPMENT DATA

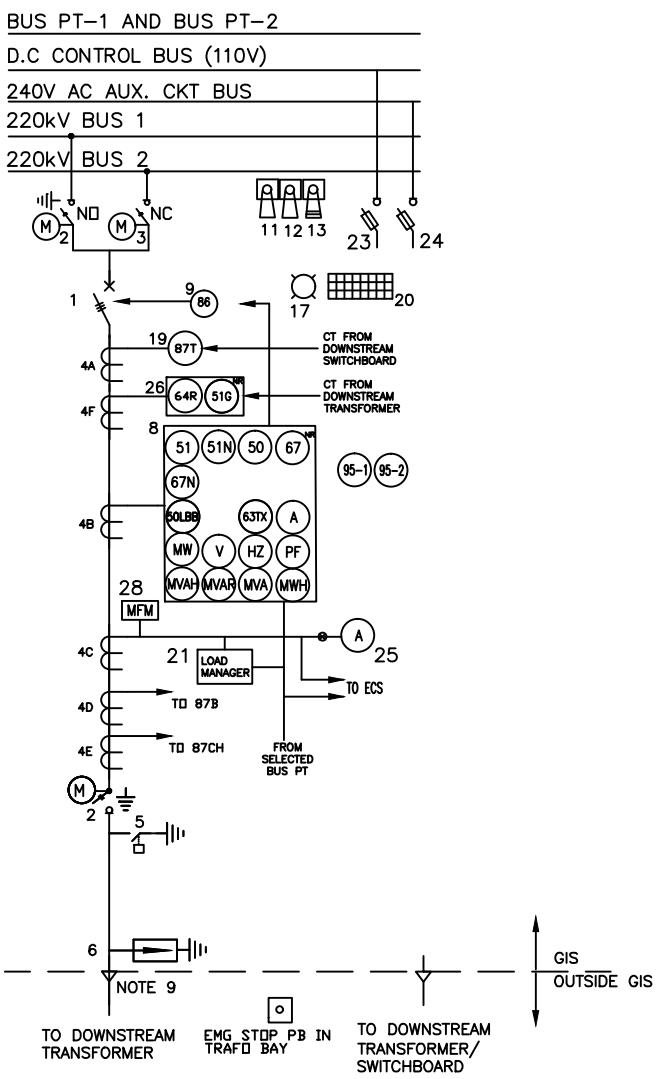
ITEM NO.	NEMA NO.	QTY	DESCRIPTION
1	--	1	3 POSN. DISCONNECTOR SWITCH WITH MOTORIZED/MANUAL OPERATION & MECHANICAL POSITION INDICATOR -ON/ISOLATED/EARTHED
2	--	--	PT 220/√3/110/√3, WITH 4 POLE MCB
R1 3	27		UNDERVOLTAGE RELAY
R1	2		TIMER
4	--	2	CONTROL SWITCH FOR DISCONNECTORS & EARTH SWITCHES
5	--	1	LOCAL/OFF/REMOTE SELECTOR SWITCH
6	--	AS REQD	SF6 GAS MONITORING, ALARMS AND INDICATIONS
7	--	AS REQD	CLUSTER LED TYPE INDICATION LAMP
8	--	AS REQD	AUXILARY RELAY
9	--	AS REQD	WINDOW ALARM ANNUNCIATIONS
10	--	2 SET	CUBICLE LAMP WITH MCB, DOOR SWITCH, PANEL SPACE HEATER & 3 PIN SOCKET WITH TOGGLE SWITCH FOR LCC & CRP
11	--	2	DP SWITCH 10A WITH FUSE FOR DC CONTROL SUPPLY FOR LCC & CRP
12	--	2	LV POWER SUPPLY SWITCH FUSE FOR LCC & CRP
13	--	1	VOLTMETER WITH 4 WAY V-S-S
14	--	3	4P MCB, 10A (FOR EACH CORE) ON SECONDARY SIDE OF PT
15	--	1	2 POSN. DISCONNECTOR SWITCH WITH MOTORIZED/MANUAL OPERATION & MECHANICAL POSITION INDICATOR -ISOLATED/EARTHED

R1 ▭ PART OF NUMERICAL RELAY

NOTES:
1. THE ONE LINE DIAGRAM SHOWN ABOVE IS ONLY INDICATIVE. ALL THE ITEMS SPECIFIED UNDER "EQUIPMENT DATA" AND IN JOB SPECIFICATION SHALL BE IN VENDOR'S SCOPE.
2. ALL PROTECTIVE RELAYS SHALL BE NUMERICAL TYPE OF APPROVED MAKES. METERING SHALL BE A PART OF NUMERICAL RELAY. SEPARATE ANALOGUE METERING DEVICES SHALL ALSO PROVIDE AS INDICATED.
3. VA BURDEN OF PT SHALL BE DECIDED BY THE SWITCHBOARD VENDOR CONSIDERING VA BURDEN REQUIREMENTS FOR OWNER'S EQUIPMENTS AS WELL.
4. INDEPENDENT BUS PT PANEL SHALL BE PROVIDED FOR BOTH THE BUSES OF THE DOUBLE BUS GIS SWITCHBOARD.
5. MIMIC DIAGRAM FOR OPERATION AND STATUS INDICATION OF ASSOCIATED DISCONNECTORS & EARTH SWITCH SHALL BE PROVIDED ON LCC. FOR CRP MIMIC SHALL BE PROVIDED IN RELAY/BCU.
6. THE COMPONENTS & EQUIPMENTS TO BE LOCATED ON GIS, LCC & CRP RESPECTIVELY SHALL BE AS SPECIFIED IN THE SPECIFICATION.
7. THREE CORE PT SHALL BE PROVIDED. PT WITH ACCURACY CLASS 1.0 SHALL BE USED FOR MEASURING, PT WITH ACCURACY CLASS 3P SHALL BE USED FOR PROTECTION & OPEN DELTA PT SHALL BE USED FOR DETECTING EARTH FAULT AND PREVENTION OF FERRO RESONANCE.
8. DUAL CORE PT SHALL BE PROVIDED. PT WITH ACCURACY CLASS 0.2 SHALL BE USED FOR MEASUREMENT AT ECS, SCAP & VOLTMETER. PT WITH ACCURACY CLASS 3P SHALL BE USED FOR PROTECTION.

ENGINEERS INDIA LIMITED NEW DELHI	220KV GIS DATA SHEET HARDWARE DATASHEET FOR BUS PT	DATA SHEET	REV
		B957-000-16-50-DS-6606 Sht.1 OF 1	A

PROJECT: BPREP PROJECT CLIENT: M/S BPCL, BINA	REV	DATE	PURPOSE	BY	CHKD	APPRV
	A	11.11.24	ISSUED WITH TENDER	SK	RSR	RSR



R1 ▭ PART OF NUMERICAL RELAY-1
R2 ▭ PART OF NUMERICAL RELAY-2
R3 ▭ PART OF NUMERICAL RELAY-3

NOTES:
1. ANTIPUMPING RELAY USED, IF ANY, SHALL BE CONSIDERED AS PART OF BREAKER MECHANISM.
2. THE ONE LINE DIAGRAM SHOWN ABOVE IS ONLY INDICATIVE. ALL THE ITEMS SPECIFIED UNDER "EQUIPMENT DATA" AND IN JOB SPECIFICATION SHALL BE IN VENDOR'S SCOPE.
3. ALL PROTECTIVE RELAYS SHALL BE NUMERICAL TYPE OF APPROVED MAKES. METERING SHALL BE A PART OF NUMERICAL RELAY. SEPARTE ANALOGUE METERING DEVICES SHALL ALSO BE PROVIDED AS INDICATED.
4. VA BURDEN OF CT & PT SHALL BE DECIDED BY THE SWITCHGEAR VENDOR CONSIDERING VA BURDEN REQUIREMENTS FOR OWNER'S EQUIPMENTS AS WELL..
5. MIMIC DIAGRAM FOR OPERATION AND STATUS INDICATION OF CIRCUIT BREAKER AND ASSOCIATED DISCONNECTORS & EARTH SWITCH SHALL BE PROVIDED ON LCC. FOR CRP MIMIC SHALL BE PROVIDED IN RELAY/BCU.
6. THE COMPONENTS & EQUIPMENTS TO BE LOCATED ON GIS, LCC & CRP RESPECTIVELY SHALL BE AS SPECIFIED IN THE TENDER DOCUMENT.
7. RELAY FOR 87T AND 64R SHALL BE SEPARATE.
8. INTERCONNECTING CABLING BETWEEN GIS, LCC AND CRP SHALL BE SUPPLIED BY VENDOR AND SHALL BE ARMOURED CABLE.
9. 220 KV CABLE TERMINATION KITS ARE ALSO INCLUDED IN SCOPE OF VENDOR.

EQUIPMENT DATA

	ITEM NO.	NEMA NO.	QTY	DESCRIPTION
	1	52	1	SF6 CIRCUIT BREAKER (TWO TRIP COILS)
	2	--	2	3 POSN. DISCONNECTOR SWITCH WITH MOTORIZED/MANUAL OPERATION & MECHANICAL POSITION INDICATOR -ON/ISOLATED/EARTHED ONE FOR BUS SIDE ONE FOR LINE SIDE
	3	--	1	2 POSN. DISCONNECTOR SWITCH WITH MOTORIZED/MANUAL OPERATION & MECHANICAL POSITION INDICATOR -ON/ISOLATED
	4A	--	3	CT FOR 87T CLASS PS
	4B	--	3	CT CLASS-5P10
	4C	--	3	CT CLASS-1 (MIN. 10VA)
	4D	--	3	CT FOR 87B CLASS PS
	4E	--	3	CT FOR 87CH CLASS PS
	4F	--	3	CT FOR 64R CLASS PS
	5	--	1	HIGH SPEED MAKE PROOF EARTHING SWITCH
	6	--	1	SURGE ARRESTOR
	7	--	--	DELETED
R1	8	51	1	IDMTL O/C RELAY (50-200%)
		51N		IDMTL E/F RELAY (10-40%)
		63TX		TRANSFORMER TROUBLE RELAY
		67		DIRECTIONAL IDMTL O/C RELAY
		67N		DIRECTIONAL IDMTL E/F RELAY
		50		INSTANTANEOUS O/C RELAY
		95-1 /2		TRIP CIRCUIT SUPERVISION RELAY
	9	86	1	TRIPPING RELAY - CONVENTIONAL VAJH TYPE
	10	--		DELETED
	11	--	6	CONTROL SWITCH FOR DISCONNECTORS & EARTH SWITCHES
	12	--	1	LOCAL/OFF/REMOTE SELECTOR SWITCH
	13	52C/ S	1	BREAKER CONTROL SWITCH (TNC) (LOCKABLE WITH SPRING RETURN TO NEUTRAL)
	14	--	1	SOCKET AT PANEL BACK FOR CABLE TESTING,CURRENT & VOLTAGE INJECTION
	15	--		DELETED
	16	--	AS REQD	SF6 GAS MONITORING, ALARMS AND INDICATIONS
	17	--	AS REQD	CLUSTER LED TYPE INDICATION LAMP
	18	--	AS REQD	AUXILARY RELAY
R2	19	87T	1	TRANSFORMER DIFFERENTIAL PROTECTION RELAY
	20	--	AS REQD	WINDOW ALARM ANNUNCIATIONS
	21	--	1	LOAD MANAGER
	22	--	2 SET	CUBICLE LAMP WITH MCB, DOOR SWITCH, PANEL SPACE HEATER & 3 PIN SOCKET WITH TOGGLE SWITCH FOR LCC & CRP
	23	--	2	DP SWITCH 10A WITH FUSE FOR DC CONTROL SUPPLY FOR LCC & CRP
	24	--	2	LV POWER SUPPLY SWITCH FUSE FOR LCC & CRP
	25	--	1	AMMETER WITH 4 WAY A-S-S
	26	64R	1	RESTRICTED EARTH FAULT RELAY
R3		51G		IDMTL BACK UP EARTH FAULT RELAY
	28	MFM	1	MULTI FUNCTION METER

ENGINEERS INDIA LIMITED
NEW DELHI

220KV GIS DATA SHEET

HARDWARE DATASHEET FOR OUTGOING TRANSFORMER FEEDER

DATA SHEET	REV
B957-000-16-50-DS-6607 Sht.1 OF 1	A

अति उच्च वोल्टेज गैस इंसुलटेड स्विचबोर्डों के लिये
निरीक्षण और परीक्षण योजना

INSPECTION AND TEST PLAN
FOR
EHV GAS INSULATED SWITCHBOARDS (GIS)

Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
1	16.02.2024	Revised and Re-issued	RKP	GS	RK	MN
0	12.09.2018	Issued for implementation	MM	RS	RKS	RKT

Abbreviations:

CB	:	Circuit Breaker	IP	:	Ingress Protection
CT	:	Current Transformer	IR	:	Insulation resistance
CRP	:	Control Relay Panel	ICP	:	Inspection Categorization Plan
EHV		Extra High Voltage	KV	:	Kilo Volt
EIL	:	Engineers India Limited	LCC	:	Local Control Panel
EMC	:	Electromagnetic Compatibility	MTC	:	Material Test Certificate
ERTL	:	Electronics Regional Test Laboratory	NEMA	:	National Electrical Manufacturers Association
FAT	:	Factory Acceptance Test	PO	:	Purchase Order
FR	:	Fire Retardant	PR	:	Purchase Requisition
FRLS	:	Fire Retardant Low smoke	PVC	:	Poly Vinyl Chloride
GIS		Gas Insulated Switchgear	QC	:	Quality Control
HT	:	High Tension	TC	:	Test Certificate
HV		High Voltage	TPI or TPIA	:	Third Party Inspection Agency
HMI	:	Human Machine Interface	VDR	:	Vendor Data Requirement
ITP	:	Inspection and Test Plan	VT	:	Voltage Transformer
IEC	:	International Electro technical Commission	XLPE	:	Cross Linked Poly Ethylene

Inspection Standards Committee

Convenor : Mr. Rajeev Kumar

Members:

Mr. G Suresh	Mr. Himangshu Pal	Mr. Chandrashekhar	Mr. R Muthu Ramalingam
Mr. Mahendra Mittal	Mr. Javed Akhtar	Mr. Arvind NP Singh (Engg)	

1.0 SCOPE

This Inspection and Test Plan covers the minimum testing requirements of Extra High Voltage Gas insulated Switch boards (EHV GIS) from 66 KV and up to 400 KV.

2.0 REFERENCE DOCUMENTS

PO/PR/ Standards referred there-in/ Job specifications/ Approved documents/ Relevant IEC.

3.0 INSPECTION AND TEST REQUIREMENTS

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1.0	**Procedures**	--	--	--	--	--	--
2.0	**Material Inspection**						
2.1	Incoming Material like Castings, GI support structures, Bushings, Compartment Partitions, Bus Bars, Surge Arrestors, Rupture discs, Expansion Bellows, Cable/Wire, Panels, Annunciators, Meters, SF6 gas etc	Visual, Dimensional, Physical and Chemical Properties, Pressure tests, Operational/performance checks including Accuracy Checks (As applicable per respective IS/ IEC standards)	100%	TC's/ Inspection & Test Records / Lab Test Records	H	H/R	R
3.0	**In process Inspection**						

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
3.1	Circuit Breakers, Disconnector and earthing switches	• Contact Resistance measurement. • Gas Leakage Check (for SF6 Breakers). • Insulation Resistance test. • High Voltage Power Frequency Test. • Partial Discharge test (for Circuit Breakers). • All Tests as per Clause 4.1	100%	Supplier's Test Records	-	P	R
3.3	Wiring checks	• Size, grade and type, make, ferruling, continuity, color coding • Pull Test for terminal Connection tightness	100%	Suppliers Test Records	-	P	R
3.4	Current Transformers	• Physical verification and verification of Markings. • Over-Voltage Inter turn tests • Power Frequency High Voltage tests on and between Primary and Secondary Windings • Determination of Accuracy/ Errors/ Composite Errors. • Knee Point Voltage and Secondary Winding Resistance for Protection CTs • Partial Discharge Measurement	100% by Supplier and random by TPIA	Supplier's Test Records/ Witness Records	-	P	H**
3.5	Voltage Transformers	• Physical checks and verification of Markings. • Partial Discharge Test. • Power Frequency High Voltage test on and between Secondary and Primary windings • Accuracy Test.	100% by Supplier and random by TPIA	Supplier's Test Records/ Witness Records	-	P	H**
4.0	**Final Inspection**						

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.1	Circuit Breakers, Disconnectors and Earth Switches -Acceptance tests	• Mechanical Endurance tests (5 times Close, Open Operations at Normal and Worst Voltage Conditions). • 5 times CO & O-0.3s-CO operations (for CB). • Measurement of Closing & Opening Time (Normal Voltage) • Simultaneous Closing/ Opening of all Poles (for CB). • Measurement of Motor Current & Spring Charging time/ Operating time. • Measurement of Coil Resistance (for CB). • Anti-pumping feature verification. • Mechanical and Electrical interlock checks.	10% (min 1 number from each type/ lot) by EIL/ TPIA	Inspection Witness Record	-	P	H
4.2	GIS Assembly -Acceptance tests	• Visual and Physical Checks • Dimension checks • Paint Shade and Thickness Checks • Bill of material check. • Measurement of Voltage Drop across the Main Circuit. • Gas Pressure Monitoring checks including Over Pressure, Loss of Gas Alarm and Lockout checks. • Operation check for Main, Auxiliary & Control Circuits. • Insulation resistance of main, auxiliary and control circuits before and after High Voltage Test. • Power Frequency high voltage withstand test on main, auxiliary and control circuits. • Partial discharge test of complete Bay including CB, Earth Switches, Disconnectors, CTs	100% by supplier and 10% (min 1 number of each type/ lot) by EIL/ TPIA	Inspection Witness Record	-	P	H

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
		• Leak Tightness checks. • Primary current injection test for current transformers.					
4.3	Local Control Cubicle -Acceptance tests	• HV and IR checks (before and after HV) • Functional/operation/ Schematic checks on LCC panel including alarm, indication, annunciation, interlocks and mimic diagram display etc. • BoM Check • Visual, Dimensional Checks • Paint shade and Thickness Checks	100% by Supplier and random (each type) by EIL/TPIA	Supplier's test Records	-	P	H
4.4	Control and Relay Panels	• Refer Std ITP 6-81-1004 for various Checks	As per sampling plan of 6-81-1004	Supplier's test Records	-	P	H
4.5	GIS Assembly -Type Tests	• Short time current withstand test on main and earthing circuit including Disconnectors and Earth Switches • Temperature Rise test. • Internal Arc test. • Lighting Impulse, Switching impulse, Power Frequency withstand test and partial discharge test(Di electric test) • Making and breaking capacity test of circuit breaker • Short circuit test duties for Circuit breaker. • Tightness test and pressure withstand test for gas filled compartment and Partitions • Operation and mechanical endurance test • Degree of protection for panels.	On Each type/Model	Test Agency Reports	-	H	R/W*

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
		• Tests to prove the satisfactory operation at limit temperatures • Tests to prove performance under thermal cycling and gas tightness tests on insulators					
4.6	Surge arrestor, CT, PT-Special and Type tests	• As per respective IEC.	On Each type/Model	Test Agency Reports	-	H	R
5.0	**Painting**						
5.1	Painting of Bays	• Pre treatment, primer and final paint, shade, thickness	100%	Supplier test records	H	W	R
6.0	**Documentation and IC**						
6.1	Documentation and IC	• Review of Internal Test Reports • Certification from supplier for complete relay parameterization of numerical relays at works • IC issuance.	100%	Supplier's Test Records / Inspection Certificate	-	-	H
6.2	Final Document submission	Compilation of Inspection reports, drawings, etc. as per VDR / PR	100%	Final data folder/ Completeness certificate	-	H	H

* Witness if called for in job specifications. In such cases specified Type test will be considered as part of Acceptance Test.

** Current Transformers and Voltage Transformers shall be accepted with TPIA witness and certification. EIL witness, if called for in Job Specification/ ICP.

Legends: H- Hold (Do not proceed without approval, P-Perform, R-Review, RW-Random witness (As specified or 10 % - Samples must include min 1 No of each type), W- Witness (Give due notice, work may proceed after scheduled date).

NOTES :-

1. This document describes the generic test requirements. Any additional test or inspection scope if specified in contract documents shall also be applicable. (Unless otherwise agreed upon).
2. Acceptance Norms for all the activities shall be as per PO/PR/ Standards referred therein/ Job specifications /Approved documents.
3. Type tests validity shall be as per Latest CEA Guidelines/ PR.

S.No.	Part Description	Description
1	Generator	One set of spare for each Generator
1.1	Generator relay	One set (each type & make)
1.2	DVR - all control card	One each type
1.3	Control fuses / MCB	10 Nos. of each rating & type
1.4	Exciter Diodes and fuses	1 set
1.5	Control and Selector switches	1 No. of each type and make
1.6	Aux. contactors	20% of each type and make OR 1 No.(min) of each type and make, whichever is more
2	66kV / 33kV Gas Insulated Switchboard (GIS)	One set of spare for each switchboard (Refer Note-7 & 10)
2.1	Portable gas filling equipment/SF6 gas cart	1 No.
2.2	Handle for disconnector switch drive	4 Nos.
2.3	Handle for earthing switch drive	4 Nos.
2.4	Pre selection / Mechanical key	1 No.
2.5	Power cable termination kit along with plug and socket (R,Y,B Phases)	2 Sets
2.6	Tripping coil	2 No.
2.7	Closing coil	2 No.
2.8	Capacitive type voltage detectors	1 Set
2.9	Control fuses / MCB	10 Nos. of each rating & type
2.10	Density monitoring device	2 Nos of each type
2.11	Indicating lamps covers	5 nos. of each colour
2.12	Indicating lamps	20% or 3 nos. (min.), whichever is more
2.13	Portable SF6 Gas Leakage Detector	1 Nos.
2.14	Ethernet Switch	1 no. of each type (Refer Note-10)
2.15	Pressure Gauge	2 Nos of each type
3	Power Transformer	One set of spare for each power transformer
3.1	Complete set of gaskets	1 set
3.2	Sealing / Gauge glass of Conservator	2 Nos of each rating & type.
3.3	Control fuses / MCB for MB cubicles	20% for each rating OR 1 No. (min.) of each rating, whichever is more
3.4	HV bushings	One set of each type and rating
3.5	OTI	1 no.
3.6	WTI	1 no.
3.7	Buchholz relay	1 no.
3.8	OLTC Diverter switch along with transition Resistance	1 set
3.9	OLTC fixed & moving contacts along with transition resistance	1 set
4	Distribution Transformer	One set of spare for each transformer
4.1	Complete set of gaskets	1 set
4.2	Sealing / Gauge glass of Conservator	2 Nos. of each rating & type.
4.3	Control fuses / MCB for MB cubicles	20% for each rating OR 1 No. (min.) of each rating, whichever is more
4.4	HV & MV bushings	One set of each type and rating
4.5	OTI	1 no.
4.6	WTI	1 no.
4.7	Buchholz relay	1 no.
5	HV Air Insulated Switchboard (AIS)	One set of spare for each switchboard (Refer Note-7 & 10)
5.1	Closing coil	1 No. of each rating & type

S.No.	Part Description	Description
5.2	Shunt trip coil	1 No. of each rating & type
5.3	Control fuses / MCB (all type & rating)	10 Nos. of each rating & type
5.4	Breaker Finger jaws	1 set for each rating and type
5.5	Indicating lamps covers	5 Nos. of each colour
5.6	Indicating lamps	20% or 3 Nos. (min.), whichever is more
5.7	Ethernet Switch	1 no. of each type (Refer Note-10)
5.8	Spring Charging Motor	1 no. each type
5.9	Numerical Protection relays	1 no. each type
6	415V MV Switchboard & iMCC (Intelligent MCC)	One set of spare for each switchboard (refer Note-9 & 10)
6.1	Closing coil	1 No. of each rating & type
6.2	Shunt trip coil	1 No. of each rating & type
6.3	Control fuses / MCB	10 Nos. each rating & type
6.4	Indicating lamps covers	5 Nos. of each colour
6.5	Indicating lamps	20% or 3 Nos. (min.), whichever is more
6.6	Breaker finger jaws	1 set for each rating and type
6.7	Contactor contacts	1 set for each rating and type
6.8	Ethernet Switch	1 no. of each type (Refer Note-10)
6.9	Electronic modules of iMCC (Intelligent MCC)	20% electronic modules of each type
6.10	Spring Charging Motor	1 no. of each type
6.11	Numerical Protection relays	1 no. of each type
6.12	Contactors(Beyond 400 Amps)	1 No. of each rating
7	Variable Frequency Drive (one set of spare for each VFD) and Soft Starter	Quantity is per VFD and Soft Starter
7.1	IGBT / Thyristor /IGCT/ Other Power Semiconductor devices	3 No. of each type & rating
7.2	Control cards	1 No of each type
7.3	Power supply cards	1 No of each rating & type
7.4	Power fuses	20% for each rating OR 1 no. (min.) of each rating, whichever is more
7.5	Drive Unit	1 No. of each type
7.6	Contactors	10% of each type OR 1 no. (min) of each type, whichever is more
7.7	Indicating lamps	20% OR 1 nos. (min.), whichever is more
7.8	Indicating lamps covers	2 nos of each colour
7.9	Blocker Diode	2 nos. of each rating & type
7.10	Control power supply module	1 No of each rating & type
7.11	Power module	3 No of each rating & type
7.12	Inverter Cell for Drive (Only HV)	1 No of each rating & type
8	Substation Automation System (SAS) / HMI / Data Concentrator	One set of spare for each SAS / HMI / Data Concentrator
8.1	All cards such as input & output cards, power supply cards, processor cards etc.	1 No. of each type
8.2	Ethernet switches	1 No. of each type
8.3	Control fuses / MCB	10 Nos. of each rating & type
9	Relays for GIS/ Switchboard / Relay control Panel	One set of spare for each GIS/ Switchboard (Refer Note-8) /Relay control Panel
9.1	Protection Relays	1 No. of each type
9.2	Auxiliary Relays	10% or minimum 2 Nos. of each type

S.No.	Part Description	Description
10	UPS System	One set of spare for each UPS system
10.1	Power Thyristors / Transistors / IGBT / IGCT	1 No. of each rating & type
10.2	Control cards	1 No. of each type
10.3	Power supply cards	1 No. of each rating and type
10.4	Power fuses	20% for each rating OR 1 no. (min.) of each rating, whichever is more
10.5	Control fuses / MCB	10 Nos. of each rating & type
10.6	Indicating lamps	10% OR 3 nos. (min.), whichever is more
10.7	Indicating lamps covers	2 Nos. of each colour
10.8	Blocker Diode	2 Nos. of each rating & type
11	DC System	One set of spare for each DC System
11.1	Power Thyristors / Transistors / IGBT / IGCT	1 No. of each rating & type
11.2	Control cards	1 No. of each type
11.3	Power supply cards	1 No. of each rating and type
11.4	Power fuses	20% for each rating OR 1 no. (min.) of each rating, whichever is more
11.5	Control fuses / MCB	10 Nos. of each rating & type
11.6	Indicating lamps	10% OR 3 nos. (min.), whichever is more
11.7	Indicating lamps covers	2 Nos. of each colour
11.8	Blocker Diode	2 Nos. of each rating & type
11.9	Thyristors/Transistors/ IGBT/ IGCT	3 Nos. of each rating & type
11.10	Power fuses	3 Nos. of each rating & type
12	Synchronous motors	One set of spare for each rating & type
12.1	Power fuses	20% for each rating OR 1 no. (min.) of each rating, whichever is more
12.2	Control fuses / MCB	10 Nos. of each rating & type
12.3	Bearing (DE & NDE)	1 set
12.4	Control cards	1 No. of each type
12.5	Terminal studs/bushing assembly	1 set each
12.6	Exciter Diodes and fuses	1 set
13	HV induction motors	One set of spare for each rating & type
13.1	Bearing (DE & NDE)	1 set
13.4	Purge panel	Complete 1 Panel (for Ex """"P"""" motor)
13.2	Terminal studs/bushing assembly	1 set each
13.3	speed switch	1 set each type
14	MV induction motors 37 kW & above	One set of spare for each rating & type
14.1	Bearing (DE & NDE)	1 set
14.3	Speed switch	1 set each type
14.2	Terminal studs/bushing assembly	1 set each
15	Fire alarm system	
15.1	All cards	1 No. of each type
15.2	Power fuses	20% for each rating OR 1 no. (min.) of each rating, whichever is more
15.3	Control fuses / MCB	10 Nos. of each rating & type
15.4	Terminal blocks	20 Nos

S.No.	Part Description	Description
15.5	Smoke/Multisensor/Heat Detectors	1% of total installed capacity of each type OR 1 no.(min.) of each type, whichever is more
15.6	Glass for Break Glass Boxes/ Manual call point	5 % of each type OR 1 No. (min.) of each type, whichever is more
15.7	Ethernet Switch	1 No. of each type
16	Paging system / Plant Communication System	
16.1	All cards	1 No of each type
16.2	Power fuses	20% for each rating OR 1 no. (min.) of each rating, whichever is more
16.3	Control fuses / MCB	10 Nos. each rating & type
16.4	Ethernet Switch	1 No. of each type
17	Thyristor control panel for heaters	
17.1	Rectifier control module (Control card fully assembled)	1 No. of each type
17.2	Power supply card	1 No. of each type
17.3	Control cards	1 No of each type
17.4	Power fuses	2 Nos. min. of each rating and type
17.5	Control fuses / MCB	10 Nos. each rating & type
17.6	Contactors	10% of each type OR one no (min) of each type, whichever is more
17.7	Indicating lamps	20% OR 1 nos. (min.), whichever is more
17.8	Indicating lamps covers	2 nos. of each colour
17.9	Blocker Diode	2 nos. of each rating & type
17.10	Power Module	1 No. of each rating and type
17.11	Thyristors	6 Nos. each rating
17.12	Transducer,Signal Isolator /Multiplier	1 No. each rating
18	Electrical Control System (ECS)	
18.1	Interposing relays (As applicable)	5 Nos. of each type
18.2	Power supply & control cards	1 No. of each type
18.3	Transducers	20% of estimated quantity of each type and make OR 1 no (min) of each type and make, whichever is more
18.4	Function generator cum counter	1 No.
18.5	4-20mA signal injection set	1 No.
18.6	Isolation transformer	1 No.
18.7	Ethernet Switch	1 No. of each type
19	Electrical Heat Tracing System	
19.1	RTD/Thermostat	1 no. of each type
19.2	Control fuses/ MCB/ELCB	5 Nos. each rating & type
19.3	Indicating lamps	10% or 2 nos. (min.) whichever is more
19.4	Indicating lamps covers	5 nos. of each colour
19.5	Contactor contacts	1 set for each rating and type
20	APFC panels for Capacitor Bank	One set of spare for total APFC panels
20.1	Control cards	One no. of each type
20.2	Power supply cards	One No of each rating & type
20.3	Power fuses	20% for each rating or one no. (min.) of each rating, whichever is more
20.4	Control fuses/ MCB	10 Nos. of each rating & type

S.No.	Part Description	Description
20.5	Auxiliary Contactors	10% of each type or 1 no. (min.) of each type, whichever is more
20.6	Numerical Relays	One no. of each type
20.7	Indicating lamp covers	2 nos. of each colour
20.8	Indicating lamps	20% or 1 no. (min.), whichever is more
21	Solar Photovoltaic System	One set of spare for each system
21.1	Power Thyristor / Transistors / IGBT / IGCT	1 No. of each rating & type
21.2	Control cards	1 No. of each type
21.3	Power supply cards	1 No. of each rating and type
21.4	Cable connectors	10% or minimum 2 Nos. of each type
22	Lift	
22.1	Control Card	1 No. of each type
22.2	PLC/VFD	1 No. of each type
22.3	Floor Level indicator	1 no. of each type
22.4	Limit switches	1 no. of each type
22.5	Brake assembly	1 no. of each type
22.6	Complete Gear box Assembly	1 No. of each type
22.7	Relays & contactors	1 no. of each type
23	220kV GIS for Petchem Project	One set of spare for each GIS
23.1	SF6 Gas Leakage Detector	1 nos.
23.2	Portable Gas filling and evacuating cart	1 nos.
23.3	SF6 Gas Analyzer	1 nos.
23.4	Portable Partial Discharge Monitoring System	1 nos.
23.5	SF6 Gas topping system	1 nos.
23.6	Handle for Disconnector switch drive (If applicable as per standard design)	4 nos.
23.7	Handle for earthing switch drive (If applicable as per standard design)	4 nos.
23.8	Tripping coil	2 nos.
23.9	Closing coil	2 nos.
23.10	Density monitoring device	2 Nos. of each type
23.11	Pressure Gauge	2 Nos. of each type
23.12	Ethernet Switch	1 Nos. of each type
23.13	Capacitive type voltage detectors	1 set
24	Excitation system for motors	
24.1	Transistors/IGBT/IGCT	3 Nos. of each rating & type
24.2	Controls cards	1 No. of each type
24.3	Power supply Cards	1 No. of each type
24.4	Power Fuses	3 Nos. of each rating & type
24.5	Contactors	no. of each rating and type (for rating > 400A)
25	Igniters	
25.1	Ignition transformer	1 No. of each rating & type
25.2	Control Card	1 No. of each rating & type
25.3	Ignition tip	1 No. of each type
26	Desalter	
26.1	Entrace Bushing	3 Nos. of each rating
26.2	Transformer Bushing	3 nos. of each rating
26.3	Insulators	3 Nos. of each rating
27	Flameproof Light Fitting	5% LED drivers for each type of FLP light fitting.

NOTES:

1. The word 'TYPE' means the Make, Model no., Type, Range, Size/ Length, Rating, Material as applicable.
2. Wherever % age is identified, Contractor shall supply next rounded figure.
3. The terminology used under 'Part Description' is the commonly used name of the part and may vary from manufacturer to manufacturer.
4. Mandatory spares as indicated above do not cover commissioning spares.
5. Mandatory spares as indicated above do not cover two year O&M spares.
6. Mandatory spares shall be applicable for electrical items of motors / sub-packages as per mandatory spares philosophy specified elsewhere in the bid document.
7. For Isolation breaker panel (GIS or AIS) one set of "Tripping Coil (1 No.), Closing coil (1 No.) and Control fuse/MCB (10 Nos. of each rating and type)" shall be considered as mandatory spares for each Isolation breaker panel (GIS or AIS).
8. For Isolation breaker panel (GIS or AIS) one set of "Auxiliary relays (1 no. of each type)" shall be considered as mandatory spares for Relays for Isolation breaker panel (GIS or AIS).
9. MV Switchboard shall include fixed and drawout type of switchboards such as PCC, MCC, PMCC, EPCC, EPMCC, ASB, LDB, ELDB, package switchboards etc.
10. 1 no. Ethernet switch of each type shall be provided for all switchboards put together.

6.2 COMMISSIONING SPARES

Commissioning Spare Parts shall be procured along with the main equipment as per equipment manufacturer's recommendations. The list of such recommended spares shall be obtained along with the offer.

Minimum 2 nos. Breaker handling trolley, 5 nos. each Breaker racking / rack out handle, Breaker spring charging handle and Fuse puller shall be procured for each type of switchboard.

6.3 RECOMMENDED SPARE FOR NORMAL OPERATION & MAINTAINENCE

Quotation for two-years spares for normal operation and maintenance (over and above mandatory spares) along with unit price shall be obtained with the proposal for Client to order the same separately.

6.4 SPECIAL TOOLS AND TACKLES

Required Special Tools and Tackles shall be procured along with the main equipment as per equipment manufacturer's recommendations. The list of such recommended special tools/tackles shall be obtained along with the offer.

7.0 VENDOR DATA REQUIREMENT

Vendor Data Requirement as indicated in the respective equipment Material Requisitions shall be followed.

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SPECIFICATION FOR DOCUMENTATION REQUIREMENTS FROM SUPPLIERS

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committe Convener	Standards Bureau Chairman
					Approved by	
2	12.06.20	General Revision	QMS Standards Committee	QMS Standards Committee	SKB	SKS
1	12.03.15	General Revision	QMS Standards Committee	QMS Standards Committee	MPJ	SC
0	04.06.09	Issued as Standard Specification	QMS Standards Committee	QMS Standards Committee	SCT	ND

Abbreviations:

DCI	-	Document Control Index
eDMS	-	Electronic Document Management System
FOA	-	Fax of Acceptance
IC	-	Inspection Certificate
IRN	-	Inspection Release Note
ITP	-	Inspection and Test Plan
LOA	-	Letter of Acceptance
MR	-	Material Requisition
PO	-	Purchase Order
PR	-	Purchase Requisition
PVC	-	Polyvinyl Chloride
QAP	-	Quality Assurance Plan
QMS	-	Quality Management System
RPO	-	Regional Procurement Office
TPIA	-	Third Party Inspection Agency
URL	-	Universal Resource Locator
V-Portal	-	Vendor Portal

QMS Standards Committee

Convener: Mr. S.K. Badlani

Members:
Mr. Sanjay Mazumdar (Engg.)
Mr. R.K. Singh (SCM)
Mr. B. Biswas (SCM)
Mr. Ravindra Kumar (Const.)
Mr. Vinod Kumar (CQA)
Mr. Swapnil Vaishnav (Projects)

CONTENTS

Attachments

1.0 SCOPE

This specification establishes the Documentation Requirements from Suppliers.

All documents / data against the PO / PR / MR shall be developed and submitted to EIL / Owner by the suppliers for review / records, in line with this specification.

2.0 DEFINITIONS

2.1 Supplier

For the purpose of this specification, the word "SUPPLIER" means the person(s), firm, company or organization who has entered into a contract with EIL / Owner for delivery of some products (including service). The word is considered synonymous to bidder, contractor or vendor.

2.2 Owner

Owner means the owner of the project for which services / products are being purchased and includes their representatives, successors and assignees.

3.0 REFERENCE DOCUMENTS

6-78-0001	Specification for Quality Management System Requirements from Bidders

4.0 DOCUMENTATION REQUIREMENTS

4.1 Order Acknowledgement and Assigning Project Manager

After placement of order, Supplier shall acknowledge order through V-Portal within 7 days of receipt of FOA / PO. Supplier shall assign a Project Manager for that order though online portal and provide requisite details. Project Manager details shall include e-mail address, mailing address, mobile/telephone nos., fax nos. and name of Project Manager. All the system generated emails pertaining to that order shall be sent to the assigned Project Manager.

4.2 Documents / Data to be submitted by the Supplier

4.2.1 The Supplier shall submit the documents and data against the PO / PR / MR as per the list given in respective PO / PR / MR.

4.2.2 Review of the supplier drawings / documents by EIL would be only to review the compatibility with basic designs and concepts and in no way absolve the supplier of his responsibility / contractual obligation to comply with PR requirements, applicable codes, specifications and statutory rules / regulations. Any error / deficiency noticed during any stage of manufacturing / execution / inspection/ installation shall be promptly corrected by the supplier without any time and cost implications, irrespective of comments on the same were received from EIL during the drawing review stage or not.

4.2.3 Unless otherwise specified, submission of documents for Review / Records shall commence as follows from the date of Fax of Intent / Letter of Intent / Fax of Acceptance (FOA) / Letter of Acceptance (LOA):

QMS	- 1 week
Document Control Index	- 2 weeks
Other Documents / Drawings	- As per approved Document Control Index

4.2.4 Documents as specified in PO / PR / MR are minimum requirements. Supplier shall submit any other document / data required for completion of the job as per EIL / Owner instructions.

4.3 Style and Formatting

4.3.1 All Documents shall be in ENGLISH language and in M.K.S System of units.

4.3.2 Before forwarding the drawings and documents, contractor shall ensure that the following information are properly mentioned in each drawing:

Purchase Requisition Number
Name of Equipment / Package
Equipment / Package Tag No.
Name of Project
Client
Drawing / Document Title
Drawing / Document No.
Drawing / Document Revision No. and Date

4.4 Review and Approval of Documents by Supplier

4.4.1 The Drawing / Documents shall be reviewed, checked, approved and duly signed / stamped by supplier before submission. Revision number shall be changed during submission of the revised supplier documents and all revisions shall be highlighted by clouds. Whenever the supplier require any sub-supplier drawings to be reviewed by EIL, the same shall be submitted by the supplier duly reviewed, approved and stamped by the supplier. Direct submission of sub-supplier's drawings without contractor's / suppliers' approval shall not be entertained.

4.5 Document Category

4.5.1 **Review Category**

Following review codes shall be used for review of supplier Drawings / Documents:

Review Code 1	-	No comments. Proceed with Manufacture / Fabrication as per the document.
Review Code 2	-	Proceed with Manufacture / Fabrication as per commented document. Revised document required.
Review Code 3	-	Document does not conform to basic requirements as marked. Resubmit for review.
R	-	Document is retained for Records. Proceed with Manufacturing / Fabrication as per PR / Tender requirements.
V	-	Void

4.6 Methodology for Submission of Documents to EIL/Owner

4.6.1 Document Control Index (DCI)

Supplier shall create and submit Document Control Index (DCI) for review based on PO / PR / MR along with schedule date of submission of each drawing / document on EIL Vendor Portal. The DCI shall be specific with regard to drawing / document no. and the exact title. Proper sequencing of the drawings / documents should be ensured in schedule date of submission.

4.6.2 Submission of Drawings / Documents / Data

Drawings / documents, data and DCI shall be uploaded on the EIL Vendor Portal as per approved DCI. The detailed guidelines for uploading documents on EIL Vendor Portal are available on following URL

http://edocx.eil.co.in/vportal

4.6.3 Statutory Approvals

Wherever approval by any statutory body is required to be taken by Supplier, the Supplier shall submit copy of approval by the authority to EIL.

4.6.4 Manufacturing Schedule

Supplier shall prepare manufacturing schedule for the order, with key milestone activities (such as document submission, sub ordering, manufacturing, Inspection, dispatches, etc) to meet delivery as per FOA / PO terms. Supplier shall submit manufacturing schedule to concerned Regional Procurement Office (RPO) of EIL / Owner for review within 2 weeks from date of FOA / PO.

4.6.5 Schedule and Progress Reporting

Supplier shall submit monthly progress (MPR) report and updated procurement, engineering, manufacturing status, Inspection and dispatch status (schedule vs. actual) and highlight constraints, if any, along with action plan for mitigation, to the concerned Regional Procurement Office (RPO) of EIL / Owner by 1st week of every month., First MPR shall be submitted within 2 weeks from FOA / LOA. In case of exigencies, EIL / Owner can ask for report submission as required on weekly / fortnightly / adhoc basis depending upon supply status and supplier shall furnish such reports promptly without any price implication. Format for progress report shall be submitted by the Supplier during kick off meeting or within 2 weeks of receiving FOA / LOA, whichever is earlier.

4.7 Inspection and Testing

4.7.1 Quality Assurance Plan / Inspection and Test Plan

If Inspection and test plans (ITP) are attached with MR / PR same shall be followed along with additional tests requirement (if any) mentioned in MR/ PR. However for cases wherein EIL Standard ITPs not available / have not been attached with MR / PR, Supplier shall submit within one week of receiving FOA / LOA, the Quality Assurance Plan for inspection & testing at various stages of production, quality control records for critical bought out items / materials and site assembly & testing as may be applicable to the specific order and obtain approval from concerned Regional procurement Office of EIL / third party inspection agency, as applicable.

For Package equipment contracts, the supplier shall prepare a list of items / equipment and their inspection categorization plan for all items included in the scope of supply immediately after receipt of order and obtains approval for the same from EIL. The items shall be categorized into different categories depending upon their criticality for the scope of inspection of TPIA and / or EIL.

4.7.2 **Inspection Requisition:**

Supplier shall perform internal inspection as per ITP/ approved QAP at their works based on approved documents / drawings. Upon satisfactory internal inspection, supplier shall raise inspection call to concerned Regional Procurement Office (RPO) of EIL / TPIA / Owner with advance notice as per contract along with Internal test reports.

All changes w.r.t. PR shall be recorded through agreed variations or Concessions & Deviations. Conflict, if any, between PR / Job specifications and approved drawings, shall be brought to the notice of EIL / owner by the supplier / contractor. Decision of EIL / owner will be binding on the supplier and to be complied without time and cost implications.

Identified bought out items/ raw material shall be procured under TPIA as per ITP.

4.7.3 **Inspection Release Note (IRN)/ Inspection Certificate (IC)**

IRN / IC shall be issued by EIL Inspector / third party inspection agency on successful inspection, review of test reports / certificates as per specifications & ITP / agreed quality plan (as applicable) and only after all the drawings / documents as per DCI are submitted and are accepted under review code-1 or code R. Supplier shall ensure that necessary documents / manufacturing and test certificates are made available to EIL / TPIA as and when desired.

Note 1: Non fulfilling above requirement shall result into appropriate penalty or with- holding of payment as per conditions of PO / PR / MR.

Note 2: For items where IRN/IC is issued by TPIA, supplier to ensure that following as a minimum must be mentioned by TPIA in IRN / IC

a) PR document number
b) List of drawings / documents with EIL approval code
c) Tests witnessed, documents reviewed
d) Compliance statement by TPIA that product meets the requirement as specified in EIL PR, standard specifications, Inspection Test Plan / QAP and approved documents.

4.8 Transportation Plan

Transportation Plan for Over Dimensional Consignments (ODC), if any, shall be submitted within 2 weeks of receiving FOA / LOA, for approval. Consignment with parameters greater than following shall be considered as over dimensional.

Dimensions: 4 meters width x 4 meters height x 20 meters length

Weight : 32 MT

Dimensions and weight provided above are inclusive of all nozzles, attachments, transportation saddles etc.

Physical Rout survey for ODC movement shall be submitted to EIL within 8 weeks of receiving FOA / LOA.

4.9 Dispatch Details

Upon receipt of IRN / IC from EIL inspector / TPIA, supplier shall dispatch items within 2 days. Supplier shall submit dispatch details to concerned RPO of EIL / Owner within a day of dispatch. Dispatch details shall include Lorry Receipt (LR) number / Dispatch Number, Transporter Name, Date of dispatch, Packing list, Invoice copy etc.

4.10 Final Documentation

4.10.1 Supplier shall prepare final documents in line with VDR (Vendor Document Requirements) attached with PR/Tender. A copy of final document along with filled in Format for Completeness of Final Documentation (Format No. 3-78-0004) to be submitted to EIL Inspector / TPIA for review & approval within 2 weeks from dispatch. Upon receipt of EIL/TPIA endorsement on Completeness of Final Documents, supplier shall submit soft / hard copies of Final documents to EIL / Owner in requisite quantity as per PO / PR details, along with covering letter. A copy of covering letter to be submitted to the concerned Regional Procurement Office (RPO) of EIL/Owner.

4.10.2 **As Built Drawings**

Minor Shop changes made by Supplier after approval of drawings under 'Code 1' by EIL and deviations granted through online system ,if any, shall be marked in hard copies of drawings which shall then be stamped 'As-built' by the supplier. These 'As-built' drawings shall be reviewed and stamped by EIL Inspector / TPIA. Supplier shall prepare scanned images files of all marked – up 'As – built' drawings. Simultaneously Supplier shall incorporate the shop changes in the native soft files of the drawings also.

4.10.3 **Packing / Presentation of Final Documents**

Final Documents shall be legible photocopies in A4, A3 size only. Drawings will be inserted in plastic pockets (both sides transparent, sheet thickness minimum 0.1 mm) with an extra strip of 12 mm wide for punching so that drawings are well placed.

Final Documentation shall be bound in Hard board Plastic folder(s) of size 265 mm x 315 mm ($10^1/_2$ inch x $12^1/_2$ inch) and shall not be more that 75 mm thick. It may be of several volumes and each volume shall have a volume number, index of volumes and index of contents of that particular volume. Where number of volumes are more, 90mm thickness can be used. Each volume shall have top PVC sheet of minimum 0.15 mm thick duly fixed and pressed on folder cover and will have 2 lever clip. In case of imported items documents, 4 lever clip shall also be accepted. All four corners of folders shall be properly metal clamped. Indexing of contents with page numbering must be incorporated by supplier. Spiral/Spico bound documents shall not be acceptable. As mentioned above, books should be in hard board plastic folders with sheets punched and having 2/4 lever clips arrangement.

Each volume shall contain on cover a Title Block indicating package Equipment Tag No. & Name, PO / Purchase Requisition No., Name of Project and Name of Customer. Each volume will have hard front cover and a reinforced spine to fit thickness of book. These spines will also have the title printed on them. Title shall include also volume number (say 11 of 15) etc.

4.10.4 **Submission of Soft Copies**

Supplier shall submit to EIL, the scanned images files as well as the native files of drawings / documents, along with proper index.

In addition to hard copies, Supplier shall submit soft copies of all the final drawings and documents in pen drive or any other specified medium with proper identification tag, all text documents prepared on computer, scanned images of all important documents (not available

as soft files), all relevant catalogues, manuals available as soft files (editable copies of drawings/text documents, while for catalogues / manuals / proprietary information and data, PDF files can be furnished).

All the above documents shall also be uploaded on the EIL Vendor Portal and if applicable on Client Server also.

4.10.5 **Completeness of Final Documentation**

Supplier shall get the completeness of final documentation verified by EIL / TPIA, as applicable, and attach the Format for Completeness of Final Documentation (Format No. 3-78-0004) duly signed by EIL Inspector or TPIA as applicable to the final document folder.

COMPLETENESS OF FINAL DOCUMENTATION

Name of Supplier/Contractor	:	
Customer	:	
Project	:	
EIL's Job No.	:	
Purchase Order No./ Contract No.	:	
Purchase Requisition No./ Tender No.	:	Rev. No. :
Name of the Work/ Equipment	:	
Tag. No.	:	
Supplier's / Contractor's Works Order No.	:	

Certified that the Engineering Documents / Manufacturing & Test Certificates submitted by the supplier (as per Index sheet mentioned in Annexure-1) are complete in accordance with the Vendor Data Requirements of Purchase Requisition / Tender.

Signature	: …….	Signature	: …….
Date	: …….	Date	: …….
Name	: ……..	Name	: ……..
Designation	: ……	Designation	: ……
Department	: ……	Department	: ……
	Supplier / Contractor		EIL / TPIA

Annexure-1

Final Documentation Index Sheet			
PR/PO/Tender No.		Rev. No.	
Serial No.	Document Title	Page/ Folder No.	No. of Pages

Signature	: …….	Signature	: …….
Date	: …….	Date	: …….
Name	: ……..	Name	: ……..
Designation	: ……	Designation	: ……
Department	: ……	Department	: ……

Supplier / Contractor

EIL / TPIA

बोलीकर्ता से गुणवत्ता प्रबंधन प्रणाली अपेक्षाओं हेतु विनिर्देश

SPECIFICATION FOR QUALITY MANAGEMENT SYSTEM REQUIREMENTS FROM BIDDERS

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convener	Standards Bureau Chairman
					Approved by	
2	12.06.20	General Revision	QMS Standards Committee	QMS Standards Committee	SKB	SKS
1	12.03.15	General Revision	QMS Standards Committee	QMS Standards Committee	MPJ	SC
0	04.06.09	Issued as Standard Specification	QMS Standards Committee	QMS Standards Committee	SCT	ND

Abbreviations:

ISO	-	International Organization for Standardization
MR	-	Material Requisition
PO	-	Purchase Order
PR	-	Purchase Requisition
QMS	-	Quality Management System

QMS Standards Committee

Convener: Mr. S.K. Badlani

Members: Mr. Sanjay Mazumdar (Engg.)
Mr. R.K. Singh (SCM)
Mr. B. Biswas (SCM)
Mr. Ravindra Kumar (Const.)
Mr. Vinod Kumar (CQA)
Mr. Swapnil Vaishnav (Projects)

CONTENTS

1.0 SCOPE

This specification establishes the Quality Management System requirements to be met by BIDDER for following purpose:

- QMS requirements to be met by suppliers / contractors after award of work / during contract execution.

2.0 DEFINITIONS

2.1 Bidder

For the purpose of this specification, the word "BIDDER" means the person(s), firm, company or organization who is under the process of being contracted by EIL / Owner for delivery of some products (including service). The word is considered synonymous to supplier, contractor or vendor.

2.2 Project Quality Plan

Document tailored from Standard Quality Management System Manual of BIDDER, specifying how the quality requirements of the project will be met.

2.3 Owner

Owner means the owner of the project for which services / products are being purchased and includes their representatives, successors and assignees.

3.0 REFERENCE DOCUMENTS

6-78-0002	Specification for Documentation Requirements from Contractors
6-78-0003	Specification for Documentation Requirements from Suppliers

4.0 QUALITY MANAGEMENT SYSTEM – GENERAL

Unless otherwise agreed with EIL / Owner, the BIDDER proposed quality system shall fully satisfy all relevant requirements of ISO 9001 "Quality Management Systems – Requirements." Evidence of compliance shall be current certificate of quality system registration to ISO 9001 or a recent compliance audit recommending registration from a certification agency. The quality system shall provide the planned and systematic control of all quality related activities for execution of contract. Implementation of the system shall be in accordance with BIDDER'S Quality Manual and PROJECT specific Quality Plan.

5.0 QUALITY SYSTEM REQUIREMENTS

5.1 BIDDER shall prepare and submit for review / record, Project Quality Plan / Quality Assurance Plan for contracted scope / job. The BIDDER'S Quality Plan shall address all of the applicable elements of ISO 9001, identify responsible parties within BIDDER'S organization, for the implementation / control of each area, reference the applicable procedures used to control / assure each area, and verify the documents produced for each area. The Project Quality Plan shall necessarily define control or make reference to the relevant procedures, for design and engineering, purchase, documentation, record control, bid evaluation, inspection, production / manufacturing, preservation, packaging and storage, quality control at construction site, pre-commissioning, commissioning and handing over (as applicable) in line with contract requirement and scope of work.

5.2 BIDDER shall identify all specified or implied statutory and regulatory requirements and communicate the same to all concerned in his organization and his sub contractor's organization for compliance.

5.3 BIDDER shall deploy competent and trained personnel for various activities for fulfillment of PO / contract. BIDDER shall arrange adequate infrastructure and work environment to ensure that the specification and quality of the deliverable are maintained.

5.4 BIDDER shall do the quality planning for all activities involved in delivery of order. The quality planning shall cover as minimum the following:

- Resources
- Product / deliverable characteristics to be controlled.
- Process characteristics to ensure the identified product characteristics are realized
- Identification of any measurement requirements, acceptance criteria
- Records to be generated
- Need for any documented procedure

The quality planning shall result into the quality assurance plan, inspection and test plans (ITPs) and job procedures for the project activities in the scope of bidder. These documents shall be submitted to EIL / Owner for review / approval, before commencement of work.

5.5 Requirements for sub-ordering of outsourced items / sub-contracting / purchasing of services specified in MR / contract / tender shall be adhered to. In general all outsourced items will be from approved vendors of EIL. Wherever requirements are not specified, or approved sub vendors do not exist, the sub-contractor shall establish and maintain a system for purchasing / sub-contracting to ensure that purchased product / service conforms to specified requirements in concurrence with EIL / Owner. Criteria for selection of sub-contractor, evaluation, re-evaluation, maintenance of purchasing data and verification of purchased product (sub-contractor services), constitute important components of this requirement.

5.6 BIDDER shall plan and carry production and service provision under controlled conditions. Controlled conditions shall include, as applicable

a) the availability of information that describes the characteristics of the product
b) the availability of work instructions
c) the use of suitable equipment
d) the availability and use of monitoring and measuring devices
e) the implementation of monitoring and measurement
f) the implementation of release, delivery and post-delivery activities

5.7 BIDDER shall validate any processes for production and service provision where resulting output cannot be verified by subsequent monitoring and measurement. This includes any process where deficiencies become apparent only after the product is in use or service has been delivered.

5.8 BIDDER shall establish a system for identification and traceability of product / deliverable throughout product realization. Product status with respect to inspection and testing requirements shall be identified.

5.9 BIDDER shall identify, verify, protect and safeguard EIL / Owner property (material / document) provided for use or incorporation into the product. If any Owner / EIL property is lost, damaged or otherwise found to be unsuitable for use, this shall be reported to the EIL / Owner.

5.10 BIDDER shall ensure the conformity of product / deliverable during internal processing and delivery to the intended destination. Requirements mentioned in the MR/ tender shall be adhered to.

5.11 BIDDER shall establish system to ensure that inspection and testing activities are carried out in line with requirements. Where necessary, measuring equipment shall be calibrated at specified frequency, against national or international measurement standards; where no such standard exists, the basis used for calibration shall be recorded. The measuring equipment shall be protected from damage during handling, maintenance and storage.

5.12 BIDDER shall ensure effective monitoring, using suitable methods, of the processes involved in production and other related processes for delivery of the scope of contract.

5.13 BIDDER shall monitor and measure the characteristics of the product / deliverable to verify that product requirement has been met. The inspection (stage as well as final) by BIDDER and EIL / Owner personnel shall be carried out strictly as per the approved ITPs or ITPs forming part of the contract. Product release or service delivery shall not proceed until the planned arrangements have been satisfactorily completed, unless otherwise approved by relevant authority and where applicable by Owner / EIL.

5.14 BIDDER shall establish and maintain a documented procedure to ensure that the product which does not conform to requirements is identified and controlled to prevent its unintended use or delivery

5.15 All non-conformities (NCs) / deficiencies found by the BIDDER'S inspection / surveillance staff shall be duly recorded, including their disposal action shall be recorded and resolved suitably. Effective corrective actions shall be implemented by the BIDDER so that similar NCs including deficiencies do not recur. The BIDDER shall take appropriate actions to address the Risks and Opportunities in the project.

5.16 All deficiencies noticed and reported by EIL / Owner shall be analyzed by the BIDDER and appropriate corrective actions shall be implemented. BIDDER shall intimate EIL / Owner of all such corrective action implemented by him.

5.17 BIDDER should follow the standards, specifications and approved drawings. Concessions / Deviations shall be allowed only in case of unavoidable circumstances. In such situations Concession / deviation request must be made by the BIDDER through online system of EIL eDMS. URL of EIL eDMS is http://edocx.eil.co.in/vportal.

5.18 BIDDER shall have documented procedure for control of documents.

5.19 All project records shall be carefully kept, maintained and protected for any damage or loss until the project completion, then handed over to EIL / Owner as per contract requirement (Refer Specification Nos. 6-78-0002 - Specification for Documentation Requirements from Contractors and 6-78-0003 - Specification for Documentation Requirements from Suppliers), or disposed as per relevant project procedure.

6.0 AUDITS

BIDDER shall plan and carry out the QMS audit for the job. Quality audit programme shall cover design, procurement, construction management and commissioning as applicable including activities carried out by sub-vendors and sub-contractors. This shall be additional to the certification body surveillance audits carried out under BIDDER'S own ISO 9001 certification scheme.

The audit programmes and audit reports shall be available with bidder for scrutiny by EIL / Owner. EIL or Owner's representative reserves the right to attend, as a witness, any audit conducted during the execution of the WORKS.

In addition to above, EIL, Owner and third party appointed by EIL / Owner may also perform Quality and Technical compliance audits. BIDDER shall provide assistance and access to their systems and sub-contractor / vendor systems as required for this purpose. Any deficiencies noted shall be immediately rectified by BIDDER.

7.0 DOCUMENTATION REQUIREMENTS

BIDDER shall submit following QMS documents immediately after award of work (Within one week) for record / review by EIL / Owner/ TPIA, as applicable.

- Organization chart (for complete organization structure and for the project)
- Project Quality Plan / Quality Assurance Plan
- Job specific Inspection Test Plans, if not attached with PR
- Job Procedures
- Inspection / Test Formats

In addition to above QMS documents, following documentation shall be maintained by the BIDDER for submission to EIL / Owner on demand at any point of time during execution of the project.

- Quality Manual
- Certificate of approval for compliance to ISO: 9001 standard
- Procedure for Control of Non-conforming Product
- Procedure for Control of Documents
- Sample audit report of the QMS internal and external audits conducted during last one year
- Customer satisfaction reports from at least 2 customers,
- Project QMS audit report
- Technical audit reports for the project
- Corrective action report on the audits

Documents as specified above are minimum requirements. BIDDER shall submit any other document / data required for completion of the job as per EIL / Owner instructions.

आपूर्तिकर्ताओं से प्रलेखन अपेक्षाओं हेतु विनिर्देश

SPECIFICATION FOR DOCUMENTATION REQUIREMENTS FROM SUPPLIERS

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committe Convener	Standards Bureau Chairman
					Approved by	
1	12.03.15	General Revision	QMS Standards Committee	QMS Standards Committee	MPJ	SC
0	04.06.09	Issued as Standard Specification	QMS Standards Committee	QMS Standards Committee	SCT	ND

Abbreviations:

DCI	-	Document Control Index
eDMS	-	Electronic Document Management System
FOA	-	Fax of Acceptance
HOD	-	Head of Division / Department
IC	-	Inspection Certificate
IRN	-	Inspection Release Note
ITP	-	Inspection and Test Plan
LOA	-	Letter of Acceptance
MOU	-	Memorandum of Understanding
MR	-	Material Requisition
PO	-	Purchase Order
PR	-	Purchase Requisition
PVC	-	Polyvinyl Chloride
QMS	-	Quality Management System
TPIA	-	Third Party Inspection Agency
URL	-	Universal Resource Locator

QMS Standards Committee

Convener: Mr. M.P. Jain

Members:
Mr. A.K. Chaudhary (Insp.)
Mr. S.K. Kaul (C&P)
Mr. R.K. Trivedi (Engg.)
Mr. Ravindra Kumar (Const.)
Mr. Tilak Raj (Projects)
Mr. Vinod Kumar (CQA)

CONTENTS

Attachments

1.0 SCOPE

This specification establishes the Documentation Requirements from Suppliers.

All documents/data against the PO / PR / MR shall be developed and submitted to EIL/Owner by the suppliers for review / records, in line with this specification.

2.0 DEFINITIONS

2.1 Supplier

For the purpose of this specification, the word "SUPPLIER" means the person(s), firm, company or organization who is under the process of being contracted by EIL / Owner for delivery of some products (including service). The word is considered synonymous to bidder, contractor or vendor.

2.2 Owner

Owner means the owner of the project for which services / products are being purchased and includes their representatives, successors and assignees.

3.0 REFERENCE DOCUMENTS

6-78-0001	Specification for Quality Management System Requirements from Bidders

4.0 DOCUMENTATION REQUIREMENTS

4.1 Documents/Data to be Submitted by the Supplier

4.1.1 The Supplier shall submit the documents and data against the PO/PR/MR as per the list given in respective PO/PR/MR.

4.1.2 Review of the supplier drawings by EIL would be only to review the compatibility with basic designs and concepts and in no way absolve the supplier of his responsibility/contractual obligation to comply with PR requirements, applicable codes, specifications and statutory rules/regulations. Any error/deficiency noticed during any stage of manufacturing/execution/installation shall be promptly corrected by the supplier without any time and cost implications, irrespective of comments on the same were received from EIL during the drawing review stage or not.

4.1.3 Unless otherwise specified, submission of documents for Review/Records shall commence as follows from the date of Fax of Intent / Letter of Intent/ Fax of Acceptance (FOA)/ Letter of Acceptance (LOA):

QMS	- 1 week
Drawing/Document Control Index	- 2 weeks
Other Documents/Drawings	- As per approved Drawing/Document Control Index/Schedule

4.1.4 Documents as specified in PO/PR/MR are minimum requirements. Supplier shall submit any other document/data required for completion of the job as per EIL/Owner instructions.

4.2 Style and Formatting

4.2.1 All Documents shall be in ENGLISH language and in M.K.S System of units.

4.2.2 Before forwarding the drawings and documents, contractor shall ensure that the following information are properly mentioned in each drawing:

Purchase Requisition Number
Name of Equipment / Package
Equipment / Package Tag No.
Name of Project
Client
Drawing / Document Title
Drawing / Document No.
Drawing / Document Revision No. and Date

4.3 Review and Approval of Documents by Supplier

4.3.1 The Drawing/Documents shall be reviewed, checked, approved and duly signed/stamped by supplier before submission. Revision number shall be changed during submission of the revised supplier documents and all revisions shall be highlighted by clouds. Whenever the supplier require any sub-supplier drawings to be reviewed by EIL, the same shall be submitted by the supplier after duly reviewed, approved and stamped by the supplier. Direct submission of sub-supplier's drawings without contractor's approval shall not be entertained.

4.4 Document Category

4.4.1 Review Category

Following review codes shall be used for review of supplier Drawings/Documents:

Review Code 1	-	No comments. Proceed with manufacture/ fabrication as per the document.
Review Code 2	-	Proceed with manufacture/fabrication as per commented document. Revised document required.
Review Code 3	-	Document does not conform to basic requirements as marked. Resubmit for review
R	-	Document is retained for Records. Proceed with manufacture/fabrication.
V	-	Void

4.5 Methodology for Submission of Documents to EIL/Owner

4.5.1 Document Control Index (DCI)

Supplier shall create and submit Document Control Index (DCI) for review based on PO/PR/MR along with schedule date of submission of each drawing/document on EIL eDMS. The DCI shall be specific with regard to drawing/document no. and the exact title. Proper sequencing of the drawings/documents should be ensured in schedule date of submission.

4.5.2 **Submission of Drawings/Documents**

Drawings/documents and data shall be uploaded on the EIL eDMS Portal as per DCI. The detail guidelines for uploading documents on EIL eDMS Portal are available on following URL

http://edocx.eil.co.in/vportal

4.5.3 **Statutory Approvals**

Wherever approval by any statutory body is required to be taken by Supplier, the Supplier shall submit copy of approval by the authority to EIL.

4.5.4 **Details of Contact Persons of Supplier**

After placement of order supplier shall assign a Project Manager for that order. The details are to be filled online through the portal. The details include e-mail address, mailing address, telephone nos., fax nos. and name of Project Manager. All the system generated emails pertaining to that order shall be sent to the assigned Project Manager.

4.5.5 **Schedule and Progress Reporting**

Supplier shall submit monthly progress report and updated procurement, engineering and manufacturing status (schedule vs. actual) every month, beginning within 2 weeks from FOA/LOA. In case of exigencies, EIL/Owner can ask for report submission as required on weekly/fortnightly/adhoc basis depending upon supply status and supplier shall furnish such reports promptly without any price implication. Format for progress report shall be submitted by the Supplier during kick off meeting or within one week of receiving FOA/LOA, whichever is earlier.

4.5.6 **Quality Assurance Plan/Inspection and Test Plan**

Inspection and test plans (ITP) attached if any, to the MR/PR are to be followed. However for cases wherein ITPs have not been attached with MR/PR, Supplier shall submit within one week of receiving FOA/LOA, the Quality Assurance Plan for manufacturing, covering quality control of critical bought out items/materials, inspection & testing at various stages of production, quality control records and site assembly & testing as may be applicable to the specific order and obtain approval from concerned Regional procurement Office of EIL/third party inspection agency, as applicable.

For Package equipment contracts, the supplier shall prepare a list of items/ equipments and their inspection categorization plan for all items included in the scope of supply immediately after receipt of order and obtains approval for the same from EIL. The items shall be categorized into different categories depending upon their criticality for the scope of inspection of TPIA and/or EIL.

4.5.7 **Inspection Release Note (IRN)/ Inspection Certificate (IC)**

IRN/ IC shall be issued by EIL Inspector/ third party inspection agency on the basis of successful inspection, review of certificates as per specifications & agreed quality plan (as applicable) and only after all the drawings/documents as per DCI are submitted and are accepted under review code-1 or code R. Supplier shall ensure that necessary documents/manufacturing and test certificates are made available to EIL/TPIA as and when desired.

Note: Non fulfilling above requirement shall result into appropriate penalty or with-holding of payment as per conditions of PO/PR/MR.

4.5.8 Transportation Plan

Transportation Plan for Over Dimensional Consignments (ODC), if any, shall be submitted within 2 weeks of receiving FOA/LOA, for approval. Consignment with parameters greater than following shall be considered as over dimensional.

Dimensions: 4 meters width x 4 meters height x 20 meters length

Weight : 32 MT

4.6 Final Documentation

4.6.1 As Built Drawings

Shop changes made by Supplier after approval of drawings under 'Code 1' by EIL and deviations granted through online system , if any, shall be marked in hard copies of drawings which shall then be stamped 'As-built' by the supplier. These 'As-built' drawings shall be reviewed and stamped by EIL Inspector/ TPIA also. Supplier shall prepare scanned images files of all marked – up 'As – built' drawings. Simultaneously Supplier shall incorporate the shop changes in the native soft files of the drawings also.

4.6.2 As Built Final Documents

As built final documents shall be submitted as listed in PO/PR/MR.

4.6.3 Packing/Presentation of Final Documents

Final Documents shall be legible photocopies in A4, A3 size only. Drawings will be inserted in plastic pockets (both sides transparent, sheet thickness minimum 0.1 mm) with an extra strip of 12 mm wide for punching so that drawings are well placed.

Final Documentation shall be bound in Hard board Plastic folder(s) of size 265 mm x 315 mm ($10^{1}/_{2}$ inch x $12^{1}/_{2}$ inch) and shall not be more that 75 mm thick. It may be of several volumes and each volume shall have a volume number, index of volumes and index of contents of that particular volume. Where number of volumes are more, 90mm thickness can be used. Each volume shall have top PVC sheet of minimum 0.15 mm thick duly fixed and pressed on folder cover and will have 2 lever clip. In case of imported items documents, 4 lever clip shall also be accepted. All four corners of folders shall be properly metal clamped. Indexing of contents with page numbering must be incorporated by supplier. Spiral/Spico bound documents shall not be acceptable. As mentioned above, books should be in hard board plastic folders with sheets punched and having 2/4 lever clips arrangement.

Each volume shall contain on cover a Title Block indicating package Equipment Tag No. & Name, PO/Purchase Requisition No., Name of Project and Name of Customer. Each volume will have hard front cover and a reinforced spine to fit thickness of book. These spines will also have the title printed on them. Title shall include also volume number (say 11 of 15) etc.

4.6.4 Submission of Soft Copies

Supplier shall submit to EIL, the scanned images files as well as the native files of drawings/documents, along with proper index.

In addition to hard copies, Supplier shall submit electronic file (CD-ROM) covering soft copies of all the final drawings and documents, all text documents prepared on computer, scanned images of all important documents (not available as soft files), all relevant catalogues, manuals available as soft files (editable copies of drawings/text documents, while for catalogues/manuals/proprietary information and data, PDF files can be furnished).

All the above documents shall also be uploaded on the EIL eDMS portal.

4.6.5 **Completeness of Final Documentation**

Supplier shall get the completeness of final documentation verified by EIL/TPIA and attach the Format for Completeness of Final Documentation (Format No. 3-78-0004) duly signed by EIL Inspector or TPIA as applicable to the document folder.

COMPLETENESS OF FINAL DOCUMENTATION

Name of Supplier/Contractor	:	
Customer	:	
Project	:	
EIL's Job No.	:	
Purchase Order No./ Contract No.	:	
Purchase Requisition No./ Tender No.	:	Rev. No. :
Name of the Work/ Equipment	:	
Tag. No.	:	
Supplier's/ Contractor's Works Order No.	:	

Certified that the Engineering Documents/ Manufacturing & Test Certificates submitted by the supplier are complete in accordance with the Vendor Data Requirements of Purchase Requisition.

Signature	:	Signature	: .....
Date	:	Date	: .....
Name	:	Name	: .....
Designation	:	Designation	: .....
Department	:	Department	: .....

Supplier/Contractor

EIL/TPIA

अनुमोदित/APPROVED
हस्ताक्षर/Sign: .....
नाम/Name: M.P. JAIN
दिनांक/Date: 12-3-2015

PROCEDURE FOR SMART INTEGRATED ENGG., DIGITAL HANDOVER OF DRAWING/DOCUMENT/ 3D MODEL AND DIGITAL INTERVENTION BY EPC CONTRACTOR

PROJECT : **BINA PETROCHEMICAL & REFINERY EXPANSION PROJECT, BPREP**

OWNER : **M/s BHARAT PETROLEUM COOPERATION LIMITED.**

CONSULTANT : **M/s ENGINEERS INDIA LTD.**

JOB NO. : **B957**

Rev. No	Date	Purpose	Prepared by	Checked by	Approved by
C	08/03/2025	REVISED AND REISSUED FOR ENGINEERING	MS	MK/KB	SV
B	04/02/2025	REVISED & RE-ISSUED FOR ENGINEERING	MS	MK/KB	SV
A	26/11/2024	ISSUED FOR ENGINEERING	MS	MK	SV

1. GENERAL

This chapter details the requirements pertaining to various drawings, documents and 3D model to be generated at various stages during the course of execution of the project by the EPC Contractor for activities associated with Smart Integrated engineering and digital handover. These stipulations are supplementary to following specifications (enclosed elsewhere in the contract):

S. No.	Spec. No.	Specification detail
1.	6-78-0001	Specification for quality management system requirements from bidders
2.	6-78-0002	Specification for documentation requirements from contractors
3.	6-78-0003	Specification for documentation requirements from suppliers

The EPC Contractor shall recognize that efficient handling of drawings and documents to be prepared by him under the contract is the key to the timely completion of the plant.

The EPC Contractor shall ensure that all drawings and documents to be submitted by him to the OWNER/CONSULTANT shall be of professional quality and conforming to the contractual requirements.

The EPC Contractor shall submit the drawings through the defined document management system for the project for review by OWNER /CONSULTANT, and shall maintain a record of drawings submitted till date at all times. Access to document management system shall be provided by client/consultant to the successful EPC Contractor which shall be utilized by the EPC Contractor for their smart engineering activities without any deviation.

Compliance of this chapter on drawings and documents is mandatory and is non-negotiable.

A pre-defined document numbering philosophy will be provided to successful EPC Contractor which shall be adopted and implemented by EPC Contractor for documents generated for this project. Document number shall also be shown in each deliverable as “Client Document Number”.

Computer aided design and drafting shall only be used. Standard, approved and well-established PC based computer programs/software packages, available in market shall only be used by the EPC Contractor and its sub-vendors etc.

All documents, before forwarding to OWNER /CONSULTANT shall be vetted in detail by EPC Contractor. Documents received without vetting will be returned without review. Also, any in accuracies/mistakes found will not only be rectified by the EPC CONTRACTOR but the EPC CONTRACTOR shall remain liable for bearing charges towards efforts spent by OWNER/CONSULTANT for discussing the same. Delay owing to these shall be to the account of EPC CONTRACTOR.

Review of the drawings/documents by OWNER/CONSULTANT would be only limited to the review of compatibility with basic designs and concepts. The review by the OWNER/CONSULTANT shall not be construed by the EPC CONTRACTOR as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications and drawings.

All drawings, datasheets, specification & model etc. shall be generated by the use of authoring tools specified elsewhere in the contract document. The digital handover shall be in soft native files along with associated database.

EPC CONTRACTOR shall furnish 3D model (with complete details with respect to equipment, Piping, Civil, Structure, Electrical & Instrumentation in line with scope of work for 3D modeling) of plant with dynamic walk-through facility to check any interference, requirement of safety, operation and maintenance for getting approval from OWNER/CONSULTANT with input data. Associated data base files along with library shall also be furnished at 30%, 60% and 90% model reviews.

Each drawing submitted by the EPC CONTRACTOR shall be clearly marked with the name of the Owner, the unit designation, the specifications, title, the specification number and the name of the Project with revision No. and date. If standard catalogue pages are submitted the applicable items shall be indicated there in. All titles, notings, markings and writings on the drawings shall be in English. The template shall be approved by the consultant/client. All documents shall be prepared on the approved template.

All the Engineering design and specifications shall be normally prepared in MKS system excepting for Civil/Structural wherein, the SI system is in vogue based on applicable design codes. Upon receiving comments on Drawings/Documents, the EPC CONTRACTOR shall provide compliance report/comment resolution sheet, separately on each of the comments, document-wise, along with the subsequent submission. Comments given by OWNER/CONSULTANT shall be discussed, if required, and finalized within the agreed schedule.

The schedule of submission of Drawings/Documents shall be in accordance with project plans only. The detailed list under different category, document-wise, shall be prepared by EPC CONTRACTOR for review/records of OWNER/CONSULTANT.

The EPC CONTRACTOR shall maintain up-to-date record of drawings & document status and make regular issue of drawing/documents index **discipline wise, on monthly basis, with copies to OWNER /CONSULTANT Site &, H.O.** indicating schedule date of submission, submission date of various revisions and date of review with code of review/ approval.

2. Category of Documents and Cycle Time

The handling of documents by OWNER/CONSULTANT /EPC CONTRACTOR shall be as follows:

2.1 OWNER /CONSULTANT's Review/Records

A detailed document list clearly identifying review/records category against each document shall be developed. Following may please be noted for all the documents engineered by the EPC CONTRACTOR:

a) Review

EPC CONTRACTOR can proceed if OWNER/CONSULTANT's comments are not received within 10 working days of its receipt by OWNER /CONSULTANT. However, if major deviation to contract specification for any design deficiency is detected in the course of review after stipulated period, it shall be the responsibility of the EPC Contractor to see that such deviations and deficiencies are corrected to ensure compliance to contract without any cost and time implication to Owner.

b) Records

EPC CONTRACTOR shall submit documents for OWNER/CONSULTANT's information and proceed with the work. OWNER/CONSULTANT comments, If any, which relates any cost and/or time implication to the owner due to inadequacies/inaccuracies may be brought to the attention of EPC CONTRACTOR at any stage for incorporation without any cost or time impact to owner.

The documents falling under review category shall in general, except for drawings requiring multi-disciplinary review, be returned with comments within 10 working days.

Documents submitted without meeting pre-requisite requirements will be returned without review.

However, documents like equipment layout etc. where multi-disciplinary activity is involved, the EPC CONTRACTOR, after submission for OWNER/CONSULTANT's review, shall visit OWNER/CONSULTANT for discussion for expeditious review of documents.

In absence of visit of EPC CONTRACTOR'S engineering team at OWNER/CONSULTANT office, review time shall be 15 working days. The information category document will be retained for records only. It is EPC CONTRACTOR'S responsibility to correct the deviation, if any, to the stipulation in the bid document, without any cost or time implication to Owner.

2.2 EPC CONTRACTOR'S Review

EPC CONTRACTOR shall furnish compliance statement to OWNER /CONSULTANT's comments while submitting the next revision within 10 days from the date of release of drawings and documents by OWNER/CONSULTANT.

2.3 Control and Monitoring of documents review and submission

Drawing schedule shall indicate the following:

- Schedule/Actual submission date to owner
- Category of submission
- Receipt of comments from Owner
- Category of return status from Owner
- Issue date for Construction

This updated schedule shall be issued on fortnightly/monthly basis, as agreed, and compared with Owner's log.

Detailed listing of documents (discipline wise) which are scheduled to be submitted or re-submitted incorporating OWNER/CONSULTANT's comments shall be provided by EPC CONTRACTOR in the weekly meetings. EPC Contractor shall ensure that drawings /documents are submitted as per the agreed schedule only. Bunching of documents/out of sequence submissions and consequential delay of documents and its review thereof shall be exclusively attributable to EPC CONTRACTOR.

2.4 Pre-Requisites from EPC Contractor

2.4.1 At the kick-off meeting, the EPC CONTRACTOR must submit discipline wise list of documents and drawings index.

2.4.2 The Drawing Index (discipline wise) shall include description of drawings/ documents, category of drawings, scheduled date of submission, actual date of submission, review code received with dates. This shall be updated fortnightly/monthly, as agreed by EPC CONTRACTOR and copies issued to OWNER /CONSULTANT site and H.O. as well as Owner. Drawings submitted before finalization of drawing index shall be rejected.

2.4.3 EPC CONTRACTOR shall separately submit list of drawings/documents involving multi-disciplinary reviews, considering the OWNER /CONSULTANT departmental activities (furnished in the contract) during the kick off meeting itself. They are also highlighted in the discipline- wise document list.

2.4.4 Critical and typical drawings/documents having impact on schedule and quality should only be identified for such timely reviews in Document Control Index. This shall be adopted after receipt of drawings/documents indexes from the EPC CONTRACTOR at the kick-off meeting with mutual understanding of the EPC CONTRACTOR/concerned specialist/Owner.

2.4.5 Any deviation on Record category drawings/documents and on review category drawings observed later or in execution at site during site visit/technical review by OWNER/CONSULTANT shall be taken seriously. EPC Contractor shall rectify the same at his own cost and time.

2.4.6 EPC CONTRACTOR shall plan submission progressively so that no bunching takes place in any discipline.

2.4.7 Review period shall be reckoned from the “Date of Receipt” of documents/drawings at OWNER /CONSULTANT to the “Date of Receiving” the reviewed documents by the EPC CONTRACTOR from OWNER /CONSULTANT office. EPC CONTRACTOR shall monitor submission and receipt.

2.4.8 Documents/drawings received prior to holiday/week end shall be accounted as received on the following working day and the review period committed shall include only working days.

2.4.9 Quality of drawings/documents is the essence for a timely review. If major comments/deviations to the contract document are noticed, the drawing shall be returned in Code-3.

2.4.10 Sequence of submission of drawings is essential for proper review of documents and timely completion of the project and the same is to be adhered to. In case sequence is not maintained, the documents submitted shall not be reviewed by OWNER/CONSULTANT and the responsibility of timely execution of the plant shall remain with EPC CONTRACTOR.

2.4.11 Piping/Instrument & other engineering drawings/documents shall be issued only after the corresponding P&IDs & Process documents coming under review category are first reviewed by the concerned department in code-2 as a minimum.

2.4.12 In principle. EPC CONTRACTOR is not expected to revise drawings/documents already reviewed in Code-1.

a) If it is of utmost necessity to revise or add some minor details in Code-1 drawings, EPC CONTRACTOR shall highlight such revisions by marking “CLOUD” and providing appropriate revision nos. to such additions/alterations. EPC CONTRACTOR is also needed to provide a “BLOCK” in the drawing indicating reasons of such changes and to insert another “Review Block”. OWNER /CONSULTANT shall put relevant code for such revisions only. Code

marking given by OWNER /CONSULTANT on such revisions shall not change the category of drawing.

b) Any major change in Code-1 drawing shall call for preparation of new drawing.

2.4.13 Based on the confidence gained on EPC CONTRACTOR'S quality of drawings/documents already submitted, "Review Category" drawings could be retained as Information/Records and vice versa at the discretion of OWNER/CONSULTANT. This however, does not change the category of drawings.

2.4.14 Once a document is already reviewed in Code-2, subsequent submission due to non-incorporation of comments shall not be accounted for any contractual commitment of review period from OWNER /CONSULTANT. EPC CONTRACTOR is expected to comply with OWNER /CONSULTANT's comments in the next revision after Code-2 and is required to submit a compliance report accordingly

2.4.15 Deviation permit, submitted for seeking deviation in vendor document management system, shall be separately identified and shall not be considered as a document for timely approval/review.

2.4.16 When OWNER/CONSULTANT deploys engineers at the EPC CONTRACTOR'S work center following shall be satisfied:

- Review is limited to identified long delivery/schedule critical items only.
- Readiness of documents/drawings shall be ensured by the EPC CONTRACTOR.
- Presence of lead engineers of all disciplines of the EPC CONTRACTOR.

2.4.17 If OWNER/CONSULTANT highlights any necessary rectifications required in the construction at the time of Technical Review/Audit, construction executed based on record category drawings not complying with Bid requirement, EPC CONTRACTOR shall rectify without any impact of time and cost to Owner.

2.4.18 EPC CONTRACTOR shall submit designs drawings for review only after the corresponding GA/Equipment datasheets etc. have been coordinated in his office and reviewed by OWNER/CONSULTANT engineers at least in Code-2. Such OWNER/CONSULTANT reviewed drawings shall be furnished along with drawings/designs for timely review.

2.4.19 EPC CONTRACTOR shall open an engineering office in India for speedy document submission and to help faster review of the drawings & documents.

2.5 Approved for Construction Drawings

Drawings reviewed under Code1 & Code2 required for execution at site shall be decided by EPC CONTRACTOR and copies need to be sent to OWNER /CONSULTANT (RCM), EPC CONTRACTOR'S RCM and BPREP (site).

- "**Approved for Construction**" stamped/sticker drawings shall be issued by EPC CONTRACTOR for execution.

- "**Approved for Construction"** stamped/sticker shall be done separately on the reviewed print and not on the Title block.

- Without changing Revision **Number**, EPC CONTRACTOR to arrange adequate number of prints of documents and drawings to EPC CONTRACTOR'S RCM, OWNER/CONSULTANT RCM and BPREP (site) with transmittal.

- Copies of only reviewed or final documents like design calculations, design basis etc. shall be sent to OWNER /CONSULTANT site for records.

- Copy of such transmittal shall be sent to OWNER /CONSULTANT (HO) & BPREP (HO) for records.

2.6 Critical Drawing/documents shall be reviewed by Licensor during the course of Project execution, list of Licensor mandatory review document is enclosed elsewhere in the contract.

2.7 Mandatory compliance to the smart engineering activities at EPC Contractor's end

2.7.1 Plant Breakdown Structure (PBS) supplied by EIL to be adhered to. The SEED file and Plant Breakdown Structure (PBS) shall be provided by consultant to the successful EPC Contractor which shall be utilized by the EPC Contractor for their smart integrated engineering activities without any deviation. For any deviation in this regard prior approval need to be taken by EPC Contractor from EIL.

2.7.2 For residual engineering (process), work share to be followed. In case any new symbol is required, same shall be obtained from/ authorized by EIL.

2.7.3 All P&IDs need to be smartly developed. All the constituents of P&ID need to be intelligently mapped with database/database driven. There shall not be any graphics/symbols/texts in the smart P&IDs. There shall not be any dummy graphics/symbols/texts in main body of the P&ID.

2.7.4 3D Modeling for Piping, Equipment, Instruments & Electrical need to be database driven. Dummy graphics need to be avoided. Quality check & data connectivity shall be ensured at EPC Contractor's end before submitting the data files/documents/3D Model to the Consultant.

2.7.5 All the applicable deliverables shall be extracted from 3D model without any manual rework done thereafter. This is to maintain the consistency between 3D model and extracted deliverables.

2.7.6 Deliverables from 3D model shall be extracted only on conforming the alignment of interfaces with client model and clash free design.

C 2.7.8 For consolidation of engineering data, critical attribute metadata excel file to be filled and submitted by vendor. Template will be provided during detailed engineering.

2.8 Digital handover of Engineering Information

Smart Integrated engineering shall be utilized to carry out engineering activities. Intelligent Systems shall be used for the management of P&ID, Equipment layout, 3D Model, Piping, Electrical and Instrumentation design & deliverables including P&IDs, Reports, MTO, procurement etc.

The data in each such intelligent system, including the 3D Model and Intelligent P&ID's to be submitted by the EPC Contractor in a predefined Software version/format, as tabulated below.

The same shall be submitted by the respective LSTK vendor/equipment suppliers strictly without any deviation.

Software versions/Format Requirements

The definition is in general terms containing (native (N), image (I), portable document format (D)) the formats in which EPC Contractor shall provide electronic versions of Documents. Acceptable applications for each format type are listed in the table below.

Data/Document Types	Authoring Software*	Version
2D CAD	S3D, AutoCAD	*/2018
Intelligent P&IDs	SPID	*
Instt. Index, Datasheet etc.	SI	*
Electrical load list/Single line diagram/Interconnection details/Cable Schedule	SEL	*
3D Model	S3D#	*
2D Documents from the 3D model	S3D#	*
Text Documents/Reports	MS Word 2013 or as agreed with Company	*
Datasheets/Lists	MS Excel 2013 or Adobe Acrobat as agreed with Company	*
Email	Rich Text Format	
Schedules	Primavera	*
Organization Charts/diagrams	Visio 2013, Microsoft power point or as agreed with Company	
Portable Document Format Files	PDF files shall always be directly generated from the authoring application. Scanned documents/Images which are converted to Adobe Acrobat format do not qualify as Portable Document Format files and shall be treated as image files for the purpose of format compliance.	

*Version shall be finalized during KOM.

In case documentation submitted is of authoring software mentioned below, the data has to be submitted comprehensively including native files, databases, catalogs etc., as detailed here.

SMART 3D[#]	Project DBs in oracle/sql** (version shall be compatible with latest version of SMART 3D) along with Reference project for Catalogues, Standards, customization develop for the job etc.
INTERGRAPH SMART P&ID	SPID Project Backup along with deliverables extracted from SPID (P&ID, PDS, Line list) and database in oracle/sql** (version shall be compatible with latest version of SMART PID)
AUTOCAD	DWG/DXF files
SMART Instrumentation	SPI Project Backup (DWG + Datasheets + Tags & Attributes in excel format) and database in oracle/sql** (version shall be compatible with latest version of SMART Instrumentation)
SMART Electrical	SE Project Backup (DWG + Tags & Attributes in excel format) and database in oracle/sql** (version shall be compatible with latest version of SMART Electrical)

**Database (oracle/sql) and Version shall be finalized during KOM.

[#] It is suggestive to use the defined 3D modelling platform for seamless integration and data exchange with smart authoring tools (SPID, SPI & SEL) and further downstream correlation with defined document management system for smart engineering and digital handover. However, if EPC Contractor choose to use any other 3D modelling software, they can do so but they need to ensure and demonstrate the capabilities (within 45 days after Kick off meeting) of converting their model into S3D format, fulfilling below project requirements, before starting the modelling activities.

- Following same PBS as being defined by consultant.
- 3D model capable of generating isometrics, GAD, MTO etc, shall have consistent and correlated data with other smart authoring tools of P&ID, instrumentation and electrical design.
- The converted 3D model data shall also be consolidated and correlated with data and document in client document management system and thus there should not be any lack of features/ data output in the converted model with respect to the model being made in S3D originally.
- Any other functionality as required.

Approval for initiation of modelling activities will be provided once the above-mentioned capabilities is fulfilled and successfully demonstrated to Consultant/Client. Also, when bidder is delivering the 3D model at any stage of the project, they have to convert all the files/database etc. to S3D format meeting above stated requirement. Validation and correctness of converted model shall be ensured by bidder before submitting the model to consultant/client.

No model review shall be done without submission of 3D model file/database in S3D format and subsequent acceptance by consultant/client.

2.9 Real Time Tracking of Major Shipments for BPREP Project and Data Sharing for Use on BPREP Control Tower

2.9.1 General Requirements

The EPC Contractor (directly and/or through their transport agency) shall provide real-time tracking information for all consignments as per the following:

1. Tracking information of all shipments through all modes of transport vs. Air, Land and Sea
2. GPS tracking for all shipments exceeding INR 10 lakhs in value
3. Electronic sharing of GPS tracking data (as applicable) and consignment tracking data (through Transport Agency's Transport Management System) via REST API and on web portal of EPC Contractor or transport agency, including depiction of location of consignments on map where GPS tracking is applicable
4. Tracking details for both international and domestic shipments.

For International Shipments mandatory vessel tracking through AIS (Automatic Identification System)

2.9.2 Mandatory Tracking Information

The EPC Contractor must provide the following information for each consignment:

1. Unique consignment identifier
2. Real-time GPS coordinates for in-transit shipments
3. Scheduled, Estimated and actual departure times from point of origin
4. Scheduled, Estimated and actual arrival times at destination
5. Current location and status updates on a daily basis (GPS Status updates shall be live)
6. Total Distance, Cumulative Actual Distance Travelled, Daily Distance Travelled to be updated on Daily basis.
7. Any deviation from planned route or schedule
8. Detailed consignment route details with GPS coordinates for key touchpoints like ports, terminals and warehouses.

2.9.3 Data Sharing Protocol

The EPC Contractor shall:

1. Provide access credentials for their tracking platform as applicable
2. Share tracking data in real-time for GPS tracking and daily basis
3. Provide notification of any tracking system failures/ downtime or data gaps

2.9.4 Security and Confidentiality

1. All tracking data shall be treated as confidential information
2. Data transmission must use secure protocols
3. EPC Contractor shall comply with relevant data protection regulations

3.0 Project Monitoring and Reporting for BPREP Project and Data Sharing for Use on BPREP Control Tower

3.0.1 Client is deploying a Project Monitoring System and Control Tower for the project. The EPC Contractor shall have the following obligations wrt Project Planning, Scheduling

and Monitoring. This will be read in conjunction with project management clauses specified elsewhere in the Tender/MR.

3.0.2 The EPC Contractor shall submit a comprehensive monthly progress report via the PMIS, which will include the following:

1. Executive Summary: A high-level overview of the reporting period's progress, summarizing key accomplishments and major issues encountered.

2. Progress Monitoring: Progress Monitoring/ Earned Value Management (Planned vs Actual) at project and Functional Level based on underling Deliverable List/DCI, Sub-ordering/ Material Control Index (MCI), Manufacturing Milestones and actual progress against planned schedules.

3. Project Schedule: EPC Contractor shall submit the Critical Path Method Schedule (CPM) Project Scheule in Primavera P6 or MS Project Format on a monthly basis.

4. Areas of Concern: A detailed description of any issues or risks impacting project timelines, Engineering, Manufacturing, or Sub-ordering activities. The EPC Contractor must identify bottlenecks, supply chain delays, and potential risks that may affect overall project progress.

5. Engineering Status: Detailed progress reports on engineering tasks, including design, technical drawings, and any engineering-related milestones, document approval status, pending approvals, revisions, or rejections etc. Any delays or issues affecting these deliverables must be clearly reported. EIL VDMS data shall may be available to EPC Contractor for reference.

6. Sub-ordering Status (MCI): A summary of all sub-ordering activities, including key milestones, supplier performance, and delivery timelines. Any delays or issues affecting suborders must be clearly outlined.

7. Manufacturing Status: A detailed update on the manufacturing process, including the production schedule, quality checks, and any deviations from planned timelines.

8. Dispatch Status: Detailed status of items dispatched, Packing Lists, LR Details, Transporter Details, Tracking Details etc.

3.0.3 Data Integration: The EPC Contractor shall ensure that all required data, including schedules, deliverables, and KPI inputs, are entered (manual entry, predefined templates) accurately into the PMIS system. EPC Contractor will be provided access to the PMIS System. The EPC Contractor is responsible for ensuring data integrity and timely submission.

3.0.4 Compliance with Workflows: The EPC Contractor must adhere to the defined workflows in the PMIS system for report submission, review, and approval. The EPC Contractor's reports will undergo review at multiple levels and the EPC Contractor shall address any feedback or corrections promptly.

3.0.5 Earned Value Management (EVM): The EPC Contractor is responsible for providing inputs that align with the Earned Value Management methodology, including schedule and cost data, weighted WBS, and progress updates, which contribute to the generation of project S-curves and EVM reports.

3.0.6 The reports will be submitted in PMIS predefined templates, reviewed through the PMIS workflows, and updated in the system on a monthly basis. The EPC Contractor shall

ensure all data is accurate and up to date to allow for timely review and integration into the overall project progress monitoring system.

3.0.7 Failure to provide data/ info on timely basis may be considered a breach of contract.

3.0.8 Contractor shall comply with cybersecurity guidelines/advisories/acceptable use policy issued by BPCL/EIL.

3.0.9 In case, any of the systems are not deployed, or are stopped during the course of the contract; executing, reporting and monitoring of the work will continue through traditional methods, other platforms as directed by the Engineer-in-Charge.

3.0.10 Non availability of platforms will not be a reason for seeking time extension, change orders pertaining to time and/ or cost.

Project	Overall Project Management as MPMC and PMC/EPCM Services for Ethylene Cracker Unit and U&O for BPREP	**Client**	BPCL		
Unit	Bulk Procurement	**Location**	Bina, Madhya Pradesh	**Job No.**	B957	**Unit No.**	000

PURCHASER'S DATA

A	**Site Conditions**		
1	Maximum Ambient Temperature	°C	48
2	Minimum Ambient Temperature	°C	1.1
3	Design Ambient Temperature	°C	45
4	Relative Humidity	%	86
5	Altitude Above MSL	m	<1000
6	Environment		Hot, humid & corrosive
B	**Operating Conditions**		
1	System Voltage		220 +/- 10% kV ± TP %
2	Frequency		50 Hz ± 3 %
3	Number of Phases		Three
4	System Fault Level	kA(for 1 sec)	50KA for 3 Sec
5	System Earthing		Solidly Earthed
6	Auxilliary Power Suppy		
i.	- for space heaters,cubicle lamps etc		240 V AC TPN 10 %
ii	- for protection metering and control		110 V DC- -10/+ 10 %
iii	- circuit breaker spring charging motor		110 V DC- 10/+ 10 %
iv	- Motor drive for disconnectors and earth switches		110 V DC- 10/+ 10 %
v	- high speed earth switch spring charging motor		110 V DC- 10/+ 10 %
vi	- gas handling and filling unit / cart		415 V AC TPN ± 10%
7	Installation		
i.	GIS		Airconditioned
ii	LCC		Airconditioned
iii	CRP		Airconditioned
C	**Electrical Data**		
1	Bus Bar System		Double
2	Bus bar rated current	A	2000
3	1 sec short circuit withstand capacity	kA	50
4	Rated peak withstand current	kA	135
5	Internal arc rating		50 kA for 0.3
6	Circuit Breaker		
i	Type of circuit breaker		SF6
ii	Duty cycle of Circuit Breaker		0-3 min-co-3 min-co
iii	Breaking capacity	kA	50
iv	Making capacity	kA	135
v	CB Operating Mechanism		Spring Charged or Electro Hydraulic 6-51-0066
vi	Shunt trip coil-1	V DC	110V DC
	Shunt trip coil -2 (see note-1)	V AC UPS	230V AC (UPS)
vii	Mechanical indicator for breaker status		Required
viii	Pre-insertion resistor		Not Required
7	Dissconnector & Earthing Switch		
i	Operating Machanism		Motorised
ii	Mechanical indicator for disconnector & earthswitch status		Required
iii	Viewing windows for disconnector and earthswitch		Required
iv	Mechanical interlock for disconnector & earthswitch		Required
v	Electrical interlock with associated circuit breaker		Required
8	High speed make-proof Earthing switch		

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Unit	Bulk Procurement	**Location**	Bina, Madhya Pradesh	**Job No.**	B957

Unit No. 000

i	Operating Machanism		Motorised
ii	Mechanical indicator for High speed earthswitch status		Required
iii	Electrical interlock with associated circuit breaker		Required
D	**Miscellaneous**		
1	Paint Shade		RAL-7032
2	Interface with ECS		Required
3	SF6 Gas monitoring system		Required
4	SF6 Gas Handling /filling unit		Required
5	Spare SF6 gas		Required
6	Quality of spare gas	%	10% of total gas as per 6.9.4 of 6-51-0066
7	Mimic on LV compartment		Required
8	Voltage Detectors		Required

MANUFACTURER'S DATA

A	**General**		
1	Name of manufacture		
2	Place of manufacture		
3	Type designation		
4	LCC		
5	Degree of protection		
i	Gas compartment		
ii	LCC		
iii	CRP		
6	Enclosure		
7	Enclosure material		
i	Gas compartment		
ii	LCC		
iii	CRP		
9	Rated Voltage	kV	
10	1 min. power frequency withstand (rms)	kV	
11	Lighting impulse withstand voltage	kV	
12	Switching impulse withstand voltage		
13	Rated current		
i	Busbar	A	
ii	Incomers and outgoing feeders	A	
14	1 sec short ckt. withstand capacity	kA	
15	Peak dynamic withstand capacity	kA	
16	Bus bar material		
17	Main Busbar size		
18.	Bus bar size for incomers and outgoing feeders	sqmm	
19	Insulating material (busbar support)		
20	Eath busbar material / size	sqmm	
B	**SF6 Gas**		
1	Average leakage rate of SF6 gas	% / year	
2	Gas monitoring devices (density guages/pressure switch		
3	Gas handling and filling arrangement /cart		
	- maximum power requirement	kW	
4	Whether GIS are dispatched filled with SF6 gas		

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Unit	Bulk Procurement	**Location**	Bina, Madhya Pradesh	**Job No.**	B957

Unit No. 000

5	SF6 gas pressure for each gas compartment		
i	Design Pressure		
ii	Operating Pressure		
iii	Alarm Pressure		
iv	Lockout Pressure		
6	Pressure of relief device		
7	Spare gas (no. of cylinders,volume/pressure of cylinder)		
C	**Circuit Breaker**		
1	Type of circuit breaker		SF6
2	Make		
3	Place of manufacture		
4	Type designation		
5	Encloser		
6	Number of poles per phase		
7	Number of interrupting chambers per pole		
8	Number of trip coils		
9	Rated continuous current for I/C and O/G fdrs		
10	Duty cycle		
11	CB Operating mechanism		
12	Short circuit withstand capacity	kA	
13	Breaking capacity	kA	
14.	Peak making capacity	kA	
15	% DC component		
16	First pole to clear factor		
17	Power required for opening	W	
18	Power required for closing	W	
19	Power required for spring charging motor	W	
20	Closing time	sec	
21	Opening time	sec	
22	Provision of manual spring charging		
23	Manual trip device		
24	Mechanical ON/OFF indicator for breaker		
25	Mechanical indication for spring status		
26	Operation counter		
27	Number of auxiliary contacts and their rating		
28	Breaker is trip free		
D	**Disconnector / Earthing switch**		
1	Make		
2	Place of manufacture		
3	Type designation		
4	Rated continuous current of dissconnector/earth switch for I/C and O/G fdr		
5	Short circuit withstand capacity		
6	Short circuit making capacity of high speed earth switch		
7	Operating mechanism		
8	Type of motor drive		

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9	Number of auxiliary contacts and their rating			
10	Mechanical ON/OFF indicator			
11	Manual operation handle			
12	Manual spring charging			
13	Power required for spring charging motor			
E	**Instrument Transformers**			
1	Current Transformer			
i	Make			
ii	Place of manufacture			
iii	Type designation			
iv	CT ratio,accuracy & VA burden			
v	Knee point voltage / secondary voltage,accuracy & VA burden			
2	Voltage Transformer			
i	Make			
ii	Place of manufacture			
iii	Type designation			
iv	Primary Voltage / Secondary Voltage ,accuracy & VA burden			
F	**Surge Arrestors**			
1	Make			
2	Type designation			
3	Place of manufacture			
4	Rated Voltage	kV		
5	MCOV(Max. Continuous voltage, accuracy & VA burden	kV		
6	Line discharge class	kA		
7	Nominal discharge current	kA		
8	High current withstand capacity	kA		
9	Temporary overvoltage for 1 sec			
10	Temporary overvoltage for 10 sec			
G	**Mechanical**			
1	Feeder / Bay			
	Max. overall weight			
	overall Dimensions(Width X Depth X Height)			
2	LCC			
	overall Dimensions(Width X Depth X Height)			
3	CRP			
	overall Dimensions(Width X Depth X Height)			
4.	Largest shipping section			
	Max overall weight			
	overall Dimensions(Width X Depth X Height)			
5	Gas handling & filling plant / service cart			
	Overall dimensions(Width X Depth X Height)			
6	Recommended clearances			
	GIS (Front / rear / above)	mm		
	LCC (Front / rear / above)	mm		
	CRP (Front / rear / above)	mm		

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7	Shock loading on foundation	
8	Requirement of EOT crane for GIS	
9	Capacity of EOT crane required	
10	Clear height recommended for EOT crane	
11	Dispatch for each feeder / bay	
H	**Copies of following test certificates enclo**	
	For each type of offered feeder/bay with circuit breaker, dissconnector and earthswitch	
1	Short circuit tests(peak and 1 sec withstand)	
2	Making and breaking tests	
3	Temperature rise test	
4	Internal arc test	
5.	Dielectric tests	
6	Operation and mechanical endurance tests	

Notes

1 Disconnector class shall be M2

2 Rated line charging interrupting current of breaker shall be as per IEC on 21 kM of transmission Over-head Line.

3 Following equipments shall be supplied along with GIS:
- a) SF6 Gas Leakage Detector
- b) Gas Filling and Evacuation Cart
- c) SF6 Gas Analyser
- d) Online Partial Discharge (PD) Monitoring System along with all software and hardware as required
- e) Online SF6 Gas filling system

4 Although the equipment shall be installed in Air Conditioned GIS/ Switchgear hall, but same shall be suitable for installation and satisfactory operation in a non air conditioned, tropical, humid and corrosive environment

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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)

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