Project: 220/220 kV GIS SUB STATION AT ERSAMA, PARADEEP, ODISHA
Customer: Odisha Power Transmission Corporation Limited (OPTCL)
Ref. No. OPTCL/GIS/PQR REV 00

Technical Qualifying Requirements for 220kV Gas Insulated Switchgear (GIS)

For the purpose of qualification of the bidders, experience & type test validity period shall be reckoned as on 11-February-2022 unless otherwise specified.

ROUTE - A

I. The bidder/ GIS manufacturer should have established manufacturing and testing facility in INDIA for **220kV or higher voltage level (50kA or above short circuit level)** SF6 Gas Insulated Switchgear (GIS) equipment and should manufacture and supply the GIS equipment from its manufacturing base in INDIA.

II. The bidder/ GIS manufacturer must have installed at least two (02) nos. of 220KV SF6 Gas Insulated switchgear substations with minimum **3 bays** in each substation in India and the same must be in satisfactory operation for a minimum period of **Two (02) years**, reckoned from the **date of bid opening (i.e. 11.02.2022).**

III. The bidder/ GIS manufacturer shall have to furnish type test report of SF6 gas insulated sub-station equipment duly designed, manufactured, tested (as per IEC standard) which, shall not be older than **Ten (10)** years, **as on date of bid opening (i.e. 11.02.2022).** The Type Test Reports shall be of the Same type and model of GIS equipment as offered for the project **(i.e. 220 kV & 50KA rating)**.

IV. Type Test should have been **preferably** conducted at any of the following internationally reputed testing laboratories like (a) KEMA (Holland) (b) CESI (Italy) (c) CERDA (France) (d) PHELA (Germany) (e) KERI (South Korea) (f) CPRI (India) (g) ERDA (India) (h) JSTC (Japan) (i) Intertek (ASTA), U.K for STL (j) VEIKI, (Hungary).

Requisite documents for ROUTE - A

SN	Documents/ proof required	Relevant Clause
1	Proof of established manufacturing & testing facility of 220kV or higher voltage level (50kA or above short circuit level) SF6 Gas Insulated Switchgear (GIS) equipment in INDIA	Clause no. I
2	**Performance Certificate** issued to bidder by End customer/ Owner without any adverse remark(s),	Clause no. II
3	Valid type test reports of same type & model of GIS equipment.	Clause no. III & IV

OR

Project: 220/220 kV GIS SUB STATION AT ERSAMA, PARADEEP, ODISHA
Customer: Odisha Power Transmission Corporation Limited (OPTCL)
Ref. No. OPTCL/GIS/PQR REV 00

Technical Qualifying Requirements for 220kV Gas Insulated Switchgear (GIS)

ROUTE - B

I. The bidder/ GIS manufacturer should have established manufacturing and testing facility in INDIA for **220kV or higher voltage level (50kA or above short circuit level)** SF6 Gas Insulated Switchgear (GIS) equipment and should manufacture and supply the GIS equipment from its manufacturing base in INDIA.

II. The bidder/ GIS manufacturer who on its own does not meet the requirement as specified in clause no. II & III of Route-A mentioned above, but has established production line in India for manufacturing of SF6 Gas Insulated Switchgear (GIS) based on technological support of its parent company (Holding company) can also be considered provided that they (Parent/ **Holding** company) have manufactured, type tested (as per IEC standard) of such equipment & with the following stipulations,

a) The bidder's/ GIS manufacturer's parent company (Holding company) has manufactured, type tested (as per IEC standard).

b) The parent company (Holding company) meets qualifying requirements stipulated under clause no. III of Route-A mentioned above.

c) The Bidder/ GIS manufacturer furnishes followings,

1. An undertaking (jointly with the parent company (Holding company) to guarantee quality, timely supply, performance and warranty obligations for a period of five (05) years as specified for the equipment(s) in the parent company's (Holding company) letter head, which is required to be submitted at the time of signing/ execution of the contract agreement.
2. Such manufacturer should submit valid collaboration agreement for technology transfer/ license to design, manufacture, test and supply GIS equipment(s) in India at the time of bidding.
3. A confirmation letter from the Collaborator(s) stating that the Collaborator(s) shall furnish performance guarantee for an amount of 10% of the Taxable Value of such equipment(s). This performance guarantee shall be in addition to Contract Performance Guarantee to be submitted by the bidder.

d) The bidder/ manufacturer shall submit a list of past supply experience of the parent company (Holding company) **for last Five (05) years** from the date 11.02.2022 & End customer/ Owner's certificate regarding the satisfactory operation/ performance for **at least two (02) years** from the date of techno commercial bid opening i.e. 11.02.2022 of 220kV voltage class GIS equipment in India/ abroad.

Requisite documents for ROUTE - B

SN	Documents/ proof required	Relevant Clause
1	Proof of established manufacturing & testing facility of 220kV or higher voltage level (50kA or above short circuit level) SF6 Gas Insulated Switchgear (GIS) equipment in INDIA	Clause no. I

Project: 220/220 kV GIS SUB STATION AT ERSAMA, PARADEEP, ODISHA
Customer: Odisha Power Transmission Corporation Limited (OPTCL)
Ref. No. OPTCL/GIS/PQR REV 00

Technical Qualifying Requirements for 220kV Gas Insulated Switchgear (GIS)

2	Valid type test reports of same type & model of GIS equipment.	Clause no. II b)
3	An undertaking by bidder (jointly with the parent company (Holding company) to guarantee quality, timely supply, performance and warranty obligations for a period of five (05) years as specified for the equipment(s) in the parent company's (Holding company) letter head	Clause no. II c), 1
4	Valid collaboration agreement between Parent/ Holding company & Bidder, for technology transfer/ license to design, manufacture, test and supply GIS equipment(s) in India at the time of bidding.	Clause no. II c), 2
5	A confirmation letter from the Collaborator(s) stating that the collaborator(s) shall furnish performance guarantee for an amount of 10% of the taxable value of such equipment(s).	Clause no. II c), 3
6	Performance certificate of GIS, issued to bidder's parent company (Holding company) by end customer without any adverse remark(s), consisting the proof of design, manufacture, supply and commissioning in India/ abroad.	Clause no. II d)

Alidish 24/02/23
PREPARED BY

24/02/23
REVIEWED BY

24.2.23
APPROVED BY

BHARAT HEAVY ELECTRICALS LIMITED

TRANSMISSION BUSINESS ENGINEERING MANAGEMENT

NOIDA

DOCUMENT NO.	TB-420-316-002	REV 00	Prepared	Checked	Approved
TYPE OF DOC.	TECHNICAL SPECFICATION	NAME	AK	DKS	VK
Title: 220kV Gas Insulated Switchgear & its accessories		SIGN			
		DATE	22.02.23	24.02.23	
		GROUP	TBEM		
		WO No.	-		
CUSTOMER	ODISHA POWER TRANSMISSION CORPORATION LIMITED				
PROJECT	400/220 kV GIS SUB STATION AT ERSAMA, PARADEEP, ODISHA				

Contents

Section No.	Description	No of Pages
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Section-2	Equipment Specification under scope of supplies	47
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Section-4	Annexures	13
	Annexure-A: Compliance Certificate to Technical Specification	01
	Annexure-B: Deviation/ Change Request to Technical Specification	01
	Annexure-C: Guaranteed Technical Particulars	05
	Annexure-D: Technical Checklist	04

Remarks: Bidder to note that data and details of guaranteed technical particulars shall not be reviewed during technical evaluation/ scrutiny, hence compliance of guaranteed technical particulars in line with technical specification shall be bidder's responsibility.

Rev. No.	Date	Altered	Checked	Approved	
Distribution				To	
				Copies	

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 duly signed and sealed & Annexure- B duly filled, signed and sealed.	Confirmed

Note: Any bidder not meeting the above requirement shall be liable for non-evaluation.

The above checklist is reviewed and verified for,

NIT Reference No.:

Name of Bidder:

Name of Project: **OPTCL, Ersama, Paradeep, Odisha**

Date: Bidder's Stamp & Signature

Contents

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

1. Scope

This technical specification covers the requirements of design, manufacture, inspection and testing at manufacturer's works, proper packing and delivery to project site, supervision of unloading and verification of material at site, supervision of installation, site testing and commissioning along with necessary equipment, training of BHEL/ OPTCL personnel for 220kV Gas Insulated Switchgear as per the specification complete in all respect for efficient & trouble free operation mentioned under this specification with all auxiliaries, accessories and spare parts.

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 only and site testing and commissioning along with necessary equipment, training, insulation coordination studies, supply of all mandatory spares, commissioning spares, special tools and tackles as defined in the equipment data sheet, drawings, standard specifications, standards and BOQ etc. attached or referred with technical specification.

This section covers the specific technical requirements of 220kV Gas Insulated Switchgear. This constitutes minimum technical parameters for the above item as specified by OPTCL. The offered 220kV Gas Insulated Switchgear 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/ Service
Section-3 : Project Details & General Technical Requirements (For all Equipment under the Project)
Section-4 : Annexures
Annexure-A: Compliance Certificate to Technical Specification
Annexure-B: Deviation/ Change Request to Technical Specification
Annexure-C: Guaranteed Technical Particulars
Annexure D- Technical Checklist

The following order of priority shall be followed. In case of conflict between requirements specified in various documents, the more stringent one shall be followed. BHEL/ OPTCL 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 Requirements of other statutory bodies as applicable, e.g. CEA etc.
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/ OPTCL will resolve listed conflicts prior to award. In case of ambiguity, bidder shall inform BHEL/ OPTCL of their interpretation. In case bidder fails to convey the same prior to award, BHEL/ OPTCL decision on interpretation shall be considered final if need arises during the execution. No additional cost or extra time on account of conflicts/ ambiguities/ deviations shall be admissible.

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

The equipment (**220kV Gas Insulated Switchgear & its accessories**) is required for the following project:

Name of the Customer	:	**Odisha Power Transmission Corporation Limited (OPTCL)**
Name of Main Contractor	:	**Bharat Heavy Electricals Limited**
Name of the Project	:	**400/220 kV GIS SUB STATION AT ERSAMA, PARADEEP, ODISHA**

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

2. Codes & Standards

The equipment (**220kV Gas Insulated Switchgear & its accessories**) shall comply with the latest edition of the following standards as applicable,

IEC 56-1/6	AC High Voltage circuit breaker
IEC 68-3	Seismic test methods for equipments
IEC 129	Alternating Current Dis-connectors & Earthing Switches
IEC 60137	Insulated bushings for alternating voltages above 1000 V
IEC 62271-1	High voltage switchgear and control gear Part 1: Common clauses for high voltage Switchgear and control-gear standards
IEC 62271-100	High voltage switchgear and control gear Part 100: High voltage alternating current Circuit breakers
IEC 62271-101	High voltage switchgear and control gear Part 101: Synthetic testing disconnections, earthing switches
IEC 62271-102	High voltage switchgear and control gear Part 102: Alternating current disconnections (isolators) and earthing switches
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 62271-303	High voltage switchgear and control gear- Gas Insulated metal-enclosed switchgear for rated voltages above 52KV
IEC 61000	Electromagnetic compatibility (EMC)
IEC 60060	High voltage test techniques
IEC 60071	Insulation coordination
IEC 60255	Electrical relays
IEC 60265	High voltage switches
IEC 60270	High voltage test techniques- Partial discharge measurements
IEC 60376	Specification and acceptance of new sulphur hexafluoride
IEC 60480	Guide to checking of sulphur hexafluoride taken from electrical equipment
IEC 60529	Degrees of protection provided by enclosures (IP code)
IEC 60815	Guide for the selection of insulators in respect of polluted conditions
IEC 61869	Instrument transformers
IEC 60044-1	Current transformers
IEC 60044-2	Voltage transformers
IEC 60099-1/4	Non-linear resistor type arresters for AC systems
IEC 61439-1	Low voltage switchgear and control gear assemblies Part1- General rules EMC
IEEE 80-2000/ IEC 60364/ 60479/ 60621	Standards for Substation grounding
CIGRE-44	Earthing of GIS- an application guide

The equipment may conform to the standards of the country of manufacture, provided these standards are based on, or equivalent or better to the above referred standards. The bidder proposing any other standards than the above referred standards must specifically indicate the standards to which the switchgear conforms. The bidder is required to furnish the English version copy of all the standards.

3. Specific Technical Requirements

Specific technical requirements for the equipment (**220kV Gas Insulated Switchgear & its accessories**) shall be as follows,

Sl. No.	Description	Technical Parameters
1.	Type of GIS	Indoor type, metal enclosed, SF6 gas insulated switchgear (Single Phase segregated)
2.	Location	Place: Ersama Distt: Paradeep State: Odisha
3.	Maximum ambient temperature	50^0C
4.	Minimum ambient temperature	5^0C
5.	Design ambient temperature	50^0C
6.	Maximum Relative humidity	100%

7.	Average Relative humidity	85%
8.	Nominal voltage class	220 kV
9.	Rated lightning impulse withstand voltage -Phase to earth -Across open contacts	 1050kVpeak 1050kVpeak
10.	Power frequency voltage (1 minute) -Phase to earth -Across open contacts	 460kVrms 460kVrms
11.	Rated frequency	50 Hz
12.	Number of phases	3 nos.
13.	Rated normal current	3150Arms
14.	Rated short circuit withstand current	50kArms Duration: 3 sec. for Bus Bar, GIB & CB and 1 sec. for balance equipment
15.	Operating mechanism of circuit breaker	Spring operated
16.	Total number of interrupting chambers per phase of 220kV Circuit breaker	One no.
17.	Average leakage rate of SF_6 gas from the GIS equipment's	Less than 0.5% per year
18.	Partial discharge level for complete bay	<5pC
19.	Enclosure	Aluminium Alloy
20.	Minimum total creepage distance for outdoor equipment	7595mm (31mm/kV)
21.	3 phase AC power supply	415V ± 10%, 50 Hz ± 5%, 3-phase 4 wire
22.	1 phase AC power supply	240V ± 10%, 50 Hz ± 5%, 1-phase , 2 wire
23.	DC power supply	220V + 10% to -15%, 2-wire ungrounded

Notes:

1. 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.
2. Thermal calculations shall be based on the climatic conditions as per technical specification.
3. Bidder shall offer their latest type tested compact model to accommodate in the specified & allocated space. In case, bidder fails to meet above requirement, its technical offer is liable for non-evaluation.
4. Bidder shall conduct insulation co-ordination & very fast transient overvoltage (VFTO) studies in line with IEC 60071 for establishing suitability of surge arrester rating, and any other

technical requirement for successful operation of GIS. Prices if VFTO study shall be included in the price quoted for Insulation Co-ordination Study.

5. 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.
6. Bidder shall submit 3D model (surface model/ light weight model) compatible with Primtech/ any other 3D software for complete GIS and its accessories.
7. GIS building shall have EOT (Electric overhead travel) crane of capacity of min. 5T safe working load and minimum height of crane shall be 8.0meters or as per actual requirement, whichever is higher. The EOT crane will be provided by BHEL, however, bidder shall provide all other technical requirements for EOT crane for suitability of crane for installation and maintenance of GIS including EOT crane capacity calculations etc.
8. Any change in bay pitch (distance between bays): In a case where shifting of GIS bays shall be called for by BHEL (during contract stage) due to layout requirement /cost optimization / revision / change in civil architectural requirement or due to expansion joint requirement in the GIS building, Bidder to incorporate the same with full compliance of technical requirement. Payment equivalent under the relevant item of BPS / BOQ item shall be operated for additional length of Main Bus, subject to such shifting is not attributed to bidder.
9. 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.
10. All supporting structures including foundation bolts/ fixing bolts/ embedded plate/ chemical anchor bolts and hardware etc. required for fixing and erection of GIS and bus duct shall be in bidder's scope.
11. Fixing and erection of GIB duct in GIS building and outside of GIS building including foundation/ fixing bolts/ embedded plate shall be in bidder scope of supply.
12. All hardware and structure required for fixing and erection of GIS on GIS floor including foundation bolts/ fixing bolts/ embedded plate shall be in bidder scope of supply.
13. All supporting structures including foundation bolts/ fixing bolts/ embedded plate/ chemical anchor bolts and hardware etc. for SF6 to air bushing shall be in Bidders' scope.
14. Bidder shall ensure installation/ supervision of installation, testing and commissioning any subsystem of GIS, including online gas monitoring/ partial discharge system etc.
15. The quantification including details, supply and supervision of installation of interconnecting cables including cable tags, glands, ferrules, lugs etc. between GIS to LCC and between LCC to LCC shall be in the scope of bidder.
16. 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.
17. 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.
18. Each end of the main bus bars of GIS shall be designed for convenient future extension of the switchgear and related technical details shall be provided by bidder to meet the requirements of other make /GIS supplier.

19. Ersama project shall have separate 400kV & 220kV GIS. Only 220kV GIS shall be in bidder's scope and 400kV GIS shall be supplied by BHEL/ other vendor. Both GIS will be indoor type and will be housed in separate GIS buildings. Online Partial Discharge Monitoring System (PDM), adopting UHF technique, will be installed for both the ratings of GIS. Supply & installation of Online PD Monitoring system will be BHEL/ other vendor's scope, however bidder to provide PD sensors on the 220kV GIS & its associated GIB ducts and Voltage Transformers.
20. 220kV GIS shall have in Built UHF Based Sensors for On-Line PD Measurement for ready Connection and interfacing with BHEL/ other vendor supplied continuous Online PD Measurement System. These sensors shall be in bidder's scope of supply and the number and location of PD Sensors built in the GIS Equipment shall be supported with the necessary documentation for confirming the sufficiency/ adequacy of the PD sensors provided, considering the coverage of all portions of the GIS equipment.
21. All steel structure members shall be hot-dip galvanized after fabrication. **Unless otherwise specified, minimum mass of zinc coating for Galvanizing for angles/ channels/ plates of more than 5mm thickness shall be 910 gm/square meter & 610gm/square meter for less than 5mm thickness**. 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.

4. Other General Requirements

The other general requirements for the equipment (**220kV Gas Insulated Switchgear & its accessories**) shall be as follows,

1. Schedule
   - Bidder shall submit detailed activity schedule for engineering approval, site installation, testing and commissioning activities.
   - In addition to this, packing of GIS & its accessories shall be suitable for long term storage without any deterioration in quality and performance (min. 2 years, if required).
2. Open/ closed store
   - Open/ closed store area shall be provided by BHEL, 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 with type of storage.
   - In addition to this, bidder shall also provide their standard recommendations for precautions to be taken during unloading and storage etc. for approval of BHEL/ OPTCL.
   - Supervision of unloading of materials at site, supervision for storage in open/ closed store as per requirement shall be in bidder's scope.
   - During storage of materials in BHEL provided open/ closed store, watch and ward shall be provided by BHEL.
3. Office facility at project site
   - Office facilities including sitting arrangement, stationary, printer etc. for OEM/ bidder's staff at project site shall be in BHEL scope.

- Arrangement of drinking water and electrical supply for official work shall be provided by BHEL, however, personal protective equipment for bidder/ OEM's staff /workers shall be in bidder's scope.

4. Transportation of Special Tools & Tackles, Testing Instruments
   - Transportation of special tools & tackles, testing instruments, special plant including HV test on returnable basis is deemed to be included in bidder's scope, however unloading/ loading, unpacking/ packing and shifting at working place shall be in BHEL scope.
5. Power supply for construction/ testing
   - For construction/ testing requirements, the necessary power supply at site shall be provided by BHEL at suitable point free of cost.
6. Site Installation, Testing & Commissioning
   - 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.
   - Bidder shall provide list of general tools, tackle, slings, spanners, gauges, slings and other lifting devices, drills, instruments, testing kits and appliances necessary for the complete assembly, installation, gas filling, maintenance, site testing of the GIS, however, it shall be arranged by BHEL/ its sub-contractor.
   - Bidder shall arrange all Consumables as per manufacturer requirement for successful erection, testing & commissioning.
   - HV test kit required for HV testing and partial discharge measurement shall be provided with operator along with valid calibration certificate by bidder on returnable basis. HV test kit may be brought at site multiple times as per site requirements, reasons not attributable to BHEL/ OPTCL.
   - Bidder shall depute his qualified testing & commissioning engineer at site for successful testing and commissioning of GIS system.
   - Bidder shall submit complete methodology for conduction of site tests for further approval of BHEL/ OPTCL before testing & commissioning activities.
   - GIS bays may be commissioned at different point of time depending on the site conditions and the L2 schedule for the project, and hence deployment of the resources at multiple times at site by bidder in line with actual requirement is envisaged and payment for the same shall be made to bidder, for the reasons not attributable to bidder.
7. Training of BHEL/ OPTCL personnel
   - Training of BHEL/ OPTCL personnel on 220kV GIS & its accessories shall be provided at vendor's works as well as project site. However, to & fro travelling charges, lodging and boarding charges for BHEL/ OPTCL personnel shall not be borne by bidder.
8. Earthing of GIS
   - Bidder to submit detailed calculations, sizing and layout drawings for earthing system during detailed engineering stage. Bidder to provide the bill of quantity for entire items required for the earthing of the GIS. However, supply of 40mm MS ROD, 75X10/50x6mm GI Flat & erection of earth mat shall be done by BHEL under supervision of bidder/ manufacturer as per manufacturer's design. Any other earthing material except 40mm MS Rod, 75X10/50x6mm GI Flat, if required shall be in bidder's scope of supply only & bidder shall quote price for the same against the relevant items

of price schedule.

- It is to be noted that earthing riser shall be copper flat size of 50x6mm with bi-metallic arrangement to connect from ground earth mat to enclosure of GIS equipment.
- Earthing design philosophy shall be submitted by bidder in line with customer technical specification and guidelines of IEEE Std 80, CIGRE-44 and other applicable standards to protect operating staff against any hazardous touch voltages and electro-magnetic interferences.
- If any other special earthing including high frequency earthing etc., if required shall be in bidder's scope of supply.

9. Modular Design of GIS
   - 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 sections, Gas Insulated Bus-duct, local control cubicle and all necessary components required for safe & reliable operation and maintenance.
   - Documents indicating sequence of repair work steps and description of necessary restrictions during work shall be submitted during detailed engineering stage.
   - Each bay module should be equipped with suitable arrangement for easy dismantling and refitting during maintenance without disturbing other units.
10. Future Extension of GIS
   - The GIS system shall be suitable for future extension on either end. The arrangement of gas sections or compartments shall be such as to facilitate future extension without any drilling, cutting or welding on the existing equipment. To add equipment, it shall not be necessary to move or dislocate the existing switchgear bays.
   - The 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.
   - The physical layout shall ensure free movement of the SF6 Gas Cart and easy access to all components of the GIS for maintenance purposes.
11. Service continuity requirements and sectionalization of GIS
   - The offered GIS should completely meet the requirement of modular design & sectionalization as mentioned in Section-2 of this specification.
   - The GIS equipment with the given bus switching arrangement is divided into different gas compartments. During the work such as a fault repair or major maintenance, requiring the dismantling of a gas compartment for which more than one compartment may needed to be de-gassed.
   - 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.
   - Working conditions, method statements and procedures are to be furnished by the GIS manufacturer in order to ensure equipment and operating personnel's safety and to achieve following service continuity conditions to the extent possible in line with Annexure-F of IEC 62271-203:
     a) During a fault in Circuit Breaker compartment, no bus-bar is permitted out of service during maintenance and repair / replacement.

b) During a fault in GIS compartment other than CB compartment, maximum one busbar and/or one feeder permitted out of service during maintenance and repair / replacement.

12. GIS will be placed in a non-air conditioned building during service.
13. Bidder shall check and ensure adequacy of the system protection for successful operation of GIS. After checking of system/site by bidder, GIS shall be installed and if any failure, malfunction of any part occurs after commissioning bidder shall replace the part unconditionally within 15 days. Further root cause analysis (RCA) shall be submitted and necessary changes to be done as per the RCA report wherever required.
14. No support structure shall be placed within 2 meters around the GIS building periphery.
15. All essential and desirable accessories are deemed inclusive of offer i.e. and not limited to Gas Monitoring Devices, Pressure Switches, PD sensors, Pressure relief device, insulator, expansion joint/ flexible, bellows/ compensators like lateral mounting units, Axial compensators, Parallel compensators, tolerance compensators and vibration compensators etc. complete in all respect.
16. Any Item not quoted mentioning "Not Applicable" in bid price schedule and found applicable as per technical specification and system requirement shall be supplied free of cost by bidder without any time / cost implication to BHEL /Customer.
17. Length & route of GIB in BOQ/BPS is purely indicative and same shall be finalized during detailed engineering stage. Bus duct lengths shall be taken from the end of bay equipment (VT, LA etc.) to termination equipment (SF6 to Air bushing). This includes indoor as well as outdoor portions of GIB. Tees/ bends/ elbows required for completion of gas insulated bus duct connection shall be treated as part of gas insulated bus duct only.
18. BHEL reserve rights to amend Bay sequence during contract stage, no separate claim shall be admissible in this regards.
19. Main Bus-1/2 etc. Gas Insulated Bus Bars running across the length of the switchgear to interconnect each of the bay modules (as per layout) and necessary interfaces (as applicable under the technical requirement) is deemed inclusive in the scope. The same may or may not be indicated with break-up in BOQ / BPS.

5. Bill of Quantities

1. Schedule of quantities for supply & services for the equipment (**220kV Gas Insulated Switchgear & its accessories**) shall be as per **ANNEXURE- BOQ for 220kV GIS & its Accessories**. However, any supply/ service not appearing herein but required for completeness of the work is deemed to be included in bidder's scope.
2. BHEL reserves the right for quantity variation due to any reason upto **±20% of total value** at same unit rate and terms during execution of contract. The quantity of individual items may however vary upto any extent.

6. Drawings / Documents required for Technical Clearance for Manufacturing

Drawings/ documents detailed as per **Annexure B- Details for Technical Clearance for Manufacturing** shall be used for providing technical clearance for manufacturing of the equipment (**220kV Gas Insulated Switchgear & its accessories**), which shall be used for delay analysis, if applicable by the concerned engineer.

Technical clearance for manufacturing shall be issued after approval of drawings in Category-I (approval without any comments)/ category-II (approval with comments to be incorporated) from customer/ BHEL, however it shall be sole discretion of BHEL engineering department to include/ exclude the drawing/ document earmarked for consideration for any particular Lot. In case drawing/ document are not duly stamped in category-1/ category-2 by customer, BHEL stamp in Category-1 & 2/ confirmation shall be treated final to proceed further.
Date of Submission of drawings/ documents shall be counted only from the date of submission of reasonably correct drawings/ documents.

The successful bidder shall have to extend all possible supports like timely submission/ re-submission of drawings, visit to end customer to facilitate documents approval without any commercial implications to BHEL. Acceptance of bidder's documents shall be subject to end customer/ OPTCL approval.

7. Type Testing

Bidder shall ensure that the electrical equipment (**220kV Gas Insulated Switchgear & its accessories**) being procured have valid type test certificates as specified in IEC standard 62271 - 203 & 62271-100 (amended up to date) at any NABL accredited laboratories/ any authorized testing lab in line with applicable IS/ partia IEC.

The validity of type test reports shall be as per the latest CEA guidelines (amended time to time) as on the original scheduled date bid submission for BHEL tender **(i.e. 11.02.2022)** In case, where type test certificates are older than period as per latest CEA guidelines (amended time to time), bidder/ manufacturer shall carry out the type tests prior to dispatch of equipment without any commercial implication on BHEL/ OPTCL. Further, in case, any type tests, which has not been conducted on the offered design of GIS 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 of GIS without any commercial implication on BHEL/ OPTCL.

The type tests shall be as per IEC 62271-203 and in line with section-2 and the report shall include following tests, but not limited to,
a) Test to verify the insulation level of the equipment including partial discharge test and dielectric tests on each GIS device (CB, Disconnector, and bus etc.)
(i) Lightning impulse test
(ii) Switching impulse test
(iii) One-minute power frequency test
(iv) Partial discharge test.
b) Test to prove the temperature rise of any part of the equipment and measurement of the Resistance of the main circuit.
c) Test to prove the ability of the main and the earthing circuits to carry the rated peak and the rated short time withstand current.
d) Test to verify the making and breaking capacity of circuit breaker.
e) Test to prove the satisfactory operation of switching devices i.e., circuit breaker, dis-connector, earth switch.
f) Tests to prove the strength of enclosures.

g) Test for degree of protection of the enclosure.
h) Tests to assess the effects of arcing due to an internal fault (internal arc test).
i) Gas tightness tests.
j) Type tests on Circuit breakers, dis-connectors, earth switches, surge arrestors, CT, PT etc. as per the relevant standards.
k) Tests to prove the radio interference voltage (RIV) level (if applicable).
l) Electromagnetic compatibility tests (EMC).
m) Additional tests on auxiliary and control circuits.
n) Tests on partitions.
o) Tests to prove the satisfactory operation at limit temperatures.
p) Tests to prove performance under thermal cycling and gas tightness tests on Insulators.
q) Corrosion test on earthing connections (if applicable)
r) Tests to assess the effects of arcing due to an internal fault
s) Earthquake withstand test
t) Mechanical operation test
u) Dielectric tests on auxiliary circuits
v) Tests on solid dielectric components (operating rods, spacers etc.)
w) Test on Auxiliary switches (Electrical & Mechanical Endurance, Heat run, IR & HV test)

8. Quality Plan

The successful bidder shall submit Quality Assurance Plan for **220kV Gas Insulated Switchgear & its accessories** etc. including in-process inspection methods, tests, records, etc. for BHEL/ OPTCL approval. Customer hold points will also be included in the plan, which shall be mutually agreed by the BHEL/ OPTCL. In case bidder has reference Quality Assurance Plan agreed with BHEL/ OPTCL, same shall be submitted for specific project to BHEL/ OPTCL approval. There shall be no commercial implication to BHEL/ OPTCL 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 the equipment (**220kV Gas Insulated Switchgear & its accessories**). 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 tests for the equipment (**220kV Gas Insulated Switchgear & its accessories**) shall be deemed to be included in bidder's scope.

9. Inspection & Testing

1. GIS and its associated materials shall be subject to inspection by BHEL/OPTCL or authorized representative at bidder/manufacturers' works. Hence, Bidder shall furnish all necessary information concerning the supply to BHEL/ OPTCL.
2. Routine and acceptance tests as listed in relevant standard and section-2, technical specifications shall be complied.
3. Bidder shall also furnish factory acceptance test (FAT) from manufacturers for BHEL/ OPTCL approval in line with specific requirements mentioned in section-2, technical specification.

10. Field Testing & Commissioning

1. Bidder/ OEM shall carry out field testing and commissioning of 220kV GIS & its Accessories, however for installation, only supervision of installation shall be done by bidder. Further appropriate test and commissioning reports along as-built documentation as necessary shall be submitted.
2. Bidder shall also submit site acceptance testing (SAT) procedures and get them approved from BHEL/ OPTCL before carrying out the activities at site.
3. Bidder 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.
4. In general, field testing and commissioning shall be as per section-2, technical specification and applicable standard.

11. 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.
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. Hence, packing of the equipment shall be suitable for long storage (minimum 2 years).
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.

12. Specific Exclusions (NOT IN BIDDER’S SCOPE)

The following items are specifically excluded from the bidder’s scope of supply & services:

1. Supply & supervision of ETC of 400kV GIS.
2. Supply & installation of online PD monitoring system. However, UHF Sensors are to be installed by bidder.
3. Any scope of supply/ services mentioned in Section-2 or Section-3 of technical specification but not having any relationship with 220kV GIS, LCC & its Accessories and not covered in Section-1 or BPS / BOQ shall be deemed excluded from bidder's scope.
4. Installation/ erection of 220kV GIS with LCC & its Accessories except supervision work.
5. Cable laying & terminations, except supervision work. However, termination of special cables shall be in bidder's scope.
6. Local transportation/ conveyance for vendor's engineers shall be arranged by BHEL between local stay and site.
7. Office assistance shall be provided by BHEL including sitting facility etc.
8. Receipt & unloading of material at site except supervision work.
9. Terminal connector of SF6 to Air Bushing to conductor or any other interfacing equipment.
10. Open & Closed stores at site, however, bidder shall provide space requirement during tendering stage.
11. During storage of materials in BHEL provided open/ closed store, watch and ward shall be provided by BHEL.
12. Civil Construction works i.e. GIS buildings, civil works requirement for GIS System.
13. EOT crane, Ventilation System, Illumination System & Fire detection & alarm system, however complete input shall be provided for EOT and other system, however design input, applicable for GIS manufacture, shall be provided.
14. Control Relay & Protection Panels/ Merging Unit/SCU/Process Bus Panels, Numerical Relays, Bus Bar Protection Panel, SAS & DCS system, ACDB, DCDB, Battery & Charger as applicable.
15. 40 mm MS Rod and 75X10, 50x6 mm GI Flat for earthing.
16. Outdoor AIS Equipment.
17. Power & Control cable beyond LCC (except any special cables, if required).
18. BHEL/ Customer/ BHEL appointed 3rd party inspector travel, lodging & boarding charges during testing / inspection.

13. Terms Used

The terms used in this specification namely, "Employer/ Purchaser/ Owner" refers to OPTCL/ BHEL & "Contractor/ Sub-contractor/Manufacturer/ Bidder" refers to successful bidder.

14. List of Documents/ Drawings

Following drawing/ documents are attached for information purpose,

1. Annexure BOQ- BOQ for 220kV GIS & its Accessories
2. Annexure B- Details for Lot wise Technical Clearance for Manufacturing
3. TB-3-420-316-001: Single Line Diagram for 220/220kV GIS at Ersama
4. TB-420-316-002: Layout Plan & Section Drawing for 220/220kV GIS at Ersama

Sl. No.	ITEM	DETAILED DESCRIPTION/ REMARKS	Unit	Qty
A	**Supply- GIS: 220kV, 50kA, 3150A GIS double main bus scheme as per latest IEC standard & type tested equipment as per technical specification**	The 220 KV, 3150A, 50kA for (3 sec for Bus Bar & CB) & 50kA for (1 sec for Disconnector, Grounding Switch, CT & VT, as applicable), Two Main Bus configuration GIS complete with local control centre (LCC) etc with open future proof & flexible system in line with IEC 61850 & IEC 62271-203. (Circuit breaker shall be C2 - M2 class as per IEC 62271-100). GIS shall comprise following bays but not limited to (Refer attached Single Line Diagram), a) Two (2) Sets of fully equipped ICT Bays b) Four (4) Sets of fully equipped Line Bays. c) One (1) Set of fully equipped Bus Coupler Bay d) Two (2) Sets of fully equipped Bus Voltage Transformer Bays with Bus Isolator and Grounding Switches. Typical bay includes but not limited to SF6 gas, Single Phase (isolated) Busbar, circuit breaker, current transformer, bus-bar disconnectors with common grounding switch, Motorised disconnectors with safety grounding switch(es), high speed fault making motorised grounding switch, Local control cubicle, SF6 gas monitoring system for complete GIS, SF6 bus duct termination arrangement including SF6 to air bushing module, PD sensor (adequate number of UHF sensors in the offered GIS equipment for detection of Partial discharge (of 5 pC and above) as per IEC 60270 through Partial Discharge (PD) monitoring system, different gas compartment, O- ring & gaskets, Nuts, Bolts & Washers Absorbent, Limit Switch etc. to complete GIS modules & its earthing arrangement for GIS equipment with earthing strips of adequate size (as per IEEE-80-2000 and CIGRE44 to protect operating staff against any hazardous touch voltages and electro-magnetic interferences) as per the technical specification. The Switchgear shall be complete with all necessary terminal boxes, inspection window, SF6 gas filling, inter-connecting wiring, grounding connections, gas monitoring equipment and piping, support structures etc. The scope of supply shall also include all erection and mounting hardwares and interconnecting power and control cables between GIS to LCC and between LCC to LCC including cable tray, glands, lugs, ferrules etc. However cables beyond LCC shall be supplied and laid by BHEL.	**Header Item; Unit & Quantity as per A1 to A13 below.**	
A.1	Fully Equipped 220kV, 50kA, 3150A GIS - ICT/ Transformer GIS bay module	220kV, 3150A, 50kA (3 sec for CB & 1 sec for Disconnector, Grounding Switch, CT, VT as applicable), SF6 gas-insulated metal enclosed ICT bay module. Each set shall be complete & shall comprise of but not limited to: a) ONE set of 3x1-phase, SF6 insulated Circuit Breaker, complete with operating mechanism b) THREE sets of 3-phase group operated Disconnector complete with manual and motor driven operating mechanisms. c) TWO sets of 3-phase, group operated maintenance Earthing Switches, complete with manual and motor driven operating mechanisms. d) ONE set of 3-phase, group operated High Speed Earthing Switches, complete with manual and motor driven operating mechanisms. e) TWO sets of 3x1-phase, multi ratio, Current Transformers as per single line diagram. (Core details & location wrt CB shall be finalised at detail engg. stage) f) UHF PD sensors, gas monitoring device, pressure relief device, busbar, insulators/ barriers, expansion joint/ flexible joints and other items as required. GIS bus duct, SF6 to air bushing module etc. are not included in this bay module and these items are covered in separate items in the BOQ.	Set	2

A.2	Fully Equipped 220kV, 50kA, 3150A GIS - Line bay module	220kV, 3150A, 50kA (3 sec for CB & 1 sec for Disconnector, Grounding Switch, CT, VT as applicable), SF6 gas-insulated metal enclosed LINE bay module. Each set shall be complete & shall comprise of but not limited to: a) ONE set of 3x1-phase, SF6 insulated Circuit Breaker, complete with operating mechanism b) THREE sets of 3-phase group operated Disconnector complete with manual and motor driven operating mechanisms. c) TWO sets of 3-phase, group operated maintenance Earthing Switches, complete with manual and motor driven operating mechanisms. d) ONE set of 3-phase, group operated High Speed Earthing Switches, complete with manual and motor driven operating mechanisms. e) TWO sets of 3x1-phase, multi ratio, Current Transformers as per single line diagram. (Core details & location wrt CB shall be finalised at detail engg. stage) f) ONE set of 3x1-phase, 3-secondary, Voltage Transfromer as per single line diagram. g) UHF PD sensors, gas monitoring device, pressure relief device, busbar, insulators/ barriers, expansion joint/ flexible joints and other items as required. GIS bus duct, SF6 to air bushing module etc. are not included in this bay module and these items are covered in separate items in the BOQ.	Set	4
A.3	Fully Equipped 220kV, 50kA, 3150A GIS -Buscoupler GIS bay module	220kV, 3150A, 50kA (3 sec for CB & 1 sec for Disconnector, Grounding Switch, CT, VT as applicable), SF6 gas-insulated metal enclosed BUS COUPLER bay module. Each set shall be complete & shall comprise of but not limited to: a) ONE set of 3x1-phase, SF6 insulated Circuit Breaker, complete with operating mechanism b) TWO sets of 3-phase group operated Disconnector complete with manual and motor driven operating mechanisms. c) TWO sets of 3-phase, group operated maintenance Earthing Switches, complete with manual and motor driven operating mechanisms. d) TWO sets of 3x1-phase, multi ratio, Current Transformers as per single line diagram. (Core details & location wrt CB shall be finalised at detail engg. stage) e) UHF PD sensors, gas monitoring device, pressure relief device, busbar, insulators/ barriers, expansion joint/ flexible joints and other items as required. GIS bus duct, SF6 to air bushing module etc. are not included in this bay module and these items are covered in separate items in the BOQ.	Set	1
A.4	220kV, 50kA, 3150A GIS - Busbar GIS module	One set of three single phase (isolated), 220kV, 3150A, 50kA for 3 sec, SF6 gas-insulated metal enclosed bus bars, each comprising of but not limited to: a) Three individual 3150A bus bars enclosures running across the length of the switchgear to inter connect each of the circuit breaker bay modules in one and half breaker bus system. b) UHF PD sensors, Gas monitoring systems, pressure switches, telescopic enclosure etc. as required. c) Barriers Length of bus bar to be indicated by bidder.	Set	2

A.5	220kV, 50kA, 3150A GIS - Bus VT Modules for Main Buses	220kV, 50kA (1 sec for Disconnector, Grounding Switch, CT, VT as applicable), 3150A, SF6 gas insulated Bus VT bay module, Disconnector module with Earth switches connected to Main Bus Bars, each comprising of but not limited to: b) ONE set of 3-phase group operated Disconnector complete with manual and motor driven operating mechanisms. c) TWO sets of 3x1-phase, group operated maintenance Earthing Switches, complete with manual and motor driven operating mechanisms. d) ONE set of 3x1-phase, 3-secondary, Voltage Transfromer as per single line diagram. e) UHF PD sensors, gas monitoring device, pressure relief device, busbar, insulators/ barriers, expansion joint/ flexible joints and other items as required.	Set	2
A.6	220kV, 50kA, 3150A GIS - Gas Insulated Bus Duct from GIS bay modules upto SF6 Air bushings of Outgoing Lines/ ICT (includes both indoor & outdoor Bus Duct)	220kV, 50kA for 3 sec for insulated Bus Duct, 3150A ,SF6 gas insulated GIS Bus Duct shall be complete & shall comprise of but not limited to: a) Single phase (isolated) SF6 ducts along with all accessories, bends, joints etc to connect 220kV GIS bay modules to SF6 Air bushings of Outgoing Lines/ ICT (includes both indoor & outdoor Bus Duct) b) UHF PD sensors, Gas monitoring devices, barriers, pressure switches, etc. as required. The service condition shall be as per IEC-62271-203- (Special - Outdoor) to be followed]outside GIS Hall The total tentative length indicated is the sum of all 1 phase SF6 bus duct from end of respective bay to SF6 to air bushing/ connection. However, exact length shall be decided during detailed engineering stage. (The GIBus duct length is to be calculated from the end of the GIS module and shall include both the indoor and outdoor GIB)	Mtr	750
A.7	220kV, 50kA, 3150A GIS - SF6 to air bushing	220kV, 3150A, 50 kA for 1 sec, 31mm/kV creepage, SF6 to Air Bushing for Over head connection of Line/ICT bays with GIS. Bushing shall be of Polymer / composite insulator type and shall be seamless sheath of a silicone rubber compound. The hollow silicone composite insulators shall comply as per IEC 61462 and the relevant parts of IEC 62217. The design of the composite insulators shall be tested and verified according to IEC 61462	No	18

A.8	220kV, 50kA, 3150A GIS - Bus bar GIS Module for Future Extension	220kV, 50kA (3 sec for Bus bar & 1 sec for Disconnector, Grounding Switch), 3150A, Bus bar module for future extension, comprising of following but not limited to, (a) ONE set of 3-phase group operated Disconnector complete with manual and motor driven operating mechanisms. b) ONE set of 3x1-phase, group operated maintenance Earthing Switches, complete with manual and motor driven operating mechanisms. c) Suitable Gas Tight Spacers/ compartments shall be provided at the end where the Future Extension is foreseen. 3 phase isolated GIS bus module shall be used for future extension of bus bars, and accordingly, bidder shall propose the arrangement as per their type tested design. d) UHF PD sensors, gas monitoring device, pressure relief device, insulator, expansion joint/ flexible joints etc. as required. **Please refer clause 3.1, 3.1.14, 3.1.17, 3.2.5.1 and 13.0 of Section-2 of technical specification and mentioned elsewhere in Technical Specification.**	Set	2
A.9	220kV, 50kA, 3150A GIS - GIS Bus bar Module for Connection between bays	220kV, 50kA (3 sec for Bus bar), 3150A, Bus bar module for connection between bays, comprising of following but not limited to, (a) 3 phase isolated Bus bar mdoule section shall be used for connection between sections of bus bars to create electrical connectivity due to shifting of GIS bays, arising due to civil and architectural requirements or expansion joint in the building that houses GIS. (b) This module shall include the bellows/ compensators like lateral mounting units, Axial compensators, Parallel compensators, tolerance compensators and vibration compensators etc. as per requiremnts. c) UHF PD sensors, gas monitoring device, pressure relief device, insulator, expansion joint/ flexible joints etc. as required. **It shall be in line with clause 3.1.19, 3.2.8.1 of Section-2 of technical specification and mentioned elsewhere in Technical Specification.**	Set	2
A.10	220kV GIS - Local Control Centre (LCC)	Local Control Cabinets (LCC) for LINE/ICT/ LINES/ BUS VT bays including cables between GIS & LCC. **Please refer clause of 3.2.11 of section 2 and mentioned elsewhere in Technical Specification.**	Nos.	9
A.11	220kV GIS - SF6 gas required for placing GIS into successful operation	First filling of SF6 gas for the equipment supplied plus an additional quantity sufficient for conducting all tests on equipment at site before placing it into successful operation. Additionally, 10% of total quantity of SF6 gas shall also be supplied in non returnable cylinders as spare requirement. Bidder to indicate quantity with break up. **Please refer clause 3.1.4, 3.1.7, 3.1.9, 3.1.11 of section 2 and mentioned elsewhere in Technical Specification.**	MT	5

A.12	220kV GIS - Supply of structure Material for Installation of GIS including support structure for GIS ducts, SF6 to air bushings, supports, platforms, ladders, foundation bolts, embedded parts in floors, Rails etc., which are required for installation of GIS as per the specification. (The civil works will be done based on supplier design & drawings).	Structure Materials for support of GIS, Bus Ducts, SF6 to air bushing/ connection including Foundation Bolts, Embedded Items, Rails and/ or any other 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 910 gm/square meter.** All field assembly joints shall be bolted and hence, Field welding shall not be acceptable. Noncorrosive metal or plated steel shall be used for bolts and nuts throughout the work. Bidder shall provide suitable foundation channels and anchor bolts to support the switchgear assemblies. All anchor fasteners, mounting bolts, nuts and washers shall be provided to fasten the switchgear base frames to the foundation channels. In addition to above, supports, platforms, walkway, catwalk, foundation bolts, embedded parts in floors etc., are also included in the scope as per the specification, but not limited to the following, (a) Base Plate, Channel, Metallic / Structural Member for seating of GIS system (b) Lattice / Pipe structure required for GIS bay, GIB, SF6 to air bushing/ connection. (c) Foundation bolt / Anchor Fastener for GIS system, if required. (d) Equipment fixing hardware. (e) Cable tray arrangement (mounted on structures of) GIS bay, GIB, SF6 to air bushing/ connection. (f) Any other structural item required to complete the system in all respects but not limited to above. **Please refer clause 3.1.16 of section 2 and mentioned elsewhere in Technical Specification.** Bidder to indicate estimated weight in the bid (in MT) alongwith support documents & unit prices per MT in their offer. Bidder to quote in units as MT. Addition/deletion shall be on unit rate basis but only if there is any change in input.	MT	40
A.13	220kV, 50kA, 3150A GIS - Complete Earthing Materials including materials for High Frequency Earthing	Earthing Materials, except 40mm MS rod,75x10mm/ 50x6 GI Flat, which shall be provided by BHEL as free issue items, but, exact quatity requirenment shall be intimated by bidder based on the approved earthing philosphy, and Supervision of erection of all earthing connection for GIS to Earth Mesh on Floor shall be in scope including any special requirements including high frequency earthing. In case, high frequency earthing is not required, necessary design and calculations shall be submitted by bidder in line with IEEE-80-2000 and CIGRE44 to protect operating staff against any hazardous touch voltages and electro-magnetic interferences as per the technical specification. For further details, Please refer Section-2 along with applicable drawing. Bidder shall define clearly what constitutes the main grounding bus of the GIS. Bidder must supply, commission the entire grounding work of GIS viz conductor, clamps, joints, bimetallic strips (for connection between different type of earthing materials), operating and satety platforms etc. Bidder shall provide suitable measure to mitigate trasient enclosure voltage caused by high frequency currents caused by lightning strikes, operation of surge arrester, phase/earth fault and discharge between contracts during switching operation.	Lot	1
B	**Supply- Mandatory Spares for 220kV GIS**		**Header Item; Unit & Quantity as per B1 to B24 below.**	
B.1	220KV Gas Insulated Single phase voltage transformer with enclosure	220KV Gas Insulated Single phase voltage transformer with enclosure	No	1
B.2	220KV Gas Insulated Single phase Current transformer with enclosure	220KV Gas Insulated Single phase Current transformer with enclosure	No	1
B.3	SF6 gas Pressure relief devices for 220kV GIS	SF6 gas Pressure relief devices for 220kV GIS (1 Set= 1 no of each type)	Set	1
B.4	SF6 Pressure gauges cum switch or Density Monitors and pressure switches for 220KV GIS	SF6 Pressure gauges cum switch or Density Monitors and pressure switches for 220KV GIS (1 Set= 1 no of each type)	Set	1

B.5	Trip coil assembly with resistor for 220KV GIS Circuit breaker	Trip coil assembly with resistor for 220KV GIS Circuit breaker	No	6
B.6	Closing coil assembly with resistor for 220KV GIS Circuit breaker	Closing coil assembly with resistor for 220KV GIS Circuit breaker	No	6
B.7	All types of control valves for SF6 gas of each type for 220KV GIS	All types of control valves for SF6 gas of each type for 220KV GIS (1 Set= 1 no of each type)	Set	1
B.8	Locking device to keep the Disconnectors and Earthing switches in close or Open position in case of removal of driving mechanism for 220KV GIS.	Locking device to keep the Disconnectors and Earthing switches in close or Open position in case of removal of driving mechanism for 220KV GIS.	Set	1
B.9	SF6 to Air bushing as applicable for 220KV GIS	SF6 to Air bushing as applicable for 220KV GIS	No	1
B.10	Set of spares for local control cabinet including MCB, fuses, time relays, all type of auxiliary relay & contactors, lamps, semaphor, terminals, push buttons etc. for 220KV GIS	Set of spares for local control cabinet including MCB, fuses, time relays, all type of auxiliary relay & contactors, lamps, semaphor, terminals, push buttons etc. for 220KV GIS (1 Set= 1 no of each type and rating)	Set	1
B.11	Auxiliary contacts for 220KV GIS circuit breaker	Auxiliary contacts for 220KV GIS circuit breaker (1 Set= 1 no of each type and rating)	Set	1
B.12	Limit switch & Auxiliary contacts for 220KV GIS DS and ES	Limit switch & Auxiliary contacts for 220KV GIS DS and ES (1 Set= 1 no of each type and rating)	Set	1
B.13	SF6 gas in steel bottle	SF6 gas in steel bottle (1 Set= 1 no SF6 gas in one bottle of 50kg capacity)	Set	2
B.14	Spring charge motor for 220KV GIS circuit breakers	Spring charge motor for 220KV GIS circuit breakers (1 Set= 1 no of each type and rating)	Set	1
B.15	Complete Drive single phase for 220KV GIS circuit breaker-	Complete Drive single phase for 220KV GIS circuit breaker-	No	1
B.16	Complete drive mechanism for disconnect switches and grounding switches for 220KV GIS	Complete drive mechanism for disconnect switches and grounding switches for 220KV GIS	No	1
B.17	Motor for disconnect switches and grounding switches for 220KV GIS	Motor for disconnect switches and grounding switches for 220KV GIS	No	1
B.18	Complete drive mechanism for fast acting grounding switches for 220KV GIS	Complete drive mechanism for fast acting grounding switches for 220KV GIS	No	1
B.19	Motor for fast acting grounding switches for 220KV GIS	Motor for fast acting grounding switches for 220KV GIS	No	1
B.20	Rupture disc for circuit breakers for 220KV GIS	Rupture disc for circuit breakers for 220KV GIS (1 Set= 1 no of each type and rating)	Set	1
B.21	Rupture disc for potential transformer for 220KV GIS	Rupture disc for potential transformer for 220KV GIS (1 Set= 1 no of each type)	Set	1
B.22	Limit switch & Auxiliary switch for 220KV GIS	Limit switch & Auxiliary switch for 220KV GIS (1 Set= 1 no of each type)	Set	1
B.23	Rupture disc for other compartments for 220KV GIS	Rupture disc for other compartments for 220KV GIS (1 Set= 1 no of each type)	Set	1
B.24	Bus supplort insulator for 220KV GIS	Bus supplort insulator for 220KV GIS (1 Set= 1 no of each type)	Set	1

C	**Supply- Operation & Maintenance Spares for 220kV GIS**	Bidder to quote BOQ for recommended spares for two years of normal operation & maintenance from the date of commissioning. In case of no such requirement, bidder shall submit the certification stating that " We do not hereby recommend any operation & maintenance spares for the period of two years from the date of commissioning, however in case of such requirement in future, same shall be supplied free of cost." 1 Lot= Complete requirement for two years of normal operation & maintenance from the date of commissioning.	Lot	1
D	**Service- 220kV GIS - Supervision of Erection, Testing & Commissioning and handing over to Customer**	These activities shall be carried out at site in stages as per front availability at site, and hence multiple visits for completion of work are envisaged.	**Header Item; Unit & Quantity as per D1 to D10 below.**	
D.1	Site visit for supervision of unloading & verification of 220kV GIS materials for proper storage and up-keeping at site	Site visit for supervision of unloading & verification of materials for proper storage and up-keeping at site includes following activities but not limited to, (a) Supervision of safe unloading of GIS & its accessories at site. (b) Reconcililation, storage & upkeeping of materials, with due instructions/ training to site persons for long storage.	Lot	1
D.2	Supervision of erection of 220kV GIS bays including LCC	Supervision of complete GIS bays along with all bay equipment such as GIS extension module, GIS bus extension module, voltage transformer, LCC including structure, cabling, earthing & other associated activities shall be included in the scope. Consumables required for successful erection is included in bidder's scope. Payment shall be made on prorata basis, if required.	Lot	1
D.3	Supervision of erection of 220kV Gas insulated bus duct	Supervision of erection of GIS- gas insulated bus duct including support structure, earthing & other associated activities shall be included in the scope. (The GIBus duct quantity will be calculated from the end of the GIS module and shall include both the indoor and outdoor GIB) Consumables required for successful erection is included in bidder's scope. Payment shall be made on actual measurement basis, if required.	Mtr	750
D.4	Supervision of erection of 220kV SF6 to air bushing/ connection	Supervision of erection of SF6 to Air bushing including support structure, earthing & other associated activities shall be included in the scope. Consumables required for successful erection is included in bidder's scope. Payment shall be made on actual measurement basis, if required.	No	18
D.5	Testing & commissioning of 220kV GIS bays including LCC	Testing & commissioning of complete GIS bays including other associated activities in line with site acceptance testing as per customer approved SAT procedure shall be in bidder's scope. Consumables required for successful commissioning is included in bidder's scope. Payment shall be made on prorata basis, if required.	Lot	1
D.6	Testing & commissioning of 220kV GIS Gas insulated bus duct	Testing & commissioning of GIS- gas insulated bus duct including support structure, earthing & other associated activities shall be included in the scope. Consumables required for successful commissioning is included in bidder's scope. Payment shall be made on actual measurement basis, if required.	Lot	1
D.7	Testing & commissioning of 220kV SF6 to air bushing/ connection	Testing & commissioning of SF6 to Air Bushing including support structure, earthing & other associated activities shall be included in the scope. Payment shall be made on actual measurement basis, if required.	Lot	1
D.8	Final Successful High Voltage/ Power Frequency Testing of complete 220kV GIS	Carrying out successful HV/ Power Frequency Testing of GIS as per IEC including Arrangement of HV Test kit (on returnable basis) shall be in scope of bidder, which includes charges HV test kit with operator, accessories & tools required for completion of HV testing. Bays may be commissioned separately. No delay shall be permitted on account of the non availability of the HV test kit. Payment shall be made on the basis site certification.	Lot	1

D.9	Insulation Co-ordination Studies for 220kV GIS System	Bidder shall conduct insulation co-ordination studiy in line with IEC 600071-2006.and any other technical requirement for successful operation of GIS. In case of non availability of exact input details, same shall be done be done on basis of standard inputs available and shall be revised, if required after availability of exact input details. Payment shall be made on the basis engineering certification.	Lot	1
D.10	Final Documentation of 220kV GIS	Final Documentation including As Bulit Drawing/ Document, Site Testing Reports/ Protocols, Handing over proptcols along with manuals shall be submitted etc. by bidder. Payment shall be made on the basis engineering certification.	Lot	1
E	**Service- Training for 220kV GIS**		**Header Item; Unit & Quantity as per E1 to E2 below.**	
E.1	220kV GIS Training of 6 nos. Engineers (4 nos. customer engineers+2 nos. BHEL engineers) for a period of at least 7 working days at Manufacturer's works	To and fro travelling charges, lodging and boarding charges of engineers shall be in BHEL scope. Only training shall be arranged at Manufacturer's works. **Training shall be in line with clause 3.2.14, Section-2 of technical specification and mentioned elsewhere in Technical Specification.**	Lot	1
E.2	220kV GIS Training of 6 nos. Engineers (4 nos. customer engineers+2 nos. BHEL engineers) for a period of at least 7 working days at project site	To and fro travelling charges, lodging and boarding charges of engineers shall be in BHEL scope. Only training shall be arranged at project site. **Training shall be in line with clause 3.2.14, Section-2 of technical specification and mentioned elsewhere in Technical Specification.**	Lot	1
F	**Supply- Unit reference price of 220kV GIS part item/ equipment**	**GIS part item/ equipment shall be required for supply as a mandatory spares or any addition/ deletion of equipment, due to damage, theft, additional requirement by customer during detailed engineering or later stage. It is to be ensured by bidder that unit prices have a logical relationship with prices of assemblies in main items (Bay, Busbar etc). The reference prices shall be used for breakup rates, if required at any stage. The reference prices shall be considered for evaluation.**	**Header Item; Unit & Quantity as per F1 to F26 below.**	
F.1	220kV, 3150A Circuit breaker (1 pole complete with enclosure without operating mechanism)	220kV, 3150A Circuit breaker (1 pole complete with enclosure without operating mechanism)	Set	1
F.2	220kV, 3150A Disconnector (1 pole) without operating mechanism	220kV, 3150A Isolator (3 pole) complete with enclosure without operating mechanism	Set	1
F.3	220 kV Maintenance Earthing switch without operating mechanism	220 kV Maintenance Earthing switch (3 pole) with enclosure without operating mechanism	Set	1
F.4	220kV High speed earth switch/ High speed make proof grounding switch without operating mechanism	220kV High speed earth switch (3 pole) with enclosure without operating mechanism	Set	1
F.5	Surge Arrestor including Surge Counter	Surge Arrester with enclosure and surge counte/ monitor. Rated arrester voltage may be changed after insulation coordination study. Rated arrester voltage considered is 198kV.	Set	1
F.6	220kV Current transformer of Class PS (1 No. of each type) (Individual prices to be furnished).	220kV Current transformer (1 pole) of Class PS (1 No. of each type) Without enclosure (Individual prices to be furnished).	Set	1

F.7	220kV Current transformer of Class 0.2s (1 No. of each type) (Individual prices to be furnished).	220kV Current transformer (1 pole) of Class 0.2s (1 No. of each type) Without enclosure (Individual prices to be furnished).	Set	1
F.8	220kV Voltage transformer (1 No. of each type) (Individual prices to be furnished).	220kV Voltage transformer (1 pole) (1 no. of each type) Without enclosure (Individual prices to be furnished).	Set	1
F.9	Operating Mechanism box for 220kV, 3150 A Circuit Breaker	Operating Mechanism box for 220kV, 3150 A Circuit Breaker	Set	1
F.10	Operating Mechanism box for 220kV, 3150 A Isolator	Operating Mechanism box for 220kV, 3150 A Isolator	Set	1
F.11	Operating mechanism for 220kV, Maintenance Earthing Switch	Operating mechanism for 220kV, Maintenance Earthing Switch	Set	1
F.12	Operating Mechanism for 220kV, High Speed Earthing Switch	Operating Mechanism for 220kV, High Speed Earthing Switch	Set	1
F.13	220kV, 1 Phase bus bar conductor	220kV, 1 Phase bus bar conductor	Mtr	1
F.14	220kV, 1 phase GIS metalic enclosure for bus bar/ any eqipment	220kV, 1 phase GIS metalic enclosure for bus bar/ any eqipment	Mtr	1
F.15	220kV, 1 Phase conductor for bus duct	220kV, 1 Phase conductor for bus duct	Mtr	1
F.16	220kV, 1 phase GIS metalic enclosure for bus duct	220kV, 1 phase GIS metalic enclosure for bus duct	Mtr	1
F.17	Gas permeable/ communication/ barrier type Insulator	Gas permeable/ communication/ barrier type Insulator (1 Set= 1 No of each rating and type)	Set	1
F.18	Gas non- permeable/ non - communication/ non-barrier type Insulator	Gas non- permeable/ non - communication/ non-barrier type Insulator (1 Set= 1 No of each rating and type)	Set	1
F.19	UHF PD sensors	UHF PD sensors (1 Set= 1 No of each rating and type)	Set	1
F.20	Pressure/ density monitor monitor device & Switch	Pressure/ density monitor monitor device & Switch (1 Set= 1 No of each rating and type)	Set	1
F.21	Pressure relief device	Pressure relief device (1 Set= 1 No of type)	Set	1
F.22	Rupture disc	Rupture disc (1 Set= 1 No of type)	Set	1
F.23	Elbow/ bend/ cross and T section	Elbow/ bend/ cross and T section (1 Set= 1 No of type)	Set	1
F.24	Expansion joint	Expansion joint (1 Set= 1 No of type)	Set	1
F.25	Flexible connection for conductor	Flexible connection for conductor (1 Set= 1 No of type)	Set	1
F.26	Gas seals	Gas seals (1 Set= 1 No of type)	Set	1
G	**Service- Unit reference price of GIS service item**	Reference unit prices for service of Individual Item/ Equipment for any addition/ deletion of equipment, due to damage, theft, additional requirement by customer, any other reasons not attributable to vendor during detailed engineering/ contract execution. The reference prices shall be considered for evaluation. Total charges for one visit of engineer/ HV test kit operator shall include respective unit rate of item G.1/ G.2 man-day+ item of G.4.	**Header Item; Unit & Quantity as per G1 to G4 below.**	
G.1	Services of supervision for Erection of 220kV GIS	Services of supervision for erection of any part equipment/ section of GIS, as and when required at site. This also includes lodging and boarding charges of erection engineer. To & fro tarvelling charges are not included in this item.	Manday	1

G.2	Services of Testing & Commissioning of 220kV GIS	Services of Testing & Commissioning of any part equipment/ section of GIS, as and when required at site. This also includes lodging and boarding charges of T&C engineer. To & fro tarvelling charges are not included in this item.	Manday	1
G.3	Hiring charges of HV test kit with operator	Additional HV test kit charges including charges of operator, HV test kit, accessories & tools required for completion of HV test (Dielectric Test after installation of GIS). HV test kit charges shall include HV testing of one or more bay at site as per requirements. This also includes lodging and boarding charges of operator. To & fro tarvelling charges are not included in this item.	Lot	1
G.4	To and fro travelling charges of vendor's engineer from the vendor's office/ factory to project site	To and fro travelling charges of OEM/ vendor's engineer from the office/ factory to project site shall be provided by BHEL.	No. of Visit	1

NOTES:

1) CT & VT core details given in single line diagram/TS are tentative and may change at contract stage. Changes to be incorporated by bidder without any cost and delivery implication to BHEL/ Customer.
2) BHEL reserves the right for quantity variation due to any reason upto ±20% of total value at same unit rate and terms during execution of contract. The quantity of individual items may however vary upto any extent.
3) While quoting against individual line items of Tender BOQ, bidder to carefully read and quote as per the descriptions & detailed descriptions mentioned in this Annexure-BOQ of Section-1.

Annexure B- Details for Technical Clearance for Manufacturing

PROJECT NAME **400/220 kV GIS SUB STATION AT ERSAMA, PARADEEP, ODISHA**

CUSTOMER **Odisha Power Transmission Corporation Limited (OPTCL)**

Sl. No.	BHEL/ Customer Drawing/ Doc. No	Vendor Drawing/ Doc. No	Document Title	Approval Category (A- approval, I-Information)	Applicable for GIS items	Submission date	Remarks
1	TB-420-316-071-01A	--	GIS Gas Single Line Diagram (SLD) and Gas Schematics	A	GIS Bays, GIB ducts and cable connection/ Oil connection/ SF6 to Air bushing module, LCC with gas monitoring system, CSD & PD monitoring system etc.		BHEL shall provide all the technical inputs requirements (e.g. Title Block, Master Drawing list, SLD, CT VT Parameters, Layout Plan & Section Drawings, interfacing drawings etc. as applicable) required for submission of drawings/ documents during detailed engineering stage, pendancy of any input from BHEL, if equired, bidder shall inform within two week time.
2	TB-420-316-071-03A	--	GIS Layout, Plan & Section and Isometric view (overall GIS) with BOM of GIB duct	A	GIS Bays, GIB ducts and cable connection/ Oil connection module etc.		
3	TB-420-316-071-02A	--	GIS Guaranteed Technical Particulars (GTP)	A	GIS Bays, GIB ducts and cable connection/ Oil connection module etc.		
4	TB-420-316-071-08A	--	GIS Manufacturing Quality Plan	A/ I	GIS Bays, GIB ducts and cable connection/ Oil connection module, LCC with gas monitoring system, CSD & PD monitoring system, Maintenance Equipment etc.		
5	TB-420-316-071-07A	--	GIS Type Test Reports	A/ I	GIS Bays, GIB ducts and cable connection/ Oil connection module etc.		
6	TB-420-316-071-04A	--	GIS Interface Drawing for Cable connection Module/ Oil connection/ SF6 to Air bushing module	A	Cable connection/ Oil connection module etc.		
7	TB-420-516-071-05A	--	GIS Secondary Engineering base Design (LCC Overview drawing and Interlock Logic Drawing)	A	LCC with gas monitoring system etc.		
8	TB-420-516-071-25A	--	CSD Manual/ Catalog	I	CSD etc.		
9	TB-420-516-071-10A	--	GIS LCC Schematics for GIS Bays	A	LCC with gas monitoring system etc.		
10	TB-420-316-071-12A	--	GIS GA Drawing, GTP, Schematics of Gas Monitoring System	A	LCC with gas monitoring system etc.		
11	TB-420-316-071-13A	--	GIS GA Drawing, GTP, Schematics of PD Monitoring System	A	PD monitoring system etc.		
12	TB-420-316-071-26A	--	GIS Maintenance Equipment Catalouge & GTP	A	GIS Maintenance Equipment etc.		
13	TB-420-316-071-19A	--	Insulation co-ordination study	A/ I	Surge Arrester etc., if applicable		
14	TB-420-316-071-14A	--	GIS Quantification of Spares	A/ I	Spares etc.		
15	TB-420-316-071-23A	--	GIS Earthing Layout Drawing with BOM and Design	A/ I	Earthing materials etc.*		
16	TB-420-316-071-25A	--	GIS Support Structure Layout Drawing with BOM and Design	A/ I	Structure & harwares etc.*		
17	TB-420-316-071-20A	--	GIS Civil Work Specification along Foundation loading and other interfacing details	A/ I	Input for civil engineering activities*		
18	TB-420-316-071-22A	--	GIS O&M Manual	A/ I	GIS Manual*		
19	TB-420-316-071-27A	--	GIS General and Special Tool List	A/ I	GIS general & special tools list, as applicable*		
20	TB-420-316-071-28A	--	Quantification of SF6 gas and Hydraulic Oil	A/ I	SF6 gas, Hydraulic Oil, as applicable*		

GIS PO	BOQ Item Sr. No.	Remarks
PO-1 (Main & ref. price Items Supply & Services)	A, D, E , F & G and/ or any other item not covered in PO 2	Based on engineering approval of drawing/ documents, as applicable, technical clearance for part/ full quantity shall be provided.
PO-3 (Spares)	B & C	Based on engineering approval of drawing/ documents, as applicable technical clearance for part/ full quantity shall be provided.

Notes:

1 Drawing/ document marked * shall not be considerd for Engineering Delay Analysis.

2 Supply items such as **SF6 gas/ Hydraulic oil, Structures & hardware, Earthing Material** shall not be considered for Engineering Delay Analysis, However, bidder shall ensure timely supply, availability and completeness of work at site without any delay.

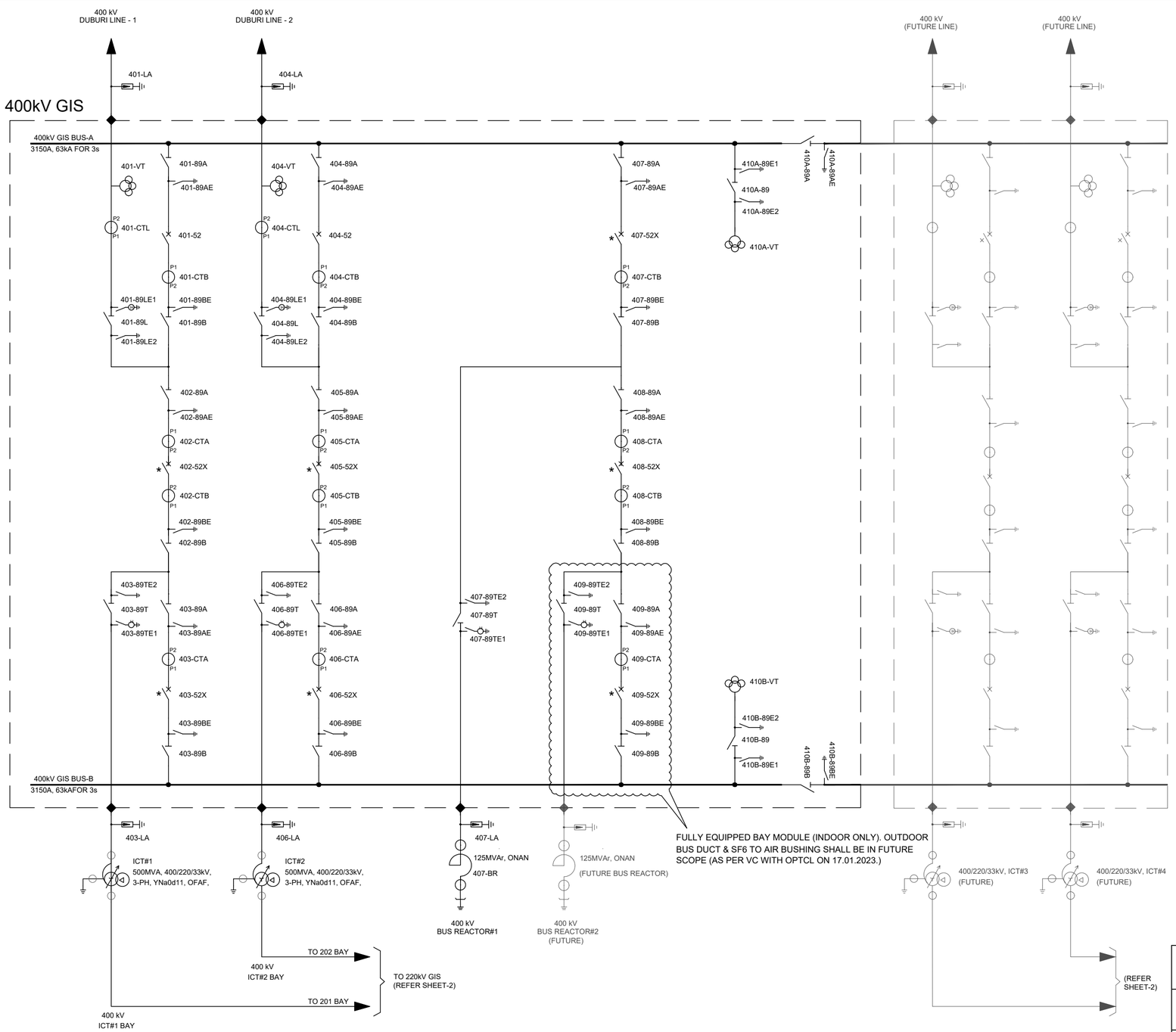
3 Drawings/ documents, not mentioned above but required for completeness of work shall be submitted for approval/ Information, if required.

4 In case drawing/ document are not duly stamped in category-1/ category-2 by Customer/ OPTCL, BHEL stamped drawing in category-1 shall be treated final to proceed further.

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. TB-3-420-510-001



EQUIPMENT DESIGNATION FOR SLD

4	01	–	89	A/B/L/T	E

- E – EARTH SWITCH
- A/B/L/T – A–EQUIPMENT CONNECTED ON BUS–1 SIDE; B–EQUIPMENT CONNECTED ON BUS–2 SIDE; L–DEVICE CONNECTED TO LINE SIDE; T–EQUIPMENT CONNECTED TO TRANSFORMER/REACTOR
- 89 – EQUIPMENT IDENTIFICATION (ISOLATOR)
- 01 – BAY NO. : 01,02.....n
- 4 – VOLTAGE LEVEL – 400kV

NOTES :

1. PRESENT ——————— FUTURE .....
2. * - CB WITH CONTROLLED SWITCHING DEVICE SHALL BE PROVIDED IN 400kV ICT#1, ICT#2 & BUS REACTOR BAYS ALONG WITH THEIR ASSOCIATED TIE BAYS.
3. BAY SEQUENCE FOR GIS IS TENTATIVE & MAY CHANGE IN LINE WITH THE REQUIREMENTS OF SERVICE CONTINUITY AND STANDARD DESIGN OF OEM.
4. LOCATION OF GIS CT IN BAY MAY CHANGE AS PER THE RECOMMENDATIONS OF OEM.
5. INDIVIDUAL EQUIPMENT OF GIS OR AIS WILL BE PROVIDED AS PER REQUIREMENTS OF TECHNICAL SPECIFICATION & DEVIATIONS (IF ANY) FROM TECHNICAL SPECIFICATION WILL BE TAKEN UP SEPARATELY.
6. CT/VT PARAMETERS OF 400kV GIS ARE DETAILED IN SEPARATE SHEET OF THIS DRAWING. PARAMETERS OF BUSHING CT OF TRANSFROMERS AND BUS REACTOR WILL BE PROVIDED LATER.

REV.	DATE	ALTERED	CHD/APPD
ZONE			

REV.	DATE	ALTERED	CHD/APPD
ZONE			

REV.	DATE	ALTERED	CHD/APPD
ZONE			

REV.	DATE	ALTERED	CHD/APPD
ZONE			

PROJECT:	400/220kVGIS SUBSTION AT ERSAMA, ODISHA & 400kV AIS FEEDER BAY EXTENSION AT DUBURI, ODISHA
OWNER:	ODISHA POWER TRANSMIISSIION CORPORATION LIMITED

BHARAT HEAVY ELECTRICALS LTD.
TRANSMISSION BUSINESS GROUP
NOIDA

	NAME	SIGN.	DATE
DRN.	AK		
CHD.	DKS		
APPD.	VK		

NO.OF VAR. N.A.

DEPT.	UNTOL. DIMS. GR.	SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM NO.	NO.OF ITEMS
TBG	g/M/f	N.T.S	N.A.	N.A.	N.A.	N.A.

TITLE: SINGLE LINE DIAGRAM OF 400/220kV GIS SUB STATION AT ERSAMA

CARD CODE: NA

DRG.NO. TB-3-420-510-001

REV. 00

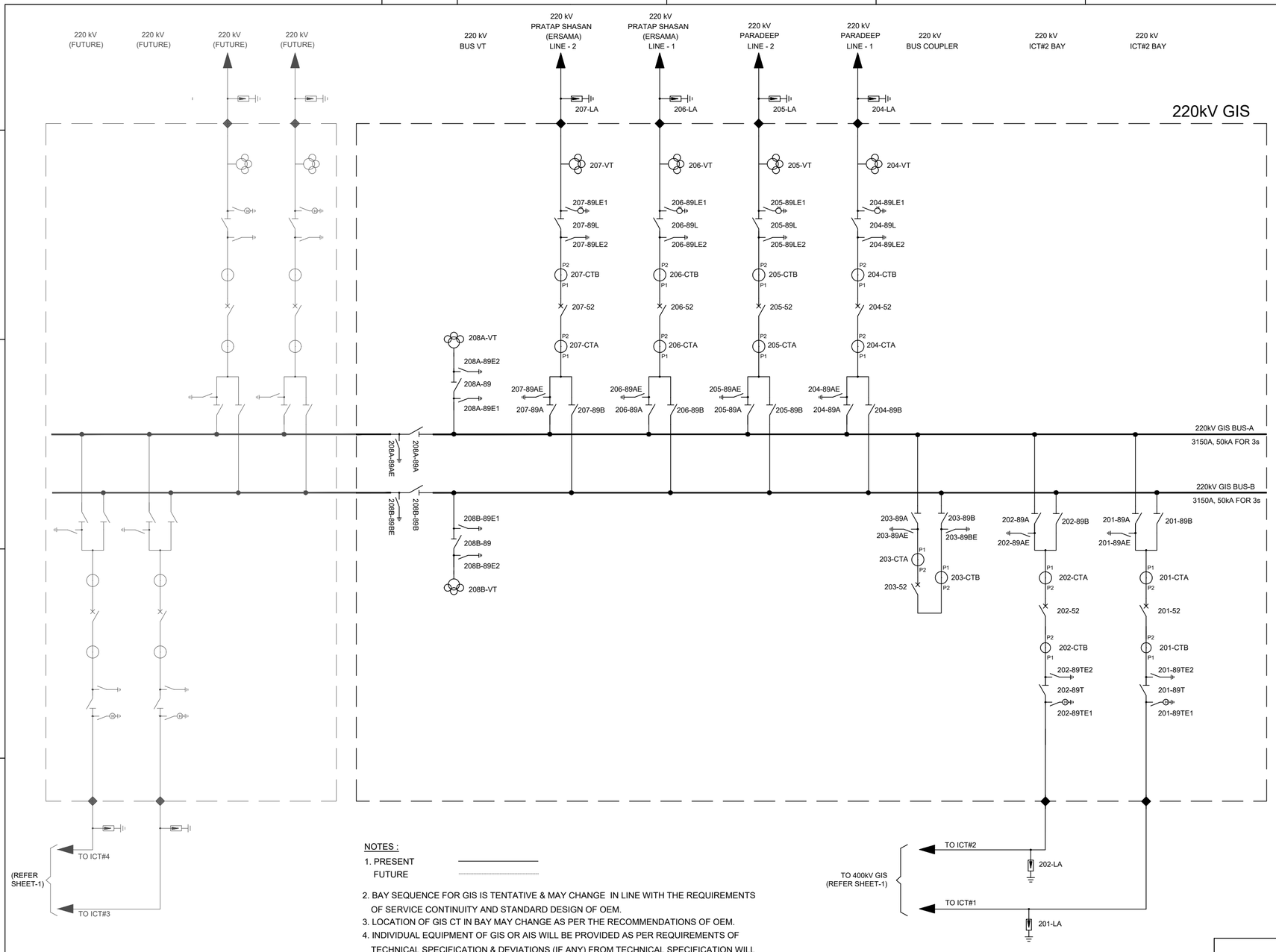
SHT. No 01 NO. OF SHT. 05

SIZE–A3

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. TB-3-420-510-001



EQUIPMENT DESIGNATION FOR SLD

2	01	–	89	A/B/L/T	E

- E: EARTH SWITCH
- A/B/L/T: A–EQUIPMENT CONNECTED ON BUS–1 SIDE; B–EQUIPMENT CONNECTED ON BUS–2 SIDE; L–DEVICE CONNECTED TO LINE SIDE; T–EQUIPMENT CONNECTED TO TRANSFORMER/REACTOR
- 89: EQUIPMENT IDENTIFICATION (ISOLATOR)
- 01: BAY NO. : 01,02.....n
- 2: VOLTAGE LEVEL – 220kV

NOTES :

1. PRESENT ——————
   FUTURE .....
2. BAY SEQUENCE FOR GIS IS TENTATIVE & MAY CHANGE IN LINE WITH THE REQUIREMENTS OF SERVICE CONTINUITY AND STANDARD DESIGN OF OEM.
3. LOCATION OF GIS CT IN BAY MAY CHANGE AS PER THE RECOMMENDATIONS OF OEM.
4. INDIVIDUAL EQUIPMENT OF GIS OR AIS WILL BE PROVIDED AS PER REQUIREMENTS OF TECHNICAL SPECIFICATION & DEVIATIONS (IF ANY) FROM TECHNICAL SPECIFICATION WILL BE TAKEN UP SEPARATELY.
5. CT/VT PARAMETERS OF 220kV GIS ARE DETAILED IN SEPARATE SHEET OF THIS DRAWING. PARAMETERS OF BUSHING CT OF TRANSFROMERS AND BUS REACTOR WILL BE PROVIDED LATER.

REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED
		CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD
ZONE			ZONE			ZONE			ZONE		

PROJECT:	400/220kVGIS SUBSTION AT ERSAMA, ODISHA & 400kV AIS FEEDER BAY EXTENSION AT DUBURI, ODISHA		
OWNER:	ODISHA POWER TRANSMIISSIION CORPORATION LIMITED		
BHEL BHARAT HEAVY ELECTRICALS LTD. TRANSMISSION BUSINESS GROUP NOIDA		NAME / SIGN. / DATE	NO.OF VAR.
	DRN.	AK	N.A.
	CHD.	DKS	
	APPD.	VK	
DEPT. TBG / CODE	UNTOL. DIMS. GR. g/M/f	SCALE N.T.S	WEIGHT (KG) N.A.
		REF. TO ASSY. DRG. N.A.	ITEM NO. N.A.
			NO.OF ITEMS N.A.
TITLE: SINGLE LINE DIAGRAM OF 400/220kV GIS SUB STATION AT ERSAMA	CARD CODE NA	DRG.NO. TB-3-420-510-001	REV. 00
		SHT. No 02	NO. OF SHT. 05

SIZE-A3

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. TB-3-420-510-001

A. 400kV GIS EQUIPMENT: –

S.N.	DESCRIPTION	SYMBOL	LEGEND	BAY NO/LOCATION	UNIT	QTY
1.	400kV, 3150A, 63kA FOR 3 SEC, 3-PH CIRCUIT BREAKER		52	401, 404	SETS	02
2.	400kV, 3150A, 63kA FOR 3 SEC, 3-PH CIRCUIT BREAKER WITH CSD		52X	402, 403, 405, 406, 407, 408, 409	SETS	07
3.	400kV, 3150A, 63kA FOR 1 SEC, 3-PH DISCONNECTOR		89A 89B 89L 89T 89	401, 402, 403, 404, 405, 406, 407, 408, 409, 410A 401, 402, 403, 404, 405, 406, 407, 408, 409, 410B 401, 404 403, 406, 407, 409 410A, 410B	SETS	28
4.	EARTH SWITCH , 3-PH , GROUP OPERATED		89AE 89BE 89LE2 89TE2 89E1 89E2	401, 402, 403, 404, 405, 406, 407, 408, 409, 410A 401, 402, 403, 404, 405, 406, 407, 408, 409, 410B 401, 404 403, 406, 407, 409 410A, 410B 410A, 410B	SETS	30
5.	HIGH SPEED EARTHING SWITCH , 3-PH, GROUP OPERATED		89LE1 89TE1	401, 404 403, 406, 407, 409	SETS	06
6.	400kV, 3000A, 63kA FOR 1 SEC, 1-PH, CURRENT TRANSFORMER (5-CORE)		CTA CTB	402, 403, 405, 406, 408, 409 401, 402, 404, 405, 407, 408	SETS	36
7.	400kV, 3000A, 63kA FOR 1 SEC, 1-PH, CURRENT TRANSFORMER (2-CORE)		CTL	401, 404	SETS	06
8.	400kV, 1-PH, 3 SECONDARY VOLTAGE TRANSFORMER		VT	401, 404, 410A, 410B	SETS	12

B. 220 kV INDOOR GIS: –

S.N.	DESCRIPTION	SYMBOL	LEGEND	BAY NO/LOCATION	UNIT	QTY
1.	220kV,3150A, 50kA FOR 3 SEC, 3-PH CIRCUIT BREAKER		52	201, 202, 203, 204, 205, 206, 207	SETS	07
2.	220kV,3150A, 50kA FOR 1 SEC, 3-PH GROUP OPERATED DISCONNECTOR		89 89A 89B 89L 89T	208A, 208B 201, 202, 203, 204, 205, 206, 207, 208A 201, 202, 203, 204, 205, 206, 207, 208B 204, 205, 206, 207 201, 202	SETS	24
3.	EARTH SWITCH , 3-PH , GROUP OPERATED		89AE 89BE 89LE2 89TE2 89E1 89E2	201, 202, 203, 204, 205, 206, 207, 208A 203, 208B 204, 205, 206, 207 201, 202 208A, 208B 208A, 208B	SETS	20
4.	HIGH SPEED EARTHING SWITCH , 3-PH, GROUP OPERATED		89TE1 89LE1	201, 202 204, 205, 206, 207	SETS	06
5.	220kV, 3000A, 50kA FOR 1 SEC, 1-PH,CURRENT TRANSFORMER (2-CORE)		CTA	201, 202, 203, 204, 205, 206, 207	SETS	21
6.	220kV, 3000A, 50kA FOR 1 SEC, 1-PH, CURRENT TRANSFORMER (3-CORE)		CTB	201, 202, 203, 204, 205, 206, 207	SETS	21
7.	220kV, 1-PH, 3 SECONDARY VOLTAGE TRANSFORMER		VT	204, 205, 206, 207, 208A, 208B	SETS	18

C. OUTDOOR EQUIPMENT: –

S.N.	DESCRIPTION	SYMBOL	LEGEND	BAY NO/LOCATION	UNIT	QTY
1.	500MVA, 400/220/33KV, YNa0d11,OFAF, 3-PH ICT		ICT	ICT#1, ICT#2	NOS	02
2.	400kV, 125MVA, 3-PH BUS REACTOR		BR	409	NOS	01
3.	390kV, 20kA, CLASS-IV, 63kA, 1-PH, SURGE ARRESTER		LA	401, 403, 404, 406, 409	NOS	15
4.	216kV, 10kA, CLASS-III, 50kA, 1-PH, SURGE ARRESTER		LA	201, 202, 204, 205, 206, 207	NOS	18
5.	400kV, 3150A, 63kA FOR 1 SEC. SF6 TO AIR BUSHING			401, 403, 404, 406, 407, 409	NOS	15
6.	220kV, 3150A, 50kA FOR 1 SEC. SF6 TO AIR BUSHING			201, 202, 204, 205, 206, 207	NOS	18

SYSTEM PARAMETERS: –

S.N.	SYSTEM PARAMETERS	400kV	220kV
1.	NOMINAL VOLTAGE	400kV	220kV
2.	HIGHEST SYSTEM VOLTAGE	420kV	245kV
3.	RATED FREQUENCY	50Hz	50Hz
4.	RATED SHORT TIME CURRENT	63kA for 3s/1s (as applicable)	50kA for 3s/1s (as applicable)
5.	POWER FREQUENCY WITHSTAND VOLTAGE	630kV (rms)	460Kv (rms)
6.	LIGHTNING IMPULSE WITHSTAND VOLTAGE	±1425 kV peak	±1050 kV peak
7.	SWITCHING IMPULSE WITHSTAND VOLTAGE	±1050 kV peak	N.A
8.	CREEPAGE	31mm/kV (13020mm)	31mm/kV (7595mm)
9.	GROUNDING	Effectively earthed	Effectively earthed

REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED
		CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD
ZONE			ZONE			ZONE			ZONE		

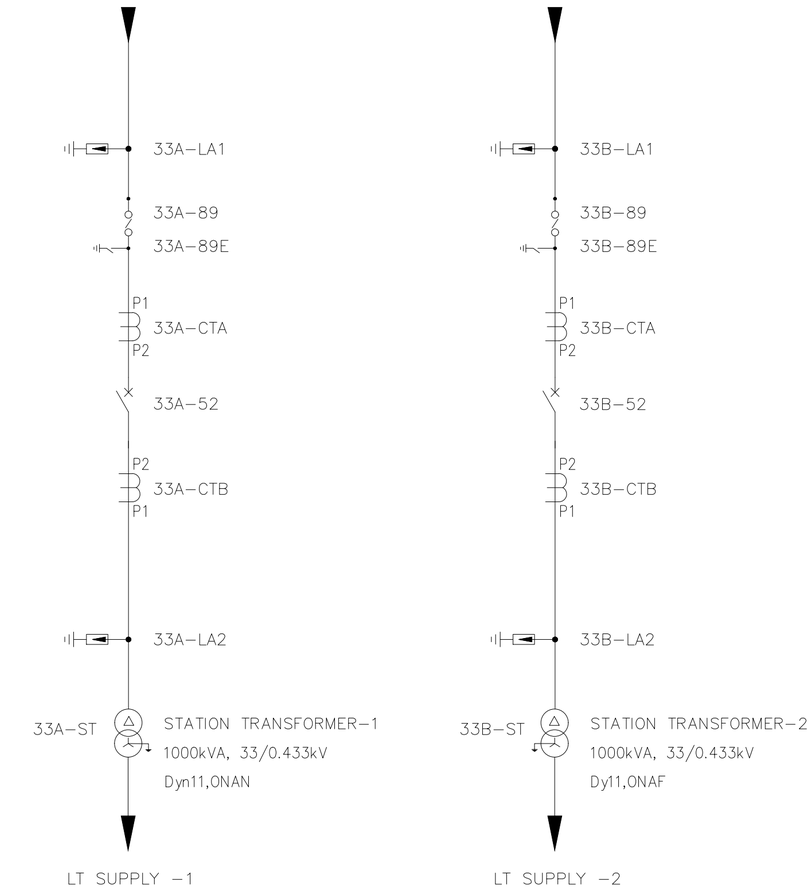
PROJECT:	400/220kVGIS SUBSTION AT ERSAMA, ODISHA & 400kV AIS FEEDER BAY EXTENSION AT DUBURI, ODISHA				
OWNER:	OPTCL ODISHA POWER TRANSMIISSIION CORPORATION LIMITED				
BHEL BHARAT HEAVY ELECTRICALS LTD. TRANSMISSION BUSINESS GROUP NOIDA		NAME	SIGN.	DATE	NO.OF VAR.
	DRN.	AK			N.A.
	CHD.	DKS			
	APPD.	VK			
DEPT. TBG / CODE	UNTOL. DIMS. GR. g/M/f	SCALE N.T.S	WEIGHT (KG) N.A.	REF. TO ASSY. DRG. N.A.	ITEM NO. N.A. / NO.OF ITEMS N.A.
TITLE SINGLE LINE DIAGRAM OF 400/220kV GIS SUB STATION AT ERSAMA	CARD CODE NA	DRG.NO. TB-3-420-510-001			REV. 00
		SHT. No 03	NO. OF SHT. 05		

SIZE-A3

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. TB-3-420-510-001



33kV SYSTEM PARAMETERS: –

S.N.	SYSTEM PARAMETERS	33kV
1.	NOMINAL VOLTAGE	33kV
2.	HIGHEST SYSTEM VOLTAGE	36kV
3.	RATED FREQUENCY	50Hz
4.	RATED SHORT TIME CURRENT	31.5kA for 3s/1s (as applicable)
5.	POWER FREQUENCY WITHSTAND VOLTAGE	70kV (rms)
6.	LIGHTNING IMPULSE WITHSTAND VOLTAGE	±170 kV peak
7.	CREEPAGE	31mm/kV (1116mm)
8.	GROUNDING	Effectively earthed

BILL OF QTY. FOR 33kV OUTDOOR EQUIPMENT:

SL.NO.	DESCRIPTION	SYMBOL	LEGEND	BAY NO./ LOCATION	UNIT	QTY. (NO.)
1	33/0.433kV, 1000kVA, 3-PH OIL FILLED STATION TRANSFORMER		ST	33A, 33B	SET	02
2	36kV, 1250A, 31.5kA FOR 3 SEC., 3-PH VACUUM CIRCUIT BREAKER		52	33A, 33B	SET	02
3	36kV, 1250A, 31.5kA FOR 1 SEC., 3-PH ISOLATOR WITH ONE EARTH SWITCH		89	33A, 33B	SET	02
4	36kV, 50A, 31.5kA FOR 1 SEC., 1-PH, CURRENT TRANSFORMER		CTA	33A, 33B	NOS.	06
5	36kV, 1200A, 31.5kA FOR 1 SEC., 1-PH, CURRENT TRANSFORMER		CTB	33A, 33B	NOS.	06
6	30kV, 10kA, CLASS-III, 1-PH, LIGHTNING ARRESTER		LA1/LA2	33A, 33B	NOS.	12

NOTES :

1. LT SUPLLY SOURCE –1 & 2: 33kV SIDE OF STATION TRANSFORMERS–1 & 2 ARE TO BE FED THROUGH TERTIARY LOADING OF ICT#1 & ICT#2. FURTHER, AS PER THE REPLY TO PRE–BID QUERY OF PKG–36(I)/2020–21, PROVIDED BY OPTCL IN ADDENDUM–2, EQUIPMENT WITH HIGHEST SYSTEM VOLTAGE OF 36kV ARE BEING PROVIDED IN THIS CIRCUIT ,

REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED
		CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD
ZONE			ZONE			ZONE			ZONE		

PROJECT:	400/220kVGIS SUBSTION AT ERSAMA, ODISHA & 400kV AIS FEEDER BAY EXTENSION AT DUBURI, ODISHA					
OWNER:	ODISHA POWER TRANSMIISSIION CORPORATION LIMITED (OPTCL)					
BHARAT HEAVY ELECTRICALS LTD. TRANSMISSION BUSINESS GROUP NOIDA		NAME	SIGN.	DATE	NO.OF VAR.	
	DRN.	AK			N.A.	
	CHD.	DKS				
	APPD.	VK				
DEPT. TBG / CODE	UNTOL. DIMS. GR. C/M/F	SCALE N.T.S	WEIGHT (KG) N.A.	REF. TO ASSY. DRG. N.A.	ITEM NO. N.A.	NO.OF ITEMS N.A.
TITLE: SINGLE LINE DIAGRAM OF 400/220kV GIS SUB STATION AT ERSAMA	CARD CODE NA	DRG.NO. TB–3–420–510–001			REV. 00	
		SHT. No 04	NO. OF SHT. 05			

SIZE–A3

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. TB-3-420-510-001

400kV GIS CT DETAILS (CTA & CTB)

Core No.	Current Ratio	Ooutput Burden at Lowest Tap (VA)	Minimum KPV (V)	Max. Ie(mA) at KPV	Maximum Rct (Ohms)	Accuracy Class	Purpose
1	3000-2000-1000/1A	-	3000-2000-1000	20-30-40	15-10-5	PS	Protection
2	3000-2000-1000/1A	-	3000-2000-1000	20-30-40	15-10-5	PS	Protection
3	3000-2000-1000/1A	20	-	-	-	0.2s, ISF≤5	Metering
4	3000-2000-1000/1A	-	3000-2000-1000	20-30-40	15-10-5	PS	Protection
5	3000-2000-1000/1A	-	3000-2000-1000	20-30-40	15-10-5	PS	Protection

400kV GIS LINE CT DETAILS (CTL)

Core No.	Current Ratio	Ooutput Burden at Lowest Tap (VA)	Minimum KPV (V)	Max. Ie(mA) at KPV	Maximum Rct (Ohms)	Accuracy Class	Purpose
1	3000-2000-1000/1A	10	-	-	-	0.2s, ISF≤5	Metering
2	3000-2000-1000/1A	10	-	-	-	0.2s, ISF≤5	Metering

220kV GIS CT DETAILS

Core No.	Current Ratio	Ooutput Burden at Lowest Tap (VA)	Minimum KPV (V)	Max. Ie(mA) at KPV	Maximum Rct (Ohms)	Accuracy Class	Purpose
CTA							
1	1600-800/1 A	-	1600-800	20-40	8-4	PS	Protection
2	1600-800/1 A	-	1600-800	20-40	8-4	PS	Protection
CTB					-		
1	1600-800/1 A	-	1600-800	20-40	8-4	PS	Protection
2	1600-800/1 A	-	1600-800	20-40	8-4	PS	Protection
3	1600-800/1 A	20	-	-	8-4	0.2s, ISF≤5	Metering

33kV OUTDOOR CT DETAILS

Core No.	Current Ratio	Ooutput Burden at Lowest Tap (VA)	Minimum KPV (V)	Max. Ie(mA) at KPV	Maximum Rct (Ohms)	Accuracy Class	Purpose
CTA							
1	50-25/1 A	15	-	-	-	PS	Protection
2	50-25/1 A	15	-	-	-	0.2s, ISF≤5	Metering
CTB							
1	1200-600/1 A	-	1200-600	50-100	6-3	PS	Protection
2	1200-600/1 A	-	1200-600	50-100	6-3	PS	Protection
3	1200-600/1 A	-	1200-600	50-100	6-3	PS	Protection

400kV GIS VT DETAILS (VT)

Winding No.	Ratio	Accuracy Class	Rated Burden (VA)	Purpose
1	(400kV/√3) / 110V/√3)	0.2	50	Metering
2	(400kV/√3) / 110V/√3)	3P	50	Protection
3	(400kV/√3) / 110V/√3)	3P	50	Protection

220kV GIS VT DETAILS (VT)

Winding No.	Ratio	Accuracy Class	Rated Burden (VA)	Purpose
1	(220kV/√3) / 110V/√3)	0.2	50	Metering
2	(220kV/√3) / 110V/√3)	3P	50	Protection
3	(220kV/√3) / 110V/√3)	3P	50	Protection

NOTES :

1. PARAMETERS OF BUSHING CT OF TRANSFROMERS AND BUS REACTOR WILL BE PROVIDED LATER.

REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED
		CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD
ZONE			ZONE			ZONE			ZONE		

PROJECT:	400/220kVGIS SUBSTION AT ERSAMA, ODISHA & 400kV AIS FEEDER BAY EXTENSION AT DUBURI, ODISHA
OWNER:	ODISHA POWER TRANSMIISSIION CORPORATION LIMITED

BHARAT HEAVY ELECTRICALS LTD.
TRANSMISSION BUSINESS GROUP
NOIDA

	NAME	SIGN.	DATE
DRN.	AK		
CHD.	DKS		
APPD.	VK		

NO.OF VAR. N.A.

DEPT. TBG	UNTOL. DIMS. GR.	SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM NO.	NO.OF ITEMS
CODE	9/M/f	N.T.S	N.A.	N.A.	N.A.	N.A.

TITLE: SINGLE LINE DIAGRAM OF 400/220kV GIS SUB STATION AT ERSAMA

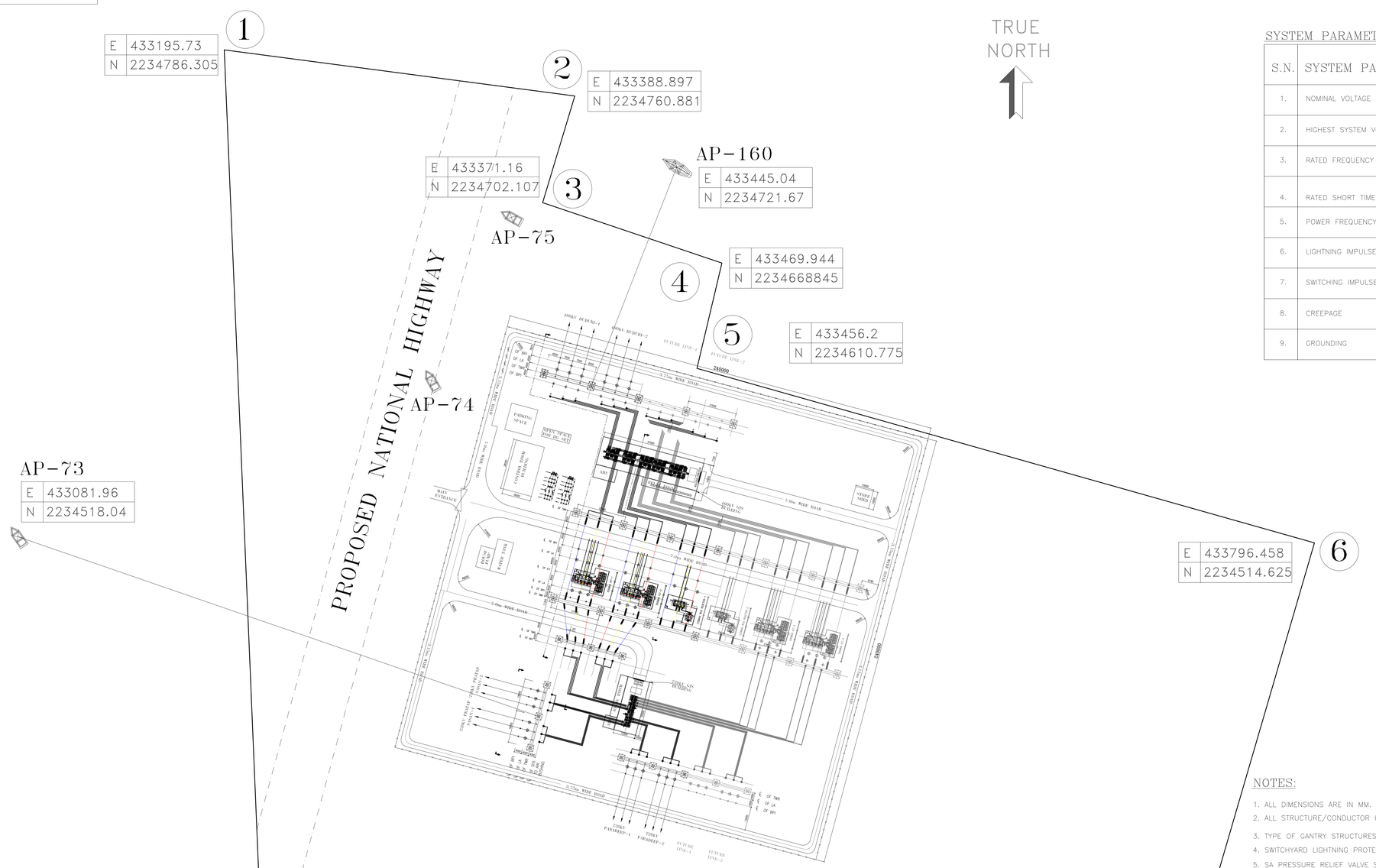
CARD CODE: NA

DRG.NO. TB-3-420-510-001

REV. 00

SHT. No 05 NO. OF SHT. 05

SIZE-A3



400/220kV GIS SUB STATION, ERSAMA OPTCL

TRUE NORTH

SYSTEM PARAMETERS:–

S.N.	SYSTEM PARAMETERS	400kV	220kV
1.	NOMINAL VOLTAGE	400kV	220kV
2.	HIGHEST SYSTEM VOLTAGE	420kV	245kV
3.	RATED FREQUENCY	50Hz	50Hz
4.	RATED SHORT TIME CURRENT	63kA for 3s/1s (as applicable)	50kA for 3s/1s (as applicable)
5.	POWER FREQUENCY WITHSTAND VOLTAGE	630kV (rms)	460Kv (rms)
6.	LIGHTNING IMPULSE WITHSTAND VOLTAGE	±1425 kV peak	±1050 kV peak
7.	SWITCHING IMPULSE WITHSTAND VOLTAGE	±1050 kV peak	N.A
8.	CREEPAGE	31mm/kV (13020mm)	31mm/kV (7595mm)
9.	GROUNDING	Effectively earthed	Effectively earthed

BILL OF QUANTITY:–

S.NO.	DESCRIPTION	SYMBOL	QUANTITY (NOS.)
1	420 kV INDOOR GIS		01
2	420kV, 1–ph SF6 TO AIR BUSHING		15
3	390kV, 1–ph SURGE ARRESTER		15
4	420kV, 8kN , 1–ph, BUS POST INSULATOR		21

S.NO.	DESCRIPTION	SYMBOL	QUANTITY (NOS.)
1	220kV INDOOR GIS		01
2	220kV, 1–ph SF6 TO AIR BUSHING		18
3	216kV, 1–ph SURGE ARRESTER		18
4	220kV, 8kN , 1–ph, BUS POST INSULATOR		45

NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. ALL STRUCTURE/CONDUCTOR HEIGHTS ARE ABOVE PLINTH LEVEL. PLINTH LEVEL IS 300 MM ABOVE F.G.L.
3. TYPE OF GANTRY STRUCTURES SHALL BE AS PER APPROVED STRUCTURAL LAYOUT DRAWING.
4. SWITCHYARD LIGHTNING PROTECTION IS ACHIEVED THROUGH SPIKES PROVIDED AT TOWER PEAKS AS PER APPROVED DSLP.
5. SA PRESSURE RELIEF VALVE SHALL NOT BE TOWARDS TRANSFORMER SIDE / ANY EQUIPMENT KEPT NEAR LIGHTING ARRESTER AND BHEL SHALL ENSURE THE SAME DURING ERECTION AT SITE.
6. FOR SECTION DETAILS, REFER SHEET No. 02.
7. SIZE OF GIS BUILDINGS, CONTROL ROOM BUILDING AND OTHER BUILDINGS ARE TENTATIVE & MAY CHANGE AS PER THE ACTUAL REQUIREMENT.
8. DEAD END TOWERS LOCATIONS SHALL BE CONFIRMED BY OPTCL IN LINE WITH THIS LAYOUT. 220kV FUTURE LINE ORIENTATION IS ALSO TO BE CONFIRMED BY OPTCL.
9. SUPPLY AND STRINGING OF 400kV & 220kV LINE CONDUCTORS, SHIELD WIRE, INSULATOR AND HARDWARE BETWEEN 400kV & 220kV DEAD END TOWERS AND SWITCHYARD TERMINAL GANTRIES ARE NOT IN BHEL SCOPE. HOWEVER, JUMPERING FOR THE RESPECTIVE EQUIPMENT, JUMPERS & HARDWARE REQUIRED FOR JUMPERS ARE IN SCOPE OF BHEL.
10. BAY SEQUENCE OF GIS BAYS MAY CHANGE DURING DETAILED ENGINEERING AS PER THE GIS OEM RECOMMENDATION AND FINAL LOCATIONS OF 400kV & 220kV LINE TERMINATIONS.
11. LOCATIONS OF 400kV & 220kV TRANSMISSION LINE TOWERS ARE AS PER CUSTOMER INPUT PROVIDED DURING KICK–OFF MEETING AT OPTCL OFFICE DATED 06.01.2023. ONLY 400kV D/C LINE FROM DUBURI & 220kV D/C LINE FROM PRATAP SASAN IS AVAILABLE WITH BHEL. REMAINING 220kV D/C LINE FROM PARADEEP & BOTH 400kV & 220kV FUTURE LINE ROUTES/ CORRIDORS TO BE PROVIDED BY OPTCL.
12. AS PER THE PRESENT LOCATIONS OF TL TOWERS OF 220kV D/C LINE FROM PRATAP SASAN, TOWERS AP–74 & AP–75 CANNOT BE USED AS TERMINATION AT SWITCHYARD GANTRY WILL NOT BE POSSIBLE. BHEL PROPOSES TO TERMINATE THIS LINE DIRECTLY FROM TWR. AP–73 TO 220kV SWITCHYARD GANTRY. OPTCL TO REVIEW THE PROPOSAL & CONFIRM THE SAME.
13. 400kV TRANSMISSION LINE TOWER AP–160 OF D/C LINE FROM DUBURI WILL BE THE DEAD END TOWER & SWITCHYARD GANTRY IS LOCATED ACCORDINGLY. OPTCL TO REVIEW THE PROPOSAL & CONFIRM THE SAME.

PROJECT:	400/220 kV GIS SUB STATION AT ERSAMA ODISHA & 400kV AIS FEEDER BAY EXTENTION DUBURI ODISHA
OWNER:	ODISHA POWER TRANSMISSION CORPORATION LIMITED

BHARAT HEAVY ELECTRICALS LTD.
TRANSMISSION BUSINESS GROUP NOIDA

	NAME	SIGN.	DATE
DRAWN	AK	–SIGNED–	31.01.23
CHECKED	DKS	–SIGNED–	31.01.23
APPROVED	VK	–SIGNED–	31.01.23

DEPT. TBEM | CODE 422 | SCALE | CARD CODE

DRG. TITLE: LAYOUT PLAN & SECTION OF 400/220kV GIS SUB STATION AT ERSAMA

DRAWING NO. TB–420–316–001 | REV. 00

SHEET No. 01 | NEXT SHEET 02

REV.	DATE	ALTERED / CHECKED / APPROVED	ZONE

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

Contents

SECTION 2:

EQUIPMENT SPECIFICATION UNDER SCOPE OF SUPPLIES/ SERVICE

1. CUSTOMER TECHNICAL SPECIFICATION

400 / 220 / 132 KV GIS SUB-STATION SYSTEM

GENERAL DESCRIPTION OF GAS INSULATED SWITCHGEAR .

STANDARD SPECIFICATIONS

The switchgear conforms to the following IEC standards:

SWITCHGEAR, GENERAL:

IEC 62271-1 : High-voltage switchgear and control gear Part 1: Common specifications

IEC 62271-203 : High-voltage switchgear and control gear Part 203: Gas-insulated metal-enclosed switchgear for rated voltages above 52 kV Circuit-breakers:

IEC 62271-100 : High-voltage switchgear and control gear Part 100: Alternating-current circuit-breakers

IEC 62271-101 : High-voltage switchgear and control gear Part 101: Synthetic testing Disconnectors, earthing switches.

IEC 62271-102 : High-voltage switchgear and control gear Part 102: Alternating-current dis connectors and earthing switches Instrument transformers:

IEC 62271-303: High-voltage switchgear and control gear – Use and handling of sulphur hexafluoride (SF_6)

IEC 61000 Electromagnetic compatibility (EMC)

IEC 60060 High voltage test techniques

IEC 60071 Insulation co-ordination

IEC 60255 Electrical relays

IEC 60265 High voltage switches

IEC 60270 High-voltage test techniques - Partial discharge measurements

IEC 60376 Specification and acceptance of new sulphur hexafluoride

IEC 60480 Guide to checking of sulphur hexafluoride (SF_6)

IEC 60529 Degrees of protection provided by enclosures (IP Code)

IEC 60815 Guide for the selection of insulators in respect of polluted conditions

IEC 61869 Instrument transformers

IEC 60364 / 60479 / 60621 / IEEE std. 80 Standards for station grounding.

CENELEC/SVDB Pressure vessel codes

CABLE CONNECTIONS:

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

OUTDOOR BUSHINGS:

BHEL Transmission Business Group Industry Sector Noida-05

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IEC 60137 : Insulated bushings for alternating voltages above 1000 V Transformer direct connection:
IEC 61639 : Direct connection between power transformers and gas-insulated metal-enclosed switchgear for rated voltages of 72.5 kV and above.

SURGE ARRESTERS:
IEC 60099-4: Surge arresters Part 4: Metal-oxide surge arresters without gaps for A.C. Systems SF6-Gas:
IEC 60480: Guidelines for the checking and treatment of sulphur hexafluoride (SF6) taken from electrical equipment and specification for its re-use
IEC/TR 62271-303: High-voltage switchgear and control gear Part 303: Use and handling of sulphur hexafluoride (SF6)

LOCAL CONTROL CUBICLES:
IEC 61439 -1: Low-voltage switchgear and control gear assemblies Part 1: General rules EMC.
IEC 62271-1: High-voltage switchgear and control gear Part 1: Common specifications The enclosures of the switchgear conform to the following EN standards:

ENCLOSURE

CENELEC standard mentioned above.

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

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

SURFACE TREATMENT
Steel (covers):
Indoor structure: Hot galvanised or painted
Outdoor structure: Hot galvanised and painted
High-Grade Steel (expansion joints):
Indoor Pre-treatment: none
Paint work: none
Outdoor Pre-treatment: degrease
Paint work: same as housings of cast aluminium

CAST-ALUMINIUM:
Pre-treatment (indoor and outdoor): Sand-blast or degrease alkaline
Internal surfaces (cast-aluminium): Seevenax protective paint **RAL 7038** (grey)
Internal surfaces (aluminium wrought alloy): without surface treatment
External surfaces: material description: high-resistant 2-component polyurethane paint
Shade: RAL 9010 (white)

GAS
Gas compartments, monitoring of gas compartments:
• SF6 serves as insulation for the enclosure of several separately-sealed gas compartments
• static filters in all gas compartments – with single-phase encapsulation for each phase for single phase encapsulation design - absorb moisture and decomposition products; the filter material is placed in filter bags which are supplied in airtight cans

• all gas compartments are equipped with rupture diaphragms and, if necessary, with gas diverter nozzles; these nozzles are arranged in a way that, if the rupture diaphragm bursts, the gas flow is guided away in a direction not unnecessary hazardous to either personnel or equipment
• the modules of circuit-breakers, voltage transformers, cable connection module and surge arresters form separate gas compartments. Sectionalizing shall ensure that Circuit breaker enclosure shall not have any other critical switching/non-switching component within same circuit breaker compartment for example current transformer, earth switch, dis-connector etc.
• the disconnector gas compartment can contain other device earthing switch
• the switch operating shafts are supported and provided with lip seals against pressure and vacuum loss in such a way that during the evacuation process before commissioning no air can penetrate and no SF6 can escape during operation; the leakage rate is less than 0.5 % SF6 per year and gas compartment.
• the gas pressure is monitored by density monitors with indication; density monitors are installed directly at the gas compartment they monitor.

1. GENERAL SPECIFICATION

The intent of this specification is to provide the work enumerated to be fully complete in every detail for the function designated. It is hereby required that the BIDDER, in accepting the contract, agrees to furnish all apparatus, appliances, material not herein specifically mentioned or included, but which may be found necessary to complete, perfect or test any portion of the apparatus or equipment herein specified in a substantial manner, and in compliance with the requirements implied in this specification and without extra cost to the PURCHASER/OWNER. The GIS manufacturer should have (1) prompt after sale service support having based in India (2) having HV testing kit & (3) provide supporting documents for the same.

NOTE: The Bus of the 400kV, 220 KV, 132kV & 33 KV GIS System shall be of **Aluminum** of adequate size and should be capable of withstanding the short circuit current level of 63kA, 50kA, 40 KA & 31.5 KA respectively for 3 sec. Care should be taken while designing the GIS system.

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

Remarks: The type of exit termination shall be as defined in the Single Line Diagram.

EQUIPMENTS TO BE SUPPLIED BY THE BIDDER:

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

(A): To be used in GIS.

1 Circuit breakers
2. Dis connector switches (Bus / Line)
3. Maintenance earthing switches
4. Fast acting line earth switches
5. Bus Pts in 400/220 / 132/33kV side
6. SF6 Bus – duct
7. Current transformers
8. Surge arrester
9. Bus and elbow sections
10. Cable end enclosures
11. SF6 to air bushings / cable terminations
12. Ground connection to the station ground grid
13. Auxiliary material to complete the GIS installation (like density switches, auxiliary power/control cable and bolts)
14. Support structures for the GIS
15. Insulating SF6 gas

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16. Local Control Cubicle
17. Special tools for installation, monitoring, testing & maintenance
18. Commissioning spares
19. Protection control and sub-station automation system with IEC 61850.

(B) Following equipment to be used in AIS: (as per site requirement & BPS)

1. Surge Arrester. (400 KV, 220KV & 33 KV side)
2. Line Capacitor Voltage Transformer: 400/220/132 KV side.
3. 33/0.43 KV,250 KVA Station Transformers

(C) Following auxiliary system also to be supplied.

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

SERVICES TO BE SUPPLIED BY TENDERER:

1. All equipment and material shall be prefabricated, factory assembled, tested and shipped in the largest practical assemblies dependent on the mode of transport.
2. The Tenderer shall provide documentation as required in this specification.
3. The Tenderer shall provide the services of operation & maintenance for the purpose of installation, testing & commissioning and on-site training.

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

2. ELECTRICAL RATINGS:

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

			420kV / 220 KV / 132kV
i)	Phase design		1-ph for (420kV & 220 kV) and 3-ph for (132 kV)
ii)	Rated voltage	KV	420 / 245 / 145

	A	Rated lightning impulse withstand voltage (peak) phase to earth Across open contacts	KV KV	1425 / 1050 / 650 1425/ 1050/ 650
	B	Power frequency 1 minute (r.m.s.) phase to earth Across open contacts	KV KV	650 / 460 / 275 650 / 460 / 275
iii)	Rated frequency		Hz	50
iv)	Rated current (bus bars) [At 40°C]		A	4000A for 400kV & 3150A for 220kV & 132kV
v)	Rated short-time current (r.m.s) (3s)		KA	63 / 50 / 40
vi)	Rated making current (peak)		KA	170 / 135 / 108
vii)	Rated short circuit breaking current		KA	63 / 50 / 40
viii)	Partial discharge level, complete bay 1.5 x U//3		pC	< 5
ix)	SF6 gas pressure at 68 °F / 20 °C, for reference		kPa	*Shall be submitted by the manufacturer.
x)	Enclosure			*Aluminium alloy
xi)	Seismic level			"High" (as per clause no 4.2 of IEC-62271-207) for the area under the Zone-V as per IS-1893. "Medium" (as per clause no 4.2 of IEC-62271-207) for the area under other than the Zone-V as per IS-1893

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

3. EQUIPMENT SPECIFICATION

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

3.1 General

The GIS shall be made of tubular Aluminum alloy and filled with SF6 gas for insulation. Enclosures shall be of single phase for 400kV & 220 kv and 3- phase encapsulation for 145kV for both the bus bars and the feeder section bays.

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

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

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

Tenderer shall confirm the nominal rating of GIS components at **50°C**

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

3.1.1 SECTIONALIZATION

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

i) To minimize operational shut down when the gas pressure is reduced due to Leakage or for maintenance purposes.
ii) Annexure F3 of Annex-F of IEC 62271-203 standard specify to meet the highest service criteria. Bidder must submit gas schematic diagram with the bid to comply these requirement
iii) To minimize the quantity of gas that has to be evacuated and recharged before and after maintaining any item of equipment.

The GIS Assembly must be sectionalized & shall Consists of separate GIS Modular compartments Such as circuit breaker compartment, bus bar compartment filled with SF6 gas and separated by Gas tight partitions so as to minimize risk to human life , allow ease of maintenance and limit the effects of gas leaks failures & internal arcs etc. Sectionalizing shall ensure that Circuit breaker enclosure shall not be housed any other critical switching/non-switching component within same circuit breaker compartment for example current transformer, earth switch, disconnector etc. Continuous bus lengths without gas segregation shall not be acceptable. Bus bar length should have mandatory gas segregation along with dedicated density monitor, Gas refiling valve and pressure relief for each gas segregation. Barrier insular should be used for creating adequte gas segregation over the bus bar length. The length of the bus bar compartments shall be such that the gas handling / quantity in an individual BUSBAR COMPARTMENT shall be limited to 100 kg.

Each section shall be provided with necessary valves to allow evacuation and refill of gas without evacuation of any other section. No external gas piping shall be used between phases to connect common density. Each section/compartment of single phase design should have dedicated individual density monitor, gas valve and pressure relief devices. For the purpose of gas monitoring and maintenance, the GIS shall be provided with gas density monitoring device along with temperature compensated gas density switch having two stages/more stages contacts in each gas compartment.

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

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

Pressure relief devices shall be provided for each gas compartment.

3.1.2 CONDUCTOR TYPE AND CONTACTS

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

3.1.3 SUPPORT INSULATORS AND SECTION BARRIERS

Support insulators shall be used to maintain the conductors and enclosure in proper relation.
Barrier insulators which are employed to isolate gas compartments as well as support insulators shall be manufactured from high quality epoxy resin, free of all voids and be designed to reduce the electrical stress on the insulators to a minimum. The support insulator shall have holes on both sides for proper flow of gas.
The mechanical strength must be sufficient to ensure the conductor's space requirements and clearances when short circuit faults occur. In addition, the gas barrier insulators sealing to the conductors and the enclosure wall shall be designed to withstand the maximum gas pressure differential under normal operating condition and maximum pressure differential with one of the adjacent enclosures at three times operating gas pressure and the other at atmospheric pressure for five minutes. Its safety factor shall be no less than 4.5 or as per relevant IEC standard (latest).

Tests shall be carried out during the manufacturing of the switchgear to ensure that all insulators are free of partial discharge at a voltage which is at least 10% higher than the rated voltage or as per relevant IEC standard (latest).

3.1.4 GAS SYSTEM

The GIS shall be furnished with sufficient sulfur hexa-fluoride (SF6) gas to pressurize the complete system in a sequential approach, one zone or compartment at a time to the rated nominal density. During commissioning the dew point of SF6 gas shall be measured and documented. Maximum water content of SF6 -gas in GIS, within guarantee period:
CB ≤ 150 PPM (volume) or as per relevant IEC standard (latest).
Others ≤ 500 PPM (volume) or as per relevant IEC standard (latest)
The Gas loss of the switchgear shall be in no case higher than 0.5% per year (as per IEC62271-203).

3.1.5 GAS SEALS

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

3.1.6 GAS FILTERS / TREATMENT

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

3.1.7 SF6 GAS QUALITY

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

3.1.8 GAS MONITORING DEVICES

SF6 Gas Monitoring Devices:

Dial type temperature compensated gas density monitoring devices shall be provided. The device

shall be provide for continuous & automatic monitoring of the state/status of gas. Separate gas density monitoring device shall be provided for each gas compartment, so that each compartment can be monitored simultaneously as follows;

(i) Compartments except circuit breaker:

a) Gas Refill level: This will be used for annunciation regarding the need for the gas refilling. The contacts shall be provided in the device for remote indication.

b) Zone Trip Level: This is the minimum level at which the manufacturer will guarantee the insulation rating of the assembly. Necessary provision of Contacts in the device shall be in accordance with requirement.

(ii) For Circuit Breaker Compartments:

a) Gas Refill level: This will be used for annunciation regarding the need for the gas refilling. The contacts shall be provided in the device for remote indication.

b) Breaker Block Level: This is the minimum level at which the manufacturer will guarantee the insulation rating of the circuit breaker. At this level the breaker block contact shall operate & the tripping circuits shall be blocked. Necessary provision of Contacts in the device shall be in accordance with requirement in order to initiate the zone trip from CRP.

SF6 gas shall be monitored with suitable gas density monitors, temperature and pressure switches with a facility to transmit the status through 4-20mA or MODBUS to SCADA. All the contacts shall be wired to SCADA through common GIS controller.

3.1.9 GAS LOSS

Maximum guaranteed gas leakage loss of the switchgear shall be in no case be more than **0.5%** per year.

3.1.10 SF6 GAS TREATMENT

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

3.1.11 SUPPLY OF SF6 GAS

The tender shall include the supply of all SF6 gas necessary for filling and putting in commercial operation the complete switchgear installation with recommended extra quantity (minimum 10% extra). The SF6 gas insulated metal-clad switchgear shall be designed for use with SF6 gas complying with the recommendations of IEC 376, 376A & 376B, at the time of the first charging with gas. All SF6 gas supplied as part of the contract shall comply with the requirements of IEC as above as a minimum & should be suitable in all respects for use in the switchgear under all operating conditions. The high pressure cylinders in which SF6 gas is supplied & stored at site shall comply with the requirements of following standards & regulations IS: 4379 Identification of the contents of industrial gas cylinders.

IS : 7311 Seamless high carbon steel cylinders for permanent & high pressure liquefiable gases. The cylinders shall also meet Indian Boilers Regulations. (Mandatory)

SF6 gas shall be tested for purity, dew point, air, hydrolysable fluorides and water contents as per IEC:376, 376A & 376B and test certificates shall be furnished to the owner indicating all test results as per IEC standards for each lot of SF6 gas. Further, site tests for moisture, air content, flash point and dielectric strength to be done during commissioning of GIS equipment. 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.

3.1.12 PRESSURE RELIEF

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

3.1.13 SWITCHGEAR ENCLOSURES

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

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

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

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

3.1.14 EXPANSION JOINTS AND FLEXIBLE CONNECTION

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

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

3.1.14.1 UHF sensors for PD detection:

400 & 220 & 132 KV GIS Equipment shall be provided with 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 the employer. Further UHF sensors shall necessarily be provided in close proximity to

VT compartments 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 coustic method). In case during site testing additional UHF sensors are required, the same shall also be supplied& installed to complete the technical requirement.

Note: GIS Equipment shall have in Built UHF Based Sensors for On-Line PD Measurement for ready Connection and interfacing with a continuous on Line PD Measurement System or Portable On-Line PD Measurement Instrument. These shall be a definite scope of supply and the number and location of PD Sensors built in the GIS Equipment supplied shall be supported with the necessary documentation for confirming the sufficiency/adequacy of the PD sensors provided, considering the coverage of all portions of the GIS equipment.

3.1.15 FINISH OF SURFACE AND CLEANING

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

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

3.1.16 SUPPORTING STRUCTURES

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

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

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

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

3.1.17 FUTURE EXTENSION

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

3.1.18 REPAIR

In case of any internal fault in the bus bar or bus bar dis - connector, circuit breaker, repair works must be possible with at least one bus bar in service. Any failure shall be immediately signaled by the systems inherent self-supervision with clear description of the nature and the location of this failure. Generally any failure shall have impact only on the direct related devices and the rest of the substation shall remain in normal operation. For 145 kV GIS, during repair or maintenance of busbar disconnector adjacent feeder shall be out of service.

3.1.19 REMOVAL OF COMPONENTS

The GIS shall be designed so that any component of the GIS can be easily removed. As minimum flexibility in the layout arrangement, it shall be possible to remove the circuit breaker with both bus

bar remaining in service and it shall be possible to remove the dis connector of the bus bars, with one bus bar remaining in service. For achieving this requirement, adequate number of intermediate compartments, if required, shall be provided to ensure equipment & operating personnel's safety. This is in line with figure F3 of Annex-F of IEC 62271-203. Bidder must submit gas schematic diagram with the bid to comply these requirements.

3.1.20 EARTHING OF THE SWITCHGEAR

GROUNDING: The grounding system shall be designed and provided as per IEEE-80-2000 and CIGRE-44 to protect operating staff against any hazardous touch voltages and electro-magnetic interferences.

The GIS supplier shall define clearly what constitutes the main grounding bus of the GIS. The contractor shall supply the entire material for grounding bus of GIS viz conductor, Clamps, joints, operating and safety platforms etc. The contractor is also required to supply all the earthing conductors and associated hardware material for connecting all GIS equipment, bus ducts, enclosures, control cabinets, supporting structure, GIS surge arrestor etc. to the ground bus of GIS. The enclosure of the GIS may be grounded at several points so that there shall be grounded cage around all the live parts. A minimum of two nos. of grounding connections should be provided for each of circuit breaker, cable terminals, surge arrestors, earth switches and at each end of the bus bars. The grounding continuity between each enclosure shall be effectively interconnected externally with Copper /Aluminum bonds of suitable size to bridge the flanges. Subassembly to subassembly bonding shall be provided to bridge the gap & safe voltage gradients between all intentionally grounded parts of the GIS assembly & between those parts and the main grounding bus of the GIS.

Each marshaling box, local control panel, power and control cable sheaths and other non-current carrying metallic structures shall be connected to the grounding system of GIS via connections that are separated from GIS enclosures.

The grounding connector shall be of sufficient mechanical strength to withstand electromagnetic forces as well as capable of carrying the anticipated maximum fault current without overheating. At least two grounding paths shall be provided to connect each point to the main grounding bus. Necessary precautions should be under taken to prevent excessive currents from being induced into adjacent frames, structures of reinforcing steel and to avoid establishment of current loops via other station equipment.

(a) EARTHING OF MAIN CIRCUITS

To ensure safety during maintenance work all parts of the main circuit, to which access is required, shall be provided with provision of earthing through earth switch as applicable.

(b) EARTHING OF ENCLOSURE

The enclosure shall be connected to earth. All metal parts other than main and auxiliary circuits shall be earthed. Separate earthing strips to short circuit flanges and earth switches are not allowed. Earthing switches shall be connected to earth through enclosures. Individual earth leads for the earth Switches are not recommended.The continuity of the earthing circuits shall be ensured taking into account thermal and electrical stresses caused by the current they have to carry.
Each of the earthing strips shall be connected to the main earthing mesh installed below the GIS, at two ends.

(c) EARTHING OF GIS

The earthing system shall be based on a multi-point design ensuring the protection in case of indirect contact (Touch or step voltages, in case of system fault) and transient phenomena in case of lightning or switching operations.
Earthing conductors shall allow fault with short circuit current for at least 1 sec. Separate ground strips to short circuit flanges and earthing switches are not allowed. Grounding switches shall be connected to ground through the enclosure. Individual ground leads for the ground switches are not allowed.

3.1.21 AUXILIARY CONTACTS

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

3.1.22 SPECIAL TOOLS (NOT APPLICABLE)

Any special tools needed for installation, operation and inspection shall be included in the quotation. **These special tools shall be supplied along with the GIS and shall not be taken back by the bidder.** For gas handling purpose following tools shall be quoted as a minimum:

i) SF6 Gas Analyser
ii) Leakage detector
iii) Precision pressure gauge

3.2 TECHNICAL SPECIFICATION OF THE HIGH VOLTAGE COMPONENTS OF GIS

3.2.1 CIRCUIT BREAKER

1. General

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

Circuit-breakers shall be the SF6 gas insulated type of single phase for 400kV & 220 KV & three phase encapsulated for 132kV design with the specified ratings. The breaker shall be Self-Blast / auto Puffer type principle and consist of one interrupting arcing chambers.
Each circuit-breaker including the drive mechanism shall be completely factory assembled, adjusted and tested. The breaker shall include a suitable operating mechanism to assure proper opening and closing, and shall permit checking adjustments and opening characteristics. Each mechanism shall include dual trip coils in redundant design. The mechanism shall be capable of re-closing within the range specified in the applicable standards. The breakers are to be re-strike-free. The Circuit breaker shall be C2 class type and 400 kV, 'k' should be 1.4 times.

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

2. Technical Particulars

		420kV / 220 KV / 132kV
Nominal operating Voltage	kV	400 / 220 / 132
Highest system Voltage	kV	420 / 245 / 145
Nominal operating current(at 40°C)	A	4000A (400kV) & 3150 (220 & 132kV)
System earthing		Solidly earthed
Rated withstand voltage with respect to earth		
Lightning	kV	1425 / 1050 / 650
Power frequency	kV	650 / 460 / 275
Rated short-circuit breaking current (r.m.s.), 3s:	kA	63 / 50 / 40
Rated making current (peak):	kA	157.5 / 125 / 100
Rated break time	ms	≤ 2 cycle for 400 KV & < 3 cycle for 220/132 KV
Rated opening time	ms	As per IEC-62271-100
Rated closing time	ms	< 5 cycle
Close-open time	ms	As per IEC-62271-100

Rated cable and line charging breaking current	A	400 (400kV), 250 & 125 (220kV) and 160 & 50 (145 KV)
Number of breaks per pole	Nos.	1
First pole to clear factor		1.3 minimum
Operating mechanism :		Spring Charged
Rated operating sequence		O-0.3s-CO-3 min-CO / CO-15sec-CO
Time for recharging CO cycle		
Type		Spring Charged
Number of trip coils		2 in each pole
Number of closing coils		1 in each pole
Rated control voltage (DC)	V	220 DC
Number of operations permissible without maintenance: At no load At rated current At 40/50 kA	 CO CO CO	 10'000 6000 As per IEC

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

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

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

I) AC supply : voltage ± 10% frequency ± 5%

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

3. Constructional features

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

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

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

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

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

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

All gasket surfaces shall be smooth, straight and reinforced.

4. Breaking capacity
The total breaking time from energizing of the trip coil at rated control voltage to final arc extinction shall be as short as possible.
The circuit breaker shall be capable of breaking all currents from zero up to the specified maximum fault current in accordance with the relevant IEC publications. Official test reports shall be submitted with the tender as evidence that the offered circuit breaker meets the specific rating.

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

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

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

Closing coil rating shall be as per GIS manufacturers standard.

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

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

9. Operating mechanism
Spring-Charged operating mechanism shall be supplied for each circuit-breaker. The operating mechanism should be spring loaded for single and three pole operation in any type of mechanism. Electric motor for the mechanism shall be DC operated. In case of failure of auxiliary supply, the mechanism shall have sufficient energy stored to perform at least a O-CO cycle. Additionally, it should also be possible to operate the mechanism manually as a safety requirement (e.g. to ensure that the stored energy has been released in case of any assembly, maintenance or replacement work)

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

The mechanism shall be strong and rigid and shall be suitable for high speed auto re-closing and other duties specified.

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

Spring-Charged operating mechanism shall be complete with all control equipment. The only external requirement for operation shall be electrical supply. Low stored operating energy shall be detected as per following operations:

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

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

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

Each breaker shall have sufficient auxiliary switches all wired to terminals located in the local control cubicle.
Position indicating devices: Position indicators shall be provided to clearly indicate whether a circuit-breaker is open or closed.

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

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

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

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

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

3.2.2 DISCONNECTOR

1 General
The GIS dis connectors shall comply with the following general and the latest revision of the relevant IEC standards. Dis connectors shall be three pole, group operated, no-load break, with one motor operated mechanism per three-pole. They shall also have facilities for emergency manual operation and the necessary operating handles or hand cranks shall be supplied. Dis connector shall be interlocked to prevent the earthing switch from closing on a energized bus section.
All main contacts shall either be silver plated or shall have silver inserts. Each dis connector shall open or close only due to motor-driven or manual operation. The switch contact shall not move due to gravity or other means, even if a part fails. Once initiated, the motor mechanism shall complete an open or close operation without requiring the initiating contact to be held closed. The dis connectors shall be located as shown in single line diagram.

2 Technical Particulars

		400kV / 220 KV / 132kV
Rated Voltage	kV	420 / 245 / 145
- Lightning	kV	1425 / 1050 / 750

- Power frequency	kV	815 / 460 / 315
Nominal operating current(at 40°C)	A	3150 / 2000
Rated short-circuit withstand current (r.m.s.), 1s	kA	63 / 50 / 40
Type of operating mechanism		Motor
Number of drives per 3 phase		1
Control voltage (DC)	V	220 DC
Number of CO permissible without maintenance	No.	As per latest IEC standard or equivalent.

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

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

The mechanisms shall be arranged for locking in the open and in the closed position. Facilities shall be available to allow the switch to be padlocked in any position.
The mechanism should be easily accessible (preferably from front).

3. Position indicating
External mechanically connected position indicators shall be provided showing either open or close position. To meet safety requirement, Disconnector compartment should have minimum 75mm window to check position of Disconnector contacts.

3.2.3 MAINTENANCE EARTHING SWITCH
1. General
The GIS earthing switches shall comply with the following general requirements and the latest revision of the relevant IEC standards. Maintenance earthing switches shall be three pole, group operated, no-load break, with one motor operated mechanism per three-pole. They shall also have facilities for emergency manual operation and the necessary operating handles or hand cranks shall be supplied.
Maintenance earthing switches shall be electrically interlocked to prevent the earthing switch from closing on an energized bus section. The common point of the two bus bars along with earth switch shall be designed and housed in a single compartment so as to avoid complete shutdown of the system in case of maintenance required in any disconnector
All main contacts shall either be silver plated or shall have silver inserts. Each earthing switch shall open or close only due to motor-driven or manual operation. The switch contact shall not move due to gravity or other means, even if a part fails. Once initiated, the motor mechanism shall complete an open or close operation without requiring the initiating contact to be held closed.
The maintenance earthing switches shall be located as shown in the single line diagram.

2. Technical Particulars

		400kV / 220 KV / 132kV
Rated Voltage	KV	420 / 245 / 145
- Lightning	kV	1425/ 1050/ 750
- Power frequency	kV	815 / 460 / 315
Rated current	A	NA
Rated short-circuit withstand current (r.m.s.), 1s:	kA	63 / 50 / 40
Type of operating mechanism		Motor
Number of drives per 3 phase	Nos.	1
Control voltage (DC)	V	220 DC

Number of CO permissible without maintenance	Nos.	As per latest IEC standard or equivalent.

3. Operating mechanism

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

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

Manual operation shall be prevented if the interlocking system does not allow the operation of the switch.
The auxiliary energy shall be electrically uncoupled from the motor when the switch is operated manually.

The mechanisms shall be arranged for locking in the open and in the closed position. Facilities shall be available to allow the switch to be padlocked in any position.
The mechanism should be easily accessible (preferably from front).

4. Position indicating devices

External mechanically connected position indicators shall be provided showing either open or close position. To meet safety requirement, Disconnector-Maintenance E/S compartment should have minimum 75mm window to check position of Maintenance E/S contacts

3.2.5 FAST ACTING EARTHING SWITCH

1. General

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

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

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

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

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

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

2. Technical Particulars

		400kV / 220 KV / 132kV
Rated Voltage	kV	420kV / 245 / 145

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Rated short-circuit withstand current 1s, (r.m.s.):	kA	63 / 50 / 40
Inductive current switching capability	A , kV	As per IE C standard
Capacitive current switching capability	A , kV	As per IEC standard
Type of Mechanism		Motor
No. of drives per three phase	Nos.	1
Closing time	ms	As per manufacturer standard
Control voltage	V	220 DC
Number of permissible CO without maintenance	Nos.	As per IEC
Short-circuit making:	Class	E1

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

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

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

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

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

5. Position indicating devices
External mechanically connected position indicators shall also be provided.

Note: During maintenance of any device under any circumstances the whole substation shall not be allowed to go out of service.

3.2.5.1 End Bus Disconnector with Earth Switch:

Compartment arrangement at the end of main bus bar shall be such that simultaneous shutdown of both main bus bars is not required during future extension job. For the above purpose suitable arrangements with disconnector with earth switch on each bus bar with suitable Gas Tight Spacers / compartments shall be provided at each end where the Extension is foreseen in the Tender SLD. In case there is no indication of the Future extension, then the bidder is requested to get necessary confirmation at the time of bidding, prior to bid submission. Gas Line Diagram showing the procedure of bay extension as described above shall be submitted along with the bid by the bidder.

3.2.6 CURRENT TRANSFORMERS

CT parameters shall be as per enclosed SLD of GIS.

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

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

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

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

2. Position of the Current Transformers and Cores, Ratios and Characteristics.
The number and position of the current transformers relative to the circuit-breakers, disconnectors and earthing switches shall be as detailed in the attached single line diagram. However, there must have possibility of provision of CT on either side of CB. Each current transformer shall be arranged so that the enclosure current does not affect the accuracy or the ratio of the device or the conductor current being measured. It shall be possible to test each current transformer without the removal of gas through the insulated grounding switches.

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

However, CT ratio shall be finalized during detailed engineering.
The secondary core of current transformers shall be preferably placed outside the high voltage enclosures, mounted in suitable, accessible terminal boxes and the secondary leads of all the current transformers shall be wired to shorting type terminals.

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

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

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

4. Constructional Details:
The current transformers incorporated into the GIS will be used for protective relaying and metering and shall be of metal enclosed type. The secondary windings shall be air insulated/Gas insulated with terminals brought out for secondary connection.

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

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

Current transformers guaranteed burdens and accuracy class are to be intended as simultaneous for all cores.
The wiring diagram, for the interconnections of the three single phase CTs shall be provided inside the marshalling box.
The current transformers shall be suitable for high speed auto re-closing.
Provisions shall be made for primary injection testing either within CT or outside.

Technical Particulars

		400kV / 220 KV / 132kV
Core number per phase	Nos.	06/05/04 cores *

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Accuracy - Metering - Protection		**Metering 0.2s & protection PS class ***
Rating Primary	A	3000-2000-1000/1600-800/800-400-200*
Rated secondary current	A	1
Continuous Thermal rating	%	120
Accuracy Class		400 KV:PS-PS-0.2S-0.2S-PS-PS 220 KV:PS-PS-0.2s-PS-PS 132 KV:PS-PS-0.2s-PS
Burden in VA	Metering core	20
Max exc current at Vk		**400KV**:20ma on 3000 tap, 30ma on 2000 tap & 40ma on 1000 tap. **220KV**: 20ma on 1600 tap, 40ma on 800 tap.
Max CT sec resistance in Ohms at 75 deg C		400KV:15/10/5 220kV:8/4
Rated short-circuit withstand current 1s, (r.m.s.):	kA	63 / 50 / 40

*All protection Cores shall be of accuracy class TPS as per IEC: 60044-6.However, if a Higher accuracy class CT is required for protection, the same shall be provided.
*The details will be finalized later, based on the protection relay study.

3.2.7 POTENTIAL TRANSFORMERS (PT): Bus PT/Line PT.

VT parameters shall be as per enclosed SLD of GIS.

1. General

Each Gas Insulated Voltage Transformer shall be metal enclosed; SF6 insulated in accordance with relevant IEC 61869- 3. The Voltage transformers should be in segregated compartment and not forming a part of main bus bar. The VTs should be of either plug-in construction or the disconnect-link type, and be attached to the gas insulated system in such a manner that they can be easily disconnected while the system is being dielectrically tested. This should be achieved for VT provided with disconnector or MID [Manual Isolating Device]. The Primary and secondary terminals should have permanent markings for identification of polarity, in accordance with IEC. Requirement of earthing switch for VT earthing is not required, as the VT primary winding itself earthed for gas insulated type VTs. Provision shall be made for earthing of the secondary windings inside the VT terminal box.

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

The metal housing of the voltage transformer shall be connected to the metal enclosure of the GIS with a flanged, bolted and gasketed joint so that the transformer housing is thoroughly grounded to the GIS enclosure. Adequate measures shall be provided to prevent any unacceptable impact on the secondary control and protection circuits which might result from very fast transients (VFT) or ferro-resonance.

2. Ratios and Characteristics

The rating, ratio, accuracy class, connection, etc. for the voltage transformers shall be as specified below.
This shall be (400kV), (220kV), (132kV) / (sqrt3)/110V/ (sqrt(3)/110V(sqrt(3)/ 110V/(sqrt(3)/ accuracy class 0.2/3P/3P, connection Y/Y-Y-Y. The voltage transformers shall have 3 secondary windings, each winding with one tap.

3. Rating and diagram plates

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

4. Secondary Terminals, Earthing, MCB's:

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

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

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

The accuracy class will be at maximum tap.

5. Constructional Details of Potential Transformers:

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

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

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

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

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

6. Technical Particulars

		400kV / 220 KV / 132kV
Rated voltage	KV	420 / 245 / 145
Primary winding	kV	(400), (220), (132)/√3
Secondary winding	V	110/√3
No of secondary win dings	Nos.	3
Accuracy of secondary winding		
class		0.2 /3P/3P
Burden VA		50 / 50 /50
Partial discharge level at 1.5 U//3	pC	As per IEC
One minute power frequency withstand voltage for secondary winding		3 kV (rms)
Radio interference voltage at 1.1 Un/√3 and frequency range 0.5 to 2 MHz		1000 µV/1000 µV/500 µV
Phase angle error		±10 minutes (for metering core)
Rated voltage facor		1.2 times continuously & 1.5 times for 30 Sec

3.2.8 SURGE ARRESTERS: (GIS Surge Arrester):

SA will be applicable if recommended by OEM during detailed Engg. Bidder to submit the insulation co-ordination studies.

This clause is applicable in cases where a Direct GIB Connection between GIS and Transformer is specified or where any feeder is required to be provided with GIS Type Surge Arrestors based on System layout and / or requirements. The surge arrester shall be of heavy duty station class and gapless [metal oxide] type without any series or shunt gaps. The surge arresters shall be of capable of discharging over-voltages occurring during switching of unloaded transformers, reactors and long lines.

(a) 420kV class arrester shall be capable of discharging energy equivalent to class 3 or 4 or 5 of IEC for 420kV systems on two successive operations.
(b) 245kV class arrester shall be capable of discharging energy equivalent to class 3 or 4 of IEC for 245kV systems on two successive operations.
(c) 145kV class arrester shall be capable of discharging energy equivalent to class 3 or 4 of IEC for 145kV systems on two successive operations.

GIS SA Parameters:-

Sl No.	Particulars	400kV
1	Rated System Voltage	420kV
2	Rated Arrester Voltage	336kV
3	Nominal Discharge Current	10kA/20kA
4	Rated Frequency	50Hz
5	MCOV	272kV(rms)
6	Line Discharge Class	3/4/5
7	Lightning Impulse Withstand Voltage	1425Kvp
8	Power Frequency Withstand Voltage	680 rms

Sl No.	Particulars	220kV
1	Rated System Voltage	245kV
2	Rated Arrester Voltage	198kV
3	Nominal Discharge Current	10kA/20kA
4	Rated Frequency	50Hz
5	MCOV	160kV (rms)
6	Line Discharge Class	3/4
7	Lightning Impulse Withstand Voltage	1050kVp
8	Power Frequency Withstand Voltage	460kV(rms)

Sl No.	Particulars	132kV
1	Rated System Voltage	145kV
2	Rated Arrester Voltage	108kV
3	Nominal Discharge Current	10kA/20kA
4	Rated Frequency	50Hz
5	MCOV	87kV(rms)
6	Line Discharge Class	3/4
7	Lightning Impulse Withstand Voltage	650kVp
8	Power Frequency Withstand Voltage	275kV(rms)

Constructional Features:

The non-linear blocks shall be of metal oxide material. These shall be provided in such a way as to obtain robust construction, with excellent mechanical and electrical properties even after repeated operations. The arrester enclosure shall be vertically or horizontally mounted to suit the layout of the switchgear as suggested by manufacturer and shall be fitted with a discharge counter located in an easily accessible position. Surge arrester shall be not connected in main circuit during HV testing at site. The main grounding connection from the surge arrester to the earth shall be provided by the bidder. Surge Arrestors shall be provided with manually operated Disconnecting Switches or

Hand Operated Isolating Devices to facilitate satisfactory isolation of the Surge Arrestors any time or during HV Testing or during Maintenance periods.
GIS Surge Arresters shall be "Zinc Oxide" resistors type without spark gaps and with impulse characteristics suitable for use with SF6 gas insulated equipments. It shall be single phase SF6 insulated, self cooled suitable for installation as integrated part of GIS switchgear. Surge arresters shall be designed and tested in accordance with the requirements of IEC 60099-4/5 or latest.

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

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

Tests:
In accordance with requirements stipulated, the surge arresters shall conform to type tests and shall be subjected to routine and acceptance tests in accordance with IEC document. Each metal oxide block shall be tested for the guaranteed specific energy capability in addition to the routine/acceptance tests as per IEC -60099

Tests on Surge Monitor:
The surge monitors shall also be connected in series with the test specimen during residual voltage and current impulse withstands tests to verify efficiency of the same.

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

3.2.8.1 Buffer Compartment between Bay to Bay & between Main Bus-bar to Circuit Breaker:

GIS assembly shall consist of separate modular compartments, suitably sub-divided into individual arc and gas proof compartments preferably for;
- Bus bars or Bus bars with Bus Disconnector
- Bus Bar Disconnector (s) [in case not along with Bus Bars]
- Intermediate compartment (between the Bus Bar Disconnector & the circuit breaker)
- Circuit Breakers
- Line Disconnector
- Voltage Transformers
- Gas Insulated bus duct section between GIS & XLPE cable/overhead conductor
- Gas Insulated bus section between GIS & Oil filled transformer/reactor

These compartments shall be such that maintenance on one feeder should be performed without de-energising the adjacent feeders with outage on one associated bus bar portion. Gas Line Diagram showing the case of maintenance as described above shall be submitted along with the bid by the bidder. The design of GIS shall be such that in case a circuit breaker module of a feeder is removed for maintenance, both bus bars shall remain in service.

3.2.9 SF6/AIR BUSHINGS

1. General

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

OUTDOOR BUSHINGS:

Outdoor bushings, for the connection of conventional external conductors to the SF6 metal enclosed switchgear, shall be provided where specified and shall conform to the requirements given in GTR. The dimensional and clearance requirements for the metal enclosure will be the responsibility of the manufacturer and their dimensions must be coordinated with the switchgear.

Bushings shall generally be in accordance with the requirements of IEC -60137. Insulation levels and Creepage distances: All bushings shall have an impulse and power frequency withstands level that is greater than or equal to the levels specified for GIS. The creepage distance over the external surface of outdoor bushings shall not be less than 31mm/kV. Bushing types and fitting: The details of bushing shall be as follows:

SF6 to air Bushing shall be of Polymer / composite type and shall be robust and designed for adequate cantilever strength to meet the requirement of seismic condition, substation layout. The electrical and mechanical characteristics of bushings shall be in accordance with IEC: 60137 Polymer / composite insulator shall be seamless sheath of a silicone rubber compound. The housing & weather sheds should have silicon content of minimum 30% by weight. It should protect the bushing against environmental influences, external pollution and humidity. The hollow silicone composite insulators shall comply with the requirements of the IEC publications IEC 61462 and the relevant parts of IEC 62217. The design of the composite insulators shall be tested and verified according to IEC 61462.

Sl No.	Description	420KV	245 KV	145 KV
1	Rated Current (Amp)	2000/3150/ 5000 as applicable	1600	600
2.1	1.2/50 micro second impulse voltage (Lightning impulse withstand voltage)	1425 kVp	1050 kVp	630 kVp
2.2	250/2500 micro second switching impulse voltage	1050 kVp	-	-
3	One minute power frequency withstand voltage	650kV (rms)	460 kV (rms)	250kV(rms)
4	Minimum total Creepage distance in mm	10500	6125	3625
5	Minimum Cantilever strength (kN)	10	8	8
6	Rated Voltage	420KV	245 KV	145 KV

2. Insulation levels and creep age distances:

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

3. Mechanical forces on bushing terminals:

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

4. Interface definition

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

3.2.10 GAS INSULATED BUS DUCT

The components of the GIS shall be connected by a single phase bus ducts for 400kV & 220kV. The enclosure shall be connected by use of bolted and gasketed joints. The bus conductor shall be connected with plug in contacts with silver plated contact surface. The bus system shall be capable of withstand the mechanical and thermal stresses due to short circuit currents, as well as thermal expansion and contraction created by temperature cycling.

3.2.10 EHV-POWER CABLE CONNECTION

1. General

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

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

2. Interface definition

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

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

3.2.11 LOCAL CONTROL CUBICLE (STAND ALONE TYPE FOR 420 KV & 245 KV and INTEGRATED TYPE FOR 145 KV):

1. General

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

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

- mimic showing the single line diagram showing the position of CB, Dis, FAES, MES etc.
- Position indicators of CB, Dis, FAES, MES etc.
- Discrepancy type control switches for breaker, disconnector and earthing switch
- Local / remote selections
- Alarm and indication devices.
- Aux. relays or other devices as required by the design.

For easy overview, the LCC's should be stand-alone type for 420 KV & 245 KV and Integrated type for 145 KV in the switchgear in front of the related circuit breaker bay. A general arrangement drawing showing the installation position shall be submitted with the quotation.

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

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

1.2 CONTROLLED SWITCHING DEVICE: CSD: IEC: 60255.

Circuit Breaker Panel shall be equipped with controlled switching device for controlled switching operation of CB. The CSD shall be provided in the 400kV Circuit breakers for controlling transformers and reactors (i.e. for breakers of switchable line reactor and in Main & Tie circuit breakers of Transformers, Transmission lines with non-switchable line reactors and Bus reactors).
Note: The requirement of CSD shall be explicitly specified in price schedule

Technical Requirement for Controlled switching device:

a) The CSD shall be designed to operate correctly and satisfactorily.

b) The CSD shall meet the requirements of IEC-61000-4 16 class IV regarding HF disturbance test and fast transient test shall be as per IEC-61000 – 4-4 level IV and insulation test as per 60255 – 5.

c) The CSD shall have functions for switching ON & OFF the circuit breakers.

d) The CSD shall get command to operate the breakers manually or through auto reclose relay at random. The controller shall be able to analyse the current and voltage waves available through the signals from secondaries of CTs & CVTs/VTs for the purpose of calculation of optimum moment of the switching of the circuit breaker and issue command to circuit breaker to operate.

e) The CSD shall have an adaptive control feature to consider the next operating time of the breaker in calculation of optimum time of issuing the switching command. In calculation of net operating time of the breaker the controller must consider all factors that may affect the operating time of the breaker such as, but not limited to, ambient temperature, control voltage variation, SF6 gas density variations etc. Schematic drawing for this purpose shall be provided by the contractor. The accuracy of the operating time estimation by the controller shall be better than + 0.5 ms.

f) The CSD shall have communication port to facilitate online communication of the control switching device with SCADA directly on 61850.

g) The CSD shall be PC compatible for the setting of various parameters and downloading of the settings and measured values date time of switching etc. Window based software for this purpose shall be supplied by the contractor to be used on the owner's PC.

h) The CSD shall be suitable for current input of 1 amp from the secondary of the CTs. and 110 V (Ph to Ph) from the CVTs/VTs. The controller shall withstand transient and dynamic state values of the current from the secondary of the CTs and CVTs/VTs.

i) The CSD shall have time setting resolution of 0.1 ms or better.

j) The CSD shall have sufficient number of output/input potential free contacts for connecting the monitoring equipment and annunciation system available in the control room. Necessary details shall be worked out during engineering the scheme.

k) The CSD shall also record and monitor the switching operations and adjust the switching instants to optimize the switching behaviour as necessary. It shall provide self-diagnostic facilities, signalling of alarms and enable downloading of data captured from the switching events.

l) The provision for bypassing the Controlled switching device shall be provided through BCU and SCADA both so that whenever, the CSD is not healthy due to any reason (including auxiliary supply failure), uncontrolled trip/close command can be extended to the circuit Breaker. Alternatively, in case of any non-operation of the

CSD after receiving a close/trip command after a pre-determined time delay, the CSD should automatically be bypassed to ensure that the trip and close commands are extended to the Trip/Close coils through subsequent command.

m) The CSD shall be provided with a communication port to facilitate online communication of the CSD with Substation automation system (SAS) directly on IEC 61850 protocols. If the CSD does not meet the protocols of IEC 61850, suitable gateway shall be provided to enable the communication of CSD as per IEC 61850.

n) The CSD shall Store enough data (a minimum of 1000 nos.) the event records for further analysis.

o) The CSD Shall be compliant with Cybersecurity standard IEC 62443.

p) The CSD Shall be type tested as per EN / IEC 61000-4-16 class IV for HF disturbance test for immunity to conducted, common mode disturbances in the frequency range 0 Hz to 150 kHz (for short and continuous duration both); EN / IEC 61000-4-4, LEVEL IV for fast transient/burst immunity test and as per EN / IEC60255-5 or EN / IEC 60255-27 for insulation test.

q) Any other requirement other than above as required for the CSD shall also include for smooth operation.

2. DC Supplies and Circuits

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

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

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

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

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

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

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

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

3.2.12 TOOLS (NOT APPLICABLE)
The Tenderer shall include in his proposal the recommended tools required for installation, commissioning, operation and maintenance.

The following tools shall be supplied as a minimum:

Tools for gas handling plant (Cl No. 3.2.18(a)	1 set
Gas Leakage detector	1 piece
SF6 filling device	1 set

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 sensor shall be connected through a flexible wand for easy accessibility to joints, seals and couplings in GIS equipment and provided with a protection filter. 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 switchyard AIS/GIS. The test kit shall be compatible for EMI/EMC environment as per IEC 1000.

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

3.2.13 SPARE PARTS (Refer to the price schedule)
The Tenderer shall include in his proposal the recommended spare parts for installation, commissioning, operation and maintenance.
The following spare parts shall be supplied at a minimum:

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

3.2.14 OTHER SERVICES

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The following services shall be included in the proposal or quoted as optional items.
a) Training sessions on installation, commissioning, operation and maintenance of GIS shall be held by an experienced, English speaking instructor.
One week training for installation and commissioning shall be held prior to installation at site or at the owners' premises/at the factory.
One week training for operation and maintenance shall be held after the installation at the site.
b) Factory inspection/acceptance test: at the factory at least one module of each type (Feeder, Transformer & B/C bay module)
c) Installation Supervision
The estimated time period for installation supervision shall be shown in the proposal.
d) Commissioning / High voltage test
The estimated time period shall be shown in the proposal.

3.2.15: INTERLOCKS

Electrical interlock shall be provided between :

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

The principles of electrical interlocks are the following:

On each bay:

- The disconnector from the bus bar may not be closed if the associated circuit breaker is closed.

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

On the bus bar:

- cable disconnector can be opened and earthing switch can

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

3.2.16: ARRANGEMENTS

Wiring

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

Terminal Blocks

The design of the terminal shall be as per the relevant standards in vogue. The terminals permitting the direct control of SF 6 surveillance from pressure monitoring devices must be fitted with test point.
The outgoing terminal connection must be unique and comprises of 2 distinct parts:
- an arrangement for auxiliary voltage supply (alternating or direct current)
- an arrangement for control common.

Worker Safety
All precautions must be taken to ensure an efficient protection against accidental contact with the live elements.
Degree of protection
The required level of protection shall be established for the enclosures of boxes and cubicles as per the relevant standards in vogue.
Frame work
The boxes and cubicles shall have metallic enclosures to ensure effective protection against radio interference. If these enclosures are of non-metallic materials, the screen shall be connected to the earth to ensure efficient protection.
Cable entrance
Cable glands or grommets shall be provided for cable entry through the lower side. These cable glands should avoid electrolytic corrosion at the lower side of the box.
Closing devices
A simple handle will be suffice at the door of the cubicles.
The door must open at at least 120 deg.
Lighting and socket :
Lighting facility at the cubicles shall be activated by opening the door.
In each local control cubicle a single phase 3 pin socket with switch shall also be provided. The lighting points and sockets should be connected by a circuit separate from other circuits.
Space heaters
In each box and local control cubicle a space heater is required to prevent condensation. It should be connected by the same separate A.C. circuit as above.
The manufacturer shall indicate the electrical power of each heater.
Earthing of boxes and cubicles
Depending upon the location of boxes and cubicles, the earthing terminal is either linked to the metal enclosure, or linked directly to the general earth mat by an earthing conductor of reduced cross – section.
Equipotential connections between boxes, cubicles and doors shall be provided to ensure that no movable part of the enclosure can, once it is in place, be isolated from the part to which the earthing terminal is connected.
Voltage transformer
The cable from voltage transformers shall be terminated in the cubicles and VT box shall be padlocked. Provision of required rating MCB's in the LCC.
The fuses are connected in such a way that the locking devices forbid access to the cells corresponding to the conductors from the voltage transformers.
The fuse units shall be of 25 amp rating with a 6amp fuse cartridge.
Boxes and cubicles.
Other than stainless steel, all the boxes and cubicles shall be painted with a minimum one primer coat and one top coat.
Bolts, screws and nuts.
In case of stainless steel a diameter of 16mm and above shall be provided.
If the diameter is below 16mm hot galvanized will be allowed and in such case the thickness of zinc plating shall be 375 g /sq.m.
All precautions shall be taken:
- to ensure that contacting materials do not cause electrolytic corrosion.
- to avoid water stagnation.

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

3.2.17: LOW VOLTAGE CABLES & CONTROL CABLES

The Low voltage cables & control cables shall be of 1.1 kV XLPE/PVC insulated copper tape shielded control cables shall be complied with IEC 60502 and flame retardant to IEC 60332-1. The size of the above cables is more than 2.5 sqmm.

3.2.18: ACCESSORIES: (NOT APPLICABLE)

SF6 GAS SERVICE CART (SF6 Gas Filling, Evacuating, Filtering, Drying, Pumping & Storage Plant)

The SF6 gas service cart shall be adequate to:

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

The SF6 Gas Filling, Evacuating, Filtering, Drying, Pumping & Storage Plant with spares for 5 years Operation.

The plant necessary for filling and evacuating the SF6 gas in the switchgear shall be supplied to enable any maintenance work to be carried out. This shall include all the necessary gas cylinders for temporarily storing the evacuated SF6 gas. The capacity of the temporary storage facilities shall at least be sufficient for storing the maximum quantity of gas that could be removed from at least one phase of one complete bay. The minimum capacity of evacuation plant shall be:

(1) **400/220 KV**: Vacuum Pump: 60 M3/Hour (Nominal suction pressure) & Compressor: 15 M3/Hour (Delivery).

(2) **220/132/33 & 220/33 & 132/33** .... Vacuum Pump: 16 M3/Hour (Nominal suction pressure) & Compressor: 6.5 M3/Hour (Delivery).

The evacuation equipment shall be provided with all the necessary pipes, couplings, flexible tubes and valves for coupling up to the switchgear for filling or evacuating all the gases. The gases compartments shall be fitted with permanent non-return valves through which the gas is pumped into or evacuated form the compartments.

(a) **SF6 HANDLING PLANT**

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

It shall allow the storage of SF6 in liquid state in a built – in tank having capacity sufficient to empty any three adjacent compartment of 400kV / 220 KV / 132kV GIS.

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

-filling a compartment to the rated pressure within one hour.

-recovering SF6 gas from any compartment to the built in tank from the rated pressure to 50mb pressure within three hours.

-evacuating a compartment from 50 mb pressure to less than 1 mb pressure within one hour.

The cart shall have the following provisions:

-accessories for connections and operation (valves and coupling)

-dry type filters, dust and oil traps,

-tools and spares for operation and Maintenance,

-hand- book for description, commissioning, operation, and Maintenance.

(b) **400kV / 220 KV /132 kV GIS Equipment HV testing (at field after erection at site including conditioning and PD measurement):**

Required testing equipment for HV testing at the time of commissioning to be considered by the supplier (Supplier scope but will be taken back by the supplier after commissioning).

3.2.19: EARTHING

CONNECTION TO THE GENERAL EARTH MAT:

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

The general **HDG MS earth flat** earth circuit of the substation shall be formed by an uninterrupted loop which originates form the buried **HDG MS earth flat** conductor of a cross section of **750 sq.mm (75X10) for 220 & 132 KV & 40 mm dia MS Rod for 400 KV**. These loops shall be fixed to the base of the chassis with the help of an earth riser connection bolted into a hole in the chassis or frame by the manufacturer of the metal-clad equipment, and situated at 0.30 m above the floor level

of the switchgear. The general earth mat design, the connection device and the bimetallic plate shall be supplied by the GIS manufacturer. The earth connection from earth pad of equipment to the general earth mat near shall be provided by the supplier. The continuity of the earthing circuits shall be ensured taking into account the thermal and electrical stress by the current they may have to carry. The riser shall be of **copper flat size of 50X6 mm** with bi-metallic arrangement to connect from the ground earth mat to enclosure of the GIS equipment.

EQUIPOTENTIAL EARTHMAT:

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

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

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

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

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

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

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

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

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

3.2.20: TESTING & COMMISSIONING:

(a) TYPE TEST:

Type tests shall be according to the **IEC 62271-203** and other relevant IEC standards. Copies of the type tests conducted shall be furnished along with the BID failing which the Bid is liable for rejection. These type tests should have been conducted in a Recognized independent institution / Laboratory. The type test reports of the manufacturer or its principal (holding company) shall be acceptable, if the manufacturer is of international repute.

(b) ROUTINE TESTS:

A. Tests on GIS (with Circuit Breaker, Disconnecting Switches, Earth Switches, CT, VT, Surge Arrester, Bushing and Local Control Panel).

1. Dielectric test on the main circuit:

Power frequency withstand voltage test shall be done on main circuit filled with minimum gas pressure and other conditions as specified in relevant standard.

2. Partial Discharge measurement:

Partial discharge measurement shall be done with PD measuring instruments on complete GIS. Test voltage shall be as per relevant standard. PD value shall be < 5pC.

3. Tests on auxiliary and control circuits:

All auxiliary and control circuits shall be tested with 2kV/1min. Functional tests on all the fitments along with operating mechanisms shall be performed and interlock between control mechanisms shall be checked.

4. **Mechanical & Electrical Operation tests:**

Operational check and timing test is done with rated voltage and rated gas pressure. Operations each at rated, minimum and maximum voltage shall be performed. Operation timings and travel characteristics of all switches shall be recorded.

5. Measurement of the resistance of the main circuit:

Measurement of the resistance of main circuit shall be done by DC voltage drop method of GIS unit.

6. Tightness test:

Gas tightness test on complete GIS unit shall be performed at rated gas pressure by cumulative method and the calculated annual leakage rate shall be within specified/guaranteed limit.

7. Design and visual check:

Visual inspection will be performed of GIS & LCC units as per approved drawings, Rating plate, Hardware tightening with applicable torque and torque mark, Earthing check, Painting & dimension verification shall be performed.

B. Current transformers [The below tests are conducted at OEM place and the test reports shall be submitted during the inspection of GIS equipment].

1. Visual inspection of construction:

Construction shall be verified in accordance with applicable drawings.

2. Verification of terminal markings:

Terminal marking shall be verified by Inductive kick method.

3. Determination of the secondary winding resistance:

Winding resistance shall be measured by bridge method, and the value shall be corrected to 75°C.

4. Power-frequency voltage withstands tests on secondary terminals:

CT secondary circuits shall be tested with 3kV for 1min at 50Hz.

5. Inter-turn over voltage test:

The inter-turn overvoltage test shall be performed at the full winding in accordance with the procedures mentioned in relevant standard. The winding shall withstand the voltage without any discharge.

6. Test for rated knee point e.m.f (Ek) and exciting current at Ie:

The rated knee point e.m.f **Ek** shall be verified and the exciting current **Ie** at rated knee point e.m.f. **Ek** shall be measured for current transformers with the PX & PXR classes.

7. Test for accuracy:

Test will be made with current comparison method at rated frequency. Ratio error and phase displacement shall be within limits as specified in relevant standards.

8. Insulation resistance measurement:

Insulation resistance shall be measured by applying DC test voltage between Secondary winding to ground.

C. Voltage transformers [The below tests are conducted at OEM place and the test reports shall be submitted during the inspection of GIS equipment].

1. Visual inspection of construction:

Construction shall be verified in accordance with applicable drawings.

2. Verification of terminal markings:

Terminal marking shall be verified by Inductive kick method.

3. Determination of the secondary winding resistance:

Winding resistance shall be measured by bridge method, and the value shall be corrected to 75°C.

4. Enclosure tightness test:

Gas tightness test on complete unit shall be performed at rated gas pressure by cumulative method and the calculated annual leakage rate shall be within specified/guaranteed limit.

5. Power-frequency voltage withstand tests on primary terminals:

Power frequency withstand voltage test shall be done on main circuit filled with minimum gas pressure.

6. Partial Discharge measurement:

Partial discharge measurement shall be done with PD measuring instruments. Test voltage shall be as per relevant standard. Partial discharge value shall be within specified/guaranteed limit.

7. Power-frequency voltage withstands tests on secondary terminals:

VT secondary circuits shall be tested with 3kV for 1min at 50Hz.

8. Test for accuracy:

Test will be made with voltage comparison method at rated frequency. Measured results shall be limits as specified in relevant standards.

9. Insulation resistance measurement:

Insulation resistance shall be measured by applying DC test voltage between Secondary winding to ground and primary winding to ground.

D. Bus bar

1. Visual inspection of construction:

Construction shall be verified in accordance with applicable drawings.

2. Measurement of the resistance of the main circuit:

Measurement of the resistance of main circuit shall be done by DC voltage drop method.

3. Power-frequency voltage withstand test:

Power frequency withstand voltage test shall be done on main circuit filled with minimum gas pressure and other conditions as specified in relevant standard.

4. Partial discharge measurement:

Partial discharge measurement shall be done with PD measuring instruments, Test voltage shall be as per relevant standard. Partial discharge value shall not exceed 5pC.

5. Tightness test:

Gas tightness test on complete unit shall be performed at rated gas pressure by cumulative method and the calculated annual leakage rate shall be within specified/guaranteed limit.

E. Gas Insulated Bus-Duct

1. Visual inspection of construction:

Construction shall be verified in accordance with applicable drawings.

2. Measurement of the resistance of the main circuit:

Measurement of the resistance of main circuit shall be done by DC voltage drop method.

3. Power-frequency voltage withstand test:

Power frequency withstand voltage test shall be done on main circuit filled with minimum gas pressure and other conditions as specified in relevant standard.

4. Partial discharge measurement:

Partial discharge measurement shall be done with PD measuring instruments, Test voltage shall be as per relevant standard. Partial discharge value shall not exceed 5pC.

5. Tightness test:

Gas tightness test on complete unit shall be performed at rated gas pressure by cumulative method and the calculated annual leakage rate shall be within specified/guaranteed limit.

F. Surge Arrester [The below tests are conducted at OEM place and the test reports shall be submitted during the inspection of GIS equipment].

1. Measurement of reference voltage:

Measurement of peak voltage of power frequency shall be performed at minimum gas pressure. Measured voltage shall be within range specified/guaranteed limit.

2. Residual voltage test:

Measurement of residual voltage at the nominal lightning impulse current is performed on resistor elements. The residual voltage for the complete arrester shall not be higher than the value specified /guaranteed limit.

3. Partial discharge test:

Partial discharge test shall be performed at voltage as specified in relevant standard. Internal Partial discharge value shall not exceed 5pC.

4. Tightness test:

Gas tightness test shall be performed at rated gas pressure by cumulative method and the calculated annual leakage rate shall be within specified/guaranteed limit.

5. Measurement of Insulation resistance:

Insulation resistance shall be measured by applying DC test voltage between line terminal and earth terminal.

6. Construction check:

Construction shall be verified in accordance with applicable drawings.

7. Measurement of leakage current:

Measurement of total leakage current through the arrester at MCOV at minimum gas pressure shall be measured and shall be as specified/guaranteed limit.

G. Bushing [The below tests are conducted at OEM place and the test reports shall be submitted during the inspection of GIS equipment].

1. Dry power-frequency voltage withstand test:

Power frequency withstand voltage test shall be done on the bushing at voltage specified in relevant standard.

2. Measurement of partial discharge quantity:

Partial discharge measurement shall be done with PD measuring instruments. Test voltage shall be as per relevant standard. Internal Partial discharge value shall not exceed 5pC.

3. Tightness test:

Gas tightness test shall be performed at rated gas pressure by cumulative method and the Calculated annual leakage rate shall be within specified/guaranteed limit.

4. Visual inspection and dimensional check:

The visual inspection shall be made on each bushing. Dimensions of parts for assembling and/or interconnection shall be in accordance with the relevant drawings, checked by sampling.

5. Internal pressure test:

A pressure of (1,5 × maximum operating pressure) bar ± 0,1 bar shall be produced inside the bushing and maintained for 15 min at ambient temperature. The bushing shall be considered to have passed the test if there is no evidence of mechanical damage (e.g. deformation, rupture).

H. Local Control Panel:

1. Functional test including Interlocking checks:

Verification of the wiring which confirms to the diagram and prescribed Requirement, Dielectric checks, IR, Control and monitoring checks (BI/BO) up to Terminals, which shall be interfaced with RTU at site. GCU checks, Functionality and interlocks shall be measured. The above tests shall be performed as integrated test with LCP connected to GIS.

General: Witness testing shall be carried out on one bay of each type of highest current rating. The witness testing shall be performed on fully assembled bay or individual modules as per the shipped sections or shipped units.

(c) TESTS ON INSTALLATION AT SITE:

A. Tests on GIS (GCB, ISOLTAOR, EARTH SWITCH & BUSHING)

1. Visual inspection of installation:

Visual inspection will be performed of GIS & LCC Installation as per approved layout, Rating plate, Hardware tightening with applicable torque and torque mark, Earthing check, Painting, Cabling between GIS & LCC and Control cables labelled properly & Phase sequence marking.

2. Wiring check of control and auxiliary circuit:

Control cable termination, multiple core cable size and connections will be checked with circuit tester or buzzer with reference to schematic diagram for the wiring done at site.

3. Insulation resistance measurement:

Insulation resistance test is done on main circuit before and after HV test between each phase and ground and on auxiliary & control circuit between circuits to ground.

4. Contact resistance measurement of the main circuit:

Measurement of the resistance is done by DC voltage drop method of GIS installation with the help of earthing terminals.

5. Purity and Moisture content / Dew point measurement of SF6 gas:

Measurement of purity and the moisture content in SF6 gas for each gas compartment.

6. Gas tightness test:

Testing of gas tightness for site docking/joints/interconnected parts by means of SF6 gas leak detector by sniffing method is done with rated gas pressure.

7. SF6 gas density monitor test:

SF6 gas density switch test is done on density monitor to check operation on operating & resetting pressure.

8. Power frequency withstand voltage test on main circuit:

Power frequency withstand voltage test is done on main circuit filled with rated gas pressure and other conditions as specified for installation. V.T will be connected to main circuit and will be isolated during H.V test using VT-IID or disconnector.

9. Partial Discharge measurement:

Partial discharge measurement is done with help of PD sensors in installation after the HV test. V.T will be connected to main circuit and will be isolated during H.V test using VT-IID or disconnector.

B. Circuit breaker, Disconnecting switch and Earthing switch

1. Mechanical operation test:

Operational check and timing test is done with rated voltage and rated gas pressure. Following operation are check while operation test

a. Closing operation (GCB, DS, ES)
b. Opening operation (GCB, DS, ES)
c. Close-open operation (GCB)
d. Open-close operation (GCB)
e. Anti-pumping (GCB)
f. Pole discrepancy [as applicable] (GCB)

2. Electrical functional test:

Operations, interlocks & alarm and trip block for low gas pressure will be checked (for GCB) under the rated control voltage with the schematic diagram. (Test will be performed through LCC)

C. Current transformer and Voltage transformer

1. Polarity check:

Polarity is checked by inductive kick method

2. Insulation measurement test:

Insulation resistance measurement will be performed by applying DC test voltage between Primary winding to ground (in case of VT) and Secondary winding to ground (in case of CT & VT).

D. Surge Arrestor:

1. Insulation measurement test:

Insulation resistance is checked between live terminal and earth terminal.

E. Local control cubicle (LCC)

1. Visual Inspection:

Visual inspection is done for device labels,'Tightness of panel wiring, Ferrule/terminal numbering, Spare terminals/termination of unused spare cores of control cable, Cable duct covers, Operation of cubicle illumination and heater, Earthing of cable gland and Cubicle earthing, Painting, Cable number & Door lock/key

2. Functional test including Interlocking checks:

Checking of operation, alarm circuit for GCB, DS & ES according to relevant schematic diagram.

3. Annunciator test:

Checking of annunciator operation according to relevant schematic diagram.

The manufacturer shall provide all the testing equipment required for the site tests.

NOTE: POWER FREQUENCY TEST: ON SITE TESTING OF GIS

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

Power frequency tests for the completed GIS at site shall be possible without removing the voltage transformers. The power frequency test voltage at site shall be **80%** of the factory test voltage for 1minute at 50 Hz.

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

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

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

The manufacturer shall provide:

-The test voltage source.

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

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

- if a disruptive discharge occurs at the first test while increasing of test voltage, a second test is performed.
- If a second disruptive discharge occurs in the same compartment before reaching the highest level, there are two possibilities :
- If the second disruptive discharge is higher than the first voltage again the voltage is immediately increased. If a new discharge occurs the value of which is again higher, a new test is carried out.
- If the second disruptive discharge is lower than or equal to the first, the test is stopped and the compartment dismantled.

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

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

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

3.2.21: **SCHEDULE OF EQUIPMENT/MATERIALS**

Item No	Description of Equipment/Materials	Quantity
1	**ACCESSORIES**	
	SF6 Gas handling plant of adequate capacity	1 Set

	SF6 gas service cart with all accessories	1 Set
2	**TESTING EQUIPMENT**	
	GIS testing equipment (Bidder should include all such testing equipment ,which are required for detail testing of GIS system)	1set

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

Item No	Description	Quantity
1	Single phase voltage transformer	1 Set
2	Single phase current transformer including enclosure (considering all cores) for each voltage level	1 Set each
3	Enclosure insulators and main circuit of bus bar	1 Set
4	Tripping and closing coils	6 Nos (TC) &3 Nos (CC)
5	SF6 Pressure gauges	2 Sets
6	SF6 Pressure relief devices	2 Sets
7	Auxiliary contacts for circuit breaker	1 Set
8	Auxiliary contacts for DS and ES	1 Set
9	SF6 gas in steel bottle 50 Kg / bottle	2 Nos.
10	spring charge motor for circuit breakers	1 unit
11	Complete drive mechanism for disconnect switches and grounding switches	1 unit
12	Motor for disconnect switches and grounding switches	1 unit
13	Complete drive mechanism for fast acting grounding switches	1 unit
14	Motor for fast acting grounding switches	1 unit
15	Rupture disc for circuit breakers / potential transformer	1 no
16	Set of spares for local control cabinet including M.C.B., fuses, time relays, auxiliary relay and terminals etc. (at least one no. from each type)	1set
17	Rupture disc for other compartments	2 nos
18	**SPECIAL TOOLS**	
i)	SF6 gas leak detector	1 Set
ii)	**SF6 gas analyser**	1 Set
iv)	Milli volt drop measurement appliance(contact resistance measurement-600 A DC)	1 Set
v)	One set of Box Spanner	1 Set
vi)	One set of adjustable Spanner	1 Set
vii)	Sf6 gas bottle locking, measuring and filling assembly with all hose	2 Set
viii)	Infra red camera	1 set

(ii) SF6 gas analyzer: Portable type instruments (A). In-built calibration facility. (B). Sensitivity of the equipment shall not be affected by any atmospheric conditions like dust, humidity, heat, wind etc. (C). 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. (D). Equipment shall be supplied with suitable regulator which can be used to connect SF6 cylinder if required. (E).

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Following acidic/impurities products should be detected as per IEC 60480 and IEC 60376 (i) SF6 purity – Range: 0-100 % & Accuracy: +/- 0.5 %, (ii) Dew point - Range : -60 to +20 deg C & Accuracy: +/- 0.5 deg C, (iii) SO2 - Range : 0-150 ppm & Accuracy : +/- 2 %,(iv) CF4 – Range . 0-60% vol & Accuracy : +/- 1 % , (v) HF - Range : 0-200ppm & Accuracy : +/- 5 %, (F). Instrument should work on AC source as well as on rechargeable battery, (G). Input pressure: upto 10 bar h. It should be housed in a robust IP67 case with wheels.

4.1 ELECTRIC OVERHEAD CRANE: (NOT IN SCOPE OF BIDDER. FOR REFERENCE PURPOSEONLY)

One EOT Crane each 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 for erection & maintenance of GIS equipment.

The capacity of the crane shall be sized to lift the heaviest GIS switchgear component crane.

The Crane shall be used for the erection and maintenance of the GIS switchgear component and all plant installed in the GIS switchgear room .On completion of erection of the switchgear, the Contractor shall completely service the crane before the Taking Over Certificate is issued. Crane hook approaches shall be of the minimum possible dimensions to ensure maximum coverage of the plant area.

The crane(s) shall be capable of lifting and accurately positioning all loads ranging from full crane rated capacity toat least 10% rated capacity.

The crane shall have minimum speeds under full load of:

Speed

(a) Hoisting 2 meters/minute

(b) Cross Travel 10 meters/minute

(c) Long Travel 20 meters/minute

(d) Creep speed shall be of 25% of operating speed

The electric overhead cranes shall be provided with walkways, platforms. Guard hand rails shall be provided along the bridge rails and on the crab of EOT crane to facilitate cleaning/maintenance of the crane and to give access to the GIS room high bay lighting and ventilation duct and grilles. The platform and walkways shall be designed to support any weight to be imposed upon them during crane overhaul. An access platform shall be provided together with a guarded ladder on the crane to allow access to the bridge rails.

The crane shall be possible to be operated through the cable, through the pendant control and which shall be easily accessible from the floor of GIS building and through remote control device. Manufacturer/contractor shall submit the capacity calculation of crane for GIS hall considering a factor of safety of 5.

a) The crane for 400kV GIS hall shall have capacity of minimum 7T safe working load & minimum height of crane have shall be 9.0 meters or as per actual requirement whichever is higher.

c) The crane for 220kV GIS/132kV GIS shall have capacity of minimum 5T safe working load & minimum height of crane have shall be 8.0 meters or as per actual requirement whichever is higher.

In case the GIS hall is to be extended, the scope of work also involves extension of EOT crane girders to facilitate movement of EOT crane in the extended portion of GIS hall.

The following tests may be EOT Crane

1. The crane shall be tested at manufacturer work under full load and 25 percent overload of hoisting and cross transverse motions as a routine test .
2. Further the following tests may be done at site after installation of the crane at site

a. Check althea accessories for proper function

The following tests may be EOT Crane

1. The crane shall be tested at manufacturer work under full load and 25 percent overload of hoisting and cross transverse motions as a routine test.
2. Further the following tests may be done at site after installation of the crane at site

a. Check all the accessories for proper function

b. No load test

c. Load test as per site conditions.

(NOT IN SCOPE OF BIDDER. FOR REFERENCE PURPOSEONLY)

PARTIAL DISCHARGE MONITORING SYSTEM

Note: GIS Equipment shall have in Built UHF Based Sensors for On-Line PD Measurement for ready Connection and interfacing with a continuous on Line PD Measurement System or Portable On-Line PD Measurement Instrument. These shall be a definite scope of supply and the number and location of PD Sensors built in the GIS Equipment supplied shall be supported with the

necessary documentation for confirming the sufficiency/adequacy of the PD sensors provided, considering the coverage of all portions of the GIS equipment.

(A) Specification for Online Partial Discharge (PD) Monitoring System for EHV GIS

GIS equipment shall be designed so as to minimize partial discharge or other electrical discharge. A state-of-the art Partial Discharge Monitoring system shall be provided to monitor the entire GIS installation.

An on-line continuous Partial Discharge Monitoring (PDM) system shall be designed to provide an automatic facility for the simultaneous collection of PD data at multiple points on the GIS & its associated GIB ducts and Voltage Transformers adopting UHF technique. The data stored shall provide a historical record of the progress of PD sources and shall identify the areas of maximum activity.

The scope shall cover Engineering, supply, installation, testing and commissioning of partial discharge continuous monitoring system, with all necessary auxiliaries and accessories to make a complete system as per technical specification, including site demonstration of successful operation. Any items/accessories necessary to make the system fully functional for the trouble free online PD monitoring of complete GIS installation shall be considered as included in the scope.

The PDM system shall be provided with capacity for readily interfacing with UHF PD couplers of present and future GIS Bays as shown in SLD plus 20% additional as spare. Details of it shall be submitted during engineering stage for approval. The PD Monitoring PC Work Station shall be housed in a lockable cabinet with duplicate keys and shall be located in the control room of the GIS substation. Workstation PCs shall be pre-loaded with all necessary Hardware & Software. The PCs shall have each Combo drive & Retrievable disk drive (1 TB), Ethernet port 100Mbps, printer. The workstation PC shall be powered by suitable dedicated UPS and same is included in the present scope.

A proven and well established online continuous partial discharge monitoring must be supplied with every high voltage GIS module complying the following key features:

1. Standards:

- The System shall be type tested by independent accredited test house to ES BN 55022 (CISPR22), IEC 60068-2-1, IEC 60068-2-2, IEC 60068-2-6, IEC 60068-2-27, IEC 60068-2-56, IEC 60255-5, IEC 61000-4-2, IEC 61000-4-3, IEC 61000-4-4, IEC 61000-4-5, IEC 61000-4-6, IEC 61000-4-8, IEC 61000-4-9, IEC 61000-4-10, IEC 61000-4-12, IEC-61850, IEC-60270 standards for use within EHV substations

2. Sensors:

- Meet sensitivity according to CIGRE TF15/33.03.05 1998 or latest at every place in the GIS (5pC or better) will be verified as part of site sensitivity tests. A sensor location drawing has to be submitted by the bidder.
- The PD couplers shall be of passive, maintenance free antenna type meeting CIGRE TF15/33.03.05 standards with detection spectra range: 250 MHz to 1.5 GHz. Pre-amplifier installed as part of the coupler is not acceptable. UHF amplification or conditioning is only allowed at electronic node unit.
- 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.

3. Analyser:

- Continuous real-time measurement and PD analysis; not multiplexed data collection.

- Supports up to 200 to 300 UHF sensors on one system and shall have a signal sensitivity of -75dBm or better with fixed broadband monitoring (bandwidth >=1 GHz) and historical PRPD over 5, 10 or 15 minute recording period (software selectable).
- The System shall be capable of synchronizing, capturing and displaying PD data for a power test frequency in the range 40Hz to 220Hz. The System shall be capable of operation during and assisting with HV testing of the GIS.
- The PDM System shall be able to discriminate between partial discharge sources, external interference and transients resulting from switching operations of the high-voltage equipment either by Smart Gating with external type noise antenna and/or Smart Coincidence Filter and/or Artificial Intelligence Software detection package.
- Multiple UHF channels (on the GIS & its associated GIB ducts and Voltage Transformers adopting UHF Technique) shall be monitored continuously and simultaneously to ensure no PD pulses are missed. The data stored shall provide a historical record of the progress of PD sources and shall identify the areas of maximum activity
- The System shall be sensitive to partial discharge signals throughout the frequency range 250-1500 MHz. However, it is recognised that in some cases the use of filters may be necessary to reduce the sensitivity of the System at certain frequencies to signals arising from telecommunications and other external sources.

4. Software:

- IEC61850 standard for communications within substations with Node communication must be by Ethernet, scalable, industrial standard between data nodes central server by Node data connection via both Copper Ethernet and Multi Mode Fibre Optic.
- >2M defect records from multiple customer sites.
- UHF Signal classification (5 types or better) for GIS by Separate Multiple Hybrid Expert System and the multiphase analysis result shall be clearly indicated to the operator. The PDM System shall, combine Artificial Neural Networks (ANNs), Genetic Algorithms (GAs) and Fuzzy Logics (FLs).
- The System shall have time synchronisation facility, individual channel control and PD Alarm Wizard for configuration of all PD alarms within substations including station auxiliary supply failure.
- Automatic report generator, alarm and configurable by customer over web or client server interface with provision of SMS & E-Mail.
- The System application software shall incorporate function for the complete recording of PD activity during GIS HV tests. The function shall allow complete review of PD activity during or after the test.
- The System shall have provision for connecting to a PC at OPTCL headquarters location with remote application software which can automatically support remote accessing for remote substations.
- Ability to call and display, within Application software, 2 Dimensional GIS Schematics showing spatial relationship between couplers in the GIS, 3 Dimensional GIS models (Optional) showing spatial relationship between couplers.
- History data shall be recorded up to 15 minutes in software selectable steps. History plots shall be capable of being displayed over a period up to 5 years.
- The HMI system shall be equipped with Relational Database Management System (RDBMS) which is compliant to Microsoft ODBC (Open Database Connectivity), ANSI 92 SQL (Structured Query Language), Allow remote database access in the designated room application for further study. Examples of ODBC compliant RDBMS that provide remote access are Microsoft SQL Server, Oracle and IBM DB2. Proper authorisation and authentication shall be provided to use such software's from original producer.
- Data shall be displayed in three dimensional oblique, snapshot and real time, two dimensional point on wave (both amplitude and discharge rate), PRPD (phase resolved partial discharge) online and historical, STT (short term trends) and 24 hour Summary
- System shall record switching transient generated by CBs and dis-connectors. (Optional analysis of switching paterns)

5. Every Day Use & Maintenance: The system shall be designed suitable for an unmanned s/s and operate automatically. The system shall generate alarms if suspected partial discharge activity is noticed or the system itself is in failure, thereby eliminating the necessity of periodic system access by the user and one such alarm shall be connected to Substation automation system (SAS). The alarms shall be configured coupler wise.

6. Computers and Peripherals: The PC operating system shall be the latest version of MS Windows. It should be suitable for continuous process application and should have been tested for the same. The hardware configuration of PC should be the latest available in the market of industrial type subject to EMPLOYER'S / Engineer approval. For storing the historical PD database, sufficient storage facility in the form of hard disc and retrievable hard disk drive of 1TB as specified shall be available in the substation. The PC monitor shall be 21" LCD type of reputed make.

7. Filtering Facility: The filtering facility has to be provided in order to distinguish real PD from internal/external noise such as switching operations, self-test signal, radio, communication signal etc. The PDM system itself shall be able to discriminate the noise from real PD. The exposed gas barriers of the GIS shall be shielded effectively against noise interference & tested. The gas barrier shields/belts shall be suitable for outdoor use also & able to withstand high ambient temperature. Site measurements have to be performed after installation of the PDM system in order to identify the various sources of external noise to incorporate the same in the filtering facility. This filtering will preferably be through software by band pass, which can be manually activated (as an option) to filter out noise signals in the trend plot display. If, hardware filtering is employed then adequate measures have to be taken to avoid masking of other signals, which may lie in the same frequency range. The method adopted for the above shall be specified taking into account the sensitivity requirement of PDM system as per CIGRE document. The noise filters shall be selectable individually coupler-wise.

8. Self-Test (Diagnostic) Facility: Built-in self-checking facility shall be incorporated in the control system which will continuously verify the correct operation of the whole monitoring system with the simulated PD signal viz. checking of the sensitivity of individual detector units, response of PD sensors in addition to the checking of the system functioning. The periodicity of such self-check operation shall be specified. In case of system failure this shall trigger an alarm for communication to SAS. External check facility: Propose the arrangement/device available for externally checking the healthiness of PD sensors by pulse injection in addition to built-in monitoring facility.

9. Trend Plot: The trend plot facility shall be available with the update period of hourly/daily/weekly/monthly/yearly. It shall be possible to view the historical trends for the complete archived data accumulated over several years.

10. PD Monitoring modes: There shall be two different modes of system operation viz. a dedicated Continuous PD Monitoring mode for the normal day today operation of the system & a dedicated HV commissioning test mode which is exclusively for PD monitoring during HV commissioning test. The HV commissioning mode shall also operate as an independent feature. In the HV Commissioning mode the real time display shall be possible for a minimum of two complete bays with associated bus bars and at with one second update period. The HV test software shall automatically record the HV voltage information along with PD so as to check PD inception & extinction voltages precisely. The complete HV & PD data recorded during HV test shall be possible to be reviewed in replay mode after the HV test.

11. Alarm Facility: The PDM system shall generate alarm when action is required; viz. a) PD alarm (abnormal PD activity indicating a risk of failure) & b) PD system fail alarm to be connected to SAS.

12. Real Time Display: The PDM system should have the facility of Real Time display, which will give an instant indication of PD activity coupler wise, with one-second update period. The PDM system shall be able to capture the PD data triggered by associated switching operations of CBs & isolators.

13. Schematics: The PDM system should have GIS schemes bay-wise incorporating PD sensor identification and location along withspacer location. The sectional view of typical bay arrangement of GIS showing active parts shall also be included as part of the PDM software.

14. Print Option/Facility: PDM system should have the option/facility of printing all trend plots/reports/POW patterns/displays, etc. Laser Colour printer shall be provided for this purpose at substation.

15. Data Archives: This is to provide access to historical data and file storage with date and time stamp. Sufficient storage facility shall be available to review historical data updated for the lifetime of switchgear. The substation & headquarters PCs shall have a backup device in the form of a retrievable disk drive of 1TB capacity for this purpose.

16. PD Fault Identification & Location/Pattern Recognition/Predictive Maintenance Diagnostic Software: In order to interpret various types of PD defects, intelligent diagnostics software (expert system) shall be built- in as part of the PDM software capability. This is mainly to reduce the dependence on PD specialist. The bidder shall also make available typical point-on-wave patters as library pictures to train the user. Software Updates: It shall be possible to upgrade / update the system software throughout the lifetime of the system with the ongoing development / refinement in PD technology.

17. Fault investigation: In case of any indication of suspected PD activity by the on line system, further investigation has to be carried out by the contractor for the PD defect identification and location during the warranty period.

18. Special Tools / equipment, Spare Parts, software packages

18.1 Special Tools: Special tools for cutting and crimping of coaxial cable with 'N Connectors' shall be supplied.

18.2 Spare parts: The contractor has to supply critical spares with replacement procedure for the trouble free operation of the system during its expected lifetime as part of the contract. A detailed list shall be included in the tender and also submitted for EMPLOYER'S approval during the detailed engineering stage.

18.3 Software Packages: The complete software package shall be supplied as part of a back-up facility in the form of DVD/CDs viz. Windows operating system with end user license, PDM Software including HV Test, Drivers for modems etc., software for remote access, printer etc. The list shall be submitted for reference.

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

PORTABLE PARTIAL DISCHARGE MONITORING

(B). Portable Partial Discharge (PD) monitoring system (Shall generally applicable for

220kV&132 kV)

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

It shall be capable for measuring PD in charged GIS environment as EHV which shall have bandwidth in order of **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 built in large LCD display and the measurement shall be stored in the instrument and further downloadable to a PC for further analysis to locate actual source of PD such as free conducting particles, floating components, voids in spacers, particle on spacer surfaces etc. 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.

The equipment shall meet the following requirements

1 Measurement shall be possible in noisy environment.

2. Stable reading shall be possible in presence of vibrations within complex GIS assemblies, which can produce signals similar to PD.

(a) The no. of channels shall be minimum 6 nos. for PD monitoring

3. Equipment should have necessary synchronizing circuits to obtain PD correlation with power cycle and power frequency.

4. The equipment shall be battery operated with built-in-battery charger. It shall also be suitable for 230V AC/50 Hz input.

5. Measurement shall be possible in the charged 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 supplied along with the offer.

6. 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.

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

a) Data recording, storage and retrieval in computer

b) Data base analysis

c) Template analysis for easy location of fault inside the GIS

d) Evaluation of PD measurement i.e, Amplitude, Phase Synchronization etc.

e) Evaluation of bouncing/loose particles with flight time and estimation on size of particle.

f) Expert software system for accurate interpretation of cause of PD.

g) Report generation.

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

9. Supplier shall have "Adequate after sales service" facility in India.

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

11. Instrument shall be robust and conform to relevant standard.

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.

GIS BUILDING (NOT IN SCOPE OF BIDDER. FOR REFERENCE PURPOSEONLY)

1.1. The buildings shall house each voltage class Gas Insulated Switchgear (GIS) separately and other associated equipment inside in each of the GIS buildings. GIS building(s) shall be constructed for the specified number of bays/diameters as per section project.

1.2. Wherever GIS hall of proposed voltage is already existing, then the existing GIS hall of respective class shall be suitably extended (wherever applicable) to accommodate the number of bays/diameters as specified in the Section Project.

1.3. The contractor shall submit the design & construction proposal of the building along with necessary information, data, and drawings during the detailed engineering according to the complete requirements.

1.4. The area for GIS hall(s) is indicated in the enclosed General Arrangement drawing. The area given is for reference only and may vary according to requirement of the equipment to be installed inside. The contractor shall finalize the dimensions according to the equipment offered by them providing enough space & access for erection, operation and maintenance and future expansion.

1.5. The contractor shall place their panels i.e. Bay level units, bay mimic, relay and protection panels, RTCC panels, PLCC panels etc. in a separate room in the GIS building.. The size of the room shall be such that all the panels for the future bays/ diameters as per clause 1.1 shall be accommodated in the above room. The panel room shall be air-conditioned. Further, the temperature of the room shall be monitored through substation automation system by providing necessary temperature transducers.

Ventilation system (NOT IN SCOPE OF BIDDER. FOR REFERENCE PURPOSEONLY)

Each GIS Hall shall have an independent ventilation system. Each Ventilation system shall consist of two 100% capacity systems, one operating and one stand-by or 3 X 50%, two operating and one Standby .

The ventilation of the GIS hall shall be of a positive pressure type. The pressure inside the GIS hall shall be maintained 5 (five) mm of water (**mmWg**) above the atmospheric pressure. Fresh outdoor air shall be filtered before being blown into the GIS hall by the system to avoid dust accumulation on components present in the GIS hall.

Pressurized Ventilation

Pressurized ventilation system shall be installed in the GIS room for maintaining controlled environment for safe and efficient operation / functioning. It should be designed considering extremely tropical climatic condition and high degree of pollution level.

Design, manufacture, assembly, supply, delivery at site, installation, testing & commissioning of the Pressurized Ventilation system are within the scope of the bidder. This scope also includes supply of all components / parts, accessories / cables etc required for successful commissioning of the system.

System Description

The Ventilation System with Centrifugal Fan and related Accessories should comprise of Pre and Fine air filter, centrifugal fan, ducting network, air supply grilles, gravity dampers, electrical and instrumentation etc.

Dynamically balanced non-return louver shutter shall be provided at fan discharge side. Exhaust fan casing by heavy guage MS sheet (**HDG**) & Impeller by die cast aluminium is to be made.

Fresh outdoor air shall be filtered before being blown into the GIS room by the air fans to avoid dust accumulation on components present in the room. GIS hall shall be provided with motorized exhaust dampers with local control. To ensure that the air being supplied to the GIS room is free from dust particles, a minimum **two** stage dust filtration process shall be supplied. This shall consist of at least the following:

1. **Pre Filters**: To remove dust particles down to 10 micron in size with at least 95% efficiency.

2. **Fine Filters**: To remove dust particles down to 5 microns in size with at least 99% efficiency.

All the filters shall be panel type. Easy access should be available to the filters for replacement / cleaning.

GI Ducting

The following codes & Standard shall be followed

IS: 226 Specification for Structural Sheet (Standard Quality)

IS: 655 Specification for metal Air Duct.

IS: 277 Specification for Galvanised Steel Sheets Grade 180

The air distribution system shall be sized to have a constant frictional drop along its length. The maximum air velocity shall be restricted to 7 m/s for ventilation ducts. Ducts shall be supported by 50x50x6 MS(**HDG**) Angle with a distance of not more than 2000 mm. Guide vanes are to be provided in the ducts for proper flow of Air. Flexible connection of at least 150 mm width will be provided where the duct connects to the Fan.

Design Parameters

The following technical data / design parameters are to be considered while designing the above system:

1) 5 mm (minimum) of water above the atmospheric pressure to be maintained inside the GIS room. To maintain this overpressure it is to be taken into account that 50% air is to be exhausted. So exhaust air quantity to be arrived from the selected air quantity.

2) **Air change per hour** shall be considered as four (**04**) for arriving **Calculated Air quantity** in metre cube per hour. **Selected Air quantity** in metre cube per hour is to be considered accordingly for design purpose. However the inside temperature shall not be more than maximum 3 degree above the design ambient temperature during summer. The criteria which give the higher air flow by air changes criteria or temperature criteria shall be selected (to be supplied by design calculation during detailed engineering).

3) Centrifugal Air fan capacity and its make shall be selected for calculation of Pressurized Ventilation system considering the above criteria.

4) Each Ventilation system shall consist of two 100% capacity systems, one operating and one stand-by or 3 X 50%, two operating and one Standby .

5) The ducting arrangement shall be done in such a way that the projected portion inside the GIS room will be bare minimum for smooth operation of EOT crane.

6) Each GIS hall shall be provided with motorized exhaust dampers with local control. The size and quantity shall be selected considering 50% selected air to be released due to overpressure.

7) Necessary measure shall have to be taken to run the system with minimum noise level. Silencers are to be used to keep the noise level below 60 DB.

Note: The main bidder/main contractor shall submit the design and construction proposal of the building along with necessary information, data, and drawings in the techno-commercial bid according to the complete requirements.

SECTION- 3

PROJECT DETAILS AND GENERAL SPECIFICATIONS

3.0 GENERAL

This section stipulates the General Technical Requirements under the Contract and will form an integral part of the Technical Specification.

The provisions under this section are intended to supplement general requirements for the materials, equipment and services covered under other sections of tender documents and are not exclusive. However, in case of conflict between the requirements specified in this section and requirements specified under other sections, the requirements specified under respective sections shall prevail.

3.1 PROJECT DETAILS

	Particular	Details
a)	Customer	ODISHA POWER TRANSMISSION CORPORATION LIMITED (OPTCL)
b)	Engineer/Consultant/ Inspector	-
c)	Project Title	2X500 MVA, 400/220 KV GIS S/S AT ERSAMA & ASSOCIATED 2 NOS 400 KV BAY EXTN AT DUBURI
d)	Project Location	**400/220kV GIS S/S** Place: Erasama, Paradeep District: Jagatsingha State: Odisha **400kV AIS S/S Bay Extn.** Place: Duburi District: Jajpur State: Odisha
e)	Latitude & Longitude	**400/220kV GIS S/S** North: 20°12'32" and East: 86°21'44" **400kV AIS S/S Bay Extn.** North: 20°56'14" and East: 86°00'23"
f)	Nearest Railway Station	Erasama – At a distance of about 32 km from Paradeep station Duburi – At a distance of about 14 km from Jajpur Road station
g)	Distance of project location from the Railway station	Erasama – At a distance of about 32 km from Paradeep station Duburi – At a distance of about 14 km from Jajpur Road station
h)	Nearest Major Town	Bhubaneswar
i)	Distance of the town from the project site	86 Km from Erasama & 120 Km from Duburi
j)	Nearest commercial airport	Biju Patnaik International Airport, Bhubaneswar

k)	Distance of airport from the project site	86 Km from Erasama & 120 Km from Duburi
	SITE CONDITIONS (for design purposes)	
a)	Annual mean if maximum monthly average temperature	50°C
b)	Annual mean if minimum monthly temperature	5°C
c)	Design ambient temperature	50°C
d)	Average Rainfall in mm	1500 mm
e)	Average thunderstorm days per year	77 days
f)	Maximum Relative humidity	100 %
g)	Average Relative humidity	85 %
h)	Height above mean sea level	Less than 1000 meters
i)	Pollution Severity	Heavily polluted
j)	Criteria for Wind Resistant design of structures and equipment	Standard Applicable - IS 875 (Part 3)
k)	Basic Wind speed "Vb" at ten meters above the mean ground level.	55m/ sec for Erasama 50 m/ sec for Duburi
l)	Risk Coefficient "K1"	1
m)	Seismic Co-efficient	0.06g Horizontal 0.01g Vertical

3.1.1 SYSTEM PARAMETERS

Sl.No.	Parameters	**400 kV**	**220 kV**	**33 kV**
1	Highest system voltage	420 kV rms	245 kVrms	36
2	System Frequency	50 Hz		
3	Variation in Frequency	+ - 2.5 %		
5	Lightning Impulse voltage	±1425kVp	± 1050kVp	170
6	Switching impulse voltage	±1050kVp	-	
7	Power frequency withstand for 1 min (rms)	630 kV (rms)	460 kV (rms)	70 kV (rms)
8	Max. fault level (3/1 sec.)	63 kA	50kA	31.5kA
9	Minimum creepage distance	13020 mm (Erasama) 10500 mm (Duburi)	7595mm (Erasama) -	1116mm (Ersama) 900mm (Duburi)
10	System Neutral Earthing	Effectively Earthed		
11	Corona Extinction Voltage	320kV	156kV	-
12	Radio Interference Voltage	500µV at 266kV	500µV at 167kV	-

3.1.2 AUXILIARY POWER

Nominal Voltage V	**Variation**	**Frequency Hz or DC**	**Phase**	**Wires**	**Neutral Connection**
430	±10%	50±5%	3	4	Solidly earthed
240	±10%	50±5%	1	2	Solidly earthed
220	187V - 242V	DC	DC	2	Isolated 2 wires
50	45V - 55V	DC	DC	2	+ve earthed

3.1.3 The minimum electrical clearances for 400/220/33kV switchyard shall be as given below:

	400kV	**220kV**	**33kV**
Phase to earth clearance	3400 mm	2160mm	320mm
Phase to phase clearance	3900 mm	2160mm	320mm
Section clearance	6500 mm	5000mm	3000mm
Ground Clearance	8000 mm	5500mm	4000mm

3.2 INSTRUCTION TO BIDDERS:

The bidders shall furnish technical data sheets, catalogues, engineering data, technical information, design documents, drawings etc. fully in conformity with the technical specification.

The supplier should be approved by Employer (OPTCL). If not, it is the responsibility of the vendor to be assessed and approved by Employer, before placement of order by BHEL. Any cost involved in vendor assessment/approval must be borne by the vendor himself.

The Bidder's proposal shall be based upon the use of equipment and material complying fully with the requirements specified herein. It is recognized that the Bidder may have standardized on the use of certain components, materials, processes or procedures different than those specified herein. Alternate proposals offering similar equipment based on the manufacturer's standard practice will also be considered, provided the base offer is in line with technical specifications and such proposals meet the specified design standards and performance requirement and are acceptable to the Purchaser. Sufficient amount of information for justifying such proposals shall be furnished to Purchaser along with the bid to enable the Purchaser to determine the acceptability of these proposals.

Wherever a material or article is specified or defined by the name of a particular brand, Manufacturer or Vendor, the specific name mentioned shall be understood to be indicative of the function and quality desired and not restrictive. Other manufacturer's products may be considered provided sufficient information is furnished to enable the Employer to determine that the products proposed are equivalent to those named.

Equipment furnished shall be complete in every respect with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/ or needed for erection, completion and safe operation of the equipment as required by applicable codes, though they may not have been specifically detailed in the Technical Specifications unless included in the list of exclusions. Materials and components not specifically stated in the specification but which are necessary for commissioning and satisfactory operation of the switchyard unless specifically excluded shall be deemed to be included in the scope of the specification and shall be supplied without any extra cost. All similar standard components/parts of similar standard equipment under supply shall be inter-changeable with one another.

The bidder shall supply type tested (including special tests as per tech. specification) equipment and materials. The test reports shall be furnished by the bidder along with equipment/ material drawings. In the event of any discrepancy in the test reports, (i.e., if any test report is not acceptable due to any design/ manufacturing changes or due to non-compliance with the Technical Specification and/ or applicable standard), the tests shall be carried out without any additional cost implication to the BHEL. BHEL reserves the right to get any or all type/tests conducted/repeated.

3.3 CODES AND STANDARDS

In addition to the codes and standards specifically mentioned in the relevant technical specifications for the equipment / plant / system, all equipment parts, systems and works covered under this specification shall comply with all currently applicable statutory regulations and safety codes of the Republic of India as well as of the locality where they will be installed.

Except where otherwise specified or implied, the bidder shall comply with the latest edition of the relevant Indian Standards, International Electrotechnical Commission (IEC) standards and any other standards mentioned in this Specification. The Bidder may submit for approval, equipment or materials conforming to technically equivalent National Standards. In such cases copies of the relevant Standards or part thereof, in the English language shall be submitted with the Tender.

In case of conflict the order of precedence shall be (1) IEC, (2) IS and (3) other alternative standard.

Reference to a particular standard or recommendation in this Specification does not relieve the Bidder of the necessity of providing the Contract Works complying with other relevant standards or recommendations.

The list of standards provided in the schedules of this Specification is not to be considered exhaustive and the Bidder shall ensure that equipment supplied under this contract meets the requirements of the relevant standard whether or not it is mentioned therein.

Other International/ National standards such as DIN, VDI, BS, GOST etc. shall also be accepted for only material codes and manufacturing standards, subject to the Employer's approval, for which the Bidder shall furnish, adequate information to justify that these standards are equivalent or superior to the standards mentioned above. In all such cases the Bidder shall furnish specifically the variations and deviations from the standards mentioned elsewhere in the specification together with the complete word to word translation of the standard that is normally not published in English.

3.4 LANGUAGE AND SYSTEM OF UNITS

The English language shall be used in all written communications between the Employer, the BHEL/OPTCL and the Bidder with respect to the services to be rendered and with respect to all documents and drawings procured or prepared by the Bidder pertaining to the work, unless otherwise agreed by the Employer.

It is required that danger plates, equipment designation labels or plates, instruction notices on plant and general substation notices be written in English, Hindi and Oriya. Control switch and lamp labels, indicator lamp and annunciator inscriptions shall be in English only.

The Bidder must furnish a schedule giving the English, Hindi and Oriya version of all labels, notices, etc., for approval.

The design features of all equipment shall be based on the SI system of units.

3.5 SERVICES TO BE PERFORMED BY THE EQUIPMENT BEING FURNISHED

The 400 kV system is being designed to limit the power frequency over voltage of 1.5 p.u. and the switching surge over voltage to 2.5 p.u. In 400 kV system the initial value of temporary over voltage could be 2.0 p.u. for 1-2 cycles. All the equipment/materials covered in this specification shall perform all its function satisfactorily without undue strain, restrike etc. under such over voltage conditions.

All equipment shall also perform satisfactorily under various other electrical, electromechanical and meteorological conditions of the site of installation. All equipment shall be able to withstand all external and internal mechanical, thermal and electromechanical forces due to various factors like wind load, temperature variation, ice & snow (not applicable for this project), short circuit etc for the equipment.

3.6 CORRESPONDENCE, DRAWINGS, APPROVAL PROCEDURE AND SAMPLES

3.6.1 Drawings & Document Submission

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

Each drawing submitted by the bidder (including those of sub-vendors) shall bear project specific title block at the right hand bottom corner with clear mention of the name of the Employer, the system designation, the specifications title, the specification number, the name of the Project, drawing number and revisions. If standard catalogue pages are submitted, the applicable items shall be indicated therein. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.

All dimensions marked on drawings shall be considered correct although measurement by scale may differ from general arrangement drawings. Detailed drawings shall be worked to where they differ from general arrangement drawings.

All drawings for approval shall have the OPTCL-LOGO and the name of the Employer.

For presentation of design drawings and circuit documents IEC Publication 617 or equivalent standards for graphical symbols are to be followed.

The review of these document/data/drawings by the purchaser will cover only general conformance of the document/data/drawings to the specification and contract, interfaces with the equipment provided under specification, external connections and of the dimensions which might affect plan layout. This review by the purchaser may not indicate a thorough review of the dimensions, quantities and details of the equipment, material, any devices or items indicated or the accuracy of the information submitted. The review and/or approval by the purchaser shall not be considered by the bidder, as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications and documents.

All manufacturing, fabrication and execution of work in connection with the equipment/system prior to the approval of the drawings shall be at the bidder's risk. The bidder is expected not to make any changes in the design of the equipment /system, once they are approved by the Purchaser. However, if some changes are necessitated in the design of the equipment/system at a later date, the bidder may do so, but such changes shall promptly be brought to the notice of the Purchaser indicating the reasons for the change and get the revised drawing approved again in strict conformance to the provisions of the Technical Specification. Approval of bidder’s drawing or work by the Purchaser shall not relieve the bidder of any of his responsibilities and liabilities under the Contract.

3.6.2 Bidder’s Drawing Submission and Approval Procedure

The following procedure for submission and review/approval of the drawings, data reports, information, etc. shall be followed by the bidder:

a. All data/information furnished by Vendor in the form of drawings, documents, Catalogues or in any other form for Employer's information/interface and/or review and approval are referred by the general term "drawings".

b. The 'Master drawings list' indicating titles, Drawing Number, Date of submission and approval etc. shall be furnished by the bidder. This list shall be updated if required at suitable interval during detailed engineering.

c. All drawings (including those of sub-vendor) shall bear at the right hand bottom corner the 'title plate' with all relevant information duly filled in. The bidder shall furnish this format to his sub-vendor along with his purchase order for sub-vendor's compliance.

d. Three copies of all drawings shall be submitted for approval and three copies for any subsequent revision. Employer shall forward their comments within four (4) weeks of receipt of drawings.

e. The OPTCL/BHEL reserves the right to request any additional information that may be considered necessary in order to fully review the drawings. Drawings for approval shall be submitted as paper prints and shall bear the approved contract references.

f. Upon review of each drawings, depending on the correctness and completeness of the drawings, the same will be categorised and approval accorded in one of the following categories:

CATEGORY I	Approved
CATEGORY II	Approved, subject to incorporation of comments/modification as noted. Resubmit revised drawing incorporating the comments
CATEGORY III	Not approved. Resubmit revised drawings for Approval after incorporating comments/modifications as noted
CATEGORY IV	For information and records

g. Bidder shall resubmit the drawings approved under Category II, III within one (1) week of receipt of comments on the drawings, incorporating all comments. Every revision of the drawing shall bear a revision index wherein such revisions shall be highlighted in the form of description or marked up in the drawing identifying the same with relevant revision number enclosed in a triangle (e.g 1.2.3. etc.).

h. In case Bidder does not agree with any specific comment, he shall furnish the explanation for the same to Employer for consideration. In all such cases Bidder shall necessarily enclose explanations along with the revised drawing (taking care of balance comments) to avoid any delay and/or duplication in review work.

i. It is the responsibility of the Bidder to get all the drawings approved in the Category I or IV (as the case may be) and complete engineering activities within the agreed schedule. Any delay arising out of submission and modification of drawings shall not alter the contract completion schedule.

j. Bidder shall not make any changes in the portions of the drawing other than those commented. If changes are required to be made in the portions already approved, the Bidder shall resubmit the drawings identifying the changes (along with reasons for changes) for Employer's review and approval. **Drawings resubmitted shall show clearly the portions where the same are revised marking the relevant revision numbers and Employer shall review only such revised portion of documents.**

3.6.3 As Built Drawings

After completion of work on site all drawings shall be revised where necessary to show the equipment as installed and three copies submitted duly signed by site-in-charge. Following approval, two reproducible transparencies and twenty prints shall then be provided as required by the OPTCL/BHEL and shall be of sufficient detail to enable all parts to be identified. The bidder shall also submit, where possible, digitally stored copies of all as-built drawings on disc or CD-ROM in a format compatible with the Employer's drawing system.

Approval of drawings will not in any way relieve the Bidder of his obligations of furnishing the equipment in accordance with the specification and shall not prevent subsequent rejection if such equipment is later found to be defective.

3.6.4 Operation and Maintenance Manual

a. The Bidder shall submit to the Employer preliminary instruction manuals for all the equipment for review. The final instructions manuals incorporating Employer's comments and complete in all respect shall be submitted at least sixty (60) days before the first shipment of the equipment. The instruction manuals shall contain full details and drawings of all the equipment, the transportation, storage, installation, testing, commissioning, operation and maintenance procedures, etc. separately for each component/equipment along with log record format. After approval by the Engg. In charge the Bidder shall deliver ten (10) copies of the complete manual.

b. If after commissioning and initial operation of the plant, the instruction manuals require any modifications/additions/changes, the same shall be incorporated and the updated final instruction manuals shall be submitted.

c. The operating and maintenance instructions together with drawings (other than shop drawings) of the equipment, as completed, shall have sufficient details to enable the Employer to maintain, dismantle, reassemble and adjust all parts of the equipment. They shall give a step by step procedure for all operations likely to be carried out during the life of the plant/equipment, including erection, testing, commissioning, operation, maintenance dismantling and repair. Each manual shall also include a complete set of approved drawings together with performance/rating curves of the equipment and test certificates, wherever applicable. The contract shall not be considered completed for purpose of taking over until such instructions and drawings have been supplied to the Employer.

d. A separate section of the manual shall be for each size/type of equipment and shall contain a detailed description of construction and operation, together will all relevant pamphlets.

e. The manuals shall include the following
   a) List of spare parts along with their drawing and catalogues and procedure for ordering spares.
   b) Lubrication Schedule including charts showing lubrication checking, testing and replacement procedure to be carried daily, weekly, monthly & at longer intervals to ensure trouble free operation.

The Contract shall not be considered to be completed for purposes of taking over until the final Instructions manuals (both erection and O & M manuals) have been supplied to the Employer.

3.6.5 Final Submission of drawings and documents

The Bidder shall furnish the following after approval of all drawings /documents and test reports:
a. List of drawings bearing the Employer's and Bidder's drawing number.

b. Six (6) bound sets along-with two (2) sets of CD-ROMs/ DVD/Portable hard disk of all final drawings/documents.
c. Bidder shall also furnish six (6) bound sets of all as-built drawings including the list of all as-built drawings bearing drawing numbers. The Bidder shall also furnish two (2) sets of CD-ROMs/ DVD/Portable hard disk of all as-built drawings as decided by the Employer.
d. The Bidder shall also furnish four (4) copies and two (2) sets of CD-ROMs/ DVD/Portable hard disk of instruction/ operations & maintenance manuals (after approval) for all the equipment.

3.6.6 Test Reports

Two (2) copies of all test reports shall be supplied for approval before shipment of Equipment. The report shall indicate clearly the standard value specified for each test to facilitate checking of the reports. After final approval six (6) bound copies and two (2) sets of CD-ROMs/ DVD/Portable hard disk of all type and routine test reports shall be submitted to Employer.

3.7 MATERIAL /WORKMANSHIP

Where the specification does not contain references to workmanship, equipment, materials and components of the covered equipment, it is essential that the same must be new, of highest grade of the best quality of their kind, conforming to best engineering practice and suitable for the purpose for which they are intended and shall ensure satisfactory performance throughout the service life.

In case where the equipment, materials or components are indicated in the specification as "similar" to any special standard the purchaser shall decide upon the question of similarity. When required by the specification or when required by the purchaser the bidder shall submit, for approval, all the information concerning the materials or components to be used in manufacture. Machinery, equipment, materials and components supplied, installed or used without such approval shall run the risk of subsequent rejection, it being understood that the cost as well as the time delay associated with the rejection shall be borne by the Bidder.

The design of the Works shall be such that installation, future expansions, replacements and general maintenance may be undertaken with a minimum of time and expenses. Each component shall be designed to be consistent with its duty and suitable factors of safety subject to mutual agreements. All joints and fastenings shall be devised, constructed and documented so that the component parts shall be accurately positioned and restrained to fulfill their required function. In general, screw threads shall be standard metric threads. The use of other thread forms will only be permitted when prior approval has been obtained from the Purchaser.

Whenever possible, all similar part of the works shall be made to gauge and shall also be made interchangeable with similar parts. All spare parts shall also be interchangeable and shall be made of the same materials and workmanship as the corresponding parts of the equipment supplied under the specification. Where feasible, common component units shall be employed in different pieces of equipment in order to minimize spare parts stocking requirements. All equipment of the same type and rating shall be physically and electrically interchangeable.
The equipment offered in the bid only shall be accepted for supply, with the minimum modifications as agreed/accepted.

3.8 PROVISIONS FOR EXPOSURE TO HOT AND HUMID CLIMATE

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

3.8.1 Space Heaters

Space heaters where provided shall be suitable for continuous operation at 240V supply voltage. On-off switch and fuse shall be provided.

One or more adequately rated permanently or thermostatically connected heaters shall be supplied to prevent condensation in any compartment. The heaters shall be installed in the lower portion of the compartment and electrical connections shall be made from below the heaters to minimise deterioration of supply wire insulation. The heaters shall be suitable to maintain the compartment temperature at approximately 10C, above the outside air temperature to prevent condensation. This shall be demonstrated by tests.

3.8.2 Fungi Static Varnish

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

3.8.3 Ventilation Openings

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

3.9 CLEANING, PAINTING AND TROPICALASATION

3.9.2 General

All paints shall be applied in strict accordance with the paint manufacturer's instructions.

All painting shall be carried out on dry and clean surfaces and under suitable atmospheric and other conditions in accordance with the paint manufacturer's recommendations.

An alternative method of coating equipment such as with epoxy resin-based coating powders will be permitted, subject to the approval of the Engg. In charge (Divisional Engr.), and such powders shall comply with the requirements of IEC 455. The Bidder shall provide full details of the coating process to the Engg. In charge (Divisional Engr.) for approval.

It is the responsibility of the Bidder to ensure that the quality of paints used shall withstand the tropical heat and extremes of weather conditions specified in the schedules. The paint shall not peel off, wrinkle, be removed by wind, storm and handling on site and the surface finish shall neither rust nor fade during the service life of the equipment.

The colors of paints for external and internal surfaces shall be in accordance with the approved color schemes.

3.9.3 Works Painting Process

All steelworks, plant supporting steelworks and metalwork, except galvanised surfaces or where otherwise specified, shall be shot blasted to BS 7079 or the equivalent ISO standard. All sheet steel work shall be degreased, pickled, phosphated in accordance with the IS 6005 "Code of Practice for phosphating iron and sheet steel". All surfaces shall then be painted with one coat of epoxy zinc rich primer, two pack type, to a film thickness of 50 microns. This primer shall be applied preferably by airless spray and within twenty minutes but not exceeding one hour of shot blasting.

All rough surfaces of coatings shall be filled with an approved two pack filler and rubbed down to a smooth surface.

The interior surfaces of all steel tanks and oil filled chambers shall be shot blasted in accordance with BS 7079 or the equivalent ISO, and painted within a period of preferably twenty minutes, but not exceeding one hour with an oil resisting coating of a type and make to the approval of the BHEL/OPTCL.

The interior surfaces of mechanism chambers, boxes and kiosks, after preparation, cleaning and priming as required above, shall be painted with one coat zinc chromate primer, one coat phenolic based undercoating, followed by one coat phenolic based finishing paint to a light or white colour. For equipment for outdoor use this shall be followed by a final coat of anti-condensation paint of a type and make to the approval of the BHEL/OPTCL, to a light or white colour. A minimum overall paint film thickness of 150 microns shall be maintained throughout.

All steelworks and metalwork, except where otherwise specified, after preparation and priming as required above shall be painted with one coat metallic zinc primer and two coats of micaceous iron oxide paint followed by two coats of either phenolic based or enamel hard gloss finished coloured paint to the approval to an overall minimum paint film thickness of 150 microns.

Galvanised surfaces shall not be painted in the works.

All nuts, bolts, washers etc., which may be fitted after fabrication of the plant shall be painted as described above after fabrication.

The painted metal works shall be subjected to paint qualification test as per draft ANSI/IEEE-Std 37.21 - 1985 clause 5.2.5.

3.9.4 Colour Schemes

The Bidder shall propose a colour scheme for the sub-station for the approval of BHEL/OPTCL. The decision of BHEL/OPTCL shall be final. The scheme shall include:

- Finishing colour of indoor equipment
- Finishing colour of outdoor equipment
- Finish colour of all cubicles
- Finishing colour of various auxiliary system equipment including piping.
- Finishing colour of various building items.

All steel structures, plates etc. shall be painted with non-corrosive paint on a suitable primer. It may be noted that normally all Employer"s electrical equipment in Employer"s switchyard are painted with shade 631 of IS: 5 and Employer will prefer to follow the same for this project also. All indoor cubicles shall be of same colour scheme and for other miscellaneous items colour scheme will be subject to the approval of the BHEL/OPTCL.

Sl. No.	Equipment	Application Environment			
		Indoor		Outdoor	
		Colour	Code IS:5	Colour	Code IS:5
400kV/220kV/132kV Class Equipment					
1	Transformers	—	—	Light grey	631
2	Marshalling boxes, CTs, PT's, CVT's, surge counter casings, junction boxes etc.	Light Admiralty grey.	697	Light Admiralty grey.	697
3	Control and relay panels, PLCC cabinets etc.	Smoke grey	692	—	—
4	Porcelain parts i.e. insulators	Dark brown	412	Dark brown	412
5	All structures/ metallic parts exposed to atmosphere	Hot dip galvanised			
33kV Class equipment					
6	Switchgear cubicles	Smoke grey	692	Light grey	631
7	Control and relay panels	Smoke grey	692	—	—
	LT switchgear				
8	LT switchgear exterior	Smoke grey	692	Light grey	631
9	ACDB/ MCC	Smoke grey	692	Light grey	631
10	DCDB	Smoke grey	692	—	—
11	LT bus duct in side enclosure	Matt Paint		—	—
12	LT bus duct outside enclosure	Smoke grey	692	—	—
13	Motors	Smoke grey	692	Light grey	631
14	Diesel generator engine	Smoke grey	692	—	—
15	Diesel generator	Smoke grey	692	—	—
16	LT transformers	Smoke grey	692	Light grey	631
17	Battery charger	Smoke grey	692	—	—
18	Mimic diagram 400kV 220kV 132kV 33kV 11kV 415V	 Dark violet Golden yellow Sky blue Signal red Canary yellow Middle brown	 796 356 101 537 309 411	 — — — — — —	 — — — — — —
	Miscellaneous				
19	Control modules and console inserts	Smoke grey	692	Light grey	631
20	Lighting package equipment outside	Light grey	631	Light grey	631
21	Lighting package equipment inside	Glossy white		Glossy white	
22	Water pipes	sea green	217	sea green	217
23	Air pipes	Sky blue	101	Sky blue	101
24	Transformer oil pipes	Light brown	410	Light brown	410
25	Fire Installations	Fire red	536	Fire red	536
26	Insulating oil/ gas treatment plant	Gulf red	473	Gulf red	473

Table 10.3.4. Recommended color schemes

3.10 DEGREES OF PROTECTION

Degrees of protection shall be provided in accordance with IEC 144 and IEC 529 and be as follows:

- For outdoor applications, IP 55.
- For indoor applications where purpose built accommodation is provided, e.g. switch and control and relay rooms in auxiliary plant buildings, IP 41.
- Where dust can adversely affect equipment within the enclosure, this equipment should be separately housed with a degree of protection of IP 51.

- For indoor applications where the equipment is housed in the same building as that enclosing water and steam operated equipment, the degrees of protection stated in the previous paragraph shall be up-rated to IP 44 and IP 54 respectively.

Where more severe environments exist, e.g. steam and oil vapour or other deleterious chemical environments, special measures will be necessary and the degree of protection required will be specified separately.

The Bidder shall submit a schedule for providing the degree protection to various control boxes, junction boxes etc. for the BHEL/OPTCL's approval.

3.11 RATING PLATES, NAME PLATES AND LABELS

a) All apparatus shall be clearly labelled indicating, where necessary, its purpose and service positions. Each phase of alternating current and each pole of direct current equipment and connections shall be coloured in an approved manner to distinguish phase or polarity.

b) The material of all labels and the dimensions, legend, and method of printing shall be to approval. The surface of indoor labels shall have a matt or satin finish to avoid dazzle from reflected light.

c) Colours shall be permanent and free from fading. Labels mounted on black surfaces shall have white lettering. „Danger" plates shall have red lettering on a white background.

d) All labels and plates for outdoor use shall be of non-corroding material. Where the use of enamelled iron plates is approved, the whole surface including the back and edges, shall be properly covered and resistant to corrosion. Protective washers of suitable material shall be provided front and back on the securing screws.

e) Labels shall be engraved in Hindi, English and Oriya. Name plates shall be white with black engraved lettering and shall carry all the applicable information specified in the applicable items of the Standards.

f) Any other relevant information which may be required for groups of smaller items for which this is not possible e.g. switch bays etc. a common name plate in Oriya with the title and special instructions on it shall be provided.

g) No scratching, corrections or changes will be allowed on name plates.

h) All equipment mounted on front and rear sides as well as equipment mounted inside the panels shall be provided with individual name plates with equipment designation engraved.

i) On the top of each panel on front as well as rear sides large name plates with bold size lettering shall be provided for circuit/ feeder/ cubicle box designation.

j) All front mounted equipment shall be also provided, at the rear, with individual name plates engraved with tag numbers corresponding to the one shown in the panel internal wiring to facilitate tracing of the wiring. The name plates shall be mounted directly by the side of the respective equipment wiring.

k) Name plates of cubicles and panels may be made of non rusting metal or 3 ply lamicoid. These name plates may be black with white engraved lettering.

l) The name plate inscription and size of name plates and letters shall be submitted to the BHEL/OPTCL/ Engineer for approval.

m) The nameplates of the apparatus shall include, at least, the information listed below, together with any other relevant information specified in the applicable standards:
- Concise descriptive title of the equipment
- Rating and circuit diagrams
- Manufacturer's name, trade-mark, model type, serial number
- Instruction book number
- Year of manufacture
- Total weight (for capacitor racks indicate weight, for capacitors indicate quantity of liquid)
- Special instructions, if any, about storage, transportation, handling etc.

n) Each measuring instrument and meter shall be prominently marked with the quantity measured e.g. kV, A, MW etc. All relays and other devices shall be clearly marked with manufacturers name, manufacturer's type, serial number and electrical rating data.

o) Danger plates and plates for phase colours shall be provided as per requirement. The Bidder shall devise a system to designate equipment and sub-systems. The nameplates/labels displaying these designations shall be installed at appropriate locations. Whenever motion or flow of fluids is involved, plates showing direction of motion or flow shall also be provided.

3.12 BOLTS AND NUTS

All bolts, studs, screw threads, pipe threads, bolt heads and nuts shall comply with the appropriate national standards for metric threads, or the technical equivalent.
Except for small wiring, current carrying terminal bolts or studs, for mechanical reasons, shall not be less than 6 mm in diameter.

All nuts and pins shall be adequately locked. Wherever possible bolts shall be fitted in such a manner that in the event of failure of locking resulting in the nuts working loose and falling off, the bolt will remain in position.

All bolts, nuts and washers placed in outdoor positions shall be treated to prevent corrosion, by hot dip galvanising or electro galvanising to service condition 4. Appropriate precautions shall be taken to prevent electrolytic action between dissimilar metals.

Where bolts are used on external horizontal surfaces where water can collect, methods of preventing the ingress of moisture to the threads shall be provided.

Each bolt or stud shall project at least one thread but not more than three threads through its nut, except when otherwise approved for terminal board studs or relay stems. If bolts and nuts are placed so that they are inaccessible by means of ordinary spanners, special spanners shall be provided.

The length of the screwed portion of the bolts shall be such that no screw thread may form part of a shear plane between members. Taper washers shall be provided where necessary.

Protective washers of suitable material shall be provided front and back on the securing screws.

3.13 GALVANISING:

3.13.1 General

All machining, drilling, welding, engraving, scribing or other manufacturing activities which would damage the final surface treatment shall be completed before the specified surface treatment is carried out.

3.13.2 Galvanising

All metal surfaces shall be subjected to treatment for anti-corrosion protection. All ferrous surfaces for external use shall be hot dip galvanised. High tensile steel nuts, bolts and spring washers shall be electro galvanised to service condition 4. All steel conductors including those used for earthing and grounding (above ground level) shall also be galvanised according to IS 2629.

All galvanising shall be applied by the hot dip process and shall comply with IS 2629, IS 2633, IS 4759, IS 1367 or IS 6745.

All welds shall be de-scaled, all machining carried out and all parts shall be adequately cleaned prior to galvanising. The preparation for galvanising and the galvanising itself shall not adversely affect the mechanical properties of the coated material.

The threads of all galvanised bolts and screwed rods shall be cleared of spelter by spinning or brushing. A die shall not be used for cleaning the threads unless specially approved by the BHEL/OPTCL. All nuts shall be galvanised with the exception of the threads which shall be oiled. Surfaces which are in contact with oil shall not be galvanised or cadmium plated.

Partial immersion of the work will not be permitted and the galvanising tank must therefore be sufficiently large to permit galvanising to be carried out by one immersion.

Galvanising of wires shall be applied by the hot dip process and shall meet the requirements of IS 2141.

The minimum weight of the zinc coating and minimum thickness of coating for outdoor equipment shall be as follows:

a)	For sections & plates above 5mm of thickness	910 gm/sq.m	127 microns
b)	For sections & plates below 5mm of thickness	610 gm/sq.m	87 microns
c)	For surfaces embedded in concrete	800 gm/sq.m.	

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

After galvanising no drilling or welding shall be performed on the galvanised parts of the equipment excepting that nuts may be threaded after galvanising. Sodium dichromate treatment shall be provided to avoid formation of white rust after hot dip galvanisation.

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

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

- Coating thickness
- Uniformity of zinc
- Adhesion test
- Mass of zinc coating

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

3.14 CLAMPS AND CONNECTORS INCLUDING TERMINAL CONNECTORS

The terminal connectors shall conform strictly to the requirements if the latest versions of following standards as amended up-to-date, except otherwise,

i)	IS: 5561	Power Connectors
ii)	IS: 617	Aluminium & Aluminium Alloy
iii)	IS: 2629	Recommended Practice for HDG of iron & steel
iv)	IS: 2633	Method of testing uniformity of coating of zinc coated articles

The material of clamps and connectors shall be Aluminium alloy casting conforming to designation A6 of IS: 617 for connecting to equipment terminals and conductors of aluminium. In case the terminals are of copper, the same clamps/connectors shall be used with 4mm thick bimetallic liner.

The material of clamps and connectors shall be Galvanised mild steel for connecting to shield wire.

Bolts, nuts and plain washers shall be hot dip galvanised mild steel for sizes M12 and above. For sizes below M12, they shall be electro-galvanised mild steel. The spring washers shall be electro-galvanised mild steel.

All castings shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be rounded off to meet specified corona and radio interference requirements.

They shall have same current rating as that of the connected equipment. All current carrying parts shall be at least 10 mm thick. The connectors shall be manufactured to have minimum contact resistance.

Flexible connectors, braids or laminated strips shall be made up of copper/aluminium.

Current rating and size of terminal/conductor for which connector is suitable shall be put on a suitable sticker on each component which should last at least till erection time.

3.15 CABLE GLANDS AND LUGS/FERRULES

Cable shall be terminated using double compression type cable glands. Testing requirements of Cable glands shall conform to BS:6121 and gland shall be of robust construction capable of clamping cable and cable armour (for armoured cables) firmly without injury to insulation. Cable glands shall be made of heavy duty brass machine finished and nickel chrome plated. Thickness of plating shall not be less than 10 micron. All washers and hardware shall also be made of brass with nickel chrome plating Rubber components shall be of neoprene or better synthetic material and of tested quality. Cable glands shall be suitable for the sizes of cable supplied/erected.

Cable lugs/ferrules for power cables shall be tinned copper solderless crimping type suitable for aluminium compacted conductor cables. Cable lugs and ferrules for control cables shall be tinned copper type. The cable lugs for control cables shall be provided with insulating sleeve and shall suit the type of terminals provided on the equipment. Cable lugs and ferrule shall conform to DIN standards.

3.16 WIRING, CABLING AND CABLE INSTALLATION

3.16.1 Cubicle wiring

Panels shall be complete with interconnecting wiring between all electrical devices in the panels. External connections shall be achieved through terminal blocks. Where panels are required to be located adjacent to each other all inter panel wiring and connections between the panels shall be carried out internally. The Bidder shall furnish a detailed drawing of such inter panel wiring. The Bidder shall ensure the completeness and correctness of the internal wiring and the proper functioning of the connected equipment.

All wiring shall be carried out with 1.1 kV grade, PVC insulated, single core, stranded copper wires. The PVC shall have oxygen index not less than '29' and Temperature index not less than 250C. The wires shall have annealed copper conductors of adequate size comprise not less than three strands

The minimum cross sectional area of the stranded copper conductor used for internal wiring shall be as follows:

- All circuits excepting CT circuits and energy metering circuit of VT 2.5 sq.mm
- All CT circuits and metering circuit of VT 2.5 sq. mm

All internal wiring shall be supported, neatly arranged, readily accessible and connected to equipment terminals and terminal blocks. Wiring gutters and troughs shall be used for this purpose.

Cubicle connections shall be insulated with PVC to IEC 227. Wires shall not be jointed or teed between terminal points.

Bus wires shall be fully insulated and run separately from one another. Auxiliary bus wiring for AC and DC supplies, voltage transformer circuits, annunciation circuits and other common services shall be provided near the top of the panels running throughout the entire length of the panel suite. Longitudinal troughs extending throughout the full length of panel shall be preferred for inter panel wiring.

All inter connecting wires between adjacent panels shall be brought to a separate set of terminal blocks located near the slots of holes meant for the passage of the interconnecting wires. Interconnection of adjacent panels on site shall be straightforward and simple. The bus wires for this purposes shall be bunched properly inside each panel.

Wire termination shall be made with solderless crimping type and tinned copper lugs which firmly grip the conductor. Insulated sleeves shall be provided at all the wire terminations. Engraved core identification plastic ferrules marked to correspond with panel wiring diagram shall be fitted at both ends of each wire. Ferrules shall fit tightly on the wire and shall not fall off when the wire is disconnected from terminal blocks. Numbers 6 and 9 shall not be included for ferrules purposes unless the ferrules have numbers underscored to enable differentiation. (i.e. 6 and 9).

Fuses and links shall be provided to enable all circuits in a cubicle, except a lighting circuit, to be isolated from the bus wires.

The DC trip and AC voltage supplies and wiring to main protective gear shall be segregated from those for back-up protection and also from protective apparatus for special purposes. Each such group shall be fed through separate fuses from the bus wires. There shall not be more than one set of supplies to the apparatus comprising each group. All wires associated with the tripping circuits shall be provided with red ferrules marked "**Trip**".

It shall be possible to work on small wiring for maintenance or test purposes without making a switchboard dead.

The insulation material shall be suitably coloured in order to distinguish between the relevant phases of the circuit.

When connections rated at 380 volt and above are taken through junction boxes they shall be adequately screened and "**DANGE**R" notices shall be affixed to the outsides of junction boxes or marshalling kiosk.
Where connections to other equipment and supervisory equipment are required the connections shall be grouped together.

3.16.2 LV power cabling

LVAC cable terminals shall be provided with adequately sized, hot pressed, cast or crimp type lugs.
Where sweating sockets are provided they shall be without additional clamping or pinch bolts. Where crimp type lugs are provided they shall be applied with the correct tool and the crimping tool shall be checked regularly for correct calibration. Bi-metallic joints between the terminals and lugs shall be provided where necessary.
Terminals shall be marked with the phase colour in a clear and permanent manner.
A removable gland plate shall be provided by the Bidder. The Bidder shall be responsible for drilling the cable gland plate. ere
Armoured cables shall be provided with suitable glands for terminating the cable armour and shall be provided with an earthing ring and lug to facilitate connection of the gland to the earth bar.

3.17 PRODUCTION PROCESS REQUIREMENTS

3.17.1 CASTINGS

GENERAL

All castings shall be true to pattern, free from defects and of uniform quality and condition. The surfaces of castings which do not undergo machining, shall be free from foundry irregularities. The castings shall be subject to NDT, chemical, mechanical and metallographic tests. Details of the same shall be furnished to BHEL/OPTCLfor review/approval. Magnetic particle inspection (MPI) test, wherever applicable, shall be carried out in longitudinal and transverse direction to detect radial and axial cracks.

IRON CASTINGS

Iron casting material shall be in accordance with ASTM A 126 Class B. A copy of the ladle analysis shall be sent to the BHEL/OPTCL. Each casting shall have a test bar from which tension test specimens may be taken. Test specimen shall be in accordance with ASTM A 370 and tested in accordance with ASTM E8. The Bidder shall submit his procedures for testing and acceptance for iron castings for approval by the BHEL/OPTCL.

STEEL CASTINGS

Steel castings shall be manufactured in accordance with ASTM A 27 and shall be subjected to appropriate tests and inspection as detailed herein.
Copies of mandatory documentation, such as ladle analyses and mechanical test results, shall be sent to the BHEL/OPTCL. (Non-ferrous casting material and castings shall be manufactured in accordance with the appropriate ASTM standards for the material concerned).

3.17.2 FORGINGS

When requested by the BHEL/OPTCL, forgings will be subjected to inspection in the regions of fillets and changes of section by suitable method. Magnetic particle, dye-penetration, radiographic or ultrasonic, or any combination of these methods may be used to suit material type and forging design.
The testing is to be carried out after the rough machining operation and is to be conducted according to the appropriate ASTM standards.
MPI test on forging shall be carried out to detect both radial and axial cracks. Ferrous forgings shall be demagnetised after such tests.

Any indentations which prove to penetrate deeper than 2.5% of the finished thickness of the forging shall be reported to the BHEL/OPTCLgiving location, length, width and depth. Any indentations which will not machine out during final machining shall be gouged out and repaired using an approved repair procedure. Repair of rotating elements by welding will only be accepted subject to detailed examination of the proposal by the BHEL/OPTCLprior to the repair being carried out.

The forging shall be tested for mechanical and metallographic tests as per ASTM. The details shall be mutually discussed/agreed upon.

3.17.3 FABRICATED COMPONENTS

All components machined or fabricated from plate, sheet or bar stock shall meet the material requirements of ASTM or material specification approved by the BHEL/OPTCL.

Structural steel, rolled shapes, bars, etc. shall comply with the latest ASTM for A36.

Plate steel shall be of a designation and quality suitable for the function it is intended to perform. Insofar as it is compatible with its function, it shall comply with ASTM A283 structural quality.

All, or a representative number of such components, shall be subjected to one or more of the following tests: visual, dye penetration, magnetic particle (transverse and longitudinal), ultrasonic or radiographic. These tests shall be in accordance with the recommended practices of the ASTM. The terms of reference for acceptance shall be the applicable ASTM Specifications.

3.17.4 WELDING AND WELDERS QUALIFICATIONS

General

All welding shall be carried out by qualified welders only.

All welding shall be in accordance with the corresponding standards of the American Welding Society or the American Society of Mechanical Engineers.

Other standards to determine the quality of welding process and qualifications of welders may be considered, provided that sufficient information is first submitted for the approval of the BHEL/OPTCL.

Prior to the start of fabrication, the Bidder shall submit to the BHEL/OPTCLfor approval, a description of each of the welding procedures which he proposes to adopt, together with certified copies of reports of the results from tests made in accordance with these procedures.

The Bidder shall be responsible for the quality of the work performed by his welding organisation. All welding operators, to be assigned work, including repair of casting, shall pass the required tests for qualification of welding procedures and operators. The BHEL/OPTCL reserves the right to witness the qualification tests for welding procedures and operators and the mechanical tests at the samples.

The Bidder shall bear all his own expenses in connection with the qualification tests. If the work of any operator at any time appears questionable, such operator will be required to pass appropriate prequalification tests as specified by the Inspector and at the expense of the Bidder.

Welding

All welding shall be performed in accordance with the appropriate standards. The design and construction of welded joints subject to hydraulic pressure shall conform to the applicable requirement of ASME “Boiler and Pressure Vessel Code” shall be qualified in accordance with Section IX of this Code. The design and construction of welded joints not subjected to hydraulic pressure shall, as a minimum, conform to the requirements of AWS “Specification for Welded Highway and Railway Bridge” D2.0. Except for minor parts and items specifically exempted from stress relieving, all shop welded joints shall be stress relieved in accordance with the requirements of the ASME “Boiler and Pressure Vessel Code” Section VIII.

In addition to satisfying the procedural and quality requirements set forth in the applicable code and/or these Specifications, all welding shall meet the following requirements for workmanship and visual quality:

- Butt welds shall be slightly convex, of uniform height and shall have full penetration.
- Fillet welds shall be of the specified size, with full throat and legs of equal length.

- Repairing, chipping and grinding of welds shall be done in a manner which will not gouge, groove or reduce the thickness of the base metal.
- The edges of the member to be joined shall expose sound metal, free from laminations, surface defects caused by shearing or flame-cutting operations or other injurious defects.

Welded joints subject to critical working stress shall be tested by approved methods of non-destructive testing, such as radiographic and ultrasonic examination, magnetic particle and liquid penetration inspection. All expenses in connection with these tests shall be borne by the Bidder. The extent of testing shall be as stipulated by the ASME „Boiler and Pressure Vessel Code", Section VIII, but without prejudice to the rights of the Inspector or the BHEL/OPTCL to ask for additional tests,
The arc-welding process to be used and the welding qualifications of the welders employed on the work shall be used in accordance with AWS requirements and Section VIII and IX of the ASME (American Society of Mechanical Engineers) Code, latest edition, as they may apply. All welding rods shall conform to the requirements of the latest issue of Section It, part C of the ASME Code.
Gas shielded welding (TIG or MIG) used as appropriate for aluminium, stainless steel or other material shall be carried out in accordance with the best commercial practice and the following standard specifications:

- Specifications for copper and copper-alloy welding rods (AWS A5.7, ASTM B259)
- Specification for corrosion-resisting chromium and chromium-nickel steel welding rods and bare electrodes (AWS A5.9, ASTM A371)
- Specifications for aluminium and aluminium alloy rods and bare electrodes (AWS A5.10, ASTM B285).
- Specifications for nickel and nickel-base alloy bare welding filler metal (AWS A5.14, ASTM B304).

Gas welding will not normally be used in the equipment. When a particular equipment manufacture requires the use of gas welding, the proposed process and the welder"s qualification shall be in accordance with AWS B3.0.
Welding of galvanised components will not be allowed in the equipment.
Strict measures of quality control shall be exercised throughout the Equipment/ Works. The BHEL/OPTCL may call for an adequate NDT test of the work of any operator, who in his opinion is not maintaining the standard of workmanship. Should this NDT test prove defective, all work done by that operator, since his last test shall be tested at the Bidder"s expense. If three or more of these tests prove defective, the operator shall be removed from the project.
A procedure for the repair of defects shall be submitted to the BHEL/OPTCL for his approval prior to any repairs being made.

Welding of pipes
Before welding, the ends shall be cleaned by wire brushing, filing or machine grinding. Each weld-run shall be cleaned of slag before the next run is deposited.
Welding at any joint shall be completed uninterrupted. If this cannot be followed for some reason, the weld shall be insulated for slow and uniform cooling.
Welding shall be done by manual oxy-acetylene or manual shielded metal are process. Automatic or semi-automatic welding processes may be done only with the specific approval of BHEL/OPTCL.
As far as possible welding shall be carried out in flat position. If not possible, welding shall be done in a position as close to flat position as possible.
Downward technique is not allowed while welding pipes in horizontal position, unless permitted by the BHEL/OPTCL.
Combination of welding processes or usage of electrodes of different classes or makes in a particular joint shall be allowed only after the welding procedure has been duly qualified and approved by the BHEL/OPTCL.
No backing ring shall be used for circumferential butt welds.
Welding carried out in ambient temperature of 5C or below shall be heat treated.

A spacer wire of proper diameter may be used for weld root opening but must be removed after tack welding and before applying root run.
Tack welding for the alignment of pipe joints shall be done only by qualified welders. Since tack welds form part of final welding, they shall be executed carefully and shall be free from defects. Defective welds shall be removed prior to the welding of joints.
Electrodes size for tack welding shall be selected depending upon the root opening.
Tack welds should be equally spaced.
Root run shall be made with respective electrodes/filler wires. The size of the electrodes shall not be greater than 3.25 mm (10 SWG) and should preferably be 2.3 mm (12 SWG). Welding shall be done with direct current values recommended by the electrode manufacturers.
Upward technique shall be adopted for welding pipes in horizontally fixed position. For pipes with wall thickness less than 3 mm, oxyacetylene welding is recommended.
The root run of butt joints shall be such as to achieve full penetration with the complete fusion of root edges. The weld projection shall not exceed 3 mm inside the pipe.
On completion of each run craters, weld irregularities, slag etc. shall be removed by grinding or chipping.
During the process of welding, all movements, shocks, vibration or stresses shall be carefully avoided in order to prevent weld cracks.
Fillet welds shall be made by shielded metal arc process regardless of thickness and class of piping. Electrode size shall not exceed 10 SWG. (3.25 mm). At least two runs shall be made on socket weld joints.

3.18 QUALITY ASSURANCE

3.18.1 GENERAL

To ensure that the supply and services under the scope of this Contract, whether manufactured or performed within the Bidder's works or at his Sub-Bidder's premises or at Site or at any other place of work are in accordance with the Specification, with the Regulations and with relevant Indian or otherwise Authorized Standards the Bidder shall adopt suitable Quality Assurance Programs and Procedures to ensure that all activities are being controlled as necessary.

The quality assurance arrangements shall conform to the relevant requirements of ISO 9001 or ISO 9002 as appropriate.

Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Bidder's/ Sub-bidder's/ sub-supplier's Quality Control Organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing. The Quality Plan shall be submitted on electronic media e.g. E-mail in addition to hard copy, for review. Once the same is finalised, hard copies shall be submitted for approval. After approval the same shall be submitted in compiled form on CD ROM.

The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality Plans and reference documents/standards etc. will be subject to Employer's approval without which manufacturer shall not proceed.

These approved documents shall form a part of the contract. In these approved Quality Plans, Employer shall identify customer hold points (CHP), i.e. test/checks which shall be carried out in presence of the Employer's Project Manager or his authorised representative and beyond which the work will not proceed without consent of Employer/Authorised representative in writing. All deviations to this specification,

approved quality plans and applicable standards must be documented and referred to Employer along with technical justification for approval and dispositioning.

No material shall be despatched from the manufacturer's works before the same is accepted subsequent to pre-despatch final inspection including verification of records of all previous tests/inspections by Employer's Project Manager/Authorised representative and duly authorised for despatch by issuance of Material Dispatch Clearance Certificate (MDCC).

All material used for equipment manufacture including casting and forging etc. shall be of tested quality as per relevant codes/standards. Details of results of the tests conducted to determine the mechanical properties, chemical analysis and details of heat treatment procedure recommended and actually followed shall be recorded on certificates and time temperature chart. Tests shall be carried out as per applicable material standards and/or agreed details.

For all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable.

Repair/rectification procedures to be adopted to make the job acceptable shall be subject to the approval of the Employer/ authorised representative.

3.18.2 SUB-VENDOR

The Bidder shall ensure that the Quality Assurance requirements of this Specification are followed by any sub-vendor appointed by him under the Contract.
The Bidder shall assess the sub-vendor's Quality Assurance arrangements prior to his appointment to ensure its compliance with the appropriate ISO 9000 standard and the Specification.
Auditing of the sub-vendor's Quality Assurance arrangements shall be carried out by the Bidder and recorded in such a manner that demonstrates to the OPTCL/BHEL the extent of the audits and their effectiveness.

3.18.3 QUALITY ASSURANCE DOCUMENTS

The Bidder shall be required to submit two hard copies and two sets on CDROM of the following Quality Assurance Documents as identified in respective quality plan with tick (√) mark.

Each QA Documentation shall have a project specific Cover Sheet bearing name & identification number of equipment and including an index of its contents with page control on each document.

The QA Documentation file shall be progressively completed by the Supplier's sub-supplier to allow regular reviews by all parties during the manufacturing.

The final quality document will be compiled and issued at the final assembly place of equipment before dispatch. However CD-Rom may be issued not later than three weeks.
Typical contents of Quality Assurance Document are as below:-

i) Quality Plan,
ii) Material mill test reports on components as specified by the specification and approved Quality Plans.
iii) Manufacturer / works test reports/results for testing required as per applicable codes and standard referred in the specification and approved Quality Plans.

iv) Non-destructive examination results /reports including radiography interpretation reports. Sketches/drawings used for indicating the method of traceability of the radiographs to the location on the equipment.
v) Heat Treatment Certificate/Record (Time- temperature Chart)
vi) All the accepted Non-conformance Reports (Major/Minor) / deviation, including complete technical details / repair procedure).
vii) CHP / Inspection reports duly signed by the Inspector of the Employer and Bidder for the agreed Customer Hold Points.
viii) Certificate of Conformance (COC) whoever applicable.
ix) MDCC

Before dispatch/ commissioning of any equipment, the Supplier shall make sure that the corresponding quality document or in the case of protracted phased deliveries, the applicable section of the quality document file is completed. The supplier will then notify the Inspector regarding the readiness of the quality document (or applicable section) for review.

i) If the result of the review carried out by the Inspector of the Quality document (or applicable section) is satisfactory, the Inspector shall stamp the quality document (or applicable section) for release.
ii) If the quality document is unsatisfactory, the Supplier shall endeavour to correct the incompleteness, thus allowing to finalize the quality document (or applicable section) by time compatible with the requirements as per contract documents. When it is done, the quality document (or applicable section) is stamped by the Inspector.
iii) If a decision is made for dispatch, whereas all outstanding actions cannot be readily cleared for the release of the quality document by that time, the supplier shall immediately, upon shipment of the equipment, send a copy of the quality document Review Status signed by the Supplier Representative to the Inspector and notify of the committed date for the completion of all outstanding actions & submission. The Inspector shall stamp the quality document for applicable section when it is effectively completed. The submission of QA documentation package shall not be later than 3 weeks after the dispatch of equipment.

3.18.4 TRANSMISSION OF QUALITY DOCUMENTS

As a general rule, two hard copies of the quality document and Two CD ROMs shall be issued to the Employer on release of QA Documentation by Inspector. One set of quality document shall be forwarded to Corporate Quality Assurance Department and other set to respective Site.
For the particular case of phased deliveries, the complete quality document to the Employer shall be issued not later than 3 weeks after the date of the last delivery similarly as stated above.

3.18.5 INSPECTION, TESTING & INSPECTION CERTIFICATE

i. The word 'Inspector' shall mean the Project Manager and/or his authorised representative and/or an outside inspection agency acting on behalf of the Employer to inspect and examine the materials and workmanship of the works during its manufacture or erection.

ii. The Project Manager or his duly authorised representative and/or an outside inspection agency acting on behalf of the Employer shall have access at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the Bidder shall obtain for the Project Manager and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Bidder's own premises or works.

iii. The Bidder shall give the Project Manager/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Bidder's account except for the expenses of the Inspector's. The Project Manager/Inspector, unless the witnessing of the tests is virtually waived and confirmed in writing, will attend such tests within fifteen (15) days of the date on which the equipment is noticed as being ready for test/inspection failing which the Bidder may proceed with test which shall be deemed to have been made in the inspector's presence and he shall forthwith forward to the inspector duly certified copies of test reports in two (2) copies.

iv. The Project Manager or Inspector shall within fifteen (15) days from the date of inspection as defined herein give notice in writing to the Bidder, or any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract. The Bidder shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall inform in writing to the Project Manager/Inspector giving reasons therein, that no modifications are necessary to comply with the contract.

v. When the factory tests have been completed at the Bidder's or sub-bidder's works, the Project Manager /Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests but if the tests are not witnessed by the Project Manager /Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Bidder's test certificate by the Project Manager /Inspector. Project Manager /Inspector to issue such a certificate shall not prevent the Bidder from proceeding with the works. The completion of these tests or the issue of the certificates shall not bind the Employer to accept the equipment should it, on further tests after erection be found not to comply with the contract.

vi. In all cases where the contract provides for tests whether at the premises or works of the Bidder or any sub-bidder, the Bidder, except where otherwise specified shall provide free of charge such items as labour, material, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Project Manager /Inspector or his authorised representatives to carry out effectively such tests on the equipment in accordance with the Bidder and shall give facilities to the Project Manager/Inspector or to his authorised representative to accomplish testing.

vii. The inspection by Project Manager / Inspector and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Bidder in respect of the agreed Quality Assurance Programme forming a part of the contract.

viii. To facilitate advance planning of inspection in addition to giving inspection notice, the Bidder shall furnish quarterly inspection programme indicating schedule dates of inspection at Customer Hold Point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.

ix. All inspection, measuring and test equipment used by bidder shall be calibrated periodically depending on its use and criticality of the test/measurement to be done. The Bidder shall maintain all the relevant records of periodic calibration and instrument identification, and shall produce the same for inspection by NTPC. Wherever asked specifically, the bidder shall re-calibrate the measuring/test equipment in the presence of Project Manager / Inspector.

3.19 TYPE, ROUTINE & ACCEPTANCE TESTS:

The Bidder shall carry out the tests stated in accordance with the conditions of this Specification, without extra charge for such additional tests as in the opinion of the BHEL/OPTCL are necessary to determine that the Contract Works comply with this Specification. The tests shall be carried out generally in accordance

with the relevant IEC"s or IS or equivalent standards. The specific details of testing and inspection are given in the appropriate section of this Specification.

The Bidder shall submit Type Test Reports for all equipment being supplied by him for the BHEL/OPTCL"s approval. The BHEL/OPTCL may also give instruction to carry out Type Tests, routine tests or acceptance tests. Type Test Charges shall be paid as per the rates indicated in the Price Schedules.

All materials used shall be subjected to such routine tests as are customary in the manufacture of the types of plant included in the Contract Works. These materials shall withstand satisfactorily all such tests.

All tests shall be carried out to the satisfaction of the BHEL/OPTCL, in his presence, at such reasonable times as he may require, unless agreed otherwise. Not less than three weeks' notice of all tests shall be given to the BHEL/OPTCL in order that he may be represented if he so desires. As many tests as possible shall be arranged together. Six copies of the Bidder"s test reports and test sheets shall be supplied to the BHEL/OPTCL for approval.
Measuring apparatus shall be approved by the OPTCL/BHEL (Divisional Engr) and if required shall be calibrated at the expense of the Bidder at an approved laboratory.

The Bidder shall be responsible for the proper testing of the work completed or plant or materials supplied by a sub-bidder to the same extent as if the work, plant or materials were completed or supplied by the Bidder himself.

All apparatus, instruments and connections required for the above tests shall be provided by the Bidder, but the BHEL/OPTCL may permit the use for the tests on site, any instruments and apparatus which may be provided permanently on site as part of the contract works conditional upon the Bidder accepting liability for any damage which may be sustained by such equipment during the test.

The bidder shall supply suitable test pieces of all materials as required by the BHEL/OPTCL. If required by the BHEL/OPTCL, test specimens shall be prepared for check testing and forwarded at the expense of the Bidder to an independent testing authority selected by the BHEL/OPTCL.

Any costs incurred by the Employer in connection with inspection and re-testing as a result of a failure of the subject under test, or damage during transport, or erection on site before take-over by the Employer, shall be to the account of the Bidder.

No inspection or lack of inspection or passing by the BHEL/OPTCLof work, plant or materials, whether carried out or supplied by the Bidder or sub-bidder, shall relieve the Bidder from his liability to complete the Contract Works in accordance with the Contract or exonerate him from any of his guarantees.

3.20.1 TYPE TEST REQUIREMENTS FOR EQUIPMENTS OTHER THAN GIS

a) All equipment to be supplied shall be of type tested design. During detail engineering, the bidder shall submit for Owner's approval the reports of all the type tests as listed in this specification and carried out not earlier than ten years prior to the date of techno-commercial bid opening (03-March-2017). These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a Client.
b) However if bidder is not able to submit report of the type test(s) conducted not earlier than ten years prior to the date of techno-commercial bid opening **(11-February-2022),** or in the case of type test report(s) are not found to be meeting the specification requirements, the bidder shall conduct all such

tests under this contract at no additional cost to the owner either at third party lab or in presence of client/ owners representative and submit the reports for approval.

c) All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.

3.20 PACKAGING & TRANSPORTATION

The Bidder shall be responsible for the packing, loading and transport of the plant and equipment from the place of manufacture, whether this is at his own works or those of any Bidder, to Site, and for off-loading at site.

All apparatus and equipment shall be carefully packed for transport by air, sea, rail and road as necessary and in such a manner that it is protected against tropical climate conditions and transport in rough terrain and cross country road conditions. The method of packing shall provide complete protection to all apparatus and equipment during transport and storage at site in heavy rain. The method of packing shall provide adequate protection to main items of plant and those parts contained within and attached without, for transportation.

Precautions shall be taken to protect parts containing electrical insulation against the ingress of moisture.

All bright parts liable to rust shall receive a coat of anti-rusting composition and shall be suitably protected.

The machined face of all flanges shall be protected by means of a blank disc bolted to each face.

Where appropriate all parts shall be boxed in substantial crates or containers to facilitate handling in a safe and secure manner. Each crate or container shall be marked clearly on the outside of the case to show "TOP" and "BOTTOM" positions with appropriate signs, and where the mass is bearing and the correct position for slings. Each crate or container shall also be marked with the notation of the part or parts contained therein, contract number and port of destination. It shall be the Bidder"s responsibility to dispose of all such packing.

Any damage due to defective or insufficient packing shall be made good by the Bidder at his own expense and within reasonable time when called upon by the BHEL/OPTCL to do so. Four (4) copies of complete packing lists showing the number, size, marks, mass and contents of each package shall be delivered to the BHEL/OPTCL immediately the material is despatched.

The Bidder shall inform himself fully as to all relevant transport facilities and requirements and loading gauges and ensure that the equipment as packed for transport shall conform to these limitations. The Bidder shall also be responsible for verifying the access facilities specified.

The Bidder shall be responsible for all costs of repair or replacement of the equipment, including those incurred by the Employer, arising from damage during transport, off-loading or erection on site, until take-over by the Employer.

The Bidder shall be responsible for the transportation of all loads associated with the contract works and shall take all reasonable steps to prevent any highways or bridges from being damaged by his traffic and shall select routes, choose and use vehicles and restrict and distribute loads so that the risk of damage shall be avoided. The Bidder shall immediately report to the BHEL/OPTCL any claims made against the Bidder arising out of alleged damage to a highway or bridge.

3.21 ENCLOSURES:

1. ANNEXURE – A: SPECIFICATION FOR ELECTRICAL COMPONENTS

NOTE:
Contractor is to be replaced with subcontractor/vendor.

1. MOTORS

1.1 General

All motors shall comply with IEC 34 / IS 335 and dimensions with IEC 72, however they shall be capable of operating continuously under actual service conditions without exceeding the specified temperature rises, determined by resistance, at any frequency between 48 and 51.5Hertz together with any voltage between ±10per cent of the nominal value.

All motors shall be totally enclosed, and if situated in the open they shall be weatherproof and suitable for outdoor working. They shall be provided with a suitable means of drainage to prevent accumulation of water due to condensation and with suitable means of breathing.

Motors operating in an ambient temperature not exceeding 40°C shall have insulation to at least ClassB and preferably ClassF standards. The temperature rise shall be restricted to that associated with ClassB insulation. Where the motor may be appreciably affected by conducted heat the class of insulation shall be to approval.

All motors shall be suitable for direct starting at full voltage.

Motors shall have sealed ball or roller bearings.

The three line connections of AC motors shall be brought out to a terminal box. The terminal arrangement shall be suitable for the reception of aluminium cable. Terminal markings shall be made in a clear and permanent manner and shall comply with IEC 34. A permanently attached diagram or instruction sheet shall be provided giving the connections for the required direction of rotation. All terminal boxes shall be of the totally enclosed type designed to exclude the entry of dust and moisture and sealed from the internal air circuit of the motor. All joints shall be flanged with gaskets of neoprene or other approved material. Natural rubber insulation shall not be used.

Motors rated above 1 kW shall be three phase motors. Where single phase motors are employed the motors shall be grouped so as to form an approximately balanced three phase load.

1.2 Motor control gear

Control gear shall comply with the requirements of IEC292, the control gear being rated according to the duty imposed by the particular application.

Motor contactors shall comply with IEC158 class of intermittent duty 0-3 with type 52 enclosure protection. Apparatus shall be capable of switching the stalled current, and shall have a continuous current rating of at least 50per cent greater than the full load current of the motors they control.

The operating currents of overload trips fitted to motor contactors shall be substantially independent of ambient temperature conditions, including the effect of direct sunlight on the enclosure in which the contactors are installed.

Where small motors are connected in groups, the group protection shall be arranged so that it will operate satisfactorily in the event of a fault occurring on a single motor. The control and protection equipment shall be accommodated in the control cabinet or marshalling kiosk.

Each motor or group of motors shall be provided with control gear for starting and stopping by hand and automatically. Overload and single-phasing protection shall be provided.

2.0 CABLE BOXES

Cable boxes shall be suitable for cables entering from above or below as may be required. They shall be weatherproof, rodent and insect-proof and be complete with all gaskets, compression glands, wiping glands and all associated fittings as may be required to make-off the cables.

Gland plates shall be insulated from the cable boxes and, in the case of single core cables, shall be of non-magnetic or insulating material. If metallic gland plates are used, single core cable glands shall be insulated from the gland plate. Gland plate insulation shall be capable of withstanding a dry high voltage test of 2000volts ac for one minute.

Where cable boxes are provided for three core cables, the sockets on the outer phases shall be inclined towards the centre to minimise opening of the cable cores. Cable sockets shall be supplied under this Contract.

Cable boxes for voltages up to and including 11kV shall be suitable for PVC or XLPE insulated steel wire-armoured PVC served cables. The boxes shall be air insulated and designed to accommodate all the fittings required by the cable manufacturer. Front covers and gland plates shall be removable and a 12mm diameter breathing hole covered with a wire gauze shall be provided.

Cable boxes shall be capable of withstanding on site the cable high voltage test level in accordance with IEC 502.

The drilling of gland plates, supply and fitting of compression glands and connecting up of power cables not included in the Contract scope of work shall be carried out under a separate contract.

Connection of the power cables included in the Contract scope of works shall be carried out under this Contract.

3.0 TERMINAL BOARDS AND TERMINAL BLOCKS

Terminal boards shall be of good quality non-flammable insulating material with a comparative tracking index (CTI) of not less than 500 to IEC112.

Terminal boards shall be spaced not less than 150 mm apart. For relay panels, they shall be mounted at the sides of the cubicle, and set obliquely towards the rear doors to give easy access to termination and to enable ferrule numbers to be read without difficulty.

Studs of stud type terminal boards shall be locked in the base to prevent turning and all connections shall be made on the front of the terminal board using lock nuts or lock washers. Where crimped type termination are provided at least two sets of crimping tools for each size of crimp must be supplied for each installation.

Terminals shall be of the insertion clamp type incorporating captive pressure screws which do not bear directly on the wire but on a serrated clamping plate. The pressure screws shall have an inherent locking feature.

Where connections are to be made between multi-core cables and telephone type multi-pair cables, the terminal blocks shall be of the insulation displacement type and shall have a withdrawable insulated link in order to facilitate isolation (or busy out in the case of the apparatus associated with the telephone system) of the individual circuits. These terminals shall also be provided with facilities for the insertion of test probes on both sides of the link.

All terminations shall be numbered for identification and grouped according to function. Engraved white on black labels shall be provided on the terminal blocks.

Terminals for connections which exceed 110 Volts shall be separated from those of other circuits and shall be fitted with insulating screens and “DANGER” notices.

The use of terminal blocks as junction points for wires which are not required in the associated cubicle shall be avoided wherever practicable.

All termination racks shall have a minimum of 20 per cent spare terminals blocks. At least 20% spare terminals shall be provided on each panel and these spare terminals shall be uniformly distributed on all terminal blocks.

All internal wiring to be connected to external equipments shall terminate on terminal blocks, preferably vertically mounted on the side of each panel. Terminal blocks shall be 650 V grade and have

10A continuous rating. Terminal blocks shall be moulded in one piece, complete with insulated barriers, stud type terminals, washers, nuts and lock nuts. Terminal blocks shall include a white fibre marking strip with clear plastic, slip-on/clip-on terminal covers. Markings on the terminal strips shall correspond to terminal numbers on the wiring diagrams.

Terminal blocks for current transformer and voltage transformer secondary leads shall be provided with test links and isolating facilities. Current transformer secondary leads shall be provided with short circuiting and earthing facilities.

All terminal blocks shall be suitable for terminating on each side, two by 2.5 mm^2 standard copper conductors.

Wherever duplication of a terminal block is necessary it shall be achieved by solid bonding links.

Unless otherwise specified, terminal blocks shall be suitable for connecting the following conductors on each side :

- All CT and VT circuits : Minimum of two 2.5 mm^2 copper stranded.
- AC/DC power supply circuits : One 16 mm^2 aluminium.
- All other circuits : Minimum of one of 2.5 mm^2 copper stranded

There shall be a minimum clearance of 250 mm between the first row of terminal blocks and the associated cable gland plate or panel side wall, as per the terminal block mounting arrangement adopted. Also the clearance between the edges of two rows of terminal blocks shall be minimum of 150 mm.

Arrangement of the terminal block assemblies and the wiring channel within the enclosure shall be such that a row of terminal blocks is run in parallel and close proximity along each side of the wiring duct to provide for convenient attachment of internal panel wiring. The side of the terminal blocks opposite the wiring duct shall be reserved for external cable connections. All adjacent terminal blocks shall also share this field wiring corridor. All wiring shall be provided with adequate support inside the panels to hold it firmly and to enable free and flexible termination without causing strain on terminals.

All necessary cable terminating accessories such as gland plates, supporting clamps and brackets, wiring troughs and gutters etc. including glands and lugs for cable shall be in bidders scope of supply.

4.0 FUSES AND LINKS

Carriers and bases for fuses and links shall be in accordance with IEC 269 and colour coded to permit identification of the circuit rating.

The fuses and links mounted in cubicles for tripping circuits and protective gear test links shall be mounted on the front of the panel. Other links and fuses shall be accommodated within the cubicle or above the cubicle doors. Fuses and links shall be grouped and spaced according to their function in order to facilitate identification.

All incoming circuits in which the voltage exceeds 125V shall be fed through insulated fuses and/or links, the supplies being connected to the bottom terminal. The contacts of the fixed portion of the fuse or link shall be shrouded so that accidental contact with live metal cannot be made when the moving portion is withdrawn.

Main supply fuse links shall be of the high rupturing capacity cartridge type.

Where fuse carriers are mounted vertically the incoming (supply) side shall be the bottom terminal.

Where either fuses or circuit breakers are used it should be ensured that proper discrimination between main and sub-circuits is maintained.

5.0 COMMUNICATIONS CABLES

All cables and wiring shall have copper conductors and PVC insulation and shall comply with IEC 227. Telephone type cables shall comply with IEC 96 and IEC 189.

Cabling and wiring installations shall be arranged to minimise the risk of fire and damage which may be caused in the event of fire.

For telephone type cables conductor wires with a cross sectional area of less than 0.2 mm^2 shall not be used. Where twin or quad make up is required in any cable the cores shall be uniformly twisted and the lays arranged such that crosstalk is reduced to a minimum.

No conductor smaller than 32/0.2mm ($1mm^2$), or having less than three strands shall be used for interconnecting cabling except in the case of telephone cables. All cables shall have insulation which will withstand the highest temperature to be experienced in service.

Each conductor of a multi-core cable shall be readily identified by a numbered marker tape or, in the case of telephone type cables, colour coded insulation.

The Bidder shall submit full details of all loading on cables and in the case of interposing current transformer connections, the loop resistance of each circuit.

Apparatus cubicles, cabinets, racks and panels shall be provided with gland plates and all necessary equipment for the termination of cables. The Contract Works shall include for the checking, termination and ferruling of the cable cores and their lacing into cable forms and connection to the equipment terminal boards or tag blocks using claw washers. Crimping ferrules shall be used for each conductor.

6.0 MARSHALLING KIOSKS AND CONTROL CABINETS

The bidder shall provide within every bay of the switch yard a bay marshalling kiosk to which all incoming and outgoing connections to and from the associated bay equipment will be run. The terminal blocks within the kiosks shall be grouped together by function and shall be properly labelled and segregated. Transformer and circuit breaker control/marshalling kiosks will be provided under a separate contract, but it shall be the contractor"s responsibility to cable up to the control/marshalling kiosks as provided by the transformer and circuit breaker suppliers. The Contractor shall provide a separate stand alone kiosk for busbar protection CT marshalling and the kiosk shall house the CT shorting and switching relays required for the correct function of the busbar protection scheme.

All outdoor cabinets and kiosks shall be protected in accordance with Class IP55 of IEC 947-1 and shall be insect and rodent proof. The minimum sheet steel thickness for all cubicles, kiosks and panels shall be not less than 2 mm cold rolled or 2.5 mm hot rolled sheet steel. The top of the outdoor boxes/kiosks shall be provided with Aluminium alloy sheets having 2 mm thick with proper sloping for easy discharge of water.

Anti-condensation heaters, 240V AC single phase, shall be provided and shall be controlled by a watertight switch mounted externally. Ventilation louvres shall be provided, suitably lined internally with a mesh screen, and divisions between compartments shall be perforated.

Control cabinets shall be illuminated with a switch operated and fused 240V CFL tube. Control cabinets shall be provided with a switch operated single phase 240V 15A power socket.

All cables shall enter cabinets and kiosks at the base.

Each compartment of all kiosks and cabinets shall be provided with access doors at the front and rear. Doors and access covers shall not be secured by nuts and bolts but shall be fastened with integral handles with provision for locking with a padlock.

Doors for kiosks shall be of the lift off and hinged type and shall be provided with glazed windows of adequate size to facilitate reading of indicators from outside the kiosk. Facilities shall be provided to permit removal of the temperature indicators without the need to pass the capillary tubing and bulb through the various compartments.

Doors and covers under 15kg mass may be of the slide on pattern, but above this mass hinged doors shall be used. Door shall be provided with padlocking facilities.

When three phase connections rated at 380V and above are taken through cabinets or kiosks, the terminal blocks shall be adequately screened, insulated and suitably marked with the phase colour; "DANGER" notices shall be affixed to the terminal blocks and a DANGER notice stating the voltage shall be fixed on the inside and outside of the kiosk or cabinet. Exterior DANGER notices shall be stove enamelled and shall be written in English and Oriya and shall be of an approved class/grade.

A durable copy of the circuit wiring diagram shall be affixed to the back of the kiosk door and labels shall be provided inside each kiosk or box to describe the functions of the various items of equipment.

When the marshalling kiosks are positioned in side the switchyard , flood water shall not ingress in to the marshalling kisok. The contractor/bidder may achieve the same either positioning the marshalling kiosk appropriately or providing adequate water proof arrangement.

CT, CVT & IVT outdoor kiosks shall be of Aluminium alloy sheets having 3mm thickness. It shall have proper slop canopy for easy drainage of water.

7.0 AUXILIARY SWITCHES

With each disconnector, contactor and earthing device, there shall be supplied all necessary auxiliary switches and mechanisms for indication, protection, control, interlocking, supervisory and other services as specified. Not less than four spare auxiliary switches of each type shall be provided.

All auxiliary switches shall be wired up to a suitable terminal board on the fixed portion of the switchgear whether they are in use or not in the first instance, and shall be arranged in the same sequence on all similar items of equipment. Switches shall be provided to interrupt the supply of current to the tripping mechanism of the circuit breakers and latched contactors. All such switches and mechanisms shall be mounted in accessible positions clear of the operating mechanism, and shall be adequately protected.

The contacts of all auxiliary switches shall be strong and be capable of adjustment in relation to the movement of the circuit breaker or other item of equipment. Auxiliary switches and auxiliary circuits shall be capable of carrying a continuous current of 10 Amps.

8.0 MINIATURE OR MOULDED CASE CIRCUIT BREAKERS

Miniature or moulded case circuit breakers (MCB"s or MCCB"s) shall be designed and tested in accordance with IEC 157 and supplementary requirements of this specification. They shall be suitable for use over the full range of expected voltage variation as specified in the Schedules.

MCB"s and MCCB"s shall be suitably rated for both the continuous and short circuit loading of the circuits they are protecting under all service and atmospheric conditions stated in the specification. The bidder shall ensure that correct discrimination is maintained between main and sub-circuits.

For three phase circuits, the miniature circuit breakers shall be of the three pole type; for single phase circuits they shall be of the single pole type and for dc circuits they shall be of the double pole type.

Where miniature circuit breakers are used in circuits containing inductive loads, e.g. operating coils, it is essential that they are suitable for satisfactory operation in the circuit in which they are used, i.e. account is taken of the circuit time constant.

All miniature circuit breakers shall be provided with an auxiliary contact for remote indication of circuit breaker operation.

Means shall be provided to prevent the miniature circuit breakers being inadvertently switched to the „OFF" position.

Miniature circuit breakers shall be mounted in such a manner so as to give easily visible indication of breaker position and shall be grouped and spaced according to their function in order to facilitate identification and easy replacement.

9.0 SPACE HEATERS

Heaters shall be suitably designed to prevent any contact between the heater wire and the air. They shall consist of coiled resistance wire centred in a metal sheath and completely encased in a highly compacted powder of magnesium oxide or other material having equal heat conducting and electrical insulation properties, or they shall consist of resistance wire wound on a ceramic and completely covered with a ceramic material to prevent any contact between the wire and the air.

Alternatively, they may consist of a resistance wire mounted into a tubular ceramic body built into an envelop of stainless steel or the resistance wire wound on a tubular ceramic body and embedded in vitreous glaze. The surface temperature of the heaters shall be restricted to a value which will not shorten the life of the heater sheaths or that of insulated wire or other component in the compartments.

10.0 LVAC CABLES (NOT APPLICABLE)

10.1 General

LVAC power cables shall have aluminium conductors with XLPE insulation, galvanised steel wire armour and PVC oversheath and shall comply with the requirements of IEC 227, 228 and 502 as applicable. Cables shall be sized to carry the highest anticipated load under the worst case ambient conditions. Where a three, three and a half or four core power cable is provided, the cores shall be coloured to distinguish the relevant phases.

All sheaths shall be free from defects and impervious to water.

10.2 1.1kV grade power and control cables

10.2.1 Codes and Standards

The design, manufacture, testing and performance of cables covered under this specification shall comply with latest edition of the standards including amendments as indicated in the relevant schedules attached to this specification.

10.2.2 Technical requirements

The cables shall be suitable for laying in racks, ducts, trenches, conduits and underground buried installation with uncontrolled backfill and chances of flooding by water.

They shall be designed to withstand all mechanical, electrical and thermal stresses under steady state and transient operating conditions. The XLPE insulated LV power cables shall withstand without damage a three phase fault current of at least 45 kA for a minimum of 0.12 seconds, with an initial peak of 105 kA in one of the phases. The armour for XLPE insulated power cables shall be capable of carrying 45 kA for at least 0.12 seconds without exceeding the maximum allowable temperature of PVC outer sheath.

Progressive sequential marking of the length of cable in metres at every one metre shall be provided on the outer sheath of all cables.

Strip wire armouring following method (a) of the relevant IS shall not be accepted for any of the cables. For control cables round wire armouring only shall be used.

Cables shall have outer sheath of a material with an oxygen index of not less than 29 and a temperature index of not less than 250°C.

All the cables shall pass fire resistance test as per IS 1554 (Part-I)

The normal current rating of all PVC insulated cables shall be as per IS 3961.

Repaired cables shall not be accepted.

10.3 LV XLPE power cables

XLPE insulated cables shall conform to IS 7098 (Part-I) and its amendments read along with this Specification. The conductor shall be stranded aluminium circular/sector shaped and compacted. In multi-core cables, the core shall be identified by red, yellow, blue and black coloured strips or colouring of insulation. A distinct inner sheath shall be provided in all multi-core cables even if they are unarmoured. For armoured or unarmoured cables, the inner sheath shall be of extruded PVC to type ST-2 of IS 5831. When armouring is specified for single core cables, the same shall consist of aluminium wires/strips.

10.4 LV XLPE power cables

PVC (70C) insulated 1100V grade power cables shall conform to IS 1554 (Part-I) and its amendments, read along with this Specification and shall be suitable for a steady conductor temperature of 70°C . The conductor shall be stranded aluminium. Insulation shall be extruded PVC to type-A of IS 5831. A distinct inner sheath shall be provided in all multi-core cables. For multi-core armoured cables, the inner sheath shall be of extruded PVC. The outer sheath shall be extruded PVC to Type ST-1 of IS 5831 for all cables.

10.5 LV PVC control cables

The 1100V grade control cables shall conform to IS 1554 (Part-1) and its amendments, read along with this specification. The conductor shall be stranded copper. The insulation shall be extruded PVC to type A of IS 5831. A distinct inner sheath shall be provided in all cables whether armoured or not. The oversheath shall be extruded PVC to type ST-1 of IS 5831 and shall be grey in colour except where specifically advised by the Project Manager to be black.

Cores shall be identified as per IS 1554 (Part-1) for cables up to five cores and for cables with more than five cores the identification of cores shall additionally be done by printing legible alphabets on all cores. The alphabets shall be white and shall be printed at approximately 100 mm intervals along the cable length. Cables without such core identifications will not be accepted.

10.6 Cable drums

Cables shall be supplied non-returnable wooden or steel drums of heavy construction. Wooden drums shall be properly seasoned sound and free from defects. Wood preservative shall be applied to the entire drum.

Standard lengths for each size of power and control cables shall be 500/1000 meters. The cable length per drum shall be subject to a tolerance of plus or minus 5% of the standard drum length. The Project Manager shall have the option of rejecting cable drums with shorter lengths. However, the total quantity of cables after taking into consideration of all cable drums for each size shall be within the tolerance of ± 2%.

A layer of water proof paper shall be applied to the surface of the drums and over the outer most cable layer.

10.7 Tests

All cables shall conform to all type, routine and acceptance tests listed in the relevant IS.

The temperature index tests shall be carried out as per ASTM-D-2863.

All cables shall meet the fire-resistance test as per IS 1554 (Part-I)

10.8 Cable sizes

Following standard sizes of cables shall be considered by Bidder for various power distribution and protection,control and metering purposes in the system:

- XLPE power cables: 1c 630 mm^2, 1c 300 mm^2, 3 $^1/_2$c 300 mm^2. (armoured)
- LV XLPE power cables: (armoured)1c 150 mm^2, 3½ c70 mm^2, 3^1/2c 35 mm^2, 4c 16 mm^2, 4c 6 mm^2, 2c 6 mm^2.
- PVC control cables: 2c 2.5 mm^2, 3c 2.5 mm^2, 5c 2.5 mm^2, 7c 2.5 mm^2, 10c 2.5 mm^2, 14c 2.5 mm^2, 19c 2.5 mm^2, 27c 2.5 mm^2

11.0 BUSHINGS

All bushings shall comply with the requirements of IEC 137 and the associated barrel porcelains shall comply with IEC 233 together with the requirements of this Specification. Provision shall be made for the fitting of arcing horns.

Transformer bushings rated at 66 kV and above shall be either of the oil impregnated paper or resin impregnated type. When filled with transformer oil there shall be no connection with the oil in the transformer and an oil gauge shall be provided. The visible oil levels in the gauge shall correspond to the range of average oil temperatures, from the minimum ambient stated in the Schedules to plus 70C. The oil level at 15C shall be marked. Connections from the main windings to bushings shall be flexible and shall be such that undue mechanical stresses are not imposed on them during assembly on site.

Terminal clamps shall be supplied with each bushing for flexible or rigid busbars as may be required. The material of the clamps shall be as stated in the Schedules.

12.0 BUSHINGS, HOLLOW COLUMN INSULATORS, SUPPORT INSULATORS

Bushings shall be manufactured and tested in accordance with IS 2099 and IEC 137 while hollow column insulators shall be manufactured and tested in accordance with IEC 233/IS 5621. The support insulators shall be manufactured and tested as per IS 2544/IEC 168 and IS 2099/IEC 273. The insulators shall also conform to IEC 815 as applicable.

The bidder may also offer composite silicon insulators conforming to IEC 36.

Support insulators, bushings and hollow column insulators shall be manufactured from high quality porcelain. Porcelain used 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 uniform brown in colour, free from blisters, burrs and other similar defects.

Support insulators, bushings and hollow column insulators shall be designed to have ample insulation, mechanical strength and rigidity for the conditions under which they will be used.

When operating at normal rated voltage there shall be no electric discharge between the conductors and bushing which would cause corrosion or injury to conductors, insulators or supports by the formation of substances produced by chemical action. No radio interference shall be caused by the insulators or bushings when operating at the normal rated voltage.

Bushing porcelain shall be robust and capable of withstanding the internal pressures likely to occur in service. The design and location of clamps and the shape and the strength of the porcelain flange securing the bushing to the tank shall be such that there is no risk of fracture. All portions of the assembled porcelain enclosures and supports other than gaskets, which may in any way be exposed to the atmosphere shall be composed of completely non hygroscopic material such as metal or glazed porcelain.

All iron parts shall be hot dip galvanised and all joints shall be air tight. Surface of joints shall be trued up, porcelain parts by grinding and metal parts by machining. Insulator and bushing design shall be such as to ensure a uniform compressive pressure on the joints.

12.1 Tests

In accordance with the requirements stipulated above bushing, hollow column insulators and support insulators shall conform to type tests and shall be subjected to routine tests in accordance with IS 2099 and IS 2544.

All routine tests shall be conducted on hollow column insulators as per IEC 233. In addition the following tests shall also be conducted

1. Ultrasonic test as a routine test.
2. Pressure test as a routine test.
3. Bending load test in four directions at 50% specified bending load, as a routine test.
4. Bending load test in four directions at 100% specified bending load, as a sample test on each lot.
5. Burst pressure test as a sample test on each lot.
6. Hollow porcelain insulators should be in one integral piece in green and fired stage. No jointed porcelain will be acceptable.

12.2 Technical parameters of bushings, hollow column insulators and support insulators:

Parameter	420kV	245kV	145kV	36kV
Rated voltage kV	420	245	145	36
Impulse withstand (wet and dry) kVp	±1425	±1050	±650	±170
Switching surge withstand (wet and dry) kVp	±1050			
Power frequency withstand (wet and dry) kVrms	630	460	275	70
Total creepage distance mm	10500	6125	3625	900

Pollution level shall be Class III Heavy as per IEC 71, and as specified in Schedules for all classes of equipment.

Insulators shall also meet the requirements of IEC 815 for 420kV, 245kV and 145kV systems as applicable having alternate long and short sheds.

13.0 CIRCUIT BREAKERS

13.1 General

Circuit breakers shall be of three pole air break design, horizontal draw out type in accordance with IEC 947-2. In particular, evidence shall be provided of the performance when switching currents in the critical current range. They shall be capable of the ratings specified in the Schedules, when mounted in the switchboard.

Circuit breakers shall be fitted with trip-free, spring-operated mechanisms of the independent manually operated type and be provided with making and over current release facilities. A push-button shall be provided to trip the breaker electrically.

The breaker shall be provided with **`OPEN'. `CLOSE', `SERVICE', `TEST'** and **`SPRING CHARGED'** position indicators and shall be provided with the necessary number of auxiliary contacts for interlocking, indication and tripping purposes plus two spare.

Each incoming circuit shall be provided with thermal overload relays and short circuit protection relays; they shall also be provided with an undervoltage relay to trip breaker in the event of a supply failure.

There shall be `**SERVICE**', `**TEST**' and fully withdrawn positions for the breakers. It shall be possible to close the door in „**TEST'** position.

Movement of a circuit breaker between „**SERVICE'** and „**TEST'** positions shall not be possible unless it is in „**OPEN'** position. Attempted withdrawal of a closed circuit breaker shall not trip the circuit breaker.

Closing of a circuit breaker shall not be possible unless it is in „**SERVICE'**, „**TEST'** or fully withdrawn positions.

A breaker of particular rating shall be prevented from insertion in a cubicle of a different rating.

Circuit breakers shall be provided with electrical anti-pumping and trip free feature.

Means shall be provided to slowly close the circuit breaker in withdrawn position if required for inspection and setting of contacts. In service position slow closing shall not be possible.

Circuit breakers shall be provided with the following mechanism as specified in the Bill of Material.

13.2 Power operated mechanism

Power operated mechanism shall be provided with a universal motor suitable for operation 220V DC control supply with voltage variation from 90% to 110% rated voltage. Motor insulation shall be class `E' or better.

The motor shall be such that it requires not more than 30 seconds for fully charging the closing spring.

Once the closing springs are discharged, after the one closing operation of circuit breaker, it shall automatically initiate, recharging of the spring.

The mechanism shall be such that as long as power is available to the motor, a continuous sequence of closing and opening operations shall be possible. After failure of power supply at least one open-close-open operation shall be possible.

Provision shall be made for emergency manual charging and as soon as this manual charging handle is coupled, the motor shall automatically be mechanically decoupled.

All circuit breakers shall be provided with closing and tripping coils. The closing coils shall operate correctly at all values of voltage between 85% to 110% at rated control voltage. Tripping coils shall operate satisfactorily under all values of supply voltage between 70% to 110% of rated control voltage.

Provision for mechanical closing of the breaker only in `**TEST**' and withdrawn positions shall be made.

14.0 RELAYS

All relays and timers in protective circuits shall be flush mounted on panel front with connections from the inside. They shall have transparent dust tight covers removable from the front. All protective relays shall have a drawout construction for easy replacement from the front. They shall either have built-in test facilities, or shall be provided with necessary test blocks and test switches located immediately below each relay. Auxiliary relays and timers may be furnished in non-drawout cases.

All AC relays shall be suitable for operation at 50 Hz with 110 volts VT secondary and 1A or 5A CT secondary.

All protective relays and timers shall have at least two potential free output contacts. Relays shall have contacts as required for protection schemes. Contacts of relays and timers shall be silver faced and shall have a spring action. Adequate numbers of terminals shall be available on the relay cases for applicable relaying schemes.

All protective relays, auxiliary relays and timers shall be provided with hand reset operation indicators (flags) for analysing the cause of operation.

All relays shall withstand a test voltage of 2kV (rms) for one minute.

Motor starters shall be provided with three element, ambient temperature compensated, time lagged, hand reset type terminal overload relays with adjustable settings. The setting ranges shall be properly selected to suit the motor ratings. These relays shall have a separate black coloured hand reset push button mounted on compartment door and shall have at least one changeover contact.

All fuse protected, contactor controlled motors shall have single phasing protection, either as a distinct feature in the overload relays (by differential movement of bi-metallic strips), or as a separate device. The single phasing protection shall operate with 80% of the set current flowing in two of the phases.

15.0 CONTACTORS

Motor starter contactors shall be of air break, electromagnetic type rated for uninterrupted duty as per IS 2959.

Contactors shall be double break, non-gravity type and their main contacts shall be silver faced.

Direct line starter contactors shall be of utilisation category AC2. These contactors shall be as per IS 1822.

Each contactor shall be provided with two normally open (NO) and two normally close (NC) auxiliary contacts.

Operating coils of contactors shall be of 240V AC unless otherwise specified elsewhere. The Contactors shall operate satisfactorily between 85% to 110% of the rated voltage. Contactors shall drop out at 70% of the rated voltage.

16.0 INSTRUMENT TRANSFORMERS

All current and voltage transformers shall be completely encapsulated cast resin insulated type suitable for continuous operation at the temperature prevailing inside the switchgear enclosure, when the switchboard is operating at its rated condition and the outside ambient temperature is 50°C.

All instrument transformers shall be able to withstand the thermal and mechanical stresses resulting from the maximum short circuit and momentary current ratings of the associated switchgear.

All instrument transformer shall have clear indelible polarity markings. All secondary terminals shall be wired to a separate terminal on an accessible terminal block where star-point formation and earthing shall be done.

Current transformers may be multi or single core type. All voltage transformers shall be single phase type. Busbar VT"s shall be housed in a separate compartment.

All VT"s shall have readily accessible HRC current limiting fuses on both primary and secondary sides.

17.0 INDICATING INSTRUMENTS

All indicating and integrating meters shall be flush mounted on panel front. The instruments shall be of at least 96 mm square size with 90 degree scales, and shall have an accuracy class of 2.5 or better. The covers and cases of instruments and meters shall provide a dust and vermin proof construction.

All instruments shall be compensated for temperature errors and factory calibrated to directly read the primary quantities. Means shall be provided for zero adjustment without removing or dismantling the instruments.

All instruments shall have white dials with black numerals and lettering. Black knife edge pointer with parallax free dials will be preferred.

Ammeters provided on motor feeders shall have a compressed scale at the upper current region to cover the starting current.

Watt-hour meters shall be of three phase, three element type. Maximum demand indicators need not be provided.

18.0 CONTROL AND SELECTOR SWITCHES

Control and instrument switches shall be rotary operated type with escutcheon plates clearly marked to show the function and positions. Switches shall be suitable for flush mounting with only switch front plate and operating handle projecting from the panel front. Switches shall be of sturdy construction suitable for mounting on panel front. Switches with shrouding of live parts and sealing of contacts against dust ingress shall be preferred. Handles of different shapes along with suitable inscriptions on switches shall be provided as an aid to switch identification. The selection of operating handles for the different types of switches shall be as follows :

Switch Type	Application	Specification
Switchgear control switches	For closing and opening of breakers and isolators.	Pistol grip, black, three position type.
Synchronising switches	For synchronising check bypass facilities	Oval, black, keyed (common removable handle, or with locking facility and common key).
Selector switches	Auto, manual, local, remote and test facilities	Oval or knob, black
Instrument switches	Phase or meter selection	Round, knurled, black
Protection transfer switch	Transfer of protection.	Pistol grip, lockable and black.

TABLE 18.1 Switch operating handles

The control switches of breakers and isolators shall be of spring return to neutral type. The control springs shall be strong and robust enough to prevent inadvertent operation due to light touch. The spring return type switch shall have spring return from close and trip positions to "after close" and "after trip" positions respectively. They shall have at least two (2) contacts closing in close positions, and two (2) contacts closing in Trip positions unless specified otherwise.

Circuit breaker selector switches for breaker controlled motors shall have three stay put positions marked „**AUTO'**, „**MANUAL'** and „**TEST'** respectively. They shall have two contacts each of three positions and shall have black, pistol grip handles.

Instrument selection switches shall be of maintained contact stayput type. Ammeter selection switches shall have make-before-break type contacts so as to prevent open circuiting of CT secondaries when changing the position of the switch. Voltmeter transfer switches for AC shall be suitable for reading all line-to-line and line-to-neutral voltages for non effectively earthed systems, and for reading all line to line voltages for effectively earthed systems. Ammeter and voltmeter selector switches shall have four stayput positions with an adequate number of contacts for three phase four wire systems. These shall have black oval handles

Synchronising switches shall be of maintained contact stayput type having a common removable handle for a group of switches. The handle shall be removable only in the „**OFF'** position and it shall be co-ordinated to fit in to all the synchronising switches. These switches shall be arranged to connect the synchronising equipment when turned to the „**ON**" position. One contact of each switch shall be connected in the closing circuit of the respective breaker so that the breaker cannot be closed until the switch is turned to the „**ON**" position.

Lockable type switches which can be locked in particular positions shall be provided when specified. The key locks shall be fitted on the operating handles.

The contacts of all switches shall preferably open and close with snap action to minimise arcing. Contacts of switches shall be spring assisted and contact faces shall be with rivets of pure silver or silver alloy. Springs shall not be used as current carrying parts.

The contact combination and their operation shall be such as to give completeness to the interlocking and function of the scheme. The contact rating of the switches shall be as follows :

	Contact rating in Amps		
Description	**220V DC**	**50V DC**	**240V AC**
Make and carry continuously	10A	10A	10A
Make and carry Make and carry for 0.5 sec.	30A	30A	30A
Break			
Resistive load	3A	20A	7A
Inductive Load with L/R=40ms	0.2A	—	—

TABLE 18.2 Contact ratings of switches

19.0 AIR BREAK SWITCHES

Air breaker switches shall be of the heavy duty, single throw group operated, load break, fault make type complying with IS 4064.

The Bidder shall ensure that all switches are adequately rated so as to be fully protected by the associated fuses during all abnormal operating conditions such as overload, locked motor, short circuit etc.

Switch operating handles shall be provided with padlocking facilities to lock them in `OFF' position.

Interlocks shall be provided such that it is possible to open the cubicle door only when the switch is in `OFF' position and to close the switch only when the door is closed. However suitable means shall be provided to intentionally defeat the interlocks explained above.

Switches and fuses for AC/DC control supply and heater supply wherever required shall be mounted inside and cubicles.

20.0 PUSH BUTTONS

Push-buttons shall be of spring return, push to actuate type. Their contacts shall be rated to make, continuously carry and break 10A at 240V and 0.5A (inductive) at 220V DC.

All push-buttons shall have one normally open and one normally closed contact, unless specified otherwise. The contact faces shall be of silver or silver alloy.

All push-buttons shall be provided with integral escutcheon plates marked with the appropriate function.

The colour of the button shall be as follows :

GREEN : For motor **START**, breaker **CLOSE,** valve /damper **OPEN**

RED : For motor **TRIP**, breaker **OPEN,** valve /damper **CLOSE**

BLACK : For overload reset, all annunciator and miscellaneous functions.

All push-buttons on panels shall be located in such a way that red push buttons shall always be to the left of green push buttons.

21.0 INDICATING LAMPS

Indicating lamps shall be of the panel mounting filament type and low watt consumption. Lamps shall be provided with series resistors, preferably built-in the lamps assembly. The lamps shall have

escutcheon plates marked with its function, wherever necessary. Lamps shall have translucent lamp covers of colours appropriate to the application as indicated in Table 21.1

Colour	Indication
RED	For motor **ON**, breaker/isolator **CLOSED**, valve/damper **OPEN**
GREEN	For motor **OFF**, breaker /isolator **OPEN**, valve/damper **CLOSE**
WHITE	For motor **Auto-Trip**
BLUE	For all healthy conditions (e.g. control supply) and also for **'SPRING CHARGED"**
AMBER	For all alarm conditions (e.g. overload) Also for `**SERVICE**' and `**TEST**' positions indicators.

TABLE 21.1 Indicating lamp colours

Indication lamps should be located just above the associated push buttons/control switches. Red lamps shall invariable be located to the right of green lamps. In case a white lamp is also provided, it shall be placed between the red and green lamps along with the centre line of control switch/push button pair. Blue and amber lamps should normally be located above the red and green lamps.

When associated with push-buttons, red lamps shall be directly above the green push button, and green lamps shall be directly above the red push-button.

The wattage and resistance of the lamps shall be as follows:

- 220/250V 5 - 10W 4000 - 8000 ohms
- 110V 5 - 10W 1000 - 2000 ohms

Neon indicating lamps or LED"s shall be provided when specified. The wattage of the neon lamp shall be 0.25 to 0.5W.

Bulbs and lenses shall be interchangeable and easily replaceable from the front of the panel. Tools, if required for replacing the bulbs and lenses shall also be included in the scope of supply.

All indicating lamps shall be suitable for continuous operation at 90 to 110% of their rated voltage.

22.0 FUSES

All fuses shall be of HRC cartridge fuse link type. Screw type fuses shall not be accepted. Fuses for AC circuits shall be of Class 2 type, 20kA (RMS) breaking current at 415V AC, and for DC circuits Class 1 type 4kA breaking current.

Fuses shall have visible operation indicators.

Fuses shall be mounted on fuse carriers, which are mounted on fuse bases. Wherever it is not possible to mount fuses on carriers, they shall be directly mounted on plug in type bases. In such cases one set of insulated fuse pulling handles shall be supplied with each switchgear.

Fuse ratings shall be chosen by the bidder depending upon the circuit requirements and these shall be subject to approval of Project Manager.

23.0 NAME PLATES AND LABELS

All switchgears and ACDC distribution boards etc. shall be provided with prominent, engraved identification plates. The module identification plate shall clearly give the feeder number and feeder designation. For single front switchboards, similar panel and board identification labels shall be provided at the rear also. Language shall coform to the requirements stipulated elsewhere in the technical specification..

All name plates shall be of non-rusting metal or 3-ply lamicoid with white engraved lettering on black back ground. Inscriptions and lettering sizes shall be subject to Project Manager"s approval.

Suitable plastic sticker labels shall be provided for easy identification of all equipment, located inside the panel or module. These labels shall be positioned so as to be clearly visible and shall give the device number as mentioned in the module wiring drawings.

24.0 ELECTRIC MOTORS (LV)

24.1 Codes and Standards

All motors shall conform to the latest revisions of the relevant IEC, Indian Standards, British Standards given in the schedules, except where modified or supplemented by this Specification.

The design, manufacture, installation and performance of motors shall conform to the provisions of latest Indian Electricity Act and Indian Electricity Rules. Nothing in these specifications shall be construed to relieve the bidder of his responsibility in this regard.

In case of contradiction between this specification and IS or BS or IEC, the stipulations on this specification shall prevail.

National Electrical Code for Hazardous locations and relevant NEMA standard shall also be applicable for motors located in hazardous location.

24.2 Service conditions and temperature rise

Unless otherwise specified, machines shall be designed for a maximum ambient air temperature of 50C. Accordingly the temperature rise of the stator winding by resistance method over the ambient air temperature shall not exceed 70C.

For applications where the motor temperatures may be appreciably affected by conducted or radiated heat, the amount of heat must be specified by the bidder and the appropriate temperature rises agreed.

24.3 AC Motors

24.3.1 General

All AC motors shall be of squirrel cage type, unless otherwise specified and shall be suitable for direct on line starting.

Each motor shall be assigned a maximum continuous rating (MCR) corresponding to 70C temperature. Maximum continuous motor rating shall be at least ten percent above the maximum load demand of the driven equipment at designed capacity.

Rated voltage for AC motors shall be as given below for various MCR"s of the motor, unless specified otherwise:

- From 0.2 kW to 220 kW 415 V, three phase, 50 Hz
- Below 0.2 kW 240 V, single phase, 50 Hz

Voltage and frequency variations shall be as per clause 3.3 of IS 325.

The lowest voltage at the motor terminals throughout the starting period, with which the driven equipment shall satisfactorily start up even under the most arduous conditions specified, shall be 85% for motors rated up to 110 kW, and 80% for motors rated above.

The accelerating torque at any speed with the lowest starting voltage shall be at least ten (10) percent of rated full load torque of the motor.

The motors shall be suitable for two starts in succession under the specified conditions of load, torque and inertia, with the motor initially at its normal running temperature.

The ratio of locked rotor kVA at rated voltage to rated kW (MCR corresponding to 70C temperature rises) shall not exceed the following (without any further tolerance):

Motor MCR kW	Start kVA/Rated kW
Up to 110kW	1.0
Above 110kW	10.0

When tests to determine the breakaway starting current of cage induction motors are taken at reduced voltage, due allowance shall be made for the effect of saturation. The estimated value of breakaway starting current at rated voltage shall be given on all test certificates.

All motors shall be so designed that the maximum inrush currents and locked rotor and pull out torque, developed by them at 110% of the rated voltage, do not endanger the motor or the driven equipment.

The pull out torque at rated voltage shall not be less than 200 percent of the full load torque.

Motors for reciprocating compressors etc. shall be specially designed/rated to withstand the torque pulsation produced by the driven equipment.

24.3.2 Transient recovery

The motors shall be capable of resuming normal operation after a system disturbance causing temporary loss of supply voltage for periods of up to 0.2 second (fault clearance time), followed by sudden restoration to 70 percent rated voltage. From this voltage the motors shall be capable of acceleration and ultimate recovery under the most arduous load conditions.

24.4 DC Motors

DC motors shall comply with IS 4722 and shall be shunt wound type rated for 220V. Motor MCR kW rating at 50C ambient shall be at least ten percent higher than the power requirement of the driven equipment under the most onerous operating conditions foreseen during the plant's life.

DC motors which are to operate from batteries shall be capable of operating continuously under actual service conditions at any voltage between 190V and 240V.

DC motors supplied from rectifier equipment connected to AC power supplies shall meet the voltage and frequency variations specified for AC motors.

Rectifier equipment shall be capable of meeting the condition of transient recovery given above for AC motors and shall be provided with the necessary current limiting devices.

The pull-out torque of DC motors at the rated voltage shall not be less than 200 percent of the full load torque.

24.5 Enclosure and method of cooling

The following types of enclosure may be supplied:

- Totally enclosed, fan ventilated.
- Totally enclosed, closed air circuit, integral heat exchanger.
- Totally enclosed, closed air circuit, machine mounted heat exchanger.

In all cases protective enclosure and method of cooling of motors shall be IP 54 and IC 0141 in accordance with IS 4691 and IS 6362 respectively.

Cooling fans shall be directly driven from the motor shaft.

Motors situated outdoors or exposed to the weather shall be weather protected (IPW-55).

All totally enclosed type of motors shall have a dust tight construction with suitable means of breathing and of drainage to prevent accumulation of water from condensation. Drain holes shall exclude bodies greater than 6 mm diameter.

24.6 Constructional features

All components shall be of adequate mechanical strength and robustness and shall be constructed of metal unless otherwise approved. Glass fibre or plastic components, where employed, shall be of adequate design and robustness taking into account the conditions of service required and the effects of operating temperatures, ageing and thermal stability of the material. The material shall be resistant to flame propagation.

Rotors shall be so designed as to keep the combined critical speeds with the driven equipment away from the running speed by at least 20%.

Motors and their major components such as stators, rotors, terminal boxes, bearings and heat exchangers shall be designed to be readily interchangeable as integral units.

All motor rotors shall be dynamically balanced.

The enclosures shall be designed to provide an effective sealing between the primary and secondary air circuits.

The radial air gap between stator and rotor shall have an adequate margin to minimise the possibility of rubbing between the stator and rotor due to eccentric positioning, play and wear, shaft deflection due to rotor weight and unbalanced magnetic pull etc. The minimum radial air gap for all motors shall be in accordance with Clause 5.1.5 of IS 6381.

All requirements of clause 5.1.4 of IS 6381 shall also be complied with.

All the induction motors shall be capable of running at 75% of rated voltage for a period of 5 minutes.

Induction motors shall be designed to be capable of withstanding the voltage and torque stresses developed due to the difference between motor residual voltage and incoming supply voltage equal to 150% of the rated motor voltage during fast changeover of buses. The necessary features incorporated in the design to comply with this requirement shall be clearly indicated in this proposal.

24.7 Variable speed motors

Variable speed motors shall be such that the speed can be continuously adjusted over the required range. The speed control gear shall be provided with an interlock to ensure that the motor can only be started when its control sequence is at the correct setting. When the motor is switched off, the speed control sequence shall automatically return to this position.

24.8 Brush gear, commutators and slip-rings

Brush gear, commutators and slip-rings shall be designed to operate without injurious sparking and to run for at least three months without the need for adjustment or replacement of brushes.

Brushes shall be of electro graphite or metal graphite type. Adequate precautions shall be taken to protect the windings, commutators, slip-rings and brush gear against deposits of entrained carbon dust.

Removable covers shall be fitted to provide access to the brush gear, commutators and slip-rings. For totally enclosed type motors, windows shall be provided to permit observation of the brush gear whilst the motor is running.

Brush holders shall be of non-ferrous materials and located securely to accurately position the brushes on the commutator. Means for adjusting brush pressure and brush assembly shall be provided.

24.9 Internal electric heaters

Internal electric heaters shall be provided on motors rated above 30 kW, to maintain the windings in a dry condition during periods of standstill. The heater shall be suitable for use on a 240V, 50 Hz, AC supply.

24.10 Lifting facilities

All heavy parts of the motors shall be provided with adequate arrangements for lifting or handling during erection or overhaul.

All material used for equipment construction including castings and forging etc. shall be of tested quality as per relevant codes and standards. No welding shall be carried out on cast iron components for repair or any other purpose.

24.11 Winding and insulation

Winding insulation shall be of class B or better and of proven high quality and reliability.

All winding insulation shall be non-hygroscopic, oil resistant and of materials resistant to flame propagation. All windings shall be impregnated and suitably processed to effectively seal them to prevent deterioration from adverse environmental conditions at site during the installation period and also during normal operation.

All winding overhangs and leads shall be adequately supported, braced and blocked to provide sufficient rigidity during all normal conditions of service.

Cage windings and all joints shall be designed to give an adequate safety factor on fatigue due to thermal and mechanical stresses, taking into account the specified starting and running conditions. The short-circuiting and rings shall be of joint less construction. All electrical joints and connections shall be of brazed or welded construction.

Motors shall be designed to give a life endurance of at least 18000 starts.

24.12 Bearings

Bearings shall be of rolling type. Vertical motors shall normally have rolling type guide and thrust bearings.

Bearings shall be designed to prevent ingress of dust and water and shall be sealed against leakage of lubricant along the shaft.

When the motor shaft is not located axially by its own bearings, it shall be permanently marked to indicate its normal running position and the extent of float in either direction.

Bearings shall comply with the relevant Indian or International Standards. The bearing housing shall be correctly packed with lithium based grease at the time of assembly. Construction shall be such that the bearings can be dismantled without risk of damage.

For direct drives, bearings shall have an expected life of at least 40,000 running hours. For motors with significant external radial or axial loads, e.g. belt drives, bearing shall have a life of at least 15000 running hours. The bearing assembly shall be provided with a grease relief device to eject any surplus grease in to a separate container.

Lubrication shall be possible without removal of the guarding. All grease nipples, oil cups and dip sticks shall be readily accessible.

24.13 Heat exchangers

An adequate margin shall be included in the design of heat exchangers to allow for fouling of cooling tubes or ducts under service conditions. Provision shall be made for the easy cleaning of the cooling tubes or ducts, preferably on load.

The cooling tubes or ducts shall be adequately braced and supported to prevent vibration and premature fatigue or fracture.

24.14 Noise level

Noise levels shall comply with BS 4999, Part-51.

24.15 Vibration level

The double amplitude of vibrations as measured at motor bearings shall be within the limits specified in IS 4729, and the limits specified for the driven equipment.

24.16 Earthing terminals

Two independent earthing points shall be provided in accordance with IS 3043(1966), on opposite sides of the motor for bolted connection of Employer's earthing conductor.

24.17 Terminal boxes and associated fittings

Terminal boxes for motors rated above 110 kW shall be capable of withstanding a system fault level of 31 MVA for 0.12 seconds.

Unless otherwise approved, the terminal box shall be capable of being turned through 360 degrees in steps of 90 degrees.

415 volt terminals shall be suitable for receiving 1.1 kV grade PVC or XLPE, unarmoured or armoured power cables.

Only three line terminals need be brought out from each three phase primary winding. All inter phase connections whether star or delta shall be made inside the machine.

Marking of all terminals shall be in accordance with IS 4728.

Leads from terminals to the windings shall be adequately sized and braced to withstand heating and forces produced by maximum fault current.

Cable boxes and terminations shall be designed to enable easy disconnection and replacement of cables.

All joints other than those on cable glands shall be gasketted with neoprene, neoprene bonded cork or other approved material.

For single core cables, gland plates shall be effectively non-magnetic.

The following shall be supplied along with each motor :

1. Crimping type tinned copper lugs for power cables, with all necessary hardware.

2. Compression type tinned brass cable glands for power cables (to be supplied loose).

3. Removable type undrilled gland plate.

4. Terminal boxes shall of weather proof construction with a degree of protection of IP-55. At least one motor of each batch shall be type tested to comply with the following : the terminal boxes shall be subject to an internal air pressure of 0.207 bar g for 12 hours. After this period the pressure shall not be less than 0.104 bar g (after correcting for any change in temperature).

24.18 Rating plate

In addition to the requirements as called for in General Technical Clauses and relevant IS, the rating plate shall indicate the following:

- Maximum continuous rating in kW for 70C temperature rise.
- Bearing identification numbers (in case of ball or roller bearings) and recommended lubricant.

24.19 Paint and finish

All external parts shall be finished and painted to produce a neat and durable surface which would prevent rusting and corrosion. The equipment shall be thoroughly degreased, and sharp edges and scales removed and treated with one coat of primer and two coats of grey enamel paint. Motor colour codes shall comply with the requirements indicated elsewhere in this Specification.

All fasteners used in the construction of the equipment shall be either of corrosion resistant material or electro galvanised to service condition 4. Current carrying fasteners shall be either of stainless steel or high tensile brass or copper.

24.20 Tests

Induction motors shall be subjected to the following routine and type tests.

24.20.1 Routine Tests

Visual Checks of the following:

- Marking on rating plates
- Appearance and painting
- Location and details of terminal boxes and accessories.
- In order to observe compliance to degree of protection, following test will be performed. It shall not be possible to insert a feeler gauge of 1 mm thick in the enclosure or flange faces.

Dimensional checks

Measurement of Insulation Resistance (IR) of windings, and space heaters.

Measurement of winding resistance, and space heater resistance at ambient temperature.

High voltage test on main windings, and space heaters.

IR measurement after HV test in main windings, and space heaters.

No load running test (reading of current, voltage input and speed measurement).

Measurement of bearing temperature during steady state conditions.

Vibration measurement at rated speed and rated voltage, also measurement of vibration during coasting down.

Reduced voltage running test at no load

Locked rotor test.

Phase sequence polarity check and check for terminal markings.

Over speed test

Measurement of air gap

Functional check on auxiliaries

24.20.2 Type Tests

All tests as listed under routine tests

Measurement of noise at no load

Locked rotor test - measurement of VA power input

Momentary overload test

Temperature rise test at rated conditions as well as at maximum input conditions (during heat run test, measurement of bearing temperature, winding temperature, core temperature, coolant flow and coolant temperature). In case the temperature rise test is carried at other load than rated load, specified approval for the test method and procedure shall be obtained from the Project Manager.

Degree of protection test for the enclosure followed by IR, HV and no load run test.

Terminal box - fault level withstand test and pressure test.

Pull out torque measurement

Measurement of no-load starting time.

24.20.3 DC motors

DC motors shall be subjected to all routine and type tests as per IS 4722. In addition, following tests shall be carried out:

- Noise level measurement as type test.
- Vibration measurement as routine test
- Degree of protection test as per IS 4691 as type test.

24.21 Junction boxes and cables

Design and selection of all the components shall be made with a good margin of safety factor.

The equipment shall be installed indoor.

The reference ambient temperature outside the equipment shall be taken as 50C and relative humidity as 100%.

25.0 JUNCTION BOXES

25.1 Construction

Bidder shall supply and install junction boxes complete with terminals as required.

Junction boxes shall be suitable for mounting on walls, columns, structures etc. The brackets, bolts, nuts, cable-glands, screws and all other accessories required for the erection shall be included in the Bidders scope.

Junction boxes shall be of square or rectangular type of 2.0 mm CRCA sheet steel and shall have bolted cover with good quality gasket lining.

Junction box and covers shall be hot dip galvanised.

All the terminals blocks of ESSEN make or equivalent shall be rated for 1100V and shall be of stud type. Each terminal shall be suitable for connecting two 2.5 mm^2 copper conductor.

All terminals shall be complete with insulated barriers, terminals studs, washers, nuts, locknuts, identification strips etc.

Junction boxes located inside shall have IP-54 protection as per IS 2147. Junction boxes located outside shall have IP-55 protection as per IS 2147.

Junction boxes shall be provided with one earthing terminal suitable for galvanised steel conductor.

The general arrangement, cross sectional details and other technical details are to be submitted in the form of drawing for Project Manager"s approval.

25.2 Interconnecting cables

All cables between junction box and field devices shall be stranded copper conductor, PVC insulated, extruded PVC inner sheathed, single galvanised steel wire armoured and overall PVC sheathed 1.1 kV grade and shall conform to IS 1554. The minimum size of cable used shall be 2.5 mm^2 copper conductor. All cables shall be supplied by the Contractor.

26.0 CONDUIT AND CONDUIT ACCESSORIES

The bidder shall supply and install all rigid steel conduit, flexible conduits, Hume pipes etc. complete with accessories such as tees, bends, adaptors and couplings as required for cabling work between various field devices to junction boxes.

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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

ANNEXURE-C: Guaranteed Technical Particulars

SNO.	DESCTRIPTION	UNIT	DATA
A	**General - 220kV GIS**		
1	Installation		
2	Model		
3	Make		
4	Reference standard		
5	Enclosure design code		
6	Type of material of enclosure		
7	Type of material of air bushings		
8	Ambient temperature (design value)		
9	Nominal Operating Voltage		
10	Highest System Voltage		
11	Phase Design Encapsulation		
	a) Busbars		
	b) Feeders		
12	Rated insulation level (withstand voltages, to ground)		
	a) At power freq 1 min		
	b) At impulse (1.2/50)		
13	Rated current of		
	a) Busbars		
	b) Other Bays		
14	Rated current at 50 °C		
15	Rated 1/3 sec withstand current		
16	Rated peak withstand current		
17	Internal fault withstand time withoutburn through		
18	Temp rise at rated service current-		
	a) Joint		
	b) Conductor		
	c) Enclosure		
19	Design pressure of enclosures:		
	a) Circuit Breakers		
	b) Other Compartments		
20	SF6 gas pressure at 20 °C (actual value shall be submitted by themanufacturer)		
	a) Filling Pressure		
	b) Alarm Pressure		
	c) Blocking Pressure		
21	Operating pressure of the pressure relief devices		
	a) Circuit Breakers		

	b) Other Compartments		
	c) Type of device		
	d) Material		
22	Type test pressure of enclosures		
	a) Circuit Breakers		
	b) Other Compartments		
23	Routine test pressure of enclosures		
	a) Circuit Breakers		
	b) Other Compartments		
24	Alarm Pressure		
	a) Circuit Breakers		
	b) Other Compartments		
25	Blocking pressure		
	a) Circuit Breakers		
	b) Other Compartments		
26	Is each gas compartment equipped with		
	a) Pressure relief valve		
	b) Absorber of moisture		
	c) Density switch		
27	Weight of each bay of GIS -		
	A) Line bays		
	b) I/C Trans bays		
	c) O/G Trans bays		
	d) B/C bays		
	e) B/B earthing & measuring bay		
28	Total weight of the offered GIS		
29	Total weight of the SF6 in the offered GIS		
30	Anticipated loss of SF6 per year		
31	Maximum PD at 1.2 times rated voltage in factory		
32	Conductor : Material		
	a) Ends / plating		
	b) Contacts		
	c) Contact type		
33	No of operations w/o maintenance at No load / at full load / at S/C current		
	a) CB		
	b) Disconnector with integrated earthswitch		
	c) Fast acting Earth Switch		
34	Gas Barriers		
	a)Material		
	b)pressure withstand		
35	PD test		

36	Support Insulators Material		
37	PD test		
38	Sealing :		
	a) Material of rings		
	b) method of sealing		
39	Feeder Connection Type		
	a) for Line Bay		
	b) for ICT Bay		
	c) for GT Bay		
	c) for Bus Reactor Bay		
40	Local Control Cabinet Integral/ Non integral		
B	**220kV GIS CIRCUIT BREAKER**	**UNIT**	**DATA**
1	Make		
2	Model		
3	Nominal Operating Voltage		
4	Highest System Voltage		
5	Phase Design (1 OR 3 phase)		
6	BIL (across open contacts)		
7	Rated current		
8	Rated current at 50 °C		
9	Rated short time(1 sec) current		
10	Rated making current (rms)		
11	Rated making current (peak)		
12	Rated break current		
13	Rated closing time		
14	Rated opening time		
15	Rated break time		
16	Close-open time		
17	Out of phase breaking current, voltage factor 2.5		
18	Rated cable & line charging breaking current		
19	Number of breaks per pole		
20	Auto reclose		
21	Operating mechanism : (No per single phase CB)		
22	Rated Operating sequence		
23	Type of operating mechanism		
24	Number of trip coils		
25	Number of closing coils		
26	Rated Control Voltage		
27	Closing voltage range		
28	Trip device voltage range		
29	Charging without motor drive		
C	**220kV GIS DISCONNECTING SWITCH**	**UNIT**	**DATA**

1	Make		
2	Type		
3	Withstand voltages, (P to E / P to P)		
	a) At power freq, 1 min		
	b) At impulse (1.2 / 50)		
4	Rated cont current		
5	Rated 1 sec withstand current		
6	Peak withstand current		
7	Type of operating mechanism		
8	Number of drives per 3 phase		
9	Number of CO operations without maintenance		
10	Facility for emergency manual operation		
11	Interlocking with earthing switch		
12	Plating of main contacts		
13	Ganged operation		
14	Facility for padlock		
15	Modes		
D	**220kV GIS MAINTENANCE EARTHING SWITCH**	**UNIT**	**DATA**
1	Type		
2	Rated insulation level(withstand voltages, to ground)		
	a) At power freq, 1 min		
	b) At impulse (1.2 / 50)		
3	Rated 1 sec withstand current		
4	Peak withstand current		
5	Type of operating mechanism		
6	Number of drives per 3 phase		
7	Number of CO operations without maintenance		
8	Interlocking with isolator switch		
9	Plating of main contacts		
10	Ganged operation		
11	Facility for padlock		
12	View ports for inspection		
13	Mechanical position indicator		
E	**220kV GIS FAST ACTING EARTH SWITCH**	**UNIT**	**DATA**
1	Type		
2	Rated insulation level(withstand voltages, to ground)		
	a) At power freq, 1 min		
	b) At impulse (1.2 / 50)		
3	Rated 1 sec withstand current		
4	Peak withstand current		

5	Inductive Current switching capability.		
6	Capacitive Current switching capability.		
7	Closing time		
8	Type of operating mechanism		
9	Number of drives per 3 phase		
10	Number of CO operations without maintenance		
11	Energy storage springs		
12	Motor operation range		
13	Interlocking with isolator switch		
14	Plating of main contacts		
15	Ganged operation		
16	Facility for locking		
17	View ports for inspection		
18	Mechanical position indicator		
F	**220kV GIS CURRENT TRANSFORMER**	**UNIT**	**DATA**
1	Type		
2	Polarity		
3	RATIO / Class / Burden		
	a) Core-1		
	b) Core-2		
	c) Core-3		
	d) Core-4		
	e) Core-5		
4	Rated insulation level		
	a) At power freq, 1 min (main / sec)		
	b) At impulse (1.2 / 50)		
5	Rated 1 sec withstand current		
G	**220kV GIS Voltage Transformer**		
1	Type		
2	Applying Standard		
3	Primary voltage		
4	Secondary voltage		
5	No of secondaries		
6	Accuracy & burden :		
	a) Core-1		
	b) Core-2		
	c) Core-3		
7	Voltage factor		
8	Rated insulation level		
	a) At power freq, 1 min (main / sec)		
	b) At impulse (1.2 / 50)		

ANNEXURE-D: Technical Checklist

Sl.	Particulars	Reply by bidder	
1	**TECHNICAL QUALIFYING REQUIREMENT**		
1.1	The bidder should comply with Technical Qualifying requirement & furnish the relevant documents.	Confirmed	Yes/No
1.2	The bid shall be submitted by the Manufacturer of GIS/ Bidder who meets the PQR criteria. The bidder's scope includes supply and services like • supervision of erection, • testing and commissioning. Bids submitted by agents (who does not meet the PQR criteria) will not be considered.	Confirmed	Yes/No
1.3	All the documents shall be submitted in English. Translated pages should be attested by the bidder.	Confirmed	Yes/No
2	**Un-priced Offer** –.		
2.1.	Confirm that all items have been quoted. (If any item has not been quoted, the same shall be specifically brought out)	Confirmed	Yes/No
2.2.	Any other item /service required for the execution for the complete job is deemed to be included in the offer, whether specifically mentioned in the specification or not. List of items along with their respective quantities required for completeness (Attach list, if required).	List of Additional items required attached	Yes/No
2.3.	Foundation for GIS shall be constructed *by* Civil contractor based on the input (configuration, loads etc.) provided by bidder. The supply of all structural material to be embedded like foundation bolts as well as consumables like grouting material shall be in scope of bidder. The erection of structure shall be done by BHEL.	Confirmed	Yes/No
2.4.	SF6-GIS to Air bushing - Interface for connecting ICT/LINE/REACTOR with bus duct shall be complete with structures etc shall be provided by the bidder. Limit of supply as per technical specification and as per IEC 61639.	Confirmed	Yes/No
2.5.	Confirm that Consumables as per manufacturer requirement for successful erection, testing & commissioning shall be included in bidder's scope.	Confirmed	Yes/No

Sl.	Particulars	Reply by bidder	
2.6.	Detailed list of Commissioning spares for testing & commissioning of GIS till handing over	Attached	Yes/No
2.7.	Detailed list of Tools & tackle & Testing Equipment	Attached	Yes/No
2.8.	Detailed list of Recommended Spares/operation & maintenance spare	Attached	Yes/No
2.9.	The Switchgear shall be complete with all necessary terminal boxes, SF6 gas filling, and interconnecting power and control Cables (between GIS to GIS/GIS to LCC/ LCC TO LCC), grounding connections (GIS to GIS and GIS to Earth Mesh on Floor), gas monitoring System and piping, support structures.	Confirmed	Yes/No
2.10.	The scope of supply shall also include all erection and mounting hardware and interconnecting cables within GIS.	Confirmed	Yes/No
2.11.	Design philosophy of earthing submitted with the bid. Design of Earthing of GIS shall be in bidder scope.	Confirmed	Yes/No
2.12.	Tentative GIS Hall PLAN & SECTION Layout including hook height of EOT crane submitted with the bid	Confirmed	Yes/No
2.13.	Tentative Outdoor yard PLAN & SECTION Layout submitted with the bid	Confirmed	Yes/No
2.14.	Technical Requirement of EOT Crane capacity & hook height mentioned in GIS Hall Layout	Confirmed	Yes/No
2.15.	EOT crane for 220kV GIS hall shall have capacity of minimum 5T safe working load and minimum height of crane shall be 8.0meters or as per actual requirement, whichever is higher. However, bidder shall provide all the other technical requirements for EOT crane for suitability of crane for installation and maintenance of GIS including EOT crane capacity calculations etc.	Confirmed	Yes/No
2.16.	Tentative / estimated AC / DC Load requirement for GIS submitted with bid	Confirmed	Yes/No
2.17.	Earthing material as per Section 1, Clause 4 - 8	Confirmed	Yes/No
3	**Technical**		
3.1.	**Location of site:** *Project site is Ersama, Distt. Paradeep, Orissa; design and construction of GIS should be suitable for the climate/ Meteorological Condition as mentioned in Section-1 and in section-3.* *Bidder to inform what measures shall be taken to ensure the same at bid stage.*	Write-up attached with bid.	Yes/No
3.2.	Material of enclosure – Aluminium Alloy	Confirmed	Yes/No

Sl.	Particulars	Reply by bidder	
3.3.	Material of bus bar - Aluminium	Confirmed	Yes/No
3.4.	Requirement of AC and DC auxiliary loads	Enclosed with bid	Yes/No
3.5.	Catalogues of GIS	Enclosed with bid	Yes/No
3.6.	Catalogues of all Maintenance equipment. Bidder to confirm that offered equipment meets the requirements of specification.	Enclosed with bid	Yes/No
4	**Calculations**		
4.1	All calculations including Thermal calculations based on the climatic conditions indicated in Section 3 shall be submitted during detailed engineering stage.	Confirmed	Yes/No
4.2	Devices or techniques deployed for reducing transients to an acceptable level enclosed along with offer.	Enclosed with bid	Yes/No
4.3	The design of the equipment shall be such that the agreed permitted movement of foundations and mechanical or thermal effects do not impair the assigned performance of the equipment.	Confirmed	Yes/No
4.4	Bidder shall conduct insulation co-ordination & very fast transient overvoltage (VFTO) studies in line with IEC 60071 for establishing requirement/ suitability of surge arrester, and any other technical requirement for successful operation of GIS.	Confirmed	Yes/No
4.5	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.	Confirmed	Yes/No
5	**Technical Deviations**		
5.1	Confirm that the Complete systems have been offered as per the requirements of Technical Specification and Technical Deviation sheet has been submitted. Deviations mentioned elsewhere in the bid will not be considered.	Confirmed	Yes/No
5.2	Technical Deviation sheet has been submitted.	Confirmed	Yes/No
6A	**Activity Schedule**		
6A.1	Bidder will submit detailed activity schedule indicating all the milestones from Engineering till manufacturing/ testing, dispatch to site and commissioning based on the drawing & document schedule attached in section1.	Confirmed	Yes/No
6B	**Conditions**		

Sl.	Particulars	Reply by bidder	
6B.1	Open/ closed store area shall be provided by BHEL, 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.	Confirmed Details given with the bid.	Yes/No
7	**Site Test**		
7.1	Bidder to supply Only special tools. For other tools Bidder to submit list of tools, tackle, slings, spanners, gauges, slings and other lifting devices, drills, instruments and appliances necessary for the complete assembly and erection at site of the GIS, required for installation, gas filling, maintenance, site testing of the GIS which shall be arranged by BHEL.	Confirmed	Yes/No
7.2	Bidder to furnish detailed BOQ for non-returnable Tools and Tackles along with unit prices to be handed over to ultimate customer.	Details given with the bid.	Yes/No
7.3	All field tests including tests during installation, pre-commissioning, commissioning, field acceptance tests shall be conducted by the Contractor, in presence of representative of the Employer. No separate site test will be conducted by BHEL/Customer	Confirmed	Yes/No
8	**TYPE TESTS REQUIREMENTS**		
8.1	Bidder shall ensure that the electrical equipment (220kV Gas Insulated Switchgear & its accessories) being procured have valid type test certificates as specified in IEC standard 62271 - 203 & 62271-100 (amended up to date) at any NABL accredited laboratories/ any authorized testing lab in line with applicable IS/IEC.	Confirmed	Yes/ No
8.2	The validity of type test reports shall be as per the latest CEA guidelines (amended time to time) as on the original scheduled **date bid submission for BHEL tender (11.02.2022).** In case, where type test certificates are older than period as per latest CEA guidelines (amended time to time), bidder/ manufacturer shall carry out the type tests prior to dispatch of equipment without any commercial & delivery implication on BHEL/ OPTCL.	Confirmed	Yes/ No
8.3	Any type tests, which has not been conducted on the offered design of GIS 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 of GIS without any commercial implication on BHEL/ OPTCL.	Confirmed and enclosed with bid	Yes/ No