



भारत हेवी इलेक्ट्रीकल लिमिटेड
BHARAT HEAVY ELECTRICALS LIMITED
पारेषण व्यापार अभियांत्रिकी प्रबंधन (TBEM)
नोएडा / TBG, NOIDA

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TYPE OF DOC.	TECHNICAL SPECIFICATION	NAME	MM	AS	RS
400 KV GAS INSULATED SWITCHGEAR (GIS)		SIGN	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>
		DATE	23-9-15	28/9/15	28/9/15
		GROUP	TBEM		
		W.O. No	84004		

CUSTOMER/CONSULTANT	Gujarat State Electricity Corporation Limited, Vadodara, Gujarat/ Development Consultants Pvt. Ltd., Kolkata
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PROJECT	400kV GIS for 1x800 MW Wanakbori Thermal Power Station Extn. Unit-8
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SECTION – 1

1.1 SCOPE

Scope of work covers Design, Manufacture, Testing, Delivery at site, Supervision of installation and commissioning including site testing along with necessary equipment, training of BHEL and GSECL personnel for 400 kV Gas Insulated Substation (GIS) as per the specification complete with all auxiliaries, accessories and spare parts.

This section covers the scope and quantities of 400 kV GIS. The Specific Technical Requirements for the above item as specified by the customer (GSECL) are given in Section-2. The offered equipment shall also comply with the General Technical Requirements for the project as detailed under section-3 of this specification.

In case of any discrepancies between the requirements mentioned under Section-1/Section-2 and those specified in the Section-3. The order of precedence shall be as follows:

- a. Statutory Regulations
- b. Section-1
- c. Section – 2: GSECL Specification
- d. Section 3
- e. International standards

In case of any discrepancies between the requirements mentioned under Section-1/Section-2 and those specified in the Section-3, the specifications given under Section-1/Section-2 shall prevail and shall be treated as binding requirements.

Bidder to submit filled up **Annexure-A** attached with Section-1 confirming that there are no deviations and the offer is in full compliance with the specification.

The equipment is required for the following project:

Name of the Customer	:	Gujarat State Electricity Corporation Limited, Vadodara, Gujarat
Name of the Project	:	400kV GIS for 1x800 MW Wanakbori Thermal Power Station Extn. Unit-8
Name of the Consultant	:	Development Consultants Pvt. Ltd., Kolkata
Main Contractor	:	BHEL

400kV switchyard shall be of two main bus configuration with following bays:

- **400kV line bays (2+ 2 tie lines) = 4 Nos.**
- **400kV GT =1 No.**
- **400kV ST = 1 No.**
- **400kV Bus coupler = 1 No.**
- **400kV Bus VT = 2 Nos.**

1.2 **BILL OF QUANTITIES:**

As per Annexure-1

1.3 **SPECIFIC TECHNICAL REQUIREMENT**

As per section 2,

1.3.1 **It may be noted that:**

- *For system details and transport details refer Project Information in section 3.*
- *Covered Store will be provided by BHEL for items which require indoor storage. The size of covered store shall be 10 m X 20 m.*
- *Manufacturer to mark Indoor storage requirement on the material to be stored in covered storage. The rest of the material shall be stored outdoor.*
- *Bidder to submit list of consumables with shelf life of fewer than two years. It shall be supplied before erection after clearance from BHEL.*
- *Supplier will submit detailed bar chart indicating all the milestones from Engineering till manufacturing/ testing, dispatch to site and commissioning.*
- *Packing of GIS shall be suitable for long term (minimum 2 years) outdoor or indoor storage of GIS in project conditions.*
- *Bidder shall offer their latest Tested compact Model to minimise the building size requirement.*
- *Bay spacing if required to be changed as per building column and beam requirement. Same shall be adjusted without any cost implicating to BHEL at contract stage.*
- *The spare parts of offered GIS should be available for minimum 10 years from the date of commissioning.*
- *Bidder shall conduct system studies, insulation coordination for establishing Surge Arrester's rating and any other requirement for successful operation of GIS.*
- *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 a month.*
- *Successful bidder shall submit 3D OGA drawing for complete GIS and section drawing of each equipment. OGA drawings shall also be furnished in AutoCAD file format.*

1.4 Earthing of GIS

Supply of Earthing Material and Erection of all Earthing connection for GIS to GIS and GIS to Earth Mesh on Floor shall be in bidder's scope.

The quantity shall be estimated by the bidder, based on their design philosophy. Supply of Earthing Material and Erection of Earth mesh on floor shall be done by BHEL in supervision of manufacturer as per manufacturer's design. Design philosophy shall be submitted along with the bid in line with **Clause 5.12.00 (page no. 17)** of section 2 to be followed for earthing.

Only supply of MS Rod (40mm Dia for outdoor below ground earth mat) and GI Flat of 75x12mm or MS Rod as recommended by bidder (for earth mesh on floor) shall be in BHEL's scope. Any other earthing material if required shall be in bidder's scope of supply and erection.

1.5 Drawings Enclosed

Sl. No.	GSECL/BHEL Drg. No.	Drawing Title
1.	TB-0-375-510-001	SINGLE LINE DIAGRAM OF 400KV GIS
2.	TB-0-375-316-002	Plan & Section Drawing of 400kV Switchyard for GIS

Note: Refer attached layout drawing, GIS Building Size considered is 33m x 11.5 m, consists of space for 1 future bay on each side and maintenance on both side. GIS to be supplied should be accommodated in above area.

1.6 Type Testing

The contractor /bidder shall submit the type test reports for the tests conducted as per the relevant IEC/IS on the equipment similar to those to be supplied under this contract and the tests should have been conducted at an independent laboratory not earlier than five (5) years prior to 05.09.2014.

In case the contractor is not able to submit valid Report of Type Test(s) or in case Type tests Reports are not found to be meeting the specification requirements, or not including all specified tests, the contractor shall conduct all such tests under this contract. The costs of such test shall be deemed to be included in the price. The GSECL/BHEL shall have right to witness the Type Tests. Waiver of Type Tests will not be entertained in normal circumstances.

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.

The bidder shall submit the following type test reports for the tests conducted on the GIS package. However any other Type test reports not mentioned but required shall also be submitted.

The type tests shall be as per IEC 62271-203 and the report shall include following tests. :

- Tests to verify the insulation level of the equipment and dielectric tests on auxiliary circuits.
- Tests to prove the radio interference voltage (RIV) level (if applicable).

- c. Tests to prove the temperature rise of any part of the equipment and measurement of the resistance of the main circuit.
- d. Tests to prove the ability of the main and earthing circuits to carry the rated peak and the rated short time withstand current.
- e. Tests to verify the making and breaking capacity of the included switching devices.
- f. Tests to prove the satisfactory operation of the included switching devices.
- g. Tests to prove the strength of enclosures.
- h. Verification of the degree of protection of the enclosure.
- i. Gas tightness tests
- j. Electromagnetic compatibility tests (EMC).
- k. Additional tests on auxiliary and control circuits.
- l. Tests on partitions.
- m. Tests to prove the satisfactory operation at limit temperatures.
- n. Tests to prove performance under thermal cycling and gas tightness tests on insulators.
- o. Corrosion test on earthing connections (if applicable).
- p. Tests to assess the effects of arcing due to an internal fault.

Tests Witness

Tests shall be performed in presence of Owner's representative if so desired by the Owner. The bidder shall give at least fifteen (15) days' advance notice of the date when the tests are to be carried out.

1.7 INSPECTION & TESTING

Prior to dispatch, the routine & acceptance tests shall be carried out on equipment and accessories in accordance with the applicable IEC /IS and the material shall be offered for final inspection by BHEL and GSECL in accordance with quality assurance plan.

During manufacture and on completion, all equipment shall be subjected to the Routine tests as laid down in IEC 62271-203. Test shall include the following:

- Dielectric test on the main circuit.
- Tests on auxiliary and control circuits.
- Measurement of the resistance of the main circuit
- Tightness test.
- Design and visual checks.
- Pressure tests of enclosures.
- Mechanical operation tests
- Tests on auxiliary circuits, equipment and interlocks in the control mechanism.
- Pressure test on partitions.
- Short duration power frequency withstand test on the main circuits.
- Partial discharge measurement

1.8 Tests after installation on Site

After installation and before being put into service, the GIS shall be tested in order to ensure correct installation and dielectric integrity of the equipment as laid down in IEC60517 & 62271-203. The bidder

shall furnish a pre-commissioning test plan and a method statement for the tests on site. Test values and test procedures shall be subject to agreement between the Owner/Purchaser and the bidder. Testing equipment shall be provided by the bidder in addition to testing personnel. Tests shall include the following:

- Site installation verification
- Measurement of the resistance of the main circuit.
- Gas tightness tests.
- Gas quality verifications.
- Dielectric tests on auxiliary circuits
- Short duration power frequency withstand test on the main circuits.
- Partial discharge measurement

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.

1.9 QUALITY PLAN

The contractor shall carry out the works in accordance with sound quality management principles which shall include such as controls which are necessary to ensure full compliance to all requirements of the specification & applicable international standards. These quality management requirement shall apply to all activities during design, procurement, manufacturing, inspection, testing, packaging, shipping, inland transportation, storage, site erection & commissioning.

Contractor shall submit detailed Quality Plan for BHEL / customer's approval.

Attached Manufacturing Quality Assurance Plan (MQP) and Field Quality Plan formats in Section-3 shall be followed.

1.10 INFORMATION TO BE FURNISHED BY THE CONTRACTOR/ SUB CONTRACTOR

Information/ documents to be furnished at the TENDER STAGE shall be as per section 2 & 3.

1.11 DRAWINGS / DOCUMENTS

The drawings / documents submitted shall be project and product specific and shall incorporate all project details and title block and numbering scheme of the customer as detailed in Section 2 & 3.

ANNEXURE-A

It is confirmed that there are no deviations and the offer is in full compliance with the specification. It is also confirmed that there are no deviations in any other form such as comments, variations and/ or exceptions. Further it is confirmed that at all drawings / data sheets/QP/ type tests reports shall be submitted to BHEL for organising approval of ultimate customer. Also, furnishing of all relevant information / repetition of type tests (if required for meeting the specification requirement) shall be carried out by us at no extra cost to BHEL & without affecting delivery requirements.

Signature of the authorized representative of Bidder

Name _____

Designation _____

Place _____

Date _____

Company seal

Technical Specification for 400 kV GIS

Sl.No	SL	Description	Remarks_Long_Description	Unit	Quantity
A		Supply Item - 400kV GIS as per enclosed SLD with Double Bus Bar scheme comprising of 1 GT Incomer, 1 ST Incomer, 2 Outgoing Tie line, Bus Coupler and Bus PT bays. (Items A1-A15)	The 400 KV SF6 gas insulated switch gear shall have double bus bar arrangement. The SF6 gas insulated switch gear (50 HZ) shall be of the indoor metal- enclosed type, comprising of following modules:- 1 GT Incomer, 1 ST Incomer, 2 Outgoing Tie line, Bus Coupler and Bus PT bays and scope for extension for future bays , one on each side of bus bar. The Switchgear shall be complete with all necessary terminal boxes, inspection window, SF6 gas filling, interconnecting power and control wiring, grounding connections, gas monitoring equipment and piping, support structures. Any other item required for completion of project and not covered above - Complete List to be provided by bidder along with unit prices. The scope of supply shall also include all erection and mounting hardware and interconnecting power and control cables between GIS to LCC and between LCC to LCC including cable tray, glands, lugs, ferrules etc.	lot	1
1	A1	BusBar Modules	One set of three single phase(isolated), 2000A, 40kA for 3 sec, SF6 gas-insulated metal enclosed bus bars, each comprising of : a) Bus bars enclosures running the length of the switch gear to inter connect each of the circuit breaker bay modules in double main bus system. b) Gas monitoring systems, pressure switches, telescopic enclosure etc. as required. c) Barriers (communicating , non-cimminating types) Length of bus bar to be indicated by bidder.	Set	2
2	A2	400kV Voltage Transformer module (for Busbars)	400kV, 40 kA for 3 sec, SF6 gas insulated Bus VT bay module connected to Main Bus Bars, each comprising of: a) Three nos. single phase Voltage transformers b) One set of 3x1-phase, 2000A, group operated Disconnector switches, complete with manual and motor driven operating mechanisms. c) One set of 3x1-phase, group operated safety grounding switches, complete with manual and motor driven operating mechanisms. (Suitable for Bus Bar Earthing Duty) d) ONE set of 3x1-phase, high speed fault make grounding switch, complete with individual operated manual and motor driven operating mechanisms. e) Gas monitoring devices, barriers, pressure switches, etc. as required.	Set	2

Technical Specification for 400 kV GIS

Sl.No	SL	Description	Remarks_Long_Description	Unit	Quantity
3	A3	400kV SF6 GIS Line bay module	400kV, 40KA for 3 second, SF6 gas-insulated metal enclosed Line feeder bay module each set comprising of :- a) ONE set of 2000A, 3x1-phase, SF6 insulated circuit breaker with PIR, complete with operating mechanism (suitable for 1&3 phase auto reclose) b) TWO sets of 3x1-phase, 2000A, 3-core, multi ratio, current transformers as per single line diagram. (Core details shall be finalised at detail engg. stage) c) THREE sets of 3x1-phase, 2000A, group operated Disconnector switches, complete with manual and motor driven operating mechanisms. d) TWO set of 3x1-phase, group operated safety grounding switches, complete with manual and motor driven operating mechanisms. e) ONE set of 3x1-phase, high speed fault make grounding switch, complete with individual operated manual and motor driven operating mechanisms. f) Gas monitoring system, pressure switches etc as required. g) Barrier cones, mechanism box and other items as required.	Set	2
4	A4	400kV SF6 GIS Tie Line bay module	400kV, 40KA for 3 second, SF6 gas-insulated metal enclosed Tie Line feeder bay module each set comprising of :- a) ONE set of 2000A, 3x1-phase, SF6 insulated circuit breaker , complete with operating mechanism (suitable for 1&3 phase auto reclose) b) TWO sets of 3x1-phase, 2000A, 3-core, multi ratio, current transformers as per single line diagram. (Core details shall be finalised at detail engg. stage) c) THREE sets of 3x1-phase, 2000A, group operated Disconnector switches, complete with manual and motor driven operating mechanisms. d) TWO set of 3x1-phase, group operated safety grounding switches, complete with manual and motor driven operating mechanisms. e) ONE set of 3x1-phase, high speed fault make grounding switch, complete with individual operated manual and motor driven operating mechanisms. f) Gas monitoring devices, pressure switches etc as required. g) Barrier cones, mechanism box and other items as required.	Set	2

Technical Specification for 400 kV GIS

Sl.No	SL	Description	Remarks_Long_Description	Unit	Quantity
5	A5	400kV SF6 Generator Transformer Bay module	400kV, 40 kA for 3 sec, SF6 gas insulated GT feeder bay module each comprising of:- a) ONE set of 2000A, 3x1-phase, SF6 insulated circuit breaker, complete with operating mechanism (suitable for 1&3 phase auto reclose) b) TWO sets of 3x1-phase, 2000A, 3-core, multi ratio, current transformers as per single line diagram. (Core details shall be finalised at detail engg. stage) c) Four sets of 3x1-phase, 2000A, group operated Disconnector switches, complete with manual and motor driven operating mechanisms. d) three set of 3x1-phase, group operated safety grounding switches, complete with manual and motor driven operating mechanisms. e) ONE set of 3x1-phase, multi winding, Voltage Transformer as per single line diagram. (Winding details shall be finalised at detail engg. stage) g) Gas monitoring system, pressure switches etc as required. h) Barrier cones, mechanism box and other items as required.	Set	1
6	A6	400kV SF6 GIS Station Transformer Bay module	400kV, 40 kA for 3 sec, SF6 gas insulated ST feeder bay module each comprising of:- a) ONE set of 2000A, 3x1-phase, SF6 insulated circuit breaker, complete with operating mechanism (suitable for 1&3 phase auto reclose) b) TWO sets of 3x1-phase, 2000A, 3-core, multi ratio, current transformers as per single line diagram. (Core details shall be finalised at detail engg. stage) c) Three sets of 3x1-phase, 2000A, group operated Disconnector switches, complete with manual and motor driven operating mechanisms. d) Three sets of 3x1-phase, group operated safety grounding switches, complete with manual and motor driven operating mechanisms. (If required, high speed fault make grounding switch to be provided) e) Gas monitoring devices, pressure switches etc as required. f) Barrier cones, mechanism box and other items as required.	Set	1
7	A7	400kV SF6 GIS Bus Coupler bay module	400kV, 40KA for 3 second, SF6 gas-insulated metal enclosed Bus-Coupler bay module comprising of:- a) ONE set of 2000A, 3x1-phase, SF6 insulated circuit breaker, complete with operating mechanism (suitable for 1&3 phase auto reclose) b) TWO sets of 3x1-phase, 2000A, 3-core, multi ratio, current transformers as per single line diagram. (Core details shall be finalised at detail engg. stage) c) TWO sets of 3x1-phase, 2000A, group operated Disconnector switches, complete with manual and motor driven operating mechanisms. d) TWO sets of 3x1-phase, group operated safety grounding switches, complete with manual and motor driven operating mechanisms. e) Gas monitoring devices, pressure switches etc as required. f) Barrier cones, mechanism box and other items as required.	Set	1

Technical Specification for 400 kV GIS

Sl.No	SL	Description	Remarks_Long_Description	Unit	Quantity
8	A8	Bay Control Cabinet	Bay Control Cabinet for all bays : 1 GT Incomer, 1 ST Incomer, 2 Outgoing line, 2 Outgoing Tie line, Bus Coupler and Bus PT bays. , etc	Nos.	9
9	A9	400kV SF6 to Air Bushing	400kV, 2000A, 40 kA for 3 sec, 31mm/kV creepage, SF6 gas insulated SF6 to Air Bushing for Over head connection of Line/Tie Line/GT/ST with GIS.	Nos.	18
10	A10	400kV GIS duct from GIS GT/Tie Line/ST/Line Bays to SF6 to Air bushing	400kV, 2000A 40kA for 3 sec, SF6 gas insulated GIS duct shall be complete & comprising of:- a) Three Nos. single phase (isolated) SF6 ducts along with all accessories to connect 400kV GIS with 400kV side Lines, GTs, STs and Tie Lines. b) Gas monitoring devices, barriers, pressure switches, etc. as required. Total length is equal to sum of single phase lengths of all GIS ducts and is calculated by the bidder as per the layout drg. enclosed. Extra claim to be entertained only if there is change in layout drg. & variation more than 20%.	m	575
11	A11	First filling of SF6 gas plus extra for compensating losses for 10 % of total gas (Bidder to indicate quantity).	First filling of SF6 gas, and hydraulic fluid, if required for the equipment supplied plus an additional quantity sufficient for conducting all tests on equipment at site before placing it into successful operation plus expected gas loss during 20 years of operation. Additionally, 10 % of total quantity of SF6 gas shall also be supplied in non returnable cylinders.	Lot	1
12	A12	Supply of structure work for Installation of GIS including support structure for GIS ducts, SF6 to air bushings, supports, platforms, ladders, foundation bolts, embedded parts in floors etc., which are required for installation of GIS as per the specification. (The civil works will be done based on supplier design & drawings).	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.	Lot	1

Technical Specification for 400 kV GIS

Sl.No	SL	Description	Remarks_Long_Description	Unit	Quantity
13	A13	Supply of Earthing material for GIS including High frequency earthing material. The quantity shall be estimated provided by bidder for above floor earthing connection.	Supply of Earthing Material and Erection of all Earthing connection for GIS to GIS and GIS to Earth Mesh on Floor shall be in bidder's scope. The quantity shall be estimated by the bidder, based on their design philosophy. Design philosophy shall be submitted alongwith the bid in line with section 2. Supply of Earthing Material and Erection of Earth mesh on floor shall be done by BHEL in supervision of manufacturer as per manufacturer's design. Only supply of MS Rod (40mm Dia for outdoor below ground earth mat) and GI Flat of 75x12mm or MS Rod as recommended by bidder (for earth mesh on floor) shall be in BHEL's scope. Any other earthing material if required shall be in bidder's scope of supply and erection.	Lot	1
14	A14	Consumables required for GIS (Bidder to quote item wise with detailed BOQ for consumables)	Consumables including grouting material having limited shelf life required during erection, testing and commissioning. It shall be supplied just before erection after confirmation from BHEL.(1 lot is for complete package).	Lot	1
15	A15	Any other item required for completion of project and not covered above - Complete List to be provided by bidder along with unit prices.		Lot	1
B		Supply Item - Mandatory Maintenance equipment (B1 to B2)		lot	1
16	B1	SF6 gas processing unit	As per clause 5.03.11 of section 2 (300 litre)	Nos	1
17	B2	Wheeled maintenance unit	As per clause 5.03.11 of section 2	Nos	1
C		Supply Items - Mandatory spares (C1 to C14)	These prices will also be used for addition/deletion/replacement.	Lot	1
18	C1	O-ring and Gasket -2 set for each		set	1
19	C2	Absorbent -in Kg (bidder to indicate)		Lot	1
20	C3	SF6 Gas - One Cylinder of 20 kg		No.	1
21	C4	Single Phase PT		No.	1
22	C5	Expansion Vent diaphragms- 5 % of total		Set	1

Sl.No	SL	Description	Remarks_Long_Description	Unit	Quantity
23	C6	Disconnecting Switch motor - One no. of each type		Set	1
24	C7	Earthing Switch motor - One no. of each type		Set	1
25	C8	Limit Switches - One no. of each type		Set	1
26	C9	Bus support Insulator - 5 % of total		Set	1
27	C10	Gas density switches - 5 % of total		Set	1
28	C11	Circuit Breaker Closing and opening Coil - Two no. of each type		Set	1
29	C12	Circuit Breaker contacts - One set of each type		Set	1
30	C13	Circuit Breaker Spring charge motor - One set of each type		Set	1
31	C14	Lamps, Fuses, MCB, Aux. Relays - 10 % of each type		Set	1
D		Supply Item - Commissioning spares for testing & commissioning of GIS till handing over	Bidder to quote detailed BOQ alongwith unit price. Statup spares (also termed as commissioning spares) are those spares which will be required during the startup and commissioning of the equipment/systems and until performance testing. It is the responsibility of the contractor to supply all necessary spares as required until the equipment/systems are handed over to the Purchaser (GSECL). An adequate stock of startup spares shall be made available at the site such that the startup and commissioning of the equipment /systems, performance testing and handing over the equipment/systems to the Purchaser can be carried out without hindrance or delays. Contractor shall furnish the list of startup and commissioning spares to be brought by them to ensure the smooth commissioning of plant.	lot	1

Sl.No	SL	Description	Remarks_Long_Description	Unit	Quantity
E		Supply Item - Tools & tackle & Testing Equipment (E1 to E8)	Only special tools shall be in bidder's scope. The following list (E1 to E8) is minimum to be supplied. Any special tools required is deemed to be included in scope. 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. EOT cranes shall be provided by BHEL, capacity of EOT crane to be recommended by bidder. Bidder to furnish detailed BOQ for non-returnable Tools and Tackles along with unit prices to be handed over to ultimate customer.	Lot	1
32	E1	Portable gas leak detector		Nos.	1
33	E2	Hygrometer		Nos.	1
34	E3	Portable dust counter		Nos.	1
35	E4	Special gas mask for GIS maintenance		Nos.	5
36	E5	Vacuum meter		Nos.	1
37	E6	Digital contact resistance meter		Nos.	1
38	E7	Partial discharge measurement set		Set	1
39	E8	Mobile platform		Nos.	1
40	E9	Power operated insulation tester		Nos.	1
41	E10	Tong testers of suitable ranges		Nos.	1
42	E11	Contact resistance measuring set for micro ohms		Nos.	1
F		Services: Supervision of Erection, commissioning & site testing including earthing (F1 to F7)	GT, ST, Lines will be commissioned seperately at different stages.	Lot	1

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Sl.No	SL	Description	Remarks_Long_Description	Unit	Quantity
43	F1	Insulation co-ordination studies		Lot	1
44	F2	Site visit for unloading & verification of material at store	Store shall be provided by BHEL	Lot	1
45	F3	Supervision of Erection of GIS	Complete GIS including busbar, GT bays, Line bays, Tie Line Bays, bus coupler, bus PT etc.	Set	1
46	F4	Supervision of Erection of GIS Duct - GIS to SF6 to Air Bushings	1 set = 3x 1 phase GIS duct	Set	6
47	F5	Supervision of Erection of complete SF6 to Air Bushing		Set	18
48	F6	Testing & Commissioning of GIS	Complete GIS including busbar, GT bays, Line bays, Tie Line Bays, bus coupler, bus PT etc.	Set	1
49	F7	Final successful Testing of GIS including HV test kit	HV Test kit shall be in scope of bidder. (GT, ST & Lines may be commissioned seperately.) Final testing as per IEC for complete GIS including busbar, GT bay, ST bay, Line bays, bus PT, Ducts, SF6 to Air Bushing etc.	Lot	1
G		Services: Training (G1)		Lot	1
50	G1	Training for GIS to GSECL/BHEL engineers	Training for GIS shall cover following parts and mandays: Equipment theory and maintenance practice = 15 mandays Visit to manufacturer's works = 15 mandays Operation and maintenance of Plant (GIS) = 15 mandays Lodging and boarding of Training participants shall be in bidder's scope.	Lot	1
H		Supply - Unit Prices of Individual Item/Equipment (H1 to H25)	Unit Prices of Individual Equipment included here or in mandatory spares are required for any Addition/Deletion of Equipment and replacement of damaged items. Vendor to ensure that the unit prices have a logical relationship with prices of assemblies in main items (Bay, Busbar etc). Quoting for unit prices is mandatory and shall be considered for evaluation.	Lot	1
51	H1	400kV, 2000A Circuit breaker (1 pole complete without enclosure without operating mechanism)		No	1
52	H1	400kV, 2000A Isolator (1 pole) without operating mechanism		No	1

Technical Specification for 400 kV GIS

Technical Specification for 100 kV & GIS			Remarks_Long_Description	Unit	Quantity
Sl.No	SL	Description			
53	H2	400 kV Maintenance Earthing switch without operating mechanism		No	1
54	H3	400kV High speed earth switch without operating mechanism		No	1
55	H4	400kV Current transformer (1 of each type)		No	1
56	H5	Operating Mechanism box for 400kV, 2000 A Circuit Breaker		No	1
57	H6	Operating Mechanism box for 400kV, 2000 A Isolator		No	1
58	H7	Operating mechanism for 400kV, Maintenance Earthing Switch		No	1
59	H8	Operating Mechanism for 400kV, High Speed Earthing Switch		No	1
60	H9	Single Phase Bus bar (Any type)	Complete single phase 400kV,2000A, 40 kA for 3s bus bar including Gas monitoring systems, barriers, pressure switches	m	1
61	H10	Conductor for Single phase Bus bar/ bus duct (any type)	Conductor for bus bar, bus duct, GIB, Interconnecting conductors of any type with interconnecting parts as required.	kg	10
62	H11	GIS metallic enclosure (any type)	Enclosure for bus bar, bus duct, GIB, straight cast enclosure etc with fixing hardware as required.	m	1
63	H12	Epoxy resin insulators for bus support with holes for gas flow (of each type and rating)	Bidder to inform details at tender stage	set	1
64	H13	Gas barrier insulators (of each type and rating)	Bidder to inform details at tender stage	set	1
65	H14	Density switch		no.	1
66	H15	Gas monitoring system devices	1 set =1 no of each type	lot	1
67	H16	PD sensor		No.	1

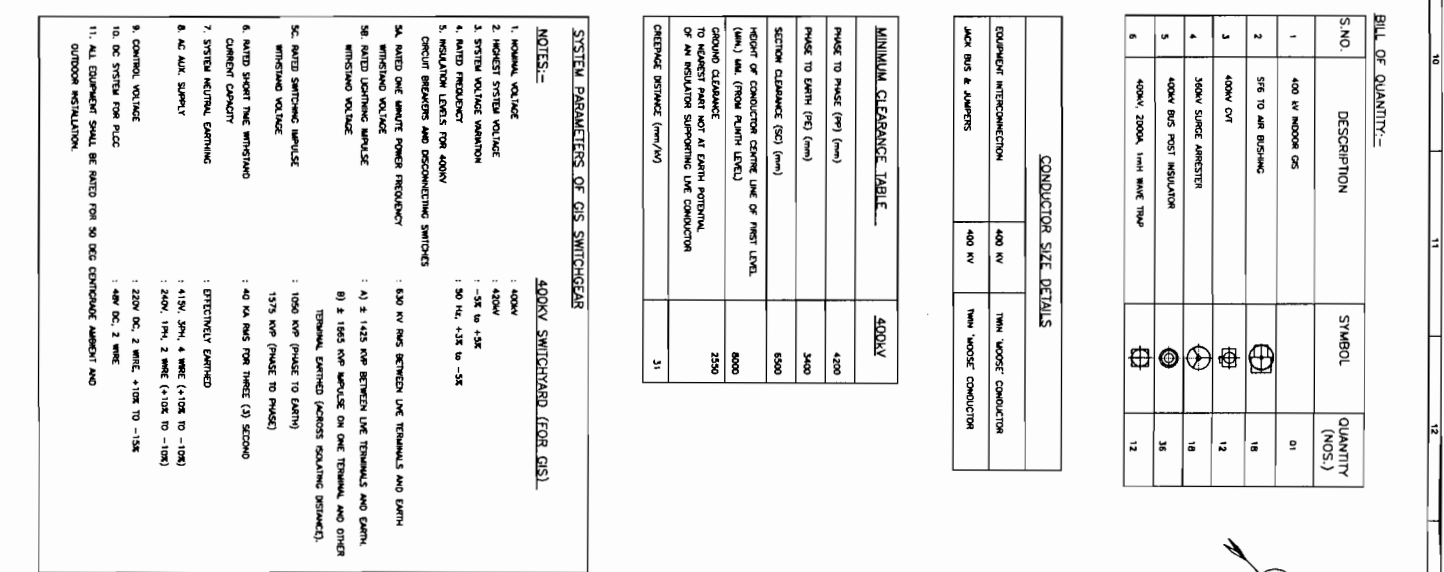
Technical Specification for 400 kV GIS

Sl.No	SL	Description	Remarks_Long_Description	Unit	Quantity
68	H17	Optical indicator for CB, Isolator		No.	1
69	H18	Elbow /Angle / T-bends		No.	1
70	H19	Telescopic enclosure		No.	1
71	H20	Sleeve enclosoure		No.	1
72	H21	Expansion joints for bellows		m	1
73	H22	cross tank		No.	1
74	H23	Services of manpower for erection per day (excl. travel time)		days	1
75	H24	Services of manpower for Testing & commissioning per day (excl. travel time)		days	1
76	H25	Hiring charges of HV test kit per day	Additional HV test kit charges including charges of manpower, HV test kit, accessories & tools required for completion of HV test (Dielectric Test after installation of GIS). HV test kit charges include one or more bay at site.	lot	1

Note :

Any item whether specifically mentioned or not in above BOQ and mentioned elsewhere in specification or required for successful operation of GIS shall be part of scope of supply. Bidder to submit list of such items.

CT & VT details given in single line diagram are tentative and may change at contract stage. Changes to be incorporated by bidder without any cost and delivery implication.



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INDEX	
SHT. No.	DESCRIPTION
01	INDEX AND LEGEND
02	CT/CVT DETAILS OF 400KV GIS
03	SCHEDULE OF EQUIPMENT AND SYSTEM DETAILS OF 400 KV GIS SLD
04	SINGLE LINE DIAGRAM OF 400 KV GIS

INDEX

-	GSECL SINGLE LINE DIAGRAM OF 400KV SWITCHYARD UPTO GENERATOR-7 BAY (EXISTING)
-	GSECL CT/CVT DETAILS OF 400KV SWITCHYARD UPTO GENERATOR-7 BAY (EXISTING)
K9213R-DWG-E-0100	KEY SINGLE LINE DIAGRAM
K9213R-DWG-E-0102	SLD - 400KV GIS & 400KV SWITCHYARD (EXTN.).
DRAWING No.	TITLE OF REFERENCE DRAWING

REFERENCE DRAWING

			TOTAL SHEETS	04
W.O. No.	DEPT.	CODE	NEXT SHEET	02
	TBEM	422	SHEET No.	01

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D-1 THE D T THE CE CAR THE

PARTICULARS	SEC. 1	SEC. 2	SEC. 3
RATIO	$\frac{400KV}{\sqrt{3}} / \frac{110V}{\sqrt{3}}$	$\frac{400KV}{\sqrt{3}} / \frac{110V}{\sqrt{3}}$	$\frac{400KV}{\sqrt{3}} / \frac{110V}{\sqrt{3}}$
BURDEN	200 VA	200 VA	100 VA
ACCURACY CLASS	3P	3P	0.2

LINE FEEDER-1&2 , tie FEEDER 1&2

PARTICULARS	SEC. 1	SEC. 2	SEC. 3
RATIO	$\frac{400W}{\sqrt{3}} \cdot \frac{110V}{\sqrt{3}}$	$\frac{400W}{\sqrt{3}} \cdot \frac{110V}{\sqrt{3}}$	$\frac{400W}{\sqrt{3}} \cdot \frac{110V}{\sqrt{3}}$
BUREN	200 VA	200 VA	100 VA
ACCURACY CLASS	3P	3P	0.2

HF Capacitance : 4400pF +10% , -5%

HF Capacitance : 440pF +10% , -5%

CT/CVT DETAILS OF 400KV GIS

			TOTAL SHEETS	04
W.O. No.	DEPT.	CODE	NEXT SHEET	03
	TBEM	422	SHEET No.	02

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SCOPE OF SUPPLY FOR 400KV GAS INSULATED SWITCHGEAR

ONE (1) SET GAS INSULATED SWITCHGEAR ASSEMBLY
CONSISTING OF FOLLOWING BAYS AND TERMINATION

DETAILS	400KV GIS
BUSBAR RATING AS PER IEC	420 KV, 40 KA / 3 SEC, 2000 A
BUS CONFIGURATION	DOUBLE BUSBAR
BAYS TO BE PROVIDED:	SEVEN BAYS (1GT+ 1ST + 2 LINE FDR. + 2 TIE FDR. + BUS COUPLER) + 2 NOS. BUS PT.
OVER HEAD LINE FEEDERS	TWO NOS. 2000A
125/65/65MVA 400.KV/11.5KV STATION TRANSFORMER FEEDERS	ONE NO, 2000A
966MVA 420KV/27KV GENERATOR TRANSFORMER FEEDERS	ONE NO, 2000A
BUS COUPLER	ONE NO, 2000A
GIS TO EXISTING AIS INTERCONNECTION	TWO NOS, 2000A
FUTURE SPACE PROVISION	ONE BAY EACH ON BOTH SIDES

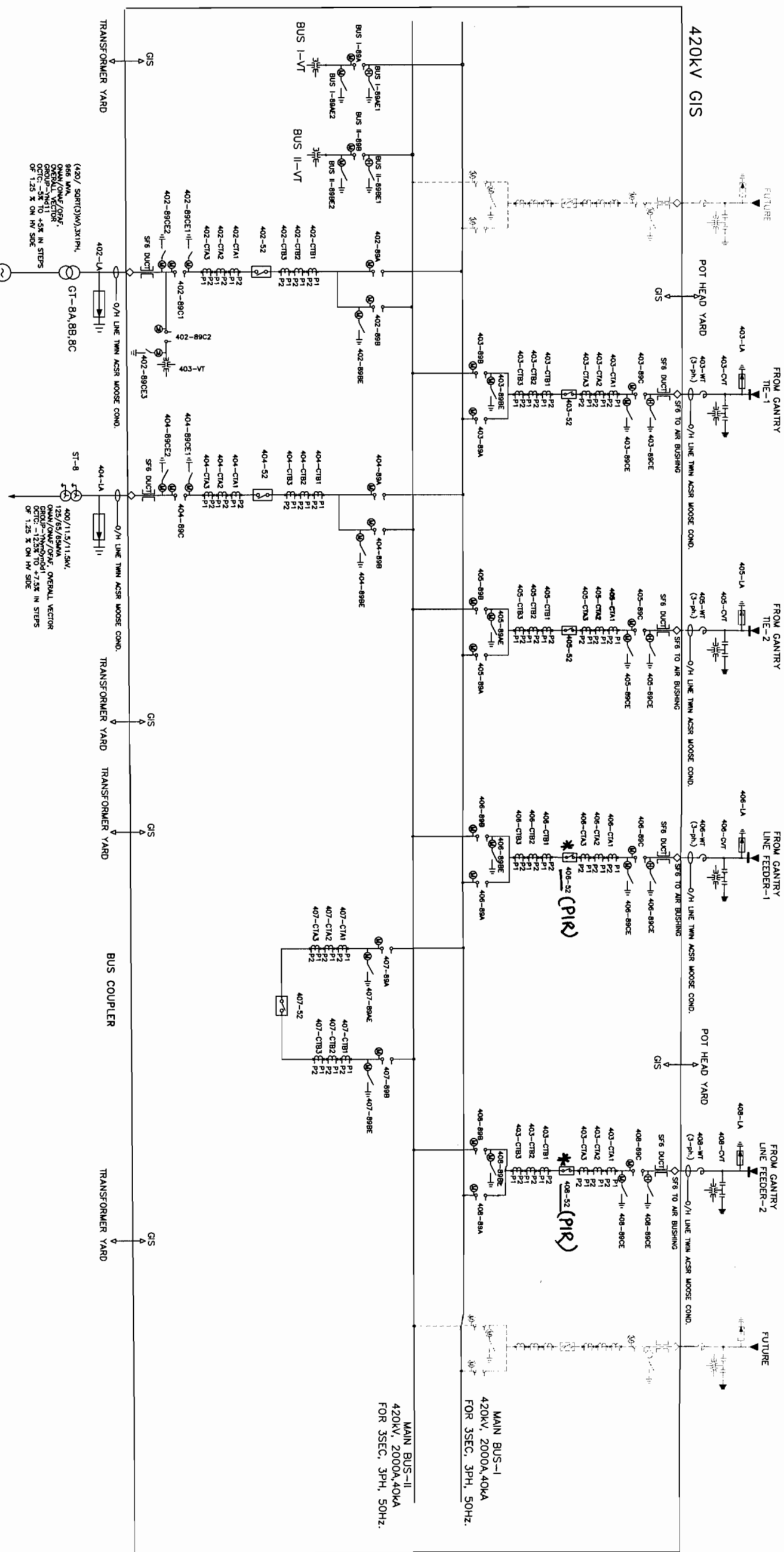
S.N.	EQUIPMENT	SYMBOL	ABBR.	QTY. (NOS.)
1.	420 KV, 2000 A, 3X1-PH , GROUP OPERATED MOTORISED DISCONNECTOR		89	23
2.	420 KV MOTORISED 3X1-PH, GROUP OPERATED MAINTENANCE EARTHING SWITCH		89E	19
3.	420 KV 3X1-PH, GROUP OPERATED FAST ACTING EARTHING SWITCH		89E	06
4.	420 KV, 1-PH, 3-CORE,2000A, CURRENT TRANSFORMER		CT	42
5.	420 KV, 2000A, 3X1-PH, METAL ENCLOSED CIRCUIT BREAKER WITHOUT PIR		52	05
6.	420 KV, 2000A, 3X1-PH, METAL ENCLOSED CIRCUIT BREAKER WITH PIR		52	02
7.	420 KV, 1-PH VOLTAGE TRANSFORMER		PT	09
8.	420 KV, 1-PH SF6/AIR BUSHING			18
9.	420 KV, SF6 BUS DUCT			

GIS B00:

S.NO.	DESCRIPTION	SYMBOL	ABR.	MAIN QTY. (IN NOS.)
1	360KV, 10KA CLASS-3 SURGE ARRESTER (1-PH)		SA	18
2	420KV CAPACITIVE VOLTAGE TRANSFORMER (1-PH) 440pF		CVT	12
3	420KV CAPACITIVE VOLTAGE TRANSFORMER (1-PH) 4400pF FOR REMOTE END FOR LINE FEEDER 1&2, SUPPLY ONLY		CVT	06
4	420KV WAVE TRAP (1-PH), . 2000A, 1.0 mH		WT	12
5	420KV WAVE TRAP (1-PH), . 2000A, 1.0 mH FOR REMOTE END FOR LINE FEEDER 1&2, SUPPLY ONLY		WT	06

RATING OF WAVE TRAP & CVT FOR LINE FEEDERS SHALL BE CONFIRMED BY CUSTOMER

[illegible]



ELECTRICAL SYSTEM PARAMETERS OF GIS SWITCHGEAR	
01. RATED VOLTAGE	400 kV rms
02. MAX SYSTEM VOLTAGE	420 kV rms
03. RATED CONTINUOUS CURRENT AT DESIGN AMBIENT TEMPERATURE	
BUS BAR	: 2000A
LINE/TRANSFORMER/ BUS COUPLER FEEDERS	: 2000./2000./2000 A
04. BASIC INSULATION LEVEL	: 1425 kVp (BETWEEN LIVE TERMINALS AND EARTH)
05. SWITCHING IMPULSE	
PH-PPH	: 1575 kVp
PPH-EARTH	: 1050 kVp
06. POWER FREQUENCY W/S VOLTAGE	: 630 kV rms (BETWEEN LIVE TERMINALS AND EARTH)
07. FAULT LEVEL (3 SEC.)	40KA rms FOR GIS
08. SYSTEM NEUTRAL GROUNDING	EFFECTIVELY EARTHED

				TOTAL SHEETS	04
W.O. No.	DEPT.	CODE	NEXT SHEET		-
	TBEM	422	SHEET No.		04

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SECTION 2

GENERAL ELECTRICAL SPECIFICATIONS

2.1 GENERAL

This section covers the general technical requirements of 400 kV Gas Insulated Substation (GIS). In case of any discrepancies between the requirements mentioned in this section and those specified in the following sections of this specification, the specifications given herein shall prevail and shall be treated as binding requirements. Requirements of Section-1 shall take precedence over all sections.

2.2 GENERAL TECHNICAL SPECIFICATIONS

As per GSECL Technical Specifications enclosed as below:

TECHNICAL SPECIFICATION FOR 400KV GAS INSULATED SWITCHGEAR
VOLUME: IIF/1 SECTION-XIV K9213R-EPC-SPC-001_V2F1-SEC-14

VOLUME : IIF/1

SECTION-XIV

**TECHNICAL SPECIFICATION
FOR
400KV GAS INSULATED SWITCHGEAR**

1.00.00 INTENT OF SPECIFICATION

1.01.00 This specification is intended to cover the design, manufacture, assembly, testing at Contractor's works, supply & delivery, properly packed for transportation to site of EHV Gas Insulated Switchgear (GIS), complete with all materials and accessories for efficient and trouble-free operation.

1.02.00 The scope of work shall also include complete erection, testing and commissioning and putting into successful commercial operation of EHV Gas Insulated Switchgear (GIS) inclusive of the supply of all labor, supervision, tools, implements and supplies.

2.00.00 SCOPE OF WORK

2.01.00 Scope of supply

Type and rating of the equipment listed below are detailed in the attached annexure and associated single line diagram. The equipment shall be offered in strict compliance with the same.

2.01.01 One (1) set Gas Insulated Switchgear assembly consisting of following bays and termination.

Details	400 Kv GIS
Busbar Rating as per IEC	400 KV, 40 kA / 3 Sec, 2000 A
Bus Configuration	Double Busbar
Bays to be provided:	Seven bays (1GT+ 1ST + 2 Line Fdr. + 2 Tie Fdr. + Bus coupler) + 2 Nos. Bus PT.
Over Head Line Feeders	Two nos, 2000.A
125 *MVA 400.KV/11.5KV /11.5kV Transformer feeders	One no, 2000A
945 *MVA 420KV/27kV Generator Transformer feeders	One no, 2000A
Bus Coupler	One no, 2000A
GIS to Existing AIS Interconnection	Two nos, 2000A
Future Space Provision	One feeder each on both sides

* Minimum indicative rating. EPC Contractor will finalise the rating.

The inter-connecting 400kV transmission lines between 400kV GIS & 400kV extension bays of existing Air insulated Switchgear (AIS) is not under this EPC specification Scope.

2.01.02 The supply of equipment with each set shall include, but not limited to:-

- Gas-insulated switchgear with associated circuit breakers, disconnect and ground switches, voltage & current transformers and surge arrestors etc. as shown in the attached Single Line Diagram.
 - All metal enclosed gas insulated buses for interconnecting various switchgear assemblies, including flexible joints to ensure service continuity during thermal cycling and vibration.
 - SF6 duct connection to power transformers and incoming lines
 - SF6 duct connection from GIS to SF6 –Air bushing outdoor at power transformer side and incoming lines with all accessories or SF6 duct directly to the HV side SF6 to oil transformer bushing.
 - ~~O/H line/AI tube connection to power transformer end including all structures.~~
 - SF6 duct connection from GIS to SF6 –Air bushing at outgoing line feeder end.
 - ~~O/H line /AI tube connection from SF6 Air bushing upto gantry structure with all accessories for connecting the outside line feeder conductor.~~
 - ~~EHV cable connections at GIS end (if required), including SF6 enclosures, terminating support structures, mounting insulators.~~
 - Transformer bushing SF6 enclosures complete with vibration dampers and /or alignment bellows.
 - Base frames & supports, wall through bushing plate, platforms, steps and walkways including fasteners to foundation.
 - Auxiliary equipment, for emergency control and local supervision, including interlocks; operating mechanisms; and control, monitoring and protective devices, installed in suitable cabinets.
 - Control cabinets with respective mimic buses, internal wiring, and terminations.
 - ~~Dedicated Battery and Battery charger as required for the auxiliary DC power.~~
- ~~220 V Nickel – Cadmium (Ni-Cd) Battery and Battery chargers for 400kV GIS [2 x 100% Battery & 2 x 100% Float cum Boost Battery Charger for each set of Battery]~~

48V Nickel – Cadmium (Ni-Cd) Battery (dedicated) and battery charger for 400kV Gas Insulated Switchgear PLCC. [1 x 100% Battery & 2x 100% Float cum Boost Battery Charger for Battery]

For technical details of the battery and battery systems , specification sub section Volume-II-F/2 , SECTION-II shall referred to.

- 400KV Capacitive Voltage transformers, Power Line Carrier Communication (PLCC) Equipment and Wave Trap ; Fire optics Reinforced ADSS Fibre Optic Cables ; 360kV Lightning Arrester , Disconnector switches and all other hardware Wiring of devices and terminations internal to the switchgear and all shielded control cables and associated raceways above foundation, between the equipment and the GIS bay control cabinets.
- PLCC system for two no. line feeders for other end to be supplied as loose to avoid mismatch. Technical parameters of PLCC system at other end of each line will be identical to PLCC at Wanakbori end and following items shall be supplied as loose:
 - Wave Trap
 - CVTs
 - Line matching unit
 - HF cable as required
 - PLCC panels
 - PLCC mounting hardwares
 - Any other materials / item as per requirement.
- Fibre reinforced ADSS optical fiber cables along with associated termination & clamping accessories shall be supplied in accordance with the requirement of this project.

The fibre optic cables will be used for communication between SCADA located in the Central Control Room of power house and the Substation Automation System (SAS) of the 400KV GIS Substation.
- Integrated Substation Automation System (SAS) as per Annexure-H
- Metering ,Protection & Control as per Annexure-C
- Wiring of devices and terminations internal to the switchgear and all shielded control cables and associated raceways above foundation, between the equipment and the GIS bay control cabinets.
- Underground earthing mat and risers , Earth pits, lightning spikes/shield wires, lighting, cabling , marshalling kiosks , fencing , rail-tracks etc..
- Ground buses and ground connection pads for connection to underground earthing mat.
- Electrically operated (EOT) craned in GIS building.
- All concrete foundation works including GIS building.

- Gas density monitors, pressure relief devices, and gas-filling connections.
- Gaskets, sealant, and desiccant for permanent sealing of field assembled joints and access covers removed during assembly.
- Initial filling of SF₆ gas, and hydraulic fluid, if required. SF₆ gas quantity shall be sufficient for first filling plus expected gas loss during 20 years of operation.
- SF₆ gas filling equipment portable type.
- ~~Over-head lines, power and control cables for external connection (Outside GIS building).~~
- ~~Fibre reinforced ADSS optical fiber cables along with associated termination & clamping accessories shall be supplied in accordance with the requirement of this project.~~
- Any other equipment that is not specifically mentioned herein but that is necessary for trouble-free operation, installation, and maintenance of the GIS.

2.01.03 One set of special tools and tackles

2.01.04 Mandatory Spare parts

2.01.05 Recommended spare parts for three(3) years operation in addition to mandatory spares

2.01.06 All relevant drawings, data and instruction manuals.

3.00.00 GENERAL REQUIREMENTS

3.01.00 Codes and Standards

3.01.01 All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) and IEC except where modified and/or supplemented by this specification.

3.01.02 Equipment and material conforming to any other standard, which ensures equal or better quality, may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the bid.

3.01.03 The electrical installation shall meet the requirements of Indian Electricity Rules as amended upto date and relevant IS Code of Practice. In addition, other rules and regulations applicable to the work shall be followed.

4.00.00 DESIGN CRITERIA

4.01.00 General layout

- 4.01.01 The bidder shall work out an optimum layout and building size based on the specific features of his product and submit the dimensional general arrangement layout drawing along with his bid.
- 4.01.02 The equipment will be installed primarily in a hot, humid and tropical atmosphere.
- 4.01.03 All equipment, accessories and wiring shall have tropical protection, involving special treatment of metal and insulation against fungus, insects and corrosion.
- 4.02.00 **Switchgear assembly**
- 4.02.01 The switchgear shall be of compact and modular design, fully metal-clad and of the sulphur-hexafluoride (SF6) insulated type. It shall be constructed for the specified busbar system, and shall include all necessary switches and current and voltage transformers, as detailed in the enclosed single line diagram. The switchgear shall be supplied complete with all auxiliary equipment necessary for operation, routine maintenance, repairs or extensions.
- 4.02.02 Each line up of switchgear shall be suitable, and prepared for future extension on either end 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.
- 4.02.03 The switchgear shall be of the freestanding, self-supporting dead-front design, with all high-voltage equipment installed inside gas-insulated, metallic grounded enclosures, and suitably sub-divided into individual arc and gas-proof compartments.
- The bus bars shall be sub-divided into compartments including the associated busbar disconnectors.
- 4.02.04 The arrangement of the switchgear shall be such as to enable dismantling a bay without affecting the adjacent bay. However, to remove the busbar disconnector, a shut down of the relevant section of the busbar is envisaged.
- 4.02.05 For routine inspections and possible repairs, all elements shall be accessible without removing support structures. The removal of individual enclosure parts, or entire breaker bays, shall be possible without disturbing the enclosure of neighboring bays.
- 4.02.06 All similar materials and removable parts shall be uniform and interchangeable with one another
- 4.03.00 **Construction**
- 4.03.01 Materials used in the manufacture of the switchgear equipment shall be of the type, composition and physical properties best suited to their particular purposes and in accordance with the latest engineering practices.
- 4.03.02 All joint surfaces shall be machined, and all castings shall be spot faced for all bolt heads or nuts and washers.
- 4.03.03 Bracing shall be provided for all mechanical components against the effects

of short circuit currents specified under system parameter. The design of the equipment shall be such that the agreed permitted movement of foundations or thermal effects do not impair the assigned performance of the equipment.

- 4.03.04 Each pressure filled enclosure shall be designed and fabricated to comply with the requirements of the applicable pressure vessel codes of the country of origin, and based on the design temperature and design pressures as defined in IEC.
- 4.03.05 The enclosure and seals shall be designed to withstand the gas pressure encountered under normal and short circuit conditions. The thickness of the enclosures shall be in compliance with IEC.
- 4.03.06 Each gas filled compartment shall be equipped with static filters. These filters shall be capable of absorbing any water vapour, which may penetrate into the enclosures.
- 4.03.07 Pressure relief devices shall be provided with a shield and be vented to provide a safe environment for field personnel and for equipment during operation. The bursting pressure of relief device should be effectively coordinated with the rated gas pressure and the pressure rise due to arcing.
- 4.03.08 Further more, no part of the enclosure, or any loose parts, may fly off the switchgear in such an event, and no holes may burn through the enclosure until the nearest protective relay has tripped. All grounding connections must remain operational during and after an arc fault.
- 4.03.09 The circuit breaker gas zone shall be independent from all other gas compartments and shall meet the requirement of relevant IEC.
- 4.03.10 Proper grounding for mitigating over voltages during disconnector operation shall be included.
- 4.03.11 The GIS equipment shall be furnished with specially designed stainless steel compensators/bellows to preserve the mechanical strength of the equipment at the connection portions to deal with the following problems:
- a) To absorb the expansion and Contraction of outer enclosure and conductor due to temperature variations.
 - b) Mismatch in various components of GIS
 - c) To absorb the vibration of the transformer and switching equipment
 - d) To absorb the dimensional variations due to uneven settling of foundation
 - e) To withstand seismic forces as mentioned in climatic condition.
- 4.03.12 Viewing windows shall be provided at the disconnectors and earthing switches to ensure that each contact position can be inspected. Each section shall have plug-in or easily removable connection pieces to allow for easy replacement of any component with the minimum of disturbance to the remainder of the equipment.

- 4.03.13 All interlocks that prevent potentially dangerous mal-operations, shall be so constructed such that they cannot be defeated easily, i.e. the operator must use tools or brute force to over-ride them.
- 4.03.14 The safety clearances of all live parts of the equipment shall be as per relevant standards.
- 4.04.00 **Duty requirement**
- 4.04.01 The switchgear shall be designed for continuous operation under all system operating conditions including sudden change of load and voltage within its ratings. The equipment shall be designed to withstand normal operating voltage even if the inside gas pressure decreases to atmospheric pressure and shall be suitable for breaking the load current.
- 4.04.02 The switchgear shall be constructed of suitable material and thickness to withstand the mechanical and thermal stresses due to short circuits and internal arc faults.
- 4.04.03 Arc faults caused by external reasons shall be positively confined to the originating compartment and shall not spread to other parts of the switchgear.
- 4.04.04 The maximum temperature in any part of the equipment at specified rating shall not exceed the permissible limits as stipulated in the relevant standards.
- 4.04.05 The disconnect switches shall be capable of interrupting the charging current of the connected GIS bus & associated components.
- 4.04.06 There shall be no radio interference when the equipment is operated at maximum service voltage.
- 4.04.07 The inspection of breaker contact in service shall be carried out after 3000 to 4000 operating cycles and after a cumulative interruption of 20 nos. at rated short circuit current.
- 5.00.00 **SPECIFIC REQUIREMENTS**
- 5.01.00 **Circuit Breakers**
- 5.01.01 Circuit breaker shall be the SF₆ gas-insulated type having ratings as indicated in Annexure – B. The breaker shall be capable of performing the specific duty cycle without derating.
- 5.01.02 Each circuit breaker shall be factory assembled, adjusted, and tested, and shall be shipped as a complete single-phase or three-phase unit.
- 5.01.03 The breaker shall include a suitable fully spring charged operating mechanism to assure proper opening and closing and should permit checking the adjustments and operating characteristics. The mechanism should be capable of reclosing, when specified, within the time range specified.
- 5.01.04 The circuit breaker shall have trip free, anti-pumping feature and pole discrepancy protection.

The circuit breaker shall have independent pole operation if auto-reclosing duty is specified. Pole discrepancy tripping is to be provided in case of single-phase operation.

- 5.01.05 Each circuit breaker shall be equipped with one closing coil and two tripping coils. It shall also be provided with an operation counter locally to count the number of breaker operation. The preferred arrangement for this device is to operate only during the opening cycle.

Mechanical indicator shall be provided to show the position of the breaker status.

All gauges, counters, and position indicators shall be readable by an operator standing near the equipment.

- 5.01.06 Necessary valves and connections should be provided to ensure ease in handling the SF₆ gas.

- 5.01.07 Breaker shall be suitable for following switching duties:

- Terminal faults
- Short line faults
- Out of phase switching
- Interruption of small inductive current including transformer magnetising inrush currents.
- Interruption of line and cable charging currents.

The breaker switching under above switching operations shall not result in excessive over voltages and/or re-strike of arc.

- 5.01.08 Breaker components shall meet Partial Discharge requirement as per relevant IEC.

- 5.01.09 The circuit breaker shall meet all the double Circuit transmission line characteristics for any type of fault or fault location, and also for line charging and dropping when used on an effectively grounded system. Effect of second circuit in parallel shall also be considered.

- 5.01.10 The circuit breakers shall be capable of being operated locally or from remote. Local operation shall be by means of an open/close control switch located in the bay control cabinet. In addition, manually operated tripping device shall be provided for emergency use as well as for maintenance purpose. Manually operated closing device shall also be furnished for use during maintenance.

- 5.01.11 The accessories and auxiliary equipment to be supplied with the circuit breaker and other components of the same bay module shall include all parts necessary for correct functioning of the circuit breaker, and also the following items to be installed in the breaker control box:

- Operation counter, electrically operated

- One set of adequately rated, thermostatically controlled, anti-condensation heaters with provision for monitoring of heater failure, wired to terminal blocks
- One copper ground busbar to be located near the control cable entrance
- Operating mechanism, pressuring unit, gauges and switches
- All motor driven auxiliaries shall have individual phase or pole thermal over-current protection
- Circuit breaker SF6 gas pressure monitoring unit
- Auxiliary switches ¹²NO + ¹²N~~C~~ for Owner/Purchaser's use besides its own interlocking
- One vermin-proof, sheet steel cabinet of adequate size shall be provided for housing the operating mechanism, aux relays, control and auxiliary equipment and for terminating all control, alarm and auxiliary circuits in suitable terminal boxes. The control cabinet shall be provided with hinged doors with provision for locking and removable cable gland plates for bottom cable entry. Viewing windows shall be provided for observation of the instruments without opening the cabinet. Suitably engraved nameplates shall be provided to identify all equipment in the control cabinet.

Contractor shall provide all control wiring and terminations internal to the switchgear, and connecting the switchgear to the bay control cabinets.

All control cables shall be shielded. Cable shields shall be grounded at both ends. Grounding connections shall be as short and direct as possible and shall terminate at the point of entry to cabinets or terminal boxes.

Co-axial type cable glands suitable for use with shielded cables shall be used at each termination.

All control cables shall be installed and terminated in such a manner as to limit the effects of transient electromagnetic voltages on the control conductors to an acceptable level.

5.02.00 Disconnecting Switches and Grounding (Maintenance & Fast acting) Switches

5.02.01 Operating Mechanism

Disconnecting switches should be three-pole, group-operated, no-load break, with one motor operated operating mechanism per three-pole. Operating mechanisms are to be provided with position indication that may be color-coded, or the position may be spelled out.

Two types of Grounding switches, namely, Maintenance Grounding switch and Fast acting Grounding switch, shall be used as shown in the Single Line Diagram. Maintenance Grounding switches shall be electrically interlocked. Grounding switches should be three-pole, group-operated, no-load break,

with motor operating mechanisms. Grounding switches located at the entrance of the transmission lines, EHV Cables and at busbar shall be of high speed, make proof type and shall be used to discharge the respective charging currents in addition to their safety grounding function.

For motor-operated disconnecting and grounding switches, the control should be electrically and/or mechanically uncoupled from the drive shaft when the switch is operated manually to prevent coincident power operation of the switch and the drive mechanism(s).

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

Each disconnecting switch and grounding switch should be furnished with electrically independent auxiliary switches. The auxiliary switches should indicate the position of the switchblades and should be provided to that the contacts can be adjusted to be fully engaged and in proper alignment when in the closed position. At least ~~NO~~ + ~~NC~~ contacts should be furnished for interlocking. 20% spare contacts shall be kept and wired upto bay control cabinet.

12 12

5.02.02 Visual verification

Visual verification shall be provided for each pole of each disconnecting switch and grounding switch to permit visual inspection of each switchblade position. External position indicators should also be provided. Inspection view ports should have removable covers to prevent damage of the actual view port due to the elements or from abrasive action while cleaning the port for viewing.

5.02.03 Duty

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

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

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

5.02.04 Access

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

5.02.05 Low-voltage test provision

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

5.02.06 Operation & Control

Opening and closing of disconnecting switches shall be either by local or remote control. Local operation shall be by means of a two-position control devices located in the bay control cabinet. Grounding switches shall be operated from local only from bay control cabinet.

5.02.07 Interlock

The disconnecting switch operation shall be interlocked electrically with the associated circuit breakers such that its control is inoperative if the circuit breaker is closed. Interlocks with other bays for bus transfer switching scheme shall be done through bay control cabinets. Actuation of the emergency manual operating device shall also disable the electrical control. Disconnecting switch in open condition shall be secured against reclosure.

Disconnecting switches and their adjacent grounding switch/es shall have electrical interlocks to prevent closure of the grounding switches when the disconnecting switches are in the closed position and to prevent closure of the disconnecting switches when the respective grounding switches are in the closed position. The disconnecting switches shall be pad lockable in the close & open position.

Disconnecting switches having adjacent fast acting grounding switches shall be interlocked such that the ground switches close first to discharge the line charging currents before the respective disconnecting switches opened.

When the lines are taken out of service for maintenance, etc., the disconnecting switches and fast acting grounding switches located in the transmission line feeder modules of the GIS switchgear are required to operate as follows:

After tripping of circuit breaker, operation of the respective disconnecting control switch 'to open' will first initiate rapid closure of the associated fast acting-grounding switch. When this grounding switch is signaled 'closed' by its auxiliary switches, an adjustable time delay relay will start to allow time for any trapped charges to dissipate into the grounding network. After the set time delay, the disconnecting switch motor operating mechanism will be energized to open it.

Operation of the disconnecting control switch 'to close' will close it, which, when proved 'closed', will signal the fast acting grounding switch 'to open'.

Local control of the disconnecting switches and fast acting grounding switches from the bay control cabinet shall be by individual control devices with the Remote/Local transfer switch set to Local.

5.03.00 Gas system

5.03.01 Furnishing the GIS

The GIS shall be furnished, with sufficient SF6 gas to pressurize the complete system in a sequential approach, one zone or compartment at a time, to the rated nominal density. The SF6 gas should conform to relevant IEC. The initial gas filling of the switchgear and sufficient extra SF6 gas for compensation of possible losses during installation and service for 20 years shall be supplied.

5.03.02 Reuse or recycling of removed gas

The Contractor should provide guidelines or recommended practices for the reuse or recycling of SF6 gas removed from the equipment. These guidelines should be consistent with current industry practices, as they pertain to the effect of SF6 on global warming; i.e. SF6 gas should be reused and recycled whenever possible and never be unnecessarily released into the atmosphere.

5.03.03 GIS enclosure

The GIS enclosure should be divided into several sections separated by gas-tight barrier insulators. Each section should be provided with the necessary piping and valves to allow isolation, evacuation, and refill of gas without evacuation of the any other section. Location of gas barrier insulators is to be clearly discernable outside the enclosure by a band of distinct colour normally used for safety purposes.

5.03.04 Gas schematic diagram

A gas schematic diagram should be submitted for approval. It should include the necessary valves, connections, density monitors, gas monitor system and controls, indication, orifices, and isolation to prevent current circulation. Means of calibrating density monitors without de-energizing the equipment should be specified by the Contractor.

5.03.05 External fixtures

The external fixtures should be made of corrosion-resistant material and should be capped where required.

5.03.06 Monitoring and maintenance

For the purpose of gas monitoring and maintenance, the GIS should be divided into the following individually monitored zones:

- a) Each power circuit breaker
- b) Additional zones as mutually agreed upon by the Owner/Purchaser and the Contractor

5.03.07 Single-phase bus construction

For single-phase bus construction, single-phase gas pressure and density monitoring shall be provided.

5.03.08 Leakage rate

The leakage rate of SF6 gas from any single compartment to atmosphere and between compartments shall not exceed 0.5% per year for the service life of the equipment.

5.03.09 Alarms

Each gas zone should be furnished with a temperature compensated gas-monitoring device capable of signaling two adjustable, independent alarms. The signaling is to be done by two sets of adjustable, electrically independent contacts that operate at the alarm levels as follows:

First alarm – refill gas density normally 5-10% below the nominal fill density

Second alarm – minimum gas density to achieve-equipment ratings

In special cases determined by the Contractor, a third stage with a set of contacts may be necessary in certain areas.

5.03.10 Connections

Provisions should be made for connecting density relay, the service cart, and moisture instrumentation to each one of the gas sections.

5.03.11 SF6 Gas Processing Unit

a) An SF6 gas-processing unit suitable for evacuating, liquefying, evaporating, filling, drying and purifying SF6 gas during the initial installation, subsequent maintenance and future extension of GIS shall be provided. The cart shall be equipped with rubber wheels and shall be easily maneuverable within the GIS building.

b) A wheeled maintenance unit shall be supplied which shall be self-contained (except for additional gas storage bottles and external power supply at 415 V AC, 3-phase, 50 Hz) and fully equipped with an electric vacuum pump, gas compressor, gas drier, gas filter, refrigeration unit, evaporator, gas storage tank, full instrumentation for measuring vacuum, compressor inlet temperature, tank pressure and temperature, valving and piping to perform the following operations as a minimum requirement:

Evacuation from a gas filled compartment using the vacuum pump,

Transfer of SF6 gas from a system at some positive or negative pressure to the storage tank via the gas drier and filter;

Recirculation of SF6 gas in the storage tank through the drier,

Recirculation of SF6 gas in any switchgear or bus duct compartment through the drier and filter;

Evaporating and filling SF6 gas,

Drawing off and liquefying SF6 gas,

A combination operation of filling SF6 gas into a gas system and evacuating a second, gas system using the vacuum pump.

- c) Adequate length of hoses shall be provided for filling of SF6 gas in any of the gas compartment with the help of gas cart.

5.04.00 SF6 – to –Air bushings

5.04.01 SF6-to-air bushings shall be used for connections between air insulated overhead transmission lines and GIS.

5.04.02 Each bushing should be constructed of commercial-grade porcelain or an acceptable substitute, with all surfaces free from imperfections.

5.04.03 Bushing connections to an overhead line shall be by standard four-hole aluminum pad with connector suitable for ACSR conductor and terminals are suitable specified conductor size.

5.04.04 Each porcelain component or ceramic bushing that has an internal pressure shall comply with relevant IEC

5.04.05 Creepage distance of the bushing surface shall be based on specified creep length

5.05.00 Transformer Connections

5.05.01 Enclosure adapters is to be provided to connect the SF6 bus directly to the HV side SF6-to-oil transformer using, bolting directly to a flange on the bushing, and totally enclosing the insulator and live parts in the SF6 environment.

The adapter should have a removable cover and removable bus link to permit disconnecting the transformer from the bus, testing of the bus or transformer separately, and removal of the transformer, if required.

5.05.02 The bus enclosure is to be insulated from the transformer tank to minimize circulating currents through the transformer tank.

The bus connecting the transformer to the GIS shall also contain bellows assembly and flexible conductor connection to minimize vibration transfer from the transformer.

6.05.03 GIS Contractor shall coordinate the designs of the interface to permit alignment of the bus and the bushing; Necessary drawings from Contractor will be handed over to the successful Contractor

5.06.00 Bus bars And Bus Ducts

5.06.01 The SF6 single-phase/three phase encapsulated bus bars & bus ducts shall be mounted in horizontal/vertical configuration to suit the switchgear layout.

5.06.02 The conductors of the bus bars shall be fabricated of Aluminum/ copper Alloy tubular sections of cross sectional area suitable to meet the current rating requirements.

The tubular bus sections shall be housed in a properly designed aluminum / steel enclosure, filled with pressurized SF6 gas.

- 5.06.03 The conductors shall be supported from the enclosures by homogeneous epoxy resin insulators shaped to ensure uniform electrical field distribution at rated voltage.
- 5.06.04 Adequate provision shall be made for absorption of thermal expansion of the conductors and of differential thermal expansion between the conductors and the enclosures. Metal bellow type compensators with adjustable tensions shall be provided, where required.
- 5.06.05 The enclosures shall be designed to eliminate as much as possible all external effects of the flux created by normal and fault currents.
- The power losses in the system shall be kept to a min. and induced voltages on the enclosures shall not be allowed to exceed reasonable limits of safety for operating personnel. The Contractor shall furnish supporting calculations in respect of induced voltage & losses guaranteed for the enclosure.
- 5.06.06 Bus end connections shall be made with multi-contact connectors to allow for axial thermal expansion of the bus. Enclosure end connections shall be flanged, and shall be fitted with gaskets or O-ring seals to provide an effective gastight joint between sections.
- 5.06.07 The common point of the two busbars should be in a separate enclosure with an earthing switch in order to ensure availability of one busbar in service at all times.
- 5.06.08 Each end of the busbars shall be designed for convenient future extension of the switchgear. Bus conductor end connectors and enclosure flanges shall be designed accordingly.
- 5.06.09 All necessary steel supporting structures required shall be provided for proper erection. The Contractor shall provide leveling and alignment of the busbars and bus ducts.
- 5.07.00 **Current Transformers (CT)**
- 5.07.01 Current transformer shall be ring type and shall be so arranged that the enclosure current does not affect the desired technical parameters. The CTs shall have multi cores with multi ratio, which shall be changeable by means of taps on the secondary side. All Current Transformers shall have effective electromagnetic shields to protect against high frequency transients.
- 5.07.02 The secondary leads of the Current Transformer shall be brought out into the secondary terminal box outside the enclosure. The terminal box shall have sufficient number of terminals with sorting arrangements.
- 5.07.03 It should be possible to test each current transformer without the removal of gas.
- 5.07.04 Tariff Metering core secondary shall be wired to a separate sealable compartment.
- 5.08.00 **Voltage Transformers (VT)**

- 5.08.01 Voltage Transformer shall be inductive type with graded insulation and shall be effectively shielded against high frequency electro-magnetic transient. Special care shall be taken to prevent risk of ferro-resonance, if any, resulting due to interaction of capacities of the switchgears and reactance of the voltage transformers. VT shall be SF6 insulated.
- 5.08.02 Voltage transformers shall 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.
- Alternately, a voltage transformer may be designed so that it does not have to be disconnected during dielectric testing. The metal housing of the transformer should be connected to the metal enclosure of the GIS with a flanged, bolted, and gasketed joint so that the transformer housing is grounded to the GIS enclosure.
- 5.08.03 Special covers and any necessary corona shields shall be supplied so that the system can be pressurized and dielectrically tested after removal of the transformer.
- 5.08.04 Primary and secondary terminals shall have permanent markings for identification of polarity, in accordance with relevant standard.
- 5.08.05 Secondary terminals of the voltage transformer shall be brought out into a terminal box with adequate number of terminals, external to the enclosure.
- 5.08.05 Tariff Metering core secondary shall be wired to a separate sealable terminal box.
- 5.09.00 **Metal-enclosed surge arresters**
- 5.09.01 Outdoor Gapless, zinc-oxide lightning arrestor of suitable rating shall be provided at the overhead line entry terminals and at cable entry terminals to GIS.
- 5.09.02 The contractor shall carry-out insulation co-ordination study to ascertain requirement of additional surge arrestor at any other location like Primary & secondary terminals of Step down transformer, outgoing cable termination, over the Bus within GIS installation.
- 5.09.03 If it is found from the study that additional lightning arresters are required, same shall be provided by the contractor. These shall be of either the "plug-in" construction or the disconnect-link type and be attached to the gas-insulated system in such a manner that they can be readily disconnected from the system while the system is being dielectrically tested. The metal housing of the arrester shall be connected to the metal enclosure of the GIS with a flanged, bolted joint.
- 5.09.04 The ground connection shall be sized for the fault level of the GIS. It shall be insulated from the GIS-enclosure and grounded externally to permit periodic maintenance and monitoring of the leakage current.

- 5.09.05 If the arresters are not equipped with removable links, special covers and any necessary corona shields should be supplied so that the system can be pressurized and dielectrically tested after removal of the arrester.
- 5.09.06 Access to the arrester ground connection, when it is provided with means for leakage current monitoring should not be obstructed.
- 5.10.00 **Capacitor voltage couplers**
- 5.10.01 Suitable capacitive voltage couplers (UHF Coupler) shall be furnished to provide for specialized measurements, such as ultra-high-frequency partial discharge and diagnostic monitoring.
- 5.10.02 Capacitive voltage couplers designed for partial discharge measurements do not normally have to be disconnected from the equipment during high potential testing.
- 5.11.00 **Steel Structures**
- 5.11.01 Contractor shall supply all GIS equipment supporting structures, access ladders / stairway / walkways, transverse and longitudinal beams and supporting members, complete with all necessary hardware. Any temporary scaffolding or a movable platform, required for maintenance, shall also be supplied.
- 5.11.02 All steel structure members shall be hot-dip galvanized after fabrication. Minimum quantity of Galvanising shall be 640 grams per square meter. All field assembly joints shall be bolted. Field welding shall not be acceptable.
- 5.11.03 Non-corrosive metal or plated steel shall be used for bolts and nuts throughout the work. Contractor 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.
- 5.11.04 Foundation channels and anchor bolts shall be installed in the civil works by others in accordance with instructions provided by the Contractor.
- 5.12.00 **Grounding of GIS**
- 5.12.01 GIS will be installed on the floor over structure. The under ground mat below the substation with adequate number of risers shall be done by the contractor. The contractor shall supply the ground rods, risers, electrode etc.
- 5.12.02 The Contractor shall supply entire material for ground bus of GIS such as conductor, clamps, joints, operating and safety platforms etc. to be laid/ embedded in GIS floors. The Contractor is also required to supply all grounding connectors and associated hardware material for:
- i) Connecting all GIS equipment, Bus duct, enclosures, control cabinets, supporting structures etc. to the ground bus of GIS
 - ii) Connecting ground bus of GIS to the ground mat risers.

- 5.12.03 The grounding arrangement of GIS shall ensure safety of the personnel. The enclosures of the GIS shall be grounded at several points such that there shall be a grounded cage around all live parts. The ground continuity between each enclosure shall be affected over flanges, with or without links or straps to bridge the flanges. Copper/Aluminum straps shall however bridge the metallic expansion bellows.
- 5.12.04 Where operating mechanism cabinets are mounted on the switchgear, the grounding shall be made by separate conductor. Bay control cabinets shall be grounded through a separate conductor.
- 5.12.05 All conduits and control cable sheaths shall be connected to the control cabinet grounding bus. All steel structures shall be grounded.
- 5.12.06 Each removable section of catwalk shall be bolted to the support structure for ground continuity.
- 5.12.07 The enclosure grounding system shall be designed to minimize circulating currents and to ensure that the potential rise during an external or internal fault is kept to an acceptable level. The guidelines of IEEE Std. 80-1986 on GIS grounding, especially the transient ground potential rise caused by high frequency phenomena, shall be taken into consideration while designing the grounding system for GIS.
- 5.12.08 The Contractor shall furnish readily accessible connectors of sufficient mechanical strength to withstand electromagnetic forces as well as capable of carrying the anticipated maximum fault current without overheating by at least from two paths to ground from the main ground bus.
- 5.12.09 Provisions of IEC regarding safeguards in grounding of connected cables, testing during maintenance and other safety measures shall be ensured.
- 5.13.00 **Bay control cabinet**
- 5.13.01 Control cabinet
- The Contractor shall furnish one local control cabinet for each bay. Each cabinet shall be completely fabricated, wired, assembled, and tested at the factory. Each cabinet furnished shall be fully equipped and completely wired to the terminal blocks for termination of circuit breaker and switch control instrument transformer leads, indication and gas alarm cables.
- 5.13.02 Cabinet guidelines
- The EPC Contractor shall install a suitable data Acquisition and control system, Relaying & Protection. GIS's local control system shall be compatible with that system.
- 5.13.03 The local control cubicle shall be based on the bay control solutions (BCS). The BCS shall include all required functions for control and supervision of a complete GIS as well as the marshalling of all connections to and from the GIS bays.
- 5.13.04 Safe station operation is ensured through following base functions.

Feeder & station interlocking, depending on the position of all high voltage components with their blocking functionality.

Blocking of commands when crank handle of disconnectors or earthing switches is introduced.

Extensive circuit breaker supervision through "Anti-Pumping", pole discrepancy, Gas density and position supervision of circuit breaker,

- 5.13.05 The bay control mimic shall be the main component of the control cubicle. The features to be included are:

Representation of Single Line diagram / Gas schematic diagram including position indication of all primary components such as circuit breakers, disconnectors, and earthing switches with reliable LEDs

Monitoring & Control of all high voltage switching devices in a bay

Integrated Local/Remote key switch.

Digital Display Of Current, Voltage, Active & Reactive power, frequency.

Alarm unit for feeder alarms e.g. gas alarms, DC & AC supervision.

- 5.13.06 The bay control cubicle shall be fitted with pre wired interface terminal blocks for connection to feeder & station Protection. The interface includes CT & VT inputs for protection & Measuring system, Protection trip 1 & 2 signals, Aux switch contacts etc.

- 5.13.07 Signals for Alarm, control command, status of different components will be interfaced with Data acquisition through Fiber optic cable in IEC 61850 protocol. Necessary provision shall be considered for the same.

5.14.00 Wiring

- 5.14.01 Wiring shall be complete in all respects to ensure proper functioning of the control, protection, and monitoring and interlocking schemes.

- 5.14.02 DC circuit for trip coil 1 & 2 shall be wired separately so as to connect with duplicate DC supply.

- 5.14.03 Wiring shall be done with flexible 1100V grade, fire resistance (FR) PVC insulated, switchboard wires with 2.5 mm² stranded copper conductor. Wiring between individual poles, terminal boxes and control cabinet shall be routed through G.I. rigid conduits.

- 5.14.04 Each wire shall identified at both ends with permanent markers bearing wire numbers as per Contractor's wiring diagram.

- 5.14.05 Wire termination shall be done with crimping type connectors with insulating sleeves. Wires shall not be spliced between terminals.

- 5.14.06 All spare contacts of relays, push buttons, auxiliary switches etc. shall be wired upto terminal blocks in the control cubicle.

- 5.14.07 Terminal blocks shall be 1100V grade, enclosed clamp type with engraved numbers suitable for termination of at least two numbers of 2.5 mm² stranded copper conductor.
- 5.14.08 Not more than two wires shall be connected to any terminal. Spare terminals equal in number to 20% active terminals shall be furnished.
- 5.14.09 Terminal blocks shall be located to allow easy access. Wiring shall be so arranged that individual wires of an external cable can be connected to consecutive terminals.
- 5.14.10 Terminal connectors that carry power supply should be shrouded from adjoining connectors.
- 5.15.00 **Name Plate**
- 5.15.01 Each equipment shall be provided with name plate clearly marked the particulars.
- 5.15.02 The name plate shall be provided in visible portion of normal service and installation.
- 5.16.00 **Finish**
- 5.16.01 Supporting steel structures shall be hot dip galvanized.
- 5.16.02 All equipment shall be finished with a undercoat of high quality primer followed by two coats of synthetic enamel paints unless otherwise indicated.
- 5.16.03 The interior surface finish shall be as per Contractor's standard. The shade of exterior surface finish shall be in accordance with the coloured shade specified in the Annexure. The contractor shall take care of derating if any due to painting and its shade during design.
- 5.16.04 Pretreatment consisting of degreasing, derusting etc. shall be done on all fabricated parts before painting or galvanising.
- 5.16.05 Paints shall be carefully selected to withstand heat and weather conditions. The paint shall not scale-off or crinkles or gets removed by abrasion due to normal handling.
- 5.16.06 Sufficient quantities of all paints and preservatives required for touching up at sites shall be furnished.
- 5.17.00 Not Used.
- 5.18.00 **Installation Work**
- The installation work shall be carried out in accordance with the requirement given in attached Annexure-J.
- 6.00.00 **TESTS**
- 6.01.00 **Routine Tests**

During manufacture and on completion, all equipment shall be subjected to the Routine tests as laid down in IEC 62271-203. Test shall include the following :

- Dielectric test on the main circuit.
- Tests on auxiliary and control circuits.
- Measurement of the resistance of the main circuit
- Tightness test.
- Design and visual checks.
- Pressure tests of enclosures.
- Mechanical operation tests
- Tests on auxiliary circuits, equipment and interlocks in the control mechanism.
- Pressure test on partitions.

6.02.00 Type Tests

6.02.01 Type test certificate, dated not more than five years back, shall be furnished for the offered model of the GIS.

6.02.02 The type tests shall be as per IEC 62271-203 and the report shall include following tests

- Tests To verify the insulation level of the equipment and dielectric tests on auxiliary circuits.
- Tests to prove the radio interference voltage (RIV) level (if applicable).
- Tests to prove the temperature rise of any part of the equipment and measurement of the resistance of the main circuit.
- Tests to prove the ability of the main and earthing circuits to carry the rated peak and the rated short time withstand current.
- Tests to verify the making and breaking capacity of the included switching devices.
- Tests to prove the satisfactory operation of the included switching devices.
- Tests to prove the strength of enclosures.
- Verification of the degree of protection of the enclosure.
- Gas tightness tests
- Electromagnetic compatibility tests (EMC).

- Additional tests on auxiliary and control circuits.
- Tests on partitions.
- Tests to prove the satisfactory operation at limit temperatures.
- Tests to prove performance under thermal cycling and gas tightness tests on insulators.
- Corrosion test on earthing connections (if applicable).
- Tests to assess the effects of arcing due to an internal fault.

6.03.00 Test Witness

6.03.01 Routine Tests shall be performed in presence of Owner/Purchaser's representative if so desired by the Owner/Purchaser. The Contractor shall give at least fifteen (15) days' advance notice of the date when the tests are to be carried out.

6.04.00 Test Certificates

6.04.01 Certified reports of all the tests carried out at the works shall be furnished in required number copies for approval of the Owner/Purchaser.

6.04.02 The equipment shall be dispatched from works only after receipt of Owner/Purchaser's written dispatch clearance & approval of the test reports.

6.04.03 Routine test certificates of bought out components shall be furnished

6.04.04 Type test certificate on any equipment or component if so desired by the Owner/Purchaser shall be furnished. Type test certificates shall not be older than five (5) years from the date of inspection, otherwise the equipment shall have to be type tested, free of charge, to prove the design.

6.05.00 Tests after installation on Site

6.05.01 After installation and before being put into service, the GIS shall be tested in order to ensure correct installation and dielectric integrity of the equipment as laid down in IEC60517 & 62271-203. The Contractor shall furnish a pre-commissioning test plan and a method statement for the tests on site. Test values and test procedures shall be subject to agreement between the Owner/Purchaser and the contractor. Testing equipment shall be provided by the Contractor in addition to testing personnel. Tests shall include the following:

- site installation verification
- Measurement of the resistance of the main circuit.
- Gas tightness tests..
- Gas quality verifications.
- Dielectric tests on auxiliary circuits

- Short duration power frequency withstand test on the main circuits.
- Partial discharge measurement

7.00.00 SPECIAL TOOLS & TACKLES

7.01.00 A set of special tools & tackle, gas manifold, special lifting devices (other than permanently installed EOT crane provided the Owner/Purchaser), which are necessary or convenient for erection, commissioning, maintenance and overhauling of the equipment shall be supplied. In addition, the list shall include following:

- One (1) number portable gas leak detector
- One (1) number hygrometer
- One (1) number portable dust counter
- Five (5) sets of special gas mask for GIS maintenance
- One (1) number vacuum meter
- One (1) number digital contact resistance meter
- One (1) set partial discharge measurement set
- One mobile platform

7.02.00 These shall be shipped in separate containers, clearly marked with the name of the equipment for which they are intended.

8.00.00 DRAWINGS, DATA & MANUALS

8.01.00 Drawings, Data and Manuals shall be submitted in triplicate with the bid and in quantities and procedures as specified in General Conditions on Contract and/or elsewhere in this specification for approval and subsequent distribution after the issue of Letter of Intent.

8.02.00 To be submitted with the Bid

8.02.01 Typical general arrangement drawings of the equipment indicating space requirement, room dimensions, crane capacity etc.

8.02.02 Proposal Technical Particulars, leaflets on equipment and special tools explaining construction features, principle of operation, special features etc.

8.02.03 Type test certificate of the offered model of the GIS for the specified type tests.

8.03.00 To be submitted for Owner/Purchaser's Approval and Distribution

(A) : 'Approval Category'

(R) : 'Reference Category'

- 8.03.01 Guaranteed Technical Particulars (A) & Quality assurance plan.(R)
- 8.03.02 Dimensional general arrangement drawing showing disposition of various fittings, (A)
- 8.03.03 Calculation on GIS enclosure Voltage rise (A)
- 8.03.04 Calculation for Surge Protection (A)
- 8.03.05 Structure Plan with details and loading. (R)
- 8.03.06 Foundation loadings for all GIS equipment and supporting structure (R)
- 8.03.07 Assembly drawing for erection at site with part numbers and schedule of materials Transport/shipping dimensions with weights (R)
- 8.03.08 Control schematic (A) and wiring diagrams (R).
- 8.03.09 Gas schematic Diagram (A)
- 8.03.10 Grounding arrangement and ground bus details (A) including Contractor's recommendation on Grounding of reinforcement bars of Column foundation.
- 8.03.11 Any other relevant drawing or data necessary for satisfactory installation, operation and maintenance.
- 8.03.12 Instruction manuals on GIS and its accessories (R)
- The manual shall clearly indicate method of installation, check ups and tests to be carried out before commissioning of the equipment.
- 8.04.00 The drawings and documents marked with (A) above are of 'Approval' category and are subject to review by Owner/Purchaser. Those marked (R) are for 'reference' category.
- The Owner/Purchaser may review the documents marked (R) if thought necessary. The contractor shall note that the approval of drawings & documents by the Owner/Purchaser does not relieve him of his contractual obligation.
- 8.05.00 The bidder may note that the drawings, data and manuals listed herein are minimum requirement only. The bidder shall ensure that all other necessary write-up, curves, etc require to fully describe the equipment are to be submitted with the bid.
- 8.06.00 All drawings shall be prepared by using Auto CAD and documents shall be generated using Electronic version. The paper copy of the drawings & document shall be submitted for approval & reference. All final drawings and documents shall be submitted in CD in AutoCAD 2005 and MS office format as applicable for Owner/Purchaser's future reference. Also AutoCAD version of Main GA drawings is to be submitted for Owner/Purchaser's layout finalization.

ANNEXURE-A
SYSTEM DETAILS

- 1.0 EHV System
 - 1.1 Rated Voltage : 400KV
 - 1.2 Frequency : 50 Hz $\pm$ 5%
 - 1.3 Phase : 3
 - 1.4 System Neutral Earthing : Effectively Earthed
 - 1.5 Fault Level (Sym.) : 40 KA rms
- 2.0 Auxiliary Power Supply
 - 2.1 A.C. Supply : 415V $\pm$ 10%, 3 phase, 50 Hz $\pm$ 5%, 4 wire, effectively earthed system. Fault level 50 KA r.m.s symm.
 - 2.2 D.C. Supply system. : 220V+10%,-15%, 2 wire, ungrounded
Fault level 25 KA.
- 3.0 Supply Point
 - 3.1 Auxiliary power supplies listed above will be made available to each circuit breaker as below: -
 - A.C. Supply : Single feeder
 - D.C. Supply : Duplicate feeder
 - 3.2 MCCB shall be provided at the circuit breaker for receiving each incoming supply.

ANNEXURE-B

RATINGS & REQUIREMENTS

1.0	GIS SWITCHGEAR		
1.1	Reference standard	:	IEC62271-203, IEC62271-1
1.2	Type of design		
	Construction	:	Metal enclosed, 3-1Phase SF6 gas filled, isolated design
	Enclosure	:	Aluminum alloy , grade 63401
	Conductor	:	Aluminum alloy , grade 19501
1.3	Service	:	Indoor / Outdoor
1.4	Rated Voltage	:	400.KV rms
1.5	Phase	:	Three
1.6	Rated Frequency	:	50 Hz
1.7	System grounding	:	Effectively Earthed
1.8	Design ambient temperature	:	50°C
1.9	Rated continuous Current at design ambient temperature		
	Bus bar	:	2000A
	Line/transformer/bus coupler feeders	:	2000./2000./2000 A
1.10	Temperature Limit		
	Conductor	:	105 °C
	Enclosure	:	80°C (70 °C for accessible portion)
1.11	Short Circuit Rating		
	Rated short time withstand current	:	40KA rms
	Duration	:	3 Sec.
1.12	Rated peak withstand current	:	2.5 x rated short time current

1.13	Insulation level		
	a) Rated one minute power Frequency withstand voltage	:	
	Phase- Phase		650KV (r.m.s)
	Phase- Earth		650KV (r.m.s)
	b) Rated Lightning impulse withstand voltage	:	
	Phase- Phase		1425KV (peak)
	Phase- Earth		1425KV (peak)
	c) Rated switching impulse withstand voltage	:	
	Phase- Phase		1575KV (peak)
	Phase- Earth		1050KV (peak)
1.14	SF6 gas		
	Characteristic	:	As per IEC62271-100
	Leakage rate	:	less than 0.5% per year
1.15	AC/DC Power Supply		
	Rated Control voltage	:	220V DC (190V - 242 V)
	Service voltage	:	240V, 1 Ph, 50 Hz
1.16	Termination details		
	Line feeder	:	Gas to air bushing
	Transformer feeder	:	Gas to oil bushing /Gas to air bushing (as applicable)
1.17	Painting		
	Internal surface	:	as per manufacturer's practice
	External surface		
	a) base Epoxy / enameled	:	as per manufacturer's practice
	b) Paint shade No. as per IS	:	
	Indoor portion & Outdoor portion	:	
1.18	Support structure	:	Galvanized steel

2.0 CIRCUIT BREAKER

- | | | | |
|-----|-------------------------------------|---|--|
| 2.1 | Reference Standard | : | IEC 62271-100, IEC62271-203, IEC60694 |
| 2.2 | Type | : | SF6 gas-insulated type. |
| 2.3 | P o l e | : | 3 |
| 2.4 | Rated Voltage | : | 420 KV rms |
| 2.5 | Rated Frequency | : | 50 Hz |
| 2.6 | Mechanical Endurance Class | : | M1 |
| 2.7 | Electrical Endurance Class | : | E1 |
| 2.8 | Re-strike Probability Class | : | C1 |
| 2.9 | Electromagnetic Compatibility (EMC) | : | Normal EMC Severity lass as per IS 12729/ IEC62271-1 |

2.10 Rated Insulation Level

a) Rated one minute power frequency withstand voltage

- | | | |
|--------------------------|---|----------|
| - between phase to earth | : | 650KVrms |
| - between phase to Phase | : | 650KVrms |
| - Across open contacts | : | 815KVrms |

b) Rated Lightning Impulse withstand voltage

- | | | |
|--------------------------|---|------------------|
| - between phase to earth | : | 1425KVpeak |
| - between phase to Phase | : | 1425KVpeak |
| - Across open contacts | : | 1425+(240)KVpeak |

The value in brackets are the peak value of the power frequency voltage $0.7 U_r \times \sqrt{2}/\sqrt{3}$ applied to the opposite terminal (combined Voltage)

c) Rated Switching Withstand Voltage

- | | | |
|-----------------------------|---|-----------------|
| - between phase to earth | : | 1050KVpeak |
| - between phase to phases | : | 1575KVpeak |
| - Across open contacts | : | 1050KVpeak |
| - Across isolating distance | : | 900+(345)KVpeak |

The value in brackets are the peak value of the power frequency voltage $U_r \times \sqrt{2}/\sqrt{3}$ applied to the opposite terminal (combined Voltage)

2.11	Max. radio interference voltage at $1.1 U_{rated}/\sqrt{3}$	:	<1000.Micro-Volts
2.12	Rated continuous current at design ambient temperature	:	2000 Arms
	Line/Trafo/ /Bus coupler	:	2000./2000/2000.Arms
2.13	Temperature rise over Design Ambient Temperature	:	As per IS/IEC duly adjusted for site condition.
2.14	Rated Short-circuit breaking current		
	- Symmetrical	:	40KArms
	- Percentage D.C. component	:	As per IEC62271-100
2.15	Rated short-circuit making current	:	2.5 X Symmetrical Current kA peak
2.16	Rated short time withstand current	:	40KArms
2.17	Rated duration of rated short time withstand current.	:	3 Sec.
2.18	Rated line charging breaking current	:	400Arms
2.19	Rated cable charging breaking current	:	400Arms
2.20	Rated Out of phase breaking current In % of rated Short Ckt. Breaking current	:	25%
2.21	Rated Out of phase making current In % of rated out of phase breaking current	:	Crest value of the rated out of phase breaking current. (As per IEC -62271-100)
2.22	Characteristic for short-line fault related to rated short-circuit breaking current	:	.As per IEC-62271-100
2.23	Rated capacitive switching breaking (Arms) / in rush making current (KA peak)	:	400Arms/20KApeak

2.24	TRV Characteristics	:	As per IEC-62271-100
2.25	Inductive current breaking capability without exceeding over-voltage by 2.0p.u	:	Interruption of steady and transient magnetizing currents of connected transformers and reactors
2.26	First pole to clear factor	:	As per IEC-62271-100-
2.27	Operating mechanism	:	<u>Spring Charged</u>
2.28	Opening time (ms)	:	Not more than 40
2.29	Closing time (ms)	:	Not more than 100
2.30	Rated Operating Sequence	:	0 - 0.3s-CO-3m-CO (for line breakers) CO-15s-CO (for transformer breakers)
2.31	Rated Supply Voltage and frequency for		
	- Closing & Tripping	:	220 V D.C
	- Heater/Lamp/Socket	:	240V, 1 Ph, 2W , 50Hz
2.32	Nos. of trip coil per pole	:	2
2.33	Minimum Creepage distance	:	31mm/kV
2.34	Noise level Dbat the base of CB	:	less than 85db
3.0	DISCONNECTING SWITCH		
3.1	Reference standard	:	IEC62271-102, IEC62271-203
3.2	Type	:	
3.3	Pole	:	3
3.4	Rated voltage	:	420kV rms
3.5	Rated Frequency	:	50Hz
3.6	Rated Insulation Level		
	a) Rated one minute power frequency withstand voltage		
	- between phase to earth	:	650KVrms
	- between phase to Phase	:	650KVrms

- Across open contacts : 815KVrms
- b) Rated Lightning Impulse withstand voltage
 - between phase to earth : 1425KVpeak
 - between phase to Phase : 1425KVpeak
 - Across open contacts : 1425+(240)KVpeak

The value in brackets are the peak value of the power frequency voltage $0.7 U_r \times \sqrt{2}/\sqrt{3}$ applied to the opposite terminal (combined Voltage)

- c) Rated Switching Withstand Voltage
 - between phase to earth : 1050KVpeak
 - between phase to phases : 1575KVpeak
 - Across open contacts : 1050KVpeak
 - Across isolating distance : 900+(345)KVpeak

The value in brackets are the peak value of the power frequency voltage $U_r \times \sqrt{2}/\sqrt{3}$ applied to the opposite terminal (combined Voltage)

- 3.7 Rated Continuous current at design ambient temperature : 2000Arms
- 3.8 Rated Short time current for 3secs : 40KA rms
- 3.9 Rated peak Withstand current KA peak : 2.5 X Rated short time current
- 3.10 Magnetising & capacitive current Make & brake ability : Bidder to finalized
- 3.11 Operating Mechanism : Motor Operated and Manual.
- 3.12 Operating voltage : 220V DC
- 4.0 MAINTENANCE GROUNDING SWITCH
- 4.1 Reference standard : IEC62271-102
- 4.2 Type :
- 4.3 Pole : 3
- 4.4 Rated Insulation Level

- a) One Minute Power Frequency

	Withstand Voltage	:	650.KVrms	
	b) Rated Lightning Impulse Withstand Voltage	:	1425Vpeak	
	c) Rated Switching Impulse Withstand Voltage	:	1050.KVpeak	
4.5	Rated Short time current for 3secs	:	40 KA rms	
4.6	Rated Peak Withstand current KA peak	:	2.5 X Rated short time current	
4.7	Inductive & Capacitive current switching ability	:	Bidder to decided	
4.8	Operating Mechanism	:	Motor Operated and Manual.	
4.9	Operating voltage	:	220V DC	
5.0	FAST ACTING GROUNDING SWITCH			
5.1	Reference standard	:	IEC62271-102	
5.2	Type operated	:	Electrically/mechanically	gang
5.3	Pole	:	3	
5.4	Rated Insulation Level			
	a) One Minute Power Frequency Withstand Voltage	:	650KVrms	
	b) Rated Lightning Impulse Withstand Voltage	:	1425.KVpeak	
	c) Rated Switching Impulse Withstand Voltage	:	1050KVpeak	
5.5	Rated Short time current for 3secs	:	40 KA rms	
5.6	Rated Peak Withstand current KA peak	:	2.5 X Rated short time current	
5.7	Inductive & Capacitive current switching ability	:	Bidder to finalized	
5.8	Operating Mechanism	:	Motor Operated and Manual.	
5.9	Operating voltage	:	220V DC	

6.0 CURRENT TRANSFORMER

- | | | | |
|-----|--|---|---|
| 6.1 | Reference Standard | : | IEC60044-1 |
| 6.2 | Type | : | Ring type |
| 6.3 | Rated continuous thermal Current | : | 120% of rated primary current |
| 6.4 | Rated Insulation Level | | |
| | a. 1 minute 50 Hz withstand voltage | | |
| | o HV terminal & earth | : | 630KVrms |
| | o Secondary winding | : | 3 KVrms |
| | b. Impulse withstand voltage | : | 1425KVpeak |
| | c. Switching impulse withstand voltage | : | 1050KVpeak |
| 6.5 | Short time current | | |
| | a) Short-time current for 3sec | : | 40KArms |
| | b) Dynamic current | : | 2.5 times rated short time thermal current KApeak |

6.6 C.T. Ratios & Parameters :

Core No	Description	Current Ratio A/A	Output Burden VA	Acc. Class	ISF	Min. Knee-point voltage V_K (volt) at highest ratio KPV	Max Excitation Current I_e (mA) at KPV	Max CT Sec. Resistance R_{CT} (ohm) at highest ratio							
Feeder type : Line Feeder															
CT-1															
Core-1	Main-I Distance Protection	To be decided the bidder with back up calculation. AS PER SLD													
Core-2	Main-II Distance Protection, Bkr. Failure * Directional O/C & E/F														
Core-3	Tariff metering.														
CT-2															
Core-1	Metering.														
Core-2	Bus Differential/ Check Bus differential														
Core-3	Misc. Relaying														
Feeder type : Generator Transformer Bay															
CT-1															
Core-1	Bus Differential/ Check Bus Differential	To be decided the bidder with back up calculation. AS PER SLD													
Core-2	Spare														
Core-3	Spare														
CT-2															
Core-1	Overall Differential (Gen, GT & UT)														
Core-2	Bkr. Failure. Failure Back Up O/C & E/F														
Core-3	Metering														
Feeder type : Station transformer Bay															
CT-1															
Core-1	ST Differential	To be decided the bidder with back up calculation.													
Core-2	Bkr. Failure. Failure Back Up O/C & E/F														
Core-3	Metering														

CT-2		
Core-1	Bus Differential/ Check Bus Differential	
Core-2	Spare	
Core-3	Spare	

7.0 VOLTAGE TRANSFORMER

- 7.1 Reference standard : IEC60044-2
- 7.2 Type : Inductive type with graded insulation
- 7.3 Insulation Level
- a. 1 minute 50 Hz withstand voltage
- o Main circuit : 630KVrms
 - o Secondary circuit : 3KVrms
- b. Impulse withstand voltage : 1425KVpeak
- c. Switching impulse withstand voltage : 1050KVpeak
- 7.4 Voltage ratio & other parameters :

	Secondary - I	Secondary - II	Secondary - III
Voltage Ratio	$\frac{400KV}{\sqrt{3}} / \frac{110V}{3}$	$\frac{400KV}{\sqrt{3}} / \frac{110V}{\sqrt{3}}$	$\frac{400KV}{\sqrt{3}} / \frac{110V}{\sqrt{3}}$
Application	Protection	Synchronization	Metering
Output burden VA	200	200	200
Accuracy Class*	3P	0.2S	0.2S

(* within frequency variation range)

- 7.5 Voltage factor : 1.5 times rated primary voltage for 30 sec.
- ## 8.0 GAS TO AIR BUSHING
- 8.1 Reference standard :
- 8.2 Type : composite (polymer)
- 8.3 Rated continuous current at Site condition : 2000Arms
- 8.4 Insulation Level
- a. 1- minute 50 Hz withstand voltage : 650.Kvrms
- b. Impulse withstand voltage : 1425KVpeak

c.	Switching impulse withstand voltage	:	1050KVpeak (Phase to Earth) 1575KVpeak (Phase to Phase)
8.5	Minimum Creepage distance	:	31mm/Kv
9.0	CONNECTION		
9.1	Line termination details	:	Bidder to finalized
9.2	Cable termination details	:	Bidder to finalized
9.3	Transformer termination details	:	Bidder to finalized

19.00.00 TRAINING OF OWNER'S PERSONNEL

The Contractor shall extend all possible assistance and co-operation to the Purchaser regarding the transfer of technology and developing expertise in the area of engineering operation and maintenance of the ~~Plant~~ **GIS**.

Number of man-days of training as mentioned below shall ~~be included in~~ his Tender.

19.01.00 Training at Contractor's Premises

The Contractor shall conduct training of sixty (60) engineers of the Owner on engineering, operation and maintenance of the Plant at the Contractor's or Associates or Sub-contractor's premises where adequate training facilities are available during the design and manufacturing stage of the Contractor.

The total man-months for training of engineers shall be maximum sixty (60), having following indicative break-up :

Discipline	No. of Engineers	No. of Man-month
Operation	20 heads	20
Maintenance Boiler, Turbine, Mechanical	20 heads	20
Electrical Maintenance	8 heads	4
Control & Instrumentation	8 heads	4
Maintenance Planning	4 heads	2
	<u>60 heads</u>	<u>60</u>

However, the details of the training programme will be discussed and finalised with the successful Bidder.

The training may also be arranged by the Contractor in any Plant where the equipment manufactured by the Contractor or his Associates is under installation, operation or testing to enable the trainees to become familiar with the equipment being furnished by the Contractor. All expenses inherently related to the training shall be borne by the Contractor and shall include but not limited to travel expenses (international and inland fares), lodging and per diem charges as well as medical insurance, instructors fee, programme and miscellaneous cost to be incurred during the training.

The training programme shall be adequate for the trainees to acquire the necessary expertise and competence in the area of engineering, operation and maintenance and as trainers for in-house technology transfer programme of the Purchaser.

The Contractor shall be responsible for the development of the Training Module and Programme Schedule which shall be submitted to the Purchaser for approval.

The components of the training modules shall include but not be limited to the training procedures/methodology, instructional materials such as audio visual materials, CDs and slides and manuals for each trainee.

Three (3) sets of the materials included in the training modules shall be handed over to the Purchaser upon completion of the training. An evaluation shall be jointly undertaken by the Contractor and the Purchaser's representative on the adequacy, appropriateness and relevance of the training and the programme effectiveness after the training. The training material shall be in English language only.

The content of the training programme shall include but not be limited to :

1. ~~Coal-fired thermal plant principles in management and practice for operators, technicians and maintenance personnel.~~
2. ~~Plant operation and systems training for operators including simulator training as applicable.~~
3. ~~Maintenance training programme covering electrical, mechanical and instrumentation and control.~~

Said training programme shall be submitted to the Purchaser for approval.

The timing of the training should be such that the participants will be conversant with sufficient know-how to participate in the pre-commissioning and commissioning tests of the Plant.

The Contractor shall provide qualified English speaking instructors and training coordinator(s) during the tenure of the training programme.

19.02.00 Operation and Maintenance Training at Site

The Contractor shall provide a comprehensive training programme related to design application, plant management, operation and maintenance, including trouble shooting, of the Contractor's supplied system and equipment at the Site starting from Start of Commissioning and thereafter up to the Final Acceptance of the first Unit.

The following instructors shall be at the Site continuously during the training :

- a) One (1) for Steam Generator and Auxiliaries ;
- b) One (1) for Turbine Generator and Auxiliaries ;
- c) One (1) for Electrical Works ;
- d) One (1) for Instrumentation and Control (Boiler and Auxiliaries) ;
- e) One (1) for Instrumentation and Control (Turbine and Auxiliaries).

19.03.00 **On-the-Job Training**

During the period of pre-commissioning, commissioning and trial operation, the Purchaser shall provide operation and maintenance personnel to assist the Contractor in the operation and maintenance of his supply and work under the direction of the Contractor for the purpose of on-the-job training.

The Purchaser shall have the right to send to the Site his employees later intended to operate and maintain the equipment supplied under this Contract. The Contractor shall, without additional cost, use his site staff to instruct these employees on the operation and maintenance of the equipment. All instructions shall be in the English language.

20.00.00 **DEVIATIONS**

~~The Bidder is required to submit with his proposal in the relevant schedules a detail list of any and all deviations taken by him clearly without any ambiguity. In the absence of such a list it will be understood and agreed that the Bidder's proposal is based on strict conformance to this specification and no post-contract negotiations would be allowed in this regard.~~

~~Unless otherwise specifically indicated in the deviation list, it will be construed and agreed that details indicated in documents & drawings furnished by the Bidder along with the offer is in-line with the specification requirement.~~

SECTION-3

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, equipments and services covered under other respective sections 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 hold good.

3.1 PROJECT INFORMATION AND SYSTEM PARAMETERS

a)	Customer/ Purchaser/ Owner	Gujrat State Electricity Corporation Ltd. Vadodara
b)	Consultant	Development Consultants Pvt. Ltd., Kolkata - 700 091
c)	Project Title	400kV Switchyard Extension and 400 kV Switchyard for GIS for 1x800 MW Supercritical Thermal Power Project
d)	Location	Wanakbori is connected with roads by the National Highway, NH-8 (about 10 km from plant -Dakor-Godhra) and state highway SH-59 (about 2 km from plant -Balasinor- Sevalia). Wanakbori is connected with railways by Ahmedabad- Vadodara main Broad Gauge line of Western Railway (about 8 km from Sevalia). Nearest Airports are Vadodara at distance of 85 Km from site and Ahemedabad at a distance of 100 Km from the Site.
e)	Elevation above MSL	72.0 meters
f)	Transport Facilities	Road/Rail, Nearest railway station is Sevalia. Nearest Airports are Vadodara at distance of 85 Km from site and Ahemedabad at a distance of 100 Km from the Site.
g)	Postal Address	To follow
METEOROLOGICAL DATA OF SITE IS GIVEN BELOW		
a)	Max. daily average temp	34 °C
b)	Min. daily average temp	11.7 °C
c)	Max. Ambient air temp. (daily)	34°C
d)	Max. Ambient air temp. (yearly)	30°C
e)	Max. Ambient air temp.	42°C
f)	Wet bulb temperature	28°C
g)	Design ambient temp. for all electrical equipment	50°C
h)	Wind Design	Basic Wind Speed, Vb = 39m/s
i)	Pollution Severity	Highly Polluted
j)	Seismic Criteria	III
k)	Relative Humidity	100%

l)	Average annual rainfall	750 mm
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SITE PROFILE

Location	Wanakbori, District-Kheda, Gujarat
Access by – nearest railway station	Ahmedabad – Vadodara Main Broad Gauge line, Sevaliya (8 KM)
Nearest Airport	Ahmedabad and Vadodara
Nearest sea port	Kandla
Access by Road	10KM from Godhra NH No.8; 02 KM from Balasinor-Sevaliya SH No.59
Major Towns / Cities	13KM from Balasinor and 10KM from Sevaliya
Availability of Land	Within existing Thermal Power Station
Latitude	22° -52'N
Longitude	73° -21'E
Altitude	80Meters from mean sea level for existing Units 70Meters from mean sea level for 800MW Unit 8

3.2 EVACUATION OF POWER

For evacuation of power through outgoing line feeders, 400 KV transmission lines established by GETCO between the proposed power plant and existing 400 KV substation of GETCO. The interface point between this switchyard and 400 KV transmission lines of GETCO will be at the take off gantry structures inside the switchyard fence.

Following title block shall be included in all documents for submission

3.4 SYSTEM PARAMETERS

Nominal system voltage	400 kV
Highest system voltage	420 kV
Rated lightning impulse withstand voltage	a) ± 1425 kVp between live terminals and earth. b) ± 1665 kVp impulse on one terminal and other terminal earthed (across isolating distance).
Rated one minute power Frequency withstand voltage	630kVrms
Rated switching impulse withstand voltage	1050 kVp (Phase to earth) 1575 kVp (Phase to Phase)
Corona extinction voltage	320 kV
Frequency	50 Hz
Rated short time withstand current capacity	40 kA for 3 sec
Creepage distance	31mm/kV
System Earthing	Effectively Earthed

3.5 AUXILIARY POWER SUPPLY

3 phase A.C power supply	415V, 50 Hz, 3-phase 4 wire, solidly earthed with variation in frequency of +3/-5% and variation in voltage +/-10%. For motors above 200W up to 160 KW. Fault level 50 KA symm.
1 phase A.C power supply	240V, 50 Hz, 1-phase, 2 wire, AC supply with variation in frequency of +/-5% and variation in voltage +/-10%. For motors up to 200W, Lighting, space heating, A. C. control & protective devices.
D.C. power supply	220V(variation from 190V to 240V) , 2-wire ungrounded 50V, 2 wire system (+) earthed. D.C. Supply Voltage : 187 to 242 Volt for 220VDC. For D.C. alarm, control & protective devices. Fault level 25* KA (Minimum) * Indicative only; the actual value will be decided by the bidder, after substantiating the same by calculation.
Combined variation of voltage and frequency for AC supply shall be +/- 10%	

3.6 GENERAL CONDITIONS

3.6.1 NAME PLATES (RATING PLATES)

Instruction plates, name plates or labels shall be permanently attached to each main and auxiliary item of plant in a conspicuous position. These plates shall be engraved with the identifying name, type and manufacturers serial number, together with the loading conditions under which the item of plant has been designed to operate.

Items such as valves, etc. which are subject to hand operation, shall be provided with nameplates so constructed as to remain clearly legible throughout the life of the plant giving due consideration to the difficult climatic conditions to be encountered. Nameplates shall be securely mounted where they will not be obscured in service by insulation, cladding, actuators or other equipment. Direction of flow is also to be engraved.

All trade nameplates and labels shall be in English language. All The size and location of nameplates shall be subject to approval of the Engineer.

3.6.3 Latent Defects:

Notwithstanding the issue of the Take Over Certificate, the Contractor shall be responsible for making good with all possible speed any Latent Defect in any Works /equipment of the plant which appears at any time before the expiry of defect liability period. And shall remedy such defect at its own cost and expense. The latent defect liability period shall be a minimum of 5 years from the end of defect liability period. The defects to which this applies are defects in design, materials or workmanship or defects arising from any act or omission of the Contractor done or omitted prior to Take-over of the portion of the Plant affected by the defects or during the Warranty Period which a reasonable examination at the end of the Warranty Period would not have disclosed.

3.8 OPERATION, MAINTENANCE & AVAILABILITY CONSIDERATIONS

- 3.8.1 Equipment/works offered shall be designed for high availability, high reliability, low maintenance and ease of operation & maintenance. The Bidder shall specifically state the design features incorporated to achieve high degree of reliability, availability, operability and ease of maintenance. He shall also furnish details of availability records in plants stated in his experience list.
- 3.8.2 Ample space for ease of operation and maintenance including equipment removal, tube bundle/cartridge/rotor pulling etc. shall be provided. All valves, gates, dampers and other devices shall be located and oriented in such a way that they are accessible from operating floor levels. Where this cannot be adhered to, platforms and walkways with access ladders shall be provided to facilitate operation and maintenance.
- 3.8.3 Motorized lifting devices, i.e. hoists, chain pulleys, jacks, etc. shall be provided for handling and carrying out maintenance of any equipment and/or part having weight in excess of 3000 Kg. Suitable beams, hooks etc. for this purpose shall be provided in the buildings. No lifting arrangement is necessary for part having weight less than 500 Kg. Hoist shall be well protected by environment. Suitable painting and coating covering hoist at outdoor shall be provided. Lifting devices like lifting tackles, slings, etc. to be connected to hook of the hoist/crane shall be provided by the Bidder for lifting the equipment, accessories covered under this specification.
- 3.8.4 All similar parts of the equipment shall be made to gauge and shall be interchangeable with and shall be made of same material and workmanship as the corresponding parts of the equipment. Where feasible common components shall be employed in different pieces of equipment in order to optimize the spares inventory and utilization.

3.9 MATERIALS

- 3.9.1 In selecting materials of construction of equipment, the Contractor shall pay particular attention to the atmospheric conditions existing at the Site and the nature of material/fluid handled. Wherever deviations are taken in respect of materials specified, the reasons shall be spelt out clearly in the proposal.
All materials shall be new, and shall be of the quality most suited to the proposed application.
- 3.9.2 In as far as is possible; materials shall be in accordance with Indian or international standard specifications and shall be used in accordance with Indian or international codes of practice. Where such standards or codes of practice are not available sufficient information shall be provided to allow the Engineer to assess the suitability of the material for the particular application. All materials used shall have performed lengthy satisfactory service in similar or more arduous conditions to those proposed by the Contractor.

All parts which could deteriorate or corrode under the influence of the atmospheric,

meteorological or soil conditions at the Site, or under the influence of the working conditions shall be suitably and effectively protected so that such deterioration or corrosion is a minimum over the life of the plant.

- 3.9.3 Spare parts for equipment shall be interchangeable with the original components and, so far as possible, be of common design and manufacture.
- 3.9.5 All similar standard components/parts of similar standard equipment provided shall be interchangeable with one another. Further identical equipments shall be provided for similar duties so that the same are interchangeable with one another in totality and component wise.
- 3.9.6 All heavy parts (500 Kg and above) must be provided with a convenient arrangement for slinging and handling during erection and overhaul. Any item of plant normally stripped or lifted during periods of maintenance and weighing one tonne or above, shall be clearly marked with its weight.

3.10 PACKAGING & MARKING

All the equipment shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at site till the time of erection. While packing all the materials, the limitations from the point of view of availability of railway wagon sizes in India should be taken account of. The details of various wagons normally available with Indian Railways for transportation of heavy equipment shall be considered by the Bidder. The Contractor shall be responsible for all loss or damage during transportation, handling and storage due to improper packing. As per the information available, the dimensions of OD consignment for transportation of the equipment by rail (if any equipment to be handled through rail transportation) are as below:

- a) Width of the Package: 3.2 Meters (from centre-line of rails- 1.6 meters on both sides)
- b) Height of the package from rail top: 4.47 Meters

The above indicates the dimensions which can be normally transported on the wagons without infringement of the "moving gauge". This is however not indicative of the consignment which can be carried out with infringement of "moving gauge" duly authorized and approved by the Indian Railways. There may be difference between the "moving gauge" and the "fixed structure gauge" and consignments infringing the "moving gauge" can be moved after investigation regarding possible infringement with the fixed structures. As the critical fixed structures in each route are different, consignments infringing moving dimensions have to be individually investigated to select a route and also determine the restrictions under which such movement is to be carried out. Such routes selected or other mode of transport envisaged is to be clearly brought out in the proposal wherever transport of over dimensional equipment is involved.

Bidder to consider unloading of material delivered through rail transportation, at near by railway station/site unloading siding. The subsequent transportation up to project work place shall be considered by road only. All unloading and handling equipment both at railway station siding and at project

site shall be arranged by the Bidder. Necessary arrangement to be organized with the railway authority for such purpose shall also be under the scope of services if the Bidder. Bidder may

consider entire material delivered up to site through rail transportation only. The identification marking indicating the name and address of the consignee shall be clearly marked in indelible ink on two opposite sides and top of each of the packages. In addition the Contractor shall include in the marking gross and net weight, outer dimension and cubic measurement. Each package shall be accompanied by a packing note (in weather proof paper) quoting specifically the name of the Contractor, the number and date of contract and names of the office placing the contract, nomenclature of contents and Bill of Material. For imported equipment and material, suitable port facilities may be used in which case material may be transported from the port by tractor-trailer. Bidder may consider this aspect.

3.11 PROTECTION

Equipment having antifriction or sleeve bearings shall be protected by weather tight enclosures. Coated surfaces shall be protected against impact, abrasion, discoloration and other damages. Surfaces that are damaged shall be repainted.

Electrical equipment, controls and insulations shall be protected against moisture and water damages. All external gasket surfaces and flange faces, couplings, rotating equipment shafts, bearings and like items shall be thoroughly cleaned and coated with rust preventive compound as specified above and protected with suitable wood, metal or other substantial type covering to ensure their full protection. All exposed threaded parts shall be greased and protected with metallic or other substantial type protectors.

All piping, tubing and conduit connections on equipment and other equipment openings shall be closed with rough usage covers or plugs. Female threaded openings shall be closed with rough usage covers or forged steel plugs. The closures shall be taped to seal the interior of the equipment. Open ends of piping, tubing and conduit shall be sealed and taped. Returnable containers and special shipping devices shall be returned by the manufacturer's field representative at the Contractor's expense.

3.12 PAINTING

3.12.1 GENERAL

All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. Surfaces not easily accessible after shop assembly shall be treated before-hand and protected for life of the equipment. Surfaces to be finish painted after installation shall be shop painted with at least

two (2) coats of primer. Steel surfaces, which are not to be painted, shall be coated with suitable rust preventive compound subject to the approval of the Owner. All paints shall be used in accordance with the manufacturer's instructions. No thinners or other substance shall be added to the coating material without the approval of the Engineer. The quality and vendor of the paints shall require approval of the Owner.

All paints, when applied in a normal full coat, shall be free from runs, sags, wrinkles, patchiness, brush marks or other defects.

All primers shall be well marked into the surface, particularly in areas where pitting is evident, and the first priming coat shall be applied as soon as possible after cleaning, within four hours

maximum. The paint shall be applied by brush, roller or airless spray, according to the manufacturer's instructions. Spray

painting shall be carried out by operators trained and thoroughly experienced in the use of the equipment. If the drying interval between successive coats, which should not exceed one week, has been so long as to endanger the adhesion of the following coat, the paint already applied shall be lightly rubbed down with fine abrasive paper before putting on the next coat. Paint spraying on large surfaces shall not normally be done indoors, except with the approval of the Engineer.

Spray guns shall not be used outdoors in

windy weather or near unprotected surfaces of a contrasting color and under no circumstances shall spray guns be used where spray may be carried into or onto exposed electrical equipment. Paint containers shall not be opened until required and the paint shall be mechanically mixed thoroughly before use, and agitated occasionally during use. Electrical equipment shall be shop finished with one or more coats of primer and two coats of high-grade oil resistant enamel. The interior of all panels' cabinets and enclosures shall be finished with gloss white enamel.

The Contractor shall furnish sufficient touch-up paint for one complete finish coat on all exterior factory surfaces of each item of equipment. The touch-up paint shall be of the same type and colour as the factory applied paint and shall be carefully packed to avoid damage during shipment. Complete painting

instructions shall be furnished. Shop primer for steel and iron surfaces which will have a continuous operating temperature below 35 Deg.C shall be selected by the Contractor, in accordance to the relevant standard. Special high temperature primer shall be used on surface exposed to operating temperature above 35 Deg.C. The colour scheme shall be submitted during execution of contract for approval by the Purchaser/Engineer.

3.12.2 PREPARATION

Oil and grease shall be removed from the surface by washing with a suitable detergent, rinsing with clean water, and drying. Surfaces to be shot blasted shall be cleaned to Swedish Standard SA 2.5 or equivalent, and all dust remaining after cleaning shall be removed. The priming coat shall be applied without delay.

3.12.3 DAMAGED PAINTWORK

Any damaged paintwork shall be made good as follows:

- a) The damaged area, together with an area extending 25mm around its boundary, shall be cleaned down to bare metal.
- b) A priming coat shall be immediately applied, followed by a full paint finish equal to that originally applied and extending 50mm around the perimeter of the original damage.
- c) The repainted surface shall present a smooth surface. This shall be obtained by carefully chamfering the paint edges before and after priming.

3.12.4 PAINTING SYSTEMS

The requirements for the dry film thickness (DFT) of paint and the materials to be used shall be as stated below, unless otherwise specified elsewhere in this specification.

- a) Surfaces Subject To Weathering

All surfaces shall have a minimum of four coats of paint made up as follows:

Primer coat: 35 micron DFT

Tie coat: 35 micron DFT
Finishing coat (2 Nos.): 35 micron DFT per coat
The total minimum DFT shall be 140 micron.

b) Surfaces Inside Buildings

All surfaces shall have a minimum of three coats of paint made up as follows:

Primer coat : 35 micron DFT

Tie coat : 35 micron DFT

Finishing coat (2 Nos.) : 25 micron DFT per coat

The total minimum DFT shall be 120 micron.

The type and colour of primer & finish coat shall be selected by the Contractor after approval by the Owner.

For detail painting on building & structural steel elements refer Section-IIG/1 & IIG/2 of this specification.

3.12.5 COLOUR CO-ORDINATION & FINISH

3.12.5.1 Exterior surfaces throughout the plant shall be finished in colours and textures which will blend harmoniously together and with the surrounding landscape.

3.12.5.2 Interior surfaces throughout the plant shall be finished in colours and textures which will blend harmoniously together and which will be conducive to; the comfort, well-being and high productivity of the operators. Operating plant and services provided shall be colour coded for ease of identification.

3.12.5.3 All finishes shall be durable and as far as possible maintenance free. Finishes shall be easily cleaned.

3.12.5.4 Final colours and finishes shall be to the Approval of the Engineer.

3.13 NOISE LEVEL REQUIREMENT

The plant will be designed, constructed and provided with suitable acoustic measures to ensure the noise level criteria as per the following stipulations.

a) Maximum noise level shall not exceed 85 dB (A) when measured at 1.0M away from the noise emission source.

b) Maximum noise level from its source within the premises shall not exceed 70 dB (A) as per Environment (Protection) Rules 1986, Schedule-III, 'Ambient Air Quality Standards' in respect of noise.

c) Any statutory changes in stipulations regarding noise limitation that may occur in future according to State Pollution Control Board or Central pollution Control Board or Ministry of Environment & Forest regulation during tenure of the contract, the contractor shall comply with the requirement.

3.14 INSPECTION AND TESTING

3.14.01 Inspection and Tests during Manufacture

3.14.02 The method and techniques to be used by the Contractor for the control of quality during manufacture of all plant and equipment shall be agreed with the Owner prior to the Award of Contract.

3.14.03 The Owner's general requirements with respect to quality control and the required shop tests are set out elsewhere in this specification.

3.14.04 Before any item of plant or equipment leaves its place of manufacture the Owner shall be given the option of witnessing inspections and tests for compliance with the specification and related standards.

3.14.05 Advance notice shall be given to the Owner as agreed in the Contract, prior to the stage of manufacture being reached, and the piece of plant must be held at this stage until the Owner has inspected the piece, or has advised in writing that inspection is waived. If having consulted the Owner and given reasonable notice in writing of the date on which the piece of plant will be available for inspection, the Owner does not attend the Contractor may proceed with manufacture having forwarded to the Owner duly certified copies of his own inspection and test results. The Contractor shall forthwith forward to the engineer duly certified copies of the Test Certificates in six copies (one to the Purchaser and five to the Consulting Engineer) for approval. Distribution of six (6) copies of Test Certificates for approval will be two(2) copies to owner and four(4) copies to consultant. These four(4) copies will be further distributed by consultant after approval to owner, site and bidder. One copy will be retained with the consultant for record purpose. Further, nine (9) copies of Shop Test Certificates shall be bound with Instruction Manuals referred to elsewhere. Distribution of nine (9) copies of Shop Test Certificates for approval will be Two (2) copies to owner, Three (3) copies to site, Two (2) copies to consultant, Two (2) copies to owner's library /record.

3.14.06 Under no circumstances any repair or welding of castings be carried out without the consent of the Engineer. Proof of the effectiveness of each repair by radiographic and/or other non-destructive testing technique, shall be provided to the Engineer.

3.14.07 All the individual and assembled rotating parts shall be statically and dynamically balanced in the works.

Where accurate alignment is necessary for component parts of machinery normally assembled on site, the Contractor shall allow for trial assembly prior to dispatch from place of manufacture.

3.14.08 All materials used for the manufacture of equipment covered under this specification shall be of tested quality. Relevant test certificates shall be made available to the Purchaser as per Owner's approved QAP. The certificates shall include tests for mechanical properties and chemical analysis of representative material.

3.14.09 All pressure parts connected to pumping main shall be subjected to hydraulic testing at a pressure

of 150% of shut-off head for a period not less than one hour. Other parts shall be tested for one and half times the maximum operating pressure, for a period not less than one hour.

3.14.10 All necessary non-destructive examinations shall be performed to meet the applicable code requirements.

3.14.11 All welding procedures adopted for performing welding work shall be qualified in accordance with the requirements of Section-IX of ASME code or IBR as applicable. All welded joints for pressure parts shall be tested by liquid penetrant examination according to the method outlined in ASME Boiler and Pressure Vessel code. Radiography, magnetic particle examination magnuflux and ultrasonic testing shall be employed wherever necessary/recommended by the applicable code. At least 10% of all major butt welding joints shall be radio graphed.

3.14.12 Statutory payments in respect of IBR approvals including inspection for design and manufacturer of equipment shall be made by the Bidder. All payment for erection and testing at site (i.e. under IBR jurisdiction) shall also be made by the Bidder. In such case Contractor's scope shall also be extended to preparation of all necessary documents, co-ordination and follow-up with IBR authorities for above approval.

3.15 PERFORMANCE TESTS AT SITE

3.15.01 The full requirements for testing the system shall be agreed between the Owner and the Bidder prior to Award of Contract. The completely erected System shall be tested by the Contractor on site under normal operating conditions. The Contractor shall also ensure the correct performance of the System under abnormal conditions, i.e. the correct working of the various emergency and safety devices, interlocks, etc.

3.15.02 The Bidder shall provide complete details of his normal procedures for testing, for the quality of erection and for the performance of the erected plant. These tests shall include site pressure test on all erected pipe work to demonstrate the quality of the piping and the adequacy of joints made at site.

3.15.03 The Contractor shall furnish the quality procedures to be adopted for assuring quality from the receipt of material at site, during storage, erection, pre commissioning to tests on completion and commissioning of the complete system/equipment.

3.15.04 For details of specific tests required on individual equipment refers to respective section of this specification

3.16 PACKING FOR SHIPMENT

3.16.01 The equipment complete with its accessories, spares, special tools and tackles shall be suitably protected by respective packing for shipment considering handling during transit, distance and

weather conditions involved. The Contractor shall submit the packaging method for shipment to be adopted by him, if so desired by the Owner / Purchaser.

3.16.02 Each consignment shall be marked with Equipment name, Owner /Purchaser's name & address, Project details, handling instruction etc. It shall be complete with part list and identification details. The copies of the part list of each consignment shall also be furnished to the Owner / Purchaser after dispatch.

3.16.03 Equipment shall be packaged for transportation so as to meet the space and weight limitation of transport facilities. The contractor shall obtain approval from concerned authorities for transportation of over dimensioned consignment/package, if any, before starting manufacture of such equipment.

3.17 TYPE & RATING OF EQUIPMENT

3.17.01 The number of types and sizes of motor, controls, and other electrical equipment shall be kept to a minimum so that the requirement of spares is minimized.

3.17.02 Equipment shall be rated for the load and duty cycle of the intended service Circuit breakers and fuses shall be rated to withstand and interrupt the maximum fault current at the point of application in the circuit.

3.18 TROPICAL PROTECTION

3.19.01 All electrical equipment, accessories and wiring shall have fungus protection involving special treatment of insulation and metal against fungus, insects and corrosion.

3.19.02 Fine mesh screen of corrosion resistant material shall be furnished on all ventilating openings to prevent entry of insects.

3.20 ELECTRICAL SWITCH BOARDS

3.20.01 GENERAL

Switchboards shall be dead-front, free-standing, vertical, cubicle/panel type, completely wired, having access doors with concealed hinges and locking type latches.

3.20.02 Panels shall be fabricated from minimum 1.6mm thick for non-load bearing members & 2 mm thick for load bearing members, CRCA (cold rolled continuously annealed) sheet steel, free from any surface imperfections and suitably reinforced to provide a sturdy and rigid assembly. Load bearing wall/covers/back covers shall be 2 mm thick and for non-load bearing the wall/cover/back cover shall be 1.6 mm thick.

3.20.03 Panels shall be adequately sized for installation of field cables and access for maintenance. The working zone shall be limited between 300 mm and 1800mm from floor level.

3.20.04 Each panel shall be provided with internal illumination lamp operated by door switch, thermostat controlled space heater with miniature circuit breaker (MCB) unit, and plug socket with MCB for

hand lamp.

3.20.05 Removable eye bolt/lifting lugs shall be furnished on all panels.

3.20.06 Unless otherwise stated, equipment rating and module sizes shall be as per annexure B. Module selection chart is specified for guidance of bidder in respect to requirement of module space and component ratings.

3.21 EQUIPMENT MOUNTING

3.21.01 All instruments, switches etc. mounted on the front face of the panels shall be of flush type.

3.21.02 All equipment shall be so mounted that removal and replacement may be accomplished individually without interruption of service to others.

3.21.03 All equipment inside the panel shall be so located that their terminals and adjustments are readily accessible for inspection and maintenance. Adequate ventilation shall be provided in enclosed panel.

3.21.04 At least 20% with a minimum of one spare feeders of each type & rating shall be provided in MCC/Switch Board.

3.22 PANEL WIRING

3.22.01 All panels shall be fully wired at the factory to ensure proper functioning of all control, protection and interlock schemes. All wiring for external connections shall be brought to terminal blocks and numbered.

3.22.02 Panel wiring shall be carried out with flexible, 1100 grade, heat as well as fire resistance type PVC insulated stranded copper wire of minimum 2.5 Sq.mm(7/0.67mm) cross section.

3.22.03 Solder less compression/clamp type connection shall be used for wire terminals. Wiring shall be continuous between terminals without splicing. Each wire shall be identified at both ends with permanent markers having wire numbers as per approved wiring drawings.

3.22.04 All spare contacts of relays, aux. relays, contactors, aux. contactors, switches, push buttons etc. shall be terminated up-to external terminal block.

3.22.05 Terminal blocks shall be Box clamp type with marking strip. Not more than two wires shall be connected to one terminal. Spare terminal equal in number to 20% of active terminals shall be furnished.

3.23 GROUNDING

A copper ground bus for HT Switchgear and GI ground bus for LT boards, sized to carry maximum short circuit current, shall run along the entire length of panel structure and shall have terminal connector at each end for connection to station ground grid. Minimum size of ground bus shall be 75 X 10 sq. mm.

3.24 PAINTING

All metal surface shall be cleaned, phosphated and given two coats of rust-resistant primer followed by two coats of epoxy based finish paint. The shades for different equipment shall be as follows:

- a) For switchgears, MCCs, Distribution boards and other panels-Light Grey RAL 7032.
- b) For transformer –Battle ship Grey shade 632 of IS-5.
- c) For motors-Battle ship grey shade 632 of IS-5
- d) For generator isolated phase Bus duct enclosure –Inside shall be Matt Black & outside will be light grey shade RAL 7032 for indoor part and battle ship gray shade 632 of IS-5 for outdoor. All supporting steel structures shall be galvanised.HT and LT Bus duct shall be same as generator Bus duct.

3.25 NAME PLATE

Name plate of approved design shall be furnished on each panel and for each instrument or device mounted on panel. The material for name plate shall be 3 mm thick lamicaid or approved equal, with white letters on black background.

3.26 TESTS

Each panel shall be completely assembled, wired, adjusted and tested at the factory prior to shipment. The test shall include wiring continuity tests, insulation tests and functional tests to ensure satisfactory operation and control of individual equipment.

3.27 SPECIAL CABLES

Special cables for specific purpose, as required, shall be supplied and installed by the EPC Contractor.

3.28 CONDUITS

3.28.01 Conduits shall be of heavy gauge rigid steel, hot-dip galvanized, cut square, reamed, threaded and screwed tight at all joints.

3.28.02 Conduit entrances to pull boxes and switches shall have double lock nuts &insulating bushings. No running thread shall be used.

3.28.03 Flexible metallic conduit shall be used for connection to equipment, which are subject to vibration, and also for connection to level/limit/pressure switches.

3.28.04 HDPE PVC pipes shall be used for single core power cables.

3.29 SPECIFIC REQUIREMENT - SERVICES (DESIGN & INSTALLATION)

3.29.01 Methods and Workmanship

3.29.02 All equipment shall be installed in a first class, neat workmanlike manner by mechanics/electricians skilled in the trade involved.

3.29.03 The erection work shall be supervised by competent supervisors holding relevant supervisory license from the Government.

3.29.04 All details on installation shall be electrically and mechanically correct.

3.29.05 The installation shall be carried out in such a manner as to preserve access to other equipment installed.

3.30 PROTECTION OF WORK

3.30.01 For protection of this work, the Contractor shall provide fencing and lighting arrangement, connect space heaters and provide heating arrangement as necessary or as directed by the Owner/Consultant.

3.31 ANNEXURE-B: MODULE SELECTION

MOTOR FEEDER

Type Motor Rating MCCB Rating Contactor Cable size

AU/AR 0 - 5.5 KW 32A 16A 3/c – 2.5 Sq.mm - Cu

BU/BR 5.6 - 11 KW 63A 32A 3/c - 16 Sq.mm - Al

CU 11.1 - 22 KW 63A 63A 3/c - 35 Sq.mm - Al

DU 22.1 - 50 KW 100A 100A 3/c - 95 Sq.mm - Al

EU 50.1 - 75 KW 200A 160A 3/c - 185 Sq.mm - Al

FU 75.1 - 110 KW 400A 300A 2 x 3/c - 185 Sq.mm - Al

NOTE :

1. MCCB with short circuit release, thermal overload relay with SPP feature, Contractor are to be co-ordinate (Type-2) with motor rating by the Contractor.

2. "U" stands for Undirectional and "R" for Reversible drives.

OUTGOING FEEDER

Type MCCB Rating Cable Size

AF 32A 4/c – 16 Sq.mm - Cu

BF 63A 4/c – 35 Sq.mm - Al

CF 100A 3.1/2 – 95 Sq.mm - Al

DF 200A 3.1/2 – 300 Sq.mm - Al

EF 400A 4 x 1/c – 630 Sq.mm - Al

Note: Cable sizes as indicated above are indicative. However EPC contractor shall submit the sizing calculation of cable and select the cable accordingly.

3.32 ANNEXURE-C: TECHNICAL PARAMETERS FOR ELECTRICAL SYSTEM

L.V. SYSTEM DATA

1	Nominal 3 phase voltage to be selected for L.V. system	415 V
2	Type of Breaker to be selected	Air break
3	Type of outgoing feeder switching device in L.T. MCC	MCCB

4	M.C.C. type	Single front/Double front Fully draw out type
5	Short circuit level for 1 sec	50 KA

DC. SYSTEM DATA

1	Nominal voltage to be selected for DC system	220 V
2	Type of Incoming / outgoing feeder switching device	Double pole Switch-Fuse
3	DCDB type	Single front/Double front Fully draw out type
4	Short circuit level for 1 sec	To be decided by Bidder 25 KA (minimum)

UPS SYSTEM DATA

1	Nominal voltage to be selected for UPS system	240 V, 1-Ph, 50 Hz, AC
2	Type of Incoming / outgoing feeder switching device	MCCB
3	UPSDB type	Single front, Fixed type, Modular construction
4	Short circuit level for 1 sec	To be decided by bidder 25 KA (minimum)

3.33 CODES AND STANDARDS

All materials and equipment shall generally comply in all respect with the latest edition of relevant international electro-technical commission (IEC) or any other internationally accepted standard which ensure equal or better quality or relevant Indian standard(IS) mentioned against each equipment and this specification.

3.34 MATERIAL/WORKMANSHIP

3.34.01 General Requirement

Where the specification does not contain characteristics with reference to workmanship, equipment, materials and components of the covered Equipment it is understood that the same must be new, of highest grade of the best quality of their kind conforming to best engineering practice and suitable for the purpose for which they are intended.

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 and shall be used throughout the design. 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 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 be interchangeable with, 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.

All materials and equipment shall be installed in strict accordance with the manufacturer's recommendation(s). Only first-class work in accordance with the best modern practices will be accepted. Installation shall be constructed as being the erection of equipment at its permanent location. This, unless otherwise specified, shall include unpacking, cleaning and lifting into position, grouting, leveling, aligning, coupling of or bolting down to previously installed equipment bases/foundations, performing the alignment check and final adjustment prior to initial operation, testing and commissioning in accordance with the manufacturer's tolerances and instructions and the Specification. All factory assembled rotating machinery shall be checked for alignment and adjustments made as necessary to re-establish the manufacture's limits suitable guards shall be provided for the protection of personal on all exposed rotating and / or moving machine parts and shall be designed for easy installation and removal for maintenance purpose. The spare equipment(s) shall be installed at designated locations and tested for healthiness. The Contractor shall apply oil and grease of the proper specification to suit the machinery, as is necessary for the installation of the equipment. Lubricants used for installation purposes shall be drained out and the system flushed through where necessary for applying the lubricant required for operation. The Contractor shall apply all operational lubricants to the equipment installed by him.

All oil, grease and other consumables used in the Works/ Equipment shall be purchased in India unless the Contractor has any special requirement for the specific application of a type of oil or grease not available in India. In such is the case he shall declare in the proposal, where such oil or grease is available. He shall help purchaser in establishing equivalent Indian make and Indian Contractor. The same shall be applicable to other consumables too.

3.34.02 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 equipments located in non-air conditioned areas shall also be of same type.

3.34.02 COLOUR SCHEME AND CODES FOR PIPE SERVICE

All steel structures, plates etc shall be painted with non-corrosive paint on a suitable primer. It may be noted that normally all electrical equipment in switchyard are painted with shade 631 of IS-5. All The indoor cubicles shall be of same colour scheme and for other miscellaneous items, colour scheme will be approved by the purchaser.

3.34.03 PROTECTION

All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protecting device. All ends of all valves, pipings and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage.

All equipment accessories and wiring shall have fungus protection, involving special treatment of insulation and metal against fungus, insects and corrosion. The parts which are likely to get rusted, due to exposure to weather should also be properly treated and protected in a suitable manner. Screens of corrosion resistant material shall be furnished on all ventilating louvers to prevent entry of insects.

3.34.04 FUNGISTATIC VARNISH

Besides the space heaters, special moisture and fungus resistant varnish shall be applied on the 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 interface with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application to the varnish.

3.34.05 SURFACE FINISH

All interiors and exteriors of tanks, control cubicles and other metal parts shall be thoroughly cleaned to remove all rust, scales, corrosion, greases or other adhering foreign matter. All steel surfaces in contact with insulating oil as far as accessible, shall be painted with not less than two coats of heat resistant, oil insoluble, insulating paints.

All metal surfaces exposed to atmosphere shall be given two primer coats of zinc chromate and two coats of epoxy paint with epoxy base thinner. All metal parts not accessible for painting shall be made of corrosion resisting material. All machine finished or bright surfaces shall be coated with a suitable preventive compound and suitably wrapped or otherwise protected. All paints shall be carefully selected to withstand tropical heat and extremes of weather within the limit specified. The paint shall not scale off or wrinkle or be removed by abrasion due to normal handling. All external painting shall be as per shade no. 631 of IS:5.

3.34.06 GALVANIZING

All ferrous parts including all sizes of nuts, bolts, Plain and spring washers, support channels, structures, shall be hot dip galvanised conforming to latest version of IS:2629 or any other equivalent authoritative standard. However, hardware less than M12 size shall be electro-galvanized. Minimum weight of zinc coating shall be 610 gm/sq.mm and minimum thickness of coating shall be 85 microns for all items thicker than 6mm. For items lower than 6 mm thickness, requirement of coating shall be as per relevant ASTM.

3.34.07 PACKING

The following details are to be clearly indicated in the material forwarding documents:

- a) Name and address of the consignee.
- b) Purchase order number.
- c) Name of supplier/s.

- d) Description of equipment / material.
- e) Net weight.
- f) Gross weight.

All the equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. On request of the purchaser, the Contractor shall also submit packing details/associated drawing for any equipment material under his scope of supply, to facilitate the purchaser to repack any equipment/ material at a later date, in case the need arises. Any material found short inside the packing cases shall be supplied by the supplier without any extra cost. The cases containing easily damageable material shall be very carefully packed and marked with appropriate caution symbol i.e. fragile, handle with care, use no Hooks etc.

3.34.08 HANDLING, STORING AND INSTALLATION

Contractor may engage manufacturer's Engineers to supervise if required for unloading, transportation to site, storing, testing and commissioning of the various equipment being procured by them separately. In case of any doubt/misunderstanding as to the correct interpretation of manufacturer's drawings or instructions, necessary clarifications shall be obtained from the purchaser. Contractor shall be held responsible for any damage to the equipment consequent to not following manufacturer's drawings/instructions correctly.

Where assemblies are supplied in more than one section, contractor shall make all necessary mechanical and electrical connections between sections including the connection between buses. Contractor shall also do necessary adjustments/alignments necessary for proper operation of circuit breakers, isolators and their operating mechanisms. All components shall be protected against damage during unloading, transportation, storage, installation, testing and commissioning.

Contractor shall be responsible for examining all the shipment immediately of any damage, shortage, discrepancy etc. for the purpose of Purchaser's information only. Any demurrage, pilferage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor. The Contractor shall be fully responsible, for the equipment/material until the same is handed over to the purchaser in an operating condition after commissioning.

The minimum phase to earth, phase to phase and section clearance along-with other technical parameters for the various switchyard voltage levels to be maintained shall be strictly as per the approved drawings.

The design and workmanship shall be in accordance with the best engineering practices to ensure satisfactory performance throughout the service life. If at any stage during the execution of the Contract, it is observed that the erected equipment(s) do not meet the above minimum clearances, the Contractor shall immediately proceed to correct the discrepancy at his risks and costs.

3.34.09 DEGREE OF PROTECTION

The enclosures of the Control Cabinets, Junction boxes and Marshalling boxes panels etc to be installed shall be provided with degree of protection as detailed here under:

- a) Installed out door: IP-55
- b) Installed indoor in air conditioned area: IP-31
- c) Installed in covered area IP:52
- d) Installed indoor-in non air-conditioned area where possibilities of entry of water is limited:IP-41
- e) For LT switchgear (AC & DC distribution Boards): IP-54

The degree of protection shall be in accordance with IS:13947, (Part-1)/IEC-947(Part-1). Type test report/or degree of protection test on each type of the box shall be submitted for approval.

3.34.10 RATING PLATES, NAME PLATES AND LABELS

Type or serial number together with details of the loading conditions under which the item of the substation in question has designed to operate and such diagram plates as may required by the Purchaser. The rating plate of each equipment shall be according to IEC requirements.

All such nameplate instruction plates, rating plates shall be bilingual with Hindi inscription first followed by English. Alternately two separate plates one with Hindi and other with English inscriptions may be provided.

3.34.11 EARTHING

Circuit breakers, LA, Isolator, CVT , CT , BPI shall be provided with two grounding pads suitable for connection to galvanized steel flat. Control panels, Relay panel, outdoor marshalling boxes, Junction boxes, Lighting panels and distribution board shall be provided with two grounding pads, for connection to galvanized steel flat. The two pads shall be provided, one each at the middle of the two opposite sides of the bottom frame of the equipment. Earthing of hinged door shall be done by using a separate earth wire.

3.34.12 TERMINAL BLOCKS AND WIRING

Control and instrument leads from the switchboards or from other equipment will be brought to terminal boxes or control cabinets in conduits. All Inter-phase and external connections to equipment or to control cubicles will be made through terminal blocks.

Terminal blocks shall be 1100 V grade and have continuous rating to carry the maximum expected current on the terminals. Those shall be of moulded piece complete with insulated barriers stud type terminals, washers nuts and lock nuts. Screw clamp, overall insulated, insertion type, rail mounted terminals can be used in place of stud type terminals. But preferably the terminal blocks shall be non-disconnecting stud type equivalent to Elmex type CATM4, Phoenix

cage clamp type of Wedge or equivalent. The Insulating material of terminal block shall be nylon 6.6 which shall be free of halogens, fluorocarbons etc.

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

The terminal shall be that maximum contact area is achieved when a cable is terminated. The terminal shall have a locking characteristic to prevent cable from escaping from the terminal clamp unless it is done intentionally. The conducting part in contact with cable shall preferably be tinned or silver plated however Nickel plated copper or zinc plated steel shall also be acceptable. The terminal blocks shall be of extensible design. The terminal blocks shall have locking arrangement to prevent its escape from the mounting rails.

The terminal blocks shall be fully enclosed with removable covers of transparent, non deteriorating type plastic material. Insulating barriers shall be provided between the terminal blocks. These barriers shall not hinder the operator from carrying out the wiring without removing the barriers.

Unless otherwise specified terminal blocks shall be suitable for connecting the following conductors on each side.

All circuits except CT circuits :	Minimum of 2 nos. of 2.5 sq.mm, copper flexible.
All CT circuits :	Minimum of 4 nos. of 2.5 sq.mm, copper flexible..

The arrangements shall be in such a manner so that it is possible to safely connect or disconnect terminals on live circuits and replace fuse links when the cabinet is live. At least 20 % spare terminals shall be provided on each panel/cubicle/box and these spare terminals shall be uniformly distributed on all terminals rows.

There shall be a minimum clearance of 250mm between the first bottom row of terminal block and the associated cable gland plate. Also the clearance between two rows of terminal blocks shall be a minimum of 150 mm. The Supplier shall furnish all wire, conduits and terminals for the necessary inter-phase electrical connection (where applicable) as well as between phases and common terminal boxes or control cabinets.

All input and output terminals of each control cubicle shall be tested for surge withstand capability in accordance with the relevant IEC Publications, in both longitudinal and transverse modes. The supplier shall also provide all necessary filtering, surge protection, interface relays and any other measures necessary to achieve an impulse withstand level at the cable interfaces of the equipment.

3.34.13 CONTROL CABINETS, JUNCTION BOXES, TERMINALS BOXES AND MARSHALLING BOXES FOR OUTDOOR EQUIPMENTS

All types of boxes, cabinets etc. shall generally conform to and be tested in accordance with IS-5039, IS-8623 or IEC-439, as applicable and the clause given below.

Control cabinet, Junction boxes, Marshalling boxes & Terminal boxes shall be made of sheet steel or aluminium and shall be dust, water and vermin proof. Sheet used shall be least 2.0 mm cold rolled or 2.5mm hot rolled. The box shall be properly braced to prevent wobbling. There shall be sufficient reinforcement to provide level surfaces, resistance to vibrations and rigidity during transportation and installation. In case of aluminium enclosed box the thickness of aluminium shall be such that it provides adequate rigidity and long life as comparable with sheet of specified thickness. Cabinet/boxes shall be free standing floor mounting type, wall mounting type or pedestal mounting type as per requirements.

Cabinet /boxes shall be provided with double hinged doors with padlocking arrangements. The distance between two hinges shall be adequate to ensure uniform sealing pressure against atmosphere. The quality of gaskets shall be such that it does not get damaged/cracked during the operation of the equipment.

All door, removable covers and plates shall be gasketed all around with suitably profiled EPDM gaskets. The gasket shall be tested in accordance with approved quality plan. The quality of gasket shall be such that it does not get damaged /cracked during the years of the equipment or its major overhaul whichever is earlier. All gasketed surfaces shall be smooth, straight and reinforced if necessary to minimize distortion and to make a tight seal. Ventilating Louvers, if provided, shall have screen and filters. The screen shall be fine wire mesh made of brass.

All boxes/cabinets shall be designed for the entry of cables from bottom by means of weather proof and dust-proof connections. Boxes and cabinets shall be designed with generous clearances to avoid interference between the wiring entering from below and any terminal blocks or accessories mounted within the box or cabinet. Suitable cable gland plate projecting atleast 150 mm above from the base of the Marshalling Kiosk/box shall be provided for this purpose along with the proper blanking plates. Necessary number of cable glands shall be supplied and fitted on this gland. The gland shall project atleast 25mm above gland plate to prevent entry of moisture in cable crutch. Gland plate shall have provision for some future glands to be provided later, if required

3.34.14 SPACE HEATERS

The heater shall be suitable for continuous operation at 240 V AC supply voltage and shall be provided with on – off switch and fuse shall be provided for heater.

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

The heaters shall be suitably designed to prevent any contact between the heater wire and air and shall consist of coiled resistance wire centered in metal sheath and completely encased in a highly compacted powder of Magnesium Oxide or other material having equal heat conduction and electrical insulation properties, or they shall consist of a resistance wire wound on a ceramic and completely covered with a ceramic material to prevent any contact between the wire and air. Alternatively, they shall consist of resistance wire mounted into a tubular ceramic body built into an envelop of stainless steel or the resistance wire is wound on a tubular ceramic body and embedded in 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

3.35 DOCUMENTATION

3.35.01 LIST OF DOCUMENTS

The bidder shall submit a detailed list of drawings / documents along with the bid proposal which he intends to submit to the Employer after award of the contract.

The supplier shall necessarily submit all the drawings / documents unless any thing is waived.

All engineering data submitted by the Contractor after final process including review and approval by the Employer shall form part of the Contract Document and the entire works performed under this specification shall be performed in strict conformity, unless otherwise expressly requested by the Employer in Writing.

3.35.02 DRAWINGS

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

Each drawing submitted by the Contractor shall be clearly marked with the name of the Employer, name of consultant, the unit designation, GSECL contract no. , and the name of the Project .If standard catalogue pages are submitted, the applicable items shall be indicated therein. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.

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

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

3.35.03 APPROVAL PROCEDURE

The scheduled dates for the submission of these as well as for, any data/information to be furnished by the Employer would be discussed and finalized at the time of award. The supplier shall also submit required no. of copies as mentioned in this specification of all drawings/design documents/test reports for approval by the Employer. The following schedule shall be followed generally for approval.

i.	Approval/comments/by employer on Initial submission	Within 2 weeks of receipt
ii.	Resubmission	Within 2 (two) weeks (whenever from date of comments required) Including both ways postal time.
iii.	Approval or comments	Within 2 weeks of receipt of resubmission
iv.	Furnishing of distribution copies	2 weeks from the date of last approval.

Note: The contractor may please note that all resubmissions must incorporate, all comments given in

Gujarat State Electricity Corporation Ltd
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Section 3

Bharat Heavy Electricals Ltd.

the submission by the Employer failing which the submission of documents is likely to be returned. Every revision shall be a revision number, date and subject, in a revision block provided in the drawing, clearly marking the changes incorporated.

The title block of drawings shall contain the following information incorporated in all contract drawings.

Customer: Gujarat State Electricity Corporation Ltd.

Consultant: Development Consultants Pvt. Ltd., Kolkata

Project: 400kV Switchyard (extn.) & 400kV GIS for 1x800 MW Wanakbori Thermal Power Station Extn. Unit-8

NOA NO.

3.35.04 DOCUMENTS TO BE SUBMITTED ALONGWITH OFFER

- 1) Drawings
- 2) Guaranteed Technical Particulars
- 3) Type Test Reports
- 4) Manufacturing Quality Plan

3.35.05 DOCUMENTATION SCHEDULE

S. No.	DESCRIPTION	TENDER STAGE	CONTRACT STAGE FOR APPROVAL	FINAL DOCUMENTATION	
				Prints	CDs
1	Drawings and Data Sheets	1	10	13	-
2	Drawings "As Built "	-	-	13	05
3	Type Test Reports	1	05	13	-
4	Erection Manuals	-	11	13	-
5	Operation and Maintenance Manuals	-	11	13	-
6	Manufacturing Quality Plan	1	11	13	-
7	Field Quality Plan	1	11	13	-
8	Inspection Test Reports	-	-	13	-

Drawings will also be submitted in mini cartridges in AUTOCAD Release -2008 package or any other CAD package along with conversion files for all major items.

Final Documentation shall be submitted in bound volumes with Customer & Project etc. written on top.

3.35.06 AS-BUILT DRAWINGS

The Contractor shall furnish drawings and document in as-built condition as stipulated in the specification.

On completion of the project, contractor should submit Three Sets of As commissioned drawings, Three Sets of as Installed Bill of Materials and Three Sets of As Commissioned Data/ Specification /Parameter Sheets Duly Signed by the Competent Authority.

3.35.07 DRAWINGS, DATA, INFORMATION AND MANUALS

3.35.08 Drawings, data, information & manuals shall be submitted as indicated below:

3.35.09 To be submitted after award of the Contract.

- a) Single line diagram giving rating of each equipment.
- b) Design calculations in support of selection of equipment rating and system design.
- c) Technical Data sheets, characteristic curves.
- d) Equipment layouts, layout of switchyard with sections.
- e) Grounding & lightning protection drawings and details.
- f) Cabling, cable trench and tray layouts with section and details with cable sizing calculation.
- g) Dimensional general arrangement drawing along with cross- sections for equipment.
- h) Foundation plan and loading data : design calculation and detail drawing of foundation.
- i) Design calculation and detail drawing for civil work related to this specification.
- j) Design calculation, GA drawing for GI structure and equipment supporting structure, and subsequently detailed drawings.
- k) Mounting details of equipment and structure.
- l) Fire fighting and sump arrangement.
- m) Control & operation write up/Block logic diagrams.
- n) Control schematic and wiring diagram.
- o) Cable schedule and interconnection and cable routing.
- p) Relay co-ordination.
- q) Civil & structural analysis, design calculations and working drawings including bar bending schedule and fabrication.
- r) Erection and maintenance manual.
- s) Any other drawings & data as required for satisfactory installation, operation & maintenance.

3.35.10 OPERATING MANUALS AND MAINTENANCE INSTRUCTIONS

- (i) The Contractor shall provide at least six (6) months before the time of commissioning and before

taking over of the plant and equipment, all necessary maintenance manuals and operating instructions. The instruction manual shall be submitted in the form of one (1) soft copy in CD and 15 hardcopies.

(ii) The information provided, which shall be contained in loose leaf stiff backed covers, shall include :

- a) A complete inventory of all main items of plant, with identification details.
- b) Service manuals for all plant and equipment giving full descriptions of the main items and auxiliary items such as power packs, hydraulic equipment, actuators, lubricating pumps, etc.
- c) A separate electrical manual covering items such as switchgear, cabling, instrumentation, controls, cabling layouts and wiring diagrams.
- d) A schedule of recommendations for routine maintenance of all electrical and mechanical equipment, recommended inspection point, information on detection, cause and rectifications of troubles & faults.
- e) A lubrication schedule with all necessary drawings diagrams to identify the lubrication points.
- f) Manufacturer's literature.

(iii) The instruction manual shall be subject to the approval of Owner.

3.35.11 PLANT HANDBOOK

The Contractor shall submit to the Engineer, a preliminary plant handbook preferably in A-4 size sheets which shall contain the design and performance data of various plant, equipment and systems covering the complete project including single line flow diagrams, within twenty four (24) months from the date of his acceptance of the letter of award. The final plant handbook complete in all respects shall be submitted by the Contractor six (6) months before start-up and commissioning activities. The plant handbook shall be submitted in the form of two (2) soft copy in CD (one to Owner and one to Consultant) and twenty five (25) hard copies in decent bound forms.

3.35.12 CONTRACT STAGE DOCUMENT SUBMISSION AND APPROVALPROCEDURE

- (i) Within fifteen (15) days of issue of Letter of Award (LOA) by the Owner, the Contractor shall furnish a schedule of drawings and design document to be submitted by him to the Owner/Engineer indicating dates against each document. The documents shall be divided into two categories:
 - a) for approval and
 - b)for information/further engineering and co-ordination by the Owner.

In preparing this schedule, the Contractor shall allow four (4) weeks from date of receipt for review and comments by the Owner/Engineer for each submission of a document.

This document submission schedule shall require approval by the Owner/Engineer.

- (ii) All contract documents shall be marked, without fail, with the name of the Owner, the Project, the specification title and number and the unit designation. All dimensions shall be in metric units. All notes, markings etc. shall be in English.
- (iii) Documents/Drawings, submitted during tender stage, shall be revalidated or revised as required and submitted as certified contract document for approval/ information of the Owner/Engineer.
- (iv) Unless specified otherwise, the following categories of documents/drawings would require approval of the Owner/Engineer:
 - a) List of sub-vendors (from Owner only)
 - b) System scheme and instrumentation diagrams
 - c) Design basis justifying selection of equipment & process parameters where not specified in the Contract
 - d) Equipment data sheets and general arrangement drawings
 - e) Materials of construction
 - f) Layout drawings.
 - g) Operation logic diagrams.
 - h) Typical control circuit.
 - i) Drawings of Instrumentation and control.
- (v) Unless specified otherwise, the following categories of documents/ drawings would be treated for information/further engineering by the Owner/Engineer. The Contractor shall, however, incorporate all additional information and clarifications in these documents / drawings as and when desired by the Owner/Engineer.
 - a) Equipment foundation drawings.
 - b) Equipment cross-section drawings, product literature etc. which are of proprietary nature.
 - c) Predicted performance curves of equipment.
 - d) Various bills of quantity, schedules etc.
 - e) Piping fabrication drawings, isometrics etc.
 - f) Panel wiring diagrams.

- g) Instruction/Operation manuals.
- h) Service manuals and trouble shooting guide for C & I system including field instruments.
- i) Cable schedule and interconnection chart.
- j) Drive/feeder wise control scheme showing all external interfaces.

In essence, the Contractor is solely responsible for corrections and adequacy of design & engineering for documents under this category.

- (vi) Upon review, the Owner/Engineer shall put his remarks and one of the following action stamps on the drawing/document:
 - a) Approved.
 - b) Approved except as noted, forward final drawing
 - c) Approved except as noted, resubmission required.
 - d) Disapproved.
 - e) For information/reference only.

For action stamps in category (c) & (d), documents must be resubmitted for review by the Owner/Engineer. For action stamp in category (b), further review by Owner/Engineer would not be necessary provided the Contractor agrees & incorporates the comments made on the document. Except for action stamp under category (c) & (d), the Contractor can proceed with manufacturing and other sequential activities for those areas of a drawing/document which do not have any review comment by the Owner/Engineer.

The Owner/Engineer may accord approval in category (c) or (d) in more than one submission of a document till he is satisfied that the intent of the specification has been fully complied with. The Contractor shall be responsible for delay in such cases and no extension of time shall ordinarily be allowed on such grounds. Approval of contract documents by the Owner/Engineer shall not relieve the Contractor of his responsibility for any errors and fulfillment of contract requirements. The Contractor's work shall be in strict accordance with the finally approved drawings and no deviation shall be permitted without written approval of the Owner/Engineer.

- (vii) Except key plan/general yard plan, any layout drawing requiring scrutiny shall not be drawn to a scale less than 1:50.
- (viii) For review by the Consulting Engineer, the Contractor shall furnish softcopies of drawings & documents and three (3) prints of each drawing/document. Two (2) prints of such submission shall also be sent to the Owner. After review, comment/approval will be sent to the Contractor. Upon action under category (a) or (e), the Contractor shall directly distribute the documents to the various

offices of the Owner and other agencies in number of copies as specified in the contract document. Such distribution copies shall be marked with the reference and date of the letter by which the Owner/Engineer has accorded his final approval. Penal action shall be taken against the Contractor for any unauthorized revision in the drawings so distributed from the drawings approved by the Owner/Engineer. The contractor shall furnish three (3) CDs of all as built/final drawings for Owner/Consultant site.

- (ix) In case of contradiction between the stipulations above and those stated elsewhere in the specification, the stipulations herein shall prevail.
- (x) For details of documentation for Civil, Structural and Architectural works, Vol.II-G may be referred.

3.36 QUALITY ASSURANCE

3.36.01 The Contractor shall follow his standard procedures for quality assurance and control. A copy of the said standard procedures shall be submitted to the Owner / Purchaser for his reference. However, Owner / Purchaser reserves the right to review the same and give his observations, if any, for compliance.

3.36.02 The procedures shall be in such a form as to clearly delineate the manufacturing sequence, inspection points, tests and test procedures, acceptable ranges / values, reference drawings etc.

3.36.03 The Owner / Purchaser shall inform the Contractor as to which of the inspection points and tests shall be witnessed. As a minimum, inspection and testing of the finished equipment shall be made prior to shipment, unless specifically waived by the Owner / Purchaser. The contractor shall give at least fifteen (15) days advance notice regarding readiness of the equipment.

3.36.04 Manufacturing and quality control procedures shall be available for audit to the Owner / Purchaser and/or its representative at the place of manufacture.

3.36.05 The Owner / Purchaser reserves the right to inspect the equipment at the point of manufacture and witness factory and other such tests as may be necessary to ensure conformance to the specification.

3.36.06 The Owner / Purchaser may inspect the Contractor's facilities prior to award of contract.

3.36.07 The Owner / Purchaser may witness any or all of the tests stipulated in the relevant standards and this specification.

3.36.08 The Owner / Purchaser may conduct surveillance of the Contractor's facilities for compliance to his standard procedures of Quality Assurance and Quality Control while work on the specified equipment is in progress.

3.36.01 QUALITY ASSURANCE REQUIREMENTS

1.00.00 QUALITY ASSURANCE PROGRAMME

1.01.00 To ensure that the equipment and services under the scope of Contract whether manufactured or performed within the Contractor's works or at his Sub-contractor's premises or at the Owner's site or at any other place or work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance programme to control such activities at all points, as necessary. Such programmes shall be outlined by the Contractor and shall be finally accepted by the Owner/Authorized representative after discussions before the award of contract. A quality assurance programme of the Contractor shall generally cover the following:

- a) His organization structure for the management and implementation of the proposed quality assurance programme.
- b) Documentation control system.
- c) Qualification data for Bidder's key personnel.
- d) The procedure for purchase of materials, parts, components and selection of Sub-contractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc.
- e) System for shop manufacturing and site erection control including process controls and fabrication and assembly controls.
- f) Control of non-conforming items and system for corrective actions.
- g) Inspection and test procedure both for manufacture and all site related works.
- h) Control of calibration and testing of measuring and testing equipments.
- i) System for quality audit.
- j) System for indication and appraisal of inspection status.
- k) System for authorizing release of manufactured product to the Owner.
- l) System for handling storage and delivery.
- m) System for maintenance of records.
- n) Furnishing of quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component as per format enclosed at Annexure-I to this section.

2.00.00 GENERAL REQUIREMENTS - QUALITY ASSURANCE

2.01.00 All materials, components and equipment covered under this specification shall be procured,

manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the Contractor for some of the major items is given in the respective technical specification. This is however, not intended to form a comprehensive programme as it is the Contractor's responsibility to draw up and implement such programme duly approved by the Owner/Consultant. The detailed Quality Plans for manufacturing and field activities should be drawn up by the Bidder, separately in the format attached at Annexure-I and will be submitted to Owner/Authorized representative for approval. Schedule of finalization of such quality plans will be finalized before award.

- 2.02.00 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 Contractor's Quality Control organization, 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.
- 2.03.00 Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Contractor's site Quality Control organization, during various stages of site activities from receipt of materials/equipment at site.
- 2.04.00 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 Owner's approval without which manufacture shall not proceed. These approved documents shall form a part of the contract. In these approved quality plans, Owner/Authorized representative shall identify customer hold points (CHP), test/checks which shall be carried out in presence of the Owners Engineer or his authorized representative and beyond which the work will not proceed without consent of Owner/Authorized representative in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Owner/Authorized representative for approval and dispositioning.
- 2.05.00 No material shall be dispatched from the manufacturer's works before the same is accepted subsequent to pre-dispatch final inspection including verification of records of all previous tests/inspections by Owner's Engineer/Authorized representative, and duly authorized for dispatch issuance of Material Dispatch Clearance Certificate (MDCC).
- 2.06.00 Materials used or supplied shall be accompanied by valid and approved materials certificates and tests and inspection report as per Owner's approved QAP. These certificates and reports shall indicate the sheet numbers or other such acceptable identification numbers of the material. The material certified shall also have the identification details stamped on it.
- 2.07.00 Castings and forgings used for construction shall be of tested quality. Details of results of chemical analysis, heat treatment record, mechanical property test results shall be furnished.
- 2.08.00 All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with

requirements of ASME Section-IX/BS-4870 or other International equivalent standard acceptable to the Owner.

All brazers, welders etc. employed on any part of the contract at Contractor's/Sub-Contractor's works or at site shall be qualified as per ASME Section-IX or BS-4871 or equivalent international standard approved by the Owner. Such qualification tests shall be conducted in presence of Owner/his authorized representative.

For welding of pressure parts and high pressure piping the requirements of IBR shall also be complied with.

- 2.09.00 All non-destructive examination (NDT) shall be carried out in accordance with approved international standard. The NDT operator shall be qualified as per SNT-TC-IA (of American Society of non-destructive examination). Results of NDT shall be properly recorded and submitted for approval.
- 2.10.00 All the sub-vendors proposed by the Contractor for procurement of major bought out items including castings, forgings, semi-finished and finished components/equipment list of which shall be drawn up by the Contractor and finalized with the Owner shall be subject to Owner's approval. Quality Plans of the successful vendors shall be discussed, finalized and approved by the Owner/Authorized representative and form part of the Purchase Order between the Contractor and the Vendor.
- 2.11.00 All the purchase specifications for the major bought-out items, list of which shall be drawn up by the Contractor and finalized with the Owner shall be furnished to the Owner for comments and subsequent approval before orders are placed. Owner reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Contractor's or their sub-vendor's quality management and control activities. The Contractor shall provide all necessary assistance to enable the Owner carry out such audit and surveillance. Quality audit/approval of the results of tests and inspection will not prejudice the right of the Owner to reject an equipment not giving the desired performance after erection and shall not in no way limit the liabilities and responsibilities of the Contractor in earning satisfactory performance of equipment as per specification.
- 2.12.00 Quality requirements for main equipment shall equally apply for spares and replacement items.
- 2.13.00 Repair/rectification procedures to be adopted to make any job acceptable shall be subject to the approval of the Owner.
- 2.14.00 For quality assurance of all civil works refer to the specifications for civil works.
- 3.00.00 QUALITY ASSURANCE DOCUMENTS
- 3.01.00 The Contractor shall be required to submit two (2) copies and two (2) sets of microfilms of the following Quality Assurance documents within three (3) weeks after dispatch of the equipment:
 - a) Material mill test reports on components as specified by the specification.

- b) The inspection plan with verification, inspection plan check points, verification sketches, if used and methods used to verify that the inspection and testing points in the inspection plan were performed satisfactorily.
- c) Non-destructive examination results /reports including radiography interpretation reports.
- d) Factory tests results for testing required as per applicable codes and standards referred in the specification.
- e) Welder identification list listing welder's and welding operator's qualification procedure and welding identification symbols.
- f) Sketches and drawings used for indicating the method of traceability of the radiographs to the location on the equipment.
- g) Stress relief time temperature charts.
- h) Inspection reports duly signed by QA personnel of the Owner and Contractor for the agreed inspection hold points. During the course of inspection, the following will also be recorded :
 - i) When some important repair work is involved to make the job acceptable.
 - ii) The repair work remains part of the accepted product quality.
- i) Letter of conformity certifying that the requirement is in compliance with finalized specification requirements.

4.00.00 INSPECTION, TESTING AND INSPECTION CERTIFICATES

- 4.01.00 The Engineer, his duly authorized representative and/or an outside inspection agency acting on behalf of the Owner 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 Contractor shall obtain for the Engineer and for his duly authorized representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works.
- 4.02.00 The Contractor shall give the Engineer/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Contractor's account except for the expenses of the Inspector. The Engineer/Inspector, unless the witnessing of the tests is virtually waived, will attend such tests within fifteen (15) days of the date on which the equipment is notified as being ready for test/inspection failing which the Contractor 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 six (6) copies.
- 4.03.00 The Engineer or Inspector shall within fifteen (15) days from the date of Inspection as defined herein give notice in writing to the Contractor, 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 Contractor shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall confirm in writing to the Engineer/Inspector giving reasons therein, that no modifications are necessary to comply with the contract.

4.04.00 When the factory tests have been completed at the Contractor's or sub-contractor's works, the Engineer/Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests but if the tests are not witnessed by the Engineer/Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Contractor's test certificate by the Engineer/Inspector. Failure of the Engineer/Inspector to issue such certificate shall not prevent the Contractor from proceeding with the works.

The completion of these tests, or the issue of the certificates shall not bind the Owner to accept the equipment should it, on further tests after erection be found not to comply with the contract.

4.05.00 In all cases where the contract provides for tests whether at the premises or works of the Contractor or any sub-contractor, the Contractor, except where otherwise specified shall provide free of charge such items as labour, materials, electricity, fuel, water, stores, apparatus and instruments as maybe reasonably demanded by the Engineer/Inspector or his authorized representatives to carry out effectively such tests on the equipment in accordance with the Contractor and shall give facilities to the Engineer/Inspector or to his authorized representative to accomplish testing.

4.06.00 To facilitate advance planning of inspection in addition to giving inspection notice as per Clause 4.02.00, the Contractor 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.

REQUIREMENTS OF SPARES, TOOLS & TACKLE, LUBRICANTS/OIL/CONSUMABLES

1.00.00 TOOLS & TACKLE

The Contractor shall supply with the equipment one complete set of special tools and tackles required for the erection, assembly, dis-assembly & maintenance of the equipment. These special tools will also include special material handing equipment, jigs & fixtures for maintenance and calibration/re-adjustment, checking & measurement aids etc. A list of such tools & tackles shall be submitted by the Bidder along with the offer. Detailed description of each tool/tackles, its function along with the equipment/part for which it is meant for and the price of each tool/tackles shall also be indicated in the offer. These tools & tackles shall be separately packed and sent to site before the first unit commissioning. The Bidder shall also ensure that these tools are not used for erection purpose.

2.00.00 SPARES

2.01.00 General

The Bidder shall indicate and include in his scope of supply all the necessary start-up, commissioning and recommended spares in addition to mandatory spares as specified elsewhere in the specification. The Owner reserves the right to buy any or all mandatory and recommended spares. The Contractor shall also state for each item of spares both mandatory and recommended, the normal expected service life.

2.01.01 All spares supplied under this contract shall be strictly interchangeable with the parts for which they are intended to replace. The spares shall be treated and packed for long storage under the climatic conditions prevailing at the site, e.g. small items shall be packed in sealed transparent plastic bags with desiccator's packs as necessary.

2.01.02 Each spare part shall be clearly marked or labeled on the outside of the packing with the description. When more than one spare part is packed in single case, a general description of the contents shall be shown on the outside and a detailed list enclosed. All cases, containers and other packages must be suitably marked and numbered for the purposes of identification.

2.01.03 All cases, containers or other packages are liable to be opened for examinations may be considered necessary by the Engineer.

2.01.04 All mandatory spares shall be delivered to site within one to three months prior to the scheduled date of the trial operation of the plant. However, they shall not be dispatched before the dispatch of the associated main equipment.

2.01.05 The Bidder shall also guarantee supply of spare parts, which will be made, based on manufacturer's drawings on special order from the Purchaser for 30years after commissioning of the plant.

2.01.06 Warranty period for all kinds of spares shall be six thousand (6000) hours of operation, except normal wear or eighteen (18) months from the date of receipt at site, whichever is later. In case of failure or non-conformance to specifications, the Contractor shall replace them free of cost.

2.02.00 Recommended Spares

2.02.01 The Contractor shall provide a list of recommended spares giving unit prices and total prices for 2 years of normal operation of the plant for spares of indigenous origin, and for 5 years of normal operation for spares of non-indigenous origin. This list shall take into consideration the mandatory spares specified elsewhere in the specification and should be a separate list.

2.02.02 The price of recommended spares will not be used for the evaluation of bids. The price of these spares shall remain valid for a period as specified elsewhere in the specification from the date of Award of the Contract. Where the recommended spares are the same as mandatory spares, the prices shall be the same. The prices of any recommended spares, which are not common with mandatory spares, shall be subject to review by the Owner, and shall be finalized after mutual discussion.

2.03.00 Start-up Commissioning Spares

2.03.01 Start-up commissioning spares are those spares which may be required during the start-up and

commissioning of the equipment/system. All spares used until the plant is handed over to the Owner shall come under this category. Said spares, properly marked, shall be supplied together with the main equipment and shall be used by the Contractor, if needed, during erection & commissioning stage. All such spares which remain unused till issuance of Taking Over Certificate by the Owner, along with an equipment-wise quantitative consumption report shall be returned to the Owner during time of handover. The list of commissioning spares to be brought by the Contractor to ensure smooth commissioning of the plant shall be subject to the Engineer's approval.

2.03.02 The Contractor shall submit a complete list of all such start-up spares. Costs of the above spares, which are consumed before the handing-over of the plant, shall be deemed to have been included in the lump sum proposal price of the package, and the Contractor shall have no claim on this account to the Owner.

2.04.00 Mandatory Spare Parts

2.04.01 The Owner considers some of the spares are essential for running the equipment irrespective of whether they are included in the list of recommended spares by the Bidder as mentioned above. Since the components involved can not be foreseen at the bidding stage, only broad requirements of the Owner in this respect are outlined hereinafter. The bidder shall include his proposal, on the basis of this guideline, an item-wise list of all components and the quantity, unit prices & total price thereof, offered as mandatory spares for each and every equipment. This list shall be separate from the list of recommended spares and shall be used for bid evaluation purposes. Any clarification in this respect may be obtained by the Bidder at the pre-bidding stage.

2.04.02 Since the components involved can not be foreseen at the bidding stage, only broad requirements of the Owner in this respect are outlined hereinafter. The Bidder shall include in his proposal, on the basis of these guidelines, an item wise list of all components and the quantity, unit prices & total price thereof, offered as mandatory spares for each and every equipment. This list shall be separate from the list of recommended spares and shall be used for bid evaluation purposes. Any clarification in this respect may be obtained by the Bidder at the pre-bidding stage.

2.04.03 The mandatory spares should be supplied to the Owner at least one month before the trial run. The dispatch programme is subject to approval of the Owner/Consultant after award of contract.

ANNEXURE-I

FORMAT OF QUALITY ASSURANCE PROGRAMME

Name of Company/ Contractor	NAME OF CONTRACT PACKAGE		QUALITY PLAN FOR							
	Package No. : _____		QP No. : _____ Date _____							
	Contractor : _____		Rev. No.: _____ Date _____							
Sl. No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check	Reference Document	Acceptance Norm	Format of Record	Agency	Remarks

Note: All the information for QAP as stipulated above shall be finalized and agreed during contract execution.

ANNEXURE-II

FIELD WELDING SCHEDULE

PROJECT : FWS NO :
CONTRACTOR : REV NO. :
PACKAGE : FIELD WELDING CODE :
SYSTEM : PAGE NO. :

Sl No.	Drawing No. for Weld Locations & Identification mark	Description of parts to be welded	Material specification	Dimensions	Process of Welding	Type of Weld	Electrode Filler Specification	WPS No.	Minimum Pre-heat Temperature	Heat Treatment Temperature [Holding Time in secs]	NDT Method Quantum	NDT Specification Number	Acceptance Norm Ref.	Remarks
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The Field Welding Schedule should be submitted for :

- ☐ Pressure Parts
- ☐ Tanks/Vessels
- ☐ Piping
- ☐ Heavy/Important Structural Steel
- ☐ Heat Exchangers
- ☐ Bus Ducts

Gujarat State Electricity Corporation Ltd.

400kV Switchyard Extension and

400 kV Switchyard for GIS for 1x800 MW Supercritical Thermal Power Project

Technical Specification for 400 kV, 50kA Gas Insulated Substation

Bharat Heavy Electricals Ltd.

Doc. No. TB-375-316-001, Rev. No.00

SECTION 4

GUARANTEED TECHNICAL PARTICULAR

As per GSECL Technical Specifications enclosed as below:

SCHEDULE-IIIC/23 FOR 400KV GAS INSULATED SWITCHGEAR

VOLUME: V3/C/Sch-XXIII/1

SCHEDULE-IIIIC/23

400kV GAS INSULATED SWITCHGEAR

1.0	GIS SWITCHGEAR		
1.1	Reference standard	:	
1.2	Type of design		
	Construction	:	
	Enclosure	:	
	Conductor	:	
1.3	Service	:	
1.4	Rated Voltage	:	KVrms
1.5	Phase	:	
1.6	Rated Frequency	:	 Hz
1.7	System grounding	:	
1.8	Design ambient temperature	:	---°C
1.9	Rated continuous current at design ambient temperature	:	
	Bus bar	:	/...../..... A
	Line/trafo/ cable/bus coupler feeders	:	/...../...../..... A
1.10	Temperature Limit		
	Conductor	:	... °C
	Enclosure portion)	:	°C /.....°C (for accessible
1.11	Short Circuit Rating		
	Rated short time withstand current	:	Karms
	Duration	:	Sec.
1.12	Rated peak withstand current	:	KVpeak

1.13	Insulation level	:	
	a) Rated one minute power Frequency withstand voltage	:	---KV (r.m.s)
	Phase- Phase		
	Phase- Earth		
	b) Rated Lightning impulse withstand voltage	:	---KV (peak)
	Phase- Phase		
	Phase- Earth		
	c) Rated switching impulse withstand voltage	:	---KV (peak)
	Phase- Phase		
	Phase- Earth		
1.14	SF6 gas		
	Characteristic	:	
	Leakage rate	:	less than% per year
	Rated filling pressure	:	Mpa
	Alarm pressure	:	Mpa
1.15	AC/DC Power Supply		
	Rated Control voltage	:	— V DC (—V - — V)
	Service voltage	:	240V, 1 Ph, 50 Hz
1.16	Termination details		
	Line feeder	:	Gas to air bushing
	Transformer feeder	:	Gas to oil bushing
1.17	Painting		
	Internal surface	:	
	External surface		
	a) base	:	
	b) Paint shade	:	

1.18	Support structure	:	
2.0	CIRCUIT BREAKER		
2.1	Reference Standard	:	
2.2	Type	:	
2.3	P o l e	:	
2.4	Rated Voltage	:	KV rms
2.5	Rated Frequency	:	 Hz
2.6	Mechanical Endurance Class	:	
2.7	Electrical Endurance Class	:	
2.8	Re-strike Probability Class	:	
2.9	Electromagnetic Compatibility (EMC)	:	
2.10	Rated Insulation Level		
	a) Rated one minute power frequency withstand voltage		
	- between phase to earth	:	KVrms
	- Across open contacts	:	KVrms
	b) Rated Lightning Impulse withstand voltage		
	- between phase to earth	:	KVpeak
	- Across open contacts	:	KVpeak
	c) Rated Switching Withstand Voltage		
	- between phase to earth	:	KVpeak
	- Across open contacts	:	KVpeak
2.11	Max.radio interference voltage at $1.1 U_{rated} / \sqrt{3}$	:	Micro-Volts
2.12	Rated continuous Current at design ambient temperature	:	 Arms
	Line/Trafo/Cable/Bus coupler	:	/...../...../.....Arms
2.13	Temperature rise over Design Ambient Temperature	:	°C

2.14	Rated Short-circuit breaking current		
	- Symmetrical	:	KArms
	- Percentage D.C. component	:	
2.15	Rated short-circuit making current	:	KA (peak)
2.16	Rated peak withstand current	:	KA (peak)
2.17	Rated short time withstand current for rated duration of 3 sec.	:	KArms
2.18	Rated line charging breaking current	:	KArms
2.19	Rated cable charging breaking current	:	KArms
2.20	Rated out of phase breaking current In % of rated Short Ckt. Breaking current	:	%
2.21	Rated out of phase making current In % of rated out of phase breaking current	:	%
2.22	Characteristic for short-line fault related to rated short-circuit breaking current	:	
2.23	Rated capacitive switching breaking (Arms) / in rush making current(KA peak)	:	KArms/KApeak
2.24	TRV Characteristics	:	
2.25	Inductive current breaking capability without exceeding	:	
2.26	First pole to clear factor	:	
2.27	Operating mechanism	:	
2.28	Opening time (ms)	:	
2.29	Closing time (ms)	:	
2.30	Rated Operating Sequence	:	
2.31	Rated Supply Voltage and frequency for		

	- Closing & Tripping	:	 V D.C
	- Heater/Lamp/Socket	:	
2.32	Nos. of trip coil per pole	:	
2.33	Minimum Creepage distance	:	mm
2.34	Noise level Dbat the base of CB	:	db
3.0	DISCONNECTING SWITCH		
3.1	Reference standard	:	
3.2	Type	:	
3.3	Pole	:	
3.4	Rated voltage	:	KV rms
3.5	Rated Frequency	:	Hz
3.6	Rated Insulation Level		
	a) One Minute Power Frequency Withstand Voltage	:	KVrms
	b) Rated Lightning Impulse Withstand Voltage across open gap	:	KVpeak
	c) Rated Switching Impulse Withstand Voltage	:	KVpeak
3.7	Rated Continuous current at site ambient	:	Arms
3.8	Rated Short time current for 3secs	:	 KA rms
3.9	Peak Withstand current	:	KA peak
3.10	Magnetising / capacitive current Make & brake ability	:	A
3.11	Operating Mechanism	:	
3.12	Operating voltage	:	220V Dc

4.0 MAINTENANCE GROUNDING SWITCH

- 4.1 Reference standard :
- 4.2 Type :
- 4.3 Pole :
- 4.4 Rated Insulation Level
- a) One Minute Power Frequency Withstand Voltage :KVrms
- b) Rated Lightning Impulse Withstand Voltage across open gap :KVpeak
- c) Rated Switching Impulse Withstand Voltage :KVpeak
- 4.5 Rated Short time current for 3secs : KA rms
- 4.6 Peak Withstand current :KA peak
- 4.7 Capacitive current switching ability :A
- 4.8 Operating Mechanism :
- 4.9 Operating voltage :V DC

5.0 FAST ACTING GROUNDING SWITCH

- 5.1 Reference standard :
- 5.2 Type :
- 5.3 Pole :
- 5.4 Rated Insulation Level
- a) One Minute Power Frequency Withstand Voltage :KVrms
- b) Rated Lightning Impulse Withstand Voltage across open gap :KVpeak
- c) Rated Switching Impulse Withstand Voltage :KVpeak
- 5.5 Rated Short time current for 3secs : KA rms

- 5.6 Peak Withstand current :KA peak
- 5.7 Inductive & Capacitive current switching ability :A
- 5.8 Operating Mechanism :
- 5.9 Operating voltage :V DC
- 6.0 CURRENT TRANSFORMER**
- 6.1 Reference Standard :
- 6.2 Type :
- 6.3 Rated continuous thermal Current :
- 6.4 Rated Insulation Level
- a. 1 minute 50 Hz withstand voltage
- o HV terminal & earth :KVrms
- o Secondary winding :KVrms
- b. Impulse withstand voltage :KVpeak
- c. Switching impulse withstand voltage :KVpeak
- 6.5 Short time current
- a) Short-time current for 3sec :KArms
- b) Dynamic current :KApeak
- 6.6 C.T. Ratios & Parameters :

Core No	Description	Current Ratio A/A	Output Burden VA	Acc. Class	ISF	Min. Knee-point voltage V_K (volt) at highest ratio KPV	Max Excitation Current I_e (m A) at KPV	Max CT Sec. Resistance R_{CT} (ohm) at highest ratio
Feeder type :								
Core-1								
Core-2								
Core-3								

7.0 VOLTAGE TRANSFORMER

- 7.1 Reference standard :
- 7.2 Type :
- 7.3 Insulation Level
- a. 1 minute 50 Hz withstand voltage
- o Main circuit :KVrms
- o Secondary circuit :KVrms
- b. Impulse withstand voltage :KVpeak
- c. Switching impulse withstand voltage :KVpeak
- 7.4 Voltage ratio & other parameters :

	Secondary - I	Secondary - II	Secondary – III
Voltage Ratio	$\frac{\text{.....KV/110V}}{\sqrt{3} \quad \sqrt{3}}$	$\frac{\text{.....KV/110V}}{\sqrt{3} \quad \sqrt{3}}$	$\frac{\text{.....KV/110V}}{\sqrt{3} \quad \sqrt{3}}$
Application	Protection	Protection	Metering
Output burden	 VA	 VA	 VA
Accuracy Class*			

(* within frequency variation range)

- 7.5 Voltage factor :
- 8.0 GAS TO AIR BUSHING**
- 8.1 Reference standard :
- 8.2 Type :
- 8.3 Rated continuous current at Site condition :Arms
- 8.4 Insulation Level
- a. 1- minute 50 Hz withstand voltage :Kvrms
- b. Impulse withstand voltage :KVpeak
- c. Switching impulse withstand voltage :KVpeak
- 8.5 Minimum creepage distance :mm/Kv

ANNEXURE-II

9.0 CONNECTION

- 9.1 Line termination details :
- 9.2 Cable termination details :
- 9.3 Transformer termination details :

10.0 BAY CONTROLLER

- 10.1 Type :
- 10.2 All interlock included :
- 10.3 Remote communication mode :
- 10.4 Communication protocol :

11.0 SUBSTATION AUTOMATION SYSTEM

1.0 General System Design

- 1.1 Write-up on the proposed system :
- 1.2 Proposed System Architecture :
- 1.3 Write-up on Communication system :
- 1.4 System protocol adopted :
- 1.5 Reference standard :

2.0 Device Details

(Catalogue for each device is to be furnished
Indicating make, type, and catalogue number)

- 2.1 Server Unit :
- 2.2 Bay Switch :
- 2.3 Communication Router :
- 2.4 Station LAN :
- 2.5 Station Terminal :
- 2.6 VOIP Router :
- 2.7 Tele protection :
- 2.8 Station Printer-1 :
- 2.9 Station Printer-2 :

SECTION 5

ENCLOSURES TO SPECIFICATIONS

ANNEXURE 2

CHECK LIST FOR INFORMATION TO BE FURNISHED WITH THE
OFFER (1 SHEET)

ANNEXURE 3

VENDOR LIST

Annexure-2

CHECK LIST FOR INFORMATION TO BE FURNISHED WITH OFFER

BIDDER SHALL PUT A TICK '✓' IF THE INFORMATION IS ENCLOSED WITH THE OFFER, PUT A CROSS 'X' IF THE INFORMATION IS NOT ENCLOSED OR WRITE 'NOT APPLICABLE' IF THE QUERY/ SCHEDULE IS NOT RELEVANT AND RETURN THIS CHECKLIST AS PART OF THE OFFER DULY SIGNED

The offer may not be considered if the following information and this Checklist are not enclosed with the offer.

BIDDER: OFFER REFERENCE:

1. Technical offer with detailed schedules of equipment/ material and spares _____
2. Guaranteed Technical Particulars _____
3. List of past supplies complete with purchase Order & Project name, quantity, order reference, etc. where identical equipment have been supplied. _____
4. Manufacturer's quality plans for approval _____
5. Field Quality plan for approval _____
6. General Arrangement drawings with dimensions and weights and foundation/fixing details _____
7. Drawing/data submissions schedule _____
8. Type test reports. The type test reports shall be accompanied with a list listing all the relevant clauses of the applicable standard and the corresponding type test report. The manufacturer shall also furnish a certificate certifying that the test reports have been carried out on equipment identical in all respects to the one offered. In case the reports are for different equipment and the applicability of the report is permitted as per applicable standards, the justification shall be enclosed to the list of type test reports. _____
9. Bar Chart showing time schedule showing time required for design, manufacture, test and inspection, transport, erection, site testing and commissioning _____
10. Makes of all important components, like motors, operating switches, fuses, etc. _____
11. Provenness Data _____
12. Any additional information called for in any part of the technical specification. _____

Date:

Signature of the authorized representative of Bidder

Company Seal

SR. NO.	DETAILS OF EQUIPMENT/SYSTEM	FINAL APPROVED VENDOR
	ELECTRICAL	
1	Protective Relays	ABB, JYOTI, SIEMENS, ESSUN & RAY, ROLLE, GEC, ALSTOM, L&T, CSEG, MAKE OF MAIN PROTECTIVE RELAY SHALL BE RESTRICTED TO AREVA/ABB/ SIEMENS AS PER NIT.
2	AUXILIARY RELAY	BCH,GEC, ALSTOM, L&T, SIEMENS,ABB
3	OVER LOAD RELAY/ THERMAL OVER LOAD RELAY	L&T, SIEMENS, TELEMCHANIQUE & CONTROLS, ABB, BCH,CGL, SCHNEIDER, SPACEAGE-HYUNDAI
4	PROTECTIVE RELAY/ MOTOR PROTECTION RELAY	ABB, ALSTOM, GEC, EASUN, Siemens, Areva
5	TIMER/ AUXILIARY CONTROL RELAY	ABB, BCH, GEC,L&T, ALSTOM,SIEMENS, TELEMCHANIQUE & CONTROLS.
6	INTER POSING RELAY FOR COMMANDS O/P TO MCC	JYOTI, H&B, GEC, ALSTOM, OEN, OMRON, HONEYWELL ENGLISH ELECTRICAL,SIEMENS ,ABB
7	MCCB	GE, HAVELLS, MDS, L&T, SIEMENS, STANDARD, SPACE AGE, HUNDAI, SCHNEIDER, CGL, NGEF, ALSTOM, CONTROL & SWITCHGEAR CO. LTD.
8	MCB	CGL, GEC, ALSTOM, HAVELLS, MDS, L&T, SIEMENS,STANDARD, SCHNEIDER, NGEF, ABB
9	FUSES & FUSES SWITCH ON / OFF SWITCHES /HRC FUSES WITH BASE	GEC, ALSTOM, L&T, NGEF, SIEMENS, COOPER BUSMAN, EE, STANDARD
10	SWITCH SOCKET OUTLET INDUSTRIAL	BCH, BEST & CROMPTON, CGL, GEC, REY ROLLE, BARN, ANCHOR.
11	AMMETER & VOLTMETER	AUTOMATIC ELECTRIC,ABB,IMP, MECO, L&T, RISHAB, SILKANS
12	METAL CLADE PLUG & SOCKET(INCLUNIND WELDING SOCKET)	BCH, BEST & CROMPTON, CGL, EE, REY ROLLE, BARN, EASUN
13	HT AC MOTORS	BHEL, CGL, GEC, ALSTOM,KIRLOSKAR ELECTRIC CO; NGEF, SIEMENS, ABB, GE, HITACHI, TOSHIBA, LG,JYOTI LIMITED MARATHON ELECTRICAL, ANSALOD (ITALY), MELCO (JAPAN)

SR. NO.	DETAILS OF EQUIPMENT/SYSTEM	FINAL APPROVED VENDOR
	ELECTRICAL	
14	LT AC Motors	ABB, CROMPTON GREAVES, ALSTOM INDUSTRIAL, GEC, KIRLOSKAR ELECTRIC CO;NGEF, JYOTI, SIEMENS, BHARAT BIJLEE LTD; LG , TOSHIBA, ANSALDO, GE, MELCO, MARATHON , BHEL
15	LT AC Geared Motors	GEC, ALSTOM, KIRLOSKER, ELECTRIC CO.
16	DC Motors	GE-USA OR EQUIVALENT ALSTOM LTD/BHEL/ CROMPTON GREAVES LTD./GE/ KIRLOSKAR ELECTRIC CO. LTD. , SIEMENS / MELCO/ ABB
17	Thruster brake	ELECTROMAG DEVICES, STROM KRAFT CONTROLS
18	DC Electro magnetic Brakes	BCH, ELECTROMAG DEVICES, STROM KRAFT CONTROLS, ELECTRONICS & POWER CONTROL .
19	Pull Cord Switch,Belt Sway Switch / Relay	AG MECHANICAL ENTERPRISE, AG SYSTEM CONTROL, DEV ENTERPRISE, PBL.
20	CONTROL/ SELECTOR SWITCH	BCH, GEC, ALSTOM, JYOTI, KEYCEE, RECOM, RICO, SWITRON, ABB, L&T, SIEMENS, KROUS-NAIMER SALZER
21	PUSH BUTTONS	BCH,GEC, ALSTOM, L&T, TELKNIC, SIEMENS, VAISHNO, RASS CONTROL
22	TERMINAL BLOCK	CONNECTWELL, ELEMAX, TECHNOPLAST , TOSHA, VINPAR, PHOENIX, WAGO
23	CT's & PT's	A.E., ABB, ASEA, G&W, GUJARAT PLUGIN (DIGITRONICS), JYOTI, KAPPA , ECS, SIEMENS,AVK-SEG & CONTROLS, PRECISE,INSUTECH., PRAYOG
25	CONTROL TRANSFORMER	A.E., AMAN , GUJARAT PLUGIN (DIGITRONICS), GUJ.TRANSFORMER, INDUSTRIAL PRAYOG, NEG, LOGICSTAT ,AVK-SEG & CONTROLS ,PRECISE

SR. NO.	DETAILS OF EQUIPMENT/SYSTEM	FINAL APPROVED VENDOR
	ELECTRICAL	
27	NEUTRAL GROUNDING TRANSFORMER	PS ELECTRICALS, PRAYOG, INTRA-VIDYUT, AMEX-IMPEX, DU PONT-RELIA TRAN. VOLTMP. VIJAY ELECTRICALS
29	415 V MCC & PMCC	L&T, SIEMENS, GE POWER, CONTROLS AND SWITCH GEAR, SCHNEIDER, CONTROLS & SCHEMATICS, SPACEAGE SCHNIDER/ AREVA
30	ESP/ AUXILIARY CONTROL PANEL & LT MAIN SWITCH BOARD	LARSON & TOUBRO LTD; CHENNAI, SIEMENS INDIA LTD; CHENNAI, SCHENIDER ELECTRIC-NASIK, CONTROL& SWITCH GEAR CO. LTD; NEW DELHI
31	CONTROL PANEL FOR CWP	PROCON-INDIA, PANAM CONTROLS-INDIA, PYROTECH-UDAIPUR
32	415 V / 3 PHASE/ AC SQ . INDUCTION MOTOR	KIRLOSKAR, BBL, SIEMENS, ABB CROMPTON, GE,MARATHON,ALSTOM
34	CONTACTOR	ABB, BCH, L&T, TELEMCHANIQUE & CONTROLS (I) LTD., SIEMENS, SCHNEIDER, SPACEAGE-HYUNDAI
35	MOTORISED ACTUATORS(ELECTRICAL ACTUATOR) FOR VALVE / GATE/ FLAPS/DAMPERS etc.	AUMA , BEACON , ROTORK, LIMIT TORQUE, TECHNO-MECH, ACTUATORS INDIA, PRECISION, CONTINENTAL PROFILES, HMT
36	Actuator (Electrical & Pneumatic)	AUMA , BEACON , ROTORK, LIMIT TORQUE, TECHNO-MECH, ACTUATORS INDIA, PRECISION, CONTINENTAL PROFILES, HMT SMC PNEUMATICS/BACHMANN/KELTROL CONTROL/INSTRUMENTATION LTD/HEIN-LEHMANN
37	HOOTER/ BELLS	ILK, INSTALARM, PROCON.
38	INDICATING METERS	AUTOMATIC ELECTRONIC LTD; GEC, ALSTOM, L&T, IMP, MECO RISHABH / CONZERV/ENERCON

SR. NO.	DETAILS OF EQUIPMENT/SYSTEM	FINAL APPROVED VENDOR
	ELECTRICAL	
39	LIGHT FITTING LUMINAIRES	BAJAJ, CROMPTON , PHILIPS, WIPRO, SPACEAGE FOLLOWING PACKAGE SUPPLIER USING ABOVE MAKE IS ACCEPTABLE :- L N T/PHILIPS/SPACEAGE/TECHNO ELECTRICAL/BAJAJ/CGL) Energy efficient type GE /CGL/ L&T/TECHNO ELECTRICAL Flame proof type BALIGA/CEAG/BAJAJ, CGL , PHILIPS
40	CABLE GLAND	BRACO, COMET, CONTRACT, HARDWARE INDUSTRIES, ELECT ENG; LAPP
41	CABLE TRAYS	AV ENGINEERS, BARODA GALVANISERS, INDIANA, NIRMAL ENGG; PAREKH ENGINEERS, VATCO, SADHNA, JAMNA METAL
43	CONTROL PANEL, CONTROL DESK, AUXILIARY PANEL & INDICATING DESKS	ABB, BEST & CROMPTON , ELEMECH, GEC , ALSTOM , NIRMAL , NGEF, OSAKA , SIEMENS , TLK, EASUN REYROLL, ELPRO, L&T, PYRO TECH , PROCON , RITTAL, BELLS, FOX BORO , ILK, APW, PECON
44	MOSAIC GRIDS	SUB-KLEW – GERMANY,SIEMENS – GERMANY ,SYMO - SWITZERLAND/PYROTECH, ICA
45	MOSAIC GRID PANELS	PYROTECH, ICA/ SUB-KLEW – GERMANY,SIEMENS – GERMANY ,SYMO - SWITZERLAND PYROTECH/IL KOTA/CHENNAI CONTROLS ADDITIONAL SUB VENDOR CONTROL & SCHMATICS/VIMAC/RITAL
46	THYRISTOR PANELS	ABB, KIRLOSKAR, L&T, OSAKA, SIEMENS
47	RELAY PANELS	ALSTOM, ABB, EASUN REY ROLLE
48	415 V 240V AC 24 V DC LIGHTING DISTRIBUTION BOARD/DCDB 415 V PCCs	USHA ENGINEERS , SHEETAL ENGRS., ELECTRICAL FABRICATION AND ERECTION,BARODA, INDUSTRIAL CONTROLS, PBB, OSAKA, ELEMECH, NIRMAL, TECHNO ELECT., L&T, SIEMENS, ALSTOM, GE POWER, CONTROL & SWITCH GEAR, CONTROLS & SCHEMATICS, HEI, SPACEAGE, VIDYUT CONTROLS, KRYPTON, ADLEC, ADVANCE, RITTAL, JASPER ENGG., HENSEL, HAVELLS , INDO ASIAN, NATIONAL ENGRS., STEMEC , MAKTEL SYSTEM, POPULAR SWITCHGEAR, SINTEX
50	TERMINAL BOX	GEC, ALSTOM, ASEA, CONNECT WELL, ELMEX

SR. NO.	DETAILS OF EQUIPMENT/SYSTEM	FINAL APPROVED VENDOR
	ELECTRICAL	
51	PANEL HEATERS & THERMOSTATE	VILECO, ANCO, RANUTROL, CSC, ISO TEMP., KC & SONS, TEMPTROL
52	KWH METER/Mvar meter/MW/Energy meter	IMP, GEC, SIMCO, SIEMENS, ENERCON
53	MINITURE PB/ ILLUMANATED PB	H&B, IL, SYLO
54	PUSH BUTTONS FOR FIELD MOUNTED PANELS	SIEMENS, L&T, C&S-NEW DELHI.
55	SINGLE LAMP FOR FIELD MOUNTED PANELS	SIEMENS, L&T, GEC, ALSTOM, TECHNIC
58	LT XLPE POWER CABLES AND PVC CONTROL CABLES	HAVELLS, TORRENT, NICCO, FINOLAX, RAVIN, GOVIND , LAPP, INDUSTRIAL CABLES, KRISHNA ELECTRIC, FINE CAB., SPL CABLES, RADIANT, SUYOG, PARAMOUNT, VIKAS CABLES, CORDS, ALPHA, GEMS CAB. , TCL, ROLLEX, KEI, CRYSTAL, POLYCAB, DELTON, RELIANCE ENGINEERS, RPG, ASSOCIATE CABLES, ELKAY TELELINKS, UNIVERSAL, FGI CCT/I/UNIVERSAL
65	ANNUCIATION	IL- KOTA, PROCON, RIS TRICON, RONAN. MASSIBUS, PYRO TECH. IIC
66	ANTI- SURGE CONTROLLER	MTL, P&F, PHONEIX
67	SURGE ABSORBER	MTL, WEIDMULLER, P&F
68	ERECTION HARDWARE	MICROPRECISION, WESMEC ENGG., MET PRESS, SMC PNEUMATIC, SAPAG
69	AC To DC Convertor	PHOENIX, SIEMENS, COSEL-GERMANY

Make of any other equipments / item / components not specified in the above list shall be subject to the approval of Purchaser.

Note:

SECTION – 6
CHECK LIST FOR 400KV GIS

Sl.	Particulars	Reply by bidder.	
1	TECHNICAL QUALIFYING REQUIREMENT		
1.1	The bidder should comply with the technical qualifying requirement and furnish the relevant documents	Confirmed	Yes/No
1.2	The bid shall be submitted by the Manufacturer of GIS. The bidder's scope includes supply and services like • supervision of installation, • testing and commissioning. Bids submitted by agents 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 shall be in scope of bidder. The erection of structure shall be done by BHEL.	Confirmed	Yes/No
2.4	Confirm that the consumables (list to be enclosed by bidder during contract stage) with shelf life of fewer than two years shall be supplied before erection after clearance from BHEL.	Confirmed	Yes/No
2.5	Detailed list of Commissioning spares for testing & commissioning of GIS till handing over	Attached	Yes/No
2.6	Detailed list of Tools & tackle & Testing Equipment	Attached	Yes/No
2.7	The Switchgear shall be complete with all necessary terminal boxes, SF6 gas filling, interconnecting power and control cables (between GIS to GIS/GIS to LCC/ LCC to LCC) , grounding connections, (GIS top GIS, GIS to earth mesh on floor) gas monitoring equipment and piping, inspection windows , support structures.	Confirmed	Yes/No
2.8	The scope of supply shall also include all erection and mounting hardware and interconnecting cables within GIS.	Confirmed	Yes/No
2.9	Design philosophy of earthing submitted with the bid (in line with sec 5.12.0 of section 2)	Confirmed	Yes/No
2.10	Supply of Earthing Material and Erection of all Earthing connection for GIS to GIS and GIS to Earth Mesh on Floor shall be in bidder's scope.	Confirmed	Yes/No

	The quantity shall be estimated by the bidder, based on their design philosophy. Supply of Earthing Material and Erection of Earth mesh on floor shall be done by BHEL in supervision of manufacturer as per manufacturer's design. Design philosophy shall be submitted along with the bid in line with Clause 5.12.00 (page no. 17) of section 2 to be followed for earthing. Only supply of MS Rod (40mm Dia for outdoor below ground earth mat) and GI Flat of 75x12mm or MS Rod as recommended by bidder (for earth mesh on floor) shall be in BHEL's scope. Any other earthing material if required shall be in bidder's scope of supply and erection.		
2.11	Length of bus duct shall be estimated by the bidder based on drawings provided in the bid. Any change in bay pitch (distance between bays) as per civil requirement for foundation layout during detailed stage shall be incorporated by bidder without any cost and delivery implication to BHEL.	Confirmed	Yes/No
3	Technical		
3.1	Details regarding the design features of equipment which are intended to prevent burn through when an internal arc occurs.	Enclosed with bid	Yes/No
3.2	Material of enclosure - Al./ steel	Confirmed	Yes/No
3.3	Material of bus bar - Al./ Cu. alloy	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 alongwith 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	Insulation co-ordination study shall be conducted and based on the same the number & location of surge arresters shall be decided. The rating, number and location of surge arresters shall be indicated with the bid. Any increase in quantity at the time of detailed engineering shall be on bidder's account.	Confirmed	Yes/No
4.5	Measures to limit external overvoltages (e.g. surge arresters) should be considered and detailed out based on the site conditions of altitude etc.	Enclosed with bid	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
6	Barchart		
6.1	Bidder will submit detailed bar chart indicating all the milestones from Engineering till manufacturing/ testing, dispatch to site and commissioning based on the drawing & document schedule attached in section1.	Confirmed	Yes/No
7	Conditions		
7.1	<i>Covered Store will be provided by BHEL for items which require indoor storage. The size of covered store shall be 10 m X 20 m.</i> <i>Manufacturer to mark Indoor storage requirement on the material to be stored in covered storage. The rest of the material shall be stored outdoor.</i>	confirmed	Yes/No
7	Site Test		
7.1	Only special tools shall be in bidder's scope. 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. HV Test kit shall be in scope of bidder.	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 bidder, 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	The 420kV GIS should have been type tested (as per relevant IEC). The GIS and equipment/components shall be of same make and type as that used in type test.	Confirmed	Yes/No
8.2	Type test report for 420 kV GIS shall be submitted along with the bid. Differences, if any, in the items offered and those which have been type tested shall be clearly brought out along with explanation for suitability. Type test reports submitted alongwith the bid shall be subject to review and approval at contract stage)	Confirmed and enclosed with bid	Yes/No
8.3	In case the test reports are not found technically valid during contract stage by BHEL/GSECL, the bidder shall repeat these test(s) at no extra cost to the purchaser and no delivery implication.	Confirmed	Yes/No

	Technical valid - Any error or incompleteness (any/all additional type tests not carried out) or discrepancy in the test reports vis-à-vis offered equipment due to any design / manufacturing changes (including substitution of components) or non-compliance with the requirement stipulated in the Technical Specification.		
8.4	Earthquake - In case the bidder has not type tested a similar module for earthquake withstand test, they shall supply supporting design calculations of simulated parameters of the test.	Confirmed	Yes/No
8.5	The type tests conducted earlier should have either been conducted in an accredited independent laboratory (accredited base on ISO / IEC Guide 25 / 17025 or EN 45001 by the national accreditation body of the country where laboratory is located). The short circuit test should have been conducted in a laboratory which should be a member of STL (Short-Circuit Testing Liaison - www.stl-liaison.org). If the laboratory is not a national laboratory and member of STL, relevant papers of accreditation shall be submitted in English. If the laboratory is in-house, the tests should have been witnessed by a client.	Confirmed. Details provided with bid.	Yes/No
8.6	The type test report shall be complete including list the test objects, photographs, oscillographs, test arrangement, drawing of tested objects (GIS, equipment etc), test connections. The type test report shall be in English. If it is in any other language, it should include an English version (Translation shall be attested by the Bidder). The English version should be complete with measured values and conclusion.	Confirmed	Yes/No
8.7	The contractor /bidder shall submit the type test reports for the tests conducted as per the relevant IEC/IS on the equipment similar to those to be supplied under this contract and the tests should have been conducted at a laboratory not earlier than five (5) years prior to 05.09.2014. In case the contractor is not able to submit valid Report of Type Test(s) or in case Type tests Reports are not found to be meeting the specification requirements, or not including all specified tests the contractor shall conduct all such tests under this contract. The costs of such test shall be deemed to be included in the price. The GSECL/BHEL shall have right to witness the Type Tests. Waiver of Type Tests will not be entertained in normal circumstances. 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.		

TYPE TESTS

Sl. No.	Type test	LAB	Report No. & Date
A	List of type test reports to be submitted for GIS equipments - Tests to verify the insulation level of the equipment and dielectric tests on auxiliary circuits. - Tests to prove the radio interference voltage (RIV) level (if applicable). - Tests to prove the temperature rise of any part of the equipment and measurement of the resistance of the main circuit. - Tests to prove the ability of the main and earthing circuits to carry the rated peak and the rated short time withstand current. - Tests to verify the making and breaking capacity of the included switching devices. - Tests to prove the satisfactory operation of the included switching devices. - Tests to prove the strength of enclosures. - Verification of the degree of protection of the enclosure. - Gas tightness tests - Electromagnetic compatibility tests (EMC). - Additional tests on auxiliary and control circuits. - Tests on partitions. - Tests to prove the satisfactory operation at limit temperatures. - Tests to prove performance under thermal cycling and gas tightness tests on insulators. - Corrosion test on earthing connections (if applicable). - Tests to assess the effects of arcing due to an internal fault.		