BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION BUSINESS ENGINEERING MANAGEMENT
NOIDA

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TYPE OF DOC.	TECHNICAL SPECFICATION	NAME	RKP	SKS	RS
400KV GAS INSULATED SWITCHGEAR (GIS) (SUITABLE FOR COASTAL AREA)		SIGN	-Sd-	-Sd-	-Sd-
		DATE	16.05.15	16.05.15	16.05.15
		GROUP	TBEM		
		W.O. No	84007		

CUSTOMER/	**TAMILNADU GENERATION AND DISTRIBUTION CORPORATION (TANGEDCO) /**
CONSULTANT	**DESEIN PRIVATE LIMITED, NEW DELHI**
PROJECT	**400kV GIS at 2 x 660 MW Ennore SEZ Supercritical Thermal Power Project at Ash Dyke of NCTPS**

Contents:

Rev	Date	Altered	Checked	Approved
01	.06.15		SKS	Rakesh

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SECTION – 1

1. SCOPE

This technical specification covers the requirements of design, manufacture, testing at works, packing, and dispatch, supervision of erection, testing & commissioning of 400 kV GIS.

This section covers the scope and quantities of 400 kV GIS. The Specific Technical Requirements for the above item as specified by the customer 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 TANGEDCO Specification
d. International standards

1.1 The equipment is required for the following project:

a)	Project	: **400kV GIS at 2 x 660 MW Ennore SEZ Supercritical Thermal Power Project at Ash Dyke of NCTPS**
b)	Customer	: **TAMILNADU GENERATION AND DISTRIBUTION CORPORATION (TANGEDCO)**
c)	**Consultant**	: **DESEIN PRIVATE LIMITED, NEW DELHI.**
d)	Main Contractor	: **BHEL**

1.2 GENERAL PROJECT DETAILS :

1.2.1 Introduction

Tamilnadu Generation and Distribution Corporation owns the proposed green-field 1320 MW (2 units of 660 MW each) Coal Based Thermal Power Station at Katupalli. This is an expansion of North Chennai Thermal Power Station (NCTPS) and located on some portion of the ashdyke of NCTPS.

1.2.2 Location

The proposed site for main power plant is located near Ennore port (approx 5 kms). The nearest Railway station is at Athipattu Pudunagar (approx 5 kms) All weather road from Pattamandri on the Thiruvottiyur-Ponneri district highway is the nearest road access. The nearest airport is at Chennai at a distance of 60 km. It is located near Sea Coast.

1.2.3 Type of Plant

The proposed 2x660 MW Super-Critical Power Project consists of coal fired steam generator connected to a reheat type steam turbine generator along with all the required auxiliaries. Circulating cooling water system is envisaged for condenser cooling. Details shall be as per BOQ, Drawings & Technical specification.

1.2.4 Power Evacuation

Power will be evacuated from the proposed thermal power station at 400 KV voltage level through 400 KV transmission lines . The power evacuation lines would be double circuit 400 KV lines which will act as Line in & Line out circuit.

1.2.5 400 KV GIS Switchyard

The 400 KV Switchyard is proposed to have one and a half bus arrangement and will comprise following circuits :

- 2 – Generator transformer bays
- 1– Start up transformer bay
- 4 – Line Bays
- 2 – Bus VT's
- 2 – Bus Reactor Bays
- 1 – Equipped bay for future GT
- 2 – Equipped bays for future lines
- 6 – Tie Bays

Above is brief description of GIS, bidder to quote in line with BOQ.

1.3 SITE INFORMATION

Refer section-3 for Site information and metrological data.

1.4 It may be noted that:

- *The covered Store will be provided by BHEL for items which require indoor storage. The size of covered storage shall be 10meter X 20meter.*
- *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. These 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.
- *Bar Chart shall be approved by BHEL before commencement of work.*
- For system details and transport limitation refer Project Information in section 3.
- *Project site Ennore is located in "Coastal Area" near Chennai hence design, material selection and construction of GIS should be suitable for the climate/ Meteorological Condition as mentioned above and in section-3. Also, Packing of GIS shall be suitable for long term (minimum 2 years) outdoor and indoor storage of GIS in such conditions .*
- *Bidder shall offer their latest Type 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.*
- *Successful bidder shall submit 3D OGA drawing for complete GIS and section drawing of each equipment. OGA drawings to shall also be furnished in AutoCad file format.*

- *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.*

2. SPECIFIC TECHNICAL REQUIREMENT
As per section 2

3. BILL OF QUANTITIES:
As per Annexure-I

4. Documents to be submitted for TANGEDCO approval:
Drawing documents submission schedule shall be As per Cl 15.00.00, 16.00.00 of Section-2 and Chapter-4 of Section-3 Bidder to submit the documents with offer and for approval after PO placement as per schedule indicated. Bidder to confirm the list and schedule.

5. 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 8.00.00 of section 2.
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.

6. Type Testing

6.1 The contractor/ bidder shall submit the Type Test Reports for the tests conducted as per 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 **supply** under this contract.

6.2 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 TANGEDCO/BHEL shall have right to witness the Type Tests. Waiver of Type Tests will not be entertained in normal circumstances.

6.3 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.

6.4 The contractor / bidder shall submit the following Type Tests Reports for the tests conducted on the GIS Package. However any other Type Tests reports not mentioned but required shall also be submitted.

Type Tests:

FOLLOWING TYPE TESTS REPORTS TO BE SUBMITTED FOR 400 kV GIS EQUIPMENTS

1. Tests to verify the insulation level of the equipment and dielectric tests on auxiliary circuits.

2. Tests to prove the radio interference voltage (RIV) level (if applicable).

3. Tests to prove the temperature rise of any part of the equipment and measurement of the resistance of the main circuit.
4. Tests to prove the ability of the main and earthing circuits to carry the rated peak and the rated short-time withstand current.

5. Tests to verify the making and breaking capacity of the included switching devices.

6. Tests to prove the satisfactory operation of the included switching devices.

7. Tests to prove the strength of enclosures.

8. Verification of the degree of protection of the enclosure.
9. Gas tightness tests

10. Electromagnetic compatibility tests (EMC)

11. Additional tests on auxiliary and control circuits.

12. Tests on partitions.

13. Tests to prove the satisfactory operation at limit temperatures.

14. Tests to prove performance under thermal cycling and gas tightness tests on Insulators.
15. Corrosion test on earthing connections (if applicable).

7. Drg. Enclosed

Sl. No.	BHEL /TANGEDCO Drg. No.	Drawing Title	Rev
1.	TB-1-378-510-001	Single Line diagram of 400kV GIS Substation	01
2.	TB-0-378-316-002	Layout drawing for 400kV GIS Substation Ennore	00

Note: Refer attached layout drawing, GIS Building Size considered is 15x75m, consists of space for maintenance = 5m on both side. GIS to be supplied should be accommodated in above area.

8. 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 TANGEDCO in accordance with quality assurance plan.

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 Manufacturing Quality Assurance Plan (MQP) and Field Quality Plan for BHEL / customer's approval.

10. INFORMATION TO BE FURNISHED BY THE CONTRACTOR/ SUB CONTRACTOR

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

Sl.No	SL	Description	Remark_Detailed_Description	Unit	Qty
	A)	**Supply Item - 400kV GIS as per enclosed SLD with One and Half Breaker scheme comprising of Items A1-A18**	The 400 KV SF6 gas insulated switch gear shall have One and Half Breaker arrangement. The SF6 gas insulated switch gear (50 HZ) shall be of the indoor metal- enclosed type, comprising of following bays:- a) Two (2) Generator Transformer bays b) One (1) Start up transformer bay c) Four (4) Line bays d) Two (2) Bus VTs e) Two (2) Bus Reactor bays f) One (1) equipped bay for future GT g) Two (2) equipped bays for future lines h) Six (6) Tie Bays. The Switchgear shall be complete with all necessary terminal boxes, inspection window, SF6 gas filling, interconnecting power and control wiring, grounding connections, gas monitoring system and piping, Trays, 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, ferrules, Lugs etc.	lot	1

l.No	SL	Description	Remark_Detailed_Description	Unit	Qty
1	A1	Phase isolated, 400kV, 63kA for 1 second, SF6 gas-insulated metal enclosed Main bus bars.	Two sets of isolated phase, 400kV, 4000A, 63kA for 1 second, SF6 gas-insulated metal enclosed bus bars, each set comprising of : (a) Three Nos. single phase(isolated) bus bars of One Bus running the length of the switch gear to inter connect each of the circuit breaker bay modules of Line/GT/ST/Reactor/ST Bays in one and half breaker bus system. (b) Gas monitoring System, pressure switches, Telescopic Enclosure etc. as required. (c) Barriers (Communicating, Non-Communicating Types) Length to be indicated by bidder.	Set	2
2	A2	400kV Bus Voltage Transformer Bay (for Busbars)	400kV, 63 kA for 1 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, 63kA 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) Gas monitoring System, barriers, pressure switches, etc. as required.	Set	2

l.No	SL	Description	Remark_Detailed_Description	Unit	Qty
3	A3	Fully equipped 400kV, 63kA for 1 second, SF6 GIS Line Line bay Module	400kV, 63kA for 1 second, SF6 gas-insulated metal enclosed Line bay module. Each set shall be complete & shall comprising of a) ONE set of 2000A, 63kA, 3x1-phase, SF6 insulated circuit breaker, complete with operating mechanism (suitable for 1&3 phase auto reclose) b) THREE sets of 3x1-phase, 2000A, 5-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, 63kA 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) ONE set of 3x1-phase, high speed fault make grounding switch, complete with individual operated manual and motor driven operating mechanisms. f) 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) Barriers and other items as required.	Set	6

l.No	SL	Description	Remark_Detailed_Description	Unit	Qty
4	A4	**Fully equipped 400kV, 63kA for 1 second, SF6 GIS GT bay Module**	400kV, 63kA for 1 second, SF6 gas-insulated metal enclosed GT bay module. Each set shall be complete & shall comprising of a) ONE set of 2000A, 63kA, 3x1-phase, SF6 insulated circuit breaker, complete with operating mechanism (suitable for 1&3 phase auto reclose) b) THREE sets of 3x1-phase, 2000A, 5-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, 63kA 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) ONE set of 3x1-phase, multi winding, Voltage Transformer as per single line diagram. (Winding details shall be finalised at detail engg. stage) f) Gas monitoring System, pressure switches etc as required. g) Barriers and other items as required.	Set	3

l.No	SL	Description	Remark_Detailed_Description	Unit	Qty
5	A5	**Fully equipped 400kV, 63kA for 1 second, SF6 GIS Reactor bay Module.**	400kV, 63kA for 1 second, SF6 gas-insulated metal enclosed Reactor bay module. Each set shall be complete & shall comprising of a) ONE set of 2000A, 63kA, 3x1-phase, SF6 insulated circuit breaker, complete with operating mechanism (suitable for 1&3 phase auto reclose) b) THREE sets of 3x1-phase, 2000A, 5-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, 63kA 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 System, pressure switches etc as required. f) Barriers and other items as required.	Set	2

l.No	SL	Description	Remark_Detailed_Description	Unit	Qty
6	A6	**Fully equipped 400kV, 63kA for 1 second, SF6 GIS ST bay Module**	400kV, 63kA for 1 second, SF6 gas-insulated metal enclosed ST bay module. Each set shall be complete & shall comprising of a) ONE set of 2000A, 63kA, 3x1-phase, SF6 insulated circuit breaker, complete with operating mechanism (suitable for 1&3 phase auto reclose) b) THREE sets of 3x1-phase, 2000A, 5-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, 63kA 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 System, pressure switches etc as required. f) Barriers and other items as required.	Set	1

l.No	SL	Description	Remark_Detailed_Description	Unit	Qty
7	A7	**Fully equipped 400kV, 63kA for 1 second, SF6 GIS Tie bay Module**	400kV, 63kA for 1 second, SF6 gas-insulated metal enclosed Tie bay module. Each set shall be complete & shall comprising of a) ONE set of 2000A, 63kA, 3x1-phase, SF6 insulated circuit breaker, complete with operating mechanism (suitable for 1&3 phase auto reclose) b) TWO sets of 3x1-phase, 2000A, 5-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, 63kA 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 System, pressure switches etc as required. f) Barriers and other items as required.	Set	6
8	A8	Single Phase isolated, 400kV, 63kA for 1 second, SF6 gas-insulated metal enclosed bus bars for Tie Bay interconnection	Isolated phase, 400kV, 2000A, 63kA for 1 second, SF6 gas-insulated metal enclosed bus bars, each set comprising of : (a) Three Nos. single phase(isolated) bus bars to inter connect the Tie Bay circuit breaker bay modules with Circuit breaker bay Modules of Line/GT/ST/Reactor/ST Bays in one and half breaker bus system. (b) Gas monitoring System, barriers, pressure switches, etc. as required. Length to be indicated by bidder.	Set	12
9	A9	SF6 to Air Bushing	400kV, 2000A, 63 kA for 1 sec, SF6 gas insulated SF6 to Air Bushing for Over head connection of Line/Reactor/GT/ST with GIS.	Nos.	36

l.No	SL	Description	Remark_Detailed_Description	Unit	Qty
10	A10	GIS Duct from GIS GT/Reactor/ST/Line Bays to SF6 to Air bushing	400kV, 2000A 63kA for 1 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 Reactors. b) Gas monitoring System, barriers, pressure switches, etc. as required. Total length is equal to sum of single phase lengths of all GIS Ducts	m	1500
11	A11	Local Control Panel	Local Control Panel for all bays : GT/Reactor/ST/Line/VT/Tie Bays	Bays	20
12	A12	First Filling of SF6 gas including extra for compensating losses for 10 % of total gas (Bidder to indicate quantity).	First filling of SF6 gas for the equipment supplied plus an additional quantity sufficient for conducting all tests on equipment at site before placing it into successful operation. Additionally, 10 % of total quantity of SF6 gas shall also be supplied in non returnable cylinders.	Lot	1
13	A13	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 shall be done based on supplier design & drawings).	Bidder to indicate estimated weight (in MT) along with 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

l.No	SL	Description	Remark_Detailed_Description	Unit	Qty
14	A14	Supply of Earthing material for GIS including High frequency earthing material. The quantity shall be estimated and 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. 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 8.00.00 of section 2. 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
15	A15	Consumables required for GIS (Bidder to quote item wise with detailed BOQ for consumables)	Consumables 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
16	A16	Continuous on-line monitoring and diagnostics systems	Continuous on-line monitoring and diagnostics systems to monitor gas density, gas pressure, leakage, moisture, etc., operating parameters such as current, voltage, temperature, etc., complete with sensors and integration of the systems with plant SCADA system.	Lot	1
17	A17	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

Sl.No	SL	Description	Remark_Detailed_Description	Unit	Qty
18	A18	Synchronizing Trolley		No.	1
	B	**Supply Item - Mandatory Maintenance equipment (B1 to B6)**	Make and Model shall be subject to customer approval.	**lot**	**1**
19	B1	Gas filling and Evacuating trolley		Nos	1
20	B2	SF6 Gas filling and evacuating plant	Portable plants shall evacuate SF6 to required vacuum and fill to required pressure in a complete three pole breaker within a reasonable time.	Nos	1
21	B3	SF6 gas filtering, drying, storage and recycling plant	a) Shall have a capacity to store and handling at least 300 liters of SF6 Gas & suitable to transfer SF6 gas directly from breaker to plant reservoir. b) Shall include necessary equipment for purging the plant before filling SF6. c) Shall be mounted on trolley or rollers. d) Shall include devices to measure purity, moisture content (or dew point measurement), air content, decomposition products, etc. of SF6 gas. The devices shall have built-in calibration facility & the sensitivity shall not be affected by dust, humidity, heat, wind, etc.	Nos	1
22	B4	SF6 gas leak detector	Shall have an accuracy of at least 5ppm. & shall reach all point on the breaker where leakages are possible. Shall be free from induced voltage effects.	Nos	2

Sl.No	SL	Description	Remark_Detailed_Description	Unit	Qty
23	B5	Breaker operation analyzer with transducers	(i) Shall be one complete system of proven make for out-door use with necessary transducers (three to record speed and travel of 3 poles of breaker), cables, pickups, attachments, etc. (ii) Shall have provision to record at least 12 function of breaker. (iii) Shall be suitably shielded against induced charges. (iv) Shall record breaker contact movement during opening, closing, auto re-closing and make break operations, speed of contacts at various stages of operation, travel of contacts, opening time, closing time, make break time, etc. (v) Shall have output on plain paper requiring no special storage facility. (vi) Shall be suitable for outdoor use and shielded against induced charges. Adapters shall be in scope of bidder.	Nos	1
24	B6	Nitrogen filling device (applicable for hydraulically operated mechanisms if required)	Shall have capacity for nitrogen filling of one pole in reasonable time and shall be complete with all accessories for nitrogen charging at site.	Nos	1
C	**C**	**Supply Items - Mandatory spares (C1 to C14)**	These prices will be used for addition/deletion/replacement. Vendor to ensure that prices have a logical relationship with A above.	Lot	1
25	C1	Set of gaskets and seals (1 set =1 of each type)		Set	1
26	C2	Support Insulator of bus bar (1 set =1 of each type)		Set	3
27	C3	Breaker module complete	Complete Circuit Breaker Pole (1 Phase) 400kV of each type & rating complete with interrupter, main circuit enclosure with operating mechanism and all necessary apparatus.	Set	1

Sl.No	SL	Description	Remark_Detailed_Description	Unit	Qty
28	C4	Disconnector with 1Earthswitch module (1 set =1 of each type)	400 kV, three phase 2000 A Disconnector switch with Earthswitch complete with operating mechanism & all necessary apparatus etc	Set	1
29	C5	CT (1 set =1 of each type)	400kV Single phase Gas insulated complete CT of each type and rating with enclosure and all accessories.	Set	1
30	C6	VT (1 set =1 of each type)	400kV Single phase Gas insulated complete VT of each type and rating with enclosure and all accessories.	Set	1
31	C7	High speed earth switch	400kV 3-phase High Speed earth switch including enclosure, driving mechanism and all accessories.	Set	1
32	C8	Gas monitoring System devices (1 set =1 gas monitoring device of each type and rating)	complete with all necessary accessories etc.	Set	1
33	C9	Control switches, control relays, Contacts, monitoring devices etc (One set consisting one no. of each type and rating of each item)		Set	1
34	C10	Trip coils for 400 kV Circuit breakers (1 set= closing coil of each type & rating)		set	6
35	C11	Closing coils for 400 kV circuit breakers (1 set= trip coil of each type and rating)		set	6

Sl.No	SL	Description	Remark_Detailed_Description	Unit	Qty
36	C12	Complete set of Rupture disc (1 set =1 of each type)		Set	2
37	C13	Gas tight bushing of each type		Nos	2
38	C14	Gas density relay (1 set =1 of each type)		Set	2
39	**D**	**Start Up & Commissioning Spares**	Bidder to quote detailed BOQ along with unit price. Start up spares (also termed as 'commissioning spares') are those spares which will be required during the start up 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. An adequate stock of start up spares shall be made available at the site such that the start up and commissioning of the equipment / systems, performance testing and handing over the equipment / systems to the Purchaser can be carried out without hindrance and delays. Contractor shall furnish the list of Start up and Commissioning Spares to be brought by them to ensure smooth commissioning of the plant.	Set	1

Sl.No	SL	Description	Remark_Detailed_Description	Unit	Qty
40	**E**	**Supply Item -Special Tools & tackles and Testing Equipments**	Special tools required shall be in bidder's scope. Bidder to submit list of tools other than Special tools which shall be arranged by BHEL like slings, spanners, gauges, lifting devices, drills, instruments and appliances necessary, required for the complete assembly erection, installation, gas filling, maintenance and site testing of the GIS. EOT cranes shall be provided by BHEL, *capacity of Crane shall be recommended by Manufacturer of GIS*. Bidder to submit both the lists at tender stage. Bidder to furnish detailed BOQ for non-returnable Tools and Tackles along with unit prices to be handed over to ultimate customer.	Lot	1
F	**F**	**Services: Supervision of Erection, commissioning & site testing including earthing and Training (F1 to F8)**	**(GT 1&2, Lines, Reactors, ST shall be commissioned separately at different stages)**	Lot	1
41	F1	Insulation co-ordination studies	Deemed to be included for GIS.	Lot	1
42	F2	Site visit for unloading & verification of material at store	Store shall be provided by BHEL	Lot	1
43	F3	Supervision of Erection of GIS	Complete GIS including busbar, GT bays, Line bays, Reactor Bays, ST Bay, bus PT, etc.	Set	1
44	F4	Supervision of Erection of GIS Duct - GIS to SF6 to Air Bushings	1 set = 3x1 Phase GIS Duct	Set	12
45	F5	Supervision of Erection of complete SF6 to Air Bushing		Set	36

Sl.No	SL	Description	Remark_Detailed_Description	Unit	Qty
46	F6	Testing & Commissioning of GIS	Complete GIS including busbar, GT bays, Line bays, Reactor Bays, ST Bay, bus PT, Bus Bars, Ducts, SF6 to Air Bushings etc.	Set	1
47	F7	Final successful testing after installation of GIS including dielectric tests on the main circuits. (Including HV Test)	HV Test kit shall be in scope of bidder. (GT 1&2, Lines, Reactors, ST may be commissioned separately) Final testing as per IEC for Complete GIS including busbar, GT bays, Line bays, Reactor Bays, ST Bay, bus PT, Bus Bars, Ducts, SF6 to Air Bushings etc.	Lot	1
48	F8	Training for GIS to TANGEDCO/BHEL Engineers	Training for GIS shall cover following parts and mandays: a) Equipment Theory and Maintenance practice=30 Mandays b) (Reference GIS Substation) Plant visit = 5 Mandays c) Visit to Manufacturer's works=15Mandays d) Operation and Maintenance of Plant (GIS)=30 Lodging and Boarding of Training Participants shall be in bidder's scope.	Lot	1
G	**G**	**Supply - Unit Prices of Individual Item/Equipment (G1 to G21)**	Unit Prices of Individual Equipment included here or in manadatory 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
49	G1	Operating Mechanism for 400kV, 2000 A Circuit Breaker		No	1
50	G2	Operating Mechanism box for 400kV, 2000A Disconnector Switch		No	1
51	G3	Operating mechanism for 400kV, 2000A Maintenance Grounding Switch		No	1

Sl.No	SL	Description	Remark_Detailed_Description	Unit	Qty
52	G4	Operating Mechanism for 400kV, 2000A High Speed Grounding Switch		No	1
53	G5	Single Phase Bus Bar (Any Type)	Complete Single Phase 400kV, 4000A, 63kA for 1 second, Bus Bar including (a) Gas monitoring System, Barriers, pressure switches, etc. as required.	m	1
54	G6	Conductor for Single Phase Bus Bar / Bus Duct (Any Type)	Conductor for Bus Bar, Bus Duct, GIB, Interconnecting conductors, or any Type etc with interconnecting parts as required.	kg	10
55	G7	GIS metallic enclosure (Any Type)	Enclosure for Bus Bar, Bus Duct, GIB, Straight Cast Enclosure etc with fixing hardware as required.	m	1
56	G8	Epoxy resin insulators for bus support with holes for gas flow (of Each Type and Size)	Bidder to inform details at tender stage	Set	1
57	G9	Gas barrier insulators (of Each Type and Size)	Bidder to inform details at tender stage	Set	1
58	G10	Density switch		Nos.	1
59	G11	Gas Monitoring System Devices	1 Set =1 no of each Type	set	1
60	G12	PD sensor		Nos.	1
61	G13	Optical indicator for CB, Isolator		Nos.	1
62	G14	Elbows / Angle/ T-Bends		Nos.	1
63	G15	Telescopic enclosure		Nos.	1

Sl.No	SL	Description	Remark_Detailed_Description	Unit	Qty
64	G16	Sleeve enclosure		Nos.	1
65	G17	Expansion joints or bellows		m	1
66	G18	Cross tank		Nos.	1
67	G19	Services of manpower for erection per day (excl. travel time)		Days	1
68	G20	Services of manpower for Testing & commissioning per day (excl. travel time)		Days	1
69	G21	Hiring charges of HV test kit	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:
1. 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. Bidders to submit list of such items.

2. CT and 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.

SECTION – 2

TECHNICAL SPECIFICATION OF 400 kV GAS INSULATED SUBSTATION

1.00.00 SYSTEM DESCRIPTION

400 kV substation comprising indoor gas insulated switchgear (GIS) and outdoor air insulated switchyard shall be provided for evacuation of net power generated at the plant to the grid. The scope covers design, manufacture, assembly, testing at manufacturer's works before despatch, packing, marking, shipping, erection, testing and commissioning of factory assembled, metal-enclosed, SF6 GIS, Gas Insulated Bus Ducts and ancillary equipments as specified hereunder. The GIS shall have one and a half circuit breaker configuration and will comprise following bays/ circuits:

a) Two (2) Generator Transformer bays
b) One (1) Start up transformer bay
c) Four (4) Line bays
d) Two (2) Bus VTs
e) Two (2) Bus Reactor bays
f) One (1) equipped bay for future GT
g) Two (2) equipped bays for future lines.
h) Six (6) Tie Bays

The switchgear shall be capable of future extension on both sides, without requiring a complete shutdown.

2.00.00 SCOPE OF SUPPLY

2.01.00 The scope of works under this package shall include but not be limited to complete project management, design, engineering, manufacture, shop testing, packing, loading, **transportation to site**, transit storage, insurance. Supervision of erection, testing & commissioning of 400 kV GIS substation package as per the detailed scope mentioned herein under *and as per Section-1.*

1. Above ground Earthing and high frequency earthing.
2. Further the scope shall include all equipments/ components/tools/spares required to make a complete, reliable and trouble free functional system, even if not

specifically listed in this specification. The scope also includes **special training** of owner's testing, operation and maintenance staff.

The required no. of CTs, VTs, SAs, circuit breakers, disconnector switches, earthing switches and all other accessories shall be provided.

2.02.00 GENERAL TECHNICAL PARTICULARS FOR EHV SYSTEM

(a)	Rated voltage	400 kV
(b)	Rated frequency	50 Hz
(c)	Rated short time current withstand capacity	63 kA rms for one (1) second
(d)	Rated one minute power frequency withstand voltage	a) 650 kV rms between live terminals and earth b) 815 kV rms across isolating distance
(e)	Rated lightning impulse withstand voltage	a) 1425 kVp between live terminals b) 1425 (+240) kVp across isolating distance & earth.
(f)	Rated Switching Impulse withstand voltage	a) 1575 kVp (between phases) b) 900 (+345) (across isolating distance)
(g)	Phase to phase spacing (for Outdoor Air insulated)	4000 mm
(h)	Rated terminal load	Adequate to withstand 100 kg static load as well as wind, seismic and short circuit forces without impairing reliability or current carrying capacity.
(i)	System neutral earthing	Effectively earthed
(j)	Seismic acceleration	0.16 g horizontal
(k)	Support structure height (for Outdoor air Insulated)	Adequate so that lowest part of support insulator of equipment is 2550 mm (minimum) from ground and/or plinth level.
(l)	Creepage distance (for Outdoor air Insulated)	Minimum 31 mm / kV

(m) Electrical Clearances Clearances shall be as given below and as per relevant statutory rules/codes. ***(for Outdoor air Insulated)***		
1.	Phase to earth	3500 mm
2.	Phase to phase	4000 mm
3.	Sectional clearance	6500 mm
4.	Ground clearance	8000 mm

2.02.01 NA

2.02.02 NA

2.02.03 NA

2.02.04 **SF6 Gas Filling & Evacuation Plant:**

This shall include all the necessary gas cylinders for temporarily storing the evacuated SF6 gas. The capacity of the temporary storage facilities shall at least be sufficient for storing the maximum quantity of gas that could be removed when carrying out maintenance or repair work on any pieces of the switchgear and associated equipment + 10% extra SF6. The plant shall be complete with compressor, vacuum pump, dust and moisture filter, all necessary pipes, couplings, flexible tubes and valves for coupling up to the Switchgear for filling or evacuating all the gases.

A wheeled maintenance device shall be supplied with pressure vessel, vacuum pump and all required gauges and fittings for the service of switchgear.

Manufacturer shall guarantee that the pressure loss within each individual gas filled compartment will not be more than 0.05 % per year.

2.02.05 Breaker operation analyzer with transducers.

2.02.06 NA

2.02.07 NA

2.02.08 NA

2.02.09 NA

2.02.10 NA

2.02.11 NA

2.02.12 NA

2.02.13 NA.

2.02.14 Set of Special Tools & Tackles, Start up & Commissioning spares.

2.02.15 Recommended spares for 3 years of operation & maintenance.

2.02.16 Continuous on-line monitoring and diagnostics systems to monitor gas density, gas pressure, leakage, moisture, etc., operating parameters such as current, voltage, temperature, etc., complete with sensors and integration of the systems with plant SCADA system.

2.02.17 The first filling of SF6 gas for the equipment supplied plus an additional quantity sufficient for conducting all tests on equipment at the site before placing it into successful operation. SF6 gas shall be supplied in returnable cylinders. In addition about 10 % spare gas (of total used in GIS) by weight shall be supplied in 40 litre non returnable cylinders.

2.02.18 Any other item(s) not mentioned specifically but necessary for the satisfactory completion of scope of supply as per accepted standards.

3.00.00 CODES AND STANDARDS

3.01.00 All the equipment/system shall in general confirm to the latest addition of relevant National and International codes & Standards especially Indian Statutory Regulations. The Equipment/material/systems confirming to other equivalent national and international standards shall also be considered provided the same ensures equal or better features compared to standards listed in Annexure A.

4.00.00 GENERAL DESIGN REQUIREMENTS OF 400 kV INDOOR GIS & OUTDOOR SWITCHYARD

4.01.00 The layout of the switchyard shall be such that adequate space for maintenance of prime equipment like circuit breakers and current transformers is available. The GIS bay equipments shall be viewable from the switchyard control room.

4.02.00 Corona rings & corona bells shall be used wherever required and same shall be of non-magnetic material. The requirements regarding RIV and corona extinction voltage shall include terminal fittings.

5.00.00 DEGREE OF PROTECTION

Degree of protection for various enclosures as per IS: 13947 shall be considered.

6.00.00 DETAILED TECHNICAL SPECIFICATIONS

6.01.00 The detailed technical requirements of 400 kV GIS equipments like Circuit breakers, instrument transformers, disconnections switches are covered in Annexure A.
This section also covers about the outdoor switchyard equipment like Surge arrestors, Disconnectors, String insulators and all miscellaneous items.

6.02.00 NA

7.00.00 DESIGN & CONSTRUCTION REQUIREMENTS FOR 400 kV GIS SYSTEM

7.00.01 The GIS shall comply with IEC 62271-203/60694. The general requirements and special requirements for Gas insulated switchgear are given in this section. Materials and components not specifically stated in this specification but are necessary for the satisfactory operation of the equipment shall be deemed to be included unless specifically excluded and shall be supplied at no extra cost.

7.00.02 The switchgear assembly shall be suitable for installation in indoor area. Constructional features shall be selected not only to withstand satisfactorily the specified atmospheric conditions under Project Information but allow for thermal expansion during its normal use. All components of the same rating and construction shall be interchangeable.

7.00.03 Gas enclosures shall be designed to withstand high vacuum by provision of suitable reinforcement(s) at all the required locations. The gas filled enclosures shall conform to relevant pressure vessel code of ANSI/IEC.

7.00.04 Equipment shall be complete with all necessary supports, platforms, ladders, staircases, catwalks, mechanism cabinets, internal cable raceways etc. for each bay and it shall be of extensible design.

7.00.05 The GIS shall be modular in structure and shall be housed indoor. The modules shall be single phase encapsulated and provided with hooks for handling by overhead cranes to be provided in the building. The modular design shall be capable of extension on either side without any major dismantling.

7.00.06 The equipment and connections within each compartment shall be arranged so as to allow removal and replacement of any section both during normal and abnormal (fault) working conditions with minimum disturbance to adjacent pressurized sections.

7.00.07 The lines shall be terminated on takeoff gantry. The take off from GIS shall be through bushing and the post insulator, surge arrestor shall be outdoor type. The terminations of Generator transformer shall be with over head conductors. High speed earth switches shall be provided where ever required.

7.00.08 The bus bars shall be rated for the duty specified and current rating shall be as per attached Single Line Diagram.

7.00.09 The metal enclosures for the GIS shall be made up of non magnetic material and shall be suitable designed and fabricated from mechanical and electromagnetic aspects. The enclosure surface shall be painted suitably for protection against deterioration due to corrosion, humidity, temperature ageing, and attack from fungus, rodents. Interior finishing shall not contain any substances which could contaminate the SF6 gas and its insulating properties over a period of time.

7.00.10 The enclosures shall be such as to eliminate dangerous electrostatic charges. The enclosures shall meet the pressure vessel requirement as per ASME or equivalent. The modular design shall offer maximum flexibility from the design, operation and maintenance point of view. The enclosures shall be sectionalized with gas tight barriers between sections or compartments. The wall thickness of the enclosure shall be based on the design pressure as well as considering a burn through duration of 0.1 sec.

7.00.11 The support insulators and section barriers shall be free from voids and shall be so designed so as to reduce the electrical stresses to the minimum. Gas barrier insulators and support insulators shall have the same basis of design. The support insulator shall have holes on both sides for proper flow of gas. The section barriers and enclosure walls shall be gas tight (permissible leakage rate of 0.5% per annum) and capable of withstanding the maximum pressure differential i.e. vacuum on one side and maximum gas pressure on other side.

7.00.12 Minimum assembly work is envisaged during installation. Each section shall have plug-in or easily removable connection pieces to allow easy replacement of any component with minimum disturbance to the remainder of the equipment.

7.00.13 Inspection windows / access openings shall be provided at the switchgear to ensure that each switchgear component can be inspected / monitored during installation and future maintenance.

7.00.14 The manufacturer shall guarantee that the pressure loss within each individual gas filled compartment shall not be more than half percent (0.5 %) per year.

7.00.15 Each Gas filled compartment shall be equipped with static filters, density switches, filling valve and safety diaphragm. The filters shall be capable of absorbing any water vapour as well as any byproducts of SF6 during interruption.

7.00.16 Each gas compartment shall be fitted with pressure relief device for evacuating, gas filling, and for checking the gas pressure /density. Gas pressure and density shall be continuously monitored and displayed by a suitable temperature compensated instrument, which will provide an alarm signal in case of pressure drop before the allowable minimum pressure is reached.

7.00.16 The internal components shall be maintenance free for at least 10 years. Routine replacements of insulating gas shall not be required in intervals of less than ten years.

7.00.17 The thermal rating of all current carrying parts shall be minimum one second for the rated symmetrical short circuit current.

7.00.18 The manufacturer should propose appropriate methods for determination of location of fault.

7.00.19 The arrangement of individual switchgear bays shall be such so as to have optimum space saving, neat, logical arrangement and adequate accessibility to all external components.

7.00.20 It should be impossible to unwillingly touch live parts of the switchgear. All interlocks that will prevent potentially dangerous mal-operations shall be provided with both electrical & mechanical.

7.00.21 The enclosure surface shall be smooth with no projection or irregularities which may cause visible corona. No corona shall be visible in complete darkness when the equipment is subjected to specified test voltage.

7.00.22 The enclosure shall be of continuous design and shall confirm to clause 10 of latest edition of IEEE 80. The enclosure shall be sized for carrying induced current equal to the rated current of bus. The enclosure shall be designed to practically eliminate the external electromagnetic field and thereby electromagnetic stresses even under short circuit conditions.

7.00.23 The average intensity of electromagnetic field shall not be more than 50 micro tesla. The contractor shall furnish all calculations and documents in support of above during detailed engineering.

7.00.24 The CT"s for GIS shall be of external or internal mounted type with SF6 Gas insulated or cast resin type. The secondary terminals shall be brought out in a dustproof enclosure.

7.00.25 The switchgear shall have provision for connection with ground mat risers. This shall consist of grounding pads to be connected the ground mat risers with in the vicinity of the equipment.

7.00.26 During an operation, the level of noise emitted by the switchgear should not exceed the prescribed value in the relevant standard.

7.01.00 Indication & Verification of Switch position:

a) All circuit breakers, isolators and earth switches shall have externally mounted indicators to show clearly the 'open' and 'Close' positions. The indications shall be mechanically coupled directly to the main contact operating drive or linkage and shall be mounted in a position where they are clearly visible. The positions shall be designated as 'Open 'and 'Close '. Use of color code alone to differentiate position indication is not acceptable.

b) The contractor shall offer equipment fitted with viewing ports on each isolator and earth switch for viewing and illuminating the position of switch. Viewing port shall be of a type whereby the open/close position can be checked without any danger to the eyes should a flashover occur at that time.

7.02.00 **Local Control Panel**

7.02.01 Individual local control panels for each circuit shall be supplied to facilitate local control of circuit breakers, isolators and earth switches. Theses panels shall also house the various relays, timers etc. to realise specified interlock requirement among circuit breakers, isolators and earth switches. The contacts, signals and conditions originating from/going to the switchgear, associated auxiliary, monitoring equipment and CT/VT wiring from the terminal boxes shall be wired up to the local control panels. Trip normal & close switches is also to be provided.

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

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

7.02.04 Synchronizing facility shall be provided in Local Control Panel. 1 no. Synchronizing *trolley to be provided.*

7.03.00 **Switches/MCBs**

7.03.01 Switches/MCBs shall be hand operated, air break, heavy duty, quick make, quick break type conforming to applicable IEC standards.

7.03.02 It shall be the responsibility of the Manufacturer to fully coordinate the overload and short circuit tripping of the MCBs with the sub circuit MCBs/fuses to provide satisfactory discrimination.

7.03.03 Switch handle shall have provision for locking in both fully open and fully closed positions. MCBs shall preferably be provided with suitable locking facility.

7.03.04 Single throw isolating switches for complete isolation of the DC control circuits shall be provided.

7.04.00 **Fuses**

7.04.01 Only HRC fuses shall be used & shall have a rupturing capacity of not less than 46 kA at 220V DC.

7.04.02 Fuses shall be provided with visible operation indicators to show that they have operated.

7.05.00 **Control & Auxiliary Power Supply**

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

7.05.02 All control equipment shall be suitable for operation on specified DC system.

7.05.03 Separate circuits with switches, fuses, etc. of adequate rating shall be provided for control of space heater, lighting and power receptacle. Theses shall be on 240 V single ph AC supply, unless specified otherwise.

7.05.04 D.C. & A.C. power supply shall be done in a manner which will enable isolation of individual equipment. Common supply bus shall be formed in the cubicle and then power supply shall be distributed to individual equipment through MCBs/fuses.

7.06.00 **Relays**

7.06.01 Relays for various controls, monitoring and blocking functions of particular circuit element shall be numerical, installed in associated local control panel. All relay shall have dust tight covers.

7.06.02 Necessary auxiliary relays for alarm, time-delay relays, voltage relays as required for control and protection shall be mounted inside the local control panel. Voltage operator relays shall have sufficient thermal capacity for continuous energization, using external resistors, if necessary.

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

7.06.04 Each relay shall be provided with at least 2 NO and 2 NC potential free contacts for external use.

7.06.05 Coils of all the relays shall be adequately rated to avoid spurious operation of relays on D.C. system ground or induced surges.

7.06.06 All relays shall be tropicalised and shall be suitable for maximum ambient temperature of 50°C.

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

7.07.00 **Push Buttons**

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

7.08.00 **Indicating Lamps**

Indication lamps shall be of cluster LED type.

7.09.00 **Space Heater**

Strip type space heaters of adequate capacity shall be provided inside each cabinet/control panel. Heaters shall be complete with rotary type ON-OFF switch, HRC fuse on phase or a single-pole MCB with overload and short circuit protection, link on the neutral and a thermostat to cut off the heater at 45° C. The heaters shall be suitable for operation on a 240V, 1 phase 50 Hz supply.

7.10.00 **Internal Wiring**

Cabinets/Panels shall be supplied completely wired ready for external connections at the terminal blocks. All wiring shall be carried out with wires of 650 V grade, stranded copper conductors. The insulation shall be halogen free and flame retardant. Power circuits shall be wired with stranded aluminum conductors of adequate sizes to suit the rated current, the minimum size shall be 4 sq.mm. Unless otherwise specified, control alarm and indication circuits shall be wired with stranded, tinned copper conductors of sizes not smaller than 1.5 sq.mm. CT and VT circuits shall be wired with stranded copper conductor of size not smaller than 2.5 sq.mm.

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

7.10.02 CT/PT terminals shall have disconnecting links for test purpose and other device terminals shall be of stud type.

7.10.03 The wire terminations shall be made with solder less crimping type of tinned copper lugs.

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

7.10.05 20% spare terminals shall also provided.

7.11.00 **Local Alarm/Annunciation**

7.11.01 Window type alarm annunciation shall be provided on local control panels of each bay for the specified abnormal conditions. The alarm windows shall have provision for differentiating cleared and uncleared faults and flashing for new faults.

7.11.02 Windows for the following unhealthy conditions shall be provided:

a) Low Gas pressure for each gas compartment of the bay.
b) Low-Low Gas pressure for each gas compartment of the bay.
c) High gas pressure for each gas compartment of the bay.
d) Hydraulic motor excessive start.
e) Hydraulic motor run excessive
f) Hydraulic motor overload
g) Hydraulic motor circuit trouble
h) Low hydraulic pressure
i) LV-Low hydraulic pressure
j) Low hydraulic oil level
k) Breaker pole discrepancy

l) Isolator open/close incomplete

m) Control supply fails.

NOTE: (Serial no. e) to j) shall be applicable only in case of hydraulic operated breaker.)

7.11.03 In addition to the above, the manufacturer may add any other condition, as felt necessary for annunciation during detailed engineering. In case of auto reclosing feeders, all four stages breaker operation due to hydraulic pressures – pressure low, reclose blocked, closing blocked and tripping shall be provided.

7.12.00 **Labels and Diagram Plate**

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

7.12.02 Inside the door, a metal pouch shall be provided along with a copy of as built drawings of the respective panel.

8.00.00 EARTHING

8.01.00 The CONTRACTOR shall provide a "Main Ground Bus" for the specified short circuit current magnitude and duration to which all intentionally earthed parts of the assembly shall be bonded.

8.02.00 High frequency earthing for GIS shall be provided.

8.03.00 It shall be the responsibility of the Manufacturer to provide a sufficient number of earth connections so that dangerous voltages are not induced in the enclosure by the fault currents circulating in the inner conductor. The earthing terminal shall have clamping screw or bolt of at least 12mm for connection to earthing conductor. The connecting point shall be marked with the 'Protection Earthing Symbol' as per IEC-60417.

8.04.00 Provision shall be made for future extension and/or bonding to ground bus of other switchgear.

8.05.00 In addition to bonding and grounding of GIS enclosures ground mats shall be provided that are connected to GIS structures and grounded.

8.06.00 To avoid the circulation of enclosure currents, the power cable sheath grounds should be tied to the grounding system via connections that are separated from the GIS enclosures. The design of cable terminations should be such that an isolating air gap or proper insulation elements are provided.

8.07.00 The GIS building shall have a simple monolithic concrete steel reinforced slab. The reinforcing steel mesh should be tied to the common ground bus (main ground bus) in order to maintain the same potential level of GIS enclosures and the structural steel of the foundation.

8.08.00 When grounded at the designated points, the bus enclosure design should ensure that no significant voltage differences exists between individual enclosure sections and that neither the supporting structures nor any part of the grounding sytems is adversely influenced by the flow of induced currents.

8.09.00 While calculating the touch voltage, clause 10.8.07 IEEE-80 shall be followed.

8.10.00 The contractor shall furnish full details of the circulating currents expected to flow from the switchgear metal cladding to enable the Purchaser to design the main earthing grid.

8.11.00 Every section of the SF6 switchgear equipment including all panels, cubicles, kiosks and boxes shall be solidly bonded to the earthing system, by at least two independent leads.

8.12.00 The design of the earthing system shall be such as to ensure the safety and protection of all operating and maintenance personnel under all normal and fault conditions. The earthing of GIS shall be as per the standard CIGRE -44 "Earthing of GIS- An application guide".

9.00.00 PERFORMANCE GUARANTEE

a) The CONTRACTOR shall guarantee the successful and satisfactory operation of the equipment furnished under this contract and shall meet the ratings and performance requirements as stipulated in this specification.

b) CONTRACTOR shall furnish without tolerance the guaranteed figures for the items being supplied under this package in the Performance guarantee schedule.

c) CONTRACTOR shall conduct the performance guarantee testing in line with the stipulations of specification and shortfall of guaranteed ratings/defect should be satisfactorily rectified and replaced, within a time period decided by the OWNER. After rectification, re-testing shall be carried out by CONTRACTOR till the satisfactory performance in the opinion of OWNER is achieved. No extra cost shall be charged to the OWNER for such rectification and re-testing. However, if even after modification and rectification, the CONTRACTOR is not able to demonstrate the guarantees by re-testing, OWNER at his discretion may reject the equipment and recover the payment already made or accept the equipment only after deducting from the contract price an amount equivalent to the deficiency of the equipment system as assessed by the OWNER.

d) The Contractor shall further guarantee that the equipment provided by him shall be free from the defects in design, material and workmanship and shall upon written notice from the OWNER, fully rectify, free of expenses to the OWNER such defects as developed under the normal use of the said equipment within the period of guarantee / warranty.

10.00.00 QUALITY ASSURANCE, INSPECTION & TESTING

The Contractor shall carry out a comprehensive inspection and testing program during manufacture of the equipment.

The makes of all major bought out items shall be subject to Owner's approval. The Contractor shall also prepare a comprehensive inspection and testing program for all bought out/sub-contracted items and shall submit the same to the Owner.

GIS shall be completely assembled with all fittings & accessories meant for the particular breaker before offering for inspection & testing by Owner.

11.00.00 LIST OF TESTS TO BE CONDUCTED FOR 400 kV GIS PACKAGE

11.01.00 TYPE TESTS :

Type Tests Reports to be submitted as per clause 6.4 of Section 1.

11.02.00 ROUTINE TESTS

All the acceptance and routine tests as per the specification and the relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price. For all outdoor switchyard equipment, routine tests shall be conducted as per relevant IEC standards.

The routine tests inline with IEC shall be conducted on GIS & shall also include the following:

a) Pressure test on all individual enclosures.

b) Gas leakage test on all modules after assembly.

c) Circuit breaker tests

1) All mechanical operation like visual checks, timing test, operation of magnetic release. Operating test of motor and hydraulic or pressure mechanism etc.
2) Measurement of resistance
3) Check of auxiliary and control circuit (2000 V for 1 minute)
4) Power frequency voltage dry test of main circuit.

d) Tests on disconnect switches and ground switches:

1) Visual check of fifty operating cycles at rated supply voltage.
2) Visual check of ten operating cycle at specified maximum voltage.
3) Visual check of ten operating cycle at specified minimum voltage.
4) Measurement of resistance of main circuit.
5) Check of auxiliary and control circuit 2000 V for 1 minute.
6) Power frequency voltage dry test of main circuit.

e) Current transformer tests as per IEC 185, clause 9.2:

1) Verification of terminal markings.
2) Power frequency withstand tests on secondary windings.
3) Power frequency withstand tests between sections.
4) Inter turn over voltage test
5) Power frequency withstand voltage test on primary voltage measurement of partial discharge.

6) Test for accuracy

f) Potential transformer tests as per IEC 186 clause 10.2:

1) Verification of terminal markings.
2) Power frequency withstand tests on secondary windings.
3) Power frequency withstand tests between sections
4) Induced over voltage withstand test
5) Measurement of partial discharges (150% of rated max. phase).
6) Test for accuracy

g) Pressure and gas tightness test

h) Tests on complete assembled feeder bay:

1) Dielectric voltage withstand

I. Power frequency voltage test
II. Lightening Impulse withstand voltage test
III. Switching Impulse withstand voltage test
IV. Partial discharge test

2) Measurement of the resistance of the main circuit
3) Gas leakage test

i) All test on local control cabinets as per relevant IEC.

11.03.00 FIELD TESTS

Before assembly and installation, all parts of switch gear shall be checked properly and during inspection if any damage is found, the same shall be repaired or equipment shall be replaced by contractor. After installation complete assembly shall be field tested as per relevant IEC. The testing equipment including high voltage testing kit shall be arranged by contractor which may be taken back by the Contractor. The following field tests shall be performed:

a) Dielectric Test
1) Power frequency voltage withstand test

2) Partial discharge measurement test

b) Visual inspection, checks and verifications

c) Mechanical operation tests of circuit breakers, isolating and grounding switches and high speed grounding switches.

d) Gas leakage test.

e) Insulation resistance measurement

f) DC resistance measurement of the main circuit.

g) Gas density monitor check

h) Inter lock test

i) Measurement of moisture content

j) Manual operating check of circuit breakers, isolators and grounding switches.

k) Voltage tests on the main circuit as per IEC 517.

l) Power frequency test of auxiliary & control circuit (2kV rms for 1 minute).

12.00.00 NA

13.00.00 **SPARES, TOOLS & TACKLES**

13.01.00 Spares

13.01.01 The Contractor shall include in his scope:

(a) Start-up / commissioning spares as necessary.
(b) Mandatory Spares
(c) Recommended Spares

Contractor shall also state for each item of spares both mandatory and recommended, the normal expected service life.

13.01.02 The spares shall be delivered at the site well in time as per the schedule agreed during the award of contract, well before the start up and commissioning of the plant.

13.01.03 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 site.

13.01.04 Each spare part shall be clearly marked or labelled on outside of the packing with the description as indicated elsewhere in the specification.

13.01.05 In all cases, containers or other packages is liable to be opened for examination as

may be considered necessary by the Purchaser.

13.02.00 Start Up & Commissioning Spares

Start up spares (also termed as 'commissioning spares') are those spares which will be required during the start up 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. An adequate stock of start up spares shall be made available at the site such that the start up and commissioning of the equipment / systems, performance testing and handing over the equipment / systems to the Purchaser can be carried out without hindrance and delays. Contractor shall furnish the list of Start up and Commissioning Spares to be brought by them to ensure smooth commissioning of the plant.

13.03.00 Mandatory Spares

13.03.01 The list of mandatory spares, which are considered essential by the Purchaser, if indicated elsewhere in the Specification and Contractor shall include the unit price and total price for all these spares.

13.03.02 The Prices for mandatory spares must be given separately and shall be used for Bid Evaluation.

13.03.03 Recommended Spares

13.03.04 In addition to the spares mentioned above, Contractor shall also furnish in the Schedule of Recommended Spares a detailed list of recommended spare parts for three (3) years normal operation with unit prices. The Purchaser reserves the right to buy any of the recommended spare parts as considered necessary by them.

13.03.05 A detailed list of recommended spares shall also be furnished by the Contractor for ten years of operation and maintenance of the plant. This list shall also take into consideration the mandatory spares indicated elsewhere in the specification. The prices of any recommended spares, which are not common with mandatory spares, shall be subject to review by the Purchaser and shall be finalised after mutual discussion.

14.00.00 Special Tools & Tackles

A set of special tools and tackle which are necessary or convenient for erection, commissioning and putting into satisfactory operation, maintenance and overhauling of the equipment shall be supplied.

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

14.01.00 Contractor shall also note that the Purchaser, if required, shall approach directly the individual equipment manufacturers / suppliers for procuring recommended spare parts. The Purchaser shall not necessarily procure these spare parts through the Contractor.

15.00.00 DATA / INFORMATION TO BE SUBMITTED BY THE CONTRACTOR ALONG WITH THE BID

Contractor shall furnish the following drawings & documents along with bid:

a) Data Sheets
b) Dimensional general arrangement drawings showing the equipment position and identification including control block.
c) Type Test Reports.
d) Technical leaflets and catalogues of equipment supplied.
e) Experience list for similar rating equipment.

16.00.00 DRAWINGS AND DOCUMENTS TO BE SUBMTTED AFTER AWARD OF CONTRACT

a. Development of General arrangement drawings.
b. Development of detailed layout (Plan & section / elevation) drawings.
c. Development of Single line drawings with parameters of equipment and details of protection.
d. Development of protection & control philosophy, selection of protection, control and annunciation schemes.
e. Development of interlocking schemes.
f. Development of earthing system.
g. Insulation coordination and lightning protection design calculations.
h. Development of power & control cable laying and termination schedules.
i. Development of erection key diagrams with bill of material.
j. Development cable trench layout and sections & release of construction drawings.
k. Calculations for electric & magnetic field strength, corona extinction voltage for conductor.
l. All drawings related to 400 kV GIS substation package.
m. Shop inspection and testing procedures along with QAP.
n. Complete erection, testing commissioning of all the equipment required for complete 400 kV GIS substation package. The field testing equipment required for site testing shall be arranged by the contractor.
o. Installation and Testing Plan and Procedure
p. Installation and Maintenance Instruction manual.

Refer section-3 for detailed documentation schedule.

Windows XP Printer Test Page

Congratulations!

If you can read this information, you have correctly installed your HP LaserJet 9040 PCL 6 on H-B-DEEPAKJAIN.

The information below describes your printer driver and port settings.

Submitted Time: 11:41:20 AM 6/11/2015
Computer name: H-B-DEEPAKJAIN
Printer name: HP LaserJet 9040 PCL 6
Printer model: HP LaserJet 9040 PCL 6
Color support: Yes
Port name(s): IP_10.21.51.10
Data format: RAW
Share name:
Location:
Comment:
Driver name: UNIDRV.DLL
Data file: HPC904X6.GPD
Config file: UNIDRVUI.DLL
Help file: UNIDRV.HLP
Driver version: 5.00
Environment: Windows NT x86
Monitor: HP Master Monitor

Additional files used by this driver:

C:\WINDOWS\System32\spool\DRIVERS\W32X86\3\HPC90506.XML	
C:\WINDOWS\System32\spool\DRIVERS\W32X86\3\HPZSC041.DTD	
C:\WINDOWS\System32\spool\DRIVERS\W32X86\3\HPLJ9050.CFG	
C:\WINDOWS\System32\spool\DRIVERS\W32X86\3\HPC905X6.GPD	
C:\WINDOWS\System32\spool\DRIVERS\W32X86\3\HPC90XX6.GPD	
C:\WINDOWS\System32\spool\DRIVERS\W32X86\3\HPC9050C.INI	
C:\WINDOWS\System32\spool\DRIVERS\W32X86\3\HPZST041.DLL	(60.041.124.11)
C:\WINDOWS\System32\spool\DRIVERS\W32X86\3\HPZUI041.DLL	(60.41.124.11)
C:\WINDOWS\System32\spool\DRIVERS\W32X86\3\HPZ6R041.DLL	(60.41.124.11)
C:\WINDOWS\System32\spool\DRIVERS\W32X86\3\HPZ6M041.GPD	
C:\WINDOWS\System32\spool\DRIVERS\W32X86\3\HPZSM041.GPD	
C:\WINDOWS\System32\spool\DRIVERS\W32X86\3\HPZEV041.DLL	(60.41.124.11)
C:\WINDOWS\System32\spool\DRIVERS\W32X86\3\HPZAR041.HLP	
C:\WINDOWS\System32\spool\DRIVERS\W32X86\3\HPZHC041.HLP	
C:\WINDOWS\System32\spool\DRIVERS\W32X86\3\HPZHT041.HLP	
C:\WINDOWS\System32\spool\DRIVERS\W32X86\3\HPZCS041.HLP	
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Section 2 Annexure # A

400 kV GIS SWITCHGEAR EQUIPMENT

1.00.00 CIRCUIT BREAKERS

1.01.00 Codes & Standards

i.	Gas Insulated Switchgear	IEC 62271-203 / IEC 60694 IEEE C37.122-1993, CIGRE – 44 "Earthing of GIS an application guide (Elecra no. 151, dec'93), IEC 62271-306,305, IEC 60859, IEC 60071, IEC 62271-102, IEC 60137, IS 2705, IS 315
ii.	Circuit Breakers	IEC 62271-100, IS: 2516, IEC 60480
iii.	SF6 Gas	IEC 60376
iv.	SF6 Cylinders	IS: 4379, IS: 7285
v.	Air Receivers	BS: 5179, BS: 5500
vi.	Air Piping	BS: 2871

1.02.00 Type Indoor SF6, single pressure puffer type re-strike free and without opening resistors

1.03.00 Rating

a)	Voltage	420 kV
b)	No. of poles	3
c)	Rated Continuous Current	As required
d)	Rated Short Circuit Breaking Circuit Breaking Current	63 kA with percentage of DC component as per IEC 62271-100 corresponding to minimum opening time under operating conditions specified.
e)	Short Circuit Making Current	163 kAp
f)	Rated Line charging Breaking Current	400 A
g)	Rated Break Time	Not more than 40 ms
h)	Rated Closing Time	Not more than 45 ms

1.04.00	**Operational Requirements**	
1.04.01	Rated Operating Duty Cycle O-0.3 sec. – CO- 1 min- CO	
1.04.02	Re-Closing	Single and three phase high speed auto re-closing
1.04.03	Trip and closing coil voltage	220V DC
1.04.04	Auxiliary contacts	As required plus 5NO and 5NC contacts per pole/10NO and 10NC per CB as spare
1.04.05	Noise level	As per IEC 61672
1.04.06	Controls	

i. Closing Circuits

Circuits shall operate correctly at all values of supply voltage between 85% and 110% of rated voltage.

ii. Trip Circuits

Two independent tripping circuits, valves, pressure switches and coils shall be provided for connection to different set of relays. The circuits shall operate correctly under all operating conditions up to rated breaking capacity and at all values of supply voltages between 70% - 100% of rated supply voltage. However, even at 50% of rated supply voltage the breaker shall be able to operate. Trip coil supervision shall be provided in both open and close position.

iii. Operation

Shall have both local and remote operation of breaker with local/remote lockable selector switch and close and trip control switch/push buttons shall be provided in the breaker control cabinet.

iv. Pressure Switch Contacts

Shall have density meter and pressure switch contacts suitable for direct use as permissive in closing and tripping circuits. Separate contacts to be used for each of tripping and closing circuits. Fail safe logic/schemes to be employed if multiplying relays used.

v. Supply Voltage Monitoring

DC supply voltage for all auxiliary circuits to be monitored. Provision shall be made for remote annunciations and operation lockout in case of supply failure.

vi. Out of phase closing

One closing operation under phase opposition with twice rated voltage across terminals.

vii. Safety aspect

Breaker position shall be maintained on loss of operating media and/or quenching media pressure.

viii. Central Control Cabinet

A central control cabinet shall be provided which shall house all the control equipment required for operation, indication, lockout and all requirements as per detailed list given below:

a) Local/remote changeover switch

b) Operation counters

c) Pneumatic/ hydraulic pressure gauges

d) SF6 pressure gauges

e) Power supply control switches

f) Fuses

g) Anti-pumping relay

h) Pole discrepancy relay

i) AC/DC supervision relays

1.04.07 The circuit breaker shall also be capable of

a) Interrupting line charging current as per IEC 62271-100 without any restrike and without use of opening resistors

b) Clearing short line fault current with source impedance behind the bus equivalent to symmetrical fault current specified

1.05.00 Design and Constructional Features

1.05.01	Interrupter	Shall be with adsorbing product box to minimize the effect of SF6 decomposing product and moisture.
1.05.02	SF6 Density	SF6 Density shall be monitored and regulated on each pole using individual pressure switches and pressure gauges. Density Monitor shall be adequately temperature compensated It shall be possible to dismantle the monitor with out draining SF6 gas & also to remove SF6 gas from each pole separately for maintenance purpose.
1.05.03	D.C. Supply	Dual DC supply shall be provided for connection to independent trip circuits, monitoring & control circuits.
1.05.04	Aux. switch	Aux. switch of breaker to be positively driven by operating rod.

1.05.05 Operating Mechanism

a. Type Electro-hydraulic / spring charged or combination of the both with Anti-pumping and trip free features.

b. Housing Operating box/cabinet shall be accessible to man standing on ground and shall be hot dip galvanized

c. Operation indicator — A mechanical indicator to show open/close position of breaker shall be provided which should be visible with housing closed.

d. Power Supply — Dual AC power supply with changeover facility.

1.05.06 Spring Operated Mechanism

(i) Shall be complete with motor, opening and closing spring with limit switch for automatic charging and shall generally meet all the design and operation requirements for satisfactory and trouble free operation.

(ii) Motor shall be rated to fully charge the closing springs in less than 30 seconds and shall have adequate thermal rating for repeated sequence of closing and opening operations of breaker.

(iii) Closing action of mechanism shall compress/charge the opening spring so that it is ready for tripping. Closing springs shall be immediately charged after the closing operation. After failure of power supply, at least one CO operation should be possible. Breaker operation shall be prevented when spring is in partial charged condition. Indication of spring in charged condition shall be provided in local and remote cabinet.

1.05.07 Hydraulically Operated Mechanism

(i) Shall comprise of power cylinder, control valves, high & low pressure reservoir, motor, etc. Hydraulic oil used shall be fully compatible for the specified temperature range. Further it shall generally meet all the design and operation requirements for satisfactory and trouble free operation.

(ii) On failure of power supply and pressure equal to the lowest pressure of auto reclose duty; at least two CO operations should be possible. Also complete duty cycle of breaker to be possible meeting all parameters of break/opening time when oil is at lowest permissible pressure before make up.

(iii) Provision to be made to continuously monitor oil/nitrogen pressure both local and remote.

(iv) One hand operated pump shall be provided per station for emergency operation.

1.05.08 The gap between open contacts shall withstand at least rated phase to ground voltage for eight (8) hours at zero gauge pressure of SF6 gas. The breaker shall also withstand all dielectric stresses in open position at SF6 lockout pressure for 60 minutes.

1.05.09 Multi-break interrupters shall have uniform voltage distribution across them.

1.05.10 Breakers shall have provision for attaching operational analyzer.

1.05.11 Contractor shall supply spare SF6 gas equal to 20% of the total requirement for the station.

1.06.00 SF_6 Gas

SF_6 gas shall in general confirm to IEC 60376 but for following recommendations:

Air	≤	250 ppm by weight
CF_4	≤	250 ppm by weight
H_2O	≤	5 ppm by weight
Mineral oil	≤	5 ppm by weight

1.07.00 Mandatory Maintenance Equipment

The following (1 no. each) shall be supplied along with circuit breakers.

1.07.01 SF6 gas handling equipment

Shall be of proven make and shall be supplied complete with all necessary pipes, plants, coupling, flexible tube and valves and shall comprise of the following

(i) SF6 Gas filling and evacuating plant

Portable plants shall evacuate SF6 to required vacuum and fill to required pressure in a complete three pole breaker within a reasonable time. And shall comply to clause no. 2.02.04 of Section-2.

(ii) SF6 gas filtering, drying, storage and recycling plant

a) Shall have a capacity to store and handling at least 300 liters of SF6 Gas & suitable to transfer SF6 gas directly from breaker to plant reservoir.

b) Shall include necessary equipment for purging the plant before filling SF6.

c) Shall be mounted on trolley or rollers.

d) Shall include devices to measure purity, moisture content (or dew point measurement), air content, decomposition products, etc. of SF6 gas. The devices shall have built-in calibration facility & the sensitivity shall not be affected by dust, humidity, heat, wind, etc.

1.07.02 SF6 gas leak detector — Shall have an accuracy of at least 5ppm. & shall reach all point on the breaker where leakages are possible. Shall be free from induced voltage effects.

1.07.03 Operational Analyzer

(i) Shall be one complete system of proven make for out-door use with necessary transducers (three to record speed and travel of 3 poles of breaker), cables, pickups, attachments, etc.

(ii) Shall have provision to record at least 12 function of breaker.

(iii) Shall be suitably shielded against induced charges.

(iv) Shall record breaker contact movement during opening, closing, auto re-closing and make break operations, speed of contacts at various stages of operation, travel of contacts, opening time, closing time, make break time, etc.

(v) Shall have output on plain paper requiring no special storage facility.

(vi) Shall be suitable for outdoor use and shielded against induced charges.

1.07.04 Nitrogen filling

device (applicable for hydraulically operated mecha nisms)	Shall have capacity for nitrogen filling of one pole in reasonable time and shall be complete with all acce-ssories for nitrogen charging at site.

2.00.00 DISCONNECTING SWITCHES & EARTH SWITCHES

2.01.00 Codes and Standards

Disconnecting Switches and Earth Switches IEC: 62271-102 IS: 9921

2.02.00 Type

Three separate poles mechanically coupled and group operated, motor as well as manual operated

2.03.00 Rating

2.03.01 **Disconnecting Switches (DS)**

For 400 kV		
(i)	Rated continuous Current	As required
(ii)	Short circuit making current	163 kAp
(iii)	Rated Mechanical Terminal Load	As per Table III of IEC
(iv)	Auxiliary contacts	As required plus 4 NO + 4 NC per DS as spare
(v)	Temperature Rise	As per Table V of IEC 60694 for specified ambient
(vi)	Rated withstand voltage across isolating distance - Power frequency - Lightning impulse	 610 kV 1425 kVp

(vii)	Rated capacitive current make and break capacity	0.50 A

2.03.02 **Earth Switch (ES)**

For 400 KV:		
(i)	Short circuit making capacity	163 kAp
(ii)	Rated short time current	63 kA
(iii)	Auxiliary contacts	As required plus 4 NO + 4 NC per ES as spare

2.04.00 Design and Constructional Features – Disconnecting Switches

2.04.01 The three pole group operated disconnectors shall be operated by electric motor suitable for use on 220V DC system and shall be equipped with a manual operating mechanism for emergency use. The motor shall be protected against over current and short circuit.

2.04.02 Disconnectors shall be designed as per relevant IEC. These shall be suitable to make and break the charging currents during their opening and closing. They shall also be able to make and break loop current which appears during transfer between bus bars. The contact shielding shall also be designed to prevent restrikes and high local stresses caused by transient recovery voltages when these currents are interrupted.

2.04.03 The disconnecting switches shall be arranged in such a way that all the three phases operate simultaneously. All the parts of the operating mechanism shall be able to withstand starting torque of the motor mechanism without damage until the motor overload protection operates.

2.04.05 It shall be possible to operate the disconnecting switches manually by cranks or hand wheels. The contacts shall be both mechanically and electrically disconnected during the manual operation.

2.04.06 The operating mechanisms shall be complete with all necessary linkages, clamps, couplings, operating rods, support brackets and grounding devices. All the bearings shall be permanently lubricated or shall be of such a type that no lubrication or maintenance is required.

2.04.07 The opening and closing of the disconnectors shall be achieved by either local or remote control. The local operation shall be by means of a two-position control switch located in the bay module control cabinet.

2.04.08 Remote control of the disconnectors from the control room shall be made by means of remote/ local transfer switch.

2.04.09 The disconnector operations shall be inter-locked electrically with the associated circuit breakers in such a way that the disconnector control is inoperative if the circuit breaker is closed.

2.04.10 Each disconnector shall be supplied with auxiliary switch having four normally open and four normally closed contacts for future use over and above those required for switchgear interlocking and automation purposes. The auxiliary switch contacts are to be continuously adjustable such that, when required, they can be adjusted to make contact before the main switch contacts.

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

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

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

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

2.04.15 The disconnectors and safety grounding switches shall have a mechanical key (pad locking key) and electrical inter-locks to prevent closing of the grounding switches when isolator switches are in the closed position and to prevent closing of the disconnectors when the grounding switch is in the closed position.

2.04.16 The local control of the Isolator and high-speed grounding switches from the bay module control panel should be achieved from the individual control switches with the remote/local transfer switch set to local.

2.04.17 All electrical sequence interlocks will apply in both remote and local control modes.

2.04.18 Each disconnector shall have a clearly identifiable local, positively driven mechanical position indicator, together with position indicator on the bay module control cabinet and provisions for taking the signals to the control room. The details of the inscriptions and colouring for the indicator are given as under:

	SIGN	**COLOUR**
Open position	Open	Green
Closed position	Closed	Red

2.04.19 All the disconnecting switches shall have arrangement allowing easy visual inspection of the travel of the switch contacts in both open and close positions, from the outside of the enclosure.

2.04.20 The disconnecting switches shall be provided with rating plates and shall be accessible for inspection.

2.04.21 The disconnecting switches shall be capable of being padlocked in both the open and closed positions with the operating motor automatically disengaged. The padlocking device shall be suitable for a standard size lock with a 10 mm shank. The padlock must be visible and directly lock the final output shaft of the operating mechanism. Integrally mounted lock when provided shall be equipped with a unique key for such three phase group. Master key is not permitted.

2.05.00 Design and Constructional Features for Safety Earth Switches

2.05.01 The three pole group operated disconnectors shall be operated by electric motor suitable for use on 220 V DC system and shall be equipped with a manual operating mechanism for emergency use. The motor shall be protected against over current and short circuit.

2.05.02 Each safety grounding switch shall be electrically interlocked with its associated disconnector and circuit breaker such that it can only be closed if both the circuit

breaker and disconnector are in open position. Safety grounding switch shall also be mechanically key interlocked with its associated disconnector

2.05.03 Each safety grounding switch shall have clearly identifiable local positive driven mechanical indicator together with position indicator on the bay module control cabinet and provision for taking the signal to control room.

2.05.04 The details of the inscriptions and colouring for the indicator are given as under:

	SIGN	**COLOUR**
Open position	Open	Green
Closed position	Closed	Red

2.05.05 Interlocks shall be provided so that manual operation of the switches or insertion of the manual operating device will disable the electrical control circuits.

2.05.06 Each earth switch shall be fitted with auxiliary switches having 6 NO & 6 NC contacts for use of owner over and above those required for local interlocking, position & indication purpose

2.05.07 Provision shall be made for padlocking the earth switches in either the open position or closed position

2.05.08 All portions of the Earth switch and operating mechanism required for grounding shall be connected together utilizing a flexible copper conductors having a minimum cross section area of 50 Sqmm

2.05.09 The main grounding connections on each grounding switch shall be rated to carry the full short circuit rating of the switch for 1 second and shall be equipped with a silver plated terminal connector suitable for steel strap of adequate rating for connection to the grounding grid

2.05.10 The Safety Earth switches shall confirm to the requirement of IEC 62271-102

2.05.11 Mechanical position indication shall be provided locally at each switch and remotely at each bay module control cabinet / substation automation system.

3.00.00 HIGH SPEED EARTH SWITCHES

3.01.00 **Codes and Standards**

Disconnecting Switches and Earth Switches IEC: 62271-102 IS: 9921

3.02.00 **Type**

Indoor, SF6 Gas Insulated

3.03.00 **Design & Constructional Features**

3.03.01 Earth switches located at the beginning of feeder module shall be of high speed, make proof type and will be used to discharge the respective charging currents, in addition to their safety grounding function. These grounding switches shall be capable of interrupting the inductive currents and to withstand the associated Transient Enclosure Voltage (TEV).

3.03.02 Single phase switches shall be provided with operating mechanism suitable for 220 V DC

3.03.03 The switches shall be fitted with a stored energy closing system to provide fault making capacity

3.03.04 The short circuit making current rating of each ground switch shall be atleast equal to its peak withstand current rating of 163 kA. The switches shall have inductive /capacitive current switching capacity as per IEC-62271-102

3.03.05 Each high speed make grounding switch shall have clearly identifiable local positive driven mechanical indicator together with position indicator on the bay module control cabinet and provision for taking the signal to control room.

3.03.06 The details of the inscriptions and colouring for the indicator are given as under:

	SIGN	COLOUR
Open position	Open	Green
Closed position	Closed	Red

3.03.07 High speed earth switch operation should be possible locally from the bay module control cabinet, or remotely from the control room in conjunction with opening of the associated disconnector.

3.03.08 These high speed grounding switches shall be electrically interlocked with their associated circuit breakers and disconnectors so that the grounding switches can not be closed if the circuit breakers and disconnectors are closed.

3.03.09 Interlocks shall be provided so that the insertion of the manual operating devices will disable the electrical control circuits.

3.03.10 Each high speed earth switch shall be fitted with auxiliary switches having 6 NO & 6 NC auxiliary contacts for use by owner over and above those required for local interlocking, position & indication purpose. All contacts shall be wired to terminal blocks in the local bay control cabinet. Provision shall be made for padlocking the ground switches in their open or closed position

3.03.11 The main grounding connections on each grounding switch shall be rated to carry the full short circuit rating of the switch for 1 second and shall be equipped with a silver plated terminal connector suitable for steel strap of adequate rating for connection to the grounding grid

3.03.12 The main grounding connections on each grounding switch shall be rated to carry the full short circuit rating of the switch for 1 second and shall be equipped with a silver plated terminal connector suitable for steel strap of adequate rating for connection to the grounding grid

3.03.13 The high speed Earth switches shall confirm to the requirement of IEC 622271-102

4.00.00 SF6 TO AIR TRANSITION BUSHINGS

4.00.01 All bushings shall have an impulse and power frequency withstand level that is greater than or equal to the level specified for the switchgear.

4.00.02 Bushing shall be suitable for hot line washing and shall be provided with "water cut sheds".

4.00.03 Puncture strength of bushings shall be greater than the dry flash-over value. When operating at normal rated voltage, there shall be no electric discharge between the conductors and bushing which would cause corrosion or injury to conductors, insulators or supports by the formation of substances produced by chemical action. No radio interference shall be caused by the bushing when operating at the normal rated voltage.

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

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

4.00.06 All current carrying contact surface shall be silver faced.

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

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

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

4.00.08 A test tap shall be provided for measurement of Capacitance & Tan delta factor.

5.00.00 INSTRUMENT TRANSFORMERS

5.01.00 Codes and Standards

Current Transformers	IEC 60044-1, BS:3938, IS: 2705
Voltage Transformers	I IEC 60044-2, EC 60186, IEC 60186A, IEC 60358, IS : 3156
Insulating Oil	IS : 335

5.02.00 Type

Current Transformers : Single primary External or internal mounted type with SF6 insulated or Resin cast

Voltage Transformers : Shall be metal enclosed gas insulated inductive type.

5.03.00 Rating

5.03.01 Rated Insulation Levels for Instrument Transformers

i)	Rated lightning impulse withstand Voltage	1425 kVp
ii)	One minute power frequency withstand voltage	1050 kV rms.

5.03.02 **Current Transformers**

(i)	Rated primary current	as required
(ii)	Rated dynamic current	163 kA peak
(iii)	One minute power frequency withstand voltage between secondary terminal and earth	3 kV rms
(iv)	Partial discharge	10 pico-Coulombs max 1
(v)	Temperature rise	------As per IEC------

5.03.03 Voltage transformers

(i)	Rated primary Voltage	420 kV
(ii)	One minute power frequency withstand voltage - Between LV (HF) terminal and earth - For secondary Winding	 630 kV rms 3 kV rms
(iii)	Rated capacitance	----------
(iv)	Standard reference range of frequencies for which accuracies are valid	96% to 102% for protection and99% to 101% for measurement.
(v)	Temp rise of Electromagnetic Unit	As per IEC: 60186
(vi)	Rated voltage factor	1.2 continuous; 1.5 for 30seconds
(vii)	Phase angle error	+/- 20 minutes for metering
(viii)	Partial discharge level	10 pico Columbs max
(ix)	Rated thermal burden	1500 VA

5.04.00 Design and Construction Features

5.04.01 **Current Transformers**

5.04.02 The current transformers and accessories shall conform to IEC: 60044-1 and other relevant standards except to the extent explicitly modified in the specification.

5.04.03 The current transformers shall have class B type insulation and shall be suitable for high speed auto reclosure.

5.04.04 The particulars of the various cores may change within reasonable limits as per the requirements of protection relay supplier. The manufacturer is required to have these values confirmed from the purchaser before proceeding with design of the cores. The other characteristics of CTs shall be as given in technical parameter of Current Transformer.

5.04.05 Where multi-ratio current transformers are required the various ratios shall be obtained by changing the effective number of turns on the secondary winding.

5.04.06 Rating and diagram plates shall be as specified in the IEC specification incorporating the year of manufacture. The rated extended current rating voltage and rated thermal current shall also be marked on the name plate.

5.04.07 The diagram plates shall show the terminal markings and the relative physical arrangement of the current transformer cores with respect to the primary terminals (P1 & P2).

5.04.08 The position of each primary terminal in the current transformer SF6 gas section shall be clearly marked by two plates fixed to the enclosure at each end of the current transformer.

5.04.09 The current transformers incorporated into the GIS will be used for protective relaying and metering and shall be of metal-enclosed type. The secondary windings shall be air insulated and mounted inside the metal enclosure. All the current transformers shall have effective electromagnetic shields to protect against high frequency transients.

5.04.10 Each current transformer shall be equipped with a marshalling box with terminals for the secondary circuits, which are connected to the local control cubicle. The star/delta

configuration and the inter connection to the line protection panels will be done at the CT terminal block located in the local control cubicle.

5.04.11 Current transformers guaranteed burdens and accuracy class are to be intended as simultaneous for all cores.

5.04.12 The rated extended primary current shall be 150% at all ratios and 200% at ratios other than highest ratios.

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

5.04.14 The wiring diagram, for the interconnections of the three single phase CTs shall be provided inside the marshalling box.

5.04.15 Provisions shall be made for primary injection testing either within CT or outside.

5.04.16 Electromagnetic shields to be provided against high frequency transients typically 1-30 MHz

5.04.17 The CTs shall be of PS class for protection and 5P20 Class for metering

5.05.00 Voltage Transformers

5.05.01 The voltage transformers shall conform to IEC 60044-2 and other relevant standards except to the extent explicitly modified in the specification.

5.05.02 Voltage transformers shall be of the inductive type with SF6 gas insulated. The earth end of the high voltage winding and the ends of the secondary winding shall be brought out in the terminal box.

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

5.05.04 The beginning and end of each secondary winding shall be wired to suitable terminals accommodated in a terminal box mounted directly on the voltage transformer section of the SF6 switchgear.

5.05.05 All terminals shall be stamped or otherwise marked to correspond with the marking on the diagram plate. Provision shall be made for earthing of the secondary windings inside the terminal box.

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

5.05.07 The accuracy class will be at maximum tap.

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

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

5.05.10 Voltage transformers secondary shall be protected by HRC cartridge type fuses for all the windings. In addition fuses shall be provided for the protection and metering windings for fuse monitoring scheme. The secondary terminals of the VT's shall be terminated to the stud type non-disconnecting terminal blocks in the secondary boxes via the fuse.

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

5.05.12 The accuracy of 0.2 on secondary should be maintained throughout the entire burden range up to 100 VA on all the three windings without any adjustments during operation.

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

SECTION – 3

PROJECT INFORMATION AND GENERAL TECHNICAL REQUIREMENTS

INDEX

CHAPTER 1

PROJECT SYNOPSIS

1.0 GENERAL BACKGROUND AND SALIENT FEATURES

1.1 Introduction

Tamilnadu Generation and Distribution Corporation owns the proposed green-field 1320 MW (2 units of 660 MW each) Coal Based Thermal Power Station at Katupalli. This is an expansion of North Chennai Thermal Power Station (NCTPS) and located on some portion of the ashdyke of NCTPS.

1.2 Location

The proposed site for main power plant is located near Ennore port (approx 5 kms).
The nearest Railway station is at Athipattu Pudunagar (approx 5 kms)
All weather road from Pattamandri on the Thiruvottiyur-Ponneri district highway is the nearest road access.
The nearest airport is at Chennai at a distance of 60 km.

1.3 NA

1.4 PROJECT INFORMATION

Project Title : **2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power Project at Ash Dyke of NCTPS**

Owner : **TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION (TANGEDCO)**

LOCATION

The site is located near Vayalur Village, Ennore

Latitude	:	$13^0$17' N to $13^0$18' N
Longitude	:	$80^0$18' E to $80^0$19' E
Distance from Chennai City	:	35 km
Nearest Airport is at Chennai at a Distance of	:	60 km
Nearest Seaport is	:	Ennore
Nearest Railway Station is	:	Athipattu Pudunagar (approx 5 kms)

Meteorological Condition

Climate : Tropical ,very dry and hot summer, dry and cold winter and good rain-fall in monsoon accompanied with strong wind.

Climatological data	:		
Ambient temp. (^{0}C)	:	Annual Maximum Mean Temp	41.5(^{0}C)
		Annual Minimum Mean Temp	24(^{0}C)
		Design Ambient temperature	45(^{0}C)
Relative Humidity	:	Maximum 100% Minimum 36% Design 75%	
Annual Rainfall	:	Maximum 2540 mm Average 1600 mm Minimum 1175 mm	
Prevailing Wind Direction	:	Nov to Jan – From NW & NE Feb to Mar – From East & SE Apr to May – From South & SE June – From SW July to Aug – From NW Sept to Oct – From SE & SW Wind Speed 11.8 kmph (avg) 50 kmph (max)	
Seismic Zone	:	Seismic Zone III as per IS:1893-2002	

1.5 Access to Site

Site is well connected to all weather road from Pattamandri on the Thiruvottiyur – Ponneri district highway. Site is located adjacent to the Chennai – Howrah broad gauge line and thus well connected by rail also.

1.6 NA

1.7 NA

1.8 NA

1.9 NA

1.10 NA

1.11 NA

1.12 NA

1.13 NA

1.14 NA

1.15 NA

CHAPTER – 2

GENERAL TECHNICAL REQUIREMENTS

1.00.00 **NA**

2.00.00 **NA**

3.00.00 **NA**

4.00.00 **COMPLETENESS**

4.01.00 Bidders may note that this is a contract inclusive of the scope as indicated elsewhere in the specification. Each of the plant shall be engineered and designed in accordance with the specification requirement. All engineering and associated services are required to ensure that a completely engineered plant is provided.

4.02.00 All equipment furnished by the Bidder shall be complete in every respect, with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/or those needed for erection, completion and safe operation & maintenance of the equipment and for the safety of the operating personnel, as required by applicable codes, though they may not have been specifically detailed in the respective specifications, unless included in the list of exclusions.

All similar standard components/ parts of similar standard equipment provided, shall be interchangeable with one another.

5.00.00 **CODES & STANDARDS**

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

(a.) Bureau of Indian Standards (BIS)

(b.) Indian electricity act

(c.) Indian electricity rules

(d.) Indian Explosives Act

(e.) Indian Factories Act and State Factories Act

(f.) Indian Boiler Regulations (IBR)

(g.) Regulations of the Central Pollution Control Board, India

(h.) Regulations of the Ministry of Environment & Forest (MoEF), Government of India

(i.) Pollution Control Regulations of Department of Environment, Government of India

(j.) State Pollution Control Board.

(k.) Rules for Electrical installation by Tariff Advisory Committee (TAC).

(l.) Any other statutory codes / standards / regulations, as may be applicable.

5.02.00 Unless covered otherwise by Indian codes & standards and in case nothing to the contrary is specifically mentioned elsewhere in the specifications, the latest editions (as applicable as on date of bid opening), of the codes and standards given below shall also apply:

(a.) Japanese Industrial Standards (JIS)

(b.) American National Standards Institute (ANSI)

(c.) American Society of Testing and Materials (ASTM)

(d.) American Society of Mechanical Engineers (ASME)

(e.) American Petroleum Institute (API)

(f.) Standards of the Hydraulic Institute, U.S.A.

(g.) International Organisation for Standardization (ISO)

(h.) Tubular Exchanger Manufacturer's Association (TEMA)

(i.) American Welding Society (AWS)

(j.) National Electrical Manufacturers Association (NEMA)

(k.) National Fire Protection Association (NFPA)

(l.) International Electro-Technical Commission (IEC)

(m.) Expansion Joint Manufacturers Association (EJMA)

(n.) Heat Exchange Institute (HEI)

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

~~5.04.00 NA~~

~~5.05.00 NA~~

5.06.00 NA

5.07.00 In case of any change in codes, standards & regulations between the date of bid opening and the date when vendors proceed with fabrication, the Owner shall have the option to incorporate the changed requirements or to retain the original standard. It shall be the responsibility of the Bidder to bring to the notice of the Owner such changes and advise Owner of the resulting effect.

6.00.00 EQUIPMENT FUNCTIONAL GUARANTEE

6.01.00 The Equipment and Auxiliaries shall be capable of continuous operation in frequency range of 47.5 to 51.5 Hz.

7.00.00 DESIGN OF FACILITIES/ MAINTENANCE & AVAILABILITY CONSIDERATIONS

7.01.00 Design of Facilities

All the design procedures, systems and components proposed shall have already been adequately developed and shall have demonstrated good reliability under similar conditions elsewhere.

The Bidder shall be responsible for the selection and design of appropriate equipment to provide the best co-ordinate performance of the entire system. The basic requirements are detailed out in various clauses of the Technical Specifications. The design of various components, assemblies and subassemblies shall be done so that it facilitates easy field assembly and dismantling.

7.02.00 Maintenance and Availability Considerations

Equipment offered shall be designed for high availability, low maintenance and ease of maintenance. The Bidder shall specifically state the design features incorporated to achieve high degree of reliability/ availability and ease of maintenance. The Bidder shall also furnish details of availability records in the reference plants stated in his experience list.

Bidder shall state in his offer the various maintenance intervals, spare parts and man-hour requirement during such operation. The intervals for each type of maintenance namely the minor and major overhauls shall be specified in maintenance manuals, clearly defining the spare parts and man-hour requirement for each stage.

8.00.00 DOCUMENTS, DATA AND DRAWINGS TO BE FURNISHED BY BIDDER

8.01.00 Each of the equipment shall be fully integrated, engineered and designed to perform in accordance with the technical specification. All engineering and technical services required ensuring a completely engineered plant shall be provided as per the scope.

The Bidder shall furnish engineering data/drgs. in accordance with the schedule of information as specified in Technical Specification and data sheets.

8.02.00 The number of copies/prints/CD-ROMs/manuals to be furnished for various types of documents is given in Chapter 4.

8.03.00 The documentation that shall be provided by the Bidder is indicated in various sections of specification. The documentation shall include but not be limited to the following:

Basic Engineering Documentation

Prior to commencement of the detailed engineering work, the Bidder shall furnish a Equipment Definition Manual within 4-6 weeks from the date of the Purchase Order. This manual shall contain the following as a minimum:

i. System description of all the mechanical, electrical, control & civil systems.

ii. Technology scan for each system / sub-system & equipment.

iii. Selection of appropriate technology / schemes for various systems/ subsystems including techno-economic studies between various options.

iv. NA.

v. Sizing criteria of all the systems, sub-systems including various equipment/ structures/ equipment foundations along with all calculations justifying and identifying the sizing and the design margins.

vi. Schemes and Process & Instrumentation diagrams for the various systems/ sub-system with functional write-ups.

vii. Operation Philosophy and the control philosophy.

viii. General Layout plan.

ix. NA

x. Documentation in respect of Quality Assurance System as listed out elsewhere in this specification.

xi. NA
xii. NA
i. Layouts, general arrangements, elevations and cross-sections drawings for all the equipment and facilities of the plant.

ii. NA
iii. NA
iv. NA
v. NA
vi. Technical data sheets for all bought out and manufactured items. Bidder shall use the specifications as a base for placement of orders on their sub-vendors.

vii. Detailed design calculations for components, system/sub-system, etc., wherever applicable including sizing calculations as per criteria specified elsewhere in specification.
viii. NA
ix. NA
x. NA
xi. NA
xii. NA
xiii. Power supply single line diagram, block logics, control schematics, electrical schematics, etc.
xiv. NA
xv. Interconnection diagrams.
xvi. Cable routing plan.
xvii. Instrument schedule, measuring point list, I/O list, Interconnection & wiring diagram, functional write-ups, installation drawings for field mounted instruments, logic diagrams, control schematics, wiring diagrams of panels and enclosures etc.
xviii. Alarm and annunciation list and alarms & trip set points.
xix. Sequence and protection interlock schemes.
xx. Type test reports
xxi. Control system configuration diagrams and card circuit diagrams and maintenance details.
xxii. Detailed software manuals & source software listing.
xxiii. Detailed flow chart for digital control system.
xxiv. Mimic diagram layout.
xxv. Civil Task drawings(for the Engineering by BHEL),Design and Drawings.
xxvi. Model study reports wherever applicable.
xxvii. NA
xxviii. Documentation in respect of Quality Assurance System as listed out elsewhere in this specification.
xxix. Documentation in respect of commissioning as listed out elsewhere in this specification.

8.03.01 **Instruction Manuals**

The Bidder shall submit, draft Instruction Manuals for all the equipment covered under the Contract by the end of one year from the date of his acceptance of the Letter of Award. The Instruction manuals shall contain full details required for erection, commissioning, operation and maintenance of each equipment. The manual shall be specifically compiled for this project. After finalization and approval of the BHEL / OWNER the Instruction Manuals shall be submitted as indicated in Chapter-4. **The Contract shall not be considered to be completed for purposes of taking over until the final Instructions manuals with As Built drawings have been supplied**. The Instruction Manuals shall comprise of the following.

Erection Manuals

The erection manuals shall be submitted atleast three (3) months prior to the commencement of erection activities of particular equipment/system. The erection manual should contain the following as a minimum.

a) Erection strategy.

b) Sequence of erection.

c) Erection instructions.

d) Critical checks and permissible deviation/tolerances.

e) List of tool, tackles, heavy equipment like cranes, dozers, etc.

f) Bill of Materials

g) Procedure for erection.

h) General safety procedures to followed during erection/installation.

i) Procedure for initial checking after erection.

j) Procedure for testing and acceptance norms.

k) Procedure / Check list for pre-commissioning activities.

l) Procedure / Check list for commissioning of the system.

m) Safety precautions to be followed in electrical supply distribution during erection

Operation & Maintenance Manuals

i. The operating and maintenance instructions together with drawings (other than shop drawings) of the equipment, as completed, shall be in sufficient detail to enable the BHEL / OWNER to operate, maintain, dismantle, reassemble and adjust all parts of the equipment. They shall give a step by step procedure for all operations likely to be carried out during the life of the plant / equipment including, operation, maintenance, dismantling and repair including periodical activities such as chemical cleaning of the generator. Each manual shall also include a complete set of drawings together with performance/rating curves of the equipment and test certificates wherever applicable. The contract shall not be considered to be completed for purposes for taking over until these manuals have been supplied.

ii. If after the commissioning and initial operation of the plant, the manuals require any modification / additions / changes, the same shall be incorporated and the updated final instruction manuals shall be submitted to the BHEL / OWNER for records.

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

iv. The manuals shall include the following :

a) List of spare parts along with their drawing and catalogues and procedure for ordering spares.

b) Lubrication Schedule including charts showing lubrication

checking, testing and replacement procedure to be carried daily, weekly, monthly & at longer intervals to ensure trouble free operation.

c) Where applicable, fault location charts shall be included to facilitate finding the cause of maloperation or break down.

v. Detailed specifications for all the consumables including lubricant oils, greases, chemicals etc. system/equipment/assembly/sub-assembly - wise required for the complete plant.

vi. On completion of erection, a complete list of bearings / equipment giving their location, and identification marks etc. shall also be furnished to the BHEL / OWNER indicating lubrication method for each type/category of bearing.

8.03.02 **Plant Handbook**

The Bidder shall submit to the BHEL / OWNER a preliminary plant hand book preferably in A-4 size sheets which shall contain the design and performance data of various equipment and systems covering the complete project including

1.	Design and performance data.
2.	Process & Instrumentation diagrams.
3.	Single line diagrams.
4.	Sequence & Protection Interlock Schemes.
5.	Alarm and trip values.
6.	General layout plan
7.	Important Do's & Don't's
8.	The plant handbook shall be submitted within twelve (12) months from the date of award of contract. After the incorporation of BHEL / OWNER's comments, the final plant handbook complete in all respects shall be submitted three (3) months before start-up and commissioning activities.

8.03.03 **Project Completion Report**

The Bidder shall submit a Project Completion Report at the time of handing over the plant.

8.03.04 **Drawings**

(a.) All documents submitted by the Bidder for BHEL / OWNER's review shall be in electronic form (soft copies) along with the desired number of hard copies as per Chapter-4. The soft copies to be supplied shall be either in CDs, or through direct transfer via E-mail, etc. depending upon the nature/volume/size of the document. The drawings submitted for approval could be in the Image form.

(b.) Final copies of the approved drawings shall be submitted on CD-ROM along with the requisite number of hard copies as per Chapter-4.

(c.) The completed plant documentation with equipment drawings, data sheets, P&ID, BOQ, schematics, logic diagrams, test reports and quality plan, etc. shall be furnished to BHEL / OWNER.

(d.) All documents/text information shall be in latest version of MS Office.

(e.) All drawings submitted by the Bidder including those submitted at the time of bid shall be in sufficient detail indicating the type, size, arrangement, weight of each component for packing and shipment, the external connection, fixing arrangement required, the dimensions required for installation and interconnections with other equipment and materials, clearance and spaces required between various portions of equipment and any other information specifically requested in the drawing schedules.

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

(g.) The Bidder shall also furnish a "Master Drawing List" which shall be a comprehensive list of all drawings/ documents/ calculations envisaged to be furnished by him during the detailed engineering to the BHEL / OWNER. Such list should clearly indicate the purpose of submission of these drawings i.e. "FOR APPROVAL" or "FOR INFORMATION ONLY".

(h.) Similarly, all the drawings/ documents submitted by the Bidder during detailed engineering stage shall be stamped "FOR APPROVAL" or "FOR INFORMATION" prior to submission.

(i.) The furnishing of detailed engineering data and drawings by the Bidder shall be in accordance with the time schedule for the project. The review of these documents/ data/ drawings by the Owner will cover only general conformance of the data/ drawings/ documents to the specifications and contract, interfaces with the equipment provided by others and external connections & dimensions which might affect plant layout. The review by the Owner should not be construed to be a thorough review of all dimensions, quantities and details of the equipment, materials, any devices or items indicated or the accuracy of the information submitted. The review and/ or approval by the BHEL / OWNER / Project Manager shall not relieve the Bidder of any of his responsibilities and liabilities under this contract.

(j.) After the approval of the drawings, further work by the Bidder shall be in strict accordance with these approved drawings and no deviation shall be permitted without the written approval of the BHEL / OWNER.

(k.) All manufacturing, fabrication and execution of work in connection with the equipment / system, prior to the approval of the drawings, shall be at the Bidder's risk. The Bidder is expected not to make any changes in the design of the equipment /system, once they are approved by the BHEL / OWNER. However, if some changes are necessitated in the design of the equipment/system at a later date, the Bidder may do so, but such changes shall promptly be brought to the notice of the BHEL / OWNER indicating the reasons for the change and get the revised drawing approved again in strict conformance to the provisions of the Technical Specification.

(l.) Drawings shall include all installations and detailed piping layout drawings. Layout drawings for all piping of 65 mm and larger diameter shall be submitted for review/ approval of BHEL / OWNER prior to erection. Small diameter pipes shall however be routed as per site conditions in consultation with site authority/representative of BHEL / OWNER based on requirements of such piping indicated in approved / finalized Flow Scheme / Process & Instrumentation Diagrams and/or the requirements cropping up for draining & venting of larger diameter piping or otherwise after their erection as per actual physical condition for the entire scope of work of this package.

(m.) Assessing & anticipating the requirement and supply of all piping and equipment shall be done by the Bidder well in advance so as not to hinder the progress of piping & equipment erection, subsequent system charging and its effective draining & venting arrangement as per site suitability.

(n.) As Built Drawings

After final acceptance of individual equipment/system by the BHEL / OWNER, the Bidder will update all original drawings and documents for the equipment/ system to "as built" conditions.

(o.) Drawings must be checked by the Bidder in terms of its completeness, data adequacy and relevance with respect to Engineering schedule prior to submission to the BHEL / OWNER. In case drawings are found to be submitted without proper endorsement for checking by the Bidder, the same shall not be reviewed and returned to the Bidder for re-submission. The Bidder shall make a visit to site to see the existing facilities and understand the layout completely and collect all necessary data/drawings at site which are needed as an input to the engineering. The Bidder shall do the complete engineering including interfacing and integration of all his equipment, systems & facilities within his scope of work as well as interface engineering & integration of systems, facilities, equipment & works under BHEL/OWNER's scope and submit all necessary drawings/ documents for the same.

(p.) The Bidder shall submit adequate prints of drawing/data/document for Owner's review and approval. The BHEL/OWNER shall review the drawings and return one (1) copy to the Bidder authorizing either to proceed with manufacture or fabrication, or marked to show changes desired. When changes are required, drawings shall be re-submitted promptly, with revisions clearly marked, for final review. Any delays arising out of the failure of the Bidder to submit/rectify and resubmit in time shall not be accepted as a reason for delay in the contract schedule.

(q.) All engineering data submitted by the Bidder after final process including review and approval by the BHEL/OWNER shall form part of the contract documents and the entire works covered under these specification shall be performed in strict conformity with technical specifications unless otherwise expressly requested by the BHEL/OWNER in writing.

8.04.00 **Engineering Information Submission Schedule**

Prior to the award of Contract, a Detailed Engineering Information Submission Schedule shall be tied up with the BHEL/OWNER. For this, the bidder shall furnish a detailed list of engineering information alongwith the proposed submission schedule. This list would be a comprehensive one including all engineering data / drawings / information for all bought out items and manufactured items. The information shall be categorised into the following parts.

(a.) Information that shall be submitted for the approval of the BHEL/OWNER before proceeding further, and

(b.) Information that would be submitted for BHEL/OWNER's information only.

The Engineering Information Schedule shall be updated monthwise.

The schedule should allow adequate time for proper review and incorporation of changes/ modifications, if any, to meet the contract without affecting the equipment delivery schedule and overall project schedule. The early submission of drawings and data is as important as the manufacture and delivery of equipment and hardware and this shall be duly considered while determining the overall performance and progress.

8.05.00 **Engineering Progress and Exception Report**

8.05.01 Report giving the status of each engineering information including

(a.) A list of drawings/engineering information which remains unapproved for more than four (4) weeks after the date of first submission

(b.) Drawings which were not submitted as per agreed schedule.

8.05.02 The draft format for this report shall be furnished to the BHEL/OWNER within four (4) weeks of the award of the contract, which shall then be discussed and finalized with the BHEL/OWNER.

8.06.00 **Co-Ordination Meetings**

8.06.01 The Bidder shall be called upon to attend monthly Design/ Co-ordination Meetings (if required) with the BHEL/OWNER/Owner's representatives, Project Consultant during the period of contract. The Bidder shall attend such meetings at his own cost at mutually agreed venue as and when required and fully co-operate with such persons and agencies involved during the discussions.

8.06.02 The Bidder should note that Time is the essence of the contract. In order to expedite the early completion of engineering activities, the Bidder shall submit all drawings as per the agreed Engineering Information Submission Schedule. The drawings submitted by the Bidder will be reviewed by the BHEL/OWNER as far as practicable within three (3) weeks from the date of receipt of the drawing .The comments of the BHEL/OWNER shall then be discussed across the table during the above co-ordination Meetings wherein best efforts shall be made by both sides to ensure the approval of the drawing.

8.06.03 The Bidder shall ensure availability of the concerned experts / consultants/ personnel who are empowered to take necessary decisions during these meetings. The Bidder shall be equipped with necessary tools and facilities so that the drawings/documents can be resubmitted after incorporating necessary changes and approved during the meeting itself.

8.06.04 Should any drawing remain unapproved for more than six (6) weeks after it's first submission, this shall be brought out in the monthly Engineering Progress and Exception Report with reasons thereof.

8.06.05 Any delays arising out of failure by the Bidder to incorporate Owner's comments and resubmit the same during the TCM shall be considered as a default and in no case shall entitle the Bidder to alter the Contract completion date.

8.07.00 **Design Improvements**

The BHEL/OWNER or the Bidder may propose changes in the specification of the equipment or quality thereof and if the parties agree upon any such changes the specification shall be modified accordingly.

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

8.08.00 NA
8.09.00 NA

8.10.00 **Lubricants, Servo Fluids and Chemicals**

8.10.01 The Bidder's scope includes all the first fill and one year's topping, requirements of consumables such as oils, lubricants including grease, fluids, gases and essential chemicals etc. Consumption of all these consumables during the initial operation and final filling after the initial operation shall also

be included in the scope of the Bidder. Bidder shall also supply a quantity not less than 10% of the full charge of each variety of lubricants, servo fluids, gases, chemicals etc. used which is expected to be utilised during the first year of operation. This additional quantity shall be supplied in separate Containers.

8.11.00 **NA**

8.12.00 **Material of Construction**

8.12.01 All materials used for the construction of the equipment shall be new and shall be in accordance with the requirements of this specification. Materials utilized for various components shall be those which have established themselves for use in such applications.

8.13.00 **Rating Plates, Name Plates & Labels**

8.13.01 Each main and auxiliary item of plant including instruments shall have permanently attached to it in a conspicuous position, a rating plate of non-corrosive material upon which shall be engraved manufacturer's name, equipment, type or serial number together with details of the ratings, service conditions under which the item of plant in question has been designed to operate, and such diagram plates as may be required by the BHEL/OWNER.

8.13.02 Each item of plant shall be provided with nameplate or label designating the service of the particular equipment. The inscriptions shall be approved by the BHEL/OWNER or as detailed in appropriate section of the technical specifications.

8.13.03 Such nameplates or labels shall be of white non-hygroscopic material with engraved black lettering or alternately, in the case of indoor circuit breakers, starters, etc. of transparent plastic material with suitably coloured lettering engraved on the back. The name plates shall be suitably fixed on both front and rear sides.

8.13.04 Items of plant such as valves, which are subject to handling, shall be provided with an engraved chromium plated nameplate or label with engraving filled with epoxy. The name plates for valves shall be marked in accordance with MSS standard SP-25 and ANSI B 16.34 as a minimum.

8.13.05 Hanger/ support numbers shall be marked on all pipe supports, anchors, hangers, snubbers and restraint assemblies. Each constant and variable spring support shall also have stamped upon it the designed hot and cold load which it is intended to support. Suitable scale shall also be provided to indicate load on support/hanger.

8.13.06 Valves, steam traps and strainers shall be identified by BHEL/OWNER's tag number of a metal tap permanently attached to non pressure parts such as the yoke by a stainless steel wire. The direction of flow shall also be marked on the body.

8.13.07 Safety and relief valves shall be provided with the following :

(a.) Manufacturer's identification.

(b.) Nominal inlet and outlet sizes in mm.

(c.) Set pressure in Kg/cm2 (abs).

(d.) Blowdown and accumulation as percentage of set pressure.

(e.) Certified capacity in Kg of saturated steam per hour or in case of liquid certified capacity in litres of water per minute.

8.13.08 All such plates, instruction plates, etc. shall be bilingual with Hindi inscription first, followed by English. Alternatively, two separate plates one with Hindi and the other with English inscriptions may be provided.

8.13.09 All segregated phases of conductors or bus ducts, indoor or outdoor, shall be provided with coloured phase plates to clearly identify the phase of the system

8.14.00 **Tools and Tackles**

The Bidder shall supply with the equipment one complete set of all special tools and tackles and other instruments required for the erection, assembly, disassembly and proper maintenance of the plant and equipment and systems (including software). These special tools will also include special material handling equipment, jigs and fixtures for maintenance and calibration / readjustment, checking and measurement aids etc. A list of such tools and tackles shall be submitted by the Bidder alongwith the offer.

The price of each tool / tackle shall be deemed to have been included in the total bid price. These tools and tackles shall be separately packed and sent to site. The Bidder shall also ensure that these tools and tackles are not used by him during erection, commissioning and initial operation. For this period the Bidder should bring his own tools and tackles. All the tools and tackles shall be of reputed make acceptable to the BHEL/OWNER.

8.15.00 **Welding**

8.15.01 If the manufacturer has special requirements relating to the welding procedures for welds at the terminals of the equipment to be per formed by others the requirements shall be submitted to the BHEL/OWNER in advance of commencement of erection work.

8.16.00 **Colour Code for all Equipment/ Pipings/ Pipe Services**

8.16.01 All equipment/ piping/ pipe services are to be painted by the Bidder in accordance with BHEL/OWNER's standard colour coding scheme, which will be furnished to the Bidder during detailed engineering stage.

8.17.00 **Protection and Preservative Shop Coating**

8.17.01 **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 metallic or a nonmetallic protection device. All ends of all valves and piping and conduit

equipment connections shall be properly sealed with suitable devices to protect them from damage. The parts which are likely to get rusted, due to exposure to weather, should also be properly treated and protected in a suitable manner. All primers/paints/coatings shall take into account the hot humid, corrosive & alkaline, subsoil or overground environment as the case may be.

8.17.02 **Preservative Shop Coating**

All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. All surfaces which will not be easily accessible after the shop assembly, shall be treated beforehand and protected for the life of the equipment. All surfaces shall be thoroughly cleaned of all mill scales, oxides and other coatings and prepared in the shop. The surfaces that are to be finish-painted after installation or require corrosion protection until installation, shall be shop painted with atleast two coats of primer.

Transformers and other electrical equipment if included shall be shop finished with one or more coats of primer and two coats of high grade epoxy. The finished colors shall be as per manufacturer's standards, to be selected and specified by the BHEL/OWNER at a later date.

8.17.03 Shop primer for all steel surfaces which will be exposed to operating temperature below 95 degrees Celsius shall be selected by the Bidder after obtaining specific approval of the BHEL/OWNER regarding the quality of primer proposed to be applied. Special high temperature primer shall be used on surfaces exposed to temperature higher than 95 degrees Celsius and such primer shall also be subject to the approval of the Owner.

8.17.04 All other steel surfaces which are not to be painted shall be coated with suitable rust preventive compound subject to the approval of the Owner.

8.17.05 All piping shall be cleaned after shop assembly by shot blasting or other means approved by the Owner. Lube oil piping or carbon steel shall be pickled.

8.17.06 Painting for Civil structures shall be done as per relevant part of technical specification.

9.00.00 QUALITY ASSURANCE PROGRAMME

9.01.00 The Bidder shall adopt suitable quality assurance programme to ensure that the equipment and services under the scope of contract whether manufactured or performed within the Bidder's works or at his sub-Bidder's premises or at the Owner's site or at any other place of work are in accordance with the specifications. Such programs shall be outlined by the Bidder and shall be finally accepted by the Owner/authorized representative after discussions before the award of the contract. The QA programme shall be generally in line with IS/ISO-9001. A quality assurance programme of the Bidder shall generally cover the following:

(a.) His organization structure for the management and implementation of the proposed quality assurance programme

(b.) Quality System Manual

(c.) Design Control System

(d.) Documentation and Data Control System

(e.) Qualification data for bidder's key personnel.

(f.) The procedure for purchase of materials, parts, components and selection of sub-Bidder's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc.

(g.) System for shop manufacturing and site erection controls including process, fabrication and assembly.

(h.) Control of non-conforming items and system for corrective actions and resolution of deviations.

(i.) Inspection and test procedure both for manufacture and field activities.

(j.) Control of calibration and testing of measuring testing equipment.

(k.) System for Quality Audits.

(l.) System for identification and appraisal of inspection status.

(m.) System for authorising release of manufactured product to the Owner.

(n.) System for handling, storage and delivery.

(o.) System for maintenance of records, and

(p.) 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.

9.02.00 **General Requirements - Quality Assurance**

9.02.01 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 Bidder 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 Bidder's responsibility to draw up and implement such programme duly approved by the Owner. The detailed Quality Plans for manufacturing and field activities shall be drawn up by the Bidder and will be submitted to Owner for approval. Schedule of finalisation of such quality plans will be finalised before award. Monthly progress reports on MQP/FQP submission/approval shall be furnished.

9.02.02 Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices

and procedures followed by Bidder's/ Sub-Bidder's/ sub-supplier's Quality Control Organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing. The Quality Plan shall be submitted on electronic media e.g. Compact Disc or E-mail in addition to hard copy, for review and approval. After approval the same shall be submitted in compiled form on CD-ROM.

9.02.03 Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Bidder's "Site Quality Control Organisation", during various stages of site activities starting from receipt of materials/equipment at site.

9.02.04 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 manufacturer shall not proceed. These approved documents shall form a part of the contract. In these approved Quality Plans, Owner shall identify customer hold points (CHP), i.e. test/checks which shall be carried out in presence of the Owner's Project Manager or his authorised representative and beyond which the work will not proceed without consent of Owner in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Owner along with technical justification for approval and dispositioning.

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

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

9.02.07 The Bidder shall submit to the Owner Field Welding Schedule for field welding activities in the format No.: QS-01-QAI-P-02/F3 to be issued at contract stage.

9.02.08 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 welding/brazing procedures shall be submitted to the Owner or its authorised representative for approval prior to carrying out the welding/brazing.

9.02.09 All brazers, welders and welding operators employed on any part of the contract either in Bidder's/sub-Bidder's works or at site or elsewhere shall be

qualified as per ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the Owner.

9.02.10 Welding procedure qualification & Welder qualification test results shall be furnished to the Owner for approval. However, where required by the Owner, tests shall be conducted in presence of Owner/authorised representative.

9.02.11 For all pressure parts and high pressure piping welding, the latest applicable requirements of the IBR (Indian Boiler Regulations) shall also be essentially complied with. Similarly, any other statutory requirements for the equipment/systems shall also be complied with. On all back-gauged welds MPI/LPI shall be carried before seal welding.

9.02.12 Unless otherwise proven and specifically agreed with the Owner, welding of dissimilar materials and high alloy materials shall be carried out at shop only.

9.02.13 No welding shall be carried out on cast iron components for repair.

9.02.14 All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.

9.02.15 All non-destructive examination shall be performed in accordance with written procedures as per International Standards, The NDT operator shall be qualified as per SNT-TC-IA (of the American Society of non-destructive examination). NDT shall be recorded in a report, which includes details of methods and equipment used, result/evaluation, job data and identification of personnel employed and details of co-relation of the test report with the job.

All plates of thickness above 40mm & all bar stock/Forging above 40mm dia shall be ultrasonically tested. For pressure parts, plate of thickness equal to or above 25mm shall be ultrasonically tested.

9.02.16 The Bidder shall list out all major items/ equipment/ components to be manufactured in house as well as procured from sub-contractors bought out items (BOI). All the sub-Bidder proposed by the Bidder for procurement of major bought out items including castings, forging, semi-finished and finished components/equipment etc., list of which shall be drawn up by the Bidder and finalised with the Owner, shall be subject to Owner's approval. The Bidder's proposal shall include vendor's facilities established at the respective works, the process capability, process stabilization, QC systems followed, experience list, etc. along with his own technical evaluation for identified sub-contractors enclosed and shall be submitted to the Owner for approval within the period agreed at the time of pre-awards discussion and identified in review category prior to any procurement. Monthly progress reports on sub-Bidder detail submission / approval shall be furnished. Such vendor approval shall not relieve the Bidder from any obligation, duty or responsibility under the contract.

9.02.17 For components/equipment procured by the contractors for the purpose of the contract, after obtaining the written approval of the Owner, the Bidder's purchase specifications and inquiries shall call for quality plans to be submitted by the suppliers. The quality plans called for from the sub-Bidder shall set out, during the various stages of manufacture and installation, the

quality practices and procedures followed by the vendor's quality control organisation, the relevant reference documents/standards used, acceptance level, inspection of documentation raised, etc. Such quality plans of the successful vendors shall be finalised with the Owner and such approved Quality Plans shall form a part of the purchase order/contract between the Bidder and sub-Bidder. With in three weeks of the release of the purchase orders /contracts for such bought out items /components, a copy of the same without price details but together with the detailed purchase specifications, quality plans and delivery conditions shall be furnished to the Owner on the monthly basis by the Bidder along with a report of the Purchase Order placed so far for the contract.

9.02.18 Owner reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Bidder's or their sub-Bidder's quality management and control activities. The Bidder shall provide all necessary assistance to enable the Owner carry out such audit and surveillance.

9.02.19 The Bidder shall carry out an inspection and testing programme during manufacture in his work and that of his sub-Bidder's and at site to ensure the mechanical accuracy of components, compliance with drawings, conformance to functional and performance requirements, identity and acceptability of all materials parts and equipment. Bidder shall carry out all tests/inspection required to establish that the items/equipment conform to requirements of the specification and the relevant codes/standards specified in the specification, in addition to carrying out tests as per the approved quality plan.

9.02.20 Quality audit/surveillance/approval of the results of the tests and inspection will not, however, prejudice the right of the Owner to reject the equipment if it does not comply with the specification when erected or does not give complete satisfaction in service and the above shall in no way limit the liabilities and responsibilities of the Bidder in ensuring complete conformance of the materials/equipment supplied to relevant specification, standard, data sheets, drawings, etc.

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

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

9.02.23 Burn in and Elevated Temperature Test Requirement for Electronics Solid State Equipment

All solid state electronic systems/equipment shall be tested as a complete system/equipment with all devices connected for a minimum of 168 hours (7 Days) continuously under energized conditions prior to shipment from manufacturing works, as per the following cycle.

Elevated Temperature Test Cycle

During the elevated temperature test which shall be for 48 hours of the total 168 hours of testing, the ambient temperature shall be maintained at 50 deg.C. The equipment shall be interconnected with devices which will cause it to repeatedly perform all operations it is

expected to perform in actual service with load on various components being equal to those which will be experienced in actual service.

During the elevated temperature test the cubicle doors shall be closed (or shall be in the position same as they are supposed to be in the field) and inside temperature in the zone of highest heat dissipating components/modules shall be monitored. The temperature rise inside the cubicle should not exceed 10 deg.C above the ambient temp. at 50 deg.C.

Burn in Test Cycle

The 48 hours elevated temperature test shall be followed by 120 hours of burn in test as above except that the temperature shall be reduced to the ambient temperature prevalent at that time.

During the above tests, the process I/O and other load on the system shall be simulated by simulated inputs and in the case of control systems, the process which is to be controlled shall also be simulated. Testing of individual components or modules shall not be acceptable.

In case the Bidder/ sub-Bidder is having any alternate established procedure of eliminating infant mortile components, the detail procedures followed by the Bidder/ sub- Bidder along with the statistical figures to validate the alternate procedure to be forwarded.

The Bidder/Sub-Bidder shall carry out routine test on 100% item at Bidder/sub-Bidder's works. The quantum of check/test for routine & acceptance test by Owner shall be generally as per criteria/sampling plan defined in referred standards. Wherever standards have not been mentioned quantum of check/test for routine / acceptance test shall be as agreed during detailed engineering stage.

9.03.00 **QA Documentation Package**

The Bidder shall be required to submit the QA Documentation in two hard copies and two CD ROMs, as identified in respective quality plan with tick (?) mark.

9.03.01 Each QA Documentation shall have a project specific Cover Sheet bearing name & identification number of equipment and including an index of its contents with page control on each document.

The QA Documentation file shall be progressively completed by the Supplier's sub-supplier to allow regular reviews by all parties during the manufacturing.

The final quality document will be compiled and issued at the final assembly place of equipment before despatch. However CD-Rom may be issued not later than three weeks.

9.03.02 Typical contents of QA Documentation is as below:-

(a.) Quality Plan

(b.) Material mill test reports on components as specified by the specification and approved Quality Plans.

(c.) Manufacturer / works test reports/results for testing required as per applicable codes and standard referred in the specification and approved Quality Plans.

(d.) Non-destructive examination results /reports including radiography interpretation reports. Sketches/drawings used for indicating the method of traceability of the radiographs to the location on the equipment.

(e.) Heat Treatment Certificate/Record (Time- temperature Chart)

(f.) All the accepted Non-conformance Reports (Major/Minor) / deviation, including complete technical details / repair procedure).

(g.) CHP / Inspection reports duly signed by the Inspector of the Owner and Bidder for the agreed Customer Hold Points.

(h.) Certificate of Conformance (COC) wherever applicable.

(i.) MDCC

9.03.03 Similarly, the Bidder shall be required to submit two sets (two hard copies and two CD ROMs), containing QA Documentation pertaining to field activities as per Approved Field Quality Plans and other agreed manuals/ procedures, prior to commissioning of individual system.

9.03.04 Before despatch / commissioning of any equipment, the Supplier shall make sure that the corresponding quality document or in the case of protracted phased deliveries, the applicable section of the quality document file is completed. The supplier will then notify the Inspector regarding the readiness of the quality document (or applicable section) for review.

(a.) If the result of the review carried out by the Inspector is satisfactory, the Inspector shall stamp the quality document (or applicable section) for release.

(b.) If the quality document is unsatisfactory, the Supplier shall endeavor to correct the incompleteness, thus allowing to finalize the quality document (or applicable section) by time compatible with the requirements as per contract documents. When it is done, the quality document (or applicable section) is stamped by the Inspector.

(c.) If a decision is made despatch, whereas all outstanding actions cannot be readily cleared for the release of the quality document by that time. The supplier shall immediately, upon shipment of the equipment, send a copy of the quality document Review Status signed by the Supplier Representative to the Inspector and notify of the committed date for the completion of all outstanding actions & submission. The Inspector shall stamp the quality document for applicable section when it is effectively completed. The submission of QA documentation package shall not be later than 3 weeks after the despatch of equipment.

9.03.05 Transmission Of QA Documentation

On release of QA Documentation by Inspector, one set of quality document shall be forwarded to Corporate Quality Assurance Department and other set to respective Project Site of Owner.

For the particular case of phased deliveries, the complete quality document to the Owner shall be issued not later than 3 weeks after the date of the last delivery of equipment.

9.04.00 **Project Manager's Supervision**

9.04.01 To eliminate delays and avoid disputes and litigation, it is agreed between the parties to the Contract that all matters and questions shall be referred to the Owner's Project Manager and without prejudice to the provisions of 'Arbitration' clause in Section General Conditions of Contract, the Bidder shall proceed to comply with the Project Manager's decision.

9.04.02 The work shall be performed under the supervision of the Project Manager. The scope of the duties of the Project Manager pursuant to the Contract, will include but not be limited to the following:

(a.) Interpretation of all the terms and conditions of these documents and specifications:

(b.) Review and interpretation of all the Bidder's drawing, engineering data, etc:

(c.) Witness or his authorised representative to witness tests and trials either at the manufacturer's works or at site, or at any place where work is performed under the contract :

(d.) Inspect, accept or reject any equipment, material and work under the contract.

(e.) Issue certificate of acceptance and/or progressive payment and final payment certificates

(f.) Review and suggest modifications and improvement in completion schedules from time to time, and

(g.) Supervise Quality Assurance Programme implementation at all stages of the works.

9.05.00 **Inspection, Testing And Inspection Certificates**

9.05.01 The word 'Inspector' shall mean the Project Manager and/or his authorized representative and/or an outside inspection agency acting on behalf of the Owner to inspect and examine the materials and workmanship of the works during its manufacture or erection.

9.05.02 The Project Manager or 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 Bidder shall

obtain for the Project Manager and for his duly authorized representative permission to inspect as if the works were manufactured or assembled on the Bidder's own premises or works.

9.05.03 The Bidder shall give the Project Manager/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Bidder's account except for the expenses of the Inspector's. The Project Manager/Inspector, unless the witnessing of the tests is virtually waived and confirmed in writing, will attend such tests within fifteen (15) days of the date on which the equipment is noticed as being ready for test/inspection failing which the Bidder may proceed with test which shall be deemed to have been made in the inspector's presence and he shall forthwith forward to the inspector duly certified copies of test reports in two (2) copies.

9.05.04 The Project Manager or Inspector shall within fifteen (15) days from the date of inspection as defined herein give notice in writing to the Bidder, or any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract. The Bidder shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall inform in writing to the Project Manager/Inspector giving reasons therein, that no modifications are necessary to comply with the contract.

9.05.05 When the factory tests have been completed at the Bidder's or sub-Bidder's works, the Project Manager /Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests but if the tests are not witnessed by the Project Manager /Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Bidder's test certificate by the Project Manager /Inspector. Project Manager /Inspector to issue such a certificate shall not prevent the Bidder from proceeding with the works. The completion of these tests or the issue of the certificates shall not bind the Owner to accept the equipment should it, on further tests after erection be found not to comply with the contract.

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

9.05.07 The inspection by Project Manager / Inspector and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Bidder in respect of the agreed Quality Assurance Programme forming a part of the contract.

9.05.08 To facilitate advance planning of inspection in addition to giving inspection notice as specified at clause no 9.05.03- of this chapter, the Bidder shall furnish quarterly inspection programme indicating schedule dates of inspection at Customer Hold Point and final inspection stages. Updated

quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.

9.05.09 All inspection, measuring and test equipment used by Bidder shall be calibrated periodically depending on its use and criticality of the test/measurement to be done. The Bidder shall maintain all the relevant records of periodic calibration and instrument identification, and shall produce the same for inspection by the Owner. Wherever asked specifically, the Bidder shall re-calibrate the measuring/test equipment in the presence of Project Manager/Inspector.

9.06.00 **Associated document for quality assurance programme:**

9.06.01 List of items requiring quality plan and sub supplier approval.

9.06.02 Status of items requiring Quality Plan and sub supplier approval.

9.06.03 Field Welding Schedule

9.06.04 Manufacturing Quality Plan

9.06.05 Field Quality Plan

Format for the above shall be issued at Contract stage.

10.00.00 PRE-COMMISSIONING AND COMMISSIONING FACILITIES

(a.) As soon as the facilities or part thereof has been completed operationally and structurally and before start-up, each item of the equipment and systems forming part of facilities shall be thoroughly cleaned and then inspected jointly by the Owner and the Bidder for correctness of and completeness of facility or part thereof and acceptability for initial pre-commissioning tests, commissioning and start-up at Site. The list of pre-commissioning tests to be performed shall be as mutually agreed and included in the Bidder's quality assurance programme as well as those included elsewhere in the Technical Specifications.

(b.) The Bidder's pre-commissioning/ commissioning/start-up engineers, specially identified as far as possible, shall be responsible for carrying out all the pre-commissioning tests at Site. On completion of inspection, checking and after the pre-commissioning tests are satisfactorily over, the commissioning of the complete facilities shall be commenced during which period the complete facilities, equipment shall be operated integral with sub-systems and supporting equipment as a complete plant.

It will be the responsibility of the Bidder to assess and furnish a list of all commissioning spares required for successful commissioning of all the equipment covered under the contract. Such a list shall be furnished by the Bidder within 12 months from the date of LOA, separately for each equipment and shall be reviewed by the Owner and discussed for mutual agreement. The commissioning spares will be so identified as not to allow the trial operation to suffer for want of

such commissioning spares. The identification of commissioning spares will not in any way relieve the Bidder of any of his responsibilities of satisfactory performance under the provisions of other conditions of contract. All the commissioning spares shall be deemed to be included in scope of the Bidder as a part of the respective equipment package at no extra cost to the Owner.

(c.) NA

(d.) The time consumed in the inspection and checking of the units shall be considered as a part of the erection and installation period.

(e.) The check outs during the pre - commissioning period should be programmed to follow the construction completion schedule. Each equipment/system, as it is completed in construction and turned over to Owner's commissioning (start-up) Engineer(s), should be checked out and cleaned. The checking and inspection of individual systems should then follow a prescribed commissioning documentation [SLs (Standard Check List) / TS (Testing Schedule) / CS (Commissioning Schedule)] approved by the Owner.

(f.) The Bidder during initial operation and performance testing shall conduct vibration testing to determine the 'base line' of performance of all plant rotating equipment. These tests shall be conducted when the equipment is running at the base load, peak load as well as lowest sustained operating condition as far as practicable.

(g.) Bidder shall furnish the commissioning organization chart for review & acceptance of Owner at least eighteen months prior to the schedule date of synchronization of 1st unit. The chart should contain :

(1.) Biodata including experience of the Commissioning Engineers.

(2.) Role and responsibilities of the Commissioning Organisation members.

(3.) Expected duration of posting of the above Commissioning Engineers at site.

10.02.00 **Initial Operation**

a) On completion of all pre-commissioning activities / tests and as a part of commissioning the complete facilities shall be put on 'Initial Operation' during which period all necessary adjustments shall be made while operating over the full load range enabling the facilities to be made ready for the Guarantee Tests.

b) The 'Initial Operation' of the complete facility as an integral unit shall be conducted for 720 continuous hours. During the period of initial operation of 720 hours, the unit shall operate continuously at full rated load for a period not less than 72 hours.

c) The Initial Operation shall be considered successful, provided that each item/ part of the facility can operate continuously at the specified

operating characteristics, for the period of Initial Operation with all operating parameters within the specified limits and at or near the predicted performacne of the equipment/ facility.

d) The Bidder shall intimate the Owner about the commencement of initial operation and shall furnish adequate notice to the Owner in this respect.

e) Any loss of generation due to constraints attributable to the Owner shall be construed as Deemed Generation.

f) An Initial Operation report comprising of observations and recordings of various parameters to be measured in respect of the above Initial Operation shall be prepared by the Bidder. This report, besides recording the details of the various observations during initial operation shall also include the dates of start and finish of the Initial Operation and shall be signed by the representatives of both the parties. The report shall have sheets, recording all the details of interruptions occurred, adjustments made and any minor repairs done during the Initial Operation. Based on the observations, necessary modifications/repairs to the plant shall be carried out by the Bidder to the full satisfaction of the Owner to enable the latter to accord permission to carry out the Guarantee tests on the facilities. However, minor defects which do not endanger the safe operation of the equipment, shall not be considered as reasons for with holding the aforesaid permission.

10.03.00 **Guarantee Tests**

a) The final test as to prove the Functional Guarantees shall be conducted at Site by the Bidder in presence of the Owner. The Bidder's Commissioning, Start-up Purchaser shall make the unit ready to conduct such test. Such test will be commenced and completed as per schedule.

b) These tests shall be binding on both the parties of the Contract to determine compliance of the equipment with the functional guarantee.

c) For performance/ demonstration tests instrumentations, of accuracy class, to the approval of the Owner shall be used. The numbers and location of the instruments shall be as per the specified test codes. In addition the values of parameters shall be logged from the information system provided under Owner's Distributed Digital Control Monitoring and Information system. Test will be conducted at specified load points.

d) Any special equipment, tools and tackles required for the successful completion of the Guarantee Tests shall be provided by the Bidder, free of cost.

e) The Guarantee tests and specific tests to be conducted on equipment have been brought out in detail elsewhere in the specification.

11.00.00 TAKING OVER

Upon successful completion of Initial Operations and all the tests other than guarantee tests conducted to the Owner's satisfaction, the Owner shall issue to the Bidder a Taking over Certificate as a proof of the final acceptance of the equipment. Such certificate shall

not unreasonably be with held nor will the Owner delay the issuance thereof, on account of minor omissions or defects which do not affect the commercial operation and/or cause any serious risk to the equipment. Such certificate shall not relieve the Bidder of any of his obligations which otherwise survive, by the terms and conditions of the Contract after issuance of such certificate.

12.00.00 TRAINING OF OWNER'S PERSONNEL

12.01.00 The scope of service under training of Owner shall include a training module in the areas of Operation & Maintenance.

Such training should cover the following areas as a minimum in order to enable these personnel to individually take the responsibility of operating and maintaining the power station in a manner acceptable to the Owner:

(a.) Training for Electric Power Supply systems

The above training shall be provided taken by the Bidder in one of the reference power plant.

12.02.00 The scope of services under training shall also necessarily include training of Owner's Engineering personnel covering a training module of upto 2 man months. This shall cover all disciplines viz, Mechanical, Electrical, C&I, & QA etc. and shall include all the related areas like Design familiarization, training on product design features and product design softwares of major equipment and systems, engineering, manufacturing, erection, commissioning, training on operating features of equipment, quality assurance and testing, plant visits and visits to manufacturer's works, exposure to various kinds of problems which may be encountered in fabrication, manufacturing, erection, welding etc. An indicative module of the training requirement of Owner's Engineering personnel is attached as Annexure-I (BOQ).

12.03.00 Bidder shall furnish in his offer, details of training module(s) covering above requirements which shall be subject to Owner's approval. Consolidated training period included above (i.e. 1 and 2 man months respectively for O&M and Engineering) is indicative only. Owner reserves the right to reappropriate the training period between O&M and engineering depending upon the details of training module proposed by the Bidder.

12.04.00 Refer Annexure-II for detailed scope of services under Training.

12.05.00 Exact details, extent of training and the training schedule shall be finalised based on the Bidder's proposal within two (2) months from placement of award.

12.06.00 In all the above cases, wherever the training of Owner's personnel is arranged at the works of the manufacturer's it shall be noted that the lodging and boarding of the Owner's personnel shall be at the cost of Bidder. The Bidder shall make all necessary arrangements towards the same.

12.07.00 Take off prices (product wise) should be indicated by the Bidder in the Bid Proposal Sheets. Owner reserves the right to include or exclude these item(s) during place of Award. All expenses except travelling expenses shall be borne by the contractor.

13.00.00 SAFETY ASPECTS DURING CONSTRUCTION AND ERECTION

In addition to the requirements given in Erection Conditions of Contract (ECC) the following shall also cover:

(a.) Working platforms should be fenced and shall have means of access.

(b.) Ladders in accordance with Owner's safety rules for construction and erection shall be used. Rungs shall not be welded on columns. All the stairs shall be provided with handrails immediately after its erection.

14.00.00 NA

15.00.00 PACKAGING AND TRANSPORTATION

All the equipment & spares 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. Each spare shall be clearly marked or labeled on the outside of the packing with its description. When more than one spare part is packaged in a single case, a general description of the contents shall be shown on the outside of such a case and other packages must be suitably marked and numbered for the purpose of identification. All cases, containers or packages, are liable to be opened for such examination as may be considered reasonable by the Engineer. In case of equipment supplied with grease/lubricants from imported origin, the supplied shall clearly indicate the indigenous equivalent of the grease/lubricant and source of supply so as to enable the Owner to procure these items from indigenous sources. While packing all the materials, the limitation from the point of view of the sizes of railway wagons available in India should be taken account of. The Bidder shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. The Bidder shall ascertain the availability of Railway wagon sizes from the Indian Railways or any other agency concerned in India well before effecting dispatch of equipment. Before dispatch it shall be ensured that complete processing and manufacturing of the components is carried out at shop, only restricted by transport limitation, in order to ensure that site works like grinding, welding, cutting & pre-assembly to bare minimum. The Owner's Inspector shall have right to insist for completion of works in shops before dispatch of materials for transportation.

- Manufacturer shall furnish detailed Packing list before dispatch of material.
- Master Packing List for complete list of Equipment or Material to be furnished to BHEL for this project during detailed Engineering Stage.

The Packed item shall have Marking Plate with following details on Packing:

बीएचईएल BHEL	BHEL-TBG-Noida-India
Manufacturer's Name	
NAME OF ITEM	

Bay No.	
CONSIGNEE	
CUSTOMER REF.	
DISPATCH ADVICE NOTE NO.	
DIMENSIONS (MM) LXBXH	
NET WEIGHT (KG)	
GROSS WEIGHT (KG)	
SPECIAL INSTRUCTIONS	HANDLE WITH CARE – KEEP DRY DO NOT DROP – DO NOT TILT (or manufacturer's instructions)
Storage Type	(Manufacturer to indicate Indoor storage or Outdoor storage)
CASE NO.	

16.00.00 ELECTRICAL ENCLOSURE

All electrical equipment and devices, including insulation, heating and ventilation devices shall be designed for ambient temperature and a maximum relative humidity as specified elsewhere in the specification.

17.00.00 INSTRUMENTATION AND CONTROL

All instrumentation and control systems/ equipment/ devices/ components, furnished under this contract shall be in accordance with the requirements stated herein, unless otherwise specified in the detailed specifications.

17.01.00 All instrument scales and charts shall be calibrated and printed in metric units and shall have linear graduation. The ranges shall be selected to have the normal reading at 75% of full scale.

All scales and charts shall be calibrated and printed in Metric Units as follows:

a)	Temperature	-	Degree centigrade (deg C)
b)	Pressure	-	Kilograms per square centimeter (Kg/cm^2). Pressure instrument shall have the unit suffixed with 'a' to indicate absolute pressure. If nothing is there, that will mean that the indicated pressure is gauge pressure.

17.02.00 All instruments and control devices provided on panels shall be of miniaturized design, suitable for modular flush mounting on panels with front draw out facility and flexible plug-in connection at rear.

17.03.00 All electronic modules shall have gold plated connector fingers and further all input and output modules shall be short circuit proof. These shall also be tropicalized & components shall be of industrial grade or better.

18.00.00 ELECTRICAL NOISE CONTROL

The equipment furnished by the Bidder shall incorporate necessary techniques to eliminate measurement and control problems caused by electrical noise. Areas in Bidder's equipment, which are vulnerable to electrical noise shall be hardened to eliminate possible problems. Any additional equipment, services required for effectively eliminating the noise problems shall be included in the proposal. The equipment shall be protected against ESD as per IEC-801- 2. Radio Frequency interference (RFI) and Electro Magnetic Interference (EMI) protection against hardware damage and control system mal-operations/errors shall be provided for all systems.

19.00.00 NA

20.00.00 TAPPING POINTS FOR MEASUREMENTS

Tapping points shall include probes, wherever applicable, for analytical measurements and sampling.

For direct temperature measurement of all working media, one stub with internal threading of approved pattern shall be provided along with suitable plug and washer. The Bidder will be intimated about thread standard to be adopted.

The following shall be provided on equipment by the Bidder. The standard which is to be adopted, will be intimated to the Bidder.

(a.) Temperature test pockets with stub and thermowell

(b.) Pressure test pockets

21.00.00 ELECTRONIC MODULE/COMPONENT DETAILS

The Bidder shall have to furnish all technical details including circuit diagrams, specifications of components, etc., in respect of each and every electronic card/module as employed on the various solid state as well as microprocessor based systems and equipment including conventional instruments, peripherals etc.

It is mandatory for the Bidder to identify clearly the custom built ICs used in the package. The Bidder shall also furnish the details of any equivalents of the same.

22.00.00 ENVIRONMENTAL MONITORING & CONTROL MEASURES

Bidder to note that MOEF has declared Manali area as critically polluted area and also imposed certain restrictions on consideration of developmental projects.

Concerned authorities have been addressed to have self monitoring system (for Air, Water & Land) so as to ascertain the level of compliance of standards prescribed by MOEF and also to furnish the action plan ie., for the establishment of self monitoring system. It is also

directed to undertake Environmental Audit (EA) to ascertain the compliance level of standards notified by MOEF.

CHAPTER - 3

PAINTING

1.0 SCOPE

This section defines the technical requirements for surface preparation, selection and application of paints on equipment, vessels, machinery, piping, ducts etc. However, manufacturers shall follow their standard procedures for painting their equipment. The bidder shall submit a detailed painting procedure for approval of owner/ owner's representative after the award of contract.

The following surface and material shall require painting:

a. All un-insulated carbon steel and alloy steel equipment like columns, vessels, storage tanks, pumps, heat exchangers etc.
b. All un-insulated carbon steel and low alloy piping, fitting and valves (including painting of identification marks).
c. All pipe structural steel supports, walkways, platforms, handrails, ladders etc.

The following surfaces and materials shall not require painting :

a. Non-ferrous materials
b. Austentic stainless steel
c. Plastic and / or plastic coated materials
d. Insulated surface of equipment and pipes except color coating wherever required.
e. Painted equipment like blowers, pumps, valves etc. with finishing coats in good condition and with matching color code.

2.0 CODES AND STANDARDS

Painting of equipment shall be carried out as per the specifications indicated below and shall conform to the relevant IS specification for the material and workmanship.

The following Indian Standards may be referred to for carrying out the painting job :

IS:5	:	Colours for ready mixed paints and enamels
IS:1303	:	Glossary of terms relating to paints
IS:2379	:	Colour code for identification of pipelines
IS:1477	:	Code of practice for painting of ferrous metals in buildings (Parts I & II)
IS:2524	:	Code of practice for painting of non-ferrous metals in buildings (Parts I & II)
IS:2395	:	Code of practice for painting of concrete, masonry and plaster surfaces (Parts I & II)
IS:2338	:	Code of practice for finishing of wood and wood based materials (Parts I & II)

IS:158	:	Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali, water and heat resisting.
IS:2074	:	Ready mixed paint, air drying, red Oxide Zinc Chrome, priming
IS:104	:	Ready mixed paint, brushing, Zinc Chrome, priming
IS:2932	:	Enamel Synthetic exterior (a) Undercoating (b) finishing
IS:4682	:	Code of practice for lining of vessels & equipment
SIS 559000	:	Swedish standard for blasting
ISO 8504-2	:	Preparation of steel substrates before application of paints and related products. Surface preparation methods Part 2 Abrasive blast cleaning
ISO 8501-1	:	Preparation of steel substrates before application of paints and related products. Visual assessment of surface cleanliness. Part 1 : Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings.
SIS 05 5800	:	Surface preparation by acid pickling
SSPC SP08	:	Surface preparation by acid pickling
IS 2629	:	Recommended practice for hot dip galvanizing of iron and steel
ASTM A780	:	Standard practice for repair of damaged galvanized coatings
SSPC	:	Steel structures painting council
NACE	:	National association of Corrosion Engineers
DIN	:	Deutsehes Institute for Normung
BS	:	British Standard
ASTM	:	American Society for Testing material
AWWA	:	American Water works association

3.0 SURFACE PREPARATION

The surface shall be prepared in a manner suitable for coatings. Chemical derusters or rust converters shall not be applied. Acid cleaning is subject to approval of Purchaser/ Purchaser's representative.

3.1 BLASTING

The surface of the part/ component shall be blasted before the coating material is applied.

Compressed air supply for blast cleaning shall be free of water and oil. Air compressors shall not be allowed to deliver air above 1100C. Blasting activity shall be performed at temperatures 30C above due point and substrata temperature between 50C & 500C and relative humidity not exceeding 85% shall be maintained during painting. Necessary safety precautions for equipment and operator shall be adhered to and shall comply with applicable laws, regulations, ordinances etc., of the local authority, state or the nation pertains to the work.

Abrasive used for blast cleaning carbon steel and alloy steel shall be as per ISO 8504-2 and SSPC painting manual. Suggested abrasives are chilled iron grit, shot steel, malleable iron grit and shots of non metallic abrasive (aluminum oxide, copper slag, garnet etc.).

The grade of blasting shall be performed in line with the approved painting scheme.

The nature, quality and grain size of abrasives and the parameter of their use are to be chosen to obtain the required surface profile depth and cleanliness.

Surfaces prepared for coating shall be coated the same day and before any visible rusting occurs (the time elapsed between blast cleaning and commencement pf painting shall under no circumstances exceed 4 hours, but in any case must commence before signs of degradation occur).

The grades of surface finish

	ISO 8501-1	SIS 055900	SSPC	NACE
White metal	Sa3	Sa3	SP5	1
Near White metal	Sa 2½	Sa 2½	SP10	2
Commercial Blast	Sa2	Sa2	SP6	3
Brush off blast	Sa1	Sa1	SP7	4

Unless otherwise specified in the documents, the surface shall satisfy the following requirements after blasting
(a) Blasting according to SIS 055900, Grade Sa 2½

Primer paint shall be Zinc Silicate of approved brand. Dry film thickness of each primer coat shall be 15-25 µm.

3.2 Manual Rust Removal

Manual rust removal shall be allowed for welded zones and for touching up installed components.

3.3 Cleaning

Removal of impurity

	Impurity	Removal
a)	Dust, Loose deposits	Vacuum cleaning, brushing
b)	Adhesive deposits	Power brushing
c)	Oils, greasy impurities	Wet Blasting, Use of Detergent Additives by agreement
d)	Salt deposits	Rinsing
e)	Markings (eg felt up pen)	Organic solvents to manufacturer's specifications eg Trichloro trifluoro ethane and solvents containing acetone (renew solvent and rag frequently)

3.4 Acid Pickling

Prior to galvanizing the surface preparation shall be done by acid pickling as per SSPC-SP-08.

4.0 PROCESSING

4.1 General

Application Conditions

The primer shall be applied to properly prepared surfaces only. The specifications of the coating material manufacturers shall be observed. The minimum temperature shall be + 5°C and the relative humidity shall not exceed 80%. The temperature of the work piece shall be at least 3°C above dew point.

4.2 Application Procedure

The primer shall be applied by means of brush or by spary. The top coats shall be applied by means of brush, roller or spray.

At points where coating application is interrupted, the individual layers shall be adequately stepped to ensure proper layer sequence when coating operations are resumed.

4.3 Touching Up

Before each layer is applied, previous coating shall be touched up where necessary by way of rust removal and cleaning according coating manufacturers specification. The final top shall be reapplies completely.

4.4 Uncoated Surfaces

Moving parts of machines (e.g stems, shafts, sliding and locating bearings), nameplates, instruments and sealing surface shall not be coated. Welds shall be left free of coating upto a distance of 30 mm on each side of the weld edge until erection and weld examinations, if any, have been completed.

4.5 Bond Strength

The pill off stress determined using the pull off test method for adhesion shall not be less than 1.5 N/mm2, according to ISO 4624.

5.0 SURFACE CONDITIONS OF COATING SURFACES

The coating surface shall have a uniform film thickness, shade and gloss and shall be free from inclusions, sags and wrinkles.

6.0 COATING SYSTEMS

6.1 General Requirements for Coating Systems

Coating materials according to SSPC, BS 5493 or DIN 55 928 shall be used. Intermediate coats are to be pigmented with micaceous iron oxide. The materials shall be matched with each other so that they are compatible. Coatings deviating this specification shall be subject to approval. Standards of surface preparation and painting shall give a time to first maintenance of 10 years.

The colour and gloss of top coats shall be in accordance with sub clause suggested colour codes for painting (Sub Clause 6.8)

6.2 Standard Coating System (External Coatings)

(a) Steel Surfaces

(i) All steel structures shall receive two primer coats and two sandwich coat of MIO Epoxy paint and one finish coat of painting. First coat of primer shall be given in shop after fabrication before dispatch to erection site after surface preparation as described below. The second coat of primer shall be applied after erection and

final alignment of the erected structures. Two intermediate coats and one finished coat shall also be applied after erection.

(ii) Steel surface which is to be painted shall be cleaned of dust and grease and the heavier layers of rust shall be removed by chipping prior to actual surface preparation. The surface shall be abrasive blasted as explained in clause 3.1 to Sa 2½ finish as per SIS05-5900. Primer paint shall be Zinc Silicate of approved brand. Dry film thickness of each primer shall be 60 microns.

(iii) Two intermediate MIO Epoxy paint, and one top polyurethane coating of approved brand shall be applied. Dry film thickness of each intermediate coat shall be 90 microns and top polyurethane coating shall be 30 microns. The under coat and finish coat shall be of different tint to distinguish the same from finish paint. The total dry film thickness shall be 330 microns. All paints shall be of approved brand and shade as per owner's requirement.

(iv) Joints to be site welded shall have weldable primer applied within 100 mm of welding zone. Similarly where friction grip fasteners are to be used removable anti corrosive coating shall be provided. On completion of the joint the surfaces shall receive the paint as specified.

(v) Surfaces inaccessible after assembly shall receive two coats of primer prior to assembly. Surfaces inaccessible after erection including top surfaces of floor beams, supporting gratings or chequered plate shall receive one additional coat of finish paint over the above number of coats specified before erection. Portion of steel member embedded/ to be encased in concrete shall not be painted.

(b) Gratings and Step Threads

(i) Surface Preparation

Gratings and step threads shall be cleared by acid pickling as per SSPC-SP-08

(ii) Hot Dip galvanizing

The hot dip galvanizing shall be done as per IS 2629. The average mass of coating shall be 610 gm/m2.

(iii) Post Treatment

Immediately after galvanizing post treatment such as chromating shall be applied to retard white rust attack.

(iv) Touch up mechanical damages

The repair of damages coatings shall be done as per the recommended practice ASTM A780.

CHAPTER 4

DRAWING DOCUMENT SUBMISSION

4.1 DISCREPANCIES BETWEEN DRAWING AND SPECIFICATION:

Should there be any discrepancy between the specifications and/or schedule of prices and/or drawings or any inconsistency, error or omission in either of them, reference must be made to the BHEL/CUSTOMER for an explanation and the Supplier will be held responsible for any errors that may occur in the work through neglect of this precaution. The explanation of the BHEL/CUSTOMER shall be final and binding on the Supplier.

4.2 APPROVAL PROCEDURE

The scheduled dates for the submission of drawings as well as for, any data/information to be furnished by the Employer would be as per the following schedule. 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.	First Submission	7 days after LOI/PO
ii.	Approval/comments/by employer on Initial submission	Reasonable time
iii.	Resubmission	Within 7 days (whenever from date of comments required) Including both ways postal time.
iv.	Approval or comments	Within 2 weeks of receipt of resubmission.
v.	Furnishing of distribution copies	2 weeks from the date of last approval.

Note: The supplier may please note that all resubmissions must incorporate, all comments given in 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. Please refer enclosed sheet for details of Title block.

4.3 TITLE BLOCK

Following Title Blocks to be used in drawings at the time of drawing approvals

Project:	**400kV GIS at 2 x 660 MW Ennore SEZ Supercritical Thermal Power Project at Ash Dyke of NCTPS**
Customer :	**TAMILNADU GENERATION AND DISTRIBUTION CORPORATION (TANGEDCO)**
Consultant	**DESEIN PRIVATE LIMITED,NEW DELHI**
Contractor	**BHEL**

4.4 DOCUMENTS TO BE SUBMITTED ALONG WITH OFFER

1) **Drawings**
2) **Guaranteed Technical Particulars**
3) **Type Test Reports**
4) **List of Part Supplies with rating**

Drawings & Documents submitted at the time of offer shall be subject to review at contract stage.

4.5 DOCUMENTATION SCHEDULE

Following Documentation schedule to be followed per project.

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

Note: Drawings will also be submitted in CD/DVD in Latest AUTOCAD-2004 or Later version or any other CAD package along with conversion files for all major items.

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

Annexure-II

41.0 TRAINING OF OWNER'S/PURCHASER'S PERSONNEL

41.1 Training requirements

41.1.1 General

The Contractor shall be responsible for the instruction and training of the BHEL/OWNER's operation and maintenance personnel and his O & M contractor in all aspects of plant design, construction, erection, commissioning, etc. and in such a way that operation, maintenance and if necessary repairs of all the power project equipment and facilities specified can be handled competently by said personnel.

Such training of the BHEL/OWNER's personnel shall be performed

- In Contractor's and/or sub supplier's/manufacturer's home office and/or workshops.
- In similar power projects and such power projects which are under erection and commissioning as well as at the proposed similar Power Project by using the training simulator.
- On the job site by the Contractor's and/or his sub-suppliers, supervisors and/or instructors deputed to the site for supervision of erection, commissioning, testing and trial operation and/or by specialized training instructors;
- At the Power Project by the supervisors deputed to the Plant during the Warranty Period;

In compliance with the provisions of the Contract and the requirements of this specification.

The personnel required for the safe and efficient plant commercial operation and maintenance of the various types of equipment installed shall be provided by the BHEL/OWNER in accordance with the recommendation to be made by the Contractor.

The training will be performed in English. Translators/ interpreters shall be provided by the Contractor.

The Contractor's instructors shall use modern training techniques, procedures and aids and make available to the trainees all required notes, manuals, drawings, etc., to supplement the Operation and Maintenance Instruction Manuals.

The Contractor shall provide a detailed description about the recommended training services, including

- Number, category, seniority, required experience, profile required, etc. of the trainees

- Preliminary training program, showing

- Training facilities, training aids places of training etc.
- Training schedule
- Specialty and details of lectures and training
- Duration of training courses

41.2 Contractor's Obligations and Tasks

The Contractor shall make every effort to train the BHEL/OWNER's personnel and his authorized O & M contractors so that they can be qualified for the management, operation and maintenance of the Contract Plant

The Contractor shall nominate a person in charge of organization and co-ordination activities for training.

The Contractor shall select instructors with proper experience and skillfulness and English speaking capability to train the BHEL/OWNER's personnel.

The training program will be carried out according to the requirements of each specialty. It will consist mainly of but not limited to the following:

a) Systematic explanation in a classroom of specific subjects, such as the equipment performance, construction, main systems, auxiliary systems, etc.
b) Visit to power plants;
c) Practical training in similar power projects which are under erection and commissioning.
d) Practical training on simulators and control rooms of similar power projects.
e) Supply of all necessary training documentation (such as books, manuals, drawings), equipment, tools and instruments etc. The Contractor will make best effort to achieve above item (c) and (d) with utility authority.

The Contractor will make available free of charge to the BHEL/OWNER's personnel working cloths, safety helmets, stationery etc. as needed by the training program.

The Contractor shall allow the BHEL/OWNER's personnel to carry back all the technical documents supplied during the training.

The Contractor shall make at the end of the training period an evaluation of the results obtained by each trainee. These results will be confidentially notified to the BHEL/OWNER.

The Contractor shall assist the BHEL/OWNER's personnel in arranging their entry visas and all the formalities staying in foreign countries for training. The Contractor shall also take all the necessary

measures to ensure the safety of the BHEL/OWNER's personnel during their stay in the foreign country.

The Contractor shall appoint a person in charge of logistic coordination. This person shall take care for booking of rooms according to the requirements of the BHEL/OWNER and arranging for transportation (free of charge) from their living place to the training site.

The Contractor shall provide free medical services to the BHEL/OWNER's personnel, but excluding dentistry, buying glasses and tonic medicines.

41.4 Training schedule and program

The Training program for the BHEL/OWNER's personnel will be defined during the liaison meeting.

Two (2) months before the arrival of the first group of the BHEL/OWNER's personnel in training site, the BHEL/OWNER shall inform the Contractor of the date when the BHEL/OWNER's personnel are expected to be sent to training site

Within 2 (two) weeks after receipt of the BHEL/OWNER's information mentioned above, the Contractor shall confirm its agreement or indicate difficulties, if any, for the staying of the personnel. Thirty (30) days before the arrival of the BHEL/OWNER's personnel in the training site the BHEL/OWNER shall inform the Contractor of the brief career of the personnel including names, date of birth, nationality, specialty, experience, qualification, position and knowledge of foreign languages, passport details etc., so that the Contractor can assist in arranging their entry visas.

The Contractor shall not charge the BHEL/OWNER with the costs for the training activities in the respective training sites.

In case the BHEL/OWNER fails to send his personnel to attend the above training, the Contractor shall reimburse the relevant amount to the BHEL/OWNER

SECTION – 4
GUARANTEED TECHNICAL PARTICULARS

A. 400 kV GIS

1.01.00	Type of GIS		
1.02.00	Name of Manufacturer		
1.03.00	Maximum ambient temperature		
1.04.00	Minimum ambient temperature		
1.05.00	Nominal voltage class, kV rms		kV
1.06.00	Rated voltage		kV
1.07.00	Rated frequency		Hz
1.08.00	Number of phases		
1.09.00	Number of busbars		
1.10.00	Rated normal current at 50 Hz, A, rms		A
1.11.00	Rated short circuit current at rated Maximum voltage, not less than, kA, rms (Symmetrical)		kA
1.12.00	Lightning impulse withstand voltage (phase to phase and phase to earth) At minimum operating gas pressure		kVp
1.13.00	Switching impulse withstand voltage		kVp
1.14.00	1 minute power frequency withstand voltage, kV, rms	kV	
1.15.00	Rated peak withstand current, kA crest system	kA	
1.16.00	Material of enclosure		
1.17.00	Material of busbars		
1.18.00	Insulation medium		
1.19.00	Leakage rate of SF_6 per annum for each compartment		
1.20.00	Partial Discharge Level, pc		
1.21.00	Noise level		
1.22.00	Degree of protection		

1.23.00	Max. SF_6 operating pressure	
1.24.00	Rated auxiliary supply voltage	
1.25.00	Inductive voltage of the GIS enclosure	

B. 400 kV Outdoor SF6 to Air Bushing (Porcelain type)

2.01.00	Applicable Standard	IEC
2.02.00	Operating voltage (Uo/U)	kV
2.03.00	Rated voltage	kV
2.04.00	Rated short circuit withstand current	kA/ 3 sec
2.05.00	Rated peak withstand current	kA
2.06.00	Insulation medium	
2.07.00	Material of enclosures	
2.08.00	Lightning Impulse withstand voltage	
	(peak) (phase to phase and phase to earth)	
	At minimum operating gas pressure	kV
2.09.00	Power Frequency withstand voltage	
	(1 min) (phase to phase and phase to earth)	
	At minimum operating gas pressure	kV
2.10.00	Rated current	A
2.11.00	Feeder & Transformer	
	At 40°C (35°C/24 h average)	
	At 50°C (45°C/24 h average)	A
2.12.00	Creepage distance at rated voltage	mm/kV

SECTION 5

ENCLOSURES TO SPECIFICATIONS

ANNEXURE I SCHEDULE OF DEVIATION

Annexure-1

SCHEDULE OF DEVIATIONS

Certified that the following **are the only deviations** from the specification (for the equipment and systems being offered)

S.No.	Page No.	Clause No.	Deviation	Reason / Justification

Notes:

1. It is mandatory for the bidder to furnish Price of Deviation in the above Schedule of Deviation.
2. Acceptance or Non-acceptance of deviation is the sole discretion of the owner.
2. Additional sheets of similar size and format may be Annexd as per bidder's requirement.
3. Deviations listed elsewhere will be summarily rejected and shall be ignored.
4. This schedule to be submitted with Technical Bid.

Date :

Signature :

Name:

Designation :

SECTION – 6
CHECK LIST
FOR 400KV GIS

Sl.	Particulars	Reply by bidder.	
1	**TECHNICAL QUALIFYING REQUIREMENT**		
1.1	The bidder should comply with Technical Qualifying requirement furnish the relevant documents.	Confirmed	Yes/No
1.2	The bid shall be submitted by the Manufacturer of GIS. 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. The erection of structure shall be done by BHEL.	Confirmed	Yes/No
2.4.	SF6-GIS to Air bushing - Interface for connecting GT/ST/LINE/REACTOR with bus duct shall be complete with structures etc shall be provided by the bidder as per clause 4.00.00 of Annexure-A of section-2. Limit of supply as per technical specification and as per IEC 61639.		
2.5.	Confirm that the consumables (list to be enclosed by bidder during contract stage) shall be supplied before erection after clearance from BHEL.	Confirmed	Yes/No
2.6.	Detailed list of Commissioning spares for testing & commissioning of GIS till handing over	Attached	Yes/No
2.7.	Detailed list of Tools & tackle & Testing Equipment	Attached	Yes/No
2.8.	Detailed list of Recommended Spares	Attached	Yes/No
2.9.	The Switchgear shall be complete with all necessary terminal boxes, SF6 gas filling, interconnecting power and control Cables	Confirmed	Yes/No

Sl.	Particulars	Reply by bidder.	
	(between GIS to GIS/GIS to LCC/ LCC TO LCC), grounding connections (GIS to GIS and GIS to Earth Mesh on Floor), Online monitoring System and piping, Inspection windows support structures.		
2.10.	The scope of supply shall also include all erection and mounting hardware.	Confirmed	Yes/No
2.11.	Design philosophy of earthing submitted with the bid	Confirmed	Yes/No
2.12.	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 8.00.00 of section 2. 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.	Confirmed	Yes/No
2.13.	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 engineering stage shall be incorporated by bidder without any cost implication to BHEL.	Confirmed	Yes/No
3	**Technical**		
3. 1	**Location of site at Coastal Area :** *Project site Ennore which is located in coastal area near Chennai hence design and construction of GIS should be suitable for the climate/ Meteorological Condition as mentioned in Section-1 and in section-3.* *Bidder to inform what measures shall be taken to ensure the same at bid stage.*	Writeup attached with bid.	Yes/No
3. 2	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. 3	Material of enclosure – Non Magnetic	Confirmed	Yes/No
3. 4	Material of bus bar - Non Magnetic	Confirmed	Yes/No
3. 5	Requirement of AC and DC auxiliary loads	Enclosed with bid	Yes/No
3. 6	Catalogues of GIS	Enclosed with bid	Yes/No
3. 7	Catalogues of all Maintenance equipment. Bidder to confirm that offered equipment meets the requirements of specification.	Enclosed with bid	Yes/No
3. 8	Approved makes – Bidder to confirm that the offered Maintenance equipment are of approved make	Confirmed	Yes/No

Sl.	Particulars	Reply by bidder.	
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 *Rating*, numbers & 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	• *The covered Store will be provided by BHEL for items which require indoor storage. The size of covered storage shall be 10meter X 20meter etc.* • *Manufacturer to mark Indoor storage requirement on the material to be stored in covered storage. The rest of the material shall be stored outdoor.*	Confirmed	Yes/No
7	**Site Test**		
7.1	Bidder to supply Only special tools. For other tools Bidder to submit list of tools, tackle, slings, spanners, gauges, slings and other lifting devices, drills, instruments and appliances necessary for the complete assembly and erection at site of the GIS, required for installation, gas filling, maintenance, site testing of the GIS which shall be arranged by BHEL. EOT crane of shall be provided by BHEL in GIS cavern. Capacity of EOT Crane shall be as per recommendation of GIS Manufacturer. 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

Sl.	Particulars	Reply by bidder.	
7.3	All field tests including tests during installation, pre-commissioning, commissioning, field acceptance tests shall be conducted by the Contractor, in presence of representative of the Employer. No separate site test will be conducted by BHEL/Customer	Confirmed	Yes/No
8	**TYPE TESTS REQUIREMENTS**		
8.1	The 4000kV 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 400 kV GIS shall be submitted alongwith the bid. Differences, if any, in the items offered and those which have been type tested shall be clearly brought out alongwith explanation for suitability. Type Tests Reports Submitted along 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/TANGEDCO, the bidder shall repeat these test(s) at no extra cost to the purchaser and no delivery implication. 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.	Confirmed	Yes/No
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	a) The contractor/ bidder shall submit the Type Test Reports for the	Confirmed	Yes/No

Sl.	Particulars	Reply by bidder.	
	tests conducted as per 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 **supply** under this contract. b) 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 TANGEDCO/BHEL shall have right to witness the Type Tests. Waiver of Type Tests will not be entertained in normal circumstances. c) All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price. d) The contractor / bidder shall submit the following Type Tests Reports for the tests conducted on the GIS Package. However any other Type Tests reports not mentioned but required shall also be submitted.		

2. TYPE TESTS:

LIST OF TYPE TESTS REPORTS TO BE SUBMITTED FOR 400 kV GIS EQUIPMENTS:

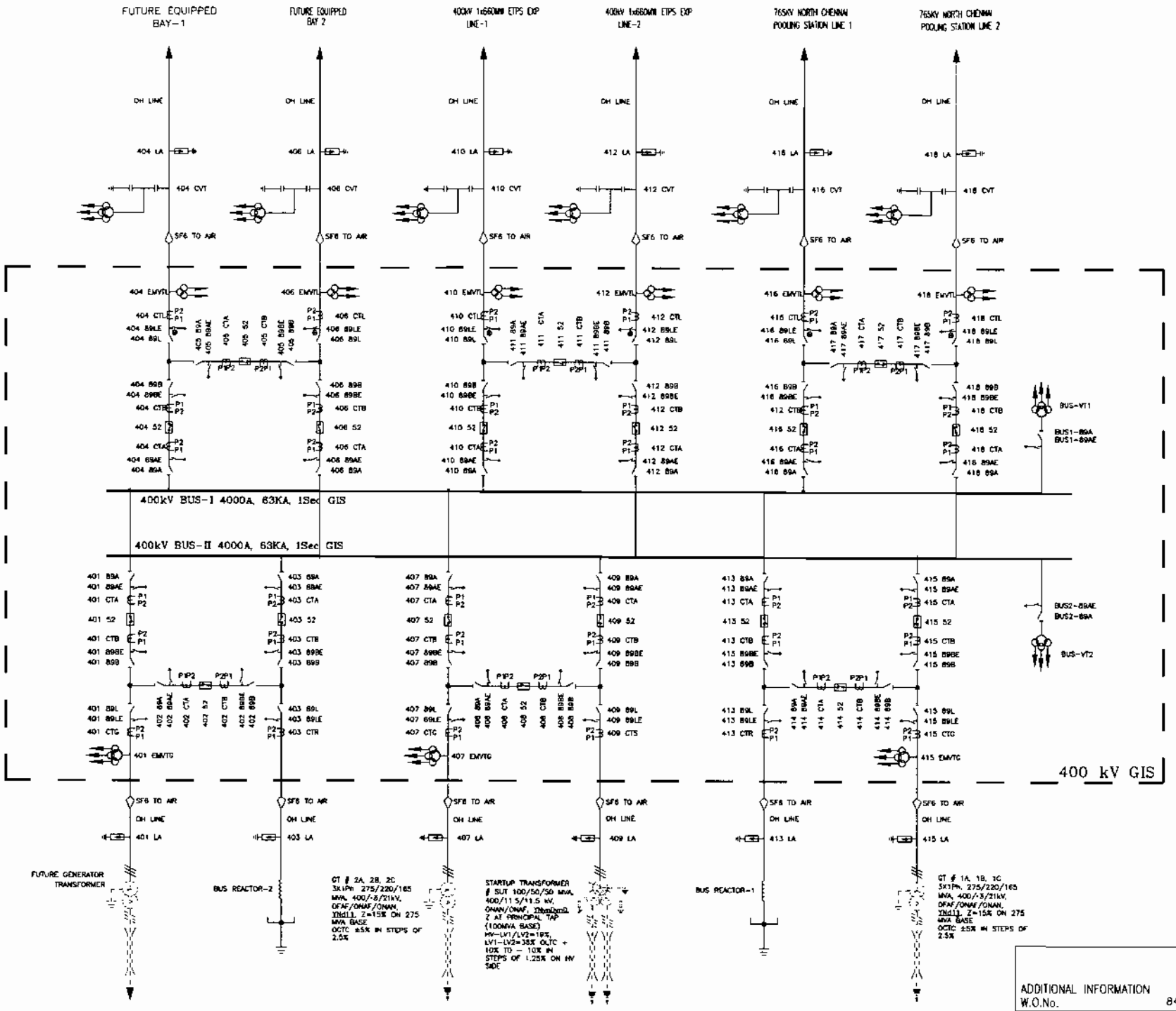
Type Tests for following Tests to be submitted:

1. Tests to verify the insulation level of the equipment and dielectric tests on auxiliary circuits.
2. Tests to prove the radio interference voltage (RIV) level (if applicable).
3. Tests to prove the temperature rise of any part of the equipment and measurement of the resistance of the main circuit.
4. Tests to prove the ability of the main and earthing circuits to carry the rated peak and the rated short-time withstand current.
5. Tests to verify the making and breaking capacity of the included switching devices.
6. Tests to prove the satisfactory operation of the included switching devices.
7. Tests to prove the strength of enclosures.
8. Verification of the degree of protection of the enclosure.
9. Gas tightness tests
10. Electromagnetic compatibility tests (EMC)
11. Additional tests on auxiliary and control circuits.
12. Tests on partitions.
13. Tests to prove the satisfactory operation at limit temperatures.
14. Tests to prove performance under thermal cycling and gas tightness tests on Insulators.
15. Corrosion test on earthing connections (if applicable).

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM.)

DRAWING NO TB-1-378-510-001

COMPUTER DRG. PATH NAME :
REF. DRG. No.
SIGN. & DATE
INVENTORY No



400 kV INDOOR GIS

S.NOS	DESCRIPTION	SYMBOLS
1.	CIRCUIT BREAKER, 2000 A (3-Ph)	
2	DISCONNECTING SWITCH, MOTORISED 2000 A (3-Ph)	
3.	EARTH SWITCH, MOTORISED 2000A (3-Ph)	
4	FAST ACTING EARTHSWITCH, MOTORISED, 2000A (3-Ph)	
5	CURRENT TRANSFORMER, 2000 A (1-Ph)	
6.	400 KV BUS EMVT (1-Ph)	
7	400 KV EMVT FOR LINE (1-Ph)	
8.	400 KV BUS EMVT FOR GT (1-Ph)	

400 kV OUTDOOR EQUIPMENT

S.NOS.	DESCRIPTION	SYMBOLS	QTY
1.	SURGE ARRESTOR 360kV, 20kA, CLASS-III		36
2	BUS REACTOR (80/125MVAR)		02
3.	SF6 TO AIR BUSHING		36
4.	400 KV LINE CVT		18

ELECTRICAL SYSTEM PARAMETERS

01	SYSTEM VOLTAGE	400 kV
02	HIGHEST SYSTEM VOLTAGE	420 kV
03	LIGHTNING IMPULSE W/S VOLTAGE	1425 kVp
04.	SWITCHING IMPULSE W/S VOLTAGE	a) 1575kVp (BETWEEN PHASES) b) 900(+345) (ACROSS ISOLATING DISTANCE)
05	POWER FREQUENCY W/S VOLTAGE	650 kV
06	FAULT LEVEL (1 SEC.)	63 KA
07.	SYSTEM NEUTRAL GROUNDING	SOLIDLY EARTHED
08.	CREEPAGE DISTANCE	Min. 31 mm / kV

NOTE:
1. BAY SEQUENCE IS SUBJECT TO FINALISATION OF PLOT PLAN.
2. CT & VT DETAILS ARE SHOWN IN SHEET-2.
3 RATING OF BUS REACTOR SHALL BE SUBJECT TO FINALIZATION OF COMMERCIAL SETTLEMENT

ADDITIONAL INFORMATION
W.O.No. 84007

STATUS OF DRAWING –

DISTRIBUTION OF PRINTS

ग्राहक/परियोजना का नाम
NAME OF CUSTOMER/PROJECT

TAMILNADU GENERATION AND DISTRIBUTION CORPORATION
400KV GIS AT 2X660MW ENNORE SEZ PROJECT CHENNAI

CONSULTANT

DESEIN CONSULTING ENGINEERS, NEW DELHI

भारत हेवी इलेक्ट्रिकल्स लिमिटेड
पारेषण व्यापार समूह
BHARAT HEAVY ELECTRICALS LTD.
TRANSMISSION BUSINESS GROUP

	नाम /NAME	हस्ता./SIGN.	दि./DATE
बनाया DRAWN	RKP/BA	-Sd-	29.01.15
जाँचा CHECKED	VK/SKS	-Sd-	
स्वीकृत APPROVED	RS	-Sd-	02.02.15

REV	DATE	ALTERED / CHECKED / APPROVED
01	28.05.15	ALTERED RKP/BA; CHECKED VK/SKS; APPROVED RS
ZONE		REVISED IN LINE WITH TANGEDCO'S COMMENTS.

विभाग DEPT TBEM
कोड CODE 422
अनुपात / SCALE 1·8 (NTS)
कार्ड कोड CARD CODE –

शीर्षक/TITLE
SINGLE LINE DIAGRAM OF 400KV GIS SUBSTATION

ड्राईंग सं./DRAWING NO. TB-1-378-510-001
पुन:/REV 01
पृष्ठ सं./SHEET No 1
अगला पृष्ठ/NEXT SHEET 2

A2 SIZE

CT CORE DETAILS AND CVT/EMVT WINDING DETAILS:

FOR GT, ST, BUS REACTOR AND TIE BAYS CT

TYPE – CTA

Core No.	RATIO	Output Burden at lowest Tap (VA)	Min KPV (V) at all Taps	Max. Ie at Vk/2	Acc Class	Purpose
1	2000-1000-500/1	-	63Rct + 130V	30 mA	PS	O/C Protection + LBB
2	2000-1000-500/1	-	63Rct + 130V	30 mA	PS	Overall Differential Protection
3	2000-1000-500/1	10 VA	-	-	0.2S	Energy Audit Metering

TYPE – CTB

Core No.	RATIO	Output Burden at lowest Tap (VA)	Min KPV (V) at all Taps	Max. Ie at Vk/2	Acc Class	Purpose
1	2000-1000-500/1	-	63Rct + 130V	30 mA	PS	Busbar Protection
2	2000-1000-500/1	-	63Rct + 130V	30 mA	PS	Busbar Protection
3	2000-1000-500/1	10 VA	-	-	0.2S	BCU Metering

TYPE – CTG

Core No.	RATIO	Output Burden at lowest Tap (VA)	Min KPV (V) at all Taps	Max. Ie at Vk/2	Acc Class	Purpose
1	2000-1000-500/1	-	63Rct + 130V	30 mA	PS	Generator Differential Protection
2	2000-1000-500/1	-	63Rct + 130V	30 mA	PS	Overall Differential Protection + REF

TYPE – CTS

Core No.	RATIO	Output Burden at lowest Tap (VA)	Min KPV (V) at all Taps	Max. Ie at Vk/2	Acc Class	Purpose
1	2000-1000-500/1	10 VA	-	-	0.2S	Energy Audit Metering
2	2000-1000-500/1	-	63Rct + 130V	30 mA	PS	O/C + REF Protection

TYPE – CTR

Core No.	RATIO	Output Burden at lowest Tap (VA)	Min KPV (V) at all Taps	Max. Ie at Vk/2	Acc Class	Purpose
1	2000-1000-500/1	-	63Rct + 130V	30 mA	PS	O/C Protection
2	2000-1000-500/1	-	63Rct + 130V	30 mA	PS	Reactor Differential Protection

FOR LINE & TIE BAYS CT IN LINE DIAMETER

TYPE – CTA

Core No.	RATIO	Output Burden at lowest Tap (VA)	Min KPV (V) at all Taps	Max. Ie at Vk/2	Acc Class	Purpose
1	2000-1000-500/1	-	200Rct + 500V	30 mA	PS	Distance Protection
2	2000-1000-500/1	-	200Rct + 500V	30 mA	PS	Distance Protection
3	2000-1000-500/1	20 VA	-	-	0.2	BCU Metering

TYPE – CTB

Core No.	RATIO	Output Burden at lowest Tap (VA)	Min KPV (V) at all Taps	Max. Ie at Vk/2	Acc Class	Purpose
1	2000-1000-500/1	-	63Rct + 130V	30 mA	PS	Busbar Protection
2	2000-1000-500/1	-	63Rct + 130V	30 mA	PS	Busbar Protection
3	2000-1000-500/1	20 VA	-	-	0.2	BCU Metering

TYPE – CTL

Core No.	RATIO	Output Burden at lowest Tap (VA)	Min KPV (V) at all Taps	Max. Ie at Vk/2	Acc Class	Purpose
1	2000-1000-500/1	10 VA	-	-	0.2S	Tariff Metering
2	2000-1000-500/1	10 VA	-	-	0.2S	Tariff Metering

Summary of Core Details of Bushing CTs

80MVAR Bus Reactor:

400kV Bus Reactor (Line Side)

Core No.	RATIO	Output Burden at lowest Tap (VA)	Min KPV (V)	Max. Ie	Max Rct	Acc Class	Purpose
1	200/1		200V	40mA at KPV/4	1 Ohms	PS	REF
2	200/1		200V	40mA at KPV/4	1 Ohms	PS	Backup Impedance

400kV Bus Reactor (Neutral Side) (CT placed before Neutral)

Core No.	RATIO	Output Burden at lowest Tap (VA)	Min KPV (V)	Max. Ie	Max Rct	Acc Class	Purpose
1	200/1	-	200V	40mA at KPV/4	1 Ohms	PS	REF
2	2000-1000-500/1	-	1000-500-250V	30-80-120 mA at KPV/2	10-5-2.5 Ohms	PS	Reactor Differential

Summary of winding Details of 400kV Line CVT

400 kV CVT, 4400 pF, 3 windings

WINDING	RATIO	ACCURACY CLASS	Rated Burden (VA)	PURPOSE
1	400 kV /√3/110V/√3	3P	100	PROTECTION
2	400 kV/√3/110V/√3	3P	100	PROTECTION
3	400 kV/√3/110V/√3	0.2	100	METERING

Simultaneous Burden of 100 VA

Summary of Core Details of 400kV BUS EMVT

WINDING	RATIO	ACCURACY CLASS	Rated Burden (VA)	PURPOSE
1	400 kV /√3/110V/√3	3P	100	PROTECTION
2	400 kV /√3/110V/√3	0.2	100	METERING
3	400 kV /√3/110V/√3	0.2	100	METERING

Summary of Core Details of 400kV tariff EMVT for lines

WINDING	RATIO	ACCURACY CLASS	Rated Burden (VA)	PURPOSE
1	400 kV/ √3/110V/√3	0.2	100	METERING
2	400 kV /√3/110V/√3	0.2	100	METERING

Summary of Core Details of 400kV EMVT for GT

WINDING	RATIO	ACCURACY CLASS	Rated Burden (VA)	PURPOSE
1	400 kV /√3/110V/√3	3P	100	PROTECTION
2	400 kV/ √3/110V/√3	0.2	100	METERING
3	400 kV /√3/110V/√3	0.2	100	METERING

REV.	DATE	ALTERED / CHECKED / APPROVED
ZONE		

REV.	DATE	ALTERED / CHECKED / APPROVED
ZONE		

REV	DATE	ALTERED / CHECKED / APPROVED
01	28.05.15	ALTERED RKP/BA; CHECKED VK/SKS; APPROVED RS
ZONE	REVISED IN LINE WITH TANGEDCO'S COMMENTS.	

ADDITIONAL INFORMATION W.O.No. 84007AXXX

STATUS OF DRAWING -

DISTRIBUTION OF PRINTS

ग्राहक/परियोजना का नाम NAME OF CUSTOMER/PROJECT: CONSULTANT

TAMILNADU GENERATION AND DISTRIBUTION CORPORATION
400KV GIS AT 2X660MW ENNORE SEZ PROJECT CHENNAI

DESEIN CONSULTING ENGINEERS, NEW DELHI

भारत हेवी इलेक्ट्रिकल्स लिमिटेड
पारेषण व्यापार समूह
BHARAT HEAVY ELECTRICALS LTD.
TRANSMISSION BUSINESS GROUP

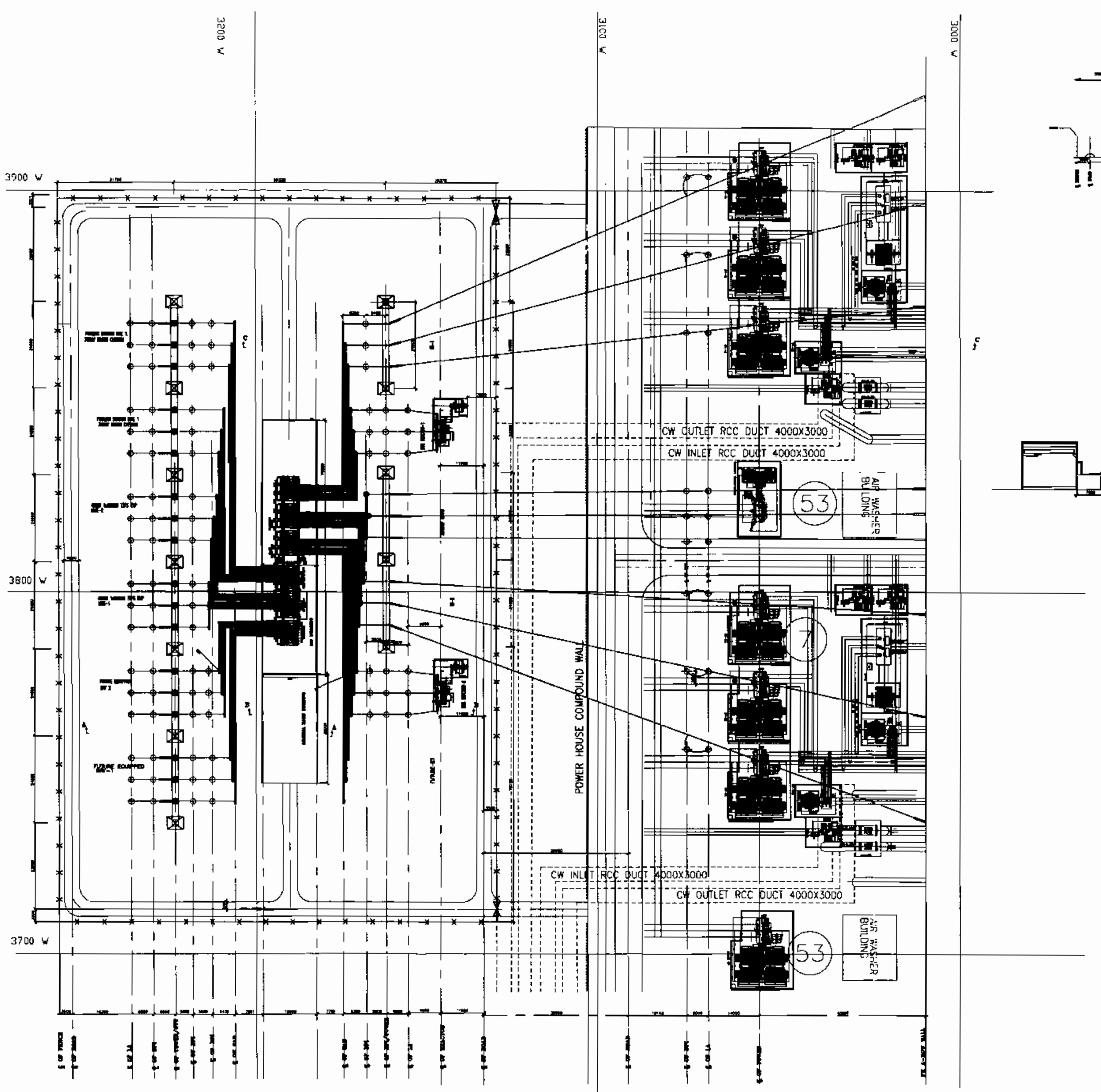
	नाम /NAME	हस्ता./SIGN.	दि./DATE
बनाया DRAWN	RKP/BA	- -	
जाँचा CHECKED	VK/SKS	- -	
स्वीकृत APPROVED	RS	- -	

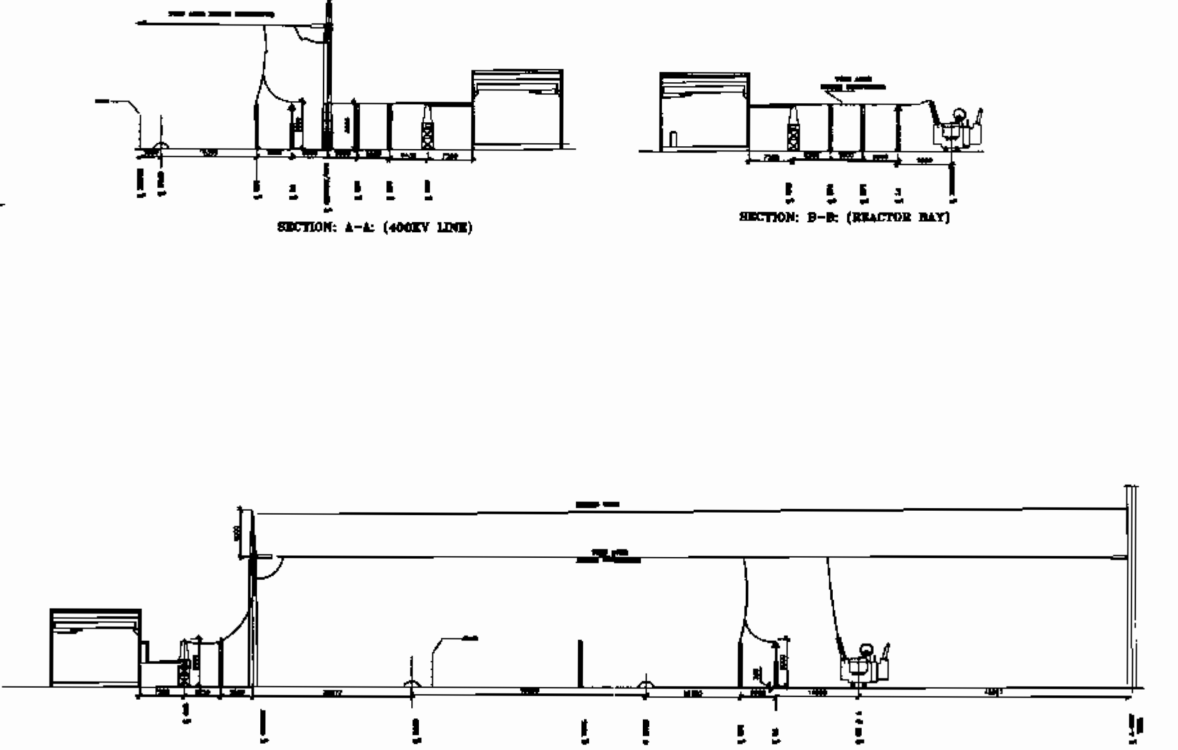
विभाग DEPT. TBEM; कोड CODE 422; अनुपात / SCALE 1.8 (NTS); कार्ड कोड CARD CODE -

शीर्षक/TITLE: SINGLE LINE DIAGRAM OF 400KV GIS SUBSTATION

ड्राईंग सं./DRAWING NO TB-1-378-510-001; पुनः/REV 01

पृष्ठ सं./SHEET No 2; अगला पृष्ठ/NEXT SHEET –





SECTION: A-A: (400KV LINE)

SECTION: B-B: (REACTOR BAY)

SECTION: C-C: (GT-1)

NOTES

[illegible]

BILL OF QUANTITY – 400KV

S.NO.	DESCRIPTION	SYMBOL	QTY
1	400 kV INDOOR GIS	—	01
2	SF6 TO AIR BUSHING	■	36
3	SURGE ARRESTER 390kV, 10kA, CLASS-4	⊕	36
4	400 kV, 80 MVAR REACTOR		02
5	400 kV LINE EXIT		10

ADDITIONAL INFORMATION
STATUS OF DRAWING
DISTRIBUTION OF PRINTS

NAME OF CUSTOMER/PROJECT: TAMILNADU GENERATION AND DISTRIBUTION CORPORATION (TANGEDCO)
400KV GIS AT 2 X 800 MW ENNORE SEZ SUPERCRITICAL THERMAL POWER PROJECT AT ASH DYKE OF NCTPS

NAME OF CONSULTANT: DESEIN PRIVATE LIMITED, NEW DELHI

BHARAT HEAVY ELECTRICALS LTD.
TRANSMISSION BUSINESS GROUP

SCALE

TITLE: 400KV GIS AND POTHEAD YARD LAYOUT PLAN ENNORE

DRAWING NO: TB-0-378-318-002 | REV: 00

COMPUTER DRG. FILE NAME	REF DRG No.	SIGN & DATE	INVENTORY No.