



BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION PROJECTS ENGINEERING MANAGEMENT
NEW DELHI

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400 KV Gas Insulated Switchgear		SIGN	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>
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		W.O. No			

CUSTOMER	TAMILNADU GENERATION AND DISTRIBUTION CORPORATION (TANGEDCO)
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PROJECT	400kV GIS at 2 x 660 MW Udangudi STPP (Stage-I)
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SECTION – 1

1. SCOPE

This technical specification covers the requirements of design, engineering, manufacturing, testing before supply, inspection, packing, loading at works, transportation to site, supervision of unloading & verification of material at site and supervision of erection.

The scope also included testing & commissioning at site of complete 400 kV Gas Insulated Substation (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:

Statutory Regulations

Section- 1

Section- 2: TANGEDCO Specification

Section- 3

International standards

Bidder to submit filled up section-5 confirming that there are no deviations and the offer is in full compliance with the specification along with other document.

1.1 PROJECT INFORMATION:

- a) Project : **400kV GIS at 2 x 660 MW Udangudi STPP (Stage-I)**
- b) Customer : **TAMILNADU GENERATION AND DISTRIBUTION CORPORATION (TANGEDCO)**
- c) Main Contractor : **BHEL**

The 400 KV GIS shall have three single phase construction, one and half breaker arrangement (D-type) having the following bays.

- a) Two (2) fully equipped Generator Transformer Bay
- b) One (1) fully equipped Standby/ Maintenance Transformer Bay
- c) Four (4) fully equipped Line Bay
- d) Two (2) fully equipped Bus Reactor Bay
- e) Two (2) fully equipped Bus Voltage Transformer Bay with Bus Grounding Switch
- f) Five (5) fully equipped Tie Bay
- g) Bus Sectionalizing isolator for each bus
- h) One (1) fully equipped Spare Bay
- i) Two (2) numbers spare bay (Unequipped)

The detailed BOQ is given in Annexure-1 of Section 1.

1.2 SPECIFIC TECHNICAL REQUIREMENT

Sl.No.	Technical Parameter	Unit	Value
1	Type of GIS	Indoor Type	
2	Location	Indoor	
2	Design ambient temperature	⁰ C	50
3	Design relative humidity	%	95
4	Nominal voltage class, rms	kV	400
5	Maximum System voltage, rms	kV	420
6	Rated frequency,	Hz	50
7	Number of phases	Nos	3
8	Lightning impulse withstand voltage, peak	kV	1425
9	Switching impulse withstand voltage, peak	kV	1050
10	Power frequency withstand voltage (dry) , rms	kV	630
11	Symmetrical Short time withstand current	kA/Sec	63 kA for 1 sec.
12	Dynamic withstand current, peak	kA	163
13	Bus bar & bus sectionaliser rating, rms	A	4000
14	Breaker & Isolator Rating (Bay) , rms	A	2000
15	Leakage rate of SF ₆ per annum for each compartment individually as well as complete installation	%	0.5
16	Creepage distance for outdoor	mm/kV	31
17	Type of earthing	Solidly grounded	
18	Duty Cycle of circuit breaker	O-0.3 sec-CO- 3 min-CO	
19	Operating mechanism of circuit breaker	Spring charged / Hydraulic	
20	LT Auxiliary Supply		
20.1	AC	415 V (± 10 %), 3 phase, 4 wire solidly earthed	
20.2	DC	220 V (+10 %,-15%),DC, 2 wire, unearthed	
21	Permissible frequency variation	+3% to – 5%	
22	Combined variation of voltage & frequency	10%	
23	Power evacuation and Startup power	400 kV (±5%), 3 phase, 3 wire, 50 Hz, effectively earthed.	

1.3 BILL OF QUANTITIES: As per Annexure-1 of Section 1.

1.4 SITE INFORMATION: Refer section-3 for Site information and metrological data.

1.5 ADDITIONAL INFORMATION AND REQUIREMENTS:

1. Project site Udangudi is located in “Coastal Area” near Thoothukudi hence design, material selection and construction of GIS should be suitable for the climate/ Meteorological Condition as mentioned above and in section-3.

GIS will be placed in **non-air conditioned building** during service.

2. Packing of GIS shall be suitable for long term (minimum 2 years) storage of GIS in given environmental conditions. Moisture absorbant desiccants/drying agent should be put in each packing box/case to maintain humidity.
3. Bidder to submit list of consumables. These shall be supplied by bidder before erection, after clearance from BHEL.
4. Supplier to submit detailed bar chart indicating all the milestones from Engineering till manufacturing/ testing, dispatch to site and commissioning.
5. Bar Chart shall be approved by BHEL before commencement of work. Tentative bar chart to be submitted by bidder on tender stage.
6. For system details and transport limitations refer Project Information in section 3.
7. Bidder shall offer their latest Type Tested compact Model to minimise the building size requirement.
8. Spacing between bays, if required to be changed to adjust with building column and beam without any cost implication to BHEL at contract stage only.
9. Bidder shall conduct system studies, insulation coordination for establishing Surge Arrester's rating and any other requirement for successful operation of GIS and cost of same shall be deemed included in scope of supply. Any additional item/ Surge arrester as required as per study to be provided by vendor. The study report shall be submitted for Approval.
10. Successful bidder shall submit 3D and 2D OGA drawing for complete GIS and section drawing of each equipment. OGA drawings shall also be furnished in AutoCad file format. The 3D drawing file format should be such that it is compatible to operate/link with reputed 3D modelling softwares.
11. Bidder shall check and ensure adequacy of the system protection for successful operation of GIS. After checking of system/site by bidder, GIS shall be installed and if any failure, malfunction of any part occurs after commissioning, bidder shall replace the part unconditionally within 15 days. Further an RCA report should be submitted and necessary changes to be done as per the RCA report wherever required.
12. No support structure shall be placed within 3 meters around the GIS building periphery.

1.6 EARTHING/GROUNDING OF GIS

Supply of Earthing Material including fixing hardware and Erection of all Earthing connection for GIS to GIS and GIS to Earth Mesh on Floor shall be in bidder's scope. In GIS building, earth mat of copper flat (in bidder's scope) shall be embedded in the concrete floor in grid / mesh form (Pl refer **chapter-3** of section 2). The quantity shall be estimated and supplied by the bidder, based on their design philosophy.

Design philosophy shall be submitted along with the bid in line with **chapter-3** of section 2 for earthing.

Erection of Earth mesh on floor shall be done by BHEL in supervision of manufacturer as per manufacturer's design.

Only supply of MS Rod (40mm Dia for outdoor below ground earth mat) and GI Flat of 75x12mm shall be in BHEL's scope for inter connection of mesh with Outdoor earthmat. Any other earthing material if required as per bidder's design philosophy shall be in bidder's scope of supply and erection.

The GIS earthing mesh shall be extended suitably to enable connection to the outdoor Switchyard earthmat.

1.7 QUALIFYING REQUIREMENT

The bidder whose equipment are offered should have designed, manufactured , tested and supplied the same for the specified system voltage and which are in satisfactory operation for at least five (5) years as on 02/07/2015. Type test certificates for test conducted on similar rating equipment shall be furnished.

1.8 TYPE TESTING

Type test certificates for test conducted on similar rating equipment shall be furnished for customer approval at contract stage.

Equipment offered shall be of type tested and proven type. In case type test reports are not found to be meeting the specification requirements, bidder shall conduct; all such type tests according to the relevant standards at his cost and Customer /BHEL will not absorb such cost.

Tests shall be carried out for all the equipment as per applicable standards as stated in the various sections of this specification. Copies of certified reports of all tests carried out at the works shall be furnished. The equipment shall be dispatched from works, only after receipt of owner's written approval of the test reports.

1.9 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 to BHEL/ TANGEDCO in accordance with Manufacturing quality plan. The cost of travel expenses including travel insurance, boarding and lodging expenses of the TANGEDCO inspector witnessing the tests (Type, routine, acceptance as applicable) have to be borne by the Supplier. This includes inspection in India and foreign countries as applicable.

1.10 TRAINING

The training of the Owner's/ BHEL personnel shall be performed:

- In suppliers/ manufacturer's home office/factory and/or workshops.
- On the Job/Similar site

The training to be performed in English.

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 training program should be submitted for customer approval.

The cost of travel expenses including travel insurance, boarding and lodging expenses of the TANGENDCO training participant have to be borne by the Supplier. This includes training in India and foreign countries as applicable.

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

- 1.12 Makes of all equipment and components shall be subjected to Owner's approval without any cost implication.

1.13 DRAWINGS ENCLOSED FOR REFERENCE

Sl. No.	Ref. Drawing No.	Drawing Title	Rev
1.	TB-1-400-316-001	Single Line diagram of 400 kV GIS Substation at 2X660 MW Udangudi STPP Stage-1	00
2.	10-1115112-E-202	Single Line Diagram for 400kV GIS Switchyard (D-Type)	00
3.	10-1115112-E-224	400kV GIS Switchyard Layout	00

The above drawings are for reference only and the customer approved drawing will be provided for detailed design of vendor equipment/system. There will be no price implication on account of same.

Section 2, Chapter 1

400 kV GIS SWITCHYARD- GENERAL

1.0.0 INTENT OF SPECIFICATION

This section covers the requirements of 400 kV GIS switchyard.

2.0.0 SCOPE OF WORK

The scope of work shall include supply, Supervision of Erection, testing and commissioning of the following:

- a) 400 kV, gas insulated switchgear comprising circuit breakers, isolators, earth switches, current transformers voltage transformers, gas barriers, GIS bushing, local control cubicle, etc.
- b) 400 kV GIS busduct
- c) SF6 gas cylinders
- d) Commissioning spares and consumables
- e) Mandatory spares
- f) Tools & tackles
- g) Any other equipment required for the system

3.0.0 CODES AND STANDARDS

The equipment to be furnished under this specification shall be in accordance with the applicable section of the latest version of the relevant IS/IEC standards including amendments, except where modified and / or supplemented by this specification. Some of the applicable standards are listed below:

- a) IEC 62271-203 Gas Insulated metal-enclosed switchgear for rated voltages above 52 KV
- b) IEC 60376 New sulphur hexafluoride
- c) IEC 62271-1 High-voltage switchgear and control gear - Common specification
- d) IEC 62271-100 High voltage alternating current circuit breakers
- e) IEC 62271-102 Alternating current disconnectors (isolators) and earthing switches
- f) IEC 61869-2 Additional requirements for current transformers
- g) IEC 61869-3 Additional requirements for inductive voltage transformers
- h) IEC 60137 Bushings for alternating voltages above 1000 V
- i) IEC 61639 Direct connection between power transformers and gas insulated metal enclosed switchgear for rated voltages of 72.5 kV and above
- j) IEEE C37.122.1 Guide for Gas-Insulated Substations
- k) IEC 61869-5 Additional requirements for capacitive voltage transformers
- l) IEC 60794-4 Optical fiber cables
- m) IS 3070-3 Lightning arresters for alternating current systems – Metal oxide lightning arresters without gaps
- n) IEC 60099-4 Metal oxide surge arresters without gaps
- o) IEC 61850 Communication network and systems in substations
- p) IEC 60255 Electrical Relays
- q) IEC 60359 Expression of the performance of electrical & electronic measuring equipment
- r) IEC 60447 Basic and safety principles for man machine interface (MMI) –

Actuating principles

- s) ANSI C37.2 Manual and automatic station control, supervisory and associated telemetering equipment
- t) IS 14697 Specification for AC static transformer operated watt-hour and varhour meters, Class 0.2S and 0.5
- u) IEC 62053 -61 Electricity metering equipment
- v) IEEE 693 Recommended practice for seismic design of substation.
- w) IEEE 80 IEEE Guide for safety in AC substation grounding

4.0.0 DESIGN ASPECTS

4.1.0 GIS Switchyard shall have three single phase construction, **one and half breaker arrangement** (D-type) having the following bays.

- Two (2) fully equipped Generator Transformer Bay
- One (1) fully equipped Standby/ Maintenance Transformer Bay
- Four (4) fully equipped Line Bay
- Two (2) fully equipped Bus Reactor Bay
- Two (2) fully equipped Bus Voltage Transformer Bay with Bus Grounding Switch
- Five (5) fully equipped Tie Bay
- Bus Sectionalizing isolator for each bus
- One (1) fully equipped Spare Bay
- Two (2) numbers spare bay (Unequipped)

4.2.0 400 kV GIS switchyard Single Line Diagram is attached in Section-1 of specification.

4.3.0 Two line feeders of double circuit tower should not be fed from same diameter/same bus. Line feeder and GT feeder shall be fed from the same diameter.

4.4.0 The gas insulated bus duct enclosures shall be of aluminum alloy material. The following equipment shall be located in the SF6 insulated enclosure.

- Circuit breakers
- Disconnectors
- Earth switches
- Current transformers
- Voltage transformers

4.5.0 GIS equipment shall be free standing, metal enclosed, sectionalized with gas tight barriers between sections or compartments, self-supporting, SF6 gas insulated, with single phase encapsulated made out of aluminium enclosures.

4.6.0 The gas sections/ compartments shall be arranged so that extension in future can be made at any end without any cutting / welding, drilling on the operational / existing bay/ equipment. Future extension shall be accessible without any shut down of operating bays.

4.7.0 Unless specified otherwise, at least 10 % margin shall be considered in equipment sizing over and above the calculated load current / fault current / power requirements.

4.8.0 The GIS sizing shall be based on design ambient temperature of 50°C and design relative humidity of 95% maximum. Temperature rise of current carrying parts shall be limited to the values stipulated in IEC-60694, under rated current and the climatic conditions at site. The temperature rise for accessible enclosure shall not exceed 20°C over an ambient temperature of 50°C.

4.9.0 Current rating of the busduct shall be same as that of the circuit breaker rating in the circuit.

4.10.0 The GIS enclosures shall be suitable to withstand an internal flash over without burn through for a period of 0.3 sec. The GIS Enclosures shall be suitably designed to withstand a fault for a period of back up protection relay to clear the fault (i.e. for approximately 0.3 sec for 63 kA minimum).

4.11.0 SF6 gas pressure loss within each gas filled compartment individually as well as complete installation shall not be more than 0.5% per year.

4.12.0 GIS shall be modular having:

- Fail safe inter and intra bay inter locking scheme
- Interchangeability of similar parts
- Gas density switch for each isolated section / module

4.13.0 GIS shall be subdivided into the following separately monitored zones:

- Each SF6 / air bushing termination (line / Generator / Transformer / Reactor) with its associated disconnecter and high speed earthing switch
- Each circuit-breaker, including its associated CTs
- Each Voltage transformers for bus bars
- Each Bus bar low speed earthing switch along with its associated disconnecter

4.14.0 The arrangement shall be single-phase enclosed. The assembly shall consist of completely separate pressurized sections designed to minimize the risk of damage to personnel or adjacent sections in the event of a failure occurring within the equipment. Rupture diaphragms shall be provided to prevent the enclosures from uncontrolled bursting and suitable deflectors provide protection for the operating personnel.

4.15.0 A separate, free-standing Local Control Cubicle (LCC) shall be provided for each GIS bay. The LCC shall contain devices required for the operation and monitoring of the circuit breaker, Disconnector & earthing switch. It shall include necessary motor protection devices, Interlocking relays, time relays, coupler relays for the remote control, alarm indicator, terminal Blocks, etc. On the front of the local control cubicle, a mimic diagram depicting all control switches, position indicator for the control shall be provided.

4.16.0 The enclosure shall be of continuous design and shall be provided with high frequency earthing arrangement as specified in IEEE- 80.

4.17.0 The enclosure shall be sized for carrying induced current equal to the rated current of the bus. The conductor and the enclosure shall form the concentric pair with effective shielding of the field internal to the enclosure.

4.18.0 The enclosure shall be designed to practically eliminate the external electromagnetic field and thereby electro-dynamic stresses even under short circuit conditions. The Average Intensity of electromagnetic field shall not be more than 50 micro tesla.

4.19.0 Current transformers, voltage transformers and tariff meters shall meet the requirements of the Electricity Regulatory Commission / Transmission Utility.

4.20.0 Gas insulated switchyard shall be located in front of transformer yard of power plant. The sequence of bays shall be so arranged that the maximum horizontal angle of deviation of the incoming power and shielding conductors does not exceed 30°. Similarly the point of anchoring on incoming towers shall be such that the vertical angle of deviation is limited to 30° from horizontal plane.

4.21.0 Separate storage facility for empty SF6 gas cylinders and filled SF6 cylinders with chain & lock arrangement shall be provided in the GIS building.

4.22.0 GIS building shall be provided with required electrically operated overhead crane, ventilation system, Air Conditioning, fire alarm and firefighting system.

5.0.0 CIRCUIT BREAKER

5.1.0 Circuit breakers shall be of sulphur hexafluoride (SF6) type and shall use SF6 gas for both insulation and arc quenching. It shall be high speed, single and three phase reclosing, with operating sequence and timing as specified. SF6 Circuit breakers shall comprise metal enclosed breaker poles (Puffer type). The Circuit breakers shall be horizontal mounted and shall withstand the forces imposed during earthquake.

5.2.0 Circuit breakers shall be of class C2-M2 as per IEC. The circuit breakers shall be capable of performing their duties without opening resistors. Specifically, they shall be capable of the following:

- Interrupting the steady state and transient magnetizing current of power transformers.
- Interrupting line / cable charging current as per IEC without use of opening resistors.
- Clearing short line faults (kilometric faults) with source impedance behind the bus equivalent to symmetrical fault current specified.
- Breaking 25% of the rated fault current at twice rated voltage under phase opposition condition.

5.3.0 The breakers shall satisfactorily withstand the high stresses imposed on them during fault clearing, load rejection and re-energization of lines with trapped charges.

5.4.0 For all line feeders pre insertion resistor (PIR) shall be provided. Further, switching controllers shall be provided in circuit breakers used for switching shunt reactors for lines / buses and transformers. The switching controller shall enable the optimization of switching behavior.

5.5.0 Circuit breaker shall have spring charged mechanism or hydraulic operated mechanism.

5.6.0 Necessary ports/Sensors/suitable means for using portable tools and tackles shall be provided

5.7.0 Auto-reclosing relay shall be provided for auto reclosing of 1 pole / 3 pole operations as specified. The breaker shall be suitable for single phase and three phase auto-reclosing.

5.8.0 Each breaker pole shall be provided with two independent tripping circuits, pressure switches and tripping coils each fed from separate DC sources and connected to different set of protective relays. SF6 lockout logic shall be fail safe.

5.9.0 The total break time shall not be exceeded under any of the following duties:

- Test duties T10, T30, T60, T100 (with TRV as per IEC- 62271-100)
- Short line fault L90, L75 (with TRV as per IEC-62271-100)
- The total break time of the breaker shall not be exceeded under combined variation of the trip coil voltage (70-110%), pneumatic/hydraulic pressure and SF6 gas pressure etc.
- The values guaranteed shall be supported with the type test reports.

6.0.0 ISOLATOR

- 6.1.0 Isolators shall be Indoor, gas insulated, single-pole, 3-phase, group operated type, off-load break type, installed in the GIS to provide electrical isolation of the circuit breakers, transformers, shunt reactor, bus and transmission lines. The Isolators shall be operated by electric motor rated for 220 V DC supply and shall be equipped with a manual operating mechanism or with hand cranks for emergency use. Isolators shall be with mechanical endurance class M1.
- 6.2.0 Isolators and earth switches shall be capable of withstanding the dynamic and thermal effects of the maximum possible short circuit current of the systems in their closed position. They shall be constructed such that they do not open under influence of short circuit current.
- 6.3.0 Isolator and earth switches shall have provision to prevent their electrical and manual operation unless the associated interlocking conditions are met. All these interlocks shall be of failsafe type. Suitable individual interlocking coil arrangements shall be provided. The interlocking coil shall be suitable for continuous operation from DC supply and within a variation range as stipulated.
- 6.4.0 The isolator shall be capable of making / breaking normal currents when no significant change in voltage occurs across the terminals of each pole of isolator on account of make / break operation.
- 6.5.0 Isolators shall be fitted with an optical indicator per pole located between pole & driving rod so that open or closed contacts of the isolator are visible from floor level.
- 6.6.0 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.

7.0.0 MAINTENANCE EARTH SWITCHES

- 7.1.0 Maintenance Earth switches shall form an integral part of the isolator. Earth switches shall be only locally operated from the local control cubicle. The maintenance earth switches shall be constructionally interlocked with the isolator so that the maintenance earth switches can be operated only when the isolator and circuit breaker is open and vice versa. The constructional interlocks shall be built in the construction of isolator and shall be in addition to the electrical interlocks. Locking facility shall be provided for both close and open position.
- 7.2.0 The earth switch shall have three poles, group operated, with one motor operated mechanism per three poles and additionally with an emergency manual operation using operating handles or hand cranks. Once initiated, the motor mechanism shall complete an open or close operation without requiring the initiating contact to be held closed. Maintenance earth switch should be able to carry the same fault current as like Isolators and shall withstand dynamic stresses.
- 7.3.0 The earth switch shall also comply with the requirements of IEC-601129, in respect of induced current switching duty as defined for Class-B Earth switches.
- 7.4.0 Maintenance earth switch shall be provided with indicators on each pole for visual inspection of each switch contact position.
- 7.5.0 Main grounding connections on each earth switch shall be rated to carry the full short circuit rating of the switch for 1 sec. and shall be equipped with a silver plated terminal connector suitable for steel strap of adequate rating for connection to the grounding grid.

8.0.0 FAST ACTING EARTH SWITCHES

- 8.1.0 Fast acting earth switches shall be used to earth insulated sections of installation to protect personnel during overhaul assembly and at each busbar all external connecting feeders like overhead lines, transformer connections, HV cables. These switches shall be located at the beginning of the feeder bay modules and shall be of high speed, make proof type and used to discharge the respective charging currents, in addition to their safety function. These switches shall be capable of interrupting the inductive currents and to withstand the associated TRV.
- 8.2.0 Fast acting Earth switches shall include the complete operating mechanism and auxiliary contacts. Fast acting Earth switches shall be locally operated from the local control cubicle as well as from remote through selection facility. These fast acting earth switches shall be electrically interlocked with their associated circuit breakers & isolators so that the grounding switches cannot be closed if the circuit breaker & isolators are closed.
- 8.3.0 Fast acting Earth switches shall be constructionally interlocked with their associated circuit breaker such that the grounding switches cannot be closed if the circuit breakers are closed. The grounding switches shall be required to close before the isolator switches are opened in order to dissipate the trapped charges, when the lines are taken out of service for maintenance, etc. The constructional interlocks shall be built in construction of isolator and shall be in addition to the electrical interlocks. Locking facility shall be provided for both close and open position.
- 8.4.0 Fast acting earth switch shall be single pole operated, with one motor operated mechanism per single pole and additionally with an emergency manual operation using operating handles or hand cranks. These shall be fitted with a stored energy closing system to provide fault making capability. Once initiated, the motor mechanism shall complete an open or close operation without requiring the initiating contact to be held closed. Maintenance earth switch should be able to carry the same fault current as its peak withstands current rating.
- 8.5.0 Fast acting earth switch shall also comply with the requirements of IEC - 622271-102 in general and IEC-601129, in respect of induced current switching duty as defined for Class-B Earth switches.
- 8.6.0 Fast acting earth switch shall be provided with indicators on each pole for visual inspection of each switch contact position.

9.0.0 CURRENT TRANSFORMERS

- 9.1.0 The current transformers shall be of metal enclosed, inductive type, non-resistant and shall be contained in their own-SF6 compartment, separated from other parts of installation. The transformers shall be effectively shielded against high frequency electromagnetic transients. Short time rating of CTs shall be not less than that of the associated switchgear.
- 9.2.0 Gas insulated current transformers, shall be used for protective relaying and metering with fully distributed secondary windings. The CT's shall have multi core with multi ratio, which shall be changeable by means of taps on the secondary side. The secondary leads shall be brought out into the secondary terminal box.
- 9.3.0 The secondary windings shall be air insulated and mounted inside the metal enclosure. All CTs shall have effective electromagnetic shields to protect against high frequency transients.
- 9.4.0 Different ratios specified shall be achieved by secondary taps only and primary reconnection shall not be accepted.
- 9.5.0 Current transformer's guaranteed burdens and accuracy class shall be simultaneous for all cores. Current transformer, characteristics shall be such as to provide satisfactory performance of

burdens ranging from 25% to 100% of rated burden over a range of 10% to 100% of rated current in case of metering CTs and up to the accuracy limit factor / knee point voltage in case of relaying CTs. For differential protection and REF protection, PS class CT shall be provided and for overcurrent protection 5P20 class shall be provided.

9.6.0 Current transformers shall be suitable for high speed auto reclosing.

9.7.0 The rated extended primary current shall be 150% at highest ratio and 200% at ratios other than highest ratios. The transformer shall be able to sustain full line to line voltage without saturation of transformer. The accuracy class shall be at maximum tap.

10.0.0 VOLTAGE TRANSFORMER

10.1.0 Voltage transformer shall be of electromagnetic inductive type fully encapsulated in GIS, single phase unit, constructed and tested in accordance with IEC 60044-02. VT gas compartment shall be segregated from the adjacent GIS compartments so that VT housing shall be grounded to the GIS enclosure. The damping device, which should be permanently connected to one of the secondary windings, should be capable of suppressing the ferro-resonance oscillations.

10.2.0 The electromagnetic unit comprising compensating reactor, intermediate transformer and protective and damping devices should have separate terminal box with all the secondary terminals brought out.

10.3.0 The VT gas compartment shall be isolated from the adjacent gas compartments with separate gas supervision. If the VT gas compartment is connected to the line isolator gas compartment. A non-return valve shall be provided to avoid entering of any decomposed gas from the isolator gas compartment to the VT gas compartment. Bus VTs shall be located in a separate bay module on the bus and connected phase to ground to the phase buses.

10.4.0 The bus VT's shall be connected through hand operated isolators, which are to be provided with lock facilities and locks.

11.0.0 LOCAL CONTROL CUBICLE (LCC)

11.1.0 For each bay, a separate local control cubicle including gas monitoring kiosk shall be provided which shall be installed in respective bay for local control & monitoring. The LCC shall be equipped with suitable hardware & software for remote control operation.

11.2.0 The LCC shall contain necessary devices for the operation and monitoring of the GIS apparatuses. On the front of the LCC, mimic diagram depicting all controls, indications and metering shall be provided.

11.3.0 All control and interlock functions shall be configured in LCC.

11.4.0 Required alarms and indications shall be provided in LCC. Alarm circuit shall not respond to faults for momentary conditions.

11.5.0 LCC shall be of simplex type design. It shall consist of CRCA sheet steel of minimum 2 mm thickness and shall provide a degree of protection not less than IP 31. Panels shall be free standing, floor-mounting type. All doors and removable covers of panels shall be gasketed all around. Anti-vibration pads shall be placed between panel and base frame. Cable entries to the panels shall be from the bottom.

12.0.0 GIS ENCLOSURE

12.1.0 SF6 Busducts shall be of aluminium alloy, modular, single phase encapsulated. Homogeneous epoxy resin insulator shall be used to support the conductors inside the enclosures. Metal bellow type compensators with adjustable tensions shall be provided, wherever required.

12.2.0 The bus enclosure should be sectionalized in a manner that maintenance work on any bus disconnector can be carried out by isolating and evacuating the small effected section and not the entire bus. The enclosure sub-divided into individual arc and gas proof compartments for Busbar section with associated busbar disconnector.

- Circuit breaker
- Line disconnectors

12.3.0 Adequate provision shall be made to allow for the thermal expansion of the conductors and of differential thermal expansion between the conductors and the enclosures. The bellows shall be metallic.

12.4.0 The enclosure shall be designed for the mechanical and thermal loads to which it is subjected in service. The enclosure shall be manufactured and tested according to the pressure vessel code. Each enclosure has to be tested as a routine test at 1.5 times the design pressure for one minute. The bursting strength of aluminium castings shall be at least 5 times the design pressure and the same shall be tested as a type test on each type of enclosure.

13.0.0 GIS GROUNDING

Refer 'Earthing' Section (Section-2, chapter 3 of this specification)

14.0.0 GIS AUXILIARY EQUIPMENT

14.1.0 Gas to Air Bushing

The Connection between overhead line and SF₆ gas equipment shall be done using 'gas to air' bushing. This bushing shall be made out of composite insulator like Silicon rubber. The internal insulation of the bushings can be a resin impregnated paper winding (RIP) or compressed SF₆ gas. The internal and external electrical field of the bushings shall be controlled by capacitive grading body or by grading shields. Bushing shall have Creepage distance of 31 mm/kV and shall be suitable for outdoor mounting on steel structure.

14.2.0 SF₆ Gas properties

The SF₆ gas shall conform to IEC-60376, IEC-60376A & IEC-60376B. The gas shall be suitable in all respects for use in the switchgear under all operating conditions. High pressure cylinder in which SF₆ gas is supplied & stored at site shall comply with the requirements of IS: 4379 & IS 7311.

14.3.0 Pressure relief device

Pressure relief devices shall be provided in the gas sections to protect the main gas enclosures from damage or distortion during the occurrence of abnormal pressure increase or shock waves generated by internal electrical fault arcs (preferably in downward direction). Each gas-filled compartment shall be equipped with filters, density switches, filling valve and safety diaphragm. Each gas compartment shall be fitted with separate non-return valve connectors for evacuating & filling the gas and checking the gas pressure etc.

Portable Partial Discharge (PD) monitoring system (Already listed under 'Special tools & tackles- Clause B of BOQ, annexure-1 of section-1) shall be provided for detecting different types of defects in GIS, such as particles, loose shields and PD as well as for detection of PDs in other of equipment like CTs, PTs, Gas busduct, etc. with hot sticks. PD monitoring equipment shall be suitable for measuring the PD in charged GIS condition with bandwidth in the order of 10 KHz - 500 KHz, with selection for intermediate bandwidths.

- 14.4.0 **SF6 Gas processing Unit:** SF6 processing unit suitable for evacuating, liquefying, evaporating, filling, drying and purifying SF6 gas shall be provided.
- 14.5.0 **SF6 Gas Monitoring Devices and Alarm circuits:** Dial type temperature compensated gas density or density monitoring devices associated pressure gauge shall be provided. The devices shall provide continuous & automatic monitoring of the state of the gas & a separate device shall be provided for each gas compartment so the each compartment shall be monitored simultaneously.
- 14.6.0 **Gas Supply System:** SF6 gas necessary for filling & putting into operation the complete switchgear installation shall be supplied. In addition, 10% of total gas requirement shall be supplied in separate cylinders as spare requirement.
- 14.7.0 **Dew Point Meter** (Already listed under 'Special tools & tackles- Clause B of BOQ, annexure-1 of section-1): This Dew point meter shall be portable and suitable for measuring the dew point of SF6 gas in the Circuit breaker.
- 14.8.0 **Portable SF6 gas leakage detector** (Already listed under 'Special tools & tackles- Clause B of BOQ, annexure-1 of section-1): SF6 gas leakage detector shall be provided with a rubber suction bulb, DC dry cell battery operated.

Section 2, Chapter 2
400 kV GIS SWITCHYARD-TECHNICAL DETAILS

1.0.0 TECHNICAL PARAMETERS OF GIS SWITCHYARD

Sl. No.	Description	Data
1.	General:	
a)	Nominal system voltage	400 kV (rms)
b)	Highest system voltage	420 kV (rms)
c)	System Neutral	Solidly grounded
d)	Design ambient temperature	50 degree C
e)	Lightning impulse withstand voltage	1425 kV (peak)
f)	Switching impulse withstand voltage	1050 kV (peak)
g)	Power frequency withstand voltage (dry)	630 kV (rms)
h)	Short time current and duration	63 kA for 1 sec.
i)	Internal arc withstand capability	63 kA for 1 sec
j)	Bus bar rating	4000 A
k)	Phase to Phase clearance for air insulation	4000 mm(for conductor –conductor configuration) 4200 mm(for rod– conductor configuration)
l)	Phase to earth clearances for air insulation	3500 mm (min.)
m)	Sectional clearance for air insulation	6500 mm (min.)
n)	Creepage distance for outdoor	31 mm/kV
o)	Bay width for outdoor	27 m
2.	Circuit Breaker:	
a)	Rated current	As per Section 1
b)	Symmetrical interrupting capability	63 kA for 1 sec
c)	Dynamic rating	163 kA (peak)
d)	Closing resistors	For line breakers
e)	Temperature rise	As per IEC
f)	Operating duty	O-0.3 sec-CO-3 min-CO
g)	Total break time (maximum)	40 ms
h)	Total make time (maximum)	90 ms
i)	First pole to clear factor	1.3
j)	TRV	As per IEC
3.	Rated current of Isolator	As per Section 1
4.	Current Transformer	
a)	Temperature rise	As per IEC 61869
b)	Radio interference voltage at $1.1 U_n/\sqrt{3}$ frequency range 0.5 to 2 MHz and	1000 microvolts
c)	Power frequency withstand voltage, secondary	3 kV

d)	Partial discharge level	10 Pico coulombs
5.	Capacitive Voltage Transformer:	
a)	Temperature rise	As per IEC 61869
b)	Power frequency withstand voltage for secondary winding	3 kV
c)	Rated power factor	0.8 lag
d)	Coefficient of earthing	<0.8
e)	Rated voltage factor	1.2 Continuous & 1.5 for 30 secs.
f)	Capacitance for carrier coupling (pf)	8800
g)	Accuracy class for tariff metering	0.2
h)	Accuracy class for other metering	0.5
i)	Accuracy for protection core	3P
6.	Lightning Arrester:	
a)	Arrester rated voltage	390 kV
b)	Type of arrester	Metal oxide, gapless
c)	Nominal discharge current	20 kA of 8/20 micro second wave
d)	Minimum discharge capability	8 kJ / kV
e)	Continuous operating voltage.	303 kV (RMS)
f)	Max. switching surge residual voltage at 1 kA Min. switching surge residual voltage at 1 kA	730 kVp 780 kVp
g)	Max. residual voltage at discharge current	850 kV (peak) at 20 kA
h)	Max. steep current impulse residual voltage	925 kV(peak) at 20 kA
i)	Long duration discharge class (IEC)	4/5
j)	High current short duration test value (4/10 micro second wave)	163 kA(peak)
k)	Low current long duration test value	As per IEC

2.0.0 TESTS

2.1.0 The equipment offered shall be of type tested and proven type. Type test reports shall be submitted for review. All routine and acceptance tests in accordance with the latest version of applicable standard shall be conducted for all the equipment.

2.2.0 Every functional unit shall be routine tested by the manufacturer at the manufacturer's works according to IEC standards. Each transport unit shall be routine tested. This includes gas tightness tests of all gas compartments, mechanical and dielectric tests of all components not yet tested as functional unit.

2.3.0 The tests shall be carried out for GIS enclosure, Circuit breaker, disconnectors and earthing switches, SF6/Air bushings, current transformers, voltage transformer and local control cubicle as per IEC.

2.4.0 The following tests shall be performed at Site, among others:

- Check to verify that the installed switchgear complies with the specification
- Functional testing of all apparatus
- Inspection of electric wiring and interlocks

- Gas leak testing
- Measurement of gas humidity
- Dielectric test
- Measurement of contact resistances

2.5 Site tests

2.5.1 The various commissioning checks / tests to be carried out on the various equipment shall be in accordance with applicable standards and equipment supplier's recommendation.

2.5.2 The following tests shall be carried out before and during erection, testing and commissioning:

- Check for physical damage
- Visual examination of zinc coating / plating
- Check from name plate that all items are as per specification
- Check tightness of all bolts, clamps and connecting terminals using torque wrenches
- For oil filled equipment, check for oil leakage. Also check oil level and top up wherever necessary
- Check ground connections for quality of weld and application of zinc rich paint over weld joint of galvanized surfaces
- Check cleanliness of insulator and bushings
- Check for surface finish of grading rings (corona control ring)
- Electrical clearance check
- Testing of torque by torque wrenches on all bus bar power connectors and other accessories
- Millivolt drop test on all power connectors
- Sag and tension check on conductors
- Millivolt drop test on all joints
- Dye penetration test and radiography test on 10% sample basis on weld joints
- Test check on 5% sample joints after cutting the weld piece to observe any voids etc.
- Visual examination for finish, damage, creepage distance etc. for insulators
- All checks and tests specified by manufacturers in their drawings and manuals as well as all tests specified in the relevant code of erection

2.5.3 All equipment and accessories included in the scope of this contract shall be tested at site after installation during commissioning. The tests and pre-commissioning checks shall include but not limited to the following:

a) Circuit Breaker

- Insulation resistance of each pole
- Breaker closing and opening time including PIR time if applicable
- Slow and power closing operation and opening
- Trip free and anti-pumping operation
- Minimum pickup voltage of coils
- Dynamic contact resistance measurement
- Functional checking of control circuits interlocks, tripping through protective relays and auto-reclose operation
- Operation from SAS
- Insulation resistance of control circuits, motor etc.
- Resistance of closing and tripping coils
- SF6 gas leakage check
- Dew point measurement

- Calibration of pressure switches and gas density monitor
- Protection against pole discrepancy
- Wiring continuity check
- Capacitance and tan delta measurement of grading capacitors

b) Isolator and Earth Switch.

- Insulation resistance of each pole
- Manual / remote and electrical operation and interlocks
- Insulation resistance of control circuits and motors
- Earth connections
- Contact resistance
- Proper alignment so as to minimize to the extent possible the vibration during operation
- Measurement of operating torque for isolator and earth switch
- Resistance of operating and interlocks coils
- Functional check of the control schematic and electrical and mechanical interlocks
- Alignment of limit switches

c) Current Transformers

- Insulation resistance test for primary (if applicable) and secondary winding
- Polarity test
- Ratio identification test
- Primary injection of current
- Magnetising current characteristics test
- Secondary winding resistance measurement
- Measurement of capacitance and tan delta of main insulation

d) Voltage Transformers

- Insulation resistance test for primary (if applicable) and secondary winding
- Ratio test
- Phasing test
- Back charging
- Dielectric test of oil (wherever applicable)
- Secondary winding resistance measurement
- Capacitance and tan delta measurement of capacitor stacks (for capacitive voltage transformer)

e) Lightning Arrester

- Leakage current measurement
- Resistance of earth connection
- Counter operation
- Earth continuity
- IR measurement of stacks

f) Earthing

- Check soil resistivity
- Check continuity of grid wires
- Check earth resistance of the entire grid as well as various sections of the same
- Check for weld joint and application of zinc rich paint on galvanised surfaces

- Carry out dip test on earth conductor prior to use
- Check earth pit resistance

3.0.0 DRAWINGS & DOCUMENTS

The following drawings and documents shall be submitted for approval during detail engineering stage.

- GIS building layout
- Single line diagram
- Bus bar and conductor sizing calculations
- Sizing calculations for various other equipment
- Block interlock diagram for breakers and isolators
- Wiring diagrams
- General arrangement drawings of various equipment
- Equipment layout for GIS Switchyard control building
- Gas schematic diagrams
- Gas system installation procedures & gas handling procedures
- Electrical and physical clearance diagrams
- Detailed erection and commissioning procedure
- Test procedures
- Type test certificates for all equipment
- Sub vendor list
- Manufacturing quality plan
- Field quality plan
- O&M manual

Section 2, Chapter 3

EARTHING

1.0.0 INTENT OF SPECIFICATION

This section covers the requirements of Earthing.

2.0.0 CODES AND STANDARDS

The equipment to be furnished under this specification shall be in accordance with the applicable section of the latest version of the following Standards except where modified and /or supplemented by this specification.

- a) IS: 3043 Code of Practice for Earthing
- b) IS: 2309 Protection of building and allied structures against lightning - Code of practice
- c) IS: 1079 Specification for hot rolled carbon steel sheet and strips
- d) IS: 2629 Recommended practice for hot dip galvanizing on iron & steel
- e) IS: 4759 Specification for hot-dip zinc coatings on structural steel and , allied products
- f) IS: 6745 Methods for determination of weight of zinc-coating on zinc coated articles.
- g) IEEE 80 IEEE Guide for safety in AC substation grounding
- h) IEEE 142 Grounding of industrial & commercial power system.
- i) CBIP manual on AC earthing system
- j) Indian Electricity Rules
- k) CIGRE 44

3.0.0 TECHNICAL REQUIREMENTS

3.1.0 Earthing System

3.1.1 The safety and equipment earthing systems should meet the following requirements:

- a) All metallic enclosures on equipment and exposed noncurrent-carrying conductive materials capable of becoming energized due to either insulation failure, inadvertent contact with an energized conductor, or building up of a static or induced voltage should be earthed.
- b) The earthing arrangement should ensure a deliberate earth fault current return path, so that the (overcurrent or earth fault) protection shall sense the fault and either trip the faulty circuit or provide an alarm to the station operator.
- c) The earthing should limit the step and touch voltage to acceptable limits during an earth fault.
- d) The earthing conductors and connections should withstand the earth fault current for the duration of the fault, without being damaged by thermal, thermo-mechanical or electromechanical stresses.
- e) The earthing conductors should be continuous; no switching device should be inserted in the earthing conductors (except where the operation of the switching device shall also automatically disconnect all power sources to the equipment earthed by that conductor). Equipment enclosures should not be used as part of the earthing conductor.
- f) The earthing conductors should be mechanically reliable or protected in order to withstand any possible mechanical stress imposed on them. The exposed connections of earthing conductors should be accessible for inspection.

- g) The earthing system should be designed to minimize corrosion to adjacent structures, equipment and enclosures.

3.1.2 The earth mat design for GIS building shall be designed as per IEEE 80. The earthing system of Switchyard shall meet the following requirements:

- Ensure adequate earth fault current for operation of earth fault protection
- Limit step and touch voltages to acceptable limits during earth fault
- Earthing conductors and connections shall withstand earth fault current for the duration of the fault

3.1.3 The earth mat shall be designed with grid spacing such that safe voltage gradients are maintained.

3.1.4 The earth mesh shall be designed to withstand 40 years of corrosion and still retain safe touch and step potentials in accordance with IEEE 80. Corrosion rate shall be arrived at as per soil resistivity report.

3.1.5 The earth mat of the station shall be designed such that the total ground resistance does not exceed 0.5 ohm.

3.1.6 Earth mat and all earthing conductors for GIS building earthing shall be of copper. The earthing conductor material for other locations shall be corrosion resistant steel.

3.1.7 400 kV system earth fault current of 63 kA shall be considered for earthing design. The earthing design shall consider the following:

- Earth fault current duration for conductor sizing : 1 sec
- Shock duration for mesh sizing : 0.5 sec
- Depth of buried earthing conductor : minimum 600 mm
- Human body weight for step / touch voltage calculation : 70 kg
- Resistivity of concrete : 500 ohm m

3.1.8 For Gas insulated switchyard the following aspects shall be considered:

- All metallic enclosures should normally operate at ground voltage level.
- When grounded at the designated points, the bus enclosure design should ensure that no significant voltage differences exist between individual enclosure sections and that neither the supporting structures nor any part of the grounding systems is adversely influenced by the flow of induced currents.
- To avoid the circulation of enclosure currents beyond regular return path within the GIS assembly, power cable sheath grounds should be tied to the grounding system via connections that are separated from the GIS enclosures. Very fast transients generated by switching or by faults in the GIS may cause these insulation elements to flashover. In such cases, the consequences of such flashovers on current distribution within the grounding system should be considered.
- Enclosure return currents also cannot be permitted to flow through any mounted current transformers.
- In GIS building, earth mat of copper flat shall be embedded in the concrete floor in grid / mesh form. Earthing conductors embedded in the concrete floor of the building shall have approximately 50 mm concrete cover.

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

- The grounding system shall ensure safe touch & step voltages in all the enclosures
- All GIS equipment, bus ducts, enclosures, control cabinets, supporting structure etc. shall be connected to the ground bus of GIS.
- The enclosure of the GIS shall be grounded at several points so that there shall be grounded cage around all the live parts. A minimum of two nos. of grounding connections should be provided for each of circuit breaker, transformer terminals, cable terminals, surge arrestors, earth switches and at each end of the bus bars.
- The grounding continuity between each enclosure shall be effectively interconnected with copper bonds of suitable size to bridge the flanges.
- Suitable measure shall be provided to mitigate transient enclosure voltage caused by high frequency currents caused by lightning strikes, operation of surge arrestor, phase/ earth fault and discharges between contacts during switching operation. Suitable barrier of nonlinear resistor at SF6/ Air termination, cable bushing etc. to mitigate transient enclosure voltage shall be provided.

3.1.10 Isolation of main plant earth mat and GIS Switchyard earth mat shall be provided by test link.

3.1.11 All ground connections shall be made by electric arc welding. All welded joints shall be allowed to cool down gradually to atmospheric temperature before putting any load on it.

3.1.12 Resistance of the joint shall not be more than the resistance of the equivalent length of the conductor.

3.1.13 For equipment earthing, earthing conductor shall be sized to withstand earth fault current of the system for the duration permissible by the protection device. Thickness of galvanising shall be atleast 610 gm/sq.m for all steel conductors.

3.1.14 Size of the earthing conductor shall be not less than the following:

Sl. No.	Equipment	Size/ type of Earthing material
1)	Earth conductor embedded in concrete in GIS building	Copper flat
2)	Electronic earthing	Chemical earth pit with copper electrode

3.1.15 Metallic frame of all electrical equipment shall be earthed by two separate and distinct connections to earthing system, each of 100% capacity. Steel columns, metallic stairs, hand rails etc. of the building housing electrical equipment shall be connected to the nearby earthing grid conductor by one earthing.

3.1.16 Metallic conduits shall not be used as earth continuity conductor.

3.1.17 Flexible earthing connectors shall be provided for moving parts.

- 3.1.18 50 mm x 6 mm galvanized steel flat shall run all along the cable tray routes and the same shall be welded / connected to each of the tray /rack. Further, this flat shall be earthed at both ends and at an interval of 30 m.
- 3.1.19 Earthing connections with equipment earthing pads shall be bolted type. Contact surfaces shall be free from scale, paint, enamel, grease, rust or dirt. Two bolts shall be provided for making earth connection. Equipment bolted connections, after being checked and tested, shall be painted with anti-corrosive paint / compound.
- 3.1.20 Connection between earthing conductors shall be welded type. For rust protection, the welds shall be treated with red lead and coated with two layers bitumen compound.
- 3.1.21 Steel to copper connections shall be brazed type and shall be treated to prevent moisture ingress.
- 3.1.22 Metallic sheaths and armour of all multi-core power cables shall be earthed at both equipment and switchgear end. Sheath and armour of single core power cables shall be earthed at switchgear end only.
- 3.1.23 Earthing conductors along their run on cable trench, ladder, walls etc. shall be supported by suitable welding / cleating at intervals of 1000 mm. Wherever it passes through walls, floors etc., pipe sleeves shall be provided for the passage of the conductor and both ends of the sleeve shall be sealed to prevent the passage of water through the sleeves.
- 3.1.24 Electronic panels and equipment shall be grounded utilising an insulated copper ground wire terminated at separate earth electrode.
- 3.1.25 For electronic equipment such as DCS, Respective control system, SAS, EMS etc., chemical earthing pit shall be provided. The earth pit shall be tested and proven type and shall be guaranteed for service life of 40 years. The chemical earth pit shall comprise pipe electrode, crystalline conductive mixture, bentonite etc. constructed in a pit of not less than 4000 mm depth. The pit shall be effective in all weather conditions and offer medium resistance. For electronic earthing system, earthing conductor shall be of copper.
- 3.1.26 Earthing of cabling system
- Armour of the LT single core cables shall be earthed only at one end of cable.
 - Armour of other cables shall be earthed at both ends of cable.
 - Screen of C&I screened control cables shall be earthed at one end.
 - Screen of electronic earthing system cables shall be earthed as per the requirements.
- 3.1.27 After completion of grounding system installation, the measurement of ground resistance shall be performed by the Contractor. Continuity of earth conductors and efficiency of all bonds and joints shall be checked. Before measurement, the overhead ground wires shall be disconnected from the GIS Switchyard. The method of measurement shall be as per relevant standards / codes. The ground resistance of GIS Switchyard grounding system shall be not more than 0.5 ohm. Earth resistance at earth terminations shall be measured in presence of Owner's representatives

4.0.0 DRAWINGS & DOCUMENTS

The following drawings and documents shall be submitted for approval during detail engineering stage.

- Earthing layout for GIS building and Switchyard

SECTION 3**PROJECT DETAILS AND GENERAL SPECIFICATIONS****3.0 GENERAL**

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

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

3.1 SITE INFORMATION

SL.NO.	DESCRIPTION	
3.1	PROJECT INFORMATION	
	a) Customer	Tamil Nadu Generation and Distribution Corporation (TANGEDCO)
	b) Project	400kV GIS at 2 x 660 MW Udangudi STPP (Stage-I)
	c) Project location	
	i) Country	India
	ii) State	Tamil Nadu
	iii) Administrative district	Thoothukudi
	iv) Next Big cities to site	Thoothukudi (approx.. 45 kms from site)
	v) Road access	East Coast Road- State high way (176)
	vi) Nearest Railway Station	Thiruchendur (approx.. 12 kms from site)
	vii) Nearest Airport	Vaigai (approx.. 60 kms from site)
	viii) Nearest Harbour	Tuticorin (approx.. 45 kms from site)
3.2	SITE CONDITIONS	
3.2.1	Ambient Air Temp.	
	a) Maximum dry bulb	41°C

	temp. (max.) °C	
	b) Minimum dry bulb temp. (min.) °C	17°C
3.2.2	Relative humidity	
	Mean Maximum humidity (Summer)	84 %
	Mean Minimum humidity (Summer)	62 %
	Maximum humidity (Monsoon)	97%
	Minimum humidity (Monsoon)	45%
3.2.3	Rain fall	
	Annual rainfall (Maximum)	718.2 mm
	Annual rainfall (Minimum)	384.1 mm
	Twenty four (24) Hour max	138.2 mm
3.2.4	High Flood Level	
	High Flood Level for site	RL 2.450 m
3.2.5	Wind	
	Mean Wind Speed (max)	20.6 km/h
	Wind direction	North, North east, North west, East
3.3	Seismic intensity	
	Seismic Intensity	As per IS:1893 Latest
	Zone	II

3.2 INSTRUCTION TO BIDDERS

The bidders shall submit the technical requirements, data and information as per the technical data sheets, provided in Section-4.

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

It is recognised that the Manufacturer may have standardised on the use of certain components, materials, processes or procedures different than those specified herein. Alternate proposals offering similar equipment based on the manufacturer's standard practice will also be considered provided such proposals meet the specified designs, standard and performance requirements and are acceptable to the Purchaser. Unless brought out clearly, the Bidder shall be deemed to conform to this specification scrupulously.

3.3 STANDARDS

The works covered by the specification shall be designed, engineered, manufactured, built, tested and commissioned in accordance with the Acts, Rules, Laws and Regulations of India.

The equipment to be furnished under this specification shall conform to latest issue (with all amendments) of specified standards.

In addition to meeting the specific requirement called for in Sections 1 and 2 of the Technical Specification, the equipment shall also conform to the general requirement of the applicable standards, which shall form an integral part of the specification.

The Bidder shall note that standards mentioned in the specification are not mutually exclusive or complete in themselves, but intended to complement each other.

When the specific requirements stipulated in the specifications exceed or differ from those required by the applicable standards, the stipulation of the specification shall take precedence.

Other internationally accepted standards, which ensure equivalent or better performance than that specified in the standards referred, shall also be accepted. The bidder shall submit copies of such standards.

In case governing standard for the equipment is different from IS or IEC, the salient points of difference shall be clearly brought out in the offer along with English language version of standard or relevant extract of the same. The equipment conforming to standards other than IS/IEC shall be subject to Purchaser's / owner's approval.

The bidder shall clearly indicate in his bid the specific standards in accordance with which the works will be carried out.

3.4 SERVICES TO BE PERFORMED BY THE EQUIPMENT BEING FURNISHED

All equipment shall also perform satisfactorily under various other electrical, electro mechanical and meteorological conditions of the site of installation. All equipment shall be able to withstand all external and internal mechanical, thermal and electro mechanical forces due to various factors like wind load, temperature variation, ice & snow, (wherever applicable) short circuit etc for the equipment.

3.5 ENGINEERING DATA

3.5.1 Drawings

The Supplier shall necessarily submit all the drawings/ documents unless anything is waived. The Supplier shall submit drawings/ design documents/ data/ test reports/manuals as may be required for the approval of the purchaser. All drawings submitted by the Manufacturer including those submitted at the time of bid shall be in sufficient detail to indicate the type, size, arrangement, material description, Bill of Materials, weight of each component, break-up for packing and shipment, the external connections, fixing arrangement required. The dimensions required for installation and interconnections with other equipment and materials, clearances and spaces required for installation and interconnections between various portions of equipment and any other information specifically requested in the specifications.

Each drawing submitted by the Manufacturer shall be clearly marked with the name of the Purchaser, the unit designation, the specifications title, the specification number and the name of the Project. If standard catalogue pages are submitted, the applicable items shall be indicated therein. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.

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

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

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

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

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

Title block for project:

1. Customer : Tamil Nadu Generation and Distribution Corporation (TANGEDCO)
2. Consultant :
3. Project : 400kV GIS at 2 x 660 MW Udangudi STPP (Stage-I)
4. Contract No./LOA No. : Lr.No.CE/Proj.II/SE/C/UTPP/EE/E/LOI/D.179/2017, dt.07.12.2017
5. Main Contractor : Bharat Heavy Electricals Limited
6. BHEL Order No. & Date :

3.5.2 Documentation

Document Distribution Schedule - After Placement of Order:

S. No.	Stage	No. of copies	
i)	Submission of Data sheets Datasheet, drawings, documents, write-ups, calculation, test reports, Preliminary	13	As per agreed schedule
ii)	Resubmission of above, if required	13	As per agreed schedule
iii)	Final approved documents	13	As per agreed schedule
iv)	Instruction manuals for erection and O&M	6	As per agreed schedule
v)	As built drawings including O &M manual -Hard copy -Soft copy in CD/Pendrive	13 6	As per agreed schedule

NOTES:

- a) The manufacturer may note that all re-submissions must incorporate all comments given in the prior submission by the Purchaser. Adequate justification for not incorporating the same must be submitted, failing which the submitted documents may be returned.

3.5.3 Format of Documentation

- a) All engineering documents and drawings shall be of international "A" series sizes, that is, A0, A1, A2, A3 and A4.
- b) Two set of CD/ pendrive containing all the drawings in Auto CAD shall also be supplied in addition to hard copies. Soft copy of all documents shall be supplied in a CD/pendrive in PDF format.
- c) Grouped documents shall be provided by size A4, with the inclusion of bigger size drawings which, however, have to be folded as Size A4.

3.6 QUALITY ASSURANCE PROGRAMME

This section contains general requirements for inspection of material, parts, equipment and workmanship of the GIS during manufacture, assembling to demonstrate compliance with specification, codes and standards to ensure overall reliability of GIS operation and performance.

The Owner and/or authorized Representatives shall, at any time, be allowed free and ready access to the Contractor's premises and those of his suppliers as well as to the site installation and the Contractor has to make the GIS items available for the purpose of inspecting the specified equipment components and obtaining information as to the progress of the work. Failure on the part of the Owner, at this or any other time, to discover or reject materials or work which do not meet specified requirements shall not be deemed an acceptance thereof nor a waiver of defects therein.

The approval of the Owner shall not prejudice the right to reject equipment if it does not give complete satisfaction in service.

To ensure that the equipment and services under the scope of this Contract, whether manufactured or performed within the Manufacturer's Works or at his Sub-manufacturer's premises or at the Purchaser's site or at any other place of Work, are in accordance with the specifications, the Manufacturer shall adopt a suitable quality assurance programme to control such activities at all points, as necessary.

Before manufacture commences and not later than 45 days after award of contract, the Contractor shall submit an outline of his proposed inspection program, which shall include all major stages during manufacturing. The inspection and test program shall include for the various items the designation No., name of equipment, part of equipment, the kind of test, test standard, company which carries out the test, place, date and witnesses by the Contractor, third party or Owner's Representative. The detailed manufacturer's quality assurance plan shall be subject to approval after award of contract.

The Owner will return a copy of the Contractor's proposed inspection program indicating those inspection stages for which notification is required. Notification shall be by Fax or email in a format to be agreed and shall be sent prior to the intended test. If the Owner intends to be represented at the test he will provide at least 24 hours' notice and if his representative does not attend on the notified date, an alternative date has to be informed by the Owner.

A quality assurance programme of the manufacturer shall generally cover the following:

- (a) Manufacturer's organisation structure for the management and implementation of the proposed quality assurance programme;
- (b) Documentation control system;
- (c) Qualification data of bidder's key personnel;
- (d) The procedure for purchases of materials, parts components and selection of sub-Manufacturer's services including vendor analysis, source inspection, incoming raw material inspection, verification of material purchases etc.
- (e) System for shop manufacturing and site erection controls including process controls and fabrication and assembly control;
- (f) Control of non-conforming items and system for corrective actions;
- (g) Inspection and test procedure both for manufacture and field activities;
- (h) Control of calibration and testing of measuring instruments and field activities;
- (i) System for indication and appraisal of inspection status;
- (j) System for quality audits;
- (k) System for authorising release of manufactured product to the Purchaser
- (l) System for maintenance of records;
- (m) System for handling storage and delivery; and
- (n) A quality plan detailing out the specific quality control measures and Procedures adopted for controlling the quality characteristics relevant to each item of equipment furnished and/or services rendered. The Purchaser or his duly authorised representative reserves the right to carry out quality audit and quality surveillance of the system and Procedure of the Manufacturer/his vendors quality management and control activities.

3.7 Quality Assurance Documents

The Manufacturer shall be required to submit all Quality Assurance Documents as stipulated in the quality plan at the time of purchaser's inspection of equipment/material.

3.8 TYPE TESTING, INSPECTION, TESTING & INSPECTION CERTIFICATE

All equipment being supplied shall conform to type tests and shall be subject to routine and acceptance tests in accordance with requirements stipulated under respective sections. Purchaser reserves the right to witness any or all the tests. The Manufacturer shall intimate the Purchaser the detailed programme about the tests at least three (3) weeks in advance in case of domestic supplies & six (6) weeks in advance in case of foreign supplies. The Manufacturer shall also submit type test procedure for approval of the Purchaser.

In the event of any discrepancy in the test reports i.e. any test report not acceptable due to any design/manufacturing changes (including substitution of components) or

due to non-compliance with the requirement stipulated in the technical specification or any/all additional type tests not carried out, Such test shall be conducted fresh without any additional cost implication to the Purchaser.

The price of conducting all tests and additional type tests is deemed to be included in Bid price. In case any bidder indicates that he shall not carry out a particular test, his offer shall be considered incomplete and shall be liable to be rejected.

Inspection may be made at any stage of manufacture, dispatch or at site at the option of the Purchaser and the equipment if found unsatisfactory due to bad workmanship or quality, material is liable to be rejected.

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

When the factory tests have been completed at the Manufacturer's works, the Purchaser/inspector shall issue a certificate to this effect within fifteen (15) days after completion of tests but if the tests are not witnessed by the Purchaser/inspector, the certificate shall be issued within fifteen (15) days of receipt of the Manufacturer's Test certificate by the Engineer/ Inspector. Failure of the Purchaser/inspector to issue such a certificate shall not prevent the Manufacturer from proceeding with the Works. The completion of these tests or the issue of the certificate shall not bind the Purchaser to accept the equipment should it, on further tests/ after erection, be found not to comply with the Contract. The equipment shall be dispatched to site only after approval of test reports and issuance of MICC by the Purchaser.

In all cases where the Contract provides for tests whether at the premises or at the works of the Manufacturer or of any Sub-Contractor, the Manufacturer except where otherwise specified shall provide free of charge such items as labour, materials, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Purchaser /Inspector or his authorised representative to carry out effectively such tests of the equipment in accordance with the Contract and shall give facilities to the Purchaser Inspector or to his authorised representative to accomplish testing.

The inspection by Purchaser and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Manufacturer in respect of the agreed quality assurance programme forming a part of the Contract.

The Purchaser reserves the right for getting any field tests not specified in respective sections of the technical specification conducted on the completely assembled equipment at site. The testing equipment for these tests shall be provided by the Purchaser.

3.9 MATERIALS AND WORKMANSHIP

Equipment materials and components shall be new, of high grade and good quality and be to the latest engineering practice. The material and workmanship throughout shall be in accordance with the purpose for which they are intended. Each component shall be designed to be consistent with its duty.

All the information concerning materials or components to be used in manufacturing, machinery, equipment, materials and components supplied, installed or used shall be submitted for approval. Without such approval the supplier shall run risk of subsequent rejection. The cost as well as time delay associated with such rejection shall be borne by the supplier.

3.10 PACKING AND STORAGE

Packing specification shall be submitted for BHEL/customer approval after award of contract.

All the equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at site till the time of erection. On request of the purchaser, the manufacturer shall also submit packing details/associated drawing for any equipment/ material at a later date, in case the need arises. While packing all the materials, the limitation from the point of view of availability of Railway wagon sizes in India should be taken into account. The manufacturer shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. Any demurrage, wharf age and other such charges claimed by the transporters, railways etc shall be to the account of the manufacturer. Purchaser takes no responsibility of the availability of the wagons.

All coated surfaces shall be protected against abrasions, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protecting device.

Supplier shall ensure that equipment shall be properly packed, blocked, padded, coated and protected so that it is not damaged due to possible mishandling. Storage requirements shall be clearly defined by the supplier. Packing shall be such that if required, long time storage (at least 2 years) at site should not deteriorate the performance of the equipment.

SECTION-4**GUARANTEED TECHNICAL PARTICULARS**

Sl.No.	Description	Unit	Data
1.0	Gas insulated substation (GIS)		
1.1	Make, type, country of manufacture		
1.2	Applicable standard		
1.3	Rated voltage / Highest System Voltage	kV	
1.4	Short circuit current	kA	
1.5	Reference ambient temperature		
1.6	Bay width	m	
1.7	Phase to phase spacing	m	
1.8	Size of the GIS building	(LXB)	
1.9	Size of the GIS building	(LXB)	
1.10	Rated insulation level (withstand voltages, to ground)		
1.11	- at power frequency 1 min	kV	
1.12	- at lightning impulse (1.2/50 μ s wave)	kVp	
1.13	- at switching impulse (250/2500 μ s wave)	kVp	
1.14	FREQUENCY	Hz	
1.15	Rated service current		
1.16	- Busbar	A	
1.17	- Feeder bay	A	
1.18	- Generator transformer bay	A	
1.19	- Station Transformer bay	A	
1.20	- Bus coupling bay	A	
1.21	Rated short time withstand current	kA	
1.22	Duration	sec	
1.23	Rated peak withstand current	kAp	
1.24	Internal fault withstand time without burn through	ms	
1.25	Temperature rise at rated service current		
1.26	- Conductor	°C	

1.27	- Enclosure	°C	
1.28	Rated SF6 gauge pressure at 20 °C		
1.29	- Circuit breaker	bar rel.	
1.30	- Switchgear	bar rel.	
1.31	SF6 gas recharge signal		
1.32	- Circuit breaker	bar rel.	
1.33	- Switchgear	bar rel.	
1.34	SF6 alarm level (*)		
1.35	- Circuit breaker	bar rel.	
1.36	- Switchgear	bar rel.	
1.37	Enclosure design pressure		
1.38	- CIRCUIT BREAKER	bar	
1.39	- Switchgear	bar	
1.40	Leakage rate of SF6 per annum for the whole substation	%	
1.41	MAXIMUM PARTIAL DISCHARGE LEVEL	pC	
1.42	Factory Dielectric routine test 50Hz	kV	
1.43	Site dielectric test	kV	
1.44	Rated test voltage of secondary circuit	kV	
1.45	Painting of switchgear		
1.46	- Coating design and execution		
1.47	- Top coat colour		
1.48	Surface protection of steel frames		
2.0	GIS Circuit Breakers		
2.1	Rated continuous current	Amp	
	• Rated short circuit breaking current and rated making current	kA/sec (peak)	
	• Short circuit withstand current rating & duration	kA sec	
2.2	Temperature rise of contacts over an ambient of 50°C while carrying rated current	°C	
2.3	Rated operating duty		
2.4	Insulation level		
	• One minute P.F withstand voltage	kV	
	• Impulse withstand voltage	kV	

	• Switching surge withstand voltage	kV	
2.5	Trip free Yes / No		
2.6	Type of operating mechanism		
2.7	Normal method of tripping		
2.8	Emergency method of tripping		
2.9	No. of trip coils	Nos.	
2.10	Rated voltage and VA Burden		
	• For Trip coils		
	• For Closing coils		
	• For Operating mechanism motor		
2.11	Rated line charging breaking and making current		
2.12	Short circuit DC component time constant	ms	
2.13	First pole to clear factor		
2.14	Breaking time	ms	
2.15	Closing time	ms	
2.16	Operating sequence		
2.17	Operating sequence without auxiliary supply		
2.18	No. of Coil for opening circuit		
2.19	No. of Coil for closing circuit		
3.0	GIS Isolators		
3.1	Rated current	Amps	
3.2	Short time withstand current & duration	KA , sec	
3.3	Dynamic withstand current	kA peak	
3.4	Insulation test values		
	a. One minute power frequency wet withstand voltage	kV(rms)	
	b. Impulse withstand voltage	kV peak	
3.5	Operating mechanism		
4.0	GIS Maintenance Earth Switch		
4.1	Rated current	Amps	
4.2	Short time withstand current & duration	KA , sec	
4.3	Dynamic withstand current	kA peak	
4.4	Insulation test values		
	a. One minute power frequency wet withstand voltage	kV(rms)	

	b. Impulse withstand voltage	kV peak	
4.5	Operating mechanism		
5.0	GIS Current Transformers		
5.1	Rated voltage class		
5.2	Insulation withstand level :		
5.3	Secondary current	A	
	a. Impulse withstand voltage	kV peak	
	• 1.2 / 50 micro sec wave		
	b. One minute power frequency withstand voltage	kV (rms)	
5.4	For Tariff Metering Cores:		
	• Accuracy class		
	• Rated burden		
	• Instrument security factor		
5.5	For Other Metering / BCU Cores:		
	• Accuracy class		
	• Rated burden		
	• Instrument security factor		
5.6	For O/C & E/F Protection Core		
	• Accuracy class		
	• Rated burden		
5.7	For Differential /REF Protection Core		
	• Accuracy class		
	• CT resistance		
	• Knee point voltage		
	• Magnetizing current		
5.8	Short time thermal current rating		
	• Current		
	• Rated time		
5.9	Dynamic current rating	kA peak	
5.10	Class of insulation of winding		
5.11	Radio interference voltage	Micro volts	
6.0	GIS EMVT		
6.1	Simultaneous Burden		

6.2	Insulation withstand level		
	• Impulse withstand voltage 1.20/50 micro sec. wave		
	• One minute power frequency withstand voltage		
6.3	Number of secondary windings for each VT		
6.4	Rated primary voltage	volts	
6.5	Rated secondary voltage	volts	
6.6	Rated VA burden for each secondary winding		
6.7	Rated power factor		
7.0	Local control cubicle of GIS		
7.1	Panel make and country of manufacture		
7.2	Degree of protection for enclosure of panel		
7.3	Sheet steel thickness	mm	
7.4	Mounting of relays		
7.5	Size		
7.6	List of devices provided		
8.0	SF6 to Air bushing		
8.1	Manufacture & country of manufacture		
8.2	Applicable standard		
8.3	Material		
8.4	Rating		
9.0	GIS Bus		
9.1	Make		
9.2	Size		
9.3	Type		
9.4	The temperature rise of the conductor while carrying the rated current		
9.5	Current rating		

SCHEDULE OF DEVIATIONS

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

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

Signature :

Name:

Designation :

Company:

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 erection, • 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. Limit of supply as per technical specification and as per IEC 61639.	Confirmed	Yes/No
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/operation & maintenance spare	Attached	Yes/No
2.9.	The Switchgear shall be complete with all necessary terminal boxes, SF6 gas filling, and interconnecting power and control Cables (between GIS to GIS/GIS to LCC/ LCC TO LCC), grounding connections (GIS to GIS and GIS to Earth Mesh on Floor), gas monitoring System and piping, support structures.	Confirmed	Yes/No

Sl.	Particulars	Reply by bidder	
2.10.	The scope of supply shall also include all erection and mounting hardware and interconnecting cables within GIS.	Confirmed	Yes/No
2.11.	Design philosophy of earthing submitted with the bid	Confirmed	Yes/No
2.12.	Tentative GIS Hall PLAN & SECTION Layout submitted with the bid	Confirmed	Yes/No
2.13.	Tentative Pothead yard PLAN & SECTION Layout submitted with the bid	Confirmed	Yes/No
2.14.	Technical Requirement of EOT Crane capacity & hook height mentioned in GIS Hall Layout	Confirmed	Yes/No
2.15.	Tentative / estimated AC / DC Load requirement for GIS submitted with bid	Confirmed	Yes/No
2.16.	Earthing material as per Section 1, Clause 1.6	Confirmed	Yes/No
2.17.	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 as per item of Expansion Joints and bellows of BOQ.	Confirmed	Yes/No
2.18.	Tentative PLAN & Section drawing of bus duct submitted with bid	Confirmed	Yes/No
3	Technical		
3. 1	Location of site at Coastal Area : <i>Project site Udangudi which is located in coastal area near Tuticorin hence design and construction of GIS should be suitable for the climate/ Meteorological Condition as mentioned in Section-1 and in section-3.</i> <i>Bidder to inform what measures shall be taken to ensure the same at bid stage.</i>	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
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	Confirmed	Yes/No

Sl.	Particulars	Reply by bidder	
	the assigned performance of the equipment.		
4.4	Insulation co-ordination study shall be conducted and based on the same the <i>Rating</i> , numbers & location of surge arresters shall be decided. The <i>Rating</i> , 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	Store shall be provided by BHEL for GIS and accessories. Confirm that the space required for the material being supplied, both indoor and outdoor has been indicated.	Details given with the bid.	Yes/No
7	Site Test		
7.1	Bidder to supply Only special tools. For other tools Bidder to submit list of tools, tackle, slings, spanners, gauges, slings and other lifting devices, drills, instruments and appliances necessary for the complete assembly and erection at site of the GIS, required for installation, gas filling, maintenance, site testing of the GIS which shall be arranged by BHEL. 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
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.	Confirmed and	Yes/No

Sl.	Particulars	Reply by bidder	
	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.	enclosed with bid	
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) <u>at no extra cost to the purchaser and no delivery implication.</u> 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 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/accredited laboratory. 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	Confirmed	Yes/No

Sl.	Particulars	Reply by bidder	
	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:**

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).