TECHNICAL PRE QUALIFICATION REQUIREMENT

Name of Project : 1X800 MW SUPER CRITICAL EXPANSION UNIT DEEN BANDHU CHHOTU RAM THERMAL POWER PLANT YAMUNA NAGAR

Name of Customer : HARYANA POWER GENERATION CORPORATION LIMITED

Name of Consultant : DESEIN PVT. LTD.

Name of Item :400KV Gas Insulated Switchgear & its accessories

TECHNICAL PRE-QUALIFICATION REQUIREMENT **Indenter to Tick (√)** Technical PQR is based on Customer PQR ☑; Customised PQR ☐; Standard PQR ☐
The Vendor/his Group Company should have Designed, Manufactured, Supplied, Erected/Supervised erection, Commissioned/Supervised Commissioning of one (1) Gas Insulated Switchgear (GIS) Installation having at least Six (6) bays of 400 kV or above voltage class with a short circuit rating of not less than 50 kA for 1 second, which should have been in successful operation for a period of not less than two (2) years prior to the date of Techno-Commercial bid opening (02.11.2023). **AND** The above Vendor should have established manufacturing facilities in India and should have supplied at least Four (4) GIS bays of 400 kV or above from their Indian manufacturing facility. Documentary evidence meeting the above requirement shall be submitted to the Owner. *Note: For the purpose of qualifying requirement, one no. of bay shall be considered as comprising of at least one circuit breaker, two disconnectors and single-phase current transformers.*

Indenter to identify and tick (√) type of bidder from the following Manufacturer ☑; Supplier ☐; Authorised agent* of OEM ☐ System Integrator ☐ *(*) Agent/ Supplier authorised by OEM for sale and after-sales support, Guarantee/ Warrantee, as applicable*

SUPPORTING DOCUMENTS TO BE ATTACHED

(As applicable as per PQ requirement)

Sr	Required Criteria	Supporting Documents to be submitted by bidder along with technical bid
1	Manufacturing	Approved Drawings / GTP / Approved Quality Plan / Factory Inspection Test Report etc
2	Supply	PO / Dispatch clearance / LR / Material Receipt certificate at site / installation or commissioning certificate e.t.c
4	Type Test	TTR approval from customer / Type Test Report etc.
5	Successful operation	Satisfactory operation means certificate issued by the Employer/Utility certifying the operation without any adverse remark.

Attachment-3K to be filled by Bidder.

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Notes (General points):

1. Consideration of offer shall be subject to customer's approval of bidder's, if applicable.

2. Bidder to submit all supporting documents in English. If documents submitted by bidder are in language other than English, a self- attested English translated document should also be submitted.

3. Notwithstanding anything stated above, BHEL reserves the right to assess the capabilities and capacity of the bidder to perform the contract, should the circumstances warrant such assessment in the overall interest of BHEL.

4. After satisfactory fulfilment of all the above criteria / requirement, offer shall be considered for further evaluation as per NIT and all the other terms of the tender.

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Sub : Sub-Qualifying Requirements for the 400 kV Switchyard

We/ Our sub vendor ..... have Designed, Manufactured, Supplied, Erected / Supervised erection, Commissioned/ Supervised Commissioning of one (1) Gas Insulated Switchgear (GIS) Installation having at least Six (6) bays of 400 kV or above voltage class with a short circuit rating of not less than 50 kA for 1 second which are in successful operation for at least two (2) years prior to the date of techno-commercial bid opening as per stipulated requirements mentioned at Clause no. 5.14.1 of Chapter 04, "Provenness" , Volume II of Bidding documents. The details of above are as under:

Sl. No.	Item Description	Installation(s)
1	Client name and its address	
2	Name & Location of the Substation/ Switchyard	
3	Name and designation of the Contact person(s) of client Organization with Address, Telephone, Fax and email etc.	
4	Name of Contract	
5	Order ref. & Date	
6	Scope of work executed by us for aforesaid Contract includes :	
	i) Design	Yes*/ No*
	ii) Construction/ Erection	Yes*/ No*
	iii) Testing	Yes*/ No*
	iv) Commissioning	Yes*/ No*
7	Details of 400 kV or above Bays	
	a) Voltage level (in kV)	
	b) No. of bays	

Sl. No.	Item Description	Installation(s)
	c) Whether Gas Insulated Substation or not	Yes*/ No*
8	Date of Commissioning	
9	Date of commencement of successful operation	
10	No. of years in successful operation as on date of techno-commercial bid opening	
11	Certificate(s) from the client(s) & copy of LOA/P.O. are enclosed along with the bid at Annexure-… to this Attachment-3K	Yes*/ No*

NOTE :

1. For the purpose of qualifying requirements, one no of bay shall be considered as a bay used for line /transformer /reactor/ bus coupler/ bus transfer or bus section and comprising of at least one circuit breaker, two disconnectors and single phase cur- rent transformers.

2. Bidder may give details of more than one installation for Owner's reference, if he so desires.

* Bidder to strike-off whichever is not applicable.

BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION BUSINESS ENGINEERING MANAGEMENT
NOIDA

DOCUMENT NO.	TB-428-316-005	REV 00	Prepared	Checked	Approved
TYPE OF DOC.	TECHNICAL SPECFICATION	NAME	SS	SKS	SKS
Title: **400kV Gas Insulated Switchgear & its accessories**		SIGN			
		DATE	27.05.26	27.05.26	27.05.26
		GROUP	TBEM		
		WO No.			

CUSTOMER	HARYANA POWER GENERATION CORPORATION LIMITED
PROJECT	1X800 MW SUPER CRITICAL EXPANSION UNIT DEEN BANDHU CHHOTU RAM THERMAL POWER PLANT YAMUNA NAGAR

Contents

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

Rev. No.	Date	Altered	Checked	Approved	
Distribution				To	
				Copies	

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

1. Scope & Intent of Specification

This technical specification covers the requirements of design, manufacture, inspection and testing at manufacturer's works, proper packing and delivery to project site, supervision of unloading and verification of material at site, supervision of installation, site testing and commissioning along with necessary equipment, training of BHEL/ HPGCL personnel for 400kV Gas Insulated Switchgear as per the specification complete in all respect for efficient & trouble free operation mentioned under this specification with all auxiliaries, accessories and spare parts.

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

This section covers the specific technical requirements of 400kV Gas Insulated Switchgear. This constitutes minimum technical parameters for the above item as specified by HPGCL. The offered 400kV Gas Insulated Switchgear shall also comply with the Section-3 (Project Details and General technical requirements for all equipment under the Project) of this specification.

The specification comprises of following sections:

Section-1	:	Scope, Project Specific Technical Requirements & Bill of Quantities
Section-2	:	Equipment Specification under scope of Supplies/ Service
Section-3	:	Project Details & General Technical Requirements (For all Equipment under the Project)
Section-4	:	Annexures Annexure-A: Compliance Certificate to Technical Specification Annexure-B: Deviation/ Change Request to Technical Specification Annexure-C: Technical Checklist Annexure D- Guaranteed Technical Particulars

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

1. Statutory Regulations
   In particular, the latest version of the following statutory regulations, as applicable, shall be followed for system,
   - o Indian Electricity Act
   - o CEA regulations
   - o The Factory Act
   - o Requirements of other statutory bodies as applicable, e.g. CEA etc.
2. Section-1
3. Section-2
4. Section-3
5. Codes & Standards

Bidder shall furnish list of conflicts/ ambiguities/ deviations, if any, along with their technical offer

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

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

The Bidder shall be deemed to have understood completely all the tender drawings and documents and quoted accordingly.

It is not the intent to specify herein all the details of design and manufacture. However, the equipment shall conform in all respect to high standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to Purchaser / Owner, who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material, which in his/their judgment is not in full accordance with the specifications.

The equipment (**400kV Gas Insulated Switchgear & its accessories**) is required for the following project:

Name of the Customer	:	**HPGCL (HARYANA POWER GENERATION CORPORATION LIMITED)**
Name of Main Contractor	:	**Bharat Heavy Electricals Limited**
Name of the Project	:	**400kV GIS Switchyard at 1X800 MW SUPER CRITICAL EXPANSION UNIT DEEN BANDHU CHHOTU RAM THERMAL POWER PLANT YAMUNA NAGAR, HARYANA**

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

2. Codes & Standards

The equipment (**400kV Gas Insulated Switchgear & its accessories**) shall comply with the latest edition of the following standards as applicable,

IEC 56-1/6	AC High Voltage circuit breaker
IEC 68-3	Seismic test methods for equipments
IEC 129	Alternating Current Dis-connectors & Earthing Switches
IEC 60137	Insulated bushings for alternating voltages above 1000 V
IEC 62271-1	High voltage switchgear and control gear Part 1: Common clauses for high voltage Switchgear and control-gear standards
IEC 62271-100	High voltage switchgear and control gear Part 100: High voltage alternating current Circuit breakers
IEC 62271-101	High voltage switchgear and control gear Part 101: Synthetic testing disconnections, earthing switches
IEC 62271-102	High voltage switchgear and control gear Part 102: Alternating current disconnections (isolators) and earthing switches
IEC 62271-203	Gas Insulated metal-enclosed switchgear for rated voltages above 52KV
IEC 62271-207	Seismic qualification for gas-insulated switchgear assemblies for rated voltages

	above 52kV
IEC 62271-303	High voltage switchgear and control gear- Gas Insulated metal-enclosed switchgear for rated voltages above 52KV
IEC 61000	Electromagnetic compatibility (EMC)
IEC 60060	High voltage test techniques
IEC 60071	Insulation coordination
IEC 60255	Electrical relays
IEC 60265	High voltage switches
IEC 60270	High voltage test techniques- Partial discharge measurements
IEC 60376	Specification and acceptance of new sulphur hexafluoride
IEC 60480	Guide to checking of sulphur hexafluoride taken from electrical equipment
IEC 60529	Degrees of protection provided by enclosures (IP code)
IEC 60815	Guide for the selection of insulators in respect of polluted conditions
IEC 61869	Instrument transformers
IEC 60044-1	Current transformers
IEC 60044-2	Voltage transformers
IEC 60099-1/4	Non-linear resistor type arresters for AC systems
IEC 61439-1	Low voltage switchgear and control gear assemblies Part1- General rules EMC
IEEE 80-2000/ IEC 60364/ 60479/ 60621	Standards for Substation grounding
CIGRE-44	Earthing of GIS- an application guide

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

3. Specific Technical Requirements

Specific technical requirements for the equipment (**400kV Gas Insulated Switchgear & its accessories**) shall be as follows,

Sl. No.	Description	Technical Parameters
1.	Type of GIS	Indoor type, metal enclosed, SF6 gas insulated switchgear (Single Phase segregated type)
2.	Location	Place: Yamunanagar State: Haryana
3.	Design ambient temperature	50˚C
4.	Maximum Relative humidity	95% (at 40°C)
5.	Nominal voltage class	400kVrms
6.	Maximum System Voltage	420kVrms
7.	Lightning Impulse Withstand Voltage	±1425kVpeak
8.	Switching Impulse Withstand Voltage	±1050kVpeak
9.	Power Frequency Withstand (for 1 min rms) Phase to Earth & Between	630kVrms

	Phases	
10.	Maximum Fault Level (1 second)	63kA
11.	Dynamic Withstand Current	157.5kApeak
12.	Rated Continuous Current Capacity (Bay)	2000A
13.	Rated Continuous Current Capacity (Bus), Minimum	2000A
14.	Leakage Rate of SF_6 Per Annum for Each Compartment Individually as well as Complete Installation, Maximum	Not More than 0.5% per year
15.	PD Level for GIS/ Partial discharge level for complete bay	<5pC
16.	Rated frequency	50 Hz
17.	Number of phases	3 nos.
18.	Type of Earthing	Solidly grounded/ Effectively earthed
19.	Duty Cycle of Circuit Breaker	O – 0.3 sec – CO – 3 min - CO
20.	Operating mechanism of circuit breaker	Pneumatic/Spring/Hydraulic/ a Combination of These
21.	Total number of interrupting chambers per phase of 400kV Circuit breaker	One no.
22.	Enclosure	Aluminium Alloy
23.	Minimum total creepage distance for outdoor equipment	13020mm (31mm/kV)
24.	3 phase AC power supply	415V±10%, 50 (±5%), 3-phase 4 wire, solidly grounded
25.	1 phase AC power supply	240V±10%, 50 (±5%), 1-phase, 2 wire, solidly grounded
26.	DC power supply	220V+10% to -15%, 2-wire ungrounded

Notes:

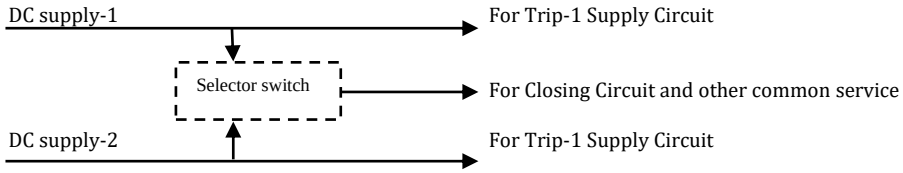
1. All current carrying components of the equipment specified shall be capable of continuous operation at the specified rated current without exceeding the maximum temperature rise specified in the relevant IEC standards.
2. Thermal calculations shall be based on the climatic conditions as per technical specification.
3. Bidder shall offer their latest type tested compact model to accommodate in the specified & allocated space. In case, bidder fails to meet above requirement, its technical offer is liable for non-evaluation.
4. ***Bidder shall conduct insulation co-ordination & very fast transient overvoltage (VFTO) studies in line with IEC 60071 for establishing suitability of surge arrester rating, and any other technical requirement for successful operation of GIS. Prices if VFTO study shall be included in the price quoted for Insulation Co-ordination Study.***
5. Bidder shall check and ensure adequacy of system protection for successful operation of GIS. After

checking of system by bidder, GIS shall be installed and if any failure, malfunction of any part occurs after/ during commissioning, same shall be replaced immediately without any extra cost.

6. Bidder shall submit 3D model (surface model/ light weight model) compatible with Primtech/ any other 3D software for complete GIS and its accessories.
7. GIS building shall have EOT (Electric overhead travel) crane of capacity of maximum 8T safe working load and height of crane shall be 9.5meters from GIS floor level. The EOT crane will be provided by BHEL, however, bidder shall provide all other technical requirements for EOT crane for suitability of crane for installation and maintenance of GIS including EOT crane capacity calculations etc.
8. Bidder to quote the prices of complete 3 phase GIS bus bar (2 sets for two nos. 3 phase bus bar) in the BOQ line item mentioned as **"Busbar GIS module"**.
9. However, during detailed engineering if there is any change in the length of bus bar due to reasons not attributed to bidder, payment of additional length of bus bar shall be covered as per actual length under the BOQ line item mentioned as **"GIS Bus bar Extension Module"**.
10. BOQ line item mentioned as **"GIS Bus bar Extension Module"** shall be applicable **ONLY IN** case where shifting of GIS bays is called for by BHEL/ HPGCL (during contract stage/ detailed engineering stage) due to layout requirement /cost optimization / revision / change in civil architectural requirement or due to building column fouling/ expansion joint requirement in the GIS building, Bidder to incorporate the same with full compliance of technical requirement. Bidder to note that the item quantity shall be reduced to **ZERO** if no change is done on account of reasons not attributed to BHEL/ HPGCL.
11. In case of any change in bus bar length or any other connection/ extension module is proposed by bidder on its own/ or due to reasons not attributed to BHEL/ HPGCL, no additional cost implication shall be admissible.
12. Bidder shall include painting and marking of all buses, individual incomers, all outgoing feeders etc. with details such as tag no., feeder rating, sending end source reference etc.
13. All supporting structures including foundation bolts/ fixing bolts/ embedded plate/rails/ chemical anchor bolts and hardware etc. required for fixing and erection of GIS and bus duct shall be in bidder's scope.
14. Bidder shall submit the drawings of structure along with BOM.
15. Fixing and erection of GIB duct in GIS building and outside of GIS building including foundation/ fixing bolts/ embedded plate/ rail shall be in bidder scope of supply.
16. All hardware and structure required for fixing and erection of GIS on GIS floor including foundation bolts/ fixing bolts/ embedded plate/ rail/ wall sealing plates shall be in bidder scope of supply.
17. All supporting structures including foundation bolts/ fixing bolts/ embedded plate/ chemical anchor bolts and hardware etc. for SF6 to air bushing shall be in Bidders' scope.
18. Bidder shall ensure installation/ supervision of installation, testing and commissioning any subsystem of GIS, including online gas monitoring/ partial discharge system etc.
19. The quantification including details, supply and supervision of installation of interconnecting cables including cable tags, glands, ferrules, lugs etc. between GIS to LCC and between LCC to LCC shall be in the scope of bidder.
20. ***GIS shall be designed in such a way that suitable walkways are provided all around the switchgears so that the operators will be able to have free access to all the operating mechanism.***
21. GIS Equipment shall be complete with all necessary supports, ladders, galleries, staircases, catwalks, movable platforms or ***walkways (for accessing the equipment above two meters for maintenance and operation)***, mechanism cabinets, internal cable raceways etc. for each bay and it shall be of modular construction and extendable design.
22. Each end of the main bus bars of GIS shall be designed for convenient future extension of the

switchgear and related technical details shall be provided by bidder to meet the requirements of other make /GIS supplier.

23. Controlled Switching Device (CSD) shall be supplied for ST/Reactor/associated Tie Bay Circuit breakers. CSD shall be mounted in respective GIS Bay LCC Panels. Special cable, if required for integration is deemed to be included in bidder's scope. The CSD shall be type tested as per EN/ IEC 61000-4-16 & IEC 60255 and other relevant standard as mentioned in the specification.
    - For online continuous partial discharge monitoring system, the requirement of any structure materials, hardware, cabling work and other associated items etc. for completion of complete system (i.e. for 400kV GIS) shall be in the scope of bidder. The online PD system shall have provision (necessary compatible ports etc.) for integration with Substation Automation System (SAS based on IEC 61850 Edition 2). Tentative distance between 400kV GIS Building & SAS room shall be 200 m.
24. The DC distribution logic for LCC panels shall be as follows,



25. A state-of-the art Partial Discharge Monitoring system shall be provided to monitor the entire GIS installation. An on-line continuous Partial Discharge Monitoring (PDM) system shall be designed to provide an automatic facility for the simultaneous collection of PD data at multiple points on the GIS & its associated GIB ducts and Voltage Transformers adopting UHF technique. The data stored shall provide a historical record of the progress of PD sources and shall identify the areas of maximum activity.
26. GIS shall have in Built UHF Based Sensors for On-Line PD Measurement for ready Connection and interfacing with a continuous on-Line PD Measurement System. These shall be a definite scope of supply and the number and location of PD Sensors built in the GIS Equipment supplied shall be supported with the necessary documentation for confirming the sufficiency/ adequacy of the PD sensors provided, considering the coverage of all portions of the GIS equipment.
27. All steel structure members shall be hot-dip galvanized after fabrication. All field assembly joints shall be bolted. Field welding shall not be acceptable. Noncorrosive metal or plated steel shall be used for bolts and nuts throughout the work. Manufacturer shall provide suitable foundation channels and anchor bolts to support the switchgear assemblies. All mounting bolts, nuts and washers shall be provided to fasten the switchgear base frames to the foundation channels.

4. Other General Requirements

The other general requirements for the equipment (**400kV Gas Insulated Switchgear & its accessories**) shall be as follows,

1. Schedule
    - Bidder shall submit detailed activity schedule for engineering approval, site installation, testing and commissioning activities.
    - ***In addition to this, packing of GIS & its accessories shall be suitable for long term storage without any deterioration in quality and performance (min. 2 years, if required).***
2. Open/ closed store
    - Open/ closed store area shall be provided by BHEL, However, bidder shall provide their tentative space requirement for covered and/ or open store area during tender stage only. In addition to this, bidder shall submit their standard storage instruction manual specifically specifying the item with type of storage.

- In addition to this, bidder shall also provide their standard recommendations for precautions to be taken during unloading and storage etc. for approval of BHEL/ HPGCL.
- Supervision of unloading of materials at site, supervision for storage in open/ closed store as per requirement shall be in bidder's scope.
- During storage of materials in BHEL provided open/ closed store, watch and ward shall be provided by BHEL.

3. Office facility at project site
   - Office facilities including sitting arrangement, stationary, printer etc. for OEM/ bidder's staff at project site shall be in BHEL scope.
   - Arrangement of drinking water and electrical supply for official work shall be provided by BHEL, however, personal protective equipment for bidder/ OEM's staff /workers shall be in bidder's scope.
4. Transportation of Special Tools & Tackles, Testing Instruments
   - Transportation of special tools & tackles, testing instruments, special plant including HV test on returnable basis is deemed to be included in bidder's scope, however unloading/ loading, unpacking/ packing and shifting at working place shall be in BHEL scope.
5. Power supply for construction/ testing
   - For construction/ testing requirements, the necessary power supply at site shall be provided by BHEL at suitable point free of cost.
6. Site Installation, Testing & Commissioning
   - Special tools & tackles for installation and testing kits for testing & commissioning shall be in bidder's scope, however, it shall be brought at site on returnable basis only.
   - Bidder shall provide list of general tools, tackle, slings, spanners, gauges, slings and other lifting devices, drills, instruments, testing kits and appliances necessary for the complete assembly, installation, gas filling, maintenance, site testing of the GIS, however, it shall be arranged by BHEL/ its sub-contractor.
   - Bidder shall arrange all Consumables as per manufacturer requirement for successful erection, testing & commissioning.
   - HV test kit required for HV testing and partial discharge measurement shall be provided with operator along with valid calibration certificate by bidder on returnable basis. HV test kit may be brought at site multiple times as per site requirements, reasons not attributable to BHEL/ HPGCL.
   - Bidder shall depute his qualified testing & commissioning engineer at site for successful testing and commissioning of GIS system.
   - Bidder shall submit complete methodology for conduction of site tests for further approval of BHEL/ HPGCL before testing & commissioning activities.
   - GIS bays may be commissioned at different point of time depending on the site conditions and the L2 schedule for the project, and hence deployment of the resources at multiple times at site by bidder in line with actual requirement is envisaged and payment for the same shall be made to bidder, for the reasons not attributable to bidder.
7. Training of BHEL/ HPGCL personnel

   - Training of BHEL/ HPGCL personnel on 400kV GIS & its accessories shall be provided at vendor's works (15 MANDAYS excluding all intervening holidays) as well as project site (15 MANDAYS excluding all intervening holidays).

   - In all the above cases, wherever the training of Owner's personnel is arranged at the works of the manufacturer's (within Owner's Country) **it shall be noted that the lodging and boarding of the Owner's personnel shall be at the cost of Bidder. The Bidder shall make all necessary arrangements towards the same.** To & fro travelling charges

for BHEL/ HPGCL personnel shall not be borne by bidder. Lodging and boarding charges for BHEL personnel shall not be borne by bidder.

- **In case the training of Owner's personnel is arranged at the works of the manufacturer's (outside Owner's Country) it shall be noted that all the expenses including travel, air fare, application processing fees, lodging and boarding of the Owner's personnel shall be at the cost of Bidder. The Bidder shall make all necessary arrangements towards the same.**

8. Modular Design of GIS
   - The GIS switch gear shall be of modular design offering high degree of flexibility. Each module shall be complete with SF6 gas circuit breaker, disconnectors, Maintenance Grounding switches, fast Earthing switches, voltage transformers, Current transformers, bus sections, Gas Insulated Bus-duct, local control cubicle and all necessary components required for safe & reliable operation and maintenance.
   - Documents indicating sequence of repair work steps and description of necessary restrictions during work shall be submitted during detailed engineering stage.
   - Each bay module should be equipped with suitable arrangement for easy dismantling and refitting during maintenance without disturbing other units.
9. Future Extension of GIS
   - The GIS system shall be suitable for future extension on either end. The arrangement of gas sections or compartments shall be such as to facilitate future extension without any drilling, cutting or welding on the existing equipment. To add equipment, it shall not be necessary to move or dislocate the existing switchgear bays.
   - The layout shall ensure that GIS bus link section is provided for future extension of the GIS buses to avoid de-gassing and modification of the existing bus.
   - The physical layout shall ensure free movement of the SF6 Gas Cart and easy access to all components of the GIS for maintenance purposes.
10. Service continuity requirements and sectionalization of GIS
    - The offered GIS should completely meet the requirement of modular design & sectionalization as mentioned in Section-2 of this specification.
    - The GIS equipment with the given bus switching arrangement is divided into different gas compartments. During the work such as a fault repair or major maintenance, requiring the dismantling of a gas compartment for which more than one compartment may needed to be de-gassed.
    - The positioning of the circuit breaker in the GIS shall be such that it shall be possible to access the circuit breaker of any feeder from the front side for routine inspection, maintenance and repair without interfering with the operation of the adjacent feeders.
    - Working conditions, method statements and procedures are to be furnished by the GIS manufacturer in order to ensure equipment and operating personnel's safety and to achieve following service continuity conditions to the extent possible in line with Annexure-F of IEC 62271-203:
      a) During a fault in Circuit Breaker compartment, no bus-bar is permitted out of service during maintenance and repair / replacement.
      b) During a fault in GIS compartment other than CB compartment, maximum one busbar and/or one feeder permitted out of service during maintenance and repair / replacement.
11. GIS will be placed in a non-air-conditioned building during service, however, ventilation system shall be provided.
12. Bidder shall check and ensure adequacy of the system protection for successful operation of GIS.

After checking of system/site by bidder, GIS shall be installed and if any failure, malfunction of any part occurs after commissioning bidder shall replace the part unconditionally within 15 days. Further root cause analysis (RCA) shall be submitted and necessary changes to be done as per the RCA report wherever required.

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

5. Earthing of GIS

The earthing of the GIS shall be carried out considering the safety requirements as per relevant standards. All parts to which access is required for maintenance work shall have provision for earthing. In addition, after opening of enclosure it shall be possible to have continuity of earth for the duration of work. The continuity of earthing shall be ensured considering electrical and thermal stresses caused by current they may have to carry.

- The grounding system shall be designed and provided as per IEEE-80-2013 and CIGRE-44 to protect operating staff against any hazardous touch voltages and electro-mechanical interferences.
- The Bidder shall define clearly what constitutes the main grounding bus of the GIS. The Bidder must supply, commission the entire grounding work of GIS viz conductor, clamps, joints, bimetallic strips (for connection between different type of earthing materials), operating and safety platforms etc.
- 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 links or straps to bridge the flanges. Subassembly-to-subassembly bonding shall be provided to provide gap & safe voltage gradients between all intentionally grounded parts of the GIS assembly & between those parts and the main grounding bus of the GIS.
- The enclosure grounding system shall be designed to minimize circulating currents and to ensure that the potential rise is kept to an acceptable level. Each marshalling box, local control panel, power and control cable sheaths and other non-current carrying metallic structures shall be connected to the grounding system of GIS via connections that are separated from GIS

enclosures.

- The Bidder shall provide suitable measure to mitigate transient enclosure voltage caused by high frequency currents caused by lightning strikes, operation of surge arrester, phase/earth fault and discharges between contracts during switching operation. The grounding system shall ensure safe touch & step voltages in all the enclosures. The Bidder shall provide suitable barrier of non-liner resistor/ counter discontinued SF6/ Transformer and SF6/ HV cable bushing etc. to mitigate transient enclosure voltage.
- Only supply of MS Rod (40mm diameter for outdoor below ground earth mat) and GI Flat of 75x12mm (or 75x10mm)/ 50x6mm (or 40x6mm), as recommended by bidder (for earth mesh on floor), shall be in BHEL's scope. ***Any other earthing material, if required, shall be in bidder's scope of supply.***
- GIS earthing mesh shall be extended suitably to enable connection to the outdoor switchyard earthmat.

Details of earthing system,

Items	**Size**	**Materials**
Main Earthing conductor	40mm dia rod	Mild steel
Conductor above ground & earthing leads (for equipment)	75x12mm (or 75x10mm)/ 50x6mm (or 40x6mm)	G.S. Flat
Rod Electrode	40mm dia, 3000mm	Mild steel
GI Earthwire	7/8 SWG	GI

Copper Flat (if required) as per Bidder's design requirement – In Bidder's scope

For Step and Touch Potential the following parameters shall be considered

- Current distribution factor – 1 (one)
- Duration of fault current – 1 sec
- Human body weight – 50kg

Grid resistance shall be less than 1(one) ohm.

- Bidder to submit detailed calculations, sizing and layout drawings for earthing system during detailed engineering stage. Bidder to provide the bill of quantity for entire items required for the earthing of the GIS including the BOQ of free issue items from BHEL (as mentioned above). Installation of earth mat shall be done by BHEL under supervision of bidder/ manufacturer as per manufacturer's design. Any other earthing material except 40mm MS Rod, 75x12mm (or 75x10mm)/ 50x6mm (or 40x6mm) GI Flat, if required shall be in bidder's scope of supply only & bidder shall quote price for the same against the relevant item of price schedule.
- If any other special earthing including high frequency earthing etc., if required shall be in bidder's scope of supply.

6. Bill of Quantities

1. Schedule of quantities for supply & services for the equipment (**400kV Gas Insulated Switchgear & its accessories**) shall be as per **ANNEXURE A- BOQ for 400kV GIS & its Accessories**. However, any supply/ service not appearing herein but required for completeness of the work is deemed to be included in bidder's scope.
2. BHEL reserves the right for quantity variation due to any reason upto **±25% of total value** at

same unit rate and terms during execution of contract. The quantity of individual items may however vary up to any extent.

7. Drawings / Documents required for Technical Clearance for Manufacturing

Drawings/ documents detailed as per **Annexure B- Details for Technical Clearance for Manufacturing** shall be used for providing technical clearance for manufacturing of the equipment (**400kV Gas Insulated Switchgear & its accessories**), which shall be used for delay analysis, if applicable for respective group.

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

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

8. Type Testing *(for 400kV Circuit Breaker)*

The Bidder shall carry out the type tests as listed in this specification on the equipment to be supplied under this contract. The Bidder shall indicate the charges for each of these type tests separately in the relevant schedule of BPS/ BOQ and the same shall be considered for the evaluation of bids. The type test charges shall be paid as per the charges quoted for each of these type tests separately in the relevant schedule of BPS/ BOQ & no quantity variation is allowed only for the test(s) conducted successfully under the contract and upon certification by the Employer/ customer's engineer.

The type tests shall be carried out in the presence of the Customer's representative, for which minimum 30 days' notice shall be given by the Bidder. The Bidder shall obtain the Customer's approval for the type test procedure before conducting the type test. The type test procedure shall clearly specify the test set up, instrument to be used, procedure, acceptance norms, recording of various parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.

In case the bidder has conducted such specified type test(s) according to the relevant standard and / or specification as per CEA Guidelines for the validity period of Type test(s) conducted on Major Electrical equipment in power Transmission-May2020 & with latest amendments as on date of bid opening, submit the type test reports to the Employer/ customer for waiver of conductance of such type test(s). These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a Client. The Employer/ customer reserves the right to waive conducting of any or all the specified type tests(s) under this contract. In case the type tests are waived, the type test charges shall not be payable to the bidder.

9. Common requirements (For GIS):

The Customer will have the right of getting any test of reasonable nature carried out on any component or completely assembled equipment at Bidder's premises or at site or in any other place in addition to the aforesaid type and routine tests, to satisfy that the materials/equipment comply with the specification.

Failure of any equipment to meet the specified requirements of tests carried out at works or at site shall be sufficient cause for rejection of the equipment. Rejection of any equipment will not be held as a valid reason for delay in the completion of the works as per schedule. Bidder shall be responsible for removing all deficiencies, and supplying the equipment that meet the requirement.

All equipment with their terminal connectors, control cabinets, main protective relays, energy meters etc as well as insulators, insulator strings with hardware, clamps and connectors, marshalling boxes etc shall be subjected to routine and acceptance tests in accordance with the requirements stipulated under respective equipment sections. Charges for the same shall be deemed to be included in the equipment price.

The following type tests (as applicable) are proposed to be conducted on a complete single pole assembly of one typical GIS switchgear bay module as per IEC 62271-203: (The one Typical GIS switchgear bay module consists of equipment like Circuit breakers, Current transformers, Disconnectors / isolator, earth switches etc. of each type / rating.)

Sl. No.	**List of Type tests as per IEC**
1.	Lightning impulse voltage dry tests
2.	Switching impulse voltage dry tests.
3.	Power frequency voltage dry tests
4.	Partial discharge tests
5.	Radio Interference Voltage test (as applicable)
6.	Test to prove the temperature rise of any part of the equipment and measurement of the resistance of the main circuit
7.	Test to prove the ability of the main circuit and earthing circuit to carry the rated peak and the rated short time withstand current
8.	Test to verify the making and breaking capacity of the included switching devices.
9.	Test for satisfactory operation of the included switching devices
10.	Test to prove the strength of enclosures
11.	Gas tightness test
12.	Electromagnetic capability test (if applicable)
13.	Test on partitions
14.	Internal arc tests.
15.	Mechanical operation tests
16.	Mechanical operation tests.
17.	Verification of degree of protection of auxiliary and control circuits
18.	Test to prove performance under thermal cycling and gas tightness test on gas barrier insulators
19.	Capacitive Current switching test
20.	Shunt reactor current switching test

The components forming parts of the GIS which are covered by other standards shall comply with

and shall be type tested according to those standards.

For surge arrestor and Bus VT following type tests are proposed to be conducted as per relevant IEC.

Surge Arresters (As per IEC 60099-4)

Sl. No.	List of Type tests as per IEC
1.	Insulation with stand test on housing
2.	Residual voltage test
3.	Long duration current impulse with stand test
4.	pressure relief test (if applicable)
5.	operating duty test
6.	Partial discharge test
7.	Leakage test

Bus VT (As per IEC 60044-2/ Latest IEC Standard)

Sl. No.	List of Type tests as per IEC
1.	Temperature rise test
2.	Lightning impulse test
3.	switching impulse test
4.	Determination of errors
5.	short circuit with stand capability
6.	chopped lightning impulse test

10. Quality Plan

The successful bidder shall submit Quality Assurance Plan for **400kV Gas Insulated Switchgear & its accessories** etc. including in-process inspection methods, tests, records, etc. for BHEL/ HPGCL approval. Customer hold points will also be included in the plan, which shall be mutually agreed by the BHEL/ HPGCL. In case bidder has ref. Quality Assurance Plan agreed with BHEL/ HPGCL, same shall be submitted for specific project to BHEL/ HPGCL approval. There shall be no commercial implication to BHEL/ HPGCL on account of Quality Plan approval.

The bidder 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 requirements shall apply to all activities during design, procurement, manufacturing, inspection, testing, packaging, shipping, inland transportation, storage, site erection & commissioning. Bidder shall submit detailed Manufacturing Quality Assurance Plan (MQP) and Field Quality Plan for BHEL / customer's approval.

Superior quality control system shall be adopted to assure high product quality. Raw materials of the best commercial grade quality and high reliability shall be used in the manufacture of the equipment (**400kV Gas Insulated Switchgear & its accessories**). All materials shall be procured, manufactured, inspected and tested by vendor/ sub-vendor as per approved quality plan. The supplier shall perform all tests necessary to ensure that the material and workmanship conform to the relevant standards and comply with the requirements of the specification. Charges for all tests for the equipment (**400kV Gas Insulated Switchgear & its accessories**) shall be deemed to be included in bidder's scope.

11. Inspection & Testing

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

12. Field Testing & Commissioning

1. Bidder/ OEM shall carry out field testing and commissioning of 400kV GIS & its Accessories, however for installation, only supervision of installation shall be done by bidder. Further appropriate test and commissioning reports along as-built documentation as necessary shall be submitted.
2. Bidder shall also submit site acceptance testing (SAT) procedures and get them approved from BHEL/ HPGCL before carrying out the activities at site.
3. Bidder shall coordinate with manufacturers of other equipment wherever required and shall freely and readily supply all technical information for this purpose as and when called for.
4. In general, field testing and commissioning shall be as per section-2, technical specification and applicable standards.

13. Packing and Dispatch

1. The equipment shall be carefully packed for transport by sea, rail and road in such a manner that it is protected against the climatic conditions and for any damage during transportation, transit and storage.
2. The SF6 equipment shall be shipped in the largest factory assembled units within transport and loading limitations and considering handling facilities on site to reduce the erection and installation work on site to a minimum. Where possible all items of equipment or factory assembled units shall be boxed in substantial crates or containers to facilitate handling in a safe and secure manner.
3. Each individual piece to be shipped, whether crate, container or large unit, shall be marked special notations such as 'Fragile', 'This side up', 'Centre of gravity', 'Weight', 'Owner's particulars', 'PO no.' etc., and other details as per purchase order.
4. The equipment may be stored outdoors for long periods before installation. The packing shall be completely suitable for outdoor storage in areas with heavy rains and high ambient temperature. Hence, packing of the equipment shall be suitable for long storage (minimum 2 years).
5. Special precautions shall be taken to protect any parts containing electrical insulation against the ingress of moisture. This applies particularly to the equipment of which each gas section shall be sealed and pressurized prior to shipping. Either dry nitrogen/air or dry SF6 gas shall be used and the pressure shall be such as to ensure that, allowing for reasonable leakage, it will always be greater than the atmospheric pressure for all variations in ambient temperature and the atmospheric pressure encountered during shipment to site and calculating the pressure to which the sections shall be filled to ensure positive pressure at all times during shipment.
6. All blanking plates, caps, seals, etc., necessary for sealing the gas sections during shipment to site shall be provided. Any seals, gaskets, `0' rings, etc. that will be used as part of the arrangement for sealing off gas sections for shipment of site, shall not be used in the final installation of the equipment at site. Vendor to provide quantity of components accordingly considering permanent installation and commissioning.

14. TRANSPORT OF EQUIPMENT TO SITE (add in section-1)

The Bidder shall be responsible for the loading, transport, handling and offloading of all equipment and materials from the place of manufacture or supply to site.

All transport packages containing critical units viz Circuit breakers and Voltage transformers shall be provided with sufficient number of electronic impact recorders (on returnable basis) during transportation to measure the magnitude and duration of the impact in all three directions.

The acceptance criteria and limits of impact in all three directions which can be withstood by the equipment during transportation and handling shall be submitted by the Bidder during detailed engineering. The recording shall commence in the factory and must continue till the units reach site. The data of electronic impact recorders shall be downloaded at site and a softcopy of it shall be handed over to Site Incharge.

PACKING, STORAGE AND UNPACKING

All the equipment shall be carefully packed for transport by sea, rail and road in such a manner that it is protected against the climatic conditions and the variations in such conditions that will be encountered enroute from the manufacturer's works to the site.

The SF6 metal clad equipment shall be shipped in the largest factory assembled units that the transport and loading limitations and handling facilities on site will allow to reduce the erection and installation work on site to a minimum.

Where possible all items of equipment or factory assembled units shall be boxed in substantial crates or containers to facilitate handling in a safe and secure manner. Should the units be considered too large for packing in crates, they shall be suitably lagged and protected to prevent damage to any part, particularly small projections, during transport and handling. Special lugs or protective supports shall be provided for lifting to prevent slings and other lifting equipment from causing damage. Each crate, container or shipping unit shall be marked clearly on the outside to show where the weight is bearing and the correct position for the slings.

Each individual piece to be shipped, whether crate, container or large unit, shall be marked with a notation of the part or parts contained therein.

Special precautions shall be taken to protect any parts containing electrical insulation against the ingress of moisture. This applies particularly to the metal clad equipment of which each gas section shall be sealed and pressurized prior to shipping. Either dry nitrogen / air or dry SF6 gas shall be used and the pressure shall be such as to ensure that, allowing for reasonable leakage, it will always be greater than the atmospheric pressure for all variations in ambient temperature and the atmospheric pressure encountered during shipment to site and calculating the pressure to which the sections shall be filled to ensure positive pressure at all times during shipment. The type of gas, the maximum pressure to which sections will be filled prior to shipment and the minimum allowable pressure during shipment shall be advised prior to dispatch.

All blanking plates, caps, seals, etc., necessary for sealing the gas sections during shipment to site which may on later stage necessarily be used during repair and maintenance shall remain the property of owner. If considered necessary, blanking plates or other sealing devices shall be provided with facilities for measuring the gas pressure and recharging at any time during the transport period. Any seals, gaskets, 'O' rings, etc. that may be used as part of the arrangement for

sealing off gas sections for shipment of site, shall not be used in the final installation of the equipment at site. Identification serial numbers shall be stamped into the blanking plates, etc., and on the switchgear equipment to which they are fitted so that they can easily be identified and refitted should it ever be necessary to ship sections of the switchgear back to the manufacturer's works for repair.

For bus ducts involving male and female joints of the current carrying conductor, the same shall be transported in disassembled condition to avoid any damage during transit. All bright parts liable to rust shall receive a coat of anti-rusting composition and shall be suitably protected.

The equipment shall only be unpacked or removed from the containers immediately prior to being installed. They shall not be left lying unnecessarily in open crates or containers. Special precautions shall be taken when gas sections which have been sealed and pressurized for shipping are opened up to reduce the ingress of dirt and atmospheric moisture to a minimum. Whenever possible this shall only be done immediately prior to installation and if any section is to be left outside for any length of time after being opened, it shall be resealed and pressurized with either dry nitrogen/air or SF6 gas until required.

15. Specific Exclusions (NOT IN BIDDER'S SCOPE)

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

1. Any scope of supply / services mentioned in Section-2 or Section-3 of technical specification but not having any relationship with 400kV GIS, LCC & its Accessories and not covered in Section-1 or BPS / BOQ shall be deemed excluded from bidder's scope.
2. Installation / Erection of GIS with LCC & its Accessories except supervision work. However, complete supply and installation of Online PD Monitoring system for both 400kV GIS shall be in bidder's scope.
3. Cable laying & terminations, however supervision work & termination of special cables shall be in bidder's scope.
4. Local transportation/ conveyance for bidder's engineers shall be arranged by BHEL between local stay and site.
5. Office assistance shall be provided by BHEL including sitting facility etc.
6. Receipt & unloading of material at site except supervision work.
7. Terminal connector of SF6 to Air Bushing to conductor or any other interfacing equipment/ materials/ items.
8. Open & Closed stores at site, however, bidder shall provide space requirement during tendering stage.
9. During storage of materials in BHEL provided open/ closed store, watch and ward shall be provided by BHEL.
10. Civil Construction works i.e. GIS buildings, civil works requirement for GIS System.
11. EOT crane, Ventilation System, Illumination System & Fire detection & alarm system, however complete input shall be provided for EOT and other related systems, however design input, applicable for GIS manufacture, shall be provided.
12. Control Relay & Protection Panels/ Merging Unit/SCU/Process Bus Panels, Numerical Relays, Bus Bar Protection Panel, SAS & DCS system, ACDB, DCDB, Battery & Charger as applicable.
13. 40 mm MS Rod and 75x12mm (or 75x10mm)/ 50x6mm (or 40x6mm) GI Flat for earthing.
14. Outdoor AIS Equipment not related with GIS & its accessories.
15. Power & Control cable beyond LCC (except any special cables, if required).

16. BHEL/ Customer/ BHEL appointed 3rd party inspector travel, lodging & boarding charges during testing/ inspection etc.

16. MAKES OF EQUIPMENT/ COMPONENTS

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

17. Terms Used

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

18. List of Documents/ Drawings

Following drawing/ documents are attached for information purpose,

1. Annexure A- BOQ for 400kV GIS & its Accessories
2. Annexure B- Details for Lot wise Technical Clearance for Manufacturing
3. Single Line Diagram for 400kV GIS Switchyard at HPGCL
4. Layout Drawing for 400/220kV GIS Switchyard at HPGCL
5. Architectural Drawing for 400kV GIS Building at HPGCL

Annexure A- BOQ for 400kV GIS & its Accessories

Sl. No.	Indent item description	Material Code	Short Item Description	Detailed Description (To be followed for project requirement)	Unit	Qty
A			**Supply- GIS: 400kV, 63kA for 1Sec GIS with one and half breaker scheme as per the enclosed SLD, latest IEC standard & type tested equipment as per technical specification**	The 400KV, 2000A, 63kA for 1 sec, One and Half Breaker GIS complete with local control centre (LCC) etc with open future proof & flexible system in line with IEC 61850 & IEC 62271-203. GIS shall comprise following bays but not limited to (Refer attached Single Line Diagram), a) Two (2) Set of fully equipped Line Bays b) One (1) Set of fully equipped GT Bays c) Two (2) Set of fully equipped ST Bays d) Two (2) Set of fully equipped ICT Bays e) One (1) Set of fully equipped Bus Reactor Bay f) Four (4) Set of fully equipped Tie Bays g) Two (2) Sets of fully equipped Bus Voltage Transformer Bays with Bus Isolator and Grounding Switches and Bus LA. Typical bay includes but not limited to SF6 gas, Single Phase (isolated) Busbar, circuit breaker, current transformer, bus-bar disconnectors with common grounding switch, Motorised disconnectors with safety grounding switch(es), high speed fault making motorised grounding switch, Local control cubicle, SF6 gas monitoring system for complete GIS, SF6 bus duct termination arrangement including SF6 to air bushing module, PD sensor (adequate number of UHF sensors in the offered GIS equipment for detection of Partial discharge (of 5 pC and above) as per IEC 60270 through Online Partial Discharge (PD) monitoring system, different gas compartment, O- ring & gaskets, Nuts, Bolts & Washers, Absorbent, Limit Switch etc. to complete GIS modules & its earthing arrangement for GIS equipment with earthing strips of adequate size (as per IEEE-80-2000 and CIGRE44 to protect operating staff against any hazardous touch voltages and electro-magnetic interferences) as per the technical specification. The Switchgear shall be complete with all necessary terminal boxes, inspection window, SF6 gas filling, inter-connecting wiring, grounding connections, gas monitoring equipment and piping, support structures etc. The scope of supply shall also include all erection and mounting hardwares and interconnecting power and control cables between GIS to LCC and between LCC to LCC including cable tray, glands, lugs, ferrules etc. However cables beyond LCC shall be supplied and laid by BHEL.	**Header Item; Unit & Quantity as per A1 to A19 below.**	
A1	SUPPLY- GIS : 400KV, 63KA FOR 1S, 2000A, ONE & HALF CIRCUIT BREAKER SCHEME - LINE GIS BAY	TB9614657723	Fully equipped 400kV, 63kA, 2000A GIS - Line bay module	400kV, 63kA for 1 sec, 2000A SF6 gas-insulated metal enclosed LINE bay module. Each set shall be complete & shall comprise of but not limited to: a) ONE set of 3x1-phase, SF6 insulated circuit breaker, complete with operating mechanism (suitable for 1&3 phase auto reclose). b) THREE sets of 3x1-phase group operated Disconnector complete with manual and motor driven operating mechanisms. c) TWO sets of 3x1-phase, group operated maintenance Earthing Switches, complete with manual and motor driven operating mechanisms. d) ONE set of 3x1-phase, group operated High Speed Earthing Switches, complete with manual and motor driven operating mechanisms. e) TWO set of 3x1-phase, 3-CORE, multi ratio, Current Transformers as per single line diagram (Core details shall be finalised at detail engg. stage). f) ONE set of 3x1-phase, 6-CORE, multi ratio, Current Transformers as per single line diagram (Core details shall be finalised at detail engg. stage). g) One set of 3x1-phase, multi winding, Voltage Transformer as per single line diagram. (Winding details shall be finalised at detail engg. stage) h) UHF PD sensors, gas monitoring device, pressure relief device, busbar, insulators/ barriers, expansion joint/ flexible joints and other items as required. GIS bus duct, SF6 to air bushing module etc. are not included in this bay module and hence, these items are covered in separate BOQ items.	Set	2

Annexure A- BOQ for 400kV GIS & its Accessories

Sl. No.	Indent item description	Material Code	Short Item Description	Detailed Description (To be followed for project requirement)	Unit	Qty
A2	SUPPLY- GIS : 400KV, 63KA FOR 1S, 2000A, ONE & HALF CIRCUIT BREAKER SCHEME - GENERATOR TRANSFORMER GIS BAY	TB9614657704	Fully equipped 400kV, 63kA, 2000A GIS - GT bay module	400kV, 63kA for 1 sec, 2000A SF6 gas-insulated metal enclosed GT bay module. Each set shall be complete & shall comprise of but not limited to: a) ONE set of 3x1-phase, SF6 insulated circuit breaker, complete with operating mechanism (suitable for 1&3 phase auto reclose) b) THREE sets of 3x1-phase group operated Disconnector complete with manual and motor driven operating mechanisms. c) TWO sets of 3x1-phase, group operated maintenance Earthing Switches, complete with manual and motor driven operating mechanisms. d) ONE set of 3x1-phase, group operated High Speed Earthing Switches, complete with manual and motor driven operating mechanisms. e) TWO set of 3x1-phase, 3-CORE, multi ratio, Current Transformers as per single line diagram (Core details shall be finalised at detail engg. stage). f) ONE set of 3x1-phase, 6-CORE, multi ratio, Current Transformers as per single line diagram (Core details shall be finalised at detail engg. stage). g) One set of 3x1-phase, multi winding, Voltage Transformer as per single line diagram. (Winding details shall be finalised at detail engg. stage) h) UHF PD sensors, gas monitoring device, pressure relief device, busbar, insulators/ barriers, expansion joint/ flexible joints and other items as required. GIS bus duct, SF6 to air bushing module etc. are not included in this bay module and hence, these items are covered in separate BOQ items.	Set	1
A3	SUPPLY- GIS : 400KV, 63KA FOR 1S, 2000A, ONE & HALF CIRCUIT BREAKER SCHEME - STATION TRANSFORMER GIS BAY	TB9614659005	Fully equipped 400kV, 63kA, 2000A GIS - ST bay module	400kV, 63kA for 1 sec, 2000A, SF6 gas-insulated metal enclosed ST bay module. Each set shall be complete & shall comprise of but not limited to: a) ONE set of 3x1-phase, SF6 insulated circuit breaker, complete with operating mechanism (suitable for 1&3 phase auto reclose) b) THREE sets of 3x1-phase group operated Disconnector complete with manual and motor driven operating mechanisms. c) TWO sets of 3x1-phase, group operated maintenance Earthing Switches, complete with manual and motor driven operating mechanisms. d) ONE set of 3x1-phase, group operated High Speed Earthing Switches, complete with manual and motor driven operating mechanisms. e) TWO set of 3x1-phase, 3-CORE, multi ratio, Current Transformers as per single line diagram (Core details shall be finalised at detail engg. stage). f) ONE set of 3x1-phase, 6-CORE, multi ratio, Current Transformers as per single line diagram (Core details shall be finalised at detail engg. stage). g) One set of 3x1-phase, multi winding, Voltage Transformer as per single line diagram. (Winding details shall be finalised at detail engg. stage) h) UHF PD sensors, gas monitoring device, pressure relief device, busbar, insulators/ barriers, expansion joint/ flexible joints and other items as required. GIS bus duct, SF6 to air bushing module etc. are not included in this bay module and hence, these items are covered in separate BOQ items.	Set	2

Annexure A- BOQ for 400kV GIS & its Accessories

Sl. No.	Indent item description	Material Code	Short Item Description	Detailed Description (To be followed for project requirement)	Unit	Qty
A4	SUPPLY- GIS : 400KV, 63KA FOR 1S, 2000A, ONE & HALF CIRCUIT BREAKER SCHEME - ICT/ TRANSFORMER BAY MODULE	TB9614658346	Fully equipped 400kV, 63kA, 2000A GIS - ICT bay module - with CSD	400kV, 63kA for 1 sec, 2000A, SF6 gas-insulated metal enclosed ICT bay module. Each set shall be complete & shall comprise of but not limited to: a) ONE set of 3x1-phase, SF6 insulated circuit breaker, complete with operating mechanism (suitable for 1&3 phase auto reclose) b) THREE sets of 3x1-phase group operated Disconnector complete with manual and motor driven operating mechanisms. c) TWO sets of 3x1-phase, group operated maintenance Earthing Switches, complete with manual and motor driven operating mechanisms. d) ONE set of 3x1-phase, group operated High Speed Earthing Switches, complete with manual and motor driven operating mechanisms. e) TWO set of 3x1-phase, 3-CORE, multi ratio, Current Transformers as per single line diagram (Core details shall be finalised at detail engg. stage). f) ONE set of 3x1-phase, 6-CORE, multi ratio, Current Transformers as per single line diagram (Core details shall be finalised at detail engg. stage). g) One set of 3x1-phase, multi winding, Voltage Transformer as per single line diagram. (Winding details shall be finalised at detail engg. stage) h) UHF PD sensors, gas monitoring device, pressure relief device, busbar, insulators/ barriers, expansion joint/ flexible joints and other items as required. GIS bus duct, SF6 to air bushing module etc. are not included in this bay module and hence, these items are covered in separate BOQ items.	Set	2
A5	SUPPLY- GIS : 400KV, 63KA FOR 1S, 2000A, ONE & HALF CIRCUIT BREAKER SCHEME - BUS REACTOR GIS BAY	TB9614658332	Fully equipped 400kV, 63kA, 2000A GIS - Bus Reactor bay module - with CSD	400kV, 63kA for 1 sec, 2000A, SF6 gas-insulated metal enclosed BUS REACTOR bay module. Each set shall be complete & shall comprise of but not limited to: a) ONE set of 3x1-phase, SF6 insulated circuit breaker, complete with operating mechanism (suitable for 1&3 phase auto reclose) b) THREE sets of 3x1-phase group operated Disconnector complete with manual and motor driven operating mechanisms. c) TWO sets of 3x1-phase, group operated maintenance Earthing Switches, complete with manual and motor driven operating mechanisms. d) ONE set of 3x1-phase, group operated High Speed Earthing Switches, complete with manual and motor driven operating mechanisms. e) TWO set of 3x1-phase, 3-CORE, multi ratio, Current Transformers as per single line diagram (Core details shall be finalised at detail engg. stage). f) ONE set of 3x1-phase, 6-CORE, multi ratio, Current Transformers as per single line diagram (Core details shall be finalised at detail engg. stage). g) One set of 3x1-phase, multi winding, Voltage Transformer as per single line diagram. (Winding details shall be finalised at detail engg. stage) h) UHF PD sensors, gas monitoring device, pressure relief device, busbar, insulators/ barriers, expansion joint/ flexible joints and other items as required. GIS bus duct, SF6 to air bushing module etc. are not included in this bay module and hence, these items are covered in separate BOQ items.	Set	1

Annexure A- BOQ for 400kV GIS & its Accessories

Sl. No.	Indent item description	Material Code	Short Item Description	Detailed Description (To be followed for project requirement)	Unit	Qty
A6	SUPPLY- GIS : 400KV, 63KA FOR 1S, 2000A, ONE & HALF CIRCUIT BREAKER SCHEME - TIE GIS BAY	TB9614651124	Fully equipped 400kV, 63kA, 2000A GIS - Tie GIS bay module	400kV, 63kA for 1 sec, 2000A, SF6 gas-insulated metal enclosed TIE bay module. Each set shall be complete & shall comprise of but not limited to: a) ONE set of 3x1-phase, SF6 insulated circuit breaker, complete with operating mechanism (suitable for 1&3 phase auto reclose) b) TWO sets of 3x1-phase group operated Disconnector complete with manual and motor driven operating mechanisms. c) FOUR sets of 3x1-phase, group operated maintenance Earthing Switches, complete with manual and motor driven operating mechanisms. d) TWO set of 3x1-phase, 4-CORE, multi ratio, Current Transformers as per single line diagram (Core details shall be finalised at detail engg. stage). f) UHF PD sensors, gas monitoring device, pressure relief device, busbar, insulators/ barriers, expansion joint/ flexible joints and other items as required. GIS bus duct, SF6 to air bushing module etc. are not included in this bay module and hence, these items are covered in separate BOQ items.	Set	4
A7	SUPPLY- GIS : 400KV, 63KA FOR 1S, 2000A, ONE & HALF CIRCUIT BREAKER SCHEME - BUSBAR GIS MODULE	TB9614659056	400kV, 63kA, 2000A GIS - Busbar GIS module	One set of three single phase (isolated), 400kV, 2000A, 63kA for 1 sec, SF6 gas-insulated metal enclosed bus bars, each comprising of but not limited to: a) Three individual 2000A bus bars enclosures running across the length of the switchgear to inter connect each of the circuit breaker bay modules in one and half breaker bus system. b) UHF PD sensors, Gas monitoring systems, pressure switches, telescopic enclosure etc. as required. c) UHF PD sensors, gas monitoring device, pressure relief device, pressure switches, telescopic enclosure, insulators/ barriers, expansion joint/ flexible jointsetc. and any other items as required. Length of bus bar to be indicated by bidder.	Set	2
A8	SUPPLY- GIS : 400KV, 63KA FOR 1S, 2000A, ONE & HALF CIRCUIT BREAKER SCHEME - BUS VT MODULES & BUS EARTH SWITCH FOR MAIN BUS	TB9614659065	400kV, 63kA, 2000A GIS - Bus VT Modules & Bus High Speed Earth Switch for Main Bus	400kV, 63kA for 1 sec, 2000A, SF6 gas insulated Bus VT bay module, Disconnector module with Earth switches connected to Main Bus Bars, each comprising of but not limited to: a) ONE sets of 3x1-phase group operated Disconnector complete with manual and motor driven operating mechanisms. b) TWO set of 3x1-phase, group operated High Speed Earthing Switches, complete with manual and motor driven operating mechanisms. c) ONE set of 3x1-phase, 3-secondary, Voltage Transfromer as per single line diagram. d) UHF PD sensors, gas monitoring device, pressure relief device, busbar, insulators/ barriers, expansion joint/ flexible joints and other items as required.	Set	2
A9	SUPPLY- GIS : 400KV, 63KA FOR 1S, ONE & HALF CIRCUIT BREAKER SCHEME - LA/ SURGE ARRESTER MODULE	TB9614609031	400kV, 63kA GIS - LA/ Surgre arrester Module for Main Bus & ICT Bays	LA/ Surge Arrester Module, comprising of following but not limited to, (a) ONE no. of single phase LA/Surge Arrester along with enclosure for one bus bar section with surge monitor/ counter (b) LA/ Surge Arrester Module shall have the provision of link for temporaray isolation during HV testing at site. (c) Number of LA/ Surge arrester and their rating shall be decided based on insulation co-ordination / transient analysis studies for the GIS system. Insulation Coordination study is in bidder scope. However the LA indicated in SLD are the minimum numbers of LA to be provided by bidder.	No.	12
A10	SUPPLY- GIS : 400KV, 63KA FOR 1S, 2000A, ONE & HALF CIRCUIT BREAKER SCHEME - GAS INSULATED BUS DUCT FROM GIS BAY MODULES UPTO SF6 AIR BUSHINGS OF OUTGOING LINES/ BUS REACTOR/ GT/ ST	TB9614659042	400kV, 63kA, 2000A GIS - Gas Insulated Bus Duct from GIS bay modules upto SF6 Air bushings of Outgoing Lines/ Bus Reactor/ GT/ ST/ ICT	400kV, 63kA for 1 sec for insulated Bus Duct, 2000A ,SF6 gas insulated GIS Bus Duct shall be complete & shall comprise of but not limited to: a) Single phase (isolated) SF6 ducts along with all accessories, bends, joints etc to connect 400kV GIS bay modules to SF6 Air bushings of Outgoing Lines/ Bus Reactor/ GT/ ST/ ICT b) UHF PD sensors, Gas monitoring devices, barriers, pressure switches, etc. as required. The total tentative length indicated is the sum of all 1 phase SF6 bus duct from end of respective bay to SF6 to air bushing/ connection. However, exact length shall be decided during detailed engineering stage.The GI Bus duct length is to be calculated from the end of the GIS module and shall include both the indoor and outdoor GIB.	Mtr	900

Annexure A- BOQ for 400kV GIS & its Accessories

Sl. No.	Indent item description	Material Code	Short Item Description	Detailed Description (To be followed for project requirement)	Unit	Qty
A11	SUPPLY- GIS : 400KV, 63KA FOR 1S, 2000A, ONE & HALF CIRCUIT BREAKER SCHEME - SF6 TO AIR BUSHING	TB9614651223	400kV, 63kA, 2000A GIS - SF6 to Air bushing	400kV, 2000A, 63 kA for 1 sec, 31mm/kV creepage, SF6 to Air Bushing for Over head connection of Outgoing Lines/ Bus Reactor/ GT/ ST bays with GIS.	No	15
A12	SUPPLY- GIS : 400KV, 63KA FOR 1S, 2000A, 1-PHASE,SF6 TO OIL DIRECT TRANSFORMER CONNECTOR	TB9614654151	400kV, 63kA, 2000A GIS - SF6 to Oil direct transformer connector	400kV, 2000A, 63 kA for 1 sec, Single phase, SF6 to Oil direct transformer connector as per IEC62271-211	No	6
A13	SUPPLY- GIS : 400KV, 63KA FOR 1S, 2000A, GIS BUS BAR EXTENSION MODULE (APPLICABLE ONLY IN CASE OF CHANGE IN STANDARD LENGTHS OF BUSBAR MODULES OF GIS/ STANDARD BAY PITCH DURING DETAILED ENGINEERING, ON ACCOUNT OF REASONS NOT ATTRIBUTED TO BIDDER. IN CASE THERE IS NO SUCH CHANGE, THE QUANTITY OF THIS ITEM SHALL BE REDUCED TO ZERO	TB9614659201	400kV, 63kA, 2000A GIS - GIS Bus bar Extension Module (Applicable only in case of change in standard lengths of busbar modules of GIS/ standard bay pitch during detailed engineering, on account of reasons not attributed to bidder. In case there is no such change, the quantity of this item shall be reduced to zero.)	400kV, 63kA for 1 sec, 2000A, Bus bar extension module for connection between bays, comprising of following but not limited to, (a) 1 phase isolated Bus bar module section shall be used for connection between sections of bus bars to create electrical connectivity due to shifting of GIS bays, arising due to civil and architectural requirements, avoiding building column fouling or expansion joint in the building that houses GIS. (b) This module shall include the bellows/ compensators like lateral mounting units, Axial compensators, Parallel compensators, tolerance compensators and vibration compensators etc. as per requiremnts. c) UHF PD sensors, gas monitoring device, pressure relief device, insulator, expansion joint/ flexible joints etc. as required.	Mtr	6
A14	SUPPLY- GIS : ONE & HALF CIRCUIT BREAKER SCHEME - LOCAL CONTROL CUBICLES (LCC)	TB9610001316	400kV GIS - Local Control Cabinet (LCC)	Local Control Cabinet (LCC) shall be provided for all Outgoing Lines/ Bus Reactor/ GT/ ST/ ICT bays including cables between GIS & LCC. However, it may please be noted that any additional requiremenst of LCC (for Bus VT, DS, ES & Bus LA etc.), other than quantity mentioned in BOQ, during detailed engineering stage shall not be payable. All equipments are to be incorporated in BOQ quantity by bidder.	Nos.	12
A15	SUPPLY- GIS : 400KV, SF6 GAS REQUIRED FOR PLACING GIS INTO SUCCESSFUL OPERATION	TB9614005596	400kV GIS - SF6 gas required for placing GIS into successful operation	First filling of SF6 gas for the equipment supplied plus an additional quantity sufficient for conducting all tests on equipment at site before placing it into successful operation. Bidder shall supply spare SF6 gas equal to 20% of the total requirement for the 400KV GIS circuit breaker in non-returnable cylinder. Bidder to indicate quantity with break up during detailed engineering.	MT	20
A16	SUPPLY- GIS : 400KV, ONE & HALF CIRCUIT BREAKER SCHEME - STRUCTURE MATERIAL INCLUDINGWALKWAY, PLATFORM, RAILING, FOUNDATION BOLTS, EMBEDDED ITEMS, RAILS AND/ OR OTHERMATERIALS ETC.	TB9614001273	Supply of structure material for Installation of 400kV GIS including support structure for GIS ducts, SF6 to air bushings, supports, platforms, ladders, foundation bolts, embedded parts in floors, Rails etc., which are required for installation of GIS as per the specification.	Structure Materials for support of GIS, Bus Ducts, SF6 to air bushing/ connection including Foundation Bolts, Embedded Items, Rails and/ or any other structural items required. All steel structure members shall be hot-dip galvanized after fabrication. Unless otherwise specified, minimum mass of zinc coating for **Galvanizing shall be 610 gm/square meter.** All field assembly joints shall be bolted and hence, Field welding shall not be acceptable. Noncorrosive metal or plated steel shall be used for bolts and nuts throughout the work. Bidder shall provide suitable foundation channels and anchor bolts to support the switchgear assemblies. All anchor fasteners, mounting bolts, nuts and washers shall be provided to fasten the switchgear base frames to the foundation channels. In addition to above, supports, platforms, walkway, catwalk, foundation bolts, embedded parts in floors etc., are also included in the scope as per the specification, but not limited to the following, (a) Base Plate, Channel, Metallic / Structural Member/ Rail for seating of GIS system (b) Lattice / Pipe structure required for GIS bay, GIB, SF6 to air bushing/ connection. (c) Foundation bolt / Anchor Fastener for GIS system, if required. (d) Equipment fixing hardware. (e) Cable tray arrangement (mounted on structures of) GIS bay, GIB, SF6 to air bushing/ connection. (f) Any other structural item required to complete the system in all respects but not limited to above. The civil works shall be done based on bidder's design & drawings.	MT	65

Annexure A- BOQ for 400kV GIS & its Accessories

Sl. No.	Indent item description	Material Code	Short Item Description	Detailed Description (To be followed for project requirement)	Unit	Qty
A17	SUPPLY- GIS : 400KV, ONE & HALF CIRCUIT BREAKER SCHEME - EARTHING MATERIALS INCLUDING HIGHFREQUENCY EARTHING, IF APPLICABLE	TB9614001285	Supply of Earthing material for 400kV GIS including High frequency earthing material, if required. The quantity shall be estimated & provided by bidder	Earthing Materials, except 40mm MS rod, 75x12mm (or 75x10)/ 50x6mm (or 40x6) GI Flat, which shall be provided by BHEL as free issue items, but, exact quatity requirenment shall be intimated by bidder based on the approved earthing philosphy, and Supervision of erection of all earthing connection for GIS to Earth Mesh on Floor shall be in scope including any special requirements including high frequency earthing. In case, high frequency earthing is not required, necessary design and calculations shall be submitted by bidder in line with IEEE-80-2000 and CIGRE44 to protect operating staff against any hazardous touch voltages and electro-magnetic interferences as per the technical specification. For further details, Please refer Section-2 along with applicable drawing. Bidder shall define clearly what constitutes the main grounding bus of the GIS. Bidder must supply, commission the entire grounding work of GIS viz conductor, clamps, joints, bimetallic strips (for connection between different type of earthing materials), operating and satety platforms etc. Bidder shall provide suitable measure to mitigate trasient enclosure voltage caused by high frequency currents caused by lightning strikes, operation of surge arrester, phase/earth fault and discharge between contracts during switching operation.	Lot	1
A18	SUPPLY- GIS : 400KV, ONE & HALF CIRCUIT BREAKER SCHEME - ONLINE CONTINUOUS PARTIAL DISCHARGE MONITORING SYSTEM (PDM) WITH ALL NECESSARY ACCESSORIES & AUXILIARIES) FOR 400KV GIS & BUSDUCTS	TB9614009022	Online continuous Partial Discharge Monitoring System (PDM) with all necessary accessories & auxiliaries) complete for 400kV GIS & Busducts	Online continuous Partial Discharge Monitoring System (PDM) for 400kV GIS have following but not limited to, 400kV GIS equipment system shall have Online continuous Partial Discharge Monitoring System (PDM) system to provide an automatic facility for the simultaneous collection of PD data at multiple points on the GIS & its associated GIB ducts and Voltage Transformers adopting UHF technique & the data stored shall provide a historical record of the progress of PD sources and shall identify the areas of maximum activity. PDM system shall be interfacing with UHF PD couplers provided.The PD Monitoring PC Work Station alongwith all accessories shall be considered. Power supply to PDM PC shall have protection against surges, overload and short circuit. A dedicated on-line UPS system shall also be provided as a backup during supply interruption, to ensure trouble-free & reliable running of the PDM System for a minimum of 15 minutes duration.	Lot	1
A19	SUPPLY- GIS : CONTROLLEDSWITCHING DEVICE (CSD)FOR GIS CB	TB9610003401	Controlled switching device (CSD)for GIS CB	1Set= complete for 3-Ph circuit breaker, CSD to be prvided in for CIRCUIT BREAKERS as per single line diagram attached with techincal specification	Set	10
B			**Supply: Mandatory Maintenance Equipment & Monitoring Equipment**	**Mandatory Maintenance Equipment shall be shipped in separate containers, clearly marked with the name of the equipment for which they are intended.**	**Header Item; Unit & Quantity as per B1 to B4 below.**	
B1	SUPPLY- GIS : 400KV, MANDATORY MAINTENANCE EQUIPMENT SUITABLE FOR GIS - SF6 GAS PROCESSING UNIT	TB9614000065	SF6 gas processing unit (Portable)	Complete requirement as per TS section 2: 4.19.00 (Ch 4 : GIS)	No.	1
B2	SUPPLY- GIS : 400KV, MANDATORY MAINTENANCE EQUIPMENT SUITABLE FOR GIS - SF6 GAS LEAKAGE DETECTOR	TB9614001433	SF6 Gas leak detector (Portable)		No.	2
B3	SUPPLY- GIS : MANDATORY MONITORING EQUIPMENTS SUITABLE FOR GIS-DEW POINT METER	TB9610007963	Dew Point Meter		No.	1
B4	SUPPLY- GIS : MANDATORY MONITORING EQUIPMENTS SUITABLE FOR GIS- PORTABLE PD MONITORING SYSTEM	TB9610007972	Portable PD Monitoring System for Gas Insulated Switchgear		No.	1

Annexure A- BOQ for 400kV GIS & its Accessories

Sl. No.	Indent item description	Material Code	Short Item Description	Detailed Description (To be followed for project requirement)	Unit	Qty
C			**Supply- Mandatory Spares for 400kV GIS**		**Header Item; Unit & Quantity as per C1 to C34 below.**	
C1	SPARES- GIS : 400KV, MANDATORY SPARES SUITABLE FOR GIS CIRCUIT BREAKER - TRIP COIL ASSEMBLY WITH RESISTOR, AS APPLICABLE	TB8614001813	Trip Coil assembly with resistor for circuit breaker as applicable	1 Set= 1 nos. of each type	Set	4
C2	SPARES- GIS : 400KV, MANDATORY SPARES SUITABLE FOR GIS CIRCUIT BREAKER - CLOSING COIL ASSEMBLY WITH RESISTOR, AS APPLICABLE	TB8614001825	Closing Coil assembly with resistor for circuit breaker as applicable	1 Set= 1 nos. of each type	Set	4
C3	SPARES- GIS : 400KV, MANDATORY SPARES SUITABLE FOR GIS - RUBBER GASKET, O-RINGS AND SEALS FOR SF6 GAS	TB8614001551	Rubber gaskets, “O” Rings and seals for SF6 gas, including Circuit Breaker, Disconnector and other GIS equipment’s	1 Set=6 nos. of each type	Set	1
C4	SPARES- GIS : 400KV, MANDATORY SPARES SUITABLE FOR GIS CIRCUIT BREAKER - MOTOR FOR CIRCUIT BREAKER OPERATING MECHANISM	TB8614000071	Motor for circuit breaker operating mechanism (If applicable)		No.	2
C5	SPARES- GIS : 400KV, MANDATORY SPARES SUITABLE FOR GIS - VALVE BLOCK WITH DRIVE CYLINDER FOR CIRCUIT BREAKERS	TB8614009876	Valve block with drive cylinder for circuit breakers	1 Set= 1 nos. of each type	Set	2
C6	SPARES- GIS : 400KV, MANDATORY SPARES SUITABLE FOR GIS- MOTOR FOR DISCONNECTORS	TB8614005552	Motor for disconnectors		No.	1
C7	SPARES- GIS : 400KV, MANDATORY SPARES SUITABLE FOR GIS- MOTOR FOR EARTHING SWITCH	TB8614005546	Motor for earthing switch		No.	1
C8	SPARES- GIS : 420KV, MANDATORY SPARES SUITABLE FOR GIS- OPERATING MECHANISM FOR DISCONNECTORS	TB8614005521	Operating mechanism for disconnectors	1 Set= 1 nos. of each type	Set	1
C9	SPARES- GIS : 420KV, MANDATORY SPARES SUITABLE FOR GIS- OPERATING MECHANISM FOR EARTHING SWITCH	TB8614005515	Operating mechanism for earthing switch	1 Set= 1 nos. of each type	Set	1
C10	SPARES- GIS : 400KV, MANDATORY SPARES SUITABLE FOR GIS - SF6 GAS IN NON-RETURNABLE CYLINDERS	TB8614008525	SF6 gas	1 NO.= 1 NO. of 40kG of SF6 Gas cylinder	No.	3
C11	SPARES- GIS : 400KV, MANDATORY SPARES SUITABLE FOR GIS CURRENT TRANSFORMER - COMPLETE CT WITH ENCLOSURE	TB8614003385	Current Transformer- Complete CT, as applicable, with enclosure, as applicable	1 Set= 1 no. of each type & rating	Set	1

Annexure A- BOQ for 400kV GIS & its Accessories

Sl. No.	Indent item description	Material Code	Short Item Description	Detailed Description (To be followed for project requirement)	Unit	Qty
C12	SPARES- GIS : 400KV, MANDATORY SPARES SUITABLE FOR GIS - SF6 TO AIR BUSHING	TB8614003195	SF6 to air bushing for 1 phase enclosure		No.	5
C13	SPARES- GIS : 400KV, MANDATORY SPARES SUITABLE FOR GIS - SPARES FOR LOCAL CONTROL CABINET INCLUDING MCB, FUSES, TIMERS, AUX. RELAY OF EACH TYPE & RATING, TERMINAL OF EACH TYPE.	TB8614001745	Spares for Local control cabinet: MCB, fuses, timers, **Control switch** & Aux Relay of each type & rating, terminals of each type	1 Set= 1 nos. of each type	Set	4
C14	SPARES- GIS : 400KV, MANDATORY SPARES SUITABLE FOR GIS - SF6 GAS PRESSURE RELIEF DEVICE	TB8614001601	SF6 gas pressure Relief Devices	1 Set= 3 nos. of each type	Set	2
C15	SPARES- GIS : 400KV, MANDATORY SPARES SUITABLE FOR GIS - SF6 PRESSURE GAUGE WITH COUPLING DEVICE CUM SWITCH OR DENSITY MONITORS AND PRESSURE SWITCH, AS APPLICABLE	TB8614001611	SF6 Pressure gauge with coupling device cum switch or density monitors and pressure gauge, as applicable	1 Set= 1 nos. of each type	Set	1
C16	SPARES- GIS : 400KV, MANDATORY SPARES SUITABLE FOR GIS - MOLECULAR FILTER FOR SF6 GAS WITH FILTER BAGS	TB8614001561	Molecular filter for SF6 gas with filter bags	1set -20% total quantity of absorber bags used in GIS	Set	1
C17	SPARES- GIS : 400KV, MANDATORY SPARES SUITABLE FOR GIS - COVERS WITH ALL ACCESSORIES NECESSARY TO CLOSE A COMPARTMENT IN CASE OF DISMANTLING OF ANY PART OF THE ENCLOSURE TO ENSURE THE SEALING OF THE COMPARTMENT	TB8614001591	Covers with all accessories necessary to close a compartment in case of dismantling of any part of the Enclosure to ensure the sealing of the compartment for 1 phase enclosure	1 Set= 3 nos. of each type	Set	1
C18	SPARES- GIS : 400KV, MANDATORY SPARES SUITABLE FOR GIS - LOCKING DEVICE TO KEEP DISCONNECTORS AND EARTHING SWITCHES IN CLOSE OR OPEN POSITION IN CASE OF REMOVAL OF THE DRIVING MECHANISM	TB8614001721	Locking device to keep the Dis-connectors and Earthing switches in close or open position in case of removal of the driving mechanism (If applicable)		No.	3
C19	SPARES- GIS : 400KV, MANDATORY SPARES SUITABLE FOR GIS - BUS SUPPORT INSULATOR	TB8614001732	Bus support insulator of each type for single phase enclosure	1 Set= 6 nos. of each type	Set	1
C20	SPARES- GIS : 400KV, MANDATORY SPARES SUITABLE FOR GIS - RELAY OF EACH TYPE & RATING	TB8614009936	Relay of each type & rating	1 no. of each type which is not covered in any other mandatory spare line item shall be supplied under this line item (if applicable)	No.	1
C21	SPARES- GIS : 400KV, MANDATORY SPARES SUITABLE FOR GIS -ALL TYPES OF CORONA SHIELD	TB8614009102	All types of Corona shield	1 Set= 3 nos. of each type	Set	1
C22	SPARES- GIS : 400KV, MANDATORY SPARES SUITABLE FOR GIS CIRCUIT BREAKER - WINDOSCOPE/ OBSERVING WINDOW	TB8614001923	Window scope/ Observing window (if applicable)	1 Set= 3 nos. of each type	Set	1

Annexure A- BOQ for 400kV GIS & its Accessories

Sl. No.	Indent item description	Material Code	Short Item Description	Detailed Description (To be followed for project requirement)	Unit	Qty
C23	SPARES- GIS : 400KV, MANDATORY SPARES SUITABLE FOR GIS CIRCUIT BREAKER - CIRCUIT BREAKER POLE COMPLETE WITH INTERRUPTER, MAIN CIRCUIT, ENCLOSURE AND MARSHALLING BOX WITH OPERATING MECHANISM	TB8614001771	Circuit Breaker:-Complete Circuit Breaker 1 phase pole of each type & rating complete with interrupter, main circuit and enclosure with operating mechanism	1 Set= 1 nos. of each type	Set	1
C24	SPARES- GIS : 400KV, MANDATORY SPARES SUITABLE FOR GIS CIRCUIT BREAKER- RELAYS, POWER CONTACTORS, PUSH BUTTONS, TIMERS & MCBS ETC.	TB8614001865	Relays, Power contactors, push buttons, timers & MCBs etc of each type & rating (If applicable)	1 Set= 1 nos. of each type	Set	1
C25	SPARES- GIS : 400KV, MANDATORY SPARES SUITABLE FOR GIS CIRCUIT BREAKER - CLOSING ASSEMBLY / VALVE, IF APPLICABLE	TB8614001875	Closing assembly/ valve (If applicable)	1 Set= 3 nos. of each type	Set	2
C26	SPARES- GIS : 400KV, MANDATORY SPARES SUITABLE FOR GIS CIRCUIT BREAKER - TRIP ASSEMBLY / VALVE, IF APPLICABLE	TB8614001882	Trip assembly/ valve (If applicable)	1 Set= 3 nos. of each type	Set	2
C27	SPARES- GIS : 400KV, MANDATORY SPARES SUITABLE FOR GIS CIRCUIT BREAKER - RUPTURE DISC	TB8614001914	Rupture disc (If applicable)	1 Set= 3 nos. of each type	Set	1
C28	SPARES- GIS : 400KV, MANDATORY SPARES SUITABLE FOR GIS DISCONNECTOR - COMPLETE SET OF 3 NOS. OF SINGLE PHASE DISCONNECTOR INCLUDING MAIN CIRCUIT, ENCLOSURE AND DRIVING MECHANISM	TB8614009172	Disconnector:-Complete set of 3 nos. of single phase disconnector including main circuit, enclosure and driving mechanism	1 Set= 3 nos. of single phase disconnector including main circuit, enclosure and driving mechanism complete in all respect	Set	1
C29	SPARES- GIS : 400KV, MANDATORY SPARES SUITABLE FOR GIS DISCONNECTOR - HIGH SPEED/ FAST ACTING FAULT MAKING GROUNDING SWITCH, INCLUDING MAIN CIRCUIT, ENCLOSURE AND DRIVING MECHANISM	TB8614007765	High speed/ fast acting fault making grounding switch, 3 nos. of single phase of each rating, including main circuit, enclosure and driving mechanism	1 Set= 3 nos. of single phase of each rating of High speed/ fast acting fault making grounding switch , including main circuit, enclosure and driving mechanism	Set	3
C30	SPARES- GIS : 400KV, MANDATORY SPARES SUITABLE FOR GIS DISCONNECTOR - LIMIT SWITCHES AND AUXILIARY SWITCH FOR DISCONNECTOR	TB8614002123	Limit switches and Aux. switches for complete 3-phase Disconnector		Set	3
C31	SPARES- GIS : 400KV, MANDATORY SPARES SUITABLE FOR GIS DISCONNECTOR - LIMIT SWITCHES AND AUXILIARY SWITCH FOR EARTH SWITCH	TB8614002114	Limit switches and Aux. switches for complete 3-phase earth switch		Set	1

Annexure A- BOQ for 400kV GIS & its Accessories

Sl. No.	Indent item description	Material Code	Short Item Description	Detailed Description (To be followed for project requirement)	Unit	Qty
C32	SPARES- GIS : 400KV, MANDATORY SPARES SUITABLE FOR GIS DISCONNECTOR - LIMIT SWITCHES AND AUXILIARY SWITCH - FOR FAST EARTHING SWITCH	TB8614003312	Limit switches and Aux. switches for complete 3-phase High speed earth switch		Set	1
C33	SPARES- GIS : 400KV, MANDATORY SPARES SUITABLE FOR GIS VOLTAGE TRANSFORMER - GIS VOLTAGE TRANSFORMER WITH ENCLOSURE	TB8614008681	Gas Insulated complete Voltage Transformer with enclosure.		No.	1
C34	SPARES- GIS : 400KV, MANDATORY SPARES SUITABLE FOR GIS - SF6 GAS INSULATED SURGE ARRESTER WITH ENCLOSURE	TB8614007923	SF6 Gas Insulated Surge Arrestor with enclosure (each type)		No.	1
D			**Services- 400kV GIS- Supervision of Erection, Testing & Commissioning and handing over to Customer**	**These activities shall be carried out at site in stages as per front availability at site, and hence multiple visits for completion of work are envisaged.**	**Header Item; Unit & Quantity as per D1 to D13 below.**	
D1	SERVICES- GIS : 400KV, SITE VISIT FOR SUPERVISION OF UNLOADING & VERIFICATION OF MATERIALS FOR PROPER STORAGE & UP-KEEPING AT SITE	TB3614002781	Site visit for supervision of unloading & verification of 400kV GIS materials for proper storage and up-keeping at site	Site visit for supervision of unloading & verification of materials for proper storage and up-keeping at site includes following activities but not limited to, (a) Supervision of safe unloading of GIS & its accessories at site. (b) Reconcililation, storage & upkeeping of materials, with due instructions/ training to site persons for long storage.	Lot	1
D2	SERVICES- GIS : 420KV, SUPERVISION OF ERECTION OF GIS BAYS INCLUDING LCC	TB3614007076	Supervision of erection of 400kV GIS bays including LCC	Supervision of complete GIS bays along with all bay equipment such as GIS extension module, GIS bus extension module, voltage transformer, Surge Arrester, LCC including structure, cabling, earthing & other associated activities shall be included in the scope. Consumables required for successful erection is included in bidder's scope. Payment shall be made on actual measurement basis, if required.	No	12
D3	SERVICES- GIS : 400KV, SUPERVISION OF ERECTION OF GAS INSULATED BUS DUCT	TB3614005684	Supervision of erection of 400kV Gas insulated bus duct	Supervision of erection of GIS- gas insulated bus duct including support structure, earthing & other associated activities shall be included in the scope. The GIBus duct quantity will be calculated from the end of the GIS module and shall include both the indoor and outdoor GIB. Consumables required for successful erection is included in bidder's scope. Payment shall be made on actual measurement basis, if required.	Mtr	900
D4	SERVICES- GIS : 400KV, SUPERVISION OF ERECTION OF SF6 TO AIR BUSHING	TB3614005696	Supervision of erection of 400kV SF6 to air bushing/ connection	Supervision of erection of SF6 to Air bushing including support structure, earthing & other associated activities shall be included in the scope. Consumables required for successful erection is included in bidder's scope. Payment shall be made on actual measurement basis, if required.	No	15
D5	SERVICES- GIS : 400KV, SUPERVISION OF ERECTION OF SF6 TO OIL DIRECT TRANSFORMER CONNECTOR	TB3614005501	Supervision of erection of 400kV SF6 to Oil direct transformer connector	Supervision of erection of SF6 to Oil direct transformer connector including support structure, earthing & other associated activities shall be included in the scope. Consumables required for successful erection is included in bidder's scope.	No	6
D6	SERVICES- GIS : 420KV, TESTING & COMMISSIONING OF GIS BAYS INCLUDING LCC	TB3614007082	Testing & commissioning of 400kV GIS bays including LCC	Testing & commissioning of complete GIS bays including other associated activities in line with site acceptance testing as per customer approved SAT procedure shall be in bidder's scope. Consumables required for successful commissioning is included in bidder's scope. Payment shall be made on prorata basis, if required.	No	12
D7	SERVICES- GIS : 400KV, TESTING & COMMISSIONING OF GAS INSULATED BUS DUCT	TB3614005664	Testing & commissioning of 400kV GIS Gas insulated bus duct	Testing & commissioning of GIS- gas insulated bus duct including support structure, earthing & other associated activities shall be included in the scope. Consumables required for successful commissioning is included in bidder's scope. Payment shall be made on actual measurement basis, if required.	Mtr	900
D8	SERVICES- GIS : 400KV, TESTING & COMMISSIONING OF GIS- FOR SF6 TO AIR BUSHING	TB3614002902	Testing & commissioning of 400kV SF6 to air bushing/ connection	Testing & commissioning of SF6 to Air Bushing including support structure, earthing & other associated activities shall be included in the scope. Payment shall be made on actual measurement basis, if required.	No	15

Annexure A- BOQ for 400kV GIS & its Accessories

Sl. No.	Indent item description	Material Code	Short Item Description	Detailed Description (To be followed for project requirement)	Unit	Qty
D9	SERVICES- GIS : 400KV, TESTING & COMMISSIONING OF SF6 TO OIL DIRECT TRANSFORMER CONNECTOR	TB3614005495	Testing & commissioning of 400kV SF6 to Oil direct transformer connector	Testing & commissioning of SF6 to Oil direct transformer connector including support structure, earthing & other associated activities shall be included in the scope. Consumables required for successful erection is included in bidder's scope. Payment shall be made on actual measurement basis, if required.	No	6
D10	SERVICES- GIS : 400KV, FINAL SUCCESSFUL HV/ POWER FREQUENCY TESTING OF GIS INCLUDING ARRANGING OF HV TEST KIT ALONG WITH OPERATOR	TB3614002911	Final Successful High Voltage/ Power Frequency Testing of complete 400kV GIS	Carrying out successful HV/ Power Frequency Testing of complete (all bays) GIS as per IEC including **one time** arrangement of HV Test kit (on returnable basis) shall be in scope of bidder, which includes charges of HV test kit with operator, accessories & tools required for completion of HV testing. No delay shall be permitted on account of the non availability of the HV test kit. Payment shall be made on the basis site certification. Bays may be commissioned separately. In case the HV testing of any bay is not completed due to reasons not attributed to bidder, the HV testing kit mobilization and demobilization shall be covered under separate unit ref. item of this BOQ. However, the payment of Successful High Voltage/ Power Frequency Testing of of balance bays in such a scenario, shall be done on prorata basis i.e. total cost quoted for complete GIS Lot/ total no. of bays.	Lot	1
D11	SERVICES- GIS : 400KV, INSULATION CO-ORDINATION STUDIES FOR GIS SYSTEM	TB3614002926	Insulation Co-ordination including VFTO Studies for 400kV GIS System	Bidder shall conduct insulation co-ordination studiy in line with IEC 600071-2006.and any other technical requirement for successful operation of GIS. In case of non availability of exact input details, same shall be done be done on basis of standard inputs available and shall be revised, if required after availability of exact input details. Payment shall be made on the basis engineering certification.	Lot	1
D12	SERVICES- GIS : 400KV, FINAL DOCUMENTATION	TB3614002932	Final Documentation of 400kV GIS	Final Documentation including As Bulit Drawing/ Document, Site Testing Reports/ Protocols, Handing over proptcols along with manuals shall be submitted etc. by bidder. Payment shall be made on the basis engineering certification.	Lot	1
D13	SERVICES- GIS : 400KV, ERECTION, TESTING & COMMISSIONING OF COMPLETE ONLINE CONTINUOUS PD MONITORING SYSTEM (PDM) FOR 400KV GIS	TB3614009161	Erection, testing & commissioning of Online continuous Partial Discharge Monitoring System (PDM) for 400kV GIS	Supervision of erection, testing & commissioning of Online continuous Partial Discharge Monitoring System (PDM) for 400kV GIS including interfacing with SAS & other associated activities shall be included in the scope. Consumables required for successful erection is included in bidder's scope. Payment shall be made on actual measurement basis, if required. These activities shall be carried out at site in stages as per front availability at site, and hence multiple visits for completion of work are envisaged.	Lot	1
E			**Service- Training for 400kV GIS**		**Header Item; Unit & Quantity as per E1 to E3 below.**	
E1	SERVICES- GIS : 400KV, TRAINING FOR GIS AT SITE	TB3614003731	400kV GIS Training at site for customer & BHEL engineer for a period of at least 5 working days	400kV GIS Training at site for customer & BHEL engineer for a period of at least 5 working days (excluding all intervening holidays)	Mandays	25
E2	SERVICES- GIS : 400KV, TRAINING FOR GIS AT MANUFACTURER'S WORKS	TB3614003724	400kV GIS Training at Manufacturer's works for customer (HPGCL) engineer for a period of at least 5 working days	400kV GIS Training at Manufacturer's works for customer (HPGCL) engineer for a period of at least 5 working days (excluding all intervening holidays) the lodging and boarding of the Owner's personnel (HPGCL) shall be at the cost of Bidder. The Bidder shall make all necessary arrangements towards the same. To & fro travelling charges for HPGCL personnel shall not be borne by bidder.	Mandays	15
E3	SERVICES- GIS : TRAINING FOR GIS TO BHEL ENGINEERS	TB3610007942	400kV GIS Training at Manufacturer's works for BHEL engineer for a period of at least 5 working days	400kV GIS Training at Manufacturer's works for BHEL engineer for a period of at least 5 working days (excluding all intervening holidays) To & fro travelling charges, Lodging and boarding charges for BHEL personnel shall not be borne by bidder.	Mandays	10
F			**Supply- Unit reference price of 400kV GIS part item/ equipment**	**GIS part item/ equipment shall be required for supply as a mandatory spares or any addition/ deletion of equipment, due to damage, theft, additional requirement by customer during detailed engineering or later stage. It is to be ensured by bidder that unit prices have a logical relationship with prices of assemblies in main items (Bay, Busbar etc). The reference prices shall be used for breakup rates, if required at any stage. The reference prices shall be considered for evaluation.**	**Header Item; Unit & Quantity as per F1 to F28 below.**	

Annexure A- BOQ for 400kV GIS & its Accessories

Sl. No.	Indent item description	Material Code	Short Item Description	Detailed Description (To be followed for project requirement)	Unit	Qty
F1	SUPPLY- GIS : 400KV, REF UNIT PRICE ITEM :CIRCUIT BREAKER (1 POLE COMPLETE WITH ENCLOSURE WITHOUT OPERATING MECHANISM)	TB9614008576	400kV, 2000A Circuit breaker complete with enclosure without operating mechanism	1 set= 1 no. of 400kV, 2000A Circuit breaker, 1 pole complete with enclosure without operating mechanism	Set	1
F2	SUPPLY- GIS : 400KV, REF UNIT PRICE ITEM : DISCONNECTOR WITHOUT OPERATING MECHANISM	TB9614007822	400kV, 2000A Disconnector without operating mechanism	1 set= 1 no. of 400kV, 2000A Isolator (3 pole) complete with enclosure without operating mechanism	Set	1
F3	SUPPLY- GIS : REF UNIT PRICE ITEM : 400 KV MAINTENANCE EARTHING SWITCH WITHOUT OPERATING MECHANISM	TB9610007816	400 kV Maintenance Earthing switch without operating mechanism	1 set= 1 no. of 400 kV Maintenance Earthing switch (3 pole) with enclosure without operating mechanism	Set	1
F4	SUPPLY- GIS : REF UNIT PRICE ITEM : 400KV HIGH SPEED EARTH SWITCH WITHOUT OPERATING MECHANISM	TB9610007802	400kV High speed earth switch/ High speed make proof grounding switch without operating mechanism	1 set= 1 no. of 400kV High speed earth switch (3 pole) with enclosure without operating mechanism	Set	1
F5	SUPPLY- GIS : REF. UNIT PRICE OF GIS INDIVIDUAL ITEM/ EQUIPMENT - SURGE ARRESTOR INCLUDING SURGE COUNTER	TB9610002553	Surge Arrestor including Surge Counter	Surge Arrester with enclosure and surge counte/ monitor. Rated arrester voltage may be changed after insulation coordination study. Rated arrester voltage considered is 336kV.	Set	1
F6	SUPPLY- GIS : REF UNIT PRICE ITEM : 400KV CURRENT TRANSFORMER OF PS CLASS	TB9610006255	400kV Current transformer of Class PS	400kV Current transformer (1 pole) of Class PS (1 No. of each type) Without enclosure (Individual prices to be furnished).	Set	1
F7	SUPPLY- GIS : REF UNIT PRICE ITEM : 400KV CURRENT TRANSFORMER OF 0.2S CLASS	TB9610007795	400kV Current transformer of Class 0.2s	400kV Current transformer (1 pole) of Class 0.2s (1 No. of each type) Without enclosure (Individual prices to be furnished).	Set	1
F8	SUPPLY- GIS : REF UNIT PRICE ITEM : 400KV VOLTAGE TRANSFORMER	TB9610006262	400kV Voltage transformer	400kV Voltage transformer (1 pole) (1 no. of each type) Without enclosure (Individual prices to be furnished).	Set	1
F9	SUPPLY- GIS : REF. UNIT PRICE OF GIS INDIVIDUAL ITEM/ EQUIPMENT - OPERATING MECHANISM FOR CIRCUIT BREAKER	TB9610002591	Operating Mechanism box for 400kV, 2000 A Circuit Breaker	1 set= 1 no. of Operating Mechanism box for 400kV, 2000 A Circuit Breaker	Set	1
F10	SUPPLY- GIS : 400KV, REF UNIT PRICE ITEM : OPERATING MECHANISM BOX FOR DISCONNECTOR (400KV)	TB9614006285	Operating Mechanism box for 400kV, 2000 A Disconnector	1 set= 1 no. of Operating Mechanism box for 400kV, 2000 A Isolator	Set	1
F11	SUPPLY- GIS : REF UNIT PRICE ITEM :OPERATING MECHANISM FOR MAINTENANCE EARTHING SWITCH (400KV)	TB9610007783	Operating mechanism for 400kV, Maintenance Earthing Switch	1 set= 1 no. of Operating mechanism for 400kV, Maintenance Earthing Switch	Set	1
F12	SUPPLY- GIS : REF. UNIT PRICE ITEM- OPERATING MECHANISM FOR HIGH SPEED EARTHING SWITCH (400KV)	TB9610002546	Operating Mechanism for 400kV, High Speed Earthing Switch	1 set= 1 no. of Operating Mechanism for 400kV, High Speed Earthing Switch	Set	1
F13	SUPPLY- GIS : 420KV, REF. UNIT PRICE OF GIS INDIVIDUAL ITEM/ EQUIPMENT - 1 PHASE BUS BAR CONDUCTOR	TB9614007315	400kV, 1 Phase bus bar conductor		Mtr	1

Annexure A- BOQ for 400kV GIS & its Accessories

Sl. No.	Indent item description	Material Code	Short Item Description	Detailed Description (To be followed for project requirement)	Unit	Qty
F14	SUPPLY- GIS : 420KV, REF. UNIT PRICE OF GIS INDIVIDUAL ITEM/ EQUIPMENT - 1-PHASE GIS METALLIC ENCLOSURE FOR BUS BAR/ ANY EQUIPMENT	TB9614007623	400kV, 1 phase GIS metalic enclosure for bus bar/ any eqipment		Mtr	1
F15	SUPPLY- GIS : 420KV, REF. UNIT PRICE OF GIS INDIVIDUAL ITEM/ EQUIPMENT - 1-PHASE CONDUCTOR FOR BUS DUCT	TB9614007616	400kV, 1 Phase conductor for bus duct		Mtr	1
F16	SUPPLY- GIS : 420KV, REF. UNIT PRICE OF GIS INDIVIDUAL ITEM/ EQUIPMENT - 1-PHASE GIS METALLIC ENCLOSURE FOR BUS DUCT	TB9614007605	400kV, 1 phase GIS metalic enclosure for bus duct		Mtr	1
F17	SUPPLY- GIS : 420KV, REF. UNIT PRICE OF GIS INDIVIDUAL ITEM/ EQUIPMENT - GAS PERMEABLE/ COMMUNICATION INSULATOR	TB9614002666	Gas permeable/ communication/ barrier type Insulator	1 Set= 1 No of each rating and type	Set	1
F18	SUPPLY- GIS : 420KV, REF. UNIT PRICE OF GIS INDIVIDUAL ITEM/ EQUIPMENT - GAS NON- PERMEABLE/ NON - COMMUNICATION/ NON-BARRIER TYPE INSULATOR	TB9614007593	Gas non- permeable/ non - communication/ non-barrier type Insulator	1 Set= 1 No of each rating and type	Set	1
F19	SUPPLY- GIS : REF UNIT PRICE ITEM : PD SENSOR(UHF TYPE)	TB9610006384	UHF PD sensors	1 Set= 1 No of each rating and type	Set	1
F20	SUPPLY- GIS : 400KV, REF UNIT PRICE ITEM : PRESSURE/ DENSITY MONITOR DEVICE & SWITCH	TB9614008491	Pressure/ density monitor monitor device & Switch	1 Set= 1 No of each rating and type	Set	1
F21	SUPPLY- GIS : 400KV, REF. UNIT PRICE OF GIS INDIVIDUAL ITEM/ EQUIPMENT - PRESSURE RELIEF DEVICE	TB9614007293	Pressure relief device	1 Set= 1 No of type	Set	1
F22	SUPPLY- GIS : 400KV, REF. UNIT PRICE OF GIS INDIVIDUAL ITEM/ EQUIPMENT- RUPTURE DISC	TB9614002715	Rupture disc	1 Set= 1 No of type	Set	1
F23	SUPPLY- GIS : REF. UNIT PRICE OF GIS INDIVIDUAL ITEM/ EQUIPMENT - ELBOWS/ BEND/ CROSS AND T SECTION	TB9610002683	Elbow/ bend/ cross and T section	1 Set= 1 No of type	Set	1
F24	SUPPLY- GIS : REF. UNIT PRICE OF GIS INDIVIDUAL ITEM/ EQUIPMENT- EXPANSION JOINTS	TB9610002691	Expansion joint	1 Set= 1 No of type	Set	1
F25	SUPPLY- GIS : REF. UNIT PRICE OF GIS INDIVIDUAL ITEM/ EQUIPMENT- FLEXIBLE CONNECTIONS	TB9610002704	Flexible connection for conductor	1 Set= 1 No of type	Set	1
F26	SUPPLY- GIS : REF. UNIT PRICE OF GIS INDIVIDUAL ITEM/ EQUIPMENT - GAS SEALS	TB9610007245	Gas seals	1 Set= 1 No of type	Set	1

Annexure A- BOQ for 400kV GIS & its Accessories

Sl. No.	Indent item description	Material Code	Short Item Description	Detailed Description (To be followed for project requirement)	Unit	Qty
F28	SUPPLY- GIS : 400KV, REF UNIT PRICE ITEM : ENCLOSURE FOR LOCAL CONTROL CUBICLES (LCC)	TB9614009224	Enclosure for LCC Panel		No.	1
G			**Service- Unit reference price of GIS service item**	**Reference unit prices for service of Individual Item/ Equipment for any addition/ deletion of equipment, due to damage, theft, additional requirement by customer, any other reasons not attributable to vendor during detailed engineering/ contract execution. The reference prices shall be considered for evaluation.**	**Header Item; Unit & Quantity as per G1 to G5 below.**	
G1	SERVICES- GIS : REF. UNIT PRICE OF GIS INDIVIDUAL ITEM/ EQUIPMENT - SERVICES FOR SUPERVISION OF ERECTION OF GIS	TB3610002745	Services of supervision for Erection of 400kV GIS	Charges for repetition of services - (if required due to reasons not attributed to the bidder) This item will be executed only if repetition of services is required by BHEL.	Manday	10
G2	SERVICES- GIS : REF. UNIT PRICE OF GIS INDIVIDUAL ITEM/ EQUIPMENT - SERVICES FOR TESTING & COMMISSIONING OF GIS	TB3610002752	Services of Testing & Commissioning of 400kV GIS	Charges for repetition of services - (if required due to reasons not attributed to the bidder) This item will be executed only if repetition of services is required by BHEL.	Manday	10
G3	SERVICES- GIS : 400KV, REF UNIT PRICE ITEM :DEMOBILIZATION & REMOBILIZATION CHARGES FOR GIS ERECTION SUPERVISION TEAM	TB3614009113	Demobilization & remobilization charges for GIS erection supervision team	This BOQ item shall be payable if required for reasons not attributable to bidder.	Set	2
G4	SERVICES- GIS : 400KV, REF UNIT PRICE ITEM :DEMOBILIZATION & REMOBILIZATION CHARGES FOR GIS TESTING & COMMISSIONING TEAM	TB3614009123	Demobilization & remobilization charges for GIS testing & commissioning team	This BOQ item shall be payable if required for reasons not attributable to bidder. Hv testing is not part of this item.	Set	2
G5	SERVICES- GIS : 400KV, REF UNIT PRICE ITEM :DEMOBILIZATION & REMOBILIZATION CHARGES HV TEST KIT ALONG WITH OPERATOR	TB3614009133	Demobilization & remobilization charges HV Test Kit along with operator	In this BOQ item, mobilization and demobilization chages for HV test kit is considered for second time or more, for reasons not attributable to bidder. HV testing charges are not included in this line item and the same may be referred from the main line item of supervision of ETC services of this BOQ.	Lot	1

Annexure B- Details for Technical Clearance for Manufacturing

PROJECT NAME 400kV GIS Switchyard at 1X800 MW SUPER CRITICAL EXPANSION UNIT DEEN BANDHU CHHOTU RAM THERMAL POWER PLANT YAMUNA NAGAR

CUSTOMER M/s HARYANA POWER GENERATION CORPORATION LIMITED

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

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

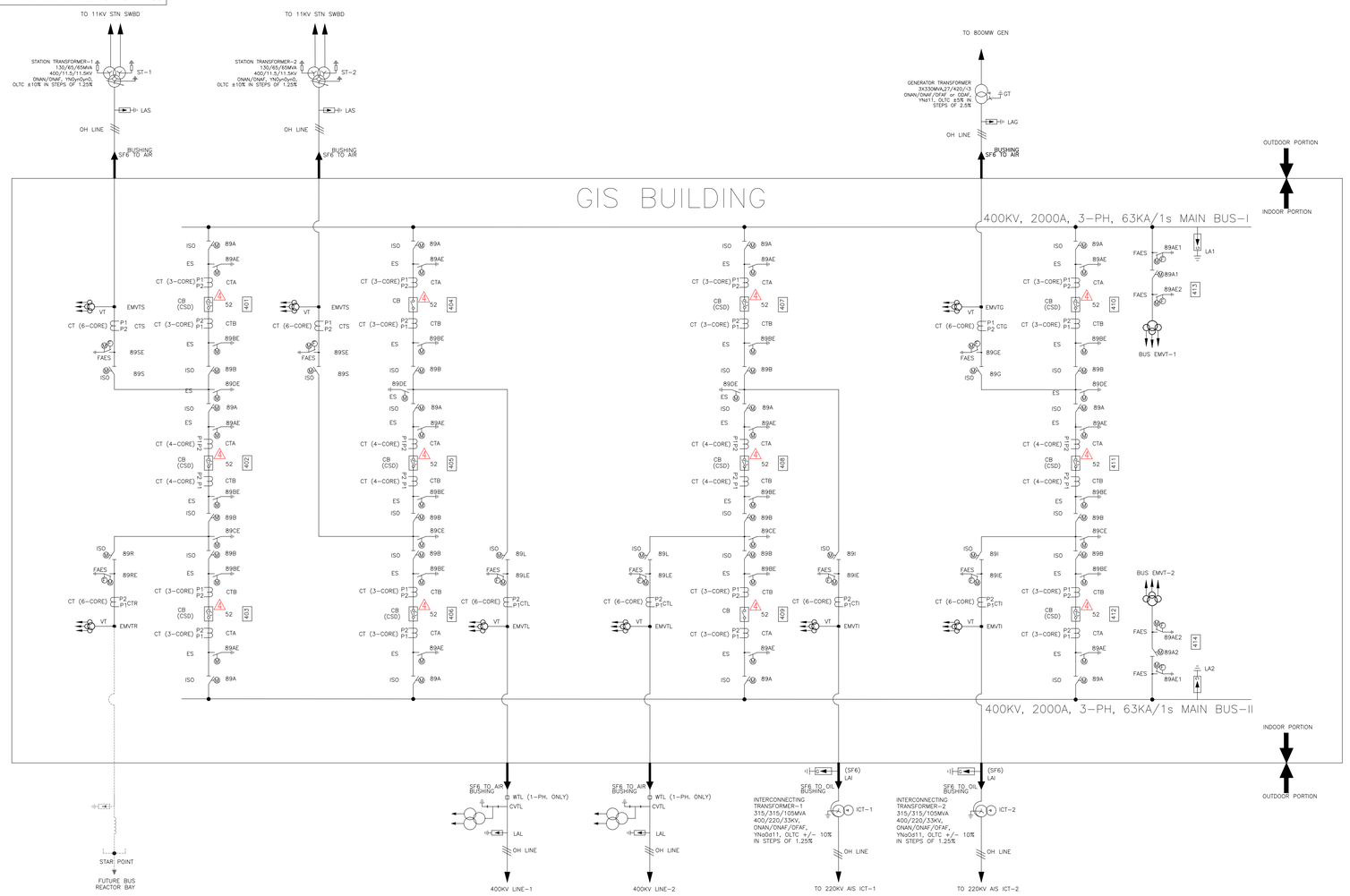
Notes:

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

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

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

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



BILL OF QUANTITY:

S.No.	KV	DESCRIPTION	SYMBOLS	QTY (NO.)	SCOPE OF SUPPLY
1.	400	CIRCUIT BREAKER, 2000 A (3-Ph)		02	BHEL
2.	400	CIRCUIT BREAKER, 2000 A (3-Ph) WITH CSD		10	BHEL
3.	400	ISOLATOR, 2000 A (3-Ph), MOTORISED		34	BHEL
4.	400	EARTH SWITCH, 2000A (3-Ph), MOTORISED		32	BHEL
5.	400	FAST ACTING EARTHSWITCH, 2000A (3-Ph), MOTORISED		12	BHEL
6.	400	6-CORE, CURRENT TRANSFORMER, 3000A (1-Ph) (1 METERING, 5 PROTECTION)		24	BHEL
7.	400	4-CORE, CURRENT TRANSFORMER, 3000A (1-Ph) (1 METERING, 3 PROTECTION)		24	BHEL
8.	400	3-CORE, CURRENT TRANSFORMER, 3000A (1-Ph) (1 METERING, 2 PROTECTION)		24	BHEL
9.	400	3-CORE, CURRENT TRANSFORMER, 3000A (1-Ph) (3 PROTECTION)		24	BHEL
10.	400	3-CORE, BUS EMVT (1-Ph)		06	BHEL
11.	400	3-CORE, EMVT FOR GT, ST, ICT, BR, LINE (1-Ph)		24	BHEL
12.	400	SURGE ARRESTOR, 336kV, 20kA (1-Ph)		15	BHEL
13.	400	SURGE ARRESTOR, 336kV, 20kA (1-Ph)-GIS		12	BHEL
14.	400	SF6 TO AIR BUSHING (1-Ph)		15	BHEL
15.	400	SF6 TO OIL BUSHING (1-Ph)		06	BHEL
16.	400	4400 pF LINE CVT (1-Ph)		06	BHEL
17.	400	WAVE TRAP (1-Ph)		02	BHEL

- OUTDOOR GIB UPTO SF6 TO AIR/SF6 TO OIL BUSHING

SYSTEM DATA:

1	SYSTEM VOLTAGE	400KV
2	HIGHEST SYSTEM VOLTAGE	420KV
3	NO OF PHASE	3
4	FREQUENCY	50Hz
5	ONE MINUTE POWER FREQUENCY WITHSTAND VOLTAGE	630kV (r.m.s)
6	LIGHTNING WITHSTAND VOLTAGE	1425 KVP
7	SWITCHING IMPULSE VOLTAGE	1050 KVP
8	SHORT CIRCUIT LEVEL	63kA FOR 1 SEC
9	CREEPAGE DISTANCE	31 mm/kV
10	TYPE OF EARTHING	SOLIDLY GROUNDED
11	LA	336kV
12	CIRCUIT BREAKER RATING	2000A
13	ISOLATOR RATING	2000A
14	BUSBAR RATING	2000A
15	TRANSFORMER BAY RATING	2000A
16	TIE BAY RATING	2000A
17	EARTHSWITCH RATING	2000A

Released for manufacture / fabrication / construction
duly approved under Category.....A*.....vide HPGCL
Memo. No.Ch-110/CE/P/M-m/DCR/03 dated 08.05.2026
subject to incorporation of comments / remarks, if any as mentioned therein. The approval / comments on this drawing / document neither relieves M/s BHEL of its sole contractual obligations in carrying out the design & engineering works correctly and fulfilling the complete requirement of contract nor does it limit the HPGCL's right under the contract.
Chief Engineer/Projects
HPGCL, Panchkula
SE/Projects (Mech.)
* Document to be updated, if required, as per approved CT & ST sizing calculations

400kV, 2000A, 63kA/1s CT DETAILS (6-CORE)

CORE	RATIO	MAX. EXCITING (mA) CURRENT AT Vk	KNEE POINT VOLTAGE (Vk)	ACCURACY	OUTPUT BURDEN (VA)	RCT (Ω)
1	2000-1000-500/1A	20 ON 2000/1 TAP 30 ON 1000/1 TAP 60 ON 500/1 TAP	2000/1000/500V	PS	--	20/10/5
2	2000-1000-500/1A	20 ON 2000/1 TAP 30 ON 1000/1 TAP 60 ON 500/1 TAP	2000/1000/500V	PS	--	20/10/5
3	2000-1000-500/1A	20 ON 2000/1 TAP 30 ON 1000/1 TAP 60 ON 500/1 TAP	2000/1000/500V	PS	--	20/10/5
4	2000-1000-500/1A	--	--	0.2PS	20	--
5	2000-1000-500/1A	20 ON 4000/1 TAP 30 ON 2000/1 TAP 60 ON 1000/1 TAP	4000/2000/1000V	PS	--	20/10/5
6	2000-1000-500/1A	20 ON 4000/1 TAP 30 ON 2000/1 TAP 60 ON 1000/1 TAP	4000/2000/1000V	PS	--	20/10/5

400kV, 2000A, 63kA/1s CT DETAILS (4-CORE)

CORE	RATIO	MAX. EXCITING (mA) CURRENT AT Vk	KNEE POINT VOLTAGE (Vk)	ACCURACY	OUTPUT BURDEN (VA)	RCT (Ω)
1	2000-1000-500/1A	20 ON 2000/1 TAP 30 ON 1000/1 TAP 60 ON 500/1 TAP	2000/1000/500V	PS	--	20/10/5
2	2000-1000-500/1A	20 ON 2000/1 TAP 30 ON 1000/1 TAP 60 ON 500/1 TAP	2000/1000/500V	PS	--	20/10/5
3	2000-1000-500/1A	20 ON 2000/1 TAP 30 ON 1000/1 TAP 60 ON 500/1 TAP	2000/1000/500V	PS		20/10/5
4	2000-1000-500/1A	--	--	0.2PS	20	--

400kV, 2000A, 63kA/1s CT DETAILS (3-CORE), TIE SIDE

CORE	RATIO	MAX. EXCITING (mA) CURRENT AT Vk	KNEE POINT VOLTAGE (Vk)	ACCURACY	OUTPUT BURDEN (VA)	RCT (Ω)
1	2000-1000-500/1A	20 ON 2000/1 TAP 30 ON 1000/1 TAP 60 ON 500/1 TAP	2000/1000/500V	PS		20/10/5
2	2000-1000-500/1A	20 ON 2000/1 TAP 30 ON 1000/1 TAP 60 ON 500/1 TAP	2000/1000/500V	PS	--	20/10/5
3	2000-1000-500/1A	--	--	0.2PS	20	--

400kV, 2000A, 63kA/1s CT DETAILS (3-CORE), BUS SIDE

CORE	RATIO	MAX. EXCITING (mA) CURRENT AT Vk	KNEE POINT VOLTAGE (Vk)	ACCURACY	OUTPUT BURDEN (VA)	RCT (Ω)
1	2000-1000-500/1A	20 ON 2000/1 TAP 30 ON 1000/1 TAP 60 ON 500/1 TAP	2000/1000/500V	PS		20/10/5
2	2000-1000-500/1A	20 ON 2000/1 TAP 30 ON 1000/1 TAP 60 ON 500/1 TAP	2000/1000/500V	PS	--	20/10/5
3	2000-1000-500/1A	20 ON 2000/1 TAP 30 ON 1000/1 TAP 60 ON 500/1 TAP	2000/1000/500V	PS		20/10/5

400kV CVT DETAILS, 4400 pF ,(+10% ,-5%)

CORE	VOLTAGE RATIO	ACCURACY CLASS	OUTPUT BURDEN (VA)
1	$\frac{400kV}{\sqrt{3}} / \frac{110V}{\sqrt{3}}$	0.2	20
2	$\frac{400kV}{\sqrt{3}} / \frac{110V}{\sqrt{3}}$	0.2	20

400kV EMVT FOR BUS, GT, ST, ICT, BR, LINE

CORE	VOLTAGE RATIO	ACCURACY CLASS	OUTPUT BURDEN (VA)
1	$\frac{400kV}{\sqrt{3}} / \frac{110V}{\sqrt{3}}$	3P	75
2	$\frac{400kV}{\sqrt{3}} / \frac{110V}{\sqrt{3}}$	3P	75
3	$\frac{400kV}{\sqrt{3}} / \frac{110V}{\sqrt{3}}$	0.2	75

NOTES:

1. CT-VT PARAMETER SHOWN IN SLD ARE TENTATIVE AND SUBJECT TO CHANGE AS PER KEY PROTECTION SLD & CT-VT SIZING CALCULATION.
2. FUTURE REACTOR BAY SCOPE IS GIS EQUIPMENT WITHIN GIS BUILDING ONLY (AS PER CORRIGENDUM-5, ANNEXURE-9, SL. NO. 2).

REV.	DATE	ALTD	CHD	APPD	REV.	DATE	ALTD	CHD	APPD	REV.	DATE	ALTD	CHD	APPD	REV.	DATE	ALTD	CHD	APPD
04	10.04.2026	SY	SS	SKS	03	03.02.2026	SY	SS	SKS	02	06.12.2024	SY	SS	SKS	01	13.08.2024	SY	SS	SKS
	REVISED AS PER TB-428-316-001-CLAR-REV 03					REVISED AS PER TB-428-316-001-CLAR-REV 02					REVISED AS PER COMMENTS DATED 20.09.2024					REVISED AS PER COMMENTS DATED 14.06.2024			

JOB NO.	510
STATUS	CONTRACT
DISTRIBUTION	

PROJECT: 1X800 MW ULTRA SUPER CRITICAL EXPANSION UNIT, DEEN BANDHU CHHOTU RAM THERMAL POWER PLANT, YAMUNA NAGAR

OWNER: HARYANA POWER GENERATION CORPORATION LTD.

OWNER'S CONSULTANT: DESEIN PRIVATE LIMITED, CONSULTING ENGINEERS, NEW DELHI

OWNER'S REVIEW CONSULTANT: DEVELOPMENT CONSULTANTS PVT. LTD., CONSULTING ENGINEERS, KOLKATA

EPC CONTRACTOR: BHARAT HEAVY ELECTRICALS LTD, NEW DELHI

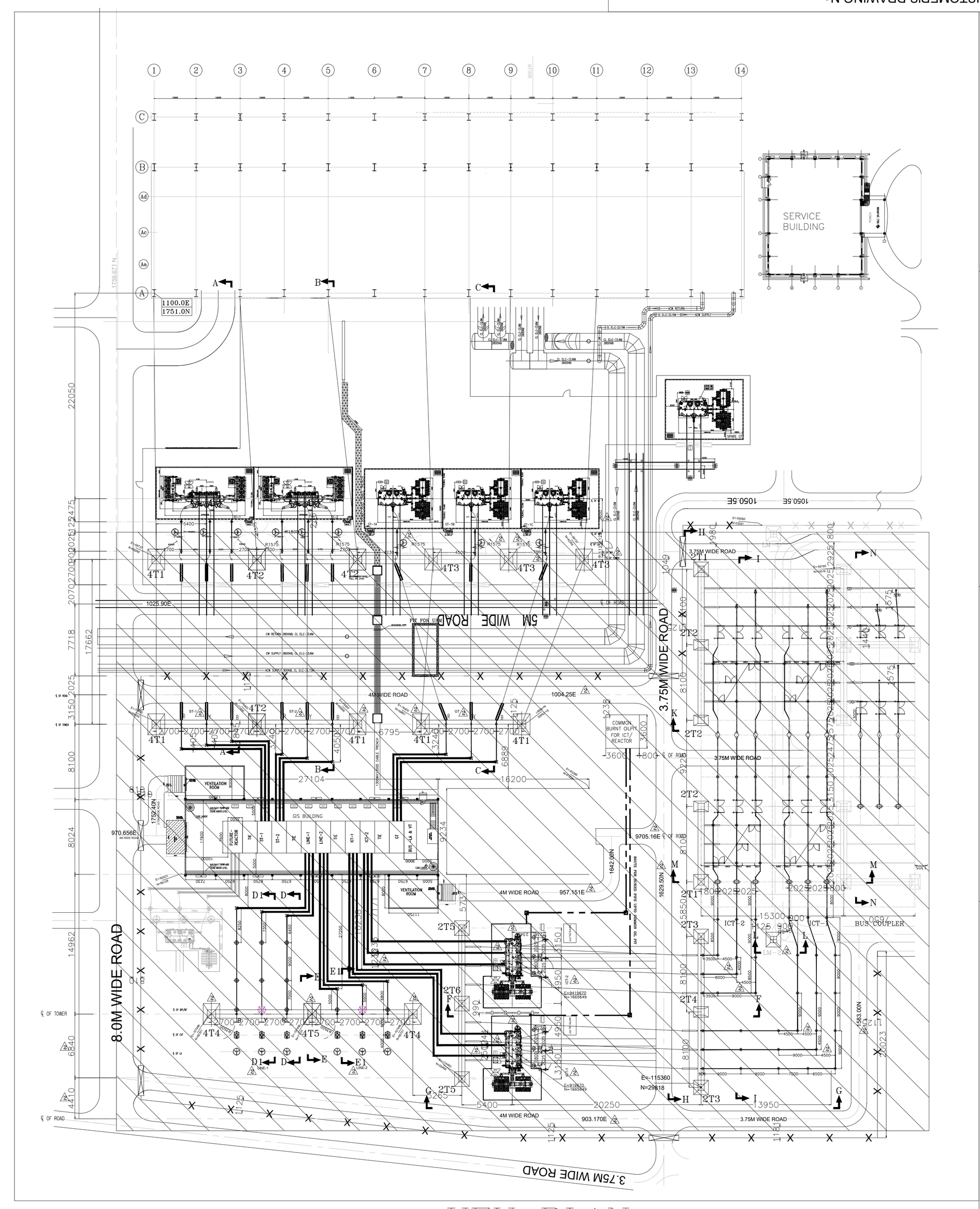
BHEL UNIT: BHARAT HEAVY ELECTRICALS LTD, POWER SECTOR TRANSMISSION BUSINESS GROUP, NOIDA

DEPT CODE		NAME	SIGN	DATE
E	DRN	SY	-SGD-	22.05.24
	DESN	SS	-SGD-	22.05.24
	CHD	SS	-SGD-	22.05.24
	APPD	SKS	-SGD-	22.05.24

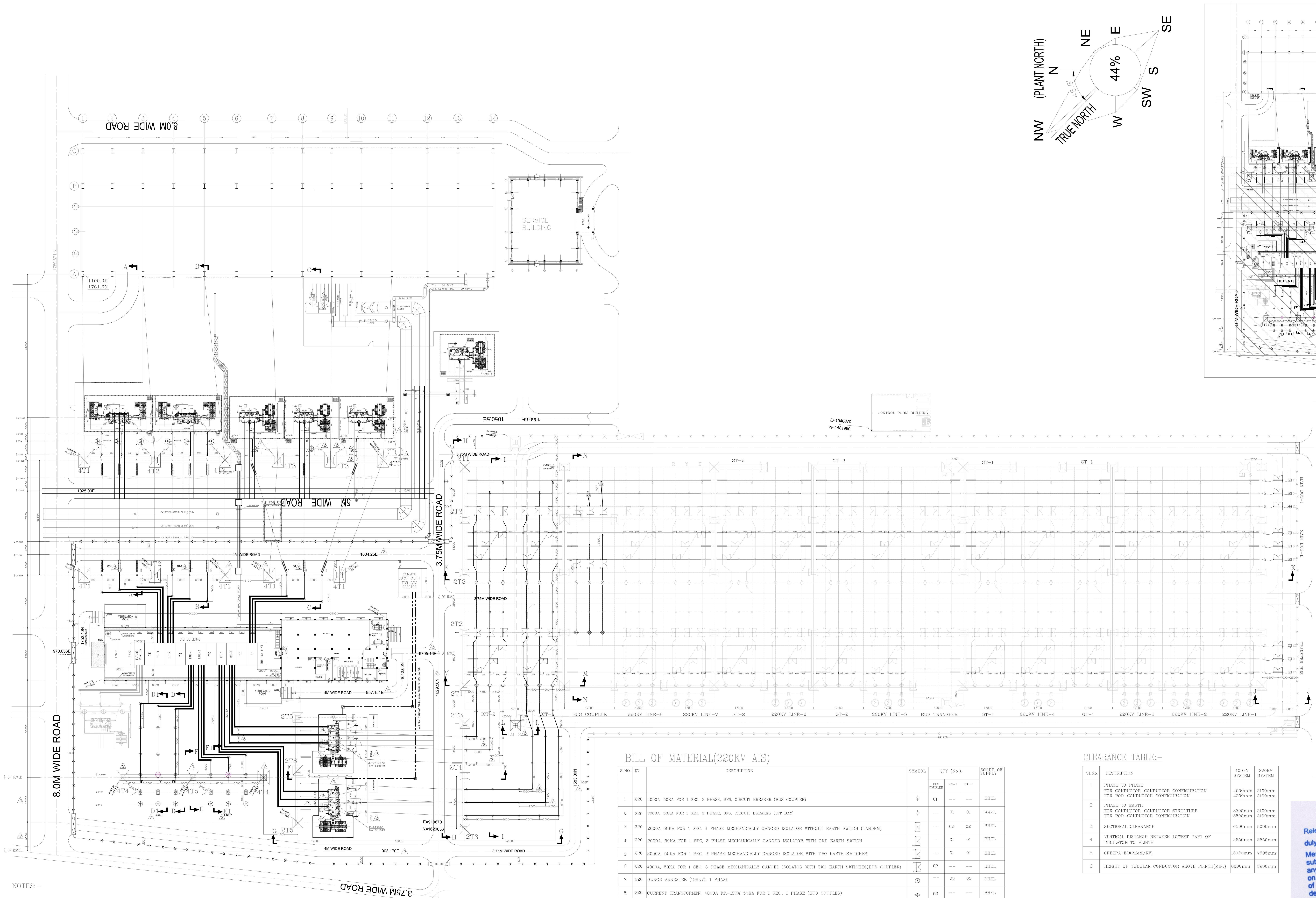
TITLE:- 400kV GIS/AIS SWITCHYARD SINGLE LINE DIAGRAM

DEPT. | SCALE | DRAWING NO. TB-428-316-001

SIGN | SHEET 02 OF 02 | REV. 04



KEY PLAN



BILL OF MATERIAL(220KV AIS)

S.NO.	KV	DESCRIPTION	SYMBOL	QTY (No.).			SCOPE OF SUPPLY
				BUS COUPLER	ICT-1	ICT-2	
1	220	4000A, 50KA FOR 1 SEC, 3 PHASE, SF6, CIRCUIT BREAKER (BUS COUPLER)		01	--	--	BHEL
2	220	2000A, 50KA FOR 1 SEC, 3 PHASE, SF6, CIRCUIT BREAKER (ICT BAY)		--	01	01	BHEL
3	220	2000A 50KA FOR 1 SEC, 3 PHASE MECHANICALLY GANGED ISOLATOR WITHOUT EARTH SWITCH (TANDEM)		--	02	02	BHEL
4	220	2000A, 50KA FOR 1 SEC, 3 PHASE MECHANICALLY GANGED ISOLATOR WITH ONE EARTH SWITCH		--	01	01	BHEL
5	220	2000A, 50KA FOR 1 SEC, 3 PHASE MECHANICALLY GANGED ISOLATOR WITH TWO EARTH SWITCHES		--	01	01	BHEL
6	220	4000A, 50KA FOR 1 SEC, 3 PHASE MECHANICALLY GANGED ISOLATOR WITH TWO EARTH SWITCHES(BUS COUPLER)		02	--	--	BHEL
7	220	SURGE ARRESTER (198kV), 1 PHASE		--	03	03	BHEL
8	220	CURRENT TRANSFORMER, 4000A Ith=120% 50KA FOR 1 SEC., 1 PHASE (BUS COUPLER)		03	--	--	BHEL
9	220	CURRENT TRANSFORMER, 2000A Ith=120% 50KA FOR 1 SEC., 1 PHASE (ICT BAY)		--	03	03	BHEL
10	220	BUS POST INSULATOR		--	40	28	BHEL

BILL OF MATERIAL(400KV AIS)

S.NO.	KV	DESCRIPTION	SYMBOL	QTY (No.).	SCOPE OF SUPPLY
10	400	BUS POST INSULATOR		39	BHEL
10	400	SURGE ARRESTOR, 336kV, 20kA (1-Ph)		15	BHEL

CLEARANCE TABLE:-

Sl.No.	DESCRIPTION	400kV SYSTEM	220kV SYSTEM
1	PHASE TO PHASE FOR CONDUCTOR-CONDUCTOR CONFIGURATION FOR ROD-CONDUCTOR CONFIGURATION	4000mm 4200mm	2100mm 2100mm
2	PHASE TO EARTH FOR CONDUCTOR-CONDUCTOR STRUCTURE FOR ROD-CONDUCTOR CONFIGURATION	3500mm 3500mm	2100mm 2100mm
3	SECTIONAL CLEARANCE	6500mm	5000mm
4	VERTICAL DISTANCE BETWEEN LOWEST PART OF INSULATOR TO PLINTH	2550mm	2550mm
5	CREEPAGE(@31MM/KV)	13020mm	7595mm
6	HEIGHT OF TUBULAR CONDUCTOR ABOVE PLINTH(MIN.)	8000mm	5900mm

NOTES:-

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
2. SHORT CIRCUIT CURRENT : 50KA for 1sec (220KV), 63KA FOR 1sec (400KV)
3. MINIMUM LEVEL OF BOTTOM OF ANY INSULATOR ABOVE GROUND LEVEL (FROM PLINTH) IS 2550 MM.
4. (2) CONDUCTOR DETAILS:

   FLEXIBLE CONDUCTOR (FOR 400KV, GT/ST/LINE CONNECTION): TWIN ACSR MOOSE CONDUCTOR
   FLEXIBLE CONDUCTOR (FOR 220KV, ICT BAY): TWIN ACSR MOOSE CONDUCTOR
   FLEXIBLE CONDUCTOR (FOR 220KV, BUS COUPLER): HTLS CONDUCTOR
   FLEXIBLE CONDUCTOR (FOR AUGMENTATION OF 220KV MAIN BUS-I/II): HTLS CONDUCTOR
   FLEXIBLE CONDUCTOR (FOR EXTENSION OF 220KV TRANSFER BUS): QUAD ACSR MOOSE CONDUCTOR

   RIGID CONDUCTOR (FOR 400KV, GT/ST/LINE CONNECTION): 4" IPS (EH)ALUMINIUM TUBE
   RIGID CONDUCTOR (FOR 220KV, ICT BAY): 4" IPS (EH)ALUMINIUM TUBE
   RIGID CONDUCTOR (FOR 220KV, BUS COUPLER): 6" IPS (EH)ALUMINIUM TUBE

5. (2) FUTURE REACTOR BAY SCOPE IS GIS EQUIPMENT WITHIN GIS BUILDING ONLY
6. SHIELD WIRE IS INDICATIVE AND FINAL REQUIREMENT WILL BE FURTHER INDICATED IN SWITCHYARD- DSLP CALCULATIONS & LAYOUT (TB-428-509-004).
7. ROAD SHALL BE FINAL AS PER FOUNDATION & ROAD LAYOUT OF SWITCHYARD (TB-0-428-607-603).
8. PLINTH ABOVE FGL=300MM
9. 220KV/400KV CLASS LA AND BPI IN FRONT OF 400/220KV ICT, GT & ST SHALL BE OF REMOVABLE TYPE. THE PEDESTAL HEIGHT OF THESE EQUIPMENTS SHOULD NOT FOUL DURING WITHDRAWAL OF ICT/GT/ST.
10. GRAVELS SHALL BE PROVIDED IN OUTDOOR PORTION OF THE 400 KV YARD.
11. CRP FOR 220KV ICT-1 & ICT-2 BAY SHALL BE PLACED IN EXISTING 220KV SWITCHYARD CONTROL ROOM BUILDING.
12. OUTDOOR CABLE TRENCH SHOULD ENTER THE BUILDINGS ABOVE FFL LEVEL THROUGH WALL.
13. ROAD SHOWN IN DASHED PATTERN IN 220KV YARD IS TO BE DISMANTLED TO MAKE SPACE FOR NEW EQUIPMENT ERECTION.
14. (2) FFL OF BUILDING (GROUND FLOOR) IN SWITCHYARD: EL 0.0M, FGL OF SWITCHYARD: EL (-)0.5M (WHICH CORRESPONDS TO RL (+)270.0M), SWITCHYARD RAIL LEVEL: EL (-)0.2M.
15. (2) TOP OF NIFPS OIL PIT: FGL EL (-)0.5M
16. (2) CUSTOMER TO INFORM THE 400KV LINE CONDUCTOR AS THE SAME IS NOT IN BHEL SCOPE.

Released for manufacture / fabrication / construction duly approved under Category A vide HPGCL Memo. No. Ch-106/U3/DCRTPP/M-III/03 dated 18/02/2026 subject to incorporation of comments / remarks, if any as mentioned therein. The approval / comments on this drawing / document neither relieves M/s BHEL of its sole contractual obligations in carrying out the design & engineering works correctly and fulfilling the complete requirement of contract nor does it limit the HPGCL's right under the contract.

SE/Projects (Mech.)

Chief Engineer/Projects HPGCL, Panchkula

CUSTOMER: HARYANA POWER GENERATION CORPORATION LTD.

CONSULTANT: DESEIN PRIVATE LIMITED
CONSULTING ENGINEERS, NEW DELHI, INDIA

1x800MW DEEN BANDHU CHOTU RAM
SUPER THERMAL POWER PLANT, YAMUNA NAGAR

JOB NO.	510
STATUS	CONTRACT
DISTRIBUTION	

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
TRANSMISSION BUSINESS GROUP
NOIDA

DEPT CODE		NAME	SIGN	DATE
E	DRN	SY	-Sd-	01.05.2025
	DESN	SS	-Sd-	01.05.2025
	CHD	SKS	-Sd-	01.05.2025
	APPD			

REV.	DATE	ALTD	CHD	APPD	DESCRIPTION
02	24.01.2026	SY	SS	SKS	REVISED AS PER CUSTOMER COMMENTS
01	06.09.2025	SY	SS	SKS	REVISED AS PER CUSTOMER COMMENTS

TITLE: SWITCHYARD- LAYOUT PLAN & SECTION

DEPT. SCALE SIGN

DRAWING NO. TB-428-316-002

SHEET 1 OF 2 REV. 02

SIZE-A0

COMPUTER FILE NAME

4T1 4T1 SHIELD WIRE TWIN ACSR MOOSE CONDUCTOR TWIN ACSR MOOSE CONDUCTOR TWIN ACSR MOOSE CONDUCTOR 4" AL.TUBE

℄ OF GIB BUSHING ℄ OF GIB BUSHING ℄ OF TOWER/BPI ℄ OF ROAD ℄ OF FENCE ℄ OF ROAD ℄ OF FENCE ℄ OF TOWER ℄ OF BPI ℄ OF LA ℄ OF BPI ℄ OF ST-2 ℄ A ROW WALL

SECTION–A

4T2 4T2 SHIELD WIRE TWIN ACSR MOOSE CONDUCTOR TWIN ACSR MOOSE CONDUCTOR TWIN ACSR MOOSE CONDUCTOR 4" AL.TUBE

℄ OF GIB BUSHING ℄ OF GIB BUSHING ℄ OF TOWER/BPI ℄ OF ROAD ℄ OF FENCE ℄ OF ROAD ℄ OF FENCE ℄ OF TOWER ℄ OF BPI ℄ OF LA ℄ OF BPI ℄ OF ST-2 ℄ A ROW WALL

SECTION–B

4T1 4T3 SHIELD WIRE TWIN ACSR MOOSE CONDUCTOR TWIN ACSR MOOSE CONDUCTOR TWIN ACSR MOOSE CONDUCTOR 4" AL.TUBE 4" AL.TUBE

℄ OF GIB BUSHING ℄ OF GIB BUSHING ℄ OF TOWER/BPI ℄ OF ROAD ℄ OF FENCE ℄ OF ROAD ℄ OF FENCE ℄ OF TOWER ℄ OF BPI ℄ OF LA ℄ OF BPI ℄ OF GT ℄ A ROW WALL

SECTION–C

HTLS CONDUCTOR (TYP.) HTLS CONDUCTOR (TYP.) HTLS CONDUCTOR (TYP.) HTLS CONDUCTOR (TYP.) R Y B R Y B 4" AL.TUBE 4" AL.TUBE

℄ OF 220KV TOWER(EXST) ℄ OF 220KV BPI(EXST) ℄ OF 220KV BPI(EXST) ℄ OF 220KV ISOLATOR-2ES ℄ OF 220KV TOWER(EXST) ℄ OF 220KV BPI(EXST) ℄ OF 220KV BPI(EXST) ℄ OF 220KV ISO-2ES ℄ OF 220KV TOWER(EXST) ℄ OF 220KV CB ℄ OF 3.75M ROAD ℄ OF 220KV HBPI(EXST) ℄ OF 220KV TOWER(EXST)/CT ℄ OF 220KV TOWER(EXST)

SECTION–N (BUS COUPLER)

2T2 TWIN ACSR MOOSE CONDUCTOR HTLS CONDUCTOR (TYP.)

℄ OF 220KV TOWER ℄ OF 220KV ISO(T) ℄ OF 220KV ISO(T) 220KV BPI ℄ OF 220KV ISO(T) ℄ OF 220KV BPI ℄ OF 220KV ISO(T) 220KV BPI ℄ OF 220KV TOWER (EXST) ℄ OF 220KV ISO ℄ OF 220KV ISO ℄ OF 220KV ISO ℄ OF 220KV TOWER (EXST) ℄ OF 220KV TOWER (EXST) ℄ OF 220KV TOWER (EXST) ℄ OF 220KV TOWER (EXST) ℄ OF 220KV TOWER (EXST)

SECTION–K (220KV MAIN BUS-I/II)

2T6 SHIELD WIRE TWIN ACSR MOOSE CNDUCTOR 2T4 4" IPS AL TUBE

℄ OF TOWER ℄ OF 400/220KV ICT ℄ OF 220KV LA ℄ OF 220KV BPI ℄ OF 3.75M ROAD ℄ OF 220KV TOWER/BPI ℄ OF 220KV BPI ℄ OF 220KV BPI ℄ OF 220KV BPI

SECTION–F

2T5 SHIELD WIRE TWIN ACSR MOOSE CNDUCTOR 2T3 4" IPS AL TUBE

℄ OF TOWER ℄ OF 400/220KV ICT ℄ OF 220KV LA ℄ OF 220KV BPI ℄ OF 3.75M ROAD ℄ OF 220KV TOWER/BPI ℄ OF 220KV BPI ℄ OF 220KV BPI ℄ OF 220KV BPI ℄ OF 220KV BPI

SECTION–G

2T1 SHIELD WIRE MAIN BUS–1 2T2 MAIN BUS–2 2T2 2T2 TRANSFER BUS 2T1 2T3 2T4 2T3 TWIN ACSR MOOSE CONDUCTOR 4" IPS AL TUBE 4" IPS AL TUBE

℄ OF 3.75M ROAD ℄ OF 220KV TOWER ℄ OF 220KV BPI ℄ OF 220KV BPI ℄ OF 220KV ISO-1ES ℄ OF 220KV TOWER ℄ OF 220KV ISO/BPI ℄ OF 220KV ISO/BPI ℄ OF 220KV ISO/BPI ℄ OF 220KV TOWER ℄ OF 220KV CB ℄ OF 3.75M ROAD ℄ OF 220KV BPI ℄ OF 220KV TOWER/ISO-2ES ℄ OF 220KV ISO/BPI ℄ OF 220KV ISO/BPI ℄ OF 220KV ISO/BPI ℄ OF 220KV TOWER/CT ℄ OF 220KV BPI ℄ OF 220KV TOWER ℄ OF 220KV BPI ℄ OF 220KV BPI ℄ OF 220KV TOWER ℄ OF 220KV BPI ℄ OF 220KV BPI ℄ OF 220KV BPI ℄ OF 220KV TOWER

SECTION–H

MAIN BUS–1 MAIN BUS–2 TRANSFER BUS R Y B R Y B R Y B 4" IPS AL TUBE TWIN ACSR MOOSE CONDUCTOR 4" IPS AL TUBE

℄ OF 220KV TOWER(EXST) ℄ OF 220KV BPI ℄ OF 220KV BPI ℄ OF 220KV ISO-1ES ℄ OF 220KV TOWER(EXST) ℄ OF 220KV ISO/BPI ℄ OF 220KV ISO/BPI ℄ OF 220KV ISO/BPI ℄ OF 220KV TOWER(EXST) ℄ OF 220KV CB ℄ OF 3.75M ROAD ℄ OF 220KV BPI ℄ OF 220KV TOWER(EXST)/ISO-2ES ℄ OF 220KV ISO/BPI ℄ OF 220KV ISO/BPI ℄ OF 220KV ISO/BPI ℄ OF 220KV TOWER(EXST)/CT ℄ OF 220KV BPI ℄ OF 220KV TOWER ℄ OF 220KV BPI ℄ OF 220KV BPI ℄ OF 220KV TOWER ℄ OF 220KV BPI ℄ OF 220KV BPI ℄ OF 220KV BPI ℄ OF 220KV TOWER

SECTION–I

4T4 LINE CONDUCTOR (CUSTOMER SCOPE) TWIN ACSR MOOSE CONDUCTOR 4" IPS AL TUBE

℄ OF 400KV LA ℄ OF 400KV CVT ℄ OF 400KV TOWER ℄ OF 400KV BPI ℄ OF 400KV BPI ℄ OF GIB BUSHING ℄ OF GIB BUSHING

SECTION–D

4T4 LINE CONDUCTOR (CUSTOMER SCOPE) TWIN ACSR MOOSE CONDUCTOR 4" IPS AL TUBE

℄ OF 400KV LA ℄ OF 400KV CVT ℄ OF 400KV TOWER WT ℄ OF 400KV BPI ℄ OF 400KV BPI ℄ OF GIB BUSHING ℄ OF GIB BUSHING

SECTION–D1

4T4 LINE CONDUCTOR (CUSTOMER SCOPE) TWIN ACSR MOOSE CONDUCTOR 4" IPS AL TUBE

℄ OF GIB BUSHING ℄ OF GIB BUSHING ℄ OF 400KV BPI ℄ OF 400KV TOWER ℄ OF 400KV CVT ℄ OF 400KV LA

SECTION–E (LINE SIDE)

4T4 LINE CONDUCTOR (CUSTOMER SCOPE) TWIN ACSR MOOSE CONDUCTOR 4" IPS AL TUBE

℄ OF GIB BUSHING ℄ OF GIB BUSHING ℄ OF 400KV TOWER/BPI ℄ OF 400KV LA

SECTION–E1 (LINE SIDE)

4T4 TWIN ACSR MOOSE CONDUCTOR

℄ OF 220KV TOWER(EXST) ℄ OF 220KV LA (EXST) ℄ OF 220KV CVT ℄ OF FENCE (EXST) ℄ OF 220KV ISO-1ES

SECTION–J

QUAD ACSR MOOSE CONDUCTOR

℄ OF 220KV TOWER ℄ OF 220KV CT ℄ OF 220KV CT ℄ OF 220KV CT ℄ OF 220KV CT ℄ OF 220KV CT ℄ OF 220KV CT ℄ OF 220KV TOWER

SECTION–M

℄ OF 220KV BPI ℄ OF LM-2(EXST) ℄ OF 220KV BPI

SECTION–L

Released for manufacturing / construction
duly approved under Category ..... A ..... vide HPGCL
Memo. No. CH-106/US(DC&TPP)M-II/183 dated. 18/02/2026
subject to incorporation of comments / remarks, if any as mentioned therein. The approval / comments on this drawing / document neither relieves M/s BHEL of its sole contractual obligations in carrying out the design & engineering works correctly and fulfilling the complete requirement of contract nor does it limit the HPGCL's right under the contract.
Chief Engineer/Projects HPGCL, Panchkula
SE/Projects (Mech.)

DISTRIBUTION

REV.	DATE	ALTD	CHD	APPD
02	24.01.2026	SY	SS	SKS
	REVISED AS PER CUSTOMER COMMENTS			
01	06.09.2025	SY	SS	SKS
	REVISED AS PER CUSTOMER COMMENTS			

CUSTOMER
HARYANA POWER GENERATION CORPORATION LTD.

CONSULTANT
DESEIN PRIVATE LIMITED
CONSULTING ENGINEERS, NEW DELHI, INDIA

1x800MW DEEN BANDHU CHOTU RAM
SUPER THERMAL POWER PLANT, YAMUNA NAGAR

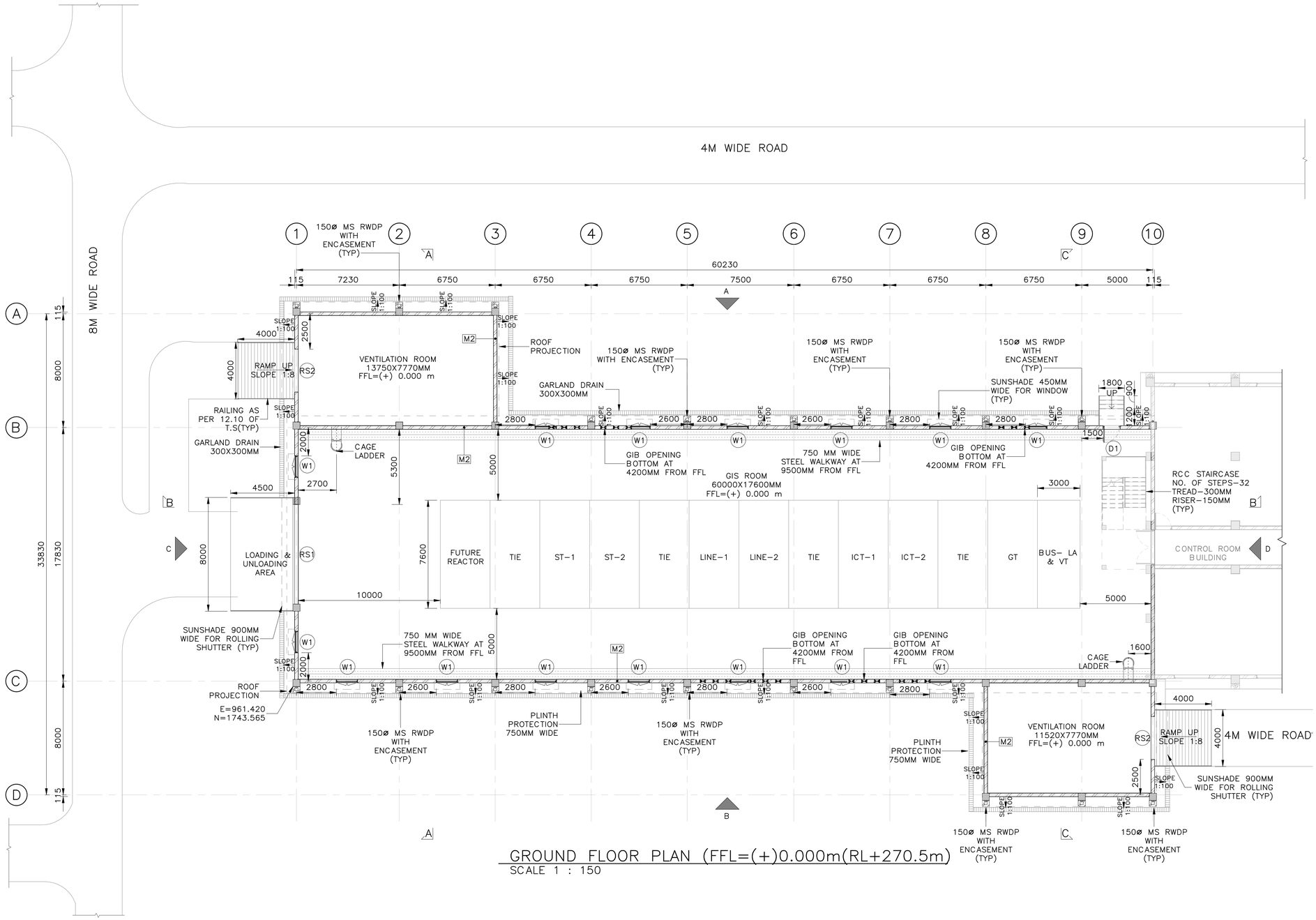
BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
TRANSMISSION BUSINESS GROUP
NOIDA

DEPT CODE		NAME	SIGN	DATE
E	DRN	SY	-Sd-	01.05.2025
	DESN	SS	-Sd-	01.05.2025
	CHD	SKS	-Sd-	01.05.2025
	APPD			

TITLE
SWITCHYARD– LAYOUT PLAN & SECTION

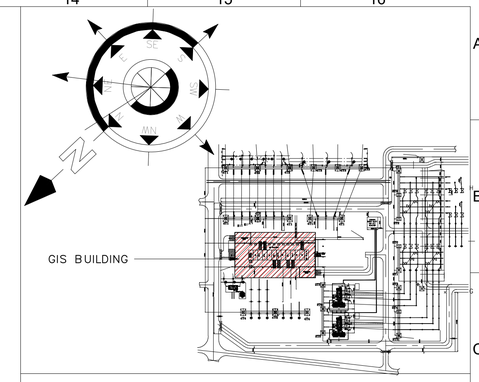
DEPT. | SCALE | SIGN | DRAWING NO. TB-428-316-002 | SHEET 2 OF 2 | REV. 02

SIZE-A0



GROUND FLOOR PLAN (FFL=(+)0.000m(RL+270.5m)

SCALE 1 : 150



LEGEND:
FFL – FINISHED FLOOR LEVEL
FGL – FINISHED GROUND LEVEL
TL – TERRACE LEVEL
BOC– BOTTOM OF CEILING
TYP – TYPICAL
THK – THICKNESS
FC – FALSE CEILING
C1 – CEILING
F1 – FLOOR FINISH
F2 – WATER PROOFING
SK1 – 150MM HIGH SKIRTING

–230 THK BRICK WALL(M2)

–125 THK RCC WALL (M3)

NOTES:

1. ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE.
2. DETAILED CIVIL STRUCTURAL DRAWING WILL BE SUBMITTED SEPARATELY.
3. THE WALL THICKNESS, ROOF TYPE, BEAM AND COLUMN LOCATION SHALL BE SUBMITTED AS PART OF DETAILED CIVIL ENGINEERING DRAWINGS.
4. DIMENSIONS IN INDIVIDUAL DRAWINGS AS INDICATED HERE SHOULD BE TREATED AS MINIMUM CLEAR DIMENSIONS DURING DETAILED ENGINEERING, ALL REQUIREMENTS OF SPECIFICATION WRT CIVIL ARCHITECTURAL AND ELECTRICAL ARE TO BE TAKEN CARE OF.
5. DETAILS OF CABLE TRAY/TRENCH ARRANGEMENT SHALL BE FURNISHED IN A SEPARATE DRAWING.
6. ALL HANDRAILS AND LADDER PIPES (EXCEPT AT OPERATING FLOORS) SHALL BE 32 MM NOMINAL BORE MS PIPES (MEDIUM CLASS) CONFORMING TO IS: 1161 AND SHALL BE FINISHED WITH SUITABLE PAINT. ALL RUNGS AND LADDERS SHALL BE FINISHED WITH SUITABLE PAINT.
7. PRESSURISED TYPE VENTILATION SYSTEM TO BE PROVIDED IN GIS BUILDING
8. EOT CRANE CAPACITY SHALL BE FINAL AS PER GIS OEM RECOMMENDATION. FOR BUILDING DESIGN PURPOSE IT IS CONSIDERED AS 8MT.
9. DOOR WIDTH ARE CLEAR MASONRY OPENINGS. WINDOWS ARE INDICATIVE, ACTUAL LOCATION SHALL BE AS PER CIVIL DRAWING.
10. ALL EQUIPMENT/PANEL DIMENSION ARE TENTATIVE. FINAL EQUIPMENT DIMENSION WILL BE INCORPORATED IN FUTURE REVISION AFTER APPROVAL OF INDIVIDUAL EQUIPMENT/PANEL DRAWING.
11. FGL:EL (–)0.5M(WHICH CORRESPONDS TO RL(+)270.0M), FFL:EL 0.0M (GROUND FLOOR).

REFERENCE DRAWINGS.

1. ARCHITECTURE DRAWING– PLAN ,ELEVATIONS & SECTIONS FOR GIS BUILDING: TB–428–316–010

DOOR/WINDOW SCHEDULE– AS PER TECHNICAL SPECIFICATION

TAG	SIZE (MM)		COUNT	FRAME TYPE	SHUTTER TYPE	GLASS
	WIDTH	HEIGHT				
RS2	3000	3000	2	MS GUIDE CHANNELS	SEAMLESS GALVALUME MOTORIZED ROLLING SHUTTER	NA
RS1	7000	6000	1	MS GUIDE CHANNELS	SEAMLESS GALVALUME MOTORIZED ROLLING SHUTTER	NA
D1	1200	2200	1	PRESSED STEEL FRAME	SINGLE LEAF SOLID CORE FLUSH DOOR	8MM CLEAR TOUGHENED FOR VISION PANEL (IF PROVIDED)
W1	1500	1200	8	ALUMINIUM FRAME	GLAZED FIXED WINDOW	6MM THK WIRED GLASS

INTERNAL FINISHING SCHEDULE AS PER TECHNICAL SPECIFICATION

S.NO.	DESCRIPTION OF AREA	FLOOR FINISH	WALL FINISH	CEILING FINISH
1.	GIS ROOM	GRANOLITHIC WITH NON–METALLIC HARDNER	ACRYLIC WASHABLE DISTEMPER	ACRYLIC DISTEMPER
2.	VENTILATION ROOM	GRANOLITHIC WITH NON–METALLIC HARDNER	ACRYLIC WASHABLE DISTEMPER	ACRYLIC DISTEMPER

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OWNER'S: HARYANA POWER GENERATION CORPORATION LTD.

OWNER'S CONSULTANT: DESEIN PRIVATE LIMITED CONSULTING ENGINEERS, NEW DELHI

OWNER'S REVIEW CONSULTANT: DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS, KOLKATA

EPC CONTACTOR: BHARAT HEAVY ELECTRICALS LTD, NEW DELHI

BHEL UNIT: BHARAT HEAVY ELECTRICALS LTD, POWER SECTOR TRANSMISSION BUSINESS GROUP, NOIDA

SCALE: 1:150

RESPONSIBLE DEP: -

SUPPLIER NAME: assystem

LANGUAGE: En.

DOCUMENT TITLE: ARCHITECTURE DRAWING- PLAN ,ELEVATIONS & SECTIONS FOR GIS BUILDING

DOCUMENT KIND: DD

STATION NAME: YAMUNA NAGAR

PRODUCT CLASS: -

CUSTOMER DRAWING NO.: -

REV NO: 02

BHEL DRAWING NO.: TB-1-428-607-670

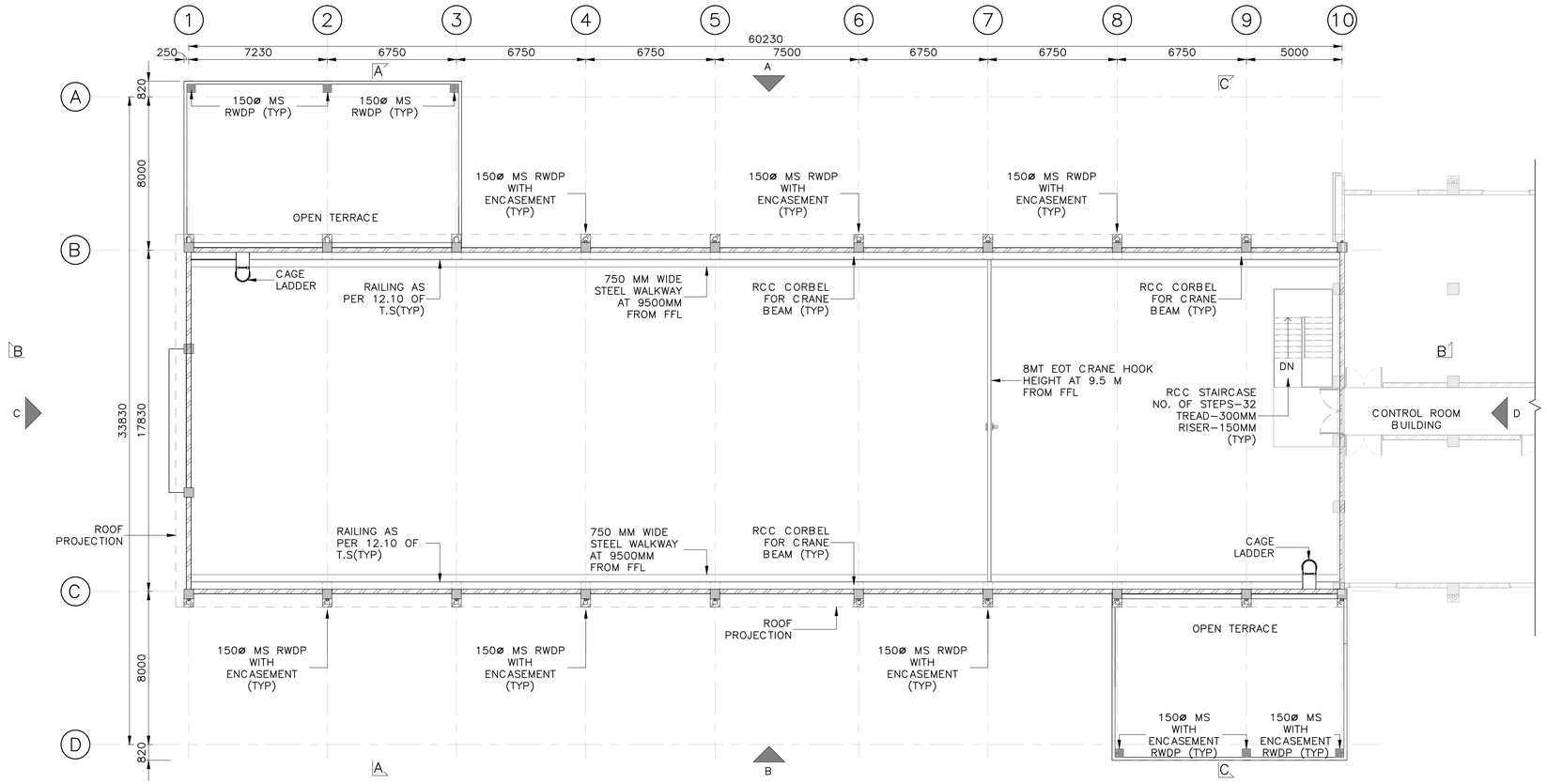
REV NO: 02

SIZE: A1

STATUS: APPROVED

ORIENTATION:

SHEET OF: 01 OF 05



CRANE GIRDER PLAN(FFL=(+)9.500m (RL+280.00M)

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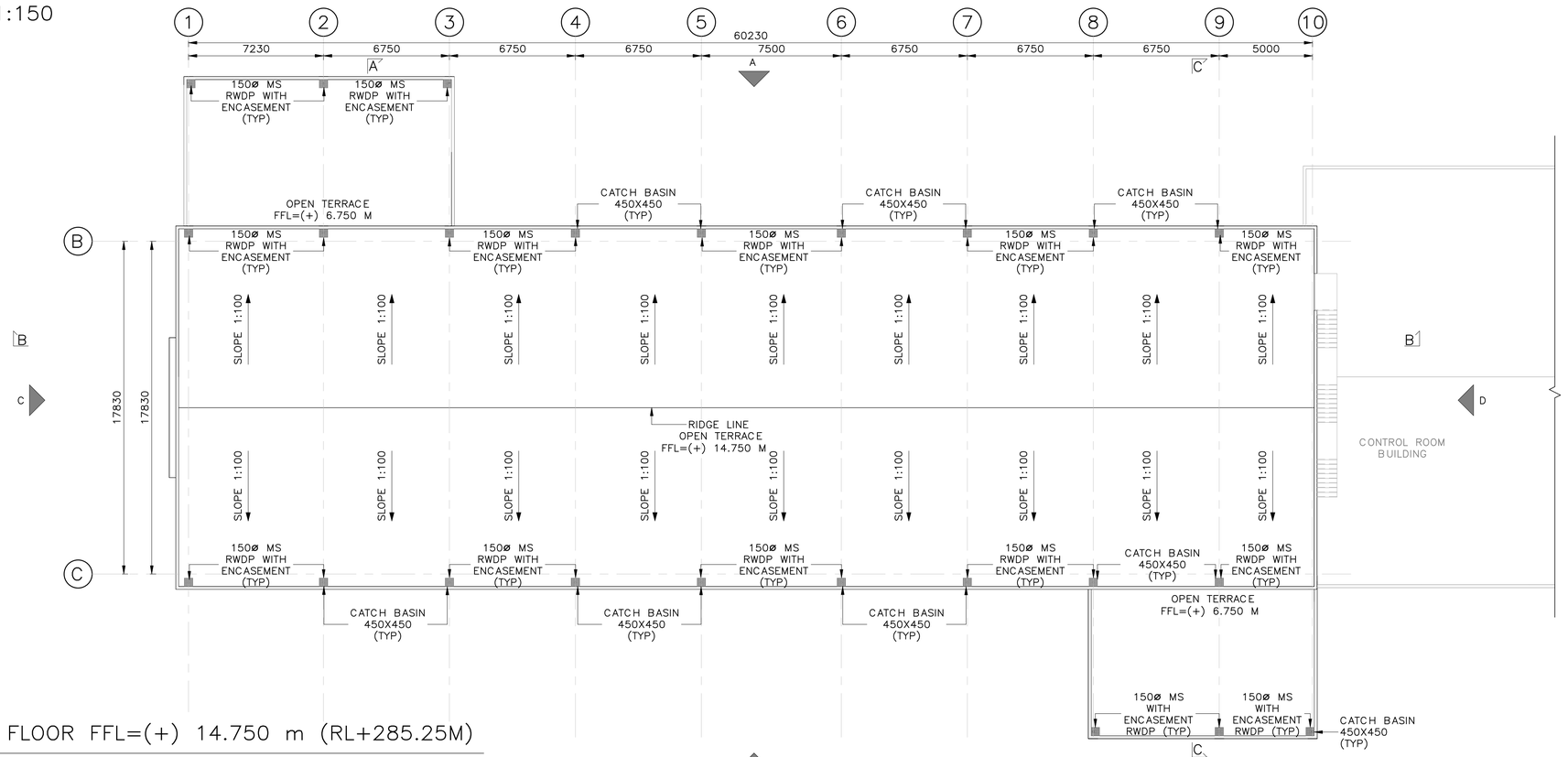

TERRACE FLOOR FFL=(+) 14.750 m (RL+285.25M)

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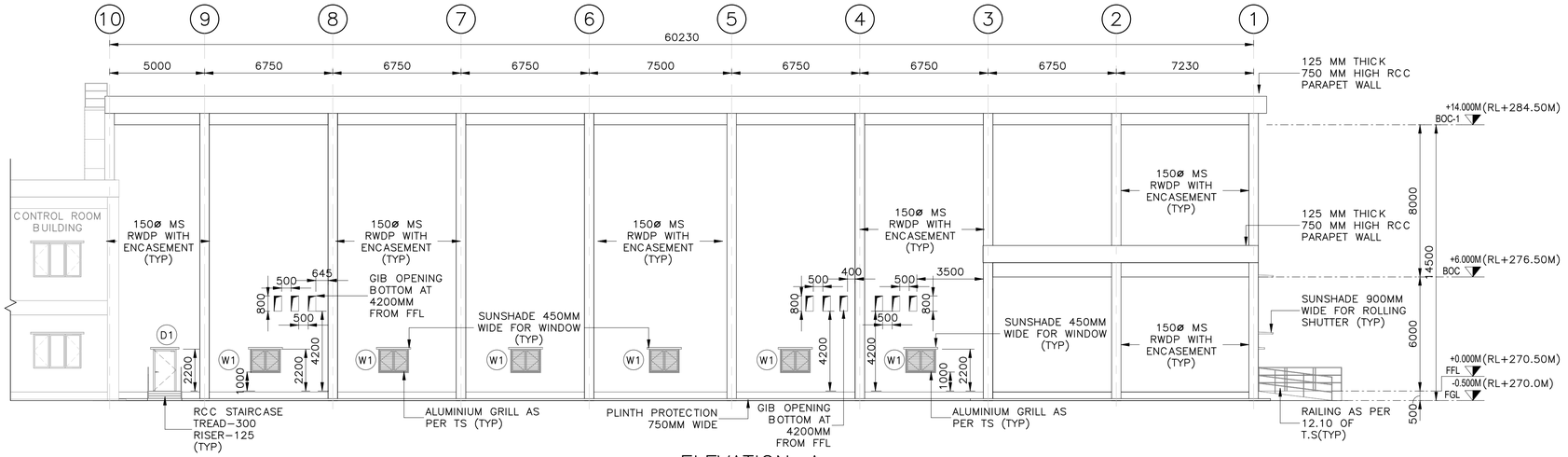
REV NO: 02

SIZE A1 | *STATUS* APPROVED | *ORIENTATION:* | *SHEET OF:* 02 OF 05



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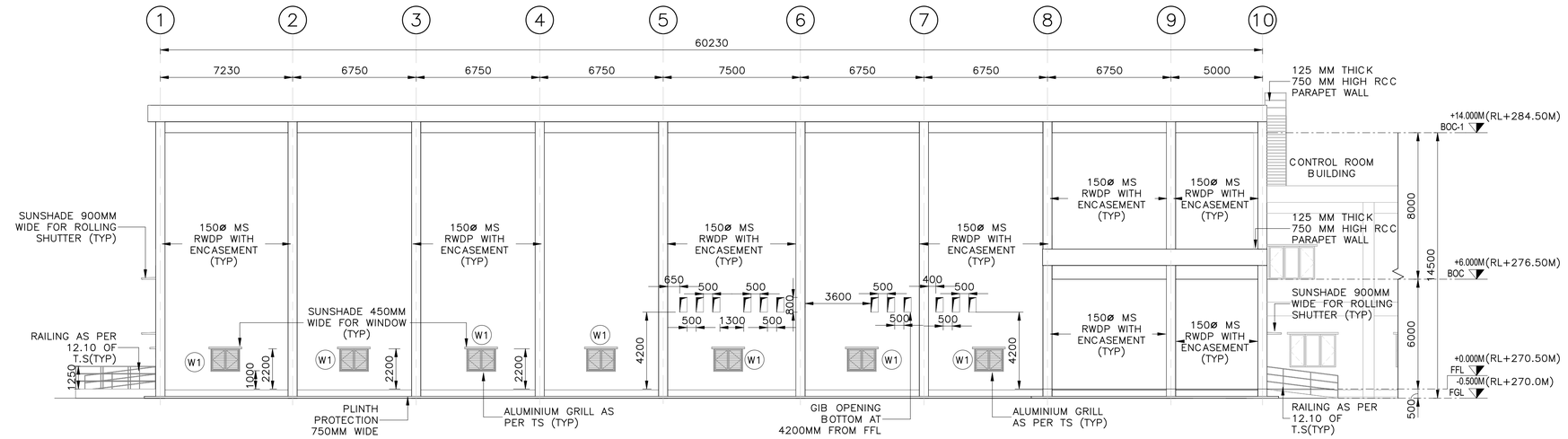

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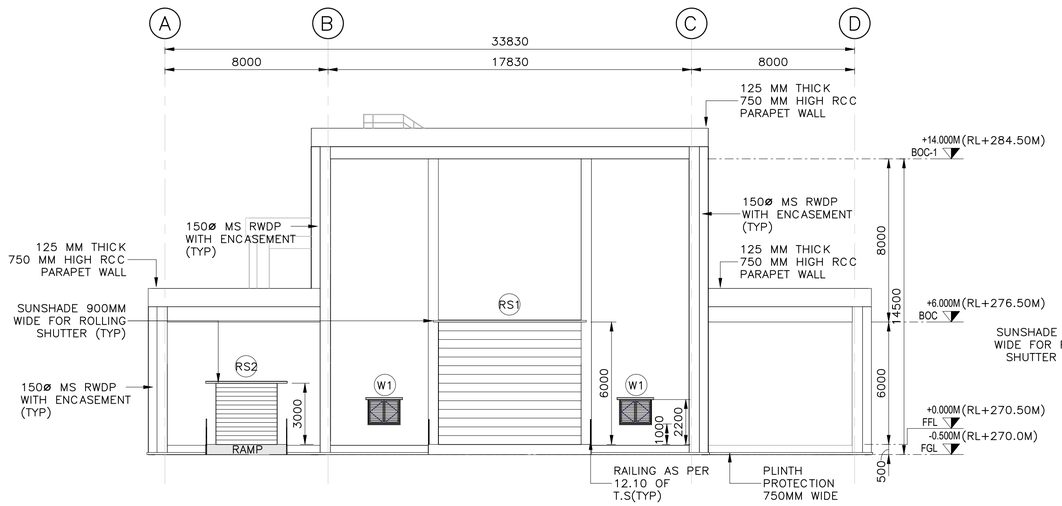

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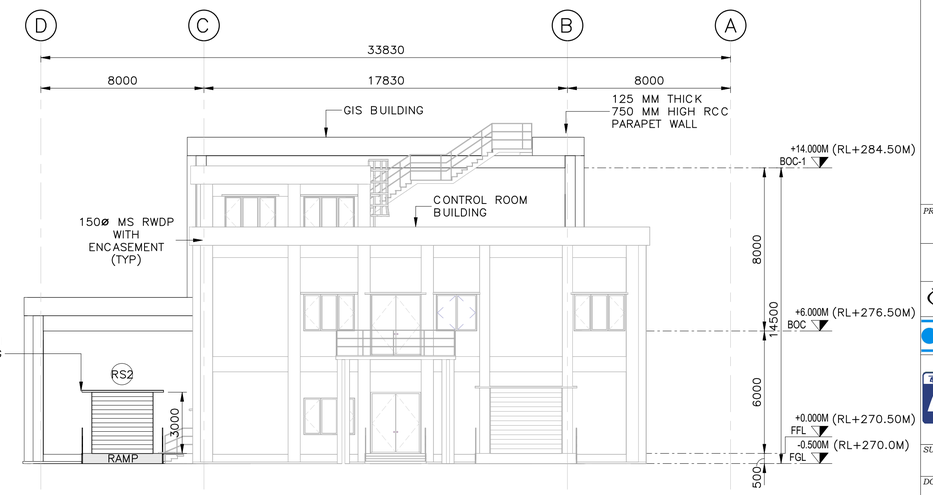

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BHEL UNIT
BHARAT HEAVY ELECTRICALS LTD, POWER SECTOR
TRANSMISSION BUSINESS GROUP, NOIDA

SCALE: 1:150
RESPONSIBLE DEP: -
LANGUAGE: En.
SUPPLIER NAME: assystem
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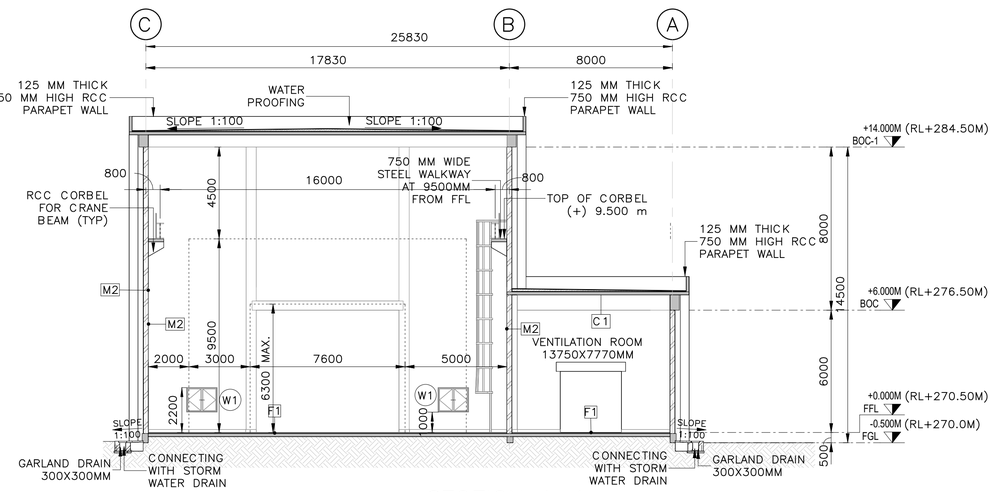
STATION NAME: YAMUNA NAGAR
PRODUCT CLASS: -
CUSTOMER DRAWING NO.: -
REV NO: 02
BHEL DRAWING NO.: TB-1-428-607-670
REV NO: 02
SIZE A1 *STATUS* APPROVED *ORIENTATION:* *SHEET OF:* 03 OF 05



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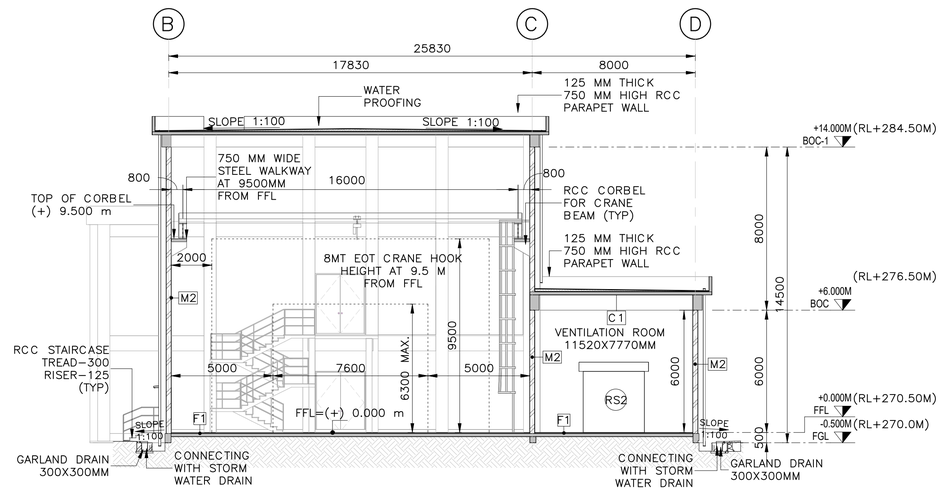

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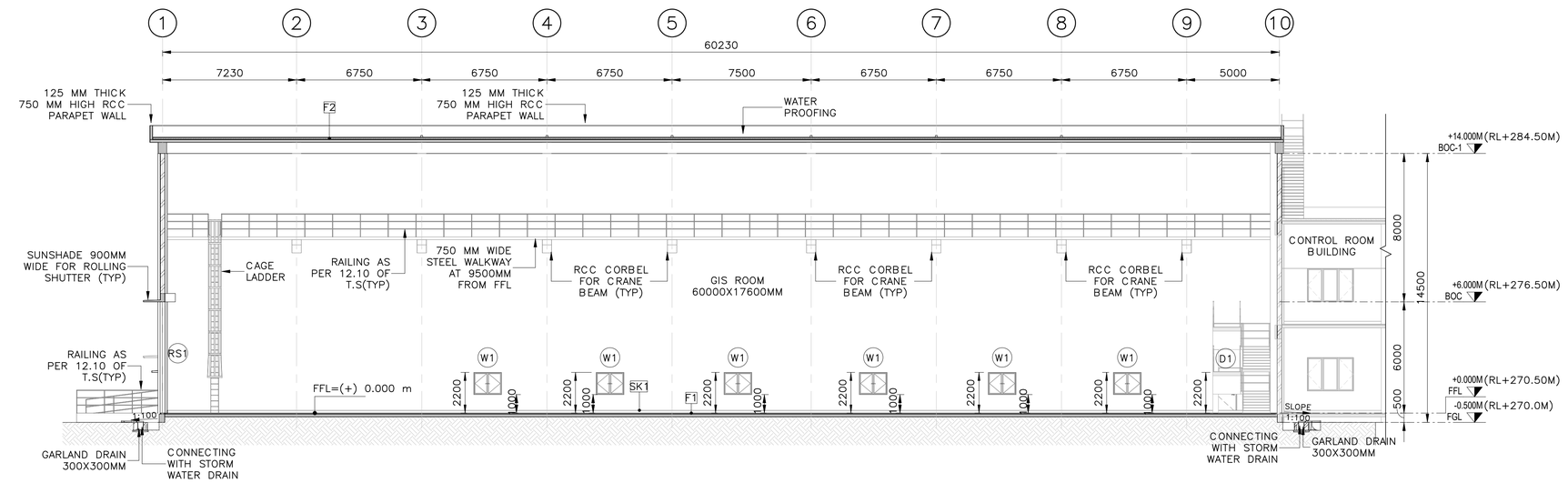

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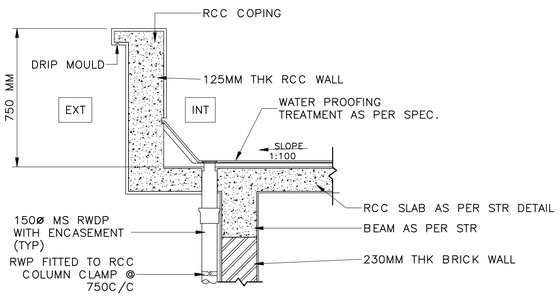

PARAPET WALL DETAILS
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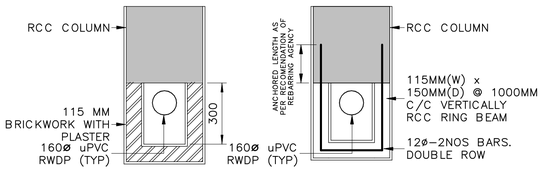

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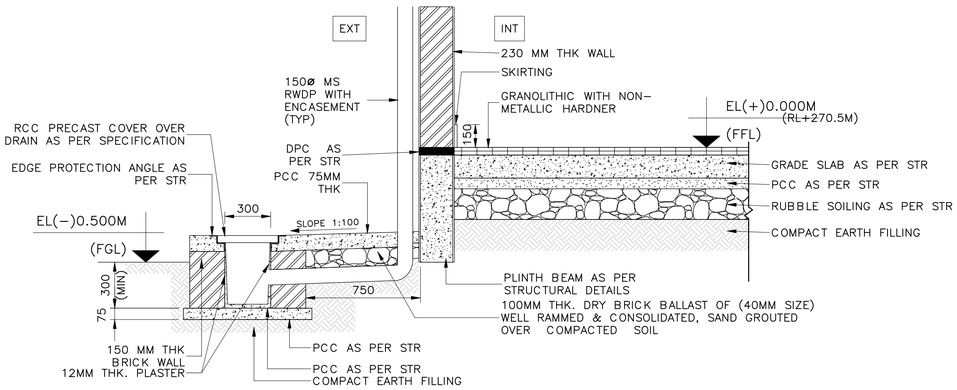
SCALE 1 : 20



DETAILS OF PLINTH PROTECTION ALONG WITH DRAIN SECTION(AS PER TECHNICAL SPECIFICATION)

SCALE 1:20

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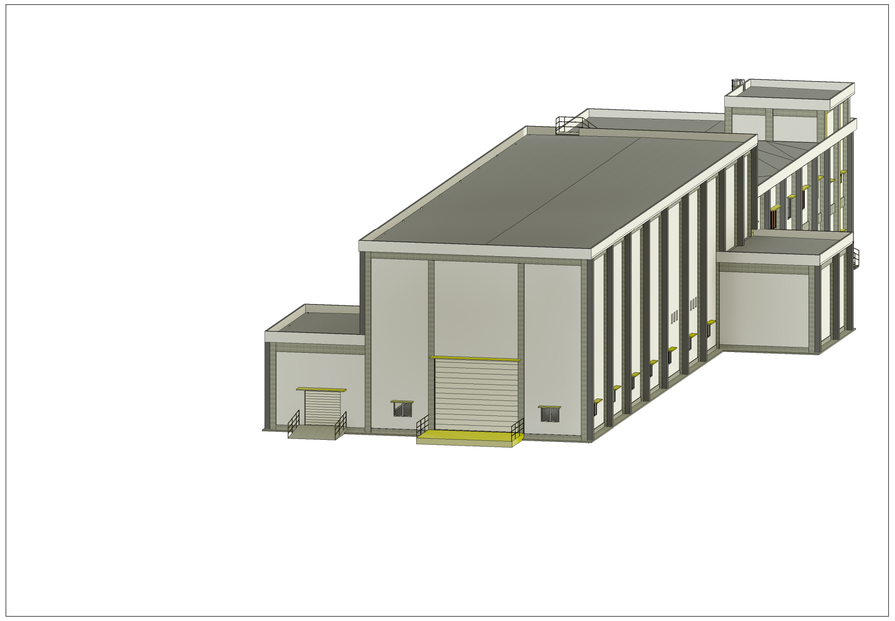
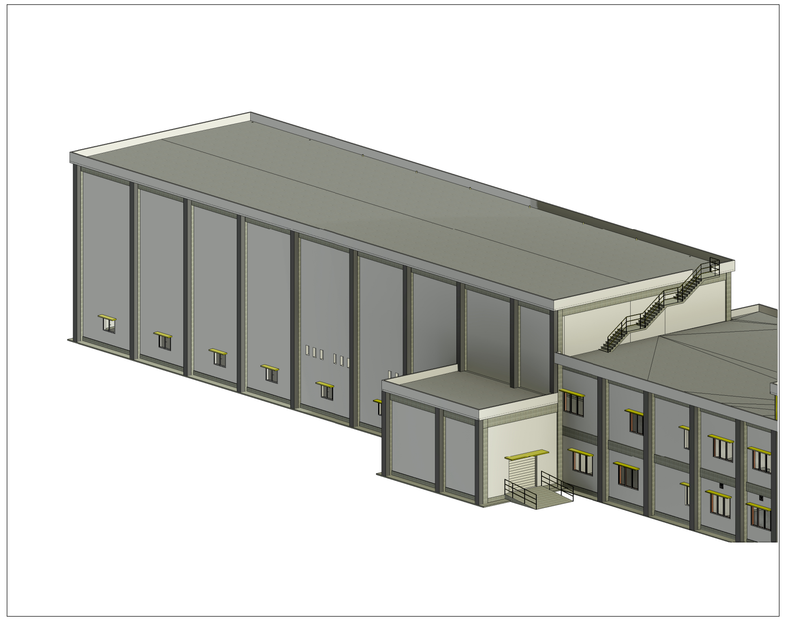
EPC CONTACTOR	BHARAT HEAVY ELECTRICALS LTD, NEW DELHI
BHEL UNIT	BHARAT HEAVY ELECTRICALS LTD, POWER SECTOR TRANSMISSION BUSINESS GROUP, NOIDA
SCALE:	1:150
RESPONSIBLE DEP:	-
SUPPLIER NAME:	assystem
LANGUAGE:	En.
DOCUMENT TITLE:	ARCHITECTURE DRAWING- PLAN ,ELEVATIONS & SECTIONS FOR GIS BUILDING
DOCUMENT KIND:	DD
STATION NAME:	YAMUNA NAGAR
PRODUCT CLASS:	-
CUSTOMER DRAWING NO.:	-
REV NO:	02
BHEL DRAWING NO.:	TB-1-428-607-670
REV NO:	02
SIZE	A1
STATUS	APPROVED
ORIENTATION:	
SHEET OF:	04 OF 05



VIEW 1



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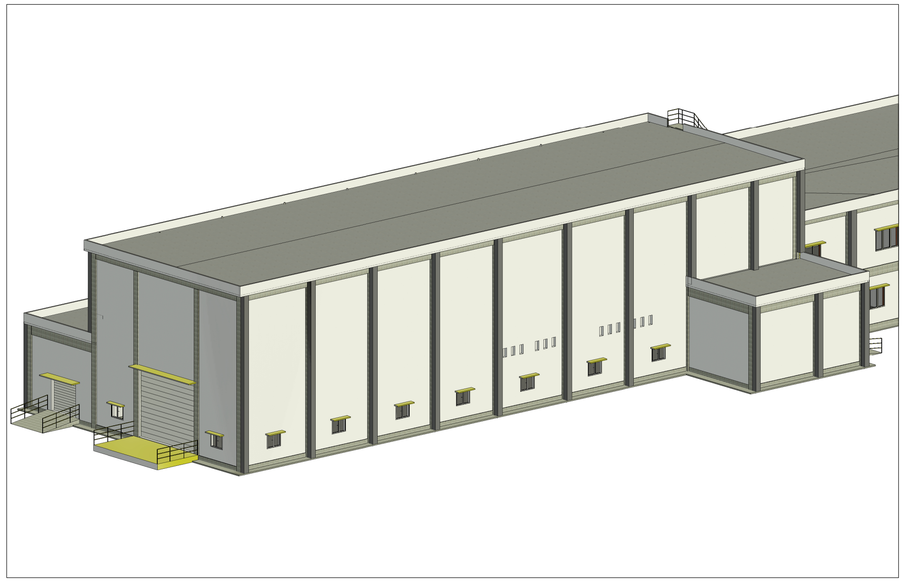

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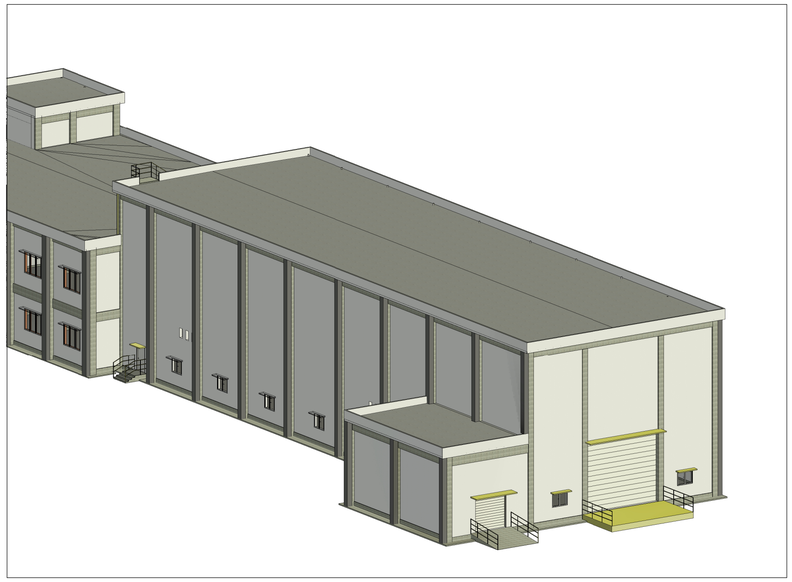

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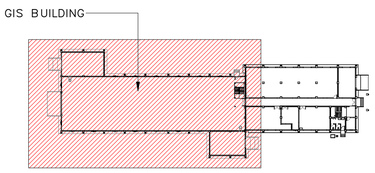

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SCALE: 1:150

RESPONSIBLE DEP: -

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Section-2
Equipment Specification under scope of supplies

4.01.00 This specification is intended to cover the design, manufacture, assembly, testing at manufacturer's works before dispatch, shipping, supervision of erection, testing, commissioning of factory assembled, metal-enclosed, SF6 Gas Insulated switchgear and gas-insulated bus duct as specified hereunder. The GIS configuration shall be based on SLD enclosed. The Switchgear shall be complete with all necessary terminal boxes, SF6 gas filling, interconnecting power & control wiring, grounding connections, gas monitoring equipment & piping, Partial discharge monitoring system, support structures, necessary firefighting arrangement, ventilation & air conditioning equipment, EOT crane etc.

4.01.01 All items of equipment and system covered under this specification shall be complete in all respect and any item of equipment or accessory not specifically mentioned in this specification but considered essential for efficient and satisfactory operation of individual equipment and system as a whole shall be included in the offer.

4.01.02 The equipment shall conform in all respect to high standards of engineering design and workmanship and should be capable of performing continuous commercial operation within the parameters guaranteed.

4.01.03 Standard designs are preferred, provided they meet the requirements of this Specification, and serve the intended purpose. Alternative design may be offered if the same provides substantial technical improvements or economic advantages. However, it will be at the discretion of the Owner HPGCL to accept such alternative proposed design. All equipments are intended for continuous duty at the specified ratings without forced cooling under the specified climatic conditions, unless otherwise specified.

4.02.00 SCOPE OF WORK

4.02.01 Scope of Supply - Electrical

The scope of supply includes design, manufacture, assembly, testing at manufacturer's works, delivery to site of 400 KV Gas insulated switchgear with all accessories as detailed in the following accompanying specification and as required.

4.02.02 400 KV GIS

400KV GIS comprises the following major components

A. The 400 KV GIS shall have following Bays/Dias

i.	Line bay	:	2
ii.	ICT Bay	:	2
iii.	ST Bay	:	2
iv.	GT Bay	:	1
v.	Bus Reactor Bay	:	1 (Spare)

Apart from above there will be two (2) bus EMVTs.

All the bays shall have its own Local Control Cubicle (LCC).

B. The 400KV GIS shall employ bus configuration with one (1) and half (1/2) breaker scheme.

C. Gas insulated busduct with SF6 to air bushings near Gantries for Line, GT and ST bays.

D. Gas insulated busduct with SF6 to oil bushings for direct connection to transformer for ICT bays.

E. The line take off arrangement from GIS building up to line take off/intermediate gantry (as required) shall be through GIS ducts. High speed earth switches (HES) shall be provided wherever required.

F. Earth mat below ground level and earthing of equipment.

G. Metering CT core for Main & Check ABT metering shall be provided inside the GIS for 400 kV GIS.

H. Overhead EOT crane of suitable size/capacity in GIS room to be defined by bidder for erection & maintenance of largest GIS component/assembly.

I. Also, circuit breakers for GT, ST and ICT shall be provided with CSD (Controlled switching device).

J. Online partial discharge monitoring system for 400 kV GIS.

K. Control and Relay Panel is located inside Switchyard Control Building adjacent to GIS building.

4.02.03 The following equipments are to be considered but not be limited for each GIS module:

A. Circuit breaker

B. Disconnect Switch

C. Maintenance earth Switch

D. Fast acting earth Switch

E. Bus earthing Switch

F. Voltage Transformer

G. Current Transformer

H. Bus and elbow Section

I. SF6 to air bushing

J. Surge Arrestor with counter – communicable type (if required)

K. Ground connection to the station grid

L. Auxiliary material to complete the GIS installation (like density switches, secondary cables, bolts etc)

M. Insulating SF6 gas

N. Local Control Cubicle

4.02.04 The hardware, materials & miscellaneous items related to 400 KV GIS & Lines shall include but not limited to the following:

A. SF6 Gas handling equipment

B. SF6 Gas Leakage Detector

C. Testing and Measuring Equipment

4.02.05 All relevant drawings, data and instruction manuals.

4.02.06 One (1) set of special tools, testing and measuring equipment for GIS.

4.02.07 Scope of Services

i) All testing equipment as required for testing & commissioning of equipment/system shall be arranged by the bidder.

ii) The bidder shall also carry out the following services but not be limited to:-

a) Repair of all minor damages such as removal of paint, loosening of components of the assembly etc.

b) Complete assembly, erection and commissioning.

c) Pre-commissioning check up to ensure correctness of erection as per actual manufacturer instructions.

d) Testing and commissioning in presence of Owner's engineers.

e) Obtaining Engineer's approval and written acceptance of satisfactory operation.

f) Handing over of installation for commercial operations.

g) Preparation and submission of drawings & job compliance Report and obtaining drawing approval for 400 KV GIS Substations.

4.03.00 **Codes and Standards**

4.03.01 The entire scope of work shall be carried out in accordance with established engineering practice and in conformity to this specification and with the relevant specifications and codes of practice of the Indian standards.

4.03.02 All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) and IEC mentioned in ***Chapter 37*** except where modified and/or supplemented by this specification. In addition, work shall also conform to the requirements of the following:

a) Indian Electricity Act and rules framed there under

b) Fire insurance regulations

c) Any other regulations laid down by Central/State/Local authorities during the execution of this Contract.

4.03.03 **Performance, Standards and Codes for GIS**

Performance, testing and rating of the switchgear shall conform to the latest edition of the following standards mentioned in Chapter 37.

4.03.04 The electrical installation shall meet the requirements of Indian Electricity Rules as amended up-to-date, relevant IS code of Practice for respective equipment and National Electrical code of India. In addition, other rules & regulations applicable to the work shall be followed. In case of discrepancies, most restrictive rules shall be binding.

4.03.04 **Guaranteed Performance**

The performance figures quoted in Technical Particular sheets shall be guaranteed within the tolerance permitted by relevant standards. In case of failure of the equipment to meet the guarantee, the equipment may be liable for rejection.

4.04.00 DESIGN CRITERIA

4.04.01 The basic system connection is shown in SINGLE LINE DIAGRAM.

4.04.02 All the equipment, material etc. to be supplied shall be new and of the best quality and shall conform to the specification given here under.

All similar materials and removable parts shall be uniform and interchangeable with one another.

4.04.03 The switchgear shall be of compact and modular design, fully metal-clad and of the sulphur-hexafluoride (SF6) insulated type. It shall be constructed for the indicated busbar system and shall include all necessary switches and current and voltage transformers, as detailed in the respective tender drawings.

The switchgear shall be supplied complete with all auxiliary equipment necessary for operation, routine maintenance, repairs or extensions.

4.04.04 The GIS Hall will have an independent ventilation system. Each ventilation system shall consist of two 100% capacity systems, one operating and one standby (BHEL SCOPE OF SUPPLY).

4.04.05 The switchgear shall be designed for continuous operation under all system operating conditions including sudden change of load and voltage and short circuits within its ratings. The equipment shall be designed to withstand normal operating voltage even if the inside gas pressure decreases to atmospheric pressure as long as no switching operations are performed.

4.04.06 Components that may require to be renewed and standard assemblies that may be transferred from one circuit to another, shall be interchangeable and where required this shall be demonstrated by the Bidder.

4.04.07 The arrangement of the switchgear shall be in such to enable dismantling a bay without affecting the adjacent bay. However, to remove the busbar disconnector, a shut down of the relevant section of the busbar will be required.

4.04.08 To secure minimum time of repair, all driving mechanisms of Circuit Breakers, Disconnectors and Earth Switches shall be respectively interchangeable to those of similar other feeders and/or spare parts shall comprise complete units.

4.04.09 The switchgear shall be constructed of suitable material and thickness to withstand the mechanical and thermal stresses due to short circuits and internal arc faults. For the rated duration of short circuit reference shall be made to the design fundamentals and latest IEC recommendations.

4.04.10 Notwithstanding scope of supply mentioned in Clause No. 4.02.00, if any equipment, tools, or instruments are considered essential for completion, the same shall also be supplied.

4.04.11 The enclosure and seals shall be designed to withstand the gas pressure encountered under normal and short circuit conditions. The thickness of the enclosures shall be in compliance with IEC – 60517.

4.04.12 Viewing windows shall be provided at the disconnectors and earthing switches to ensure that each contact position can be inspected. Each section shall have plug-in or easily removable connection pieces to allow for easy replacement of any component with the minimum of disturbance to the remainder of the equipment.

4.04.13 Materials used in the manufacture of the switchgear equipment shall be of the type, composition and physical properties best suited to their particular purposes and in accordance with the latest engineering practices. All joint surfaces shall be machined, and all castings shall be spot faced for all bolt heads or nuts and washers. All screws, bolts, studs and nuts shall conform to metric system.

4.04.14 Each pressure filled enclosure shall be designed and fabricated to comply with

the requirements of the applicable pressure vessel codes of the country of origin, or CENELEC standards and based on the design temperature and design pressures as defined in IEC 517.

4.04.15 The initial gas filling of the switchgear and sufficient extra SF6 gas for compensation of possible losses during installation shall be supplied. A wheeled maintenance device shall be supplied with pressure vessel, vacuum pump and all required gauges and fittings for the service of the switchgear. Manufacturer shall guarantee that the pressure loss within each individual gas –filled compartment will not be more than 0.5 percent per year.

4.04.16 Each gas–filled compartment shall be equipped with static filters. These filters shall be capable of absorbing any water vapour, which may penetrate into the enclosures.

4.04.17 The switchgear line-up, when installed and operating under the ambient conditions shall perform satisfactorily and safely under all normal and fault condition. Even repeated operations upto the permissible servicing intervals, under full rated fault conditions, shall not lead to diminished performance or significantly shortened useful life of the switchgear. Arc faults caused by external reasons shall be positively confined to the originating compartment and shall not spread to other parts of the switchgear. Routine replacement of insulating gas shall not be required in intervals of less than ten years.

4.04.18 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 deg C at an ambient air temperature not exceeding 50 deg C. In the case of enclosures, which are accessible but need not be touched during normal operation, the temperature rise limit may be permitted upto 30 deg C.

4.04.19 Bracing shall be provided for all mechanical components against the effects of short circuit currents specified under system parameter. The design of the equipment shall be such that the agreed permitted movement of foundations or thermal effects do not impair the assigned performance of the equipment.

4.04.20 Thermal rating for all current carrying parts shall be a minimum of 1 sec. at rated voltage for the rated symmetrical short-circuit current. If the max. short circuit time is extended, the I2x t value shall remain constant.

4.04.21 415 V ± 10%, 3 phase/240 V, single phase, 50 Hz, A.C. and 220V (+10%, -15%) D.C. auxiliary voltage supply for control, alarm, operating mechanism and space heaters shall be provided by the Bidder. The bidder may indicate any other auxiliary voltage requirement in the bid.

4.04.22 The switchgear shall be of the free-standing, self-supporting with easy accessibility to all the parts during installation, with all high-voltage equipment

installed inside gas-insulated, metallic earthed enclosures, and suitably sub-divided into individual arc and gas-proof compartments, at least for:-

i) Busbar section with associated busbar dis-connector
ii) Circuit breaker
iii) Line disconnectors
iv) Current transformer
v) Voltage transformer
vi) Gas insulated bus section between GIS and ICT.

The busbars shall be sub-divided into compartments including the associated busbar disconnectors.

4.04.23 Arrangement of the individual switchgear bays shall be such as to achieve optimum space-saving, neat and logical arrangement, and adequate accessibility to all external components.

4.04.24 Each line up of switchgear shall be suitable and prepared for future extension on either end without any drilling, cutting or welding on the existing equipment. To add equipment, it shall not be necessary to move or dislocate the existing switchgear bays.

4.04.25 For routine inspections and possible repairs, all elements shall be accessible without removing support structures. The removal of individual enclosure parts, or entire breaker bays, shall be possible without disturbing the enclosure of neighboring bays.

4.04.26 It shall be impossible to touch live parts of the switchgear unwillingly, i . e., without the use of tools or brute force, or to perform operations that lead to arcing faults.

4.04.27 The primary design goal shall be the avoidance of all known reasons for internal arcing. Should it occur, nevertheless, the release of pressurized gas into the atmosphere must occur in such a controlled way that personnel standing at the operating position of the switchgear will not be hurt directly in the process. Furthermore, no part of the enclosure, or any loose parts, may fly off the switchgear in such an event, and no holes may burn through the enclosure until the nearest protective relay has tripped. All earthing connections must remain operational during and after an arc fault.

4.04.28 All interlocks that prevent potentially dangerous mal operations, shall be constructed such that they cannot be defeated easily, i.e., the operator must use tools or brute force to over-ride them.

4.04.29 The actual position of disconnector and grounding switches shall be positively displayed by means of reliable optical indicators visible from the operating position.

4.04.30 Counter measures against expansion, vibration and noise

The GIS equipment shall be furnished with specially designed stainless-steel compensators/bellows to preserve the mechanical strength of the equipment at the connection portions to deal with the following problems:-

a) To absorb the expansion and Contraction of outer enclosure and conductor due to temperature variations.

b) Mismatch in various components of GIS

c) To absorb the vibration of the transformer and switching equipment.

d) To absorb the dimensional variations due to uneven settling of foundation.

e) To withstand seismic forces as mentioned in climatic condition.

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

4.04.32 The workmanship shall be of the highest quality and shall conform to the latest modern practices for the manufacture of high technology machinery and electrical switchgear.

4.04.33 The switchgear, which shall be of modular design, shall have complete phase isolation. The conductors and the live parts shall be mounted on high graded epoxy resin insulators. These insulators shall be designed to have high structural strength and electrical dielectric properties and shall be free of any voids and free of partial discharge at a voltage which is at least 5 % greater than the rated voltage. They should be designed to have high structural and dielectric strength properties and shall be shaped so as to provide uniform field distribution and to minimize the effects of particle deposition either from migration of foreign particles within the enclosures or from the by-products of SF6 breakdown under arcing conditions.

4.04.34 Gas barrier insulators (communication type) shall have the same basis of design and shall have holes on both sides for proper flow of gas.

4.04.35 Gas barrier insulators (Non – communicable type) shall be provided so as to divide the GIS into separate compartments. They shall be suitably located in order to minimize disturbance in case of leakage or dismantling. They shall be designed to withstand any internal fault thereby keeping an internal arc inside the faulty compartment. Due to safety requirement for working on this pressurized equipment, whenever the pressure of the adjacent gas compartment is reduced, it should be ensured by the bidder that adjacent compartment would remain in service with reduced pressure. The gas tight barriers shall be clearly marked on the outside of the enclosures.

4.04.36 The material and thickness of the enclosures shall be such as to withstand an internal flash over without burn through for a period of 300 ms at rated short time with stand current. The material shall be such that it has no effect of environment as well as from the by-products of SF6 breakdown under arcing condition. The material of the enclosure shall be of having high resistance to corrosion, low electrical losses and no magnetic losses. The enclosure shall be sized for carrying induced current equal to the rated current of the bus. The enclosure shall be designed to eliminate the external electromagnetic field to reduce electro dynamic stresses under short circuit conditions. The average intensity of the electromagnetic field shall not be more than 50 micro-tesla. The temperature rise of accessible enclosure shall not exceed 20°C above ambient temperature. In the enclosure which are not touched during normal operation, the temperature rise limit shall be up to 30°C above ambient temperature.

4.04.37 Each section shall have plug- in or easily removable connection pieces to allow for easy replacement of any component with the minimum of disturbance to the remainder of the equipment. Inspection windows shall be provided for disconnectors and earth switches.

4.04.38 The material used for manufacturing the switchgear equipment shall be of the type, composition and have physical properties best suited to their particular purposes and in accordance with the latest engineering practices. All the conductors shall be fabricated of aluminum/ copper tubes of cross-sectional area suitable to meet the normal and short circuit current rating requirements. The finish of the conductors shall be smooth so as to prevent any electrical discharge. The conductor ends shall be silver plated and fitted into finger contacts or tulip contacts. The contacts shall be of sliding type to allow the conductors to expand or contract axially due to temperature variation without imposing any mechanical stress on supporting insulators.

4.04.39 Each pressure filled enclosure shall be designed and fabricated to comply with the requirements of the applicable pressure vessel codes and based on the design temperature and design pressures as defined in IEC-62271-203.

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

4.04.41 Each gas-filled compartment shall be equipped with static filters, density switches, filling valve and safety diaphragm. The filters shall be capable of absorbing any water vapor which may penetrate into the enclosures as well as the by-products of SF6 during interruption. Each gas compartment shall be fitted with separate non-return valve connectors for evacuating & filling the gas and checking the gas pressure etc.

4.04.42 The switchgear shall be divided into separate gas compartments by the use of gas tight barriers to localise any gas leakage. Gas section volumes shall be designed to minimise the effects of any internal over pressure and shall be consistent with need to allow changes in the switching arrangements for maintenance, repair of extension ensuring the remaining parts can remain energised. Each gas compartment shall be provided with facilities for routine king of gas moisture content and purity. Gas compartments shall be fitted with permanent connection points for fitting and emptying and gas treatment equipment with out moving the switch gear and degassing the compartment.

Two stage alarms shall be wired and indicated to the LCC and control room in the event of loss of gas pressure. All SF6 gas filling ports in the GIS shall be equipped with standard non-return fitting. Each gas compartment must provide the following:

- Indicator of actual gas pressure, stage-1 pressure alarm, stage II pressure alarm pressure for all gas filled compartments.
- Monitoring of pressure and alarm for pressure losses intwo adjustable stages.
- Access for evacuating and filling via gas service cart.

4.04.43 The switchgear line-up when installed and operating under the ambient conditions shall perform satisfactorily and safely under all normal and fault conditions. Even repeated operations up to the permissible servicing intervals under 100% rated and fault conditions shall not diminish the performance or significantly shorten the useful life of the switchgear. Any fault caused by external reasons shall be positively confined to the originating compartment and shall not spread to other parts of the switchgear.

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

4.04.45 The bus enclosure should be sectionalized in a manner that maintenance work on any bus disconnector (when bus and bus disconnector are enclosed in a single enclosure) can be carried out by isolating and evacuating the small, effected section and not the entire bus. The design of the 1.5 CB bus scheme GIS shall be such that in case one circuit breaker module is removed for maintenance, there is no disruption in the power flow in any of the two circuits. Further the design of double bus with one and half breaker & double bus with single breaker scheme GIS shall be such that in case a circuit breaker module of a feeder is removed for maintenance, both busbars shall remain in service. For achieving the above requirements, adequate number of intermediate compartments, if required, shall be provided to ensure equipment and operating personnel's safety.

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

4.04.47 Circuit identifying labels shall be fitted in front and rear of each individual circuits' assembly and on control cubicles.

4.04.48 **GIS HALL LAYOUT CRITERIA**

a. Minimum clearance of 1 meter to be provided over the GIB with the crane hook, sling and lifted equipment hanging over the GIB.
b. Clear space of 5 meters shall be provided on three sides of the GIS equipment for easy movement along with equipment / trolley.
c. Clearance on maintenance bay side shall be at least 10 meter wide (clear space from edge of GIS (400kV) to inner edge of wall).

Building width shall be decided considering the requirement of turning radius to rotate the largest removable component for assembly/disassembly.

4.04.49 **GIS HALL FLOORING**

Epoxy Flooring : Supply & application of heavy duty Self leveling Epoxy Flooring system to an average thickness 2.2 mm, including Surface Preparation, application of one coat of Epoxy Primer, followed by topping the surface with Heavy duty Chemical resistant Epoxy Resin Topping in desired colour and Gloss. Laying and installations of flooring shall be as per IS: 4631- 1986. For detailed specification Civil Sections shall be referred.

4.05.00 SPECIFIC REQUIREMENT

4.05.01 GIS Equipment and Accessories

i) Circuit Breakers

a) Each circuit breaker shall comprise three metal clad breaker poles (Puffer type) and maximum two interrupting arcing chamber. They shall be designed for installation in SF6 gas- insulated metal clad switchgear and shall use SF6 gas for both insulation and arc quenching.

b) The circuit breakers shall be horizontal mounted and shall withstand the forces imposed by the earthquake.

c) Breaker shall be suitable for following switching duties:

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

d) The breaker switching under above switching operations shall not result in excessive over voltages and/or restrike of arc.

e) Breaker components shall meet Partial Discharge requirement as per relevant IEC.

f) The circuit breakers shall be designed to withstand the high stresses imposed on them during fault clearing, load rejection, out-of-phase switching, re-energization of lines with trapped charge and perform make and break operations as per the stipulated duty cycles satisfactorily.

g) Spring Operating Mechanism, one for each pole, shall be employed for closing and tripping the circuit breakers. 220-V DC will be used for control / tripping.

h) The circuit breakers shall have local storage sufficient for a duty cycle of 0-0.3 seconds-CO following the loss of supply to the main energy storage system.

i) The circuit breakers shall be trip-free and have anti-pumping and phase disagreement protection. There shall be two trip coils per pole of the breakers.

j) Line circuit breakers shall have single-phase auto-reclosing capabilities. The line breakers shall be capable of independent pole operation. Each phase shall be completely isolated from the other two phases.

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

l) Each circuit breaker pole shall be equipped with a local enclosed-type mechanical position indicator clearly visible from the breaker front, together with remote position indicator on the bay module control cabinet, and remotely at the powerhouse/ substation control room. The mechanical indicator wording and colouring shall be as follows:

	Sign	**Background Colour**
Open position	Open	Green
Closed position	Closed	Red

m) The circuit breakers shall be interlocked electrically with their associated disconnectors such that the disconnector cannot be opened or closed unless the associated circuit breakers are open. The interlocking shall prevent any incorrect switching sequence and enable the breakers to be operated without risk, either from the local bay module control cabinet or from the power house / substation control room. Actuation of the manual operating device shall also disable the electrical control circuits. Interlocks shall be provided to prevent hunting and other dangerous or undesirable operations of the circuit breaker.

n) The circuit breaker control system shall inhibit tripping or closing of the circuit breaker when there is insufficient stored energy in the operating mechanism storage cylinder or if SF6 density drops below a minimum permissible level. The state of the breaker arc-quenching and insulating gas shall be monitored by a temperature-compensated density switch with two alarm levels. The first stage alarm shall be set well before any dangerous condition is reached; the second stage shall inhibit breaker operation.

o) The circuit breakers shall be capable of being operated locally or from remote. Local operation shall be by means of an open/close control switch located in the bay module control cabinet. Remote control via a remote/local control transfer switch shall be from the powerhouse/ Substation control room. Protection trips shall

remain operable in either remote or local control mode. When in the maintenance mode, all remote trip or close control signals shall be blocked. The breaker controls shall operate from the 220-V DC system with both the trip coils connected. A manually operated tripping device shall also be provided with each breaker, which can be operated in an emergency or during maintenance. Mechanical indicators coupled to the moving contact system shall be provided to show the true position of the main breaker contacts. Operating counters shall be provided for each breaker pole or otherwise for each breaker.

p) The governing data for the selection of circuit breakers are not only those listed above but also those that can be readily calculated from these documents. The selected circuit breakers must be suitable for their intended service and location for all no load, full load and fault service conditions.

4.06.00 Operational Requirements

4.06.01 Rated Operating Duty Cycle O-0.3 sec. – CO- 3 min- CO

4.06.02	Re-Closing	Single and three phase high speed auto re-closing
4.06.03	Trip and closing coil voltage	220V DC
4.06.04	Auxiliary contacts	As required plus 5NO and 5NC contacts per pole/10NO and 10NC per CB as spare
4.06.05	Noise level	As per IEC 61672

4.06.06 Controls

i. Closing Circuits

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

ii. Trip Circuits

Two independent tripping circuits, valves, pressure switches and coils shall be provided for connection to different set of relays. The circuits shall operate correctly under all operating conditions up to rated breaking capacity and at all values of supply voltages between 70% - 110% of rated supply voltage. However, even at 50% of rated supply voltage the breaker shall be able to operate. Trip coil supervision shall be provided in both open and close position.

iii. Operation

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

iv. Pressure Switch Contacts

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

v. Supply Voltage Monitoring

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

vi. Out of phase closing

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

vii. Safety aspect

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

viii. Central Control Cabinet

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

a) Local/remote changeover switch
b) Operation counters
c) Spring charge indication
d) SF6 pressure gauges
e) Power supply control switches
f) Fuses
g) Anti-pumping relay
h) Pole discrepancy relay
i) AC/DC supervision relays

ix. Timing

a) Opening time of breaker should be less than 40 milli sec.
b) Closing time of breaker should be less than100 milli sec.

4.06.07 The circuit breaker shall also be capable of

a) Interrupting line charging current as per IEC 62271-100 without any restrike and without use of opening resistors Clearing short line fault current with source impedance behind the bus equivalent to symmetrical fault current specified

4.07.00 Design and Constructional Features

4.07.01 Interrupter Shall be with adsorbing product box to minimize the

effect of SF6 decomposing product and moisture.

4.07.02	SF6 Density	SF6 Density shall be monitored and regulated on each pole using individual pressure switches and pressure gauges. Density Monitor shall be adequately temperature compensated It shall be possible to dismantle the monitor with out draining SF6 gas & also to remove SF6 gas from each pole separately for maintenance purpose.
4.07.03	D.C. Supply	Dual DC supply shall be provided for connection to independent trip circuits, monitoring & control circuits.
4.07.04	Aux. switch	Aux. switch of breaker to be positively driven by operating rod.

4.07.05 Operating Mechanism

a. Type spring charged with Anti-pumping and trip free features.

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

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

d. Power Dual AC power supply with changeover facility.

4.07.06 Spring Operated Mechanism

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

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

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

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

pressure for 60 minutes.

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

4.07.09 Breakers shall have provision for attaching operational analyzer.

4.07.10 **Bidder shall supply spare SF6 gas equal to 20% of the total requirement for the station.**

4.08.00 Controlled Switching Requirements

4.08.01 The Circuit Breaker shall be equipped with controlled switching with consequent optimization of switching behavior when used in switching of transformers (ICT's, GT, STs) & reactor. The controller shall be provided in Main & Tie circuit breakers of transformer bays.

4.08.02 The controlling relay shall also record and monitor the switching operations and make adjustments to the switching instants to optimize the switching behavior as necessary. It shall provide self diagnostic facilities, signaling of alarms and enable downloading of data captured from the switching events. The control switching device provided shall be networked to an Engineering Workstation (EWS) located in the Switchyard Control Room.

4.08.03 Technical Requirement for controlled switching device.

4.08.04 The controller shall be designed to operate at the correctly and satisfactorily with the excursion of auxiliary A/C & DC voltages and frequency.

a) The controller shall meet the requirements of IEC- 60255-4 Appendix 'E' class III regarding HF disturbance test, and fast transient test shall be as per IEC-61000 – 4 level III and insulation test as per 60255 – 5.

b) The controller shall have functions for switching ON & OFF the circuit breakers.

c) The controller shall get command to operate the breakers manually or through auto re-close relay at random. The controller shall be able to analyze the current and voltage waves available through the signals from secondaries of CTs & CVTs for the purpose of calculation of optimum moment of the switching the circuit breaker and issue command to circuit breaker to operate.

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

e) The controller should have display facility at the front for the settings and

measured values.

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

g) The controller shall have self-monitoring facility. The controller shall be suitable for current input of 1 amp from the secondary of the CTs. and 110 V (Ph to Ph) from the CVTs. The controller shall also take care of transient and dynamic state values of the current from the secondary of the CTs and CVTs.

h) The controller shall have time setting resolution of 0.1ms or better.

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

4.09.00 Current Transformers

a) The current transformers, incorporated into the GIS, shall be used for protective relaying and metering and shall be ring type, fitted externally to the supporting enclosure. The CTs shall have multicores 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. All current transformers shall have effective electromagnetic shields to protect against high frequency transients.

b) CT shall have a short time primary current rating not less than that of the associated switchgear. Secondary windings of each CT shall be earthed at one point only. The thermal rating of the current transformer shall allow, at site conditions, a 20% continuous overloading referred to nominal rating of the current transformer.

c) All transformers are to be provided with an identifying label giving manufacturer, type, ratio, class, output and serial number.

d) Where multiple ratio secondary windings are executed, the above-mentioned label shall clearly indicate the terminal connection required for each ratio, and they must be clearly indicated on the appropriate diagrams and drawings.

e) The minimum rated output of CT's shall be 30 VA or otherwise approved, based on the stability calculations to be submitted for approval by the Bidder/Bidder. The magnetizing curves for each CT protection cores shall also be submitted for approval.

f) To guarantee the correct protection relay operation, through-fault stability calculations shall be submitted showing the correctness of the chosen CT core, i.e. rated output, class of accuracy, rated accuracy limit factors, the rated primary current, turns ratio, knee-point e.m.f. and

resistance of the secondary windings (corrected to the maximum service temperature).

g) A current transformer marshalling terminal box for all the three- phase current transformers shall be provided, outside the enclosure for connections of all cores. The marshalling box shall be used for the star/delta configuration. Sufficient terminals of Weid Muller RSF -1 type or accepted equivalent shall be provided.

h) Suitable provision shall be made for primary current injection testing of current transformer circuits.

i) Current Transformer (CT) accessories for protection and metering as per IEC 60044-1 shall be incorporated into the GIS. It shall be of metal enclosed type. The secondary windings shall be air insulated and mounted inside metal enclosure. CT shall be provided with effective electromagnetic shields to protect against high frequency transients typically 1-30MHZ. CT shall be suitable for high-speed auto reclosing. CT shall be provided with marshalling box for secondary terminals.

j) For 400kV system CT, the rated extended primary current of the CT shall be 200% of rated primary on all except 2000/1A tap. At 2000/1A tap the rated extended primary current shall be 120%. At 2000/1A ratio, the CT shall be thermally rated for 200% for 15 minutes and 120% for continuous. For 400kV CT rated for 3000A, the rated extended current shall be 120% for 3000/1A tap and 180% for 2000/1A tap and 200% for lower ratios. The secondary windings shall be rated for 2A continuously. Further, the intermediate tappings at 3000-2000A and 2000-500A shall be suitable for using as 1000/1A and 1500/1A ratios.

k) Protection class CT shall maintain the required accuracy for burdens ranging from 25% to 100% of rated burden and up to the accuracy limit factor/ knee point voltage in case of relaying CT. metering CT shall maintain the required accuracy for burdens ranging from 5% to 120% of rated current or specified rated extended current whichever is higher. For 0.2S and 0.5S class CT, accuracy shall be maintained between 1% to 120% of rated current.

l) CT burden shall not be less than 5VA to achieve required 0.2S accuracy.

m) The rated extended current rating voltage and rated thermal current shall also be marked on the name plate. The diagram plate shall show the terminal markings and relative physical arrangement of the current transformer cores with respect to the primary terminals(P1 & P2)

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

4.10.00 Voltage Transformers

a) SF6 insulated voltage transformers shall be of the inductive type, constructed and tested in accordance with IEC-60044-2. They shall be

fully encapsulated. The gas compartment shall be segregated from the adjacent compartments. Minimum burden for metering class winding shall not be less than 50VA to achieve 0.2 accuracy class.

b) The thermal rating of the voltage transformer shall allow, at site conditions, a 20% continuous overloading and 50% overloading for 30 seconds with reference to the nominal rating of the voltage transformer.

c) The busbar VT's shall be connected through hand-operated isolators, which are to be provided with padlock facilities & padlocks.

d) Furthermore, to allow the testing of cables without the removal of a V.T., disconnection facilities shall be provided.

e) Secondary fuses shall be of the HRC type, suitably covered and complying with IEC-60269, or secondary circuits shall be suitably supervised by MCCB's of adequate characteristics.

f) The V.T. gas compartment shall be isolated from the adjacent gas compartments with separate gas supervision. If the V.T. 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 V.T. gas compartment.

g) The bus voltage transformers shall be located in a separate bay module on the bus and shall be connected phase-to-ground to the phase buses and shall be used for protection, metering and synchronizing.

h) Provision for short circuit and overload protection for voltage transformers against external short circuit shall be made. The same shall be installed in a separate marshalling box or control cabinet.

4.11.00 Disconnecting Switches

a) The disconnecting switches shall be of the 3-phase, single-pole, group-operated type, installed in the switchgear, in locations as shown on the single-line diagram, to provide electrical isolation of the circuit breakers from the transformer, double bus and transmission lines. The disconnectors shall be electric motor operated and shall be equipped with a manual operating mechanism for emergency use. All the disconnector and earth switches shall be provided with inspection windows so that the travel time of the switch contacts in both open and close positions can be verified by visual inspection.

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

c) The switch operating mechanisms shall be complete with all necessary linkages, clamps, couplings, operating rods, support brackets and grounding devices. All bearings shall be permanently lubricated or shall

be such that no lubrication or maintenance is required.

d) Opening and closing of the disconnectors shall be either by local or remote control. Local operation shall be by means of a two-position control switch located in the bay module control cabinet.

e) Remote control through the Remote/Local transfer switch shall be from the Substation control room.

f) The disconnector operation shall be interlocked electrically with the associated circuit breakers such that the disconnector control is inoperative if the circuit breaker is closed. Actuation of the emergency manual operating device shall also disable the electrical control. Disconnectors in open condition shall be secured against reclosure.

g) Each disconnector switch shall be supplied with 8 NO and 8 NC auxiliary switches for use by others, over and above those required for switchgear interlocking purposes.

h) Signaling of the disconnector closed position shall not take place unless it is certain that the movable contacts has reached a position in which the rated normal current, peak withstand current and short time withstand current can be carried safely.

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

j) The auxiliary switches and auxiliary circuits shall be capable of carrying a current of at least 10 A DC continuously.

k) Auxiliary switches shall be capable of breaking at least 0.2 A in a 220 V DC circuit, with a time constant of not less than 20 milliseconds. Final value of breaking capacity of auxiliary switches shall be finalised in consultation with the Control and Protection Supplier. Auxiliary switches shall be positively driven in both directions.

l) Disconnecting switches and adjacent safety grounding switches shall have electrical interlocks to prevent closure of the grounding switches when the disconnecting switches are in the closed position and to prevent closure of the disconnecting switch when the grounding switch is in the closed position. The disconnector shall be pad lockable in the close & open position.

m) Disconnecting switches having adjacent high-speed fault making grounding switches shall be interlocked such that the fault making switches close first to discharge the line charging currents before the respective disconnectors may be opened.

n) When the lines are taken out of service for maintenance, etc., the disconnectors and high-speed grounding switches located on the transmission line feeder modules of the GIS switchgear are required to operate as follows:-

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

ii. Operation of the disconnector control switch to close will close the disconnector, which -when proved 'closed', will signal the high-speed ground switch 'to open'.

o) Local control of the disconnectors and high-speed grounding switches from the bay module control panel shall be from individual control switches with the Remote/Local transfer switch set 'to Local'.

p) All electrical sequence interlocks shall apply in both Remote and Local control modes but in local mode the time delay relay shall be blocked.

q) Each disconnector switch shall have a clearly identifiable local, positively driven mechanical position indicator, together with remote position indicator on the bay module control cabinet and remotely in the powerhouse/substation control room. The indicator shall have the following wording and colouring:

	Sign	**Colour**
Open position	Open	Green
Closed position	Closed	Red

r) Each disconnector shall be fitted with an optical indicator per pole located between the pole and the driving rod so that the open or closed contacts of the disconnector are visible from the floor level.

s) Disconnector intended for use with a circuit-breaker of equal class (extended mechanical endurance) endurance class-M2 as per IEC-62271-102.

4.12.00 Maintenance Earthing Switches

a) Three-pole, group-operated, work-in-progress maintenance earthing switches shall be provided as shown on the single-line diagram. Each earthing switch group shall be electric motor (DC) operated. Means of emergency manual operation shall also be provided.

b) In order to provide test facilities, certain earthing switches may require to be insulated from the enclosures and have easily removable ground connections.

c) Each maintenance-earthing switch shall be electrically interlocked with its associated disconnecting switch and circuit breaker such that it can only be closed if both the circuit breaker and disconnecting switch are open. Once closed it shall be secured against reopening.

d) Maintenance earthing switch shall be operable locally from the bay module control cabinet only; remote control is not required.

e) Positive mechanical position indication through reliable optical indicator shall be provided locally at each switch and remotely at each bay module control cabinet, and in the powerhouse control room. The indicator shall have the following wording and coloring :

	Sign	**Background Colour**
Open position	Open	Green
Closed position	Closed	Red

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

g) Each earthing switch shall be fitted with 4 NO and 4 NC auxiliary switches for use by others, over and above those required for local interlocking and position indication purposes.

h) Provision shall be made for padlocking the earthing switches in either the open or closed positions.

i) All portions of the earthing switch and operating mechanism requiring grounding shall be connected together utilizing flexible copper conductors having a minimum cross-sectional area of 50 sqmm.

j) On opening, the line earthing switch should be able to break current induced by parallel lines according to IEC provisions.

k) The maintenance earthing switches shall conform to the requirements of IEC 129.

l) Electrical endurance for earthing switches: Earthing switches with short-circuits making capability = class E1 and shall conform to the requirements of IEC 62271-102

4.13.00 Fast Acting Earthing Switches

a) Fast acting earthing switches shall be located at the busbar and at all external HV connections of feeders like HV cables or overhead lines or transformer connections. The switching capability shall be 200 A inductive at 25 KV and 25 A capacitive at 25 KV.

b) Fast acting earthing switch shall be single pole operated with one motor

operated mechanism per single pole position. They shall also have facility for emergency manual operation and the necessary operating handles or hand cranks shall be supplied.

c) The switches shall be fitted with a stored energy closing system to provide fault-making capability.

d) The short-circuit making current rating of each ground switch shall be at least equal to its peak withstand current rating.

e) Each switch shall have a positive local mechanical position indicator and a remote indicator at the bay module control cabinet, and in the powerhouse / switchyard control room. The indicator wording and colouring shall be as follows:

	Sign	**Background Colour**
Open position	Open	Green
Closed position	Closed	Red

f) High-speed ground switch operation shall be done locally from the bay module control cabinet, or remotely from the powerhouse/substation control room in conjunction with opening of the associated disconnector switch.

g) These high-speed grounding switches shall be electrically interlocked with their associated circuit breakers such that the grounding switches cannot be closed if the circuit breakers are closed. The grounding switches shall be required to close before the disconnector switches are opened in order to dissipate the trapped charges, when the lines are taken out of service for maintenance, etc.

h) Interlocks shall be provided such that insertion of the manual operating devices will disable the electrical control circuits.

i) Each high-speed grounding switch shall be fitted with 8 NO and 8 NC auxiliary switches for use by others, over and above those required for local interlocking and position indication. All contacts shall be wired to terminal blocks in the local bay control cabinet. Provision shall be made for padlocking the grounding switches in either the open or closed position.

j) All portions of the grounding switches and operating mechanism-requiring connection to ground shall be connected together utilizing flexible copper conductor having a minimum cross-sectional area of 50 sqmm.

k) The high-speed make proof grounding switches shall conform to the requirement of I EC 129.

l) **Electrical endurance for Fast acting earthing switches:** Earthing switches with short-circuit making capability = class E1 and shall conform to the requirements of IEC 62271-102

4.14.00 Surge Arresters

a) Surge arrester shall be of SF6 gas insulated, metal enclosed, gapless metal oxide, heavy duty, station type.

b) The surge arrester shall successfully drain the dynamic currents repeatedly caused by impulse waves. The ground connection shall be sized for the fault level of the GIS.

c) The arrester tanks shall be vertically or horizontally mounted to best suit Manufacturer's switchgear layout and shall be fitted with pressure relief vents directed away from areas frequently used by operating personnel. Each arrester unit shall be fitted with a discharge counter located in an easily accessible position.

d) **The Bidder shall carry-out insulation co-ordination study** to ascertain requirement of additional surge arrestor at any other location like Primary & secondary terminals of Step-down transformer, outgoing cable termination, over the Bus within GIS installation.

e) It is found from the study that additional lightning arresters are required, same shall be provided by the Bidder. These shall be of either the "plugin" construction or the disconnect-link type and be attached to the gas insulated system in such a manner that they can be readily disconnected from the system while the system is being dielectrically tested. The metal housing of the arrester shall be connected to the metal enclosure of the GIS with a flanged, bolted joint.

f) If the arresters are not equipped with removable links, special covers and any necessary corona shields should be supplied so that the system can be pressurized and dielectrically tested after removal of the arrester.

g) Access to the arrester ground connection, when it is provided with means for leakage current monitoring should not be obstructed.

4.15.00 GIS Termination Arrangement

a) Outdoor SF6 bushings, for the connection between the GIS and overhead lines or conventional air insulated equipment shall be provided for GT, ST and Lines.

b) Bushing shall comply with the relevant IEC standards. The bushing can be with composite insulators (Silicon rubber) or with porcelain insulators with all surfaces free from imperfection. The internal and external electrical field of the bushings can be controlled by a capacitive grading body or by grading shields.

c) For SF6/Air bushings, the GIS manufacturer shall provide detailed drawings and information.

d) For ICT enclosure adapters is to be provided to connect the SF6 bus directly to the HV side SF6-to-oil transformer bushing, bolting directly to a flange on the bushing, and totally enclosing the insulator and live parts in the SF6 environment. The adapter should have a removable cover and

removable bus link to permit disconnecting the transformer from the bus, testing of the bus or transformer separately, and removal of the transformer, if required.

e) The bus enclosure is to be insulated from the ICT tank to minimize circulating currents through the transformer tank. The bus connecting the transformer to the GIS shall also contain bellows assembly and flexible conductor connection to minimize vibration transfer from the transformer.

4.16.00 Busbars and Bus Ducts

a) The SF6 single-phase/three phase encapsulated busbars and busducts shall be mounted in horizontal/vertical configuration to suit the switchgear layout and shall be single phase encapsulated.

b) The conductors of the busbars shall be fabricated of Aluminum Alloy tubular sections of cross-sectional area suitable to meet the current rating requirements. The tubular bus sections shall be housed in an aluminum enclosure, filled with pressurized SF6gas. The conductors shall be supported from the enclosures by homogeneous epoxy resin insulators shaped to ensure uniform electrical field distribution at rated voltage. Adequate provision shall be made for absorption of thermal expansion of the conductors and of differential thermal expansion between the conductors and the enclosures. Metal bellow type compensators with adjustable tensions shall be provided, where required. The enclosures shall be designed to eliminate as much as possible all external effects of the flux created by normal and fault currents. The power losses in the system shall be kept to a minimum, and induced voltages on the enclosures shall not be allowed to exceed reasonable limits of safety for operating personnel. The Supplier shall furnish supporting calculations in respect of induced voltage and losses guaranteed for the enclosure.

c) Bus end connections shall be made with multi-contact connectors to allow for axial thermal expansion of the bus. Enclosure end connections shall be flanged and shall be fitted with gaskets or O-ring seals to provide an effective gastight joint between sections allow for axial thermal expansion of the bus. Enclosure end connections shall be flanged and shall be fitted with gaskets or O-ring seals to provide an effective gastight joint between sections.

d) The common point of the two busbars should be in a separate enclosure with an earthing switch in order to ensure availability of one busbar in service at all times.

e) Each end of the busbars shall be designed for convenient future extension of the switchgear. Bus conductor end connectors and enclosure flanges shall be designed accordingly.

f) All necessary steel supporting structures required for proper erection, the manufacturer shall provide leveling and alignment of the busbars and bus ducts.

g) In order to provide an improved dielectric withstands capacity, the interior of enclosures may not be required to be painted.

4.17.00 Steel Structures

a) Manufacturer shall supply all equipment supporting structures required access ladders / stairway/ **walkways** (for accessing the equipment above two meters for maintenance and operation), transverse and longitudinal beams and supporting members, complete with all necessary hardware. Any temporary scaffolding or a movable platform, required for maintenance, shall also be supplied.

b) All steel structure members shall be hot dip galvanized after fabrication. All field assembly joints shall be bolted. Field welding shall not be acceptable.

c) Non-corrosive metal or plated steel shall be used for bolts and nuts throughout the work. Manufacturer shall provide suitable foundation channels and anchor bolts to support the switchgear assemblies. All mounting bolts, nuts and washers shall be provided to fasten the switchgear base frames to the foundation channels.

d) Foundation channels and anchor bolts shall be provided

4.18.10 Insulating Gas

i) The SF6 gas required for first filling shall be furnished with the switchgear, along with connecting hose and fittings.

ii) Characteristics

a) SF6 gas to be filled in GIS shall in all respect conform to the following values (in accordance with IEC Publication no. 60376):-

- Impurity Max allowable concentration (by weight)
- Air 0.05% CF4 0.05% Moisture 15ppm Hydrolysable fluorides expressed as HF1.0 ppm. During commissioning the dew point of SF6 gas shall be measured and documented.
- The gas leakage from each compartment of GIS shall not be more than 0.5% per year. During Transportation SF6 compartments shall be filled with N2 and refilled with SF6 at site.

iii) Gas System

a) The gas pressure shall be based on the design. The gas system shall be independently separated into logical groups to provide the largest practical gas reservoir for least leaks, but small enough to permit optimum installation, maintenance and leak detection procedures.

b) The independent gas section shall be separated by gas-tight barriers, capable of withstanding full pressure from either side with a vacuum on the opposite side.

iv) Gas Monitoring Devices

Temperature- compensated gas density monitoring devices shall be provided for each gas compartment. The devices shall provide continuous and automatic monitoring of the density of the gas. The monitoring device shall have two alarm settings. These shall be set so that:-

a) Advance warning can be given that the gas density is unacceptably low.

b) After an urgent alarm, measures can be taken to immediately isolate the particular compartment electrically by tripping circuit breakers and opening disconnect switches.

4.19.00 SF6 Gas Processing Unit

i) One No. SF6 gas processing unit suitable for evacuating, liquefying, evaporating, filling, drying and purifying SF6 gas during the initial installation, subsequent maintenance and future extension of GIS, shall be provided. The cart shall be equipped with rubber wheels and shall be easily maneuverable by two workers within the GIS building.

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

a) Evacuation from a gas filled compartment using the vacuum pump,

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

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

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

e) Evaporating and filling SF6 gas,

f) Drawing off and liquefying SF6 gas,

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

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

iv) The plant necessary for filling and evacuating the SF6 gas in the switchgear shall be supplied to enable any maintenance work to be carried out. This shall include all the necessary gas cylinders for

temporarily storing the evacuated SF6 gas. The capacity of the temporary storage facilities shall at least be sufficient for storing the maximum quantity of gas that could be removed from at least one phase of one complete bay (switchgear and associated equipment).

v) Where any item of the filling and evacuating plant is of such a weight that it cannot easily be carried by maintenance personnel, it shall be provided with lifting hooks for lifting and moving with the overhead cranes.

vi) The minimum capacity parameters of evacuation plant will be as under:
- OIL FREE SUCTION(RECOVERY)PUMP: 30M_3/HOUR
- COMPRESSOR(TWOSTAGE): 15M_3/HOUR
- OIL FREEVACUUMPUMP: 100 M_3/HOUR

vii) The evacuation equipment shall be provided with all the necessary pipes, couplings, flexible tubes and valves for coupling up to the switchgear for filling or evacuating all the gases.

viii) SF6 Gas Leakage Detecting instruments

Two numbers portable SF6 gas leakage detecting instruments shall be provided. The portable SF6 gas detector shall be light weight and provided with long flexible probe to enable detection of SF6 gas leakage from areas of gas leakage

ix) Dew Point Meter and portable partial discharge (PD) monitoring system for GIS shall be provided.

4.19.01 Corona

In general, the contours of energized metal parts of the GIS and any other accessory shall be such as to eliminate areas or points of high electrostatic flux concentrations. Surfaces shall be smooth with no projection or irregularities, which may cause corona.

4.19.02 Fire Retardancy

i) All components shall be fire retardant and shall be tested in accordance with IEC 695. Gas emissivity when the material is heated shall be minimal. PVC material shall not be used but fire-retardant cables as per IEC 332-1 may be used.

ii) Control wire in a grouped environment shall not convey flame, continue to burn when tested as per IEC 695. The method of test and criteria for success or failure shall be in accordance with the above IEC.

4.19.03 High Voltage Transients

High Voltage Transients from switching operations and internal faults are coupled to the external sheath of GIS. Since the effects of these transients on people are not known, operation personnel are required to avoid contact with the sheath during switching operations. Such a restriction is considered undesirable, and the Supplier may therefore provide devices and techniques, which may reduce such hazard or new techniques to reduce transients to an acceptable safe level.

4.19.04 Service Life

SF6 Circuit breakers, disconnect switches and ground switches will be subjected to frequent, and occasionally repetitive, no-load operations and switching offload, Capacitive and inductive current within their ratings. In order to minimize maintenance and component replacement, the Supplier shall submit proof and further guarantee that all offered SF6 GIS equipment has a minimum service life of 10,000 normal operations. The maintenance free period for any of its external components shall not be less than 5 years intervals. Internal components including refilling of gas shall not be less than 10 years. The Supplier shall propose the recommended period for schedule maintenance.

The Electrical & Mechanical Duty class of the GIS equipments shall be as follows:

S. No.	ITEM	CAPACITIVE DUTY CLASS	MECHANICAL DUTY CLASS	ELECTRICAL DUTY CLASS
1	Circuit Breakers	C2	M2	E2
2	Disconnectors	-	M2	E2
3	Fast Acting Earth switches	-	-	E1
4	Maintenance Earth switches	-	-	E1

4.20.00 **Grounding Of GIS**

i) GIS will be housed on GIS floor. The Bidder will also provide under ground mat below the substation with adequate number of Galvanized Iron risers.

ii) The Supplier shall also supply entire material for ground bus of GIS viz. conductor, clamps, joints, operating and safety platforms etc. to be laid/embedded in GIS floors. The Supplier Is also required to supply all earthing connectors and associated hardware material for:-

a) Connecting all GIS equipment, Busduct, enclosures, control cabinets, supporting structures etc. to the ground bus of GIS.

b) Connecting ground bus of GIS to the ground mat.

iii) The grounding arrangement of GIS shall ensure that touch and step voltages are limited to safe values. The enclosures of the GIS shall be grounded at several points such that there shall be a grounded cage around all live parts. The ground continuity between each enclosure shall be affected over flanges, with or without links or straps to bridge the flanges. Copper/Aluminum straps shall however bridge the metallic expansion bellows.

iv) Where operating mechanism cabinets are mounted on the switchgear, the grounding shall be made by separate conductor. Local control cabinets and marshalling boxes shall be grounded through a separate

conductor.

v) All conduits and control cable sheaths shall be connected to the control cabinet or marshalling box grounding bus. All steel structures shall be grounded.

vi) Each removable section of catwalk shall be bolted to the support structure for ground continuity.

vii) The enclosure grounding system shall be designed to minimize circulating currents and to ensure that the potential rise during an external or internal fault is kept to an acceptable level. The guidelines of IEEE Std. 80-2000 on GIS grounding, especially the transient ground potential rise caused by high frequency phenomena, shall be taken into consideration while designing the grounding system for GIS.

viii) The manufacturer shall furnish readily accessible connectors of sufficient mechanical strength to withstand electromagnetic forces as well as capable of carrying the anticipated maximum fault current without overheating by at least from two paths to ground from the main ground bus.

ix) Provisions of IEC 517 and IEC 694 regarding safeguards in earthing of connected cables, testing during maintenance and other safety measures shall be ensured.

x) POWER CABLE EARTHING: 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.

4.21.00 **Local Control Cabinet for GIS**

i) Indoor mounted, freestanding type Local Control cabinets for GIS shall be provided, one no. for each bay with IP52 degree of protection with neoprene gasket for all doors and openings.

ii) Local control cabinet for GIS shall be provided with min. 300 terminals and two subsections, viz, indicators for bay equipments, Terminal box and auxiliary supply distribution box.

iii) Terminal box: Providing intermediate termination of all auxiliary contacts of breaker, isolator and earthing switches (whether used or not) and preparing interlocking.

iv) Auxiliary supply distribution box from where both AC auxiliary supply, heating / lighting supplies and DC auxiliary control supplies shall be distributed to various motors of all CBs, isolators, earthing switch and equipment terminal boxes.

v) All terminals shall be of Stud and Nut type and mounted on DIN channels.

vi) The Local control cabinet shall also be provided with lockable doors,

panel illumination lamps with CFL and door switch, 15A power socket with switch, space heater with thermostat switch.

vii) All auxiliary contacts of the CBs, isolators and earthing switches shall be terminated in terminal box section of bay marshalling control cabinets. All hardwired interlocking shall be wired in the above box.

viii) Provision for terminating one number of 3 phase, 4 wire AC, 50 Hz power supply shall be provided. Contacts for remote alarm for supply fail shall be provided. Control cable between LCC and GIS equipment unarmoured screen cable of 1.1kV grade multi core, annealed copper conductor, Tinned copper braided screen, prefabricated cable with heavy duty multi point plug in connection on GIS end shall be provided.

ix) Single phase, 240V, AC heating and lighting supply shall be provided in loop in / loop out mode at bay marshalling cabinets. The heating and lighting supply shall be sub-distributed in radial way to provide heating and lighting supplies for all CT / PT marshalling boxes and each bay marshalling control cabinets.

x) The scheme for all protections, controls, indications, interlocking, metering, AC distribution and all other schemes shall be prepared in such a way that cables shall be laid in radial pattern. Loop formulation of cables shall be completely avoided.

4.22.00 **Online Partial Discharge (PD) Monitoring System**

For & 400kV GIS Partial Discharge Measurement is mandatory. As such online partial discharge (PD) monitoring system as per IEC60270 shall be envisaged for continuous monitoring. The number and location of these sensors shall be based on the laboratory test on typical design of GIS as per IEC recommendation of CIGRE Document No 654.

4.23.00 **TESTING AND INSPECTION**

4.23.01 All equipment, apparatus, materials and supplies provided under this Contract shall be subject to tests in the shop in the presence of the Owner/consultant and in the field, for ensuring conformity to the requirements of the specifications. The method and procedure of the tests shall be submitted.

4.23.02 Manufacturer shall, at his own expense, promptly make good all defects evident by testing or made apparent in any other way. After defects in the plant have been remedied, the plant will be subjected to such retesting as may be necessary until the plant is proved to be in satisfactory operation.

4.23.03 Within 30 days of completion of each and every test required as proof of compliance with the specifications and/or each and every specified test, including commissioning tests, manufacturer shall submit to the Owner six (6) signed copies of a report covering such tests.

4.23.04 Test reports shall indicate the tests performed, the results obtained,

instruments used, names of test personnel and provisions for witnesses' signatures. They shall also be numbered and dated. Format of these reports shall be submitted at the same time as the test procedures specified above.

4.23.05 Type Tests

a) Evidence shall be given that the proposed switchgear components to be supplied under this Contract have been subjected to all type tests at an internationally recognized testing station, and to be approved/ recognized by Owner If it deemed necessary, Owner will decide whether additional tests are necessary to be performed.

b) The Bidder shall submit type test certificates covering the proposed switchgear components.

c) Type tests certificates/reports shall be considered acceptable if they are in compliance with the latest applicable relevant Standards (class "A" as per IEC Standards) and the following:-

- Type Tests conducted at an internationally recognized laboratory (KEMA or equivalent) acceptable to Owner.
- Repeated Type Tests conducted at the manufacturer's laboratory, witnessed by representatives from an internationally recognized laboratory (KEMA or equivalent) and accepted by owner.

d) For the offered Circuit Breaker Type, type tests results of already executed tests shall be indicated in the concerned Technical Data Sheet.

e) If the presented type test results are not in accordance with the above requirements, Owner reserves the right to ask for the type tests to be repeated in the manufacturer's premises or other places subject to the approval of Owner and at no additional cost. These tests shall be performed by an internationally recognised laboratory (KEMA or equivalent) and in the presence of Owner. The internationally recognised laboratory shall issue the relevant type test certificates upon successful test.

f) The following tests shall be carried out as a minimum requirement:-

- Dielectric tests
- Temperature rise test
- Internal arc test
- Making and breaking tests
- Rated peak withstand current and rated short time current tests on main and earthing circuits
- Operation & mechanical endurance tests.

4.23.06 Routine Tests

a) Switchgears and their components shall be subjected to routine tests as per the latest relevant IEC recommendations.

b) Routine test certificates shall be submitted for Owner's review and approval before shipment of the switchgear components.

c) Following tests shall be performed as routine tests in addition to the standard tests:

- At least one local control cubicle (LCC) shall be tested together with the GIS during factory acceptance tests
- Speed and timing tests for circuit breakers
- Partial discharge measurements
- Chattering time of the arc contact shall be measured and recorded at no-load operations
- Visual inspection of the switchgear, in order to ensure that all components are mechanically assembled and fixed properly and that there are no imperfections.

4.23.07 Site Tests

For site tests, the following shall be performed in particular:-

a) Speed and timing tests for circuit breakers

b) Timing tests for disconnectors and earthing switches

c) Humidity/dew point measurement tests of SF6 gas during commissioning, three months after that, before issuance of FAC, and at each refill operation. Critical dew points are subject to the approval of Owner.

d) Voltage drop tests during commissioning

e) Functional interlocking tests

f) Power frequency voltage test for switchgear and auxiliary circuits. The power frequency test (50 Hz) voltage shall be 65% of the rated voltage for existing busbar extensions and 80% of rated voltage for new GIS.

g) Gas leakage test on each bay with high sensitive gas leakage detector on all seals.

h) Partial discharge measurement for 400kV GIS is mandatory.

4.23.08 The Bidder/Bidder shall prove that the HV circuit breakers are capable of

interrupting

a) The capacitive current.

b) The inductive current.

4.23.09 The Bidder/Bidder shall furthermore advise and guarantee the minimum number of switching operations for the conditions as mentioned above within the arrangement as designed by him.

4.24.00 **SPECIAL TOOLS AND TACKLES**

4.24.01 A set of special tools & tackles which are necessary or convenient for erection, commissioning, maintenance and overhauling of the equipment as mentioned elsewhere shall be supplied.

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

4.25.00 SPARES

4.25.01 The bidder shall quote for the mandatory spares as mentioned in the specification.

4.26.00 DRAWINGS, DATA, INFORMATION AND MANUALS

Drawings, data, information and manuals shall be submitted as indicated below:-

4.26.01 Along with the bid

- Electrical single line diagram showing metering, protection scheme & a write-up on control philosophy.
- Type of plant & equipment proposed to be used.
- Write-ups, curves and information required to fully describe the equipment & system offered.
- List of different equipment and make.
- Technical leaflets and general constructional details.
- Type test report of similar equipment.
- Auxiliary power supply arrangement.
- BOQ of major Equipment
- Bidder to submit the Performance certificate for major items supplied /manufactured by them like CT, CB, CVT, PT, Isolator, C & R Panel

for satisfactory operation of at least three years as on date of bid opening and shall ensure that offered major items shall be supplied by them only from same manufacturing unit /works against which they will submit the above performance certificate.

4.26.02 After the award of Contract, the following drawings shall be submitted progressively:-

a) Complete Bill of Material.
b) Single line diagram giving rating of each equipment.
c) Gas Schematic Diagram.
d) Three-dimensional general arrangement drawing to show the location of equipment & access platforms.Design calculations in support of selection of equipment rating and system design.
e) Layout of substations with sections.
f) Guaranteed Technical Particulars of GIS along with each equipment and accessories.
g) Earthing drawings and details.
h) Dimensional general arrangement drawing along with cross-sections for equipment.
i) Block Logic Diagram
j) EKD for both GIS.
k) Quality Assurance Plan of major Equipment
l) Rating & Name Plate Details
m) Test Certificates of major Equipment
n) Foundation plan and loading data.
o) GIS/LCC Control schematic and wiring diagram.
p) Cable schedule and interconnection.
q) Pre- Commissioning & commissioning checklist.
r) Erection and maintenance manual.
s) Any other drawings & data as required for satisfactory installation, operation & maintenance.

TABLE – A

SYSTEM PARTICULARS

S. No.	Detail	400 kV System
1.	Voltage (Nom. /Max.)	400/420 kV
2.	Frequency	50 ±5% Hz
3.	Ambient temperature	50 Deg C
4.	Fault Level	63 kA for 1 sec
5.	System earthing	Solidly earthed
6.	Short-time current rating (for all current carrying parts)	63 KA for 1 second
7.	Basic Insulation Level	1425 kV_{peak}
8.	Switching Impulse	
a)	Ph-E	1050 kV_{peak}
b)	Ph-Ph	1575 kV_{peak}
9.	Power frequency withstand voltage KV rms Dry/Wet	630 kV_{peak}
10.	Maximum radio interference voltage level at 1 MHz & 266 KV rms phase to ground voltage for HV winding (Micro volt)	1000 µ Volt (at 320 kV rms)
11.	Rated Normal Current bus bar	2000 A
12.	Rated Normal Current feeder	2000 A
13.	Rated short breaking Current	63 kA
14.	Rated peak withstand current	157.5 kA_{peak}
15.	Rated Short-time withstand current	63 kA
16.	Leakage rate per year and gas compartment	$\leq$ 0.5%
17.	Driving mechanism of circuit-breaker	Stored energy spring
18.	Operating Sequence of Circuit Breaker	0-0.3s CO-3 min-CO for Line; CO-15 s-CO for transformer/generator
19.	Minimum clearances in air	
a)	Between Phases	4200 mm
b)	Between Phase to Earth	3500 mm
c)	Sectional Clearance	6500 mm
d)	Clearance from bottom of Insulator to Ground	2450 mm
e)	Ground Clearance	8000 mm
20	Creepage distance mm for SF6 to air bushing	Bidder to furnish
21.	Auxiliary Power Supply	
a)	AC System	415 V
b)	DC System	220 V

c)	UPS	240 V
22	Circuit breaker opening time	< 40 mill seconds
23	Circuit breaker closing time	< 150 mill seconds
24	First pole to clear factor	1.3

TABLE – B

RATING AND REQUIREMENT

S. No.	Detail	400 kV System
1.	The ratings and electrical characteristics of the complete GIS shall be as given hereunder. The ratings applicable to specific items of equipment are included in the relevant clauses dealing with that equipment.	
2.	Type of GIS	Single phase enclosed switchgear.
3.	Location	Indoor
4.	Maximum ambient temperature	50 Deg C
5.	Minimum ambient temperature	3 Deg C
6.	Nominal voltage class	400 KV_{RMS}
7.	Rated voltage	420 KV
8.	Rated frequency	50 Hz
9.	Number of phases	Three
10.	Number of busbars	2
11.	Rated normal current at 50 Hz	2000 A_{RMS}
12.	Rated short circuit current at rated maximum voltage, not less than (symmetrical)	63 KA
13.	Lightning impulse withstand voltage (phase to phase and phase to earth) At minimum operating gas pressure	1425 kV_{peak}
14.	Switching impulse withstand voltage	1050 kV_{peak} (Ph-E)
15.	1 Minute power frequency withstand voltage	630 kV_{RMS}
16.	Rated peak withstand current	157,5 kA_{peak}
17.	Material of enclosure	Aluminium Alloy
18.	Material of bus bar	Copper /Aluminium Alloy
19.	Insulation medium	SF6
20.	Leakage rate of SF6 per annum for each compartment	$\leq$ 0.5%
21.	Partial Discharge Level, pc	$\leq$ 10 pC at 1.5 Un/ 3
22.	Noise level	48 dB
23.	Degree of Protection	IP65
24.	Max. SF6 Operating pressure	$\leq$ 8.5
25.	Rated Auxiliary supply voltage	220 V DC /415 V, 3 phase/240 V, single phase

26.	All current carrying components of the equipment specified shall be capable of continuous operation at the specified rated current without exceeding the maximum temperature rises specified in the relevant IEC standards.
27.	Thermal calculations shall be based on the climatic conditions given above.

TABLE – C

HIGH VOLTAGE OUTDOOR BUSHING

S. No.	Detail	400 kV System
1.	Applicable standards	IEC 60137, 61463
2.	Operating voltage (U0/U)	400 kV
3.	Highest System voltage	420 kV
4.	Rated short-circuit withstand current	63 kA for 1 second
5.	Rated peak withstand current	157.5 kA_{PEAK}
6.	Insulation medium	SF6
7.	Material of enclosures	Porcelain/ composite insulators (Silicon rubber)
8.	Lightning impulse withstand voltage (peak) (phase to phase and phase to earth) at minimum pertaining gas pressure	1425 kV_{peak}
9.	Switching impulse withstand voltage (phase to earth) at minimum gas pressure	1050 kV_{peak}
10.	Power frequency withstand voltage (1 min.) (phase to phase and phase to earth) at minimum operating gas pressure Rated current	630 kV_{peak}

TABLE – D

DISCONNECTING SWITCH (GIS)

S. No.	Detail	400 kV System
1.	Applicable standards	IEC 62271 - 102
2.	Mechanical Endurance Class	M2
3.	Withstand Voltages	
a.	At power frequency, 1 min.	630 kV (rms)
b.	At impulse (1.2/50)	1425 kV_{RMS}
4.	Short Time Current	63 kA for 1 Sec 157.5 kA_{PEAK}
5.	Type of Operating Mechanism	Motor driven & manual
6.	Facility for emergency manual operation	Yes
7.	Interlocking with earth switch	Electrical interlock

TABLE – E

MAINTENANCE EARTH SWITCH (GIS)

S. No.	Detail	400 kV System
1.	Applicable standards	IEC 62271 - 102
2.	Mechanical Endurance Class	M1
3.	Electrical Endurance Class	E0
4.	Withstand Voltages	
a.	At power frequency, 1 min.	630 kV (rms)
b.	At impulse (1.2/50)	1425 kV_{RMS}
5.	Short Time Current	63 kA for 1 Sec 157.5 kA_{PEAK}
6.	Type of Operating Mechanism	Motor driven & manual
7.	Facility for emergency manual operation	Yes
8.	Interlocking with earth switch	Electrical interlock

TABLE – F

CURRENT TRANSFORMER (GIS)

S. No.	Detail	400 kV System
1.	Applicable standards	IEC 618691-1 & IEC 61869-2
2.	Withstand Voltages	
a.	At power frequency, 1 min.	630 kV (rms)
b.	At impulse (1.2/50)	1425 kV_{RMS}
3.	Short Time Current	63 kA for 1 Sec 157.5 kA_{PEAK}
4.	Insulation Class	E

TABLE – G

VOLATGE TRANSFORMER (GIS)

S. No.	Detail	400 kV System
1.	Applicable standards	IEC 60044-2
2.	Withstand Voltages	
a.	At power frequency, 1 min.	630 kV (rms)
b.	At impulse (1.2/50)	1425 kV_{RMS}
3.	Short Time Current	63 kA for 1 Sec 157.5 kA_{PEAK}
4.	Voltage Factor	1.2 Continuous 1.5 for 30 seconds

SECTION- 3
PROJECT DETAILS AND GENERAL SPECIFICATIONS

3.0 GENERAL

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

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

3.1 PROJECT DETAILS

	Particular	**Details**
a)	Customer	HARYANA POWER GENERATION CORPORATION LIMITED, PANCHKULA, HARYANA
b)	Project Title	Deen Bandhu Chhotu Ram Thermal Power Plant (1X800 MW Expansion Unit), Yamuna Nagar
c)	Owner's Consultant	DESEIN PRIVATE LIMITED, NEW DELHI
d)	Project Location	Place: Kalanaur District: Yamuna Nagar State: Haryana Country: India
e)	Latitude & Longitude of site	Latitude: 30^0 06' 34" N Longitude: 77^0 19' 43" E
f)	Nearest Railway Station	Kalanaur Station (2.0 Km)
g)	Nearest Major Town	Yamuna Nagar located at a distance of 8 Km
h)	Nearest Highway	National Highway - 344
i)	Nearest commercial airport	Chandigarh, 110 Km
j)	Nearest Water Body	Western Yamuna Canal, adjacent to site
k)	Site Land	Land is in possession of HPGCL.
	SITE CONDITIONS (for design purposes)	
a)	Design ambient temperature	50°C
b)	Maximum Relative humidity	95% (at 40°C)
c)	Height above mean sea level	Less than 1000meter
d)	Climatic condition	***Refer enclosed Climatological Table***
e)	Pollution Severity	Heavily polluted
f)	Criteria for Wind Resistant design of structures and equipment	Standard Applicable - IS 875 (Part 3)
g)	Basic Wind speed "Vb" at ten meters above the mean ground level.	47m/sec
h)	**SEISMIC LOAD**	• Seismic analysis shall be carried out as per the latest edition of IS:1893 (Part 1 & 4). Zone-IV shall be considered for design.

		• The structures shall be classified into four categories as per table 5 of IS:1893 (Part4). • Importance factor for each structure shall be as per Table 2 of IS:1893 (Part4) or mentioned elsewhere in specification , whichever is higher. • Method of analysis for each structure shall be decided as per clause 10.3 IS:1893 (Part4), which depends on the seismic zone & category of the structure. • Response Reduction factor shall be as per Table 3 of IS:1893 (Part4).
i)	**WIND LOAD**	• Basic wind speed at project site is 47m/sec. as per IS:875 Part-3 • Probability factor, (k1 risk coefficient), terrain, height and structure size factor, • k2 and topography factor, k3 shall be as per IS:875.

3.1.1 SYSTEM PARAMETERS:

Sl.No.	Parameters	400kV
1	Highest system voltage	420kVrms
	Rated/ nominal system voltage	400kVrms
2	Lightning Impulse voltage (Phase to earth & between phases)	±1425kVp
3	Switching impulse voltage (Phase to earth)	±1050kVp
	Switching impulse voltage (Phase to Phase)	±1575 kVp
4	Power frequency withstand for 1 min (rms) (Dry/wet)	630 kVrms
5	Max. fault level (1 sec.)	63 kA
6	Minimum creepage distance (31mm/kV)	13020 mm

3.1.2 The minimum clearances for 400kV/220kV switchyards shall be as given below:

Sl. No.	DESCRIPTION	400kV SYSTEM	220kV SYSTEM
1	PHASE TO PHASE FOR CONDUCTOR–CONDUCTOR CONFIGURATION FOR ROD–CONDUCTOR CONFIGURATION	 4000mm 4200mm	 2100mm 2100mm
2	PHASE TO EARTH FOR CONDUCTOR–CONDUCTOR STRUCTURE FOR ROD–CONDUCTOR CONFIGURATION	 3500mm 3500mm	 2100mm 2100mm
3	SECTIONAL CLEARANCE	6500mm	5000mm
4	VERTICAL DISTANCE BETWEEN LOWEST PART OF INSULATOR TO PLINTH	2550mm	2550mm
5	CREEPAGE(@31MM/KV)	13020mm	7595mm
6	HEIGHT OF TUBULAR CONDUCTOR ABOVE PLINTH(MIN.)	8000mm	5900mm

3.1.3 AUXILIARY POWER:

S. No	Description	400 kV System	220 kV System	11 kV System	6.6 kV System	415V System	415 V System (Lighting & Welding Systems)	240 V System	220 V DC System
1	Nominal Voltage	400 kV	200 kV	11 kV	6.6 kV	415 V	415 V	240 V	220 V
2	Highest System Voltage	420 kV	245 kV	12 kV	7.2 kV	457 V	457 V	264 V	242 V
3	Number of Phases (Conductor)	Three (3)	Three (3)	Three (3)	Three (3)	Three (3)	Four (4)	Two (2)	(2)
4	Frequency	50 Hz	50 Hz	50 Hz	50 Hz	50 Hz	50 Hz	50 Hz	NA
5	Voltage Variation	± 10%	± 10%	± 10%	± 10%	± 10%	± 10%	± 10%	+ 10% to – 15%
6	Frequency Variation	± 5%	± 5%	± 5%	± 5%	± 5%	± 5%	± 5%	NA
7	Combined Voltage & Frequency Variation	10 %	10 %	10 %	10 %	10 %	10 %	10 %	NA
8	Neutral Earthing	Solidly Grounded	Solidly Grounded	Medium Resistance Grounded	Medium Resistance Grounded	Solidly Grounded	Solidly Grounded	Solidly Grounded	Un-grounded
9	Fault Level	63 kA for 1 second	50 kA for 1 second	50 kA for 1 second	40 kA for 1 second	50 kA for 1 second	10 kA for 1 second	10 kA for 1 second	15 kA $$ for 1 second
	Note: $$ denotes fault level at DCDB level shall be 15kA while at DLDB level fault level shall be 10kA.								

3.2 INSTRUCTION TO BIDDERS:

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

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

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

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

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

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

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

3.3 CODES AND STANDARDS

3.3.1 In addition to the codes and standards (also refer CHAPTER – 37- CODES & STANDARDS) specifically mentioned in the relevant technical specifications for the equipment / plant / system, all equipment parts, systems and works covered under this specification shall comply with all currently applicable statutory regulations and safety codes of the Republic of India as well as of the locality where they will be installed, including the following:

a) Bureau of Indian Standards (BIS).
b) Indian Boiler Act, 1923, and Rules and Regulations specified thereunder.
c) Indian Factory Act, 1948, and Rules and Regulations specified thereunder.
d) Indian Explosives Act, 1884, and Rules and Regulations specified thereunder.
e) Indian Petroleum Act, 1934, and Rules and Regulations specified thereunder.
f) ASME Test Codes.
g) AIEE Test Codes.
h) IEEE 122.
i) IEC 34.1, 34.3.
j) American Society of Materials Testing Codes.
k) Bureau of the Indian Standards (BIS) .
l) Indian Electricity Act (2003)
m) Indian Electricity Rules
n) Indian Explosives Act
o) Indian Factories Act and State Factories Act
p) Indian Boiler Regulations (IBR)
q) Regulation of Central Electricity Authority
r) Regulations of the Central Pollution Control Board, India
s) Regulations of the Ministry of Environment & Forest (MOEF),
t) Pollution Control Regulations by Department of Environment, Government of India
u) State Pollution Control Board.
v) Building and other construction workers (Regulation of Employment and Conditions of services) Central Rules, 1998
w) Explosive Rules, 1983
x) Petroleum Rules, 1976,
y) Gas Cylinder Rules, 1981
z) Static and Mobile Pressure Vessels (Unified) Rules, 1981
aa) Workmen's Compensation Rules, 1924

bb) Rules for Electrical installation by Tariff Advisory Committee (TAC) and appropriate Electrical Inspectorate.
cc) Owner's Safety Policy
dd) Any other statutory codes / standards / regulations, as may be applicable.

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

a) British Standards (BS)
b) Japanese Industrial Standards (JIS)
c) American National Standards Institute (ANSI)
d) American Society of Testing and Materials (ASTM)
e) American Society of Mechanical Engineers (ASME)
f) American Petroleum Institute (API)
g) Standards of the Hydraulic Institute, U.S.A.
h) International Organization for Standardization (ISO)
i) Tubular Exchanger Manufacturer's Association (TEMA)
j) American Welding Society (AWS)
k) Cooling Tower Institute (CTI)
l) National Electrical Manufacturers Association (NEMA)
m) National Fire Protection Association (NFPA)
n) International Electro-Technical Commission (IEC)
o) Expansion Joint Manufacturers Association (EJMA)
p) Heat Exchange Institute (HEI)
q) IEEE standard
r) JEC standard

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

3.3.4 As regards highly standardized equipment such as Steam Turbine and Generator, National /International standards such as JIS, DIN, VDI, ISO, SEL, SEW, VDE, IEC & VGB shall also be considered as far as applicable for Design, Manufacturing and Testing of the respective equipment. In addition, these standards shall be referred for the design of machine foundations, wherever specifically mentioned in the specifications. However, for those of the above equipment not covered by these National/International standards, established and proven standards of manufacturers shall also be considered.

3.3.5 In the event of any conflict between the codes and standards referred to in the above clauses and the requirement of this specification, the requirement of Technical Specification shall govern.

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

3.3.7 Two (2) English language copies of all national and international codes and/or standards used in the design of the plant and equipment shall be provided by the Contractor to the Owner within two calendar months from the date of the Notification of Award

3.4 SERVICES TO BE PERFORMED BY THE EQUIPMENT BEING FURNISHED

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

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

3.5 ENGINEERING DATA

3.5.1 Drawings

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

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

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

All manufacturing, fabrication and execution of work in connection with the equipment/system prior to the approval of the drawings shall be at the bidder's risk. The bidder is expected not to make any changes in the design of the equipment /system, once they are approved by the Purchaser. However, if some changes are necessitated in the design of the equipment/system at a later date, the bidder may do so, but such changes shall promptly be brought to the notice of the Purchaser indicating the reasons for the change and

get the revised drawing approved again in strict conformance to the provisions of the Technical Specification. Approval of bidder's drawing or work by the Purchaser shall not relieve the bidder of any of his responsibilities and liabilities under the Contract.

All engineering data submitted by the contractor after final process including review and approval by the purchaser shall form part of the contract document and the entire work performed under these specifications shall be performed in strict conformity with technical specification, unless otherwise expressly requested by the purchaser in writing.

3.5.2 Bidder's Drawing Submission and Approval Procedure

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

a. All data/information furnished by Bidder/ vendor in the form of drawings, documents, Catalogues or in any other form for Customer/ Employer's information/interface and/or review and approval are referred by the general term "drawings".
b. The 'Master drawings list' indicating titles, Drawing Number, Date of submission and approval etc. shall be furnished by the bidder. This list shall be updated if required at suitable interval during detailed engineering.
c. All drawings (including those of sub-bidder/ vendor) shall bear at the right hand bottom corner the 'title plate' with all relevant information duly filled in. The bidder shall furnish this format to his sub-bidder/ vendor along with his purchase order for sub-bidder/ vendor's compliance.
d. Contractor shall submit all the drawings in five (5) copies for review of Customer/ Employer. Customer/ Employer shall forward their comments within four (4) weeks of receipt of drawings.
e. Upon review of each drawing, depending on the correctness and completeness of the drawings, the same will be categorised and approval accorded in one of the following categories:

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

f. Bidder shall resubmit the drawings approved under Category II, III within one (1) week of receipt of comments on the drawings, incorporating all comments. Every revision of the drawing shall bear a revision index wherein such revisions shall be highlighted in the form of description or marked up in the drawing identifying the same with relevant revision number enclosed in a triangle (e.g 1.2.3. etc.).
g. In case Bidder does not agree with any specific comment, he shall furnish the explanation for the same to Customer/ Employer for consideration. In all such cases Bidder shall necessarily enclose explanations along with the revised drawing (taking care of balance comments) to avoid any delay and/or duplication in review work.
h. It is the responsibility of the Bidder to get all the drawings approved in the Category I or IV (as the case may be) and complete engineering activities within the agreed schedule. Any delay arising out of submission and modification of drawings shall not alter the contract completion schedule.
i. Bidder shall not make any changes in the portions of the drawing other than those commented. If changes are required to be made in the portions already approved, the Bidder shall resubmit the drawings identifying the changes (along with reasons for changes) for Customer/ Employer's review and approval. **Drawings resubmitted shall show clearly the portions where the same are revised**

marking the relevant revision numbers and Customer/ Employer shall review only such revised portion of documents.

j. As Built Drawings

After final acceptance of individual equipment / system by the Customer/ Employer, the Bidder will update all original drawings and documents for the equipment / system to "as built" conditions and submit no. of copies as per clause 3.5.5.

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

3.5.3 Erection Drawings

a. Contractor shall furnish erection drawings for the guidance or commencement of erection or the first shipment, whichever is earlier. These shall generally comprise of fabrication/assembly drawings, various component/part details drawing, assembly, clearance data requirements, etc. The drawings shall contain details of components/ equipment with identification number, match marks, bill of materials, assembly procedures etc.
b. For all major equipment apart from above details, assembly sequence and instructions with check-lists shall be furnished in the form of erection manuals.

3.5.4 Instruction Manual

a. The Contractor shall submit to the Customer/ Employer preliminary instruction manuals for all the equipments for review. The final instructions manuals incorporating Customer/ Employer's comments and complete in all respect shall be submitted at least sixty (60) days before the first shipment of the equipment. The instruction manuals shall contain full details and drawings of all the equipments, the transportation, storage, installation, testing, commissioning, operation and maintenance procedures, etc. separately for each component/equipment along with log record format. These instruction manuals shall be submitted in five (5) copies for approval.
b. If after commissioning and initial operation of the plant, the instruction manuals require any modifications/additions/changes, the same shall be incorporated and the updated final instruction manuals shall be submitted.
c. The operating and maintenance instructions together with drawings (other than shop drawings) of the equipment, as completed, shall have sufficient details to enable the Customer/ Employer to maintain, dismantle, reassemble and adjust all parts of the equipment. They shall give a step by step procedure for all operations likely to be carried out during the life of the plant/equipment, including erection, testing, commissioning, operation, maintenance dismantling and repair. Each manual shall also include a complete set of approved drawings together with performance/rating curves of the equipment and test certificates, wherever applicable. The contract shall not be considered completed for purpose of taking over until such instructions and drawings have been supplied to the Customer/ Employer.
d. A separate section of the manual shall be for each size/type of equipment and shall contain a detailed description of construction and operation, together will all relevant pamphlets.
e. The manuals shall include the following
   a) List of spare parts along with their drawing and catalogues and procedure for ordering spares.
   b) Lubrication Schedule including charts showing lubrication checking, testing and replacement procedure to be carried daily, weekly, monthly & at longer intervals to ensure trouble free operation.

f. Where applicable, fault location charts shall be included to facilitate finding the cause of mal-operation or break down.
g. A collection of the manufacturer's standard leaflets will not accepted to be taken as a compliance of this clause. The manual shall be specifically compiled for the concerned project.

The Instruction Manuals shall comprise of the following:

3.5.4.1 Erection Manuals

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

a) Erection strategy.
b) Sequence of erection.
c) Erection instructions.
d) Critical checks and permissible deviation/tolerances.
e) List of tools, tackles, heavy equipments like cranes, dozers, etc.
f) Bill of Material
g) Procedure for erection and General Safety procedures to followed during erection/installation.
h) Procedure for initial checking after erection.
i) Procedure for testing and acceptance norms.
j) Procedure / Check list for pre-commissioning activities.
k) Procedure / Check list for commissioning of the system.
l) Safety precautions to be followed in electrical supply distribution during erection.

3.5.4.2 Operation and Maintenance Manuals

a) The manual shall be a two rim PVC bound stiff sided binder able to withstand constant usage or where a thicker type is required it shall have locking steel pins, the size of the manual shall not be larger than international size A3. The cover shall be printed with the Project Name, Services covered and Volume / Book number Each section of the manual shall be divided by a stiff divider of the same size as the holder. The dividers shall clearly state the section number and title. All written instructions within the manual not provided by the manufacturers shall be typewritten with a margin on the left-hand side.

3.5.5 Final Submission of drawings and documents:

The Bidder shall furnish the following after approval of all drawings /documents and test reports:

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

3.5.6 TEST REPORTS

Two (2) copies of all test reports shall be supplied for approval before shipment of Equipment. The report shall indicate clearly the standard value specified for each test to facilitate checking of the reports. After

final approval six (6) bound copies and two (2) sets of CD-ROMs/ DVD/Portable hard disk of all type and routine test reports shall be submitted to Customer/ Employer.

3.6 MATERIAL /WORKMANSHIP

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

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

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

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

3.7 PROVISIONS FOR EXPOSURE TO HOT AND HUMID CLIMATE

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

SPACE HEATERS

The heaters shall be suitable for continuous operation at 240 V as supply voltage. On –off switch and fuse shall be provided.

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

The heaters shall be suitably designed to prevent any contact between the heater wire and the air and shall consist of coiled resistance wire centered in a metal sheath and completely encased in a highly compacted powder of magnesium oxide or other material having equal heat conducting and electrical insulation properties or they shall consist of resistance wire wound on a ceramic and completely covered with a ceramic material to prevent any contact between the wire and the air. Alternatively, they shall consist of a resistance wire mounted into a tubular ceramic body built into an envelope of stainless steel or the resistance wire is wound on a tubular ceramic body and embedded in vitreous glaze. The surface temperature of the heaters shall be restricted to a value which will not shorten the life of the heater sheaths or that of insulated wire or other component in the compartments.

Control cubicles installed in air-conditioned area need not be provided with space heaters. These cubicles shall, however, have space heaters in case of storage of cubicles for long duration.

FUNGI STATIC VARNISH

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

Ventilation opening

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

Degree of Protection

The enclosure of the Control Cabinets, Junction boxes and Marshalling Boxes, panels etc. to be installed shall provide degree of protection as detailed here under:

a. Installed outdoor: IP- 55
b. Installed indoor in air-conditioned area: IP-32
c. Installed in covered area: IP-52
d. Installed indoor in non-air-conditioned area where possibility of entry of water is limited: IP-41.
e. For LT Switchgear (AC & DC distribution Boards): Indoor: IP-52, Outdoor: IP-54

The degree of protection shall be in accordance with IS: 13947 (Part –I) / IEC-947 (Part-I) / IS 12063/IEC 529. Type test report for degree of protection test, on each type of the box shall be submitted for approval.

PRESERVATIVE SHOP COATING

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

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

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

3.8 RATING PLATES, NAME PLATES AND LABELS

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

3.8.2 Such nameplates or labels shall be of white non-hygroscopic material with engraved black lettering or alternately, in the case of indoor circuit breakers, starters, etc. of transparent plastic material with suitably coloured lettering engraved on the back.

3.8.3 Each equipment shall be provided with nameplate or label designating the service of the particular equipment. The inscriptions shall be approved by the Customer/ Employer or as detailed in appropriate section of the technical specifications.

3.8.4 The rated current, extended current rating and rated thermal current shall be clearly indicated in the name plate in case of current transformer.

3.8.5 Rated voltage, voltage factor and intermediate voltage shall be clearly indicated on the nameplate in case of capacitor voltage transformer.

3.8.6 Each switch shall have a clear inscription identifying its function. Switches shall also have a clear inscription of each position indication.

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

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

3.9 GALVANISING:

3.9.1 All exposed ferrous parts shall be hot dip galvanised as per IS:2629 & IS:2633, Galvanising shall be uniform, clean, smooth continuous and free from acid spots. Should the galvanising of the sample be found defective, the entire batch of steel shall have to be re-galvanised at bidder's cost.

3.9.2 The amount of zinc deposit over threaded portion of the bolts, nuts and screws shall not be less than 300 gms. per sq. meter of surface area. The amount of zinc deposit on washers shall not be less than 340 gms. per sq. meter of surface area or a minimum of 30 microns. The threads shall have extra deposit of zinc which shall be removed by die cutting after the completion of galvanising. The removal of extra zinc shall be carefully done so that threads shall have the required deposits of zinc on them as specified.

3.10 PAINTING

Unless explicitly stated in relevant chapters of the specification, the painting of all electrical equipment shall be as follows:

Epoxy based with suitable additives. The thickness of finish coat shall be minimum 50 microns (minimum total DFT shall be 100 microns). However, in case electrostatic process of painting is offered for any electrical equipment, minimum paint thickness of 50 microns shall be acceptable for finish coat. Paint shade shall be as per technical specification.

3.11 QUALITY ASSURANCE PROGRAMME

3.11.1 The Bidder shall adopt suitable quality assurance programme to ensure that the equipment and services under the scope of contract whether manufactured or performed within the Bidder's works or at his subcontractor's premises or at the Customer/ Employer's site or at any other place of work are in accordance with the specifications. Such programmes shall be outlined by the Contractor and shall be finally accepted by the Customer/ Employer/authorised representative after discussions before the award of the contract. The QA programme shall be generally in line with ISO-9001/IS-14001.

A quality assurance programme of the contractor shall generally cover the following,

i. His organisation structure for the management and implementation of the proposed quality assurance programme.
ii. Quality System Manual
iii. Design Control System
iv. Documentation Data Control System
v. Qualification data for Bidder's key Personnel.
vi. The procedure for purchase of materials, parts, components and selection of sub-contractor's services including bidder/ vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc.
vii. System for shop manufacturing and site erection controls including process controls and fabrication and assembly controls.
viii. Control of non-conforming items and system for corrective actions and resolution of deviations.
ix. Inspection and test procedure both for manufacture and field activities.
x. Control of calibration and testing of measuring testing equipments.
xi. System for Quality Audits.
xii. System for identification and appraisal of inspection status.
xiii. System for authorising release of manufactured product to the Customer/ Employer.
xiv. System for handling storage and delivery.
xv. System for maintenance of records, and
xvi. Furnishing quality plans for manufacturing detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component as per format enclosed as Annexure-I.

3.12 GENERAL REQUIREMENTS - QUALITY ASSURANCE

3.12.1 All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the Bidder for some of the major items is given in the respective technical specification. This is, however, not intended to form a comprehensive programme as it is the Bidder's responsibility to draw up and implement such programme duly approved by the Customer/ Employer. The detailed Quality Plans

for manufacturing and field activities should be drawn up by the Bidder and will be submitted to Customer/ Employer for approval.

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

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

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

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

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

3.12.7 All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section IX/BS-4870 or other International equivalent standard acceptable to the Customer/ Employer.

3.12.8 All welding/brazing procedures shall be submitted to the Customer/ Employer or its authorised representative for approval prior to carrying out the welding/brazing.

3.12.9 All brazers, welders and welding operators employed on any part of the contract either in Bidder's/his sub-contractor's works or at site or elsewhere shall be qualified as per ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the Customer/ Employer.

3.12.10 Test results or qualification tests and specimen testing shall be furnished to the Customer/ Employer for approval. However, where required by the Customer/ Employer, tests shall be conducted in presence of Customer/ Employer/authorised representative.

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

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

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

3.12.14 Unless otherwise proven and specifically agreed with the Customer/ Employer, welding of dissimilar materials and high alloy materials shall be carried out at shop only.

3.12.15 All non-destructive examination shall be performed in accordance with written procedures as per International Standards. The NDT operator shall be qualified as per SNT-TC-IA (of the American Society of non-destructive examination). NDT shall be recorded in a report which includes details of methods and equipment used, result/evaluation, job data and identification of personnel employed and details of co-relation of the test report with the job. In general all plates of thickness greater than 40mm & for pressure parts plates of thickness equal to or greater than 25mm shall be ultrasonically tested otherwise as specified in respective equipment specification. All bar stock/Forging of diameter equal to or greater than 40mm shall be ultrasonically tested.

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

3.12.17 For components/equipment procured by the Bidders for the purpose of the contract, after obtaining the written approval of the Customer/ Employer, the Bidder's purchase specifications and inquiries shall call for quality plans to be submitted by the suppliers. The quality plans called for from the subcontractor shall set out, during the various stages of manufacture and installation, the quality practices and procedures followed by the bidder/ vendor's quality control organisation, the relevant reference documents/standards used, acceptance level, inspection of documentation raised, etc.

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

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

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

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

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

3.13 Software Reliability / Quality Certification

Certification from OEM's authorized signatory that software offered with DDCMIS, PLC, CCTV, PA, Pyrometer, CEMS, AAQMS, EQMS, BHMS etc. declaring that the all the offered software(s) had gone through the established software quality test and offered software is not of β-version and offered software is also free from all known bugs as on date of approval of systems documents by OWNERS ENGINEERING as a part of quality documentation review and approval process during detail engineering.

3.14 QUALITY ASSURANCE DOCUMENTS

The Contractor/ bidder shall be required to submit two hard copies and two sets on CDROMs/ pen drive of the following Quality Assurance Documents as identified in respective quality plan with tick (√) mark.

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

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

The final quality document will be compiled and issued at the final assembly place of equipment before despatch. However, soft copies will be furnished not later than two (2) weeks.

3.14.1 Typical contents of Quality Assurance Document are as below: -

a) Quality Plan,
b) Material mill test reports on components as specified by the specification and approved Quality Plans.
c) Manufacturer / works test reports/results for testing required as per applicable codes and standard referred in the specification and approved Quality Plans.
d) Non-destructive examination results /reports including radiography interpretation reports. Sketches/drawings used for indicating the method of traceability of the radiographs to the location on the equipment.
e) Heat Treatment Certificate/Record (Time- temperature Chart)
f) All the accepted Non-conformance Reports (Major/Minor) / deviation, including complete technical details / repair procedure).
g) CHP / Inspection reports duly signed by the Inspector of the Customer/ Employer and Contractor for the agreed Customer Hold Points.
h) Certificate of Conformance (COC) whoever applicable.
i) MDCC

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

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

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

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

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

3.15 TRANSMISSION OF QUALITY DOCUMENTS

As a general rule, two hard copies of the quality document and Two CD ROMs/ Pen drive shall be issued to the Customer/ Employer on release of QA Documentation by Inspector. One set of quality document shall be forwarded to Corporate Quality Assurance Department and other set to respective Site.

For the particular case of phased deliveries, the complete quality document to the Customer/ Employer shall be issued not later than 3 weeks after the date of the last delivery similarly as stated above.

3.16 INSPECTION, TESTING & INSPECTION CERTIFICATE

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

3.16.2 The Project Manager or his duly authorised representative and/or an outside inspection agency acting on behalf of the Customer/ Employer shall have access at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the Bidder shall obtain for the Project Manager and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Bidder's own premises or works.

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

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

3.16.5 When the factory tests have been completed at the Bidder's or subcontractor's works, the Project Manager /Inspector shall issue a certificate to this effect fifteen (15) days after completion of

tests but if the tests are not witnessed by the Project Manager /Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Contractor's test certificate by the Project Manager /Inspector. Project Manager /Inspector to issue such a certificate shall not prevent the Bidder from proceeding with the works. The completion of these tests or the issue of the certificates shall not bind the Customer/ Employer to accept the equipment should it, on further tests after erection be found not to comply with the contract.

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

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

3.16.8 To facilitate advance planning of inspection in addition to giving inspection notice, the Bidder shall furnish quarterly inspection programme indicating schedule dates of inspection at Customer Hold Point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.

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

3.17 PACKAGING & TRANSPORTATION

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. While packing all the materials, the limitation from the point of view of the sizes of railway wagons available in India should be taken account of. The Bidder shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. The Bidder shall ascertain the availability of Railway wagon sizes from the Indian Railways or any other agency concerned in India well before effecting despatch of equipment. Before despatch it shall be ensured that complete processing and manufacturing of the components is carried out at shop, only restricted by transport limitation, in order to ensure that site works like grinding, welding, cutting & preassembly to bare minimum. The Customer/ Employer's Inspector shall have right to insist for completion of works in shops before despatch of materials for transportation.

3.18 CLAMPS AND CONNECTORS INCLUDING TERMINAL CONNECTORS

3.18.1 The material of clamps and connectors shall be Aluminium alloy casting conforming to designation A6 of IS:617 for connecting to equipment terminals and conductors of aluminium. In case the terminals are of copper, the same clamps/connectors shall be used with 2mm thick bimetallic liner.

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

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

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

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

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

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

3.19 SPACERS

3.19.1 Spacers shall conform to IS: 10162. They shall be of non-magnetic material except nuts and bolts, which shall be of hot dip galvanised mild steel.

3.19.2 Spacers shall generally meet the requirements of clamps and connectors as specified above. Its design shall take care of fixing and removing during installation and maintenance.

3.19.3 In addition to the type tests as per IS: 10162, clamp slip test should have been conducted. In this test the sample shall be installed on test span of twin/quad bundle string at a tension of 44.2kN (4500 kg). One of the clamps when subjected to a longitudinal pull of 2.5kN (250 kg) parallel to the axis of conductor shall not slip, i.e. permanent displacement between conductor and clamp after test shall not exceed 1.0 mm. This test should have been performed on all other clamps of the sample.

3.20 BUSHINGS, HOLLOW COLUMN INSULATORS, SUPPORT INSULATORS, AND DISC INSULATORS

3.20.1 Bushings shall be manufactured and tested in accordance with IS: 2099 & IEC: 60137 while hollow column insulators shall be manufactured and tested in accordance with IEC62155/IS 5284. The support insulators shall be manufactured and tested as per IS: 2544/IEC 60168/IEC 60273. The insulators shall also conform to IEC 60815 as applicable having alternate long and short sheds.

Support insulators/ bushings/ hollow column insulators shall be designed to have ample insulation, mechanical strength and rigidity for the conditions under which they will be used.

3.20.2 Porcelain used shall be homogenous, free from laminations, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified, tough and impervious to moisture.

3.20.3 Glazing of the porcelain shall be uniform brown in colour, free form blisters, burns and other similar defects.

3.20.4 The design of the insulator shall be such that stresses due to expansion and contraction in any part of the insulator shall be lead to deterioration. All ferrous parts shall be hot dip galvanised.

3.20.5 Post type insulators shall consist of a porcelain/polymer part permanently secured in metal base to be mounted on supporting structures. They shall be capable of being mounted upright. They shall be designed to withstand all shocks to which they may be subjected to during operation of the associated equipment.

3.20.6 Bushing porcelain shall be robust and capable of withstanding the internal pressures likely to occur in service. The design and location of clamps, the shape and the strength of the porcelain flange securing the bushing to the tank shall be such that there is no risk of fracture. All portions

of the assembled porcelain enclosures and supports other than gaskets, which may in any way be exposed to the atmosphere shall be composed of completely non hygroscopic material such as metal or glazed porcelain.

3.20.7 All iron parts shall be hot dip galvanised and all joints shall be air tight. Surface of joints shall be trued, porcelain parts by grinding and metal parts by machining. Insulator/ bushing design shall be such as to ensure a uniform compressive pressure on the joints.

3.20.8 In accordance with the requirement stipulated elsewhere, bushing, hollow column insulators and support insulators shall conform to type tests and shall be subjected to routine tests and acceptance test/sample test in accordance with relevant standards.

3.21 CONTROL CABINETS, JUNCTION BOXES, TERMINAL BOXES & MARSHALLING BOXES FOR OUTDOOR EQUIPMENT

3.21.1 All types of control cabinets, junction boxes, marshalling boxes, lighting panels, terminal boxes, operating mechanism boxes, Kiosks etc. shall generally conform to IS:5039, IS:8623 and IEC:60439 as applicable.

3.21.2 They shall be of Stainless steel or Aluminium. The thickness of Stainless steel shall be minimum 1 mm. The thickness of aluminium shall be minimum 3 mm and shall provide rigidity. Top of the boxes shall be sloped towards the rear of the box.

3.21.3 BAY MARSHALLING BOX

Bay Marshalling Box located at a convenient location to receive and distribute cables shall be provided as required. It shall meet all the requirements as specified for cabinets/boxes.

It shall have three separate distinct compartments for following purposes:

- To receive two incoming 415V, three phase, AC supplies controlled by 100A four pole MCBs with auto changeover provision, and to distribute five (5) three phase ac supplies controlled by 32A four pole MCBs. It shall also be provided with 63A, 3 phase 4 pin industrial grade receptacle with rotary switch.

- To receive three phase incoming from first compartment and to distribute ten (10) single phase ac supplies controlled by 16A two pole MCBs.

- 150 nos. terminal blocks in vertical formation for interlocking facility.

3.21.4 AUXILIARY SWITCH

The auxiliary switch shall conform of following type tests:

a) Electrical endurance test - A minimum of 1000 operations for 2A. D.C. with a time constant greater than or equal to 20 milliseconds with a subsequent examination of mV drop/ visual defects/ temperature rise test.
b) Mechanical endurance test - A minimum of 5000 operations with a subsequent checking of contact pressure test/ visual examination
c) Heat run test on contacts
d) IR/HV test, etc.

3.22 CABLE GLANDS AND LUGS/FERRULES

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

3.22.2 The cable glands shall be tested as per BS:6121. The cable glands shall also be duly tested for dust proof and weather proof termination.

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

3.22.4 Cables lugs shall be tinned copper solder less crimping type conforming to IS:8309 and 8394 suitable for aluminum or copper conductor (as applicable). The cable lugs shall suit the type of terminals provided. The cable lugs shall be of Dowell make or equivalent.

3.23 CONDUITS, PIPES AND ACCESSORIES

3.23.1 The bidder shall supply and install all rigid conduits, mild steel pipes, flexible conduits, hume pipes, etc. including all necessary sundry materials, such as tees, elbows, check nuts, bushing reduces, enlargers, wooden plugs, coupling caps, nipples, gland sealing fittings, pull boxes, etc.

3.23.2 The size of the conduit/pipe shall be selected to limit the fill to a maximum of 40%. All conduits/pipes shall have their ends closed by caps until cables are pulled. After cables are pulled, the ends of conduits/pipes shall be sealed in an approved manner to prevent damage to threaded portions and en- trance of moisture and foreign materials.

3.23.3 PVC conduits shall be of high impact, heavy gauge (at least class 2) conduit conforming to BS-4607.

3.23.4 The outer surface of the steel conduits shall be coated with hot-dip zinc and chromate conversion coatings. The inner surface shall have silicone epoxy ester coating for easy cable pulling. Mild steel pipes shall be hot-dip galvanized. All rigid conduits/pipes shall be of a reputed make.

3.23.5 The hume pipes and accessories shall be of reinforced concrete conforming to class NP2 of IS-458. All tests on hume pipes shall be conducted as per IS-458.

3.23.6 Rigid conduits shall be flow-coat metal conduits. The outer surface of the conduits shall be coated with hot-dip zinc and chromate conversion coatings. The inner surface shall have silicone epoxy ester coating for easy cable pulling. Mild steel pipes shall be hot-dip galvanised. All rigid conduits/ pipes shall be of a reputed make.

3.23.7 Flexible conduits shall be heat-resistant lead coated steel, water-leak, fire and rust proof, and be of PLICA make or equivalent.

3.24 MOTORS

The voltage level for motors shall be as follows:

a) Upto 0.2 KW	: Single phase 240V AC / 3 phase 415V AC
b) Above 0.2 KW and upto 200 KW	: 3 phase, 415V AC
c) Above 200 KW and upto 1500 KW	: 3 phase, 3.3 kV AC
d) Above 1500 KW	: 11 kV

The bidder may adopt 415V/3.3 KV for the drives rated in the range of 160-210 KW.

The voltage rating of the drives indicated above is for basic guideline.

3.24.1 All motors shall conform to IEC-60034-5 / IS Standard and with principal dimensions in accordance with IEC 60072-1 (1991), IEC 60072-2 (1990) and IEC 60072-3 (1994).

3.24.2 All equipment shall be suitable for rated frequency of 50 Hz with a variation of +3% & -5%, and 10% combined variation of voltage and frequency unless specifically brought out in the specification

3.24.3 Paint shade shall be as per RAL 5012 (Blue) for indoor and outdoor equipment.

3.24.4 Degree of Protection

Degree of protection for various enclosures as per IEC60034-05 shall be as follows:
Indoor motors - IP 55
Outdoor motors - IP 55 (additional canopy to be provided)
Cable box-indoor area - IP 55
Cable box-Outdoor area - IP 55

3.24.5 Type:
AC Motors:

a) Squirrel cage induction motor suitable for direct-on-line starting.
b) Continuous duty LT motors upto 200 KW Output rating (at 50 deg.C ambient temperature), shall be Premium Efficiency class-IE3, conforming to IS 12615, or IEC:60034-30.
c) Crane duty motors shall be squirrel cage Induction motor as per the requirement.
d) Motor operating through variable frequency drives shall be suitable for inverter duty. Also these motors shall comply the requirements stipulated in IEC: 60034-18-41 and IEC: 60034-18-42 as applicable.

DC Motors Shunt wound

3.25 AUXILIARY SWITCH

The auxiliary switch shall conform of following type tests:

a) Electrical endurance test - A minimum of 1000 operations for 2A. D.C. with a time constant greater than or equal to 20 milliseconds with a subsequent examination of mV drop/ visual defects/ temperature rise test.
b) Mechanical endurance test - A minimum of 5000 operations with a subsequent checking of contact pressure test/ visual examination
c) Heat run test on contacts
d) IR/HV test, etc.

3.26 LAMPS AND SOCKETS

3.26.1 Lamps:
All incandescent lamps shall use a socket base as per IS-1258, except in the case of signal lamps.

3.26.2 Sockets

All sockets (convenience outlets) shall be suitable to accept both 5 Amp & 15 Amp pin round Standard Indian plugs. They shall be switched sockets with shutters.

3.26.3 Hand Lamp:
A 240 Volts, single Phase, 50 Hz AC plug point shall be provided in the interior of each cubicle with ON-OFF Switch for connection of hand lamps.

3.27 SWITCHES AND FUSES

Each control panel shall be provided with necessary arrangements for receiving, distributing, isolating and fusing of DC and AC supplies for various control, signaling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with switch-fuse units. Selection of the main and sub-circuit fuse ratings shall be such as to ensure selective clearance of sub-circuit faults. Potential circuits for relaying and metering shall be protected by HRC fuses.

All fuses shall be of HRC cartridge type conforming to IS 9228 mounted on plug-in type fuse bases. Miniature circuit breakers with thermal Protection and alarm contacts will also be accepted. All accessible live connection to fuse bases shall be adequately shrouded. Fuses shall have operation indicators for indicating blown fuse condition. Fuse carrier base shall have imprints of the fuse rating and voltage.

All control switches shall be of rotary type. Toggle/piano switches shall not be accepted.

3.28 TYPE, ROUTINE & ACCEPTANCE TESTS:

3.28.1 TYPE TEST REQUIREMENTS FOR EQUIPMENTS OTHER THAN GIS

a) All equipments to be supplied shall be of type tested design. During detail engineering, the contractor shall submit for Owner's approval the reports of all the type tests as listed in this specification. The validity period of reports shall be as per CEA Guidelines for the validity period of Type test(s) conducted on Major Electrical Equipment in power Transmission-May2020 & with latest amendments from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a Client.
b) However if contractor is not able to submit report of the type test(s) conducted as per CEA Guidelines for the validity period of Type test(s) conducted on Major Electrical equipment in power Transmission-May2020 & with latest amendments from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the owner either at third party lab or in presence of client/ owners representative and submit the reports for approval.
c) All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.

3.10 CORONA AND RIV TESTS AND SEISMIC WITHSTAND TEST:

a) The corona and RIV tests shall confirm to the requirements as per Annexure A.
b) The seismic withstand test for shall conform to requirements as per Annexure B.

3.11 Enclosures:

1. ANNEXURE- A: CORONA AND RADIO INTERFERENCE VOLTAGE (RIV) TEST
2. ANNEXURE- B: SEISMIC WITHSTAND TEST
3. ANNEXURE- I: MANUFACTURING QUALITY PLAN (customer format)
4. ANNEXURE- II: FIELD QUALITY PLAN (customer format)

ANNEXURE – A: CORONA AND RADIO INTERFERENCE VOLTAGE (RIV) TEST

1.0 General

Unless otherwise stipulated, all equipment together with its associated connectors where applicable shall be tested for external corona both by observing the voltage level for the extinction of visible corona under falling power frequency voltage and measurement of radio interference voltage (RIV).

2.0 Test Levels

The test voltage levels for measurement of external RIV and for corona extinction voltage are listed under the relevant clauses of the specification.

3.0 Test Methods for RIV (400kV):

3.1 RIV tests shall be made according to measuring circuit as per International Special committee on Radio Interference (CISPR) Publication 16 -1 (1993) Part – I. The measuring circuit shall preferably be tuned to frequency with 10 % of 0.5 MHz but other frequencies in the range of 0.5 MHZ to 2 MHz may be used, the measuring frequency being recorded. The result shall be in microvolts.

3.2 Alternatively, RIV tests shall be in accordance with NEMA standard Publication No. 107 – 1964 except otherwise noted herein.

3.3 In measurement of RIV temporary additional external corona shielding may be provided. In measurement of RIV only standard fittings of identical type supplied with the equipment and a simulation of the connections as used in the actual installation will be permitted in the vicinity within 3.5 meters of terminals.

3.4 Ambient noise shall be measured before and after each series of tests to ensure that there is no variation in ambient noise level. If variation is present, the lowest ambient noise level will form basis for the measurements. RIV levels shall be measured at increasing and decreasing voltages of 85%, 100%, 115% and 130% for the specified RIV test voltage for all equipment unless otherwise specified. The specified RIV test voltage for 420kV is listed in the detailed specification together with maximum permissible RIV level in microvolts.

3.5 The metering instruments shall be as per CISPR recommendations or equivalent device so long as it has been used by other testing authorities.

3.6 The RIV measurement may be made with a noise meter. A calibration procedure of the frequency to which noise meter shall be tuned shall establish the ratio of voltage at the high voltage terminal to the voltage read by the noise meter.

4.0 Test Methods for visible Corona (400kV AIS only)

The purpose of this test is to determine the corona extinction voltage of the apparatus, connectors etc. The test shall be carried out in the same manner as RIV test described above with the exception that RIV measurements are not required during test and a search technique shall be used near the onset and extinction voltage, when the test voltage is raised and lowered to determine their precise values. The test voltage shall be raised to 130 % of RIV test voltage and maintained there for five minutes. In case corona inception does not take place at 130 %, the voltage level shall be raised till inception of corona or rated voltage whichever is lower. The voltage will then be decreased slowly

until all visible corona disappears. The test procedure shall be repeated at least 4 times with corona inception and extinction voltage recorded each time. The corona extinction voltage for purposes of determining compliance with the specification shall be the lowest of the four values at which the visible corona (negative or positive polarity) disappears.

ANNEXURE – B: SEISMIC WITHSTAND TEST (400kV AIS only)

a.) The seismic withstand test on the complete equipment (except BPI) shall be carried out along with supporting structure.

b.) The supplier shall arrange to transport the structure from his purchaser's premises / owner's sites for purpose of seismic withstand test only.

c.) The seismic level specified shall be applied at the base of the structure. The accelerometers shall be provided at the terminal pad of the equipment and at any other point as agreed by the owner. The seismic test shall be carried out in all possible combinations of the equipment. The seismic test procedure shall be furnished for approval of the purchaser.

ANNEXURE - I

MFGR.'s LOGO	**MANUFACTURER'S NAME AND ADDRESS**	**MANUFACTURING QUALITY PLAN** **ITEM :** **SUB-SYSTEM:**	**QP NO.:** **REV.NO:** **DATE:** **PAGE: …. OF….**	**PROJECT :** **PACKAGE :** **CONTRACT NO. :** **MAIN-SUPPLIER :**

SL. NO	**COMPONENT & OPERATIONS**	**CHARACTERISTICS**	**CLASS**	**TYPE OF CHECK**	**QUANTUM OF CHECK**		**REFERENCE DOCUMENT**	**ACCEPTANCE NORMS**	**FORMAT OF RECORD**		**AGENCY**			**REMARKS**
					M	**C/N**					**M**	**C**	**N**	
1.	**2.**	**3.**	**4.**	**5.**	**6.**		**7.**	**8.**	**9.**	**D***	**** 10.**			**11.**

		LEGEND: * RECORDS, INDENTIFIED WITH "TICK" (☐☐) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.** **M:** MANUFACTURER/SUB-SUPPLIER **C:** SUPPLIER/NOMINATED INSPECTION AGENCY, **N**: THE OWNER **P:** PERFORM **W**: WITNESS AND **V:** VERIFICATION. AS APPROPRIATE, **CHP:** THE OWNER SHALL IDENTIFIED IN COLUM "N"		**DOC. NO.:** **REV…… CAT…..**	
MANUFACTURER / SUB-SUPPLIER	**MAIN-SUPPLIER**		**FOR THE OWNER USE**		
SIGNATURE				**REVIEWEDBY**	**APPROVEDBY**	**APPROVAL SEAL**

ANNEXURE - II

<table>
<tr><td rowspan="2">SUPPLIER's LOGO</td><td colspan="2" rowspan="2">SUPPLIER'S NAME AND ADDRESS</td><td colspan="7">FIELD QUALITY PLAN</td></tr>
<tr><td colspan="2">ITEM :

SUB-SYSTEM :</td><td colspan="5">QP NO.:
REV.NO.:
DATE:
PAGE: …. OF….</td></tr>
<tr><td colspan="3"></td><td colspan="7">PROJECT :
PACKAGE :
CONTRACT NO. :
MAIN-SUPPLIER :</td></tr>
<tr><td>S. NO</td><td>ACTIVITY AND OPERATION</td><td>CHARACTERISTICS / INSTRUMENTS</td><td>CLASS# OF CHECK</td><td>TYPE OF CHECK</td><td>QUANTUM OF CHECK</td><td>REFERENCE DOCUMENT</td><td>ACCEPTANCE NORMS</td><td colspan="2">FORMAT OF RECORD</td><td>REMARKS</td></tr>
<tr><td>1.</td><td>2.</td><td>3.</td><td>4.</td><td>5.</td><td>6.</td><td>7.</td><td>8.</td><td>9.</td><td>D*</td><td>10.</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="3"></td><td colspan="3" rowspan="4">LEGEND: * RECORDS, INDENTIFIED WITH "TICK" (☐) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.
LEGEND TO BE USED: CLASS #: A = CRITICAL, B=MAJOR, C=MINOR;
'A' SHALL BE WITNESSED BY THE OWNER, 'B' SHALL BE WITNESSED BY OWNER'S ERECTION / CONSTRUCTION DEPTT. AND 'C' SHALL BE WITNESSED BY ERECTION SUPPLIER (A & B CHECK SHALL BE OWNER CHP STAGE)</td><td colspan="2"></td><td colspan="2">DOC. NO.:
REV……</td><td></td></tr>
<tr><td colspan="2">MANUFACTURER/ SUB-SUPPLIER</td><td>MAIN-SUPPLIER</td><td colspan="2" rowspan="2">FOR THE OWNER USE</td><td colspan="2" rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td colspan="3">SIGNATURE</td></tr>
<tr><td colspan="3"></td><td colspan="2">REVIEWED BY</td><td>APPROVED BY</td><td>APPROVAL SEAL</td></tr>
</table>

जलवायवी सारणी
CLIMATOLOGICAL TABLE

स्टेशन : अम्बाला | STATION : Ambala | अक्षांश LAT. 30° 23' | देशांतर LONG. 76° 46' | समुद्री तल माध्य से ऊंचाई HEIGHT ABOVE M.S.L. 272 METRES | प्रेक्षणों पर आधारित BASED ON OBSERVATIONS 1981-2010

माह / MONTH		स्टेशन का सतह दाब / STATION LEVEL PRESSURE एच.पी.ए hPa	वायु तापमान / AIR TEMPERATURE — माध्य / MEAN — शुष्क बल्ब DRY BULB डि. से °C	नम बल्ब WET BULB डि. से °C	दैनिक अधिक ताम DAILY MAX डि. से °C	दैनिक न्यून तम DAILY MIN डि. से °C	माह में उच्चतम HIGHEST IN THE MONTH डि. से °C	माह में निम्नतम LOWEST IN THE MONTH डि. से °C	चरम / EXTREMES — उच्चतम HIGHEST डि. से °C	दिनांक और वर्ष DATE AND YEAR	निम्नतम LOWEST डि. से °C	दिनांक और वर्ष DATE AND YEAR	आर्द्रता / HUMIDITY — सापेक्ष आर्द्रता RELATIVE HUMIDITY प्रतिशत %	वाष्प दाब VAPOUR PRESSURE एच.पी.ए hPa	मेघ की मात्रा / CLOUD AMOUNTS — समस्त मेघ ALL CLOUDS आकाश के अष्टमाश Oktas of sky	निम्न मेघ LOW CLOUDS आकाश के अष्टमाश Oktas of sky	मासिक योग MONTHLY TOTAL मि.मि. mm	वर्षा के दिनोंकी संख्या NO. OF RAINY DAYS	वर्षा / RAINFALL — वर्षसहित सबसे नम महीने का योग TOTAL IN WETTEST MONTH WITH YEAR मि.मि. mm	वर्षसहित शुष्कतम महीने का योग TOTAL IN DRIEST MONTH WITH YEAR मि.मि. mm	24 घंटोंकी सबसे भारी वर्षा HEAVIEST FALL IN 24 HOURS मि.मि. mm	दिनांक और वर्ष DATE AND YEAR	माध्य पवन गति MEAN WIND SPEED कि.मी. प्र. घं. Kmph
जनवरी JAN	I	984.6	8.6	7.7	18.9	6.4	24.1	2.7	29.1	29	-1.3	24	87	9.9	4.1	2.6	27.3	1.9	152.7	0	118.4	16	3.4
	II	982.8	16.5	12.7						1991		2008	63	11.8	3.1	1.3			1953			1953	
फरवरी FEB	I	982.2	11.7	10.1	22.4	9.1	27.3	5	33.9	28	-0.6	1	81	11.2	3.1	1.3	35.1	2.2	233.9	0	146.8	11	4.7
	II	980.3	20.2	14.9						1956		1905	54	12.8	3	1.1			1898			1898	
मार्च MAR	I	979.6	17.5	14.4	27.8	13.8	33	8.9	41.7	31	3.7	9	70	14	2.8	0.9	27.2	1.8	176	0	103.9	13	5.1
	II	977.3	25.6	18						1945		1979	45	14.7	3.1	1.1			1982			1956	
अप्रैल APR	I	975.8	24.6	18.2	34.9	19.1	40.1	13.7	45	28	9.4	6	51	15.8	2.2	0.6	12.3	1.2	174.4	0	82	6	4.9
	II	973.1	33	20.4						1941		1967	28	14	2.5	0.9			1983			1935	
मई MAY	I	972.2	29.1	21.6	36.1	23.4	42.6	18	47.8	29	13.9	1	50	19.9	1.8	0.6	31.5	2.7	146.7	0	85.1	20	5
	II	968.9	36.3	23.2						1944		2004	31	18	2	0.9			2008			1913	
जून JUN	I	968.6	30.1	24.3	38.1	25.4	42.8	20.3	47.8	17	17.8	5	62	25.9	2.9	1.4	86.6	4.5	291.3	0	121.8	20	5
	II	965.1	36.1	25.4						1923		2000	42	23.9	2.6	1.4			1913			1973	
जुलाई JUL	I	968.3	28.7	26.1	34.4	25.5	38.9	21.8	46.7	10	19.4	5	81	31.8	5.1	2.8	264.7	9.1	715	7.2	206.7	16	4.2
	II	965.5	32.5	27.2						1903		1956	67	31.9	5	3.1			2010	1967		2001	
अगस्त AUG	I	970.4	28	26	33.3	25	36.3	22.2	43.9	7	3.7	11	84	32.1	5.1	2.8	239.2	9	649	1.7	246.2	3	3.4
	II	967.6	31.4	27.3						1918		2010	72	32.9	5.1	3.3			2004	1993		2004	
सितम्बर SEP	I	974.5	26.4	24.2	33.1	23	35.7	19.3	40.6	6	15.6	22	82	28.6	3	1.7	134.8	4.8	661	0	224.8	26	3.5
	II	971.6	30.9	25.6						1951		1972	64	28.6	3	1.9			1962			1945	
अक्तूबर OCT	I	980	21.2	18.5	31.7	17.1	34.6	12.4	39.4	6	8.3	30	76	19.5	0.8	0.3	15.1	0.8	306.5	0	141.6	5	2.6
	II	977.2	28.5	21.5						1941		1898	51	20.1	1	0.4			1955			1973	
नवम्बर NOV	I	983.6	14.5	12.7	27.1	11.1	30.5	6.6	35.6	14	1.8	29	81	13.5	1.2	0.3	4.5	0.6	136.4	0	135.1	26	2.3
	II	981.1	23	17.2						1947		1966	53	15	1.3	0.2			1951			1951	
दिसम्बर DEC	I	985.3	9.5	8.5	21.7	7.1	25.5	3.3	29.4	5	-0.6	27	86	10.4	3	1.6	19.7	1	111.2	0	72.5	10	2.5
	II	983.2	18.1	13.8						1944		1913	60	12.4	2.5	0.8			1997			1997	
वार्षिक योग या माध्य ANNUAL TOTAL OR MEAN	I	977.1	20.8	17.7	30.1	17.2	43.5	2.1	47.8	29	-1.3	24	74	19.4	2.9	1.4	898.2	39.6	2047.7	297.6	246.2	3	3.9
	II	974.5	27.7	20.6					5	1944	1	2008	52	19.7	2.9	1.4			1896	1918	8	2004	
वर्षोंकी सं NUMBER OF YEARS	I																						
	II	28	28	28	29	29	29	29	107		107		28	28	28	28	30	30	106	106	108		29

CHAPTER – 37

CODES AND STANDARDS

CONTENTS

CHAPTER – 37

CODES AND STANDARDS

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IS – 2551	Danger Notice Plates (First Revision)
IS – 2629	Recommended Practice for Hot-Dip Galvanizing on Iron and Steel
IS - 2633	Method For Testing Uniformity of Coating on Zinc Coated Articles.
IS – 2705 Part 1	General Requirements (Second Revision)
IS – 2713 Part 13	Tubular Steel Pole for Overhead Power Lines
IS – 3034	Fire Safety of Industrial Building: Electrical Generating and Distributing Stations – Code of Practice.
IS – 3043	Code Of Practice for Earthing (Same as IEC 60364)
IS – 3063	Fasteners Single Coil Rectangular Section Spring Washers.
IS – 3177	Electric Overhead Travelling Crane and Gantry Crane for all Applications – Code of Practice (Third Revision)
IS – 3347	Dimension For Porcelain Transformer Bushings for Use in Lightly Polluted Atmosphere
IS – 3480	Specification for Flexible Steel Conduits for Electrical Wiring (Same as BS 731 Part1, UL 1-1957)
IS – 3637	Specification for Gas - Operated Relays
IS – 3639	Specification for Fittings and Accessories for Power Transformers
IS 3646 Part 1	Code of Practice for Interior Illumination: Part 1 general requirements and recommendations for working interiors (First Revision) (Same as DIN 5035 Parts 1 &2)
IS – 3842 Part 1 to 12	Application Guide for Electrical Relays for AC System
IS – 3854	Switches for Domestic and Similar Purposes - Specification (Second Revision) (Same as IEC Pub 669-1)
IS – 3961	Recommended Current Ratings for Cables Part 6 Crosslinked Polyethylene Insulated PVC Sheathed Cables
IS – 3975	Low Carbon Galvanized Steel Wires Formed Wires and Taps for Armoring Of Cables
IS – 4029	Guide for Testing Three Phase Induction Motors
IS - 4146	Application guide for voltage transformers (First Revision)
IS – 4160	Interlocking Switch Socket Outlet (Same as IEC 60884-2-6)
IS – 4201	Application Guide for Current Transformers (First Revision)
IS – 4327	Specification for Electric Fans and Regulators for Use in Ships
IS – 4759	Hot-Dip Zinc Coatings on Structural Steel and Other Allied Products
IS – 4889	Method Of Determination of Efficiency of Rotating Electrical Machines (Same as IEC 2D)

IS – 4905	Random Sampling and Randomization Procedures (Same as ISO 24153)
IS – 5082	Wrought Aluminium and Aluminium Alloy Bar Rods, Tubes & Sections for Electrical Purpose
IS – 5216	Guide For Safety Procedures and Practices in Electrical Work
Part 1 – 1982	General (First Revision)
Part 2-1982	Life Saving Techniques (First Revision)
IS – 5422	Specification For Turbine Type Generators (Same as IEC 34-3)
IS - 5547	Application guide for capacitor voltage transformers (First Revision)
IS – 5572	Classification of Hazardous Areas (Other Than Mines) Having Flammable Gases and Vapours for Electrical Installation
IS – 5561	Electric Power Connectors (Same as ANSI/ NEMA CC1 : 2009, BS 159 : 1992, BS 3288-1 : 2014, IEC 61284 : 1997, IS/IEC 62271 (Part 1) : 20)
IS – 5578	Guide For Marking and Insulated Conductors (Same as IEC Pub 391)
IS – 5613	Code Of Practice for Design, Installation & Maintenance of Overhead Power Lines
Part 1-1985	Lines Upto and Including 11 kV
Section 1	Design (First Revision)
Section 2	Installation And Maintenance (First Revision)
IS – 5831	PVC Insulation and Sheath Of Electric Cables (Same as IEC Pub 502)
IS – 6005	Code Of Practice for Phosphating of Iron and Steel.
IS – 6071	Specification for Synthetic Separators for Lead Acid Batteries.
IS – 6272	Specification for Industrial Cooling Fans (Man Coolers)
IS – 6362	Designation of Methods For Cooling Rotating Machinery (Same as IEC 34-6)
IS – 6619	Safety Code for Semi-Conductor Rectifier Equipment.
IS – 6665	Code of Practice for Industrial Lighting (Same as IES Code Recommendations for Good Interior Lighting)
IS - 6745	Methods For Determination of Mass of Zinc Coating on Zinc Coated Iron & Steel Articles.
IS – 6949	Summation Current Transformers
IS – 7098	Cross Linked Polyethylene Insulated PVC Sheathed Cables
Part 1	Part 1 for working voltages up to and including 1100 volts (First Revision) (Same as IEC Pub ~ 02)
Part 2	Part 2 for working voltages from 3.3 kV up to and including 33 kV (Second Revision) (Same as IEC 60502-2)
IS – 7132	Guide For Testing Synchronous Generators (Same as IEC Pub 34-1, IEC 344, IEEE – 115)
IS – 7306	Methods For Determining Synchronous Machine Quantities from Tests (Same as IEC 34-4)

IS – 7307	Approval Tests for Welding Procedures: Part 1 Fusion Welding of Steel
IS – 8084	Interconnecting Bus Bar for AC Voltage Above 1000 V And Up to And Including 36 KV (Same as BS 159)
IS – 8130	Conductors For Insulated Electric Cables and Flexible Cords (Same as IEC 60228)
IS – 8223	Dimensions and Output Series for Rotating Electrical Machines (First Revision) (Same as IEC 72-2)
IS – 8263	Radio Interference Test on High Voltage Insulators First Revision (Same as IEC 60437)
IS – 8308	Compression Type Tubular In- Line Connectors for Aluminium Conductors of Insulated Cables
IS – 8309	Compression Type Tubular Terminal Ends for Aluminium Conductors of Insulated Cables.
IS – 8320	General Requirements and Methods of Tests for Lead Acid Storage Batteries
IS – 8468 Part 1	Tap - Changers Part 1 Performance Requirements and Test Methods (First Revision) (Same as IEC 60214-1)
IS – 8478	Application Guide for On - Load Tap – Changers (Same as IEC Doc 14)
IS – 8603	Dimensions For Porcelain Transformer Bushing for Use in Heavily Polluted Atmosphere 12/17.5 kV, 24 kV and 36 kV (First Revision)
IS – 8603 Part 4	Dimensions for porcelain transformer bushings for use in heavily polluted atmospheres: Part 4 52 kV bushings
IS – 8623 Part 2	LV Switchgear and Control Gear Assemblies: Part 2 particular requirements for busbar trunking systems (Busways) (First Revision) (Same as IEC Pub 439-2)
IS – 8686	Specification for Static Protective Relays. (Same as IEC Pub 255-4)
IS - 9000	Basic Environmental Testing Procedures for Electronic and Electrical Items.
IS – 9334	Electric Motor Operated Actuator
IS – 9385	High Voltage Fuses (Same as IEC 60282)
IS – 9431	Specification for Indoor Post Insulators of Organic Material for System with Nominal Voltages Greater Than 1000 Volts Up to and Including 300 KV (Same as IEC Doc 36C)
IS – 9434	Guide For Sampling & Analysis of Free & Dissolved Gas & Oil from Oil Filled Electrical Equipment (Same as IEC 60567)
IS – 9537	Conduit For Electrical Installation (Same as IEC Pub 614)
IS – 9595	Metal – Arc Welding of Carbon and Carbon Manganese Steels – Recommendations.
IS – 9968	Elastomer Insulated Cables
IS – 10000 (13 Parts)	Internal Combustion Engines
IS -10028	Code Of Practice for Selection Installation& Maintenance of Transformers

IS – 10118	Code Of Practice for Selection, Installation and Maintenance of Switchgear and Control Gear
Part 1	General
Part 2	Selection
Part 3	Installation
Part 4	Maintenance (Same as BS 5405, BS 79/28033)
IS – 10136	Code Of Practice for Selection of Disc Insulator Fittings For Highest System Voltages Of 72.5 kV And Above
IS – 10322	Luminaries (Same as IEC 60598)
IS – 10418	Drums for Electric Cables.
IS – 10596 Part 1 to 4	Code of Practice for Selection, Installation, Operation and Maintenance of Pumps for Industrial Applications
IS – 10810 Part 61	Method of Test for Cables Fire Retardant Test
IS – 10918	Specification for Vented Type Nickel Cadmium Batteries
IS – 11037	Electronic Type Fan Regulators — Specification (First Revision)
IS – 11353	Guide For Uniform System of Marking And Identification Of Conductors And Apparatus Terminals (Same as IEC Pub 445 (197.7))
IS – 11955	Preferred Current Ratings (Same as ISA 32)
IS – 12021	Control Transformers for Switchgear and Control Gear for Voltage Not Exceeding 1000 V AC
IS – 12065	Permissible Limits of Noise Level of Rotating Machines
IS – 12075	Measurement & Evaluation of Vibration of Rotating Electrical Machines (Same as IEC 60034-14)
IS – 12458	Method of Fire Resistance Test of Firestops
IS – 12615	Line Operating three phase AC motors (IE Code0 "Efficiency classes and performance specification" (Third Revision) (Same as IEC 60034-30-1)
IS – 12676	OIP Insulated Condenser Bushings – Dimensions and Requirements
IS – 13010	AC Watt-Hour Meters Class 0.5, 1 And 2 – Specification (Same as IEC 60521)
IS – 13573 Part 1	Cable accessories for extruded power cables - Specification: Part 1 for working voltages from 1.1 kV up to and including 3.3 kV(E) - Test methods and test requirements (First Revision) (Same as BS EN 50393)
IS – 13573 Part 2	Cable accessories for extruded power cables - Specification: Part 2 for working voltages from 3.3 kV(Ue) up to and including 33 kV(E) - Test requirements (First Revision) (Same as IEC 60502-4)
IS – 13573 Part 3	Cable accessories for extruded power cables - Specification: Part 3 for working voltages from 3.3 kV(UE) up to and including 33 KV(E) - Test methods (First Revision) (Same as IEC 61442)
IS – 13703 Part 2, Sec 1	Fuses For Use by Authorized Persons Supplementary Requirements (Same as IEC 644)

IS – 13703 Part 2, Sec 2	Fuses For Use by Authorized Persons Examples of Standardized Fuses (Same as IEC 269-2-1)
IS – 13703 Part 4	Supplementary Requirements for Fuse Links for The Protection of Semiconductor Devices (Same as IEC 269-4)
IS – 13925	Shunt Capacitor for AC Power Systems Having a Rated Voltage Above 1000 V (Same as IEC 60871)
IS – 13947 Part5/ Sec 2	Low Voltage Switchgear and Control Gear (Same as IEC 60947-5-2)
IS – 14665	Electric Traction Elevators
IS – 15086	Surge Arrester (Same as IEC 60099)
IS – 15728	Welding - Friction Welding of Metallic Materials (First Revision)
IS – 16227	Intrument Transformers (Same as IEC 61869)
IS – 16593	Arc Welding Equipment
IS/IEC – 61537	Cable Management - Cable Tray System and Cable Ladder System
IS/IEC 62271 Part 203	High Voltage Switchgear and Control Gear- Gas Insulated Metal Enclosed Switchgear for Rated Voltage above 52kV.
IEC 34-5	Degree Of Protection Provided by Enclosures for Rotating Electrical Machines
IEC 34-8	Terminal Markings & Direction of Rotation of Rotating Machines
IEC – 38	IEC Standard Voltages
IEC – 68	Environmental Testing
IEC – 255	Electrical Relays
IEC – 287-1-1	Electric Cables - Calculation of the Current Rating
IEC – 664	Insulation co-ordination for equipment within low-voltage systems
IEC – 801-2/4	Static Discharge
IEC – 801-3/3	Electromagnetic Fields
IEC – 801-4/4	Transient Fast Burst Test
IEC – 801-5/class 3	Digital I/O Surge Withstand T
IEC – 870-3/ class 2	Radio Interference Test
IS/IEC – 60034	Rotating Electrical Machine (3 Phase Induction Motor)
IEC -60044	Current And Voltage Transformers
IEC – 60056	Contact Assignment for Circuit Breaker Rated Voltage Lower Than 52 KV
IEC – 60060	HV Test Technique
IEC – 60068	Environmental Testing
IEC – 60071	Insulation Coordination
IEC – 60076	Power Transformer

IS/IEC – 60079	Explosive Atmosphere
IEC – 60099	Surge Arrester
IEC – 60099-4	Metal - Oxide Surge Arresters Without Gaps for A.C. System
IEC - 60129	A.C. Disconnectors and Earthing Switches
IEC - 60137	Bushings For Alternating Voltages Above 1000V
IEC – 60168	Test On Indoor and Outdoor Post Insulator or Ceramic Material or Glass For Systems
IEC – 60185	Protective CT For Transient Performance
IEC – 60189	Low Frequency Cables Wires with PVC Insulation and PVC Sheath
IEC – 60214	Tap Changer
IEC – 60233	Test On Indoor and Outdoor Post Insulator or Ceramic Material or Glass For Systems With Nominal Voltage Greater Than 1000 V
IEC – 60255	Electric Relay
IEC – 60265	High Voltage Switches
IEC – 60269	Low Voltage Fuses
IEC – 60270	Partial Discharge Measurement
IEC – 60273	Test On Indoor and Outdoor Post Insulator or Ceramic Material Or Glass For Systems With Nominal Voltage Greater Than 1000 V
IEC – 60296	Insulating Oil For Transformers And Switchgear (Same as BS: 148)
IEC – 60298	AC Metal Enclosed Switchgear And Control Gear
IEC – 60331	Tests For Electric Cables Under Fire Conditions
IEC – 60332	Test On Electric and Optical Fiber Cables Under Fire Condition
IEC – 60353	Line Traps for AC Power Systems
IEC – 30364	Electrical Installation for Buildings.
IEC – 60376	Specification And Acceptance of New SF_6
IEC – 60383	Insulator For Overhead For Nominal Voltage Greater Than 1000 V
IEC – 60422	Mineral Insulating Oils in Electrical Equipment- Supervision and Maintenance Guidance
IEC – 60427	Synthetic Testing of High Voltage A.C. Circuit Breaker
IEC – 60437	Radio Interference Test on HV Insulator
IEC – 60480	Guide To the Checking of SF_6 Taken for Electrical Equipments
IEC – 60481	Coupling Devices for Power Line Carrier Systems
IEC – 60502	Extruded Solid Dielectric Insulated Power Cables for Rated Voltages From 1kV Up To 30 kV
IEC – 60517	Gas - Insulated Metal Enclosed Switchgear for Rated Voltage Of 72.5 kV and above.
IEC – 60529	Degree Of Protection

IEC – 60598	Luminaries
IEC – 60694	Common Clause for HV Switchgear and Control Gear
IEC – 60754	Test On Gases Evolved During Combustion of Electric Cable
IEC – 60815	Pollution Levels
IEC – 60859	Cable Connections For GIS
IEC – 60870	Tele Control Equipment & System
IEC – 60947	LV Switchgear and Control Gear
IEC – 61000	Electromagnetic Compatibility
IEC – 61128	A.C. Disconnecters Bus Transfer Current Switching by Disconnectors.
IEC – 61129	A.C. Earthing Switches Induced Current Switching
IEC – 61259	Requirements For Switching of Bus Charging Currents with Disconnector.
IEC – 61639	Direct Connections Transformer – GIS ANSI/IEEE 80 Guide for Safety In A.C. Substation Grounding CENELEC /SVDB Pressure Vessel Codes Compliance Of The Switchgear Manufacturer With The Provisions Of This Specification Does Not Relieve Him Of The Responsibility Of Furnishing Switchgear And Accessories Of Proper Design, Electrically And Mechanically Suited To Meet The Operating Guarantees At The Specified Service Conditions.
IEC – 61800	Adjustable Speed Electrical Power Drive Systems
IEC – 61850	Communication networks and systems for power utility automation
IEC – 62056	Electricity Metering - Data Exchange for Meter Reading, Tariff and Load Control
IS/IEC – 62305-3	Protection against lightning: Part 3 physical damage to structures and life hazard
IEC – 62155	Insulators – Ceramic or Glass - Hollow Pressurized and Unpressurized - Voltage Greater than 1000V AC
IEC – 62271	High Voltage AC Circuit Breaker
IEC – 62271-102	Fast Acting Earth Switches
IEC – 62305 (Part – 3)	Practice For Protection of Building and Allied Structures Against Lightning (Part - 3)
IEC – 62351	Power Systems Management and Associated Information Exchange – Data and Communications Security
IEEE 32	Neutral Grounding Devices, Standard Requirements, Terminology and Test Procedure
IEEE C37.23	Metal Enclosed Bus and Calculating Loss in Isolated Phase-1987 Bus Duct (ANSIC.57-12.01)
IEEE 67	Guide For Operation, Maintenance of Turbine Generator
IEEE 80	AC Substation Grounding
IEEE 142	Grounding Of Industrial & Commercial Power Systems

IEEE 383	Type Test of Class 1E Electric Cables, Field Splices and Connections for Nuclear Power Generating Station
IEEE 519	Harmonic Control in Electric Power Systems
IEEE 4298	Standard For High Potential Test Requirement for Excitation System for Synchronous Machines
ANSI C.37 20 to 20C	Switchgear
ANSI C-37:23	Metal Enclosed Bus
ANSI C-37:24	Effect of Solar Radiation on Metal Enclosed Bus
ANSI C.57 – 12.01	Distribution, Power and Regulating Transformer, General Requirement for Liquid Immersed
ANSI-ASTM-A-289-70A	Specification For Alloy Steel Forgings for Non-Magnetic
ANSI C37.90	IEEE Standard for Relays and Relay Systems Associated with Electric Power Apparatus
ASTM E814	Standard Test Method for Fire Tests of Penetration Firestop System (Same as UL – 1479)
ASTM-D -2843	Standard Test Method for Density of Smoke from The Burning or Decomposition of Plastics.
ASTM-D-2863	Standard Method for Measuring the Minimum Oxygen Concentration to Support Candle Like Combustion of Plastics.
NES-715-1	Temperature Index
SS-4241475 Class F3	Swedish Chimney Test
	SVENSK Standard SS-4241475 Class F3
CIGRE WG 13.02 Chapter-3 PART-A & B	Recommendation for Substitute Test for Switching Over Voltage Test
CBIP – 317	Transformer
	Standard Technical Specification for Main Plant Package
	Standard Design Criteria/ Guidelines for Balance of Plant Thermal Power Project
HFPA – 211	Chimneys, Fireplaces, Vents, And Solid Fuel-Burning Appliances
NFPA – 850	Electric Generating Plants
NEMA – MGI	Motors & Generators
NEMA – TR-1	NEMA Standard Publication for Power transformers
BS:476	Fire Tests on Building Materials and Structures
BS:6121	Specification For Mechanical Cable Glands for Elastomers And Plastic Insulated Cables.
DIN 46267 (Part-II)	Non-Tension Proof Compression Joints for Aluminium Conductors.

DIN 46329	Cable Lugs for Compression Connections, Ring Type, For Aluminum Conductors
VDE 0278	Tests On Cable Terminations and Straight Through Joints
EEUA-45D	Performance Requirements for Electrical Alarm Annunciation System
IACS	International Annealed Copper Standard
ISO – 1940-1	Mechanical Vibration - Balance Quality Requirements for Rotors in a Constant (Rigid) State
ISO – 3046	Reciprocating Internal Combustion Engines — Performance
NES-715-1	Temperature Index
WG-1219	Short Circuit Performance of Transformer
OISD-GDN-180	Lightning Protection
	Indian Electricity Act.
	Indian Electricity Rules.
	National Electrical Code, 1985.
	Elevators Acts and Rules

ANNEXURE-A1: Compliance Certificate of Technical Specification

The bidder shall confirm compliance to the following by signing and stamping this compliance certificate and furnishing same with the offer.

1. The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusion/ deviation with regard to same.

2. There are no deviation(s) with respect to specification other than those furnished in the schedule of deviations.

3. Only those technical submittals which are specifically asked for in Notice Inviting Tender (NIT) to be submitted at tender stage shall be considered as part of offer. Any other submission, even if made, shall not be considered as part of technical offer.

4. Any comments/ clarifications on technical/ inspection requirements furnished as part of bidder's covering letter shall not be considered by BHEL, and bidder's offer shall be construed to be in conformance with the specification.

5. Any changes made by the bidder in the price schedule with respect to the description/ quantities from those given in 'BOQ' of the specification shall not be considered (i.e., technical description & quantities as per the specification shall prevail).

Date: Bidder's Stamp & Signature

ANNEXURE-A2: Deviation/ Change Request of Technical Specification

Bidder shall list out all technical potential deviation/ change request (s) along with clause with respect to technical specifications.

Sl. No.	Page No.	Clause No.	Deviation	Reason/ Justification(s)

Any deviation not specifically brought out in this section shall not be admissible for any commercial implication at later stage. Except to the technical deviations listed in this schedule, bidder's offer shall be considered in full compliance to the tender specifications irrespective of any such deviation indicated / taken elsewhere in the submitted offer.

Date: Bidder's Stamp & Signature

ANNEXURE-A3: Technical Checklist

Sl.	Particulars	Reply by bidder	
1	TECHNICAL QUALIFYING REQUIREMENT		
1.1	The bidder should comply with Technical Qualifying requirement & furnish the relevant documents.	Confirmed	Yes/No
1.2	The bid shall be submitted by the Manufacturer of GIS/ Bidder who meets the PQR criteria. The bidder's scope includes supply and services like • supervision of erection, • testing and commissioning. Bids submitted by agents (who does not meet the PQR criteria) will not be considered.	Confirmed	Yes/No
1.3	All the documents shall be submitted in English. Translated pages should be attested by the bidder.	Confirmed	Yes/No
2	Un-priced Offer –.		
2.1.	Confirm that all items have been quoted. (If any item has not been quoted, the same shall be specifically brought out)	Confirmed	Yes/No
2.2.	Any other item /service required for the execution for the complete job is deemed to be included in the offer, whether specifically mentioned in the specification or not. List of items along with their respective quantities required for completeness (Attach list, if required).	List of Additional items required attached	Yes/No
2.3.	Foundation for GIS shall be constructed *by* Civil contractor based on the input (configuration, loads etc.) provided by bidder. The supply of all structural material to be embedded like foundation bolts as well as consumables like grouting material shall be in scope of bidder. The erection of structure shall be done by BHEL.	Confirmed	Yes/No
2.4.	SF6-GIS to Air bushing - Interface for connecting ICT/LINE/REACTOR with bus duct shall be complete with structures etc shall be provided by the bidder. Limit of supply as per technical specification and as per IEC 61639.	Confirmed	Yes/No
2.5.	Confirm that Consumables as per manufacturer requirement for successful erection, testing & commissioning shall be included in	Confirmed	Yes/No

Sl.	Particulars	Reply by bidder	
	bidder's scope.		
2.6.	Detailed list of Commissioning spares for testing & commissioning of GIS till handing over	Attached	Yes/No
2.7.	Detailed list of Tools & tackle & Testing Equipment	Attached	Yes/No
2.8.	Detailed list of Recommended Spares/operation & maintenance spare	Attached	Yes/No
2.9.	The Switchgear shall be complete with all necessary terminal boxes, SF6 gas filling, and interconnecting power and control Cables (between GIS to GIS/GIS to LCC/ LCC TO LCC), grounding connections (GIS to GIS and GIS to Earth Mesh on Floor), gas monitoring System and piping, support structures.	Confirmed	Yes/No
2.10.	The scope of supply shall also include all erection and mounting hardware and interconnecting cables within GIS.	Confirmed	Yes/No
2.11.	Design philosophy of earthing submitted with the bid. Design of Earthing of GIS shall be in bidder scope.	Confirmed	Yes/No
2.12.	Tentative GIS Hall PLAN & SECTION Layout including hook height of EOT crane submitted with the bid	Confirmed	Yes/No
2.13.	Tentative Outdoor yard PLAN & SECTION Layout submitted with the bid	Confirmed	Yes/No
2.14.	Technical Requirement of EOT Crane capacity & hook height mentioned in GIS Hall Layout	Confirmed	Yes/No
2.15.	EOT crane for 400kV GIS hall shall have capacity of minimum 8T safe working load and minimum height of crane shall be 9.5 meters or as per actual requirement, whichever is higher. However, bidder shall provide all the other technical requirements for EOT crane for suitability of crane for installation and maintenance of GIS including EOT crane capacity calculations etc.	Confirmed	Yes/No
2.16.	Tentative / estimated AC / DC Load requirement for GIS submitted with bid	Confirmed	Yes/No
2.17.	Earthing material as per Section 1	Confirmed	Yes/No
3	Technical		
3.1.	Location of site: *Project site is Yamunanagar, Haryana; design and construction of GIS should be suitable for the climate/ Meteorological Condition as mentioned in Section-1 and in section-3.*	Writeup attached with bid.	Yes/No

Sl.	Particulars	Reply by bidder	
	Bidder to inform what measures shall be taken to ensure the same at bid stage.		
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 – Aluminium Alloy	Confirmed	Yes/No
3.4.	Material of bus bar - Aluminium	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 Mandatory Maintenance equipment. Bidder to confirm that offered equipment meets the requirements of specification.	Enclosed with bid	Yes/No
4	Calculations		
5.1	All calculations including Thermal calculations based on the climatic conditions indicated in Technical Specification shall be submitted during detailed engineering stage.	Confirmed	Yes/No
5.2	Devices or techniques deployed for reducing transients to an acceptable level enclosed along with offer.	Enclosed with bid	Yes/No
5.3	The design of the equipment shall be such that the agreed permitted movement of foundations and mechanical or thermal effects do not impair the assigned performance of the equipment.	Confirmed	Yes/No
5.4	Bidder shall conduct insulation co-ordination & very fast transient overvoltage (VFTO) studies in line with IEC 60071 for establishing requirement/ suitability of surge arrester, and any other technical requirement for successful operation of GIS.	Confirmed	Yes/No
5.5	Bidder shall check and ensure adequacy of system protection for successful operation of GIS. After checking of system by bidder, GIS shall be installed and if any failure, malfunction of any part occurs after/ during commissioning, same shall be replaced immediately without any extra cost.	Confirmed	Yes/No
5	Technical Deviations		
5.6	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

Sl.	Particulars	Reply by bidder	
5.7	Technical Deviation sheet has been submitted.	Confirmed	Yes/No
6A	Activity Schedule		
6A.1	Bidder will submit detailed activity schedule indicating all the milestones from Engineering till manufacturing/ testing, dispatch to site and commissioning based on the drawing & document schedule attached in section1.	Confirmed	Yes/No
6B	Conditions		
6B.1	Open/ closed store area shall be provided by BHEL; However, bidder shall provide their tentative space requirement for covered and/ or open store area during tender stage only. In addition to this, bidder shall submit their standard storage instruction manual specifically specifying the item detailed with details of type of storage.	Confirmed Details given with the bid.	Yes/No
7	Site Test		
7.1	Bidder to supply only special tools. For other tools bidder to submit list of tools, tackle, slings, spanners, gauges, slings and other lifting devices, drills, instruments and appliances necessary for the complete assembly and erection at site of the GIS, required for installation, gas filling, maintenance, site testing of the GIS which shall be arranged by BHEL.	Confirmed	Yes/No
7.2	Bidder to furnish detailed BOQ for non-returnable Tools and Tackles along with unit prices to be handed over to ultimate customer.	Details given with the bid.	Yes/No
7.3	All field tests including tests during installation, pre-commissioning, commissioning, field acceptance tests shall be conducted by the Contractor, in presence of representative of the Employer. No separate site test will be conducted by BHEL/Customer	Confirmed	Yes/No
8	TYPE TESTS REQUIREMENTS		
8.1	The Bidder shall carry out the type tests as listed in this specification on the equipment to be supplied under this contract. The Bidder shall indicate the charges for each of these type tests separately in the relevant schedule of BPS/ BOQ and the same shall be considered for the evaluation of bids.	Confirmed	Yes/ No
8.2	In case the bidder has conducted such specified type test(s) according to the relevant standard and / or specification as per CEA	Confirmed	Yes/ No

Sl.	Particulars	Reply by bidder	
	Guidelines for the validity period of Type test(s) conducted on Major Electrical equipment in power Transmission-May2020 & with latest amendments as on date of bid opening, submit the type test reports to the Employer/ customer for waiver of conductance of such type test(s). These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a Client. The Employer/ customer reserves the right to waive conducting of any or all the specified type tests(s) under this contract. In case the type tests are waived, the type test charges shall not be payable to the bidder.		
8.3	Any type tests, which has not been conducted on the offered design of GIS or there has been a change in the design after the type tests the requisite tests shall be conducted by bidder on the offered design of GIS without any commercial implication on BHEL/ CUSTOMER.	Confirmed and enclosed with bid	Yes/ No

ANNEXURE-A4: 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 µs wave)	kVp	
1.13	- at switching impulse (250/2500 µs 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		

ANNEXURE-A5: CHECKLIST FOR TECHNICAL EVALUATION

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

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

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

The above checklist is reviewed and verified for,

NIT Reference No.:

Name of Bidder:

Name of Project: **400kV GIS Switchyard at 1X800 MW SUPER CRITICAL EXPANSION UNIT DEEN BANDHU CHHOTU RAM THERMAL POWER PLANT YAMUNA NAGAR**

Date: Bidder's Stamp & Signature