Project: 420kV GIS at Vishnugad Pipalkoti Hydro Electric Project (4X111MW)
Ref. No. VPHEP/GIS/PQR
Rev. No. 00

Technical Qualifying Requirements & Experience
For
420kV Gas Insulated Switchgear (GIS)

The bidder/ its collaborator/ its parent/ its principal must have experience in Design, Manufacture, & Supply of Gas Insulated Switchgear of at least 420kV class with Bus bar rating of min. 1000A, short circuit current rating of min. 40kA for 1 Sec installed at two different power projects/ sub-stations, which shall have been in [b]**successful trouble free operation** for at least 2 successive years in the last 10 years after commissioning as on [c]**date of technical bid submission** deadline against BHEL tender.

Note:

a. The bidder, who is not meeting the above requirements on its own,
-must have established manufacturing and testing facilities in India, and
-Gas Insulated Switchgear of at least 420kV Class with Bus bar rating of min. 1000A, short circuit current rating of min. 40kA for 1 Sec. must have manufactured in its Indian works based on technological support of its collaborator/ its parent/ its principal and **type tested (as per applicable IS/IEC standard).** Type testing must have been done at NABL accredited laboratory of respective country/ Independent laboratory as per applicable IS/IEC.
b. Successful trouble free operation means performance certificate issued by customer(s) without any adverse remark.
c. Date of technical bid submission means Original scheduled date of technical bid submission date against BHEL tender.

Requisite documents:

1. Performance certificate issued by end customer without any adverse remark(s), consisting the proof of design, manufacture, supply and commissioning.
2. In case of Indian bidder, who is not meeting the above requirements on its own, certification for technological support of collaborator/ parent/ principal.

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31/10/11

BHARAT HEAVY ELECTRICALS LIMITED

TRANSMISSION BUSINESS ENGINEERING MANAGEMENT

NOIDA

DOCUMENT NO.	**TB-382-316-004**	**REV 01**	**Prepared**	**Checked**	**Approved**
TYPE OF DOC.	**TECHNICAL SPECFICATION**	**NAME**	**DKS**	**VK**	**AG**
Title: **420kV Gas Insulated Switchgear & its accessories**		**SIGN**	-sd-	-sd-	-sd-
		DATE	**30.09.22**	**30.09.22**	**30.09.22**
		GROUP	**TBEM**		
		WO No.	**84008A**		
CUSTOMER	**THDC India Limited, Rishikesh, Uttarakhand**				
PROJECT	**Vishnugad Pipalkoti Hydro Electric Project (4X111MW)**				

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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.

01	11.01.2023	DKS/-sd-	VK/ -sd-	AG/-sd-	Revision in BOQ and Annexure-B of TS.
Rev. No.	Date	Altered	Checked	Approved	
Distribution				To	
				Copies	

CHECKLIST FOR TECHNICAL EVALUATION

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

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

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

The above checklist is reviewed and verified for,

NIT Reference No.:

Name of Bidder:

Name of Project: Vishnugad Pipalkoti Hydro Electric Project (4X111MW)

Date: Bidder's Stamp & Signature

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

1. Scope

This technical specification covers the requirements of design, manufacture, inspection and testing at manufacturer's works, proper packing and delivery to project site and supervision of installation and commissioning including site testing along with necessary equipment, training of BHEL/ THDCIL personnel for 420kV 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 420kV Gas Insulated Switchgear. This constitutes minimum technical parameters for the above item as specified by the THDCIL. The offered 420kV Gas Insulated Switchgear shall also comply with the Section-3 (Project Details and General technical requirements for all equipment under the Project) of this specification.

The specification comprises of following sections:

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

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

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

The equipment (**420kV Gas Insulated Switchgear & its accessories**) is required for the following project:

Name of the Customer	:	**THDC India Limited, Rishikesh, Uttarakhand**
Name of Main Contractor	:	**Bharat Heavy Electricals Limited**
Name of the Project	:	**Vishnugad Pipalkoti Hydro Electric project (4X111MW)**

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 (**420kV 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 60071	Insulation coordination
IEC 60099-4	Non-linear resistor type arresters for AC systems
IEC 129	Alternating Current Dis-connectors & Earthing Switches
IEC 60137	Insulated bushings for alternating voltages above 1000 V
IEC 60044-1	Current transformers
IEC 60044-2	Voltage transformers
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 60376	New sulphur hexafluoride
IEC 62271-100	High voltage alternating current Circuit breakers
IEC 62271-1	Common clauses for high voltage Switchgear and control-gear standards
IEC 62271-102	Alternating current disconnections (isolators) and earthing switches
IEC 60137	Bushings for alternating voltages above 1000 V

IEC 62271-209	Cable connections for gas-insulated switchgear
IEC 60480	Guide to checking of sulphur hexafluoride taken from electrical equipment
IEC 60099-1/4	Non-linear resistor type arresters for AC systems
IEC 60439	Factory-built assemblies of low-voltage switchgear and control Gear.
IEC 80 (2000)	IEEE Guide for Safety in AC Substation grounding.
CIGRE-44	Earthing of GIS- an application guide. (Electra no. 151, Dec'93).
IEC 61639	Direct connection between Power Transformers and gas insulated metal enclosed switchgear for rated voltage 72.5kV and above

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 (**420kV Gas Insulated Switchgear & its accessories**) shall be as follows,

Sl. No.	Description	Technical Parameters
1.	Type of GIS	420kV single phase, metal enclosed, SF6 gas insulated switchgear (Phase segregated type)
2.	Location	Indoor
3.	Maximum ambient temperature	40^0C
4.	Minimum ambient temperature	-7^0C
5.	Design ambient temperature	40^0C
6.	Relative humidity	100%
7.	Nominal voltage class, kV rms	420 kV
8.	Maximum System voltage, kV	420 kV
9.	Rated frequency,	50 Hz
10.	Number of phases	3 nos.
11.	Rated normal current	2000 Arms
12.	Rated short circuit withstand current	40 kArms for 1sec
13.	Operating mechanism of circuit breaker	Hydraulic/ Spring/ Combination of spring and hydraulic mechanism, as applicable
14.	Total number of interrupting chambers per phase of 420kV Circuit breaker	~~One/~~ Two nos.
15.	3 phase AC power supply	415V ± 10%, 50 Hz ± 3%, 3-phase 4 wire
16.	1 phase AC power supply	240V ± 10%, 50 Hz ± 3%, 1-phase , 2 wire

17.	DC power supply	220V + 20% to -25%, 2-wire ungrounded
18.	Average leakage rate of SF_6 gas from the GIS equipment's	Less than 0.5% per year

Notes:

1. Bidder shall submit detailed calculation of altitude correction factor, if applicable during detailed engineering stage, as per relevant IEC. GIS shall be installed at EL 1046.

2. 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.

3. Thermal calculations shall be based on the climatic conditions as per technical specification.

4. 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.

5. 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.

6. 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.

7. Bidder shall submit 3D model (surface model/ light weight model) compatible with primtech/ any other 3D software for complete GIS and its accessories.

8. GIS building shall have an EOT (Electric overhead travel) crane of capacity 12T, which shall be provided by BHEL/ THDCIL, 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.

9. CT/ VT parameters mentioned in SLD is indicative only. Bidder has to ensure correctness of CT/VT sizing as per relays selected for GIS during contract stage/ detailed Engineering stage.

10. Any change in bay pitch (distance between bays) as per civil requirement for foundation layout during detailed engineering stage shall be incorporated.

11. 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.

12. All supporting structures including foundation bolts/ fixing bolts/ embedded plate/ chemical anchor bolts and hardware etc. required for fixing and erection of GIS and bus duct shall be in bidder scope.

13. Fixing and erection of GIB duct on GIB cum cable gallery floor including foundation/ fixing bolts/ embedded plate shall be in bidder scope of supply.

14. All hardware and structure required for fixing and erection of GIS on GIS floor including foundation/ fixing bolts/ embedded plate shall be in bidder scope of supply.

15. All supporting structures including foundation bolts/ fixing bolts/ embedded plate/ chemical anchor bolts and hardware etc. for the SF6 duct connections between the generator transformers oil to SF6 bushing and the GIS duct shall be in Bidders' scope.

16. 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 shall be in the scope of bidder.

17. Bidder shall ensure supervision of installation, testing and commissioning any subsystem of GIS, including online gas monitoring/ partial discharge system etc.
18. 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.
19. 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.
20. 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.
21. 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.
22. The Bidder is to ensure that packing size of GIS materials shall be such that it should accommodate in cut out size provided in cutout area (7m x 4 m) in GIS floor for lifting of GIS material from MAT (main access tunnel).
23. This project is hydro project located at high altitude with transportation limitations such as road width, bridge/ pool capacity and tunnel etc.
24. Bidder shall extend his support for all the activities including gas work and other associated work related to GIS termination in 420kV GIS cable connection.
25. Controlled Switching Device (CSD) compatible for remote operation with IEC 61850 protocols shall be supplied for 420kV Line Bays Circuit breakers. It shall have display facility at the front for the display of settings and measured values. In case, CSD does not have complete display facility for settings and measured values, bidder to supply one number laptop PC with pre-installed licensed software. Special cable, if required for integration is deemed to be included in bidder's scope.

4. Other General Requirements

The other general requirements for the equipment (**420kV Gas Insulated Switchgear & its accessories**) shall be as follows,

1. Schedule
   - Bidder shall submit detailed bar chart for engineering approval, site installation, testing and commissioning activities.
   - Bidder shall submit list of consumables with shelf life of fewer than two years and same shall be dispatched just before the erection and only after specific clearance from BHEL/ THDCIL/ Consultant.
   - 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/ THDCIL/ Consultant.
- 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 along with local conveyance 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.
   - 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 shall be brought at site multiple times as per site requirements, reasons not attributable to BHEL.
   - 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/ THDCIL/ Consultant before testing & commissioning activities.
   - GIS bays may be commissioned at different point of time depending on the site conditions and as per L2 schedule for the project, and hence deployment 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/ THDCIL personnel
   - Training of BHEL/ THDCIL personnel on 420kV GIS & its accessories shall be provided at vendor's works as well as project site. However, to & fro travelling charges, lodging and boarding charges for BHEL/ THDCIL personnel shall not be borne by bidder.

8. Earthing of GIS
    - Bidder to submit detailed calculations, sizing and layout drawings for earthing system during detailed engineering stage. Bidder to provide the bill of quantity for entire items required for the earthing of the GIS. However, supply of 40mm MS ROD, 75X12/ 50x6mm GI Flat & erection of earth mat shall be done by BHEL in supervision of bidder/ manufacturer as per manufacturer's design. Any other earthing material except 40mm MS Rod, 75x12/ 50x6mm GI Flat, if required shall be in bidder's scope of supply only.
    - Earthing design philosophy shall be submitted by bidder in line with customer technical specification and guidelines of IEEE Std 80 and other applicable standards.
    - If any other special earthing including high frequency earthing etc., if required shall be in bidder's scope of supply.
9. Modular Design
    - 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.
    - The bus enclosure shall 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.
    - 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.
    - Bus duct lengths shall be taken from the end of bay equipment (VT, LA etc.) to end equipment (SF6 to oil bushing/ connection etc.) and Tees/ bends/ elbow required for completion of gas insulated bus duct connection shall be treated as part of gas insulated bus duct only.
    - 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. 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.
10. Future Extension of GIS
    - The GIS system shall be suitable for future extension on either end. The arrangement of gas sections or compartments shall be such as to facilitate future extension without any drilling, cutting or welding on the existing equipment. To add equipment, it shall not be necessary to move or dislocate the existing switchgear bays .
    - The layout shall ensure that GIS bus link section is provided for future extension of the GIS buses to avoid de-gassing and modification of the existing bus.

- The physical layout shall ensure free movement of the SF6 Gas Cart and easy access to all components of the GIS for maintenance purposes.

11. Service continuity requirements of GIS
    - 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:
      a) For double main bus switching scheme during a fault in CB 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.

5. Bill of Quantities

1. Schedule of quantities for supply & services for the equipment (**420kV Gas Insulated Switchgear & its accessories**) shall be as per **ANNEXURE- BOQ for 420kV GIS & its Accessories**. However, any supply/ service not appearing herein but required for completeness of the work is deemed to be included in bidder's scope.
2. BHEL reserves the right for quantity variation due to any reason upto ±20% of total value at same unit rate and terms during execution of contract.

6. Drawings / Documents required for Technical Clearance for Manufacturing

Drawings/ documents detailed as per **Annexure B- Details for Technical Clearance for Manufacturing** shall be used for providing technical clearance for manufacturing of the equipment (**420kV Gas Insulated Switchgear & its accessories**), which shall be used for delay analysis, if applicable for respective group.

The technical clearance for manufacturing shall be provided based on the engineering approval of drawing/ documents in phase wise manner, however, items can be clubbed together subject to condition of approval of drawing/ documents. 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 engineering department to include/ exclude the drawing/ document earmarked for issue of technical clearance for manufacturing. In case drawing/ document are not duly stamped in category-1/ category-2 by customer, BHEL stamp in category-1 shall be treated final to proceed further, commercial implication, if any shall be borne by BHEL.

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/ THDCIL approval.

7. Type Testing

Bidder shall ensure that the electrical equipment (**420kV Gas Insulated Switchgear & its accessories**) being procured have valid type test certificates as specified in IEC standard 62271 - 203 & 62271-100 (amended up to date) at any NABL accredited laboratories/ any authorized testing lab in line with applicable IS/IEC.

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

The type tests shall be as per IEC 62271-203 and in line with section-2 and the report shall include following tests, but not limited to,

a) Test to verify the insulation level of the equipment including partial discharge test and dielectric tests on each GIS device (CB, Disconnector, and bus etc.)
   (i) Lightning impulse test
   (ii) Switching impulse test
   (iii) One-minute power frequency test
   (iv) Partial discharge test.

b) Test to prove the temperature rise of any part of the equipment and measurement of the Resistance of the main circuit.

c) Test to prove the ability of the main and the earthing circuits to carry the rated peak and the rated short time withstand current.

d) Test to verify the making and breaking capacity of circuit breaker.

e) Test to prove the satisfactory operation of switching devices i.e., circuit breaker, dis-connector, earth switch.

f) Tests to prove the strength of enclosures.

g) Test for degree of protection of the enclosure.

h) Tests to assess the effects of arcing due to an internal fault (internal arc test).

i) Gas tightness tests.

j) Type tests on Circuit breakers, dis-connectors, earth switches, surge arrestors, CT, PT etc. as per the relevant standards.

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

l) Electromagnetic compatibility tests (EMC).
m) Additional tests on auxiliary and control circuits.
n) Tests on partitions.
o) Tests to prove the satisfactory operation at limit temperatures.
p) Tests to prove performance under thermal cycling and gas tightness tests on Insulators.
q) Corrosion test on earthing connections (if applicable)
r) Tests to assess the effects of arcing due to an internal fault
s) Earthquake withstand test
t) Mechanical operation test
u) Dielectric tests on auxiliary circuits
v) Tests on solid dielectric components (operating rods, spacers etc.)
w) Test on Auxiliary switches (Electrical & Mechanical Endurance, Heat run, IR & HV test)

8. Quality Plan

The successful bidder shall submit Quality Assurance Plan for **420kV Gas Insulated Switchgear & its accessories** etc. including in-process inspection methods, tests, records, etc. for BHEL/ THDCIL approval. Customer hold points will also be included in the plan, which shall be mutually agreed by the BHEL/ THDCIL. In case bidder has reference Quality Assurance Plan agreed with BHEL/ THDCIL, same shall be submitted for specific project to BHEL/ THDCIL approval. There shall be no commercial implication to BHEL/ THDCIL on account of Quality Plan approval.

Superior quality control system shall be adopted to assure high product quality. Raw materials of the best commercial grade quality and high reliability shall be used in the manufacture of the equipment (**420kV 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 (**420kV Gas Insulated Switchgear & its accessories**) shall be deemed to be included in bidder's scope.

9. Inspection & Testing

1. GIS and its associated materials shall be subject to inspection by BHEL/THDCIL or authorized representative at bidder/manufacturers' works. Hence, Bidder shall furnish all necessary information concerning the supply to BHEL/ THDCIL.
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/ THDCIL approval in line with specific requirements mentioned in section-2, technical specification.

10. Field Testing & Commissioning

1. Bidder/ OEM shall carry out field testing and commissioning of 420kV 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/ THDCIL 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.

11. Makes of Equipment/ Components

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

12. 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.

13. Exceptions

1. Cable support structure for Cable sealing end (CSE) shall not be in bidder's scope. It shall be supplied and erected by BHEL/ its contractor.

2. During storage of materials in BHEL provided open/ closed store, watch and ward shall be provided by BHEL.
3. For construction requirements, the necessary power supply at site shall be provided by BHEL at one point only, however supply requirements for HV AC/ DC testing etc. shall be arranged by bidder only.

14. Definitions Used

The following expressions hereunder and elsewhere in the technical specification used and their grammatical variations shall unless repugnant to the subject or context thereof, have the following meanings hereunder respectively assigned to them, namely:

1. Bid/ Bidding Documents: The totality of the documents comprising the Bidding Document for the notice inviting tender.
2. Contract: The totality of agreement between Customer/ Purchaser/ Owner and the Contractor/ BHEL as derived from the contract documents.
3. Contractor: The bidder selected by the Customer/ Purchaser/ Owner for the performance of the work and supply of materials. In this case, it is BHEL.
4. Customer/ Purchaser/ Owner: THDC India Limited
5. Consultant: Any person(s)/ Firm nominated/ assigned by the Customer/ Purchaser/ Owner for providing the engineering consultant services.
6. Bidder/ vendor/ OEM: The bidder selected for this intended work shall be known as vendor/ OEM.

15. Abbreviations Used

The following terminology/ acronym hereunder and elsewhere in the technical specification used and their grammatical variations shall unless repugnant to the subject or context thereof, have the following full form hereunder respectively assigned to them, namely,

AC:	Alternating Current
DC:	Direct Current
kV:	Kilovolt
Hz:	Hertz
IP:	Ingress Protection
GIS:	Gas Insulated Switchgear
SAT:	Site Acceptance Testing
BOQ:	Bill of Quantities
QAP:	Quality Assurance Plan
NIT:	Notice Inviting Tender
OEM:	Original Equipment Manufacturer
BHEL:	Bharat Heavy Electricals Limited
BIS:	Bureau of Indian Standards
BS:	British Standard
ANSI:	American National Standards Institute
ASTM:	American Society for Testing and Materials

IS:	Indian Standards
IEC:	International Electro Technical Commission
IEEE:	Institute of Electrical & Electronics Engineers
CEA:	Central Electricity Authority
NEMA:	National Electrical Manufacturers Association

16. List of Documents/ Drawings

Following drawing/ documents are attached for information purpose,

1. Annexure A- BOQ for 420kV GIS & its Accessories
2. Annexure B- Details for Technical Clearance for Manufacturing
3. TB-3-382-510-001: Single Line Diagram for 420kV GIS and Pothead yard
4. TB-3-382-316-002: Layout Plan & Section Drawing for Pothead Yard
5. TB-3-382-316-014: Conceptual Layout of GIS

Annexure_BOQ_420kV GIS REV01

Project: 420kV GIS Project at Vishnugad Pipalkoti Hydro Electric Project (4X111MW)

Annexure A- BOQ for 420kV GIS & its accessories REV00

REV. No. **01**

Sl. No.	DESCRIPTION
	420kV GIS for VPHEP
A, B	Annexure_BOQ_ MAIN ITEMS & MAINTENANCE & TESTING INSTRUMENTS
C, D	Annexure_BOQ_MANDATORY SPARE & UNIT SUPPLY ITEM
E, F & G	Annexure_BOQ_ MAIN SERVICE ITEM, TRAINING & UNIT SERVICE ITEM

Sl. No.	Description	Detailed Description	Unit	Qty
A	**420kV, 2000A , 40kA for 1sec Gas Insulated Switchgear (GIS) as per TS**	GIS shall be 420kV, 40kA for 1sec, 2000A, Double Bus GIS configuration complete with local control centre (LCC) etc with open future proof & flexible system in line with IEC 61850 & IEC 62271-203. (Circuit breaker shall be C2 - M2 class as per IEC 62271-100). GIS shall comprise following bays but not limited to (Refer attached Single Line Diagram), (a) Busbar System with Bus VT & Bus Earth Switch module - 2 Set (b) Bus coupler bay module- 1 Set (c) Generator transformer bay modue- 4 Set (d) Line feeder bay module - 2 set Typical bay includes but not limited to SF6 gas, 1-phase Busbar, circuit breaker, current transformer, bus-bar dis connectors, safety grounding switch, high speed fault making grounding switch, Local control cubicle, SF6 gas monitoring system for complete bay, SF6 bus duct termination arrangement including oil to SF6 connection module/ SF6 to cable connection module, PD sensor (adequate number of UHF sensors in the offered GIS equipment for detection of Partial discharge (of 5 pC and above) as per IEC 60270 through Partial Discharge (PD) monitoring system), different gas compartment, O- ring & gaskets, Nuts, Bolts & Washers, Absorbent, Limit Switch, SF6 Gas etc. along with 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. GIS shall be complete with all necessary terminal boxes, inspection windows, SF6 gas filling, interconnecting cabling & wirings, grounding connections, gas monitoring systems and pipings, trays, support structures. Hence, the scope shall include supply, erection and mounting of hardware and interconnecting cables between GIS to LCC and between LCC to LCC including Cable Trays, Tags, Glands, ferrules, Lugs etc, however cables beyond LCC shall be supplied and laid by BHEL.		
1	Supply- GIS: 420kV, 40kA for 1sec, 2000A GIS double main bus scheme - Bus bar GIS module with Bus VT & Bus Earth Switch module	420kV, 40k for 1sec, 2000A, bus bar GIS module, comprising of following but not limited to, Bus enclosures running along the length of the switchgear to interconnect each of circuit breaker bay module along with associated eqipment comprising of, (a) 1nox3-phase disconnector switch, complete with manual and motor driven operating mechanism- 1set (b) 1nox3-phase grounding switch, complete with manual and motor driven operating mechanism- 1set (c) 1nox3-phase, high speed fault making grounding switch, complete with manual and motor driven operating mechanism- 1set (d) 1nox1-phase multi winding voltage transformer as per single line diagram- 3no (e) UHF PD sensors, gas monitoring device, pressure relief device, busbar, insulator, expansion joint/ flexible, insulators etc. as required. (f) Any other item required to complete the system in all respects but not limited to above. For further details, Please refer Section-2 along with applicable drawings.	Set	2
2	Supply- GIS: 420kV, 40kA for 1sec, 2000A GIS double main bus scheme -Buscoupler GIS bay module	420kV, 40k for 1sec, 2000A, GIS bay module, comprising of following but not limited to, (a) 1nox3-phase circuit breaker, complete with operating mechanism for 1 & 3-phase operation- 1set (b) 1nox3-phase disconnector switch, complete with manual and motor driven operating mechanism- 1set (c) 1nox3-phase grounding switch, complete with manual and motor driven operating mechanism- 1set (d) 1nox1-phase, 4-core (bus A side) , multi ratio, current transformers as per single line diagram- 3no (e) 1nox1-phase, 3-core (bus B side) , multi ratio, current transformers as per single line diagram- 3no (df) UHF PD sensors, gas monitoring device, pressure relief device, busbar, insulator, expansion joint/ flexible, insulators etc. as required. (g) Any other item required to complete the system in all respects but not limited to above. For further details, Please refer Section-2 along with applicable drawings.	Set	1
3	Supply- GIS: 420kV, 40kA for 1sec, 2000A GIS double main bus scheme -Generator Transformer GIS bay module	420kV, 40k for 1sec, 2000A, GIS bay module, comprising of following but not limited to, (a) 1nox3-phase circuit breaker, complete with operating mechanism for 1 & 3-phase operation- 1set (b) 1nox3-phase disconnector switch, complete with manual and motor driven operating mechanism- 3set (c) 1nox3-phase grounding switch, complete with manual and motor driven operating mechanism- 2set (d) 1nox3-phase, high speed fault making grounding switch, complete with manual and motor driven operating mechanism- 1set (e) 1nox1-phase, 3-core (bus side) , multi ratio, current transformers as per single line diagram- 3no (f) 1nox1-phase, 5-core (GT side) , multi ratio, current transformers as per single line diagram- 3no (g) UHF PD sensors, gas monitoring device, pressure relief device, busbar, insulator, expansion joint/ flexible, insulators etc. as required, however, however, SF6 bus duct termination arrangement with SF6 to oil connection module and surge arrestors are coverd in other line items. (h) Any other item required to complete the system in all respects but not limited to above. For further details, Please refer Section-2 along with applicable drawings.	Set	4

Sl. No.	Description	Detailed Description	Unit	Qty
4	Supply- GIS: 420kV, 40kA for 1sec, 2000A GIS double main bus scheme -Line GIS bay module	420kV, 40k for 1sec, 2000A, GIS bay module, comprising of following but not limited to, (a) 1nox3-phase circuit breaker, complete with operating mechanism for 1 & 3-phase operation- 1set (b) 1nox3-phase disconnector switch, complete with manual and motor driven operating mechanism- 3set (c) 1nox3-phase grounding switch, complete with manual and motor driven operating mechanism- 2set (d) 1nox3-phase, high speed fault making grounding switch, complete with manual and motor driven operating mechanism- 1set (e) 1nox1-phase, 3-core (bus side) , multi ratio, current transformers as per single line diagram- 3no (f) 1nox1-phase, 4-core (line side) , multi ratio, current transformers as per single line diagram- 3no (g) UHF PD sensors, gas monitoring device, pressure relief device, busbar, insulator, expansion joint/ flexible, insulators etc. as required, however, SF6 to cable connection module and surge arrestors are coverd in other line items. (h) Any other item required to complete the system in all respects but not limited to above. For further details, Please refer Section-2 along with applicable drawings.	Set	2
5	Supply- GIS: 420kV, 40kA for 1sec, 2000A GIS double main bus scheme - Gas insulated bus duct	420kV, 40kA for 1sec, 2000A SF6 gas insulated GIS Bus duct shall include the following but not limited to, (a) 1-phase SF6 gas insulated bus duct to connect GT GIS bay module with SF6 oil connection module (c) UHF PD sensors, gas monitoring device, pressure relief device, busbar, insulator, expansion joint/ flexible, insulators etc. as required. (d) Any other item including tee/ bend/ elbow required to complete the system in all respects but not limited to above. The total tentative length indicated is the sum of all 1-phase SF6 bus duct from end of respective bay to SF6 to oil bushing/ connection module. However, exact length shall be decided based on the details finalized during detailed engineering stage. For further details, Please refer Section-2 along with applicable drawings.	Mtr	375
6	Supply- GIS: 420kV, 40kA for 1sec, 2000A GIS double main bus scheme - Termination module for GIS bus duct and Oil to SF6 Bushing of Generator Transformer	420kV, 40kA for 1sec, 1-phase, 2000A, termination module for connecting generator transformer Oil to SF6 bushing with GIS bus duct. It shall confirm to IEC 62271-211. For further details, Please refer Section-2 along with applicable drawing.	Nos.	12
7	Supply- GIS: 420kV, 40kA for 1sec, 2000A GIS double main bus scheme - Termination module for GIS bay module to XLPE cable	420kV, 40kA for 1sec, 1-phase, 2000A, termination module for connecting GIS bay module with XLPE cable. This module shall be provided with reovable link for facilitation during high voltage testing of cable/ other maintenance requirements. It shall confirm to IEC 62271-209. For further details, Please refer Section-2 along with applicable drawing.	Nos.	6
8	Supply- GIS: 420kV, 40kA for 1sec, 2000A GIS double main bus scheme - GIS Surge Arrester Module with Surge Counter	390kV Surge Arresters shall be station type, heavy duty, SF6 gas-insulated, nonlinear zinc oxide gap less type. Nominal discharge current and long duration discharge class shall be 20kA and class 4 respectively. The minimum energy handling capacity and pressure relief current of Surge arrester shall be 10kJ/kV and 40kA respectively It shall conform to IEC-60099-4. For further details, Please refer Section-2 along with applicable drawing.	Set	18
9	Supply- GIS: 420kV, 40kA for 1sec, 2000A GIS double main bus scheme - SF6 gas required for placing GIS into successful operation	First filling of SF6 gas for the equipment supplied plus an additional quantity (10%) sufficient for conducting all the tests on equipment at site before placing it into successful operation and compensating losses during 20 years of operation. In addition, 10% of the total quantity of SF6 gas shall also be supplied. For further details, Please refer Section-2 along with applicable drawing.	MT	7
10	Supply- GIS: 420kV, 40kA for 1sec, 2000A GIS double main bus scheme - Hydraulic oil required for placing GIS into successful operation	First filling of hydraulic oil, if applicable, for the equipment supplied plus an additional quantity (10%) sufficient for conducting all the tests on equipment at site before placing it into successful operation and compensating losses during 20 years of operation. In addition, 10% of the total quantity of hydraulic oil shall also be supplied. For further details, Please refer Section-2 along with applicable drawing.	Lot	1
11	Supply- GIS: 420kV, 40kA for 1sec, 2000A GIS double main bus scheme - End Piece/ Interface Module for Future Extension	This item shall be used as end piece/ interfaec module for future exetension on both ends of GIS.	Set	2
12	Supply- GIS: 420kV, 40kA for 1sec, 2000A GIS double main bus scheme - Bus bar extension module	This item shall be used for inteconnection of bus bars between the bays, in case, there is change in architectural layout of GIS building.	Set	2
13	Supply- GIS: 420kV, 40kA for 1sec, 2000A GIS double main bus scheme - Local Control Centre (LCC)	Local Control Centre (LCC) for each bay shall include the following but not limited to, (a) Bus coupler bay module- 1 Set (b) Generator transformer bay modue- 4 Set (c) Line feeder bay module - 2 set LCCs shall be separate, freestanding and floor mounted type. Technical requirement of LCC for the complete GIS System shall be incorporated in 7no. of LCC only, however, it may change during detailed engineering stage even if on choice basis, payment for only 7no. shall be done. Please refer clause of 3.2.11 of section 2 and mentioned elsewhere in Technical Specification. For further details, Please refer Section-2 along with applicable drawing.	Set	7

Sl. No.	Description	Detailed Description	Unit	Qty
14	Supply- GIS: 420kV, 40kA for 1sec, 2000A GIS double main bus scheme - Online continuous gas monitoring and alarm System	420kV GIS equipment system shall have monitoring system, complete in all respect and comprising of following but not limited to, (a) All gas compartments shall have their own independent gas supervision and alarm systems. There shall not be any interconnection between different gas compartments for the purpose of gas monitoring. (b) Individual temperature compensated gas pressure gauge(s)/ density device(s) shall be provided in each of the gas compartments which will monitor and indicate the state of gas density. The system shall be such that it can be installed separately/ integrated with SAS/SCADA (As applicable). For further details, Please refer Section-2 along with applicable drawing.	Lot	1
15	Supply- GIS: 420kV, 40kA for 1sec, 2000A GIS double main bus scheme - Online continuous partial discharge monitoring system (PDM)	420kV 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. For further details, Please refer Section-2 along with applicable drawing.	Lot	1
16	Supply- GIS: 420kV, 40kA for 1sec, 2000A GIS double main bus scheme - Controlled switching Device for Line Bay CB	Controlled Switching Device (CSD) compatible for remote operation with IEC 61850 protocols shall be supplied for 420kV Line bays Circuit breakers. It shall have display facility at the front for the display of settings and measured values. In case, CSD does not have complete display facility for settings and measured values, bidder to supply one number laptop PC with pre-installed licensed software. Special cable, if required for integration is deemed to be included in bidder's scope.	Set	2
17	Supply- GIS: 420kV, 40kA for 1sec, 2000A GIS double main bus scheme - Structure Materials for support of GIS, Bus Ducts including Foundation Bolts, Embedded Items, Rails and/ or other items structural items specfic to GIS	Structure Materials for support of GIS, Bus Ducts including Foundation Bolts, Embedded Items, Rails and/ or other items 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 610gm/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. Manufacturer 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 as per following, but not limited to the following, (a) Base Plate, Channel, Metallic/ Structural Member for seating of GIS system (b) Lattice/ Pipe structure required for GIS bay, GIB, SF6 to air bushing/ connection. (c) Foundation bolt/ anchor fastening bolts for GIS system, if required. (d) Equipment fixing hardware. (e) Cable tray arrangement (mounted on structures of) GIS bay, GIB (f) Any other structural item required to complete the system in all respects but not limited to above. For further details, Please refer Section-2 along with applicable drawing.	MT	30
18	Supply- GIS: 420kV, 40kA for 1sec, 2000A GIS double main bus scheme - Complete Earthing Materials including High Frequency Earthing	Earthing Materials, except 40mm MS rod,75x10mm/ 50x6 GI Flat, which shall be provided by BHEL as free issue item (FIM), but, exact quatity requirenment shall be intimated by bidder based on the earthing philosphy approved, 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.	Lot	1
~~19~~	~~Supply- GIS: 420kV, 40kA for 1sec, 2000A GIS double main bus scheme - Consumables for GIS system the complete installation, testing, commissioning and placing into successful operation of the GIS equipment.~~	~~All consumables required for installation, testing and commissioning of GIS including grouting material and chemicals for the chemical anchors bolts etc., if applicable for GIS shall be provided by bidder, however, in case of consumables with shelf life less than six months shall be supplied with special permission and intimation from BHEL.~~ ~~For further details, Please refer Section-2 along with applicable drawing.~~	~~Lot~~	~~1~~
B	**Supply Item: Maintenance/ Testing & Commissioning instrument as per TS**			
1	Supply: Maintenance Equipment- SF6 gas processing unit	SF6 gas processing unit suitable for evacuating, liquefying, filling, drying and purifying SF6 gas during initial installation, subsequent maintenance and future extension of the GIS. SF6 gas processing unit shall be model no. L170R01 of 300 litter storage capacity of DILO make or equivalent. For further details, Please refer Section-2 along with applicable drawing.	Set	1
2	Supply: Maintenance Equipment- Contact resistance metering desk with cables	Contact resistance metering desk with cables of any reputed make & model, which shall be subject to approval by customer during detailed engineering. For further details, Please refer Section-2 along with applicable drawing.	Set	1

Sl. No.	Description	Detailed Description	Unit	Qty
3	Supply: Maintenance Equipment-Circuit Breaker analyser kit with DCRM having minimum 15 channels alongwith Laptop	Circuit Breaker analyser kit with DCRM having min. 15 channels alongwith Laptop of any reputed make & model, which shall be subject to approval by customer during detailed engineering. For further details, Please refer Section-2 along with applicable drawing.	Set	1
4	Supply: Maintenance Equipment-Ladder/ walkways/ mobile platform	Ladder/ walkways/ mobile platform of any reputed make & model, which shall be subject to approval by customer during detailed engineering. For further details, Please refer Section-2 along with applicable drawing.	Set	1
5	Supply: Maintenance Equipment-Portable gas leak detector	Portable gas leak detector of any reputed make & model, which shall be subject to approval by customer during detailed engineering. For further details, Please refer Section-2 along with applicable drawing.	Set	1
6	Supply: Maintenance Equipment-Portable dust counter	Portable dust counter of any reputed make & model, which shall be subject to approval by customer during detailed engineering. For further details, Please refer Section-2 along with applicable drawing.	Set	1
7	Supply: Maintenance Equipment-Special gas mask for GIS maintenance	Special gas mask for GIS maintenance of any reputed make & model, which shall be subject to approval by customer during detailed engineering. For further details, Please refer Section-2 along with applicable drawing.	Set	2
8	Supply: Maintenance Equipment-Power operated insulation tester	Power operated insulation tester of any reputed make & model, which shall be subject to approval by customer during detailed engineering. For further details, Please refer Section-2 along with applicable drawing.	Set	1
9	Supply: Maintenance Equipment-Tong tester for suitable range	Tong tester for suitable range of any reputed make & model, which shall be subject to approval by customer during detailed engineering. For further details, Please refer Section-2 along with applicable drawing.	Set	1
10	Supply: Maintenance Equipment-Portable SF6 gas analyser offline	Maintenance Equipment- Portable SF6 gas analyser offline of any reputed make & model, which shall be subject to approval by customer during detailed engineering. For further details, Please refer Section-2 along with applicable drawing.	Set	1
11	Supply: Maintenance Equipment-Dew point meter	Dew point meter of any reputed make & model, which shall be subject to approval by customer during detailed engineering. For further details, Please refer Section-2 along with applicable drawing.	Set	1
12	Supply: Maintenance Equipment-Mobile platform/ A-type ladder	Mobile platform/ A-type ladder shall be suitable for working at height with having the sufficeint space to keep the working tools and tackles and it shall be of reputed make, which shall be subject to approval by customer during detailed engineering. For further details, Please refer Section-2 along with applicable drawing.	Set	1

Sl.No.	Description	Detailed Description	Unit	Qty
C	**Supply Item: Mandatory Spares for five years of successful operation of 420kV GIS as per TS**			
1	Supply: Mandatory Spares- One pole of complete interrupter unit of 420kV, 2000A circuit breaker with operating mechanism	1 set= 1 pole of complete interruper unit with enclosure and 1 nos. of operating mechanism	Set	1
2	Supply: Mandatory Spares- Complete drive mechanism including motor for 420kV, 2000A, disconnector	1 set= 1 nos. drive mechanism for disconnector	Set	1
3	Supply: Mandatory Spares- Complete drive mechanism including motor for 420kV, 2000A, earthing switch	1 set= 1 nos. drive mechanism for earthing switch	Set	1
4	Supply: Mandatory Spares- Complete drive mechanism including motor for 420kV, 2000A fast acting earthing switch	1 set= 1 nos. drive mechanism for fast acting earthing switch	Set	1
5	Supply: Mandatory Spares- Trip coils for circuit breakers		Nos.	6
6	Supply: Mandatory Spares- Closing coils for circuit breakers		Nos.	6
7	Supply: Mandatory Spares- Complete set of rupture disc	1 set= 1 nos. of each type and rating	Set	2
8	Supply: Mandatory Spares- Pressure switch/ gas pressure transmitter	1 set= 1 nos. of each type	Set	2
9	Supply: Mandatory Spares- Pressure Gauge	1 set= 1 nos. of each type	Set	2
10	Supply: Mandatory Spares- Gas Density Relay	1 set= 1 nos. of each type	Set	2
11	Supply: Mandatory Spares- Gas permeable Insulator/ bushing	1 set= 1 nos. of each type	Set	2
12	Supply: Mandatory Spares- Non-gas permeable Insulator/ bushing	1 set= 1 nos. of each type	Set	2
D	**Supply: Unit reference price of 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.		
1	Supply: Unit reference price of GIS part item/ equipment- 420kV, 2000A Circuit Breaker	1 Set= 1 No of each rating and type with one poles with enclosure & without operating mechanism	Set	1
2	Supply: Unit reference price of GIS part item/ equipment- 420kV, 2000A Disconnector switch	1 Set= 1 No of each rating and type with all three poles with enclosure & without operating mechanism	Set	1
3	Supply: Unit reference price of GIS part item/ equipment- 420kV, 2000A Maintenance Earthing Switch	1 Set= 1 No of each rating and type with all three poles with enclosure & without operating mechanism	Set	1
4	Supply: Unit reference price of GIS part item/ equipment- 420kV, 2000A Fast acting make proof grounding switch/ High speed make proof grounding switch	1 Set= 1 No of each rating and type with all three poles with enclosure & without operating mechanism	Set	1
5	Supply: Unit reference price of GIS part item/ equipment- Surge Arrestor including Surge Counter (Rated arrester voltage – 398kV)	1 Set= 1 No of each rating and type with enclosure. Rated voltage may be changed after insulation coordination study.	Set	1
6	Supply: Unit reference price of GIS part item/ equipment- 420kV Current Transformer	1 Set= 1 No of each rating and type with enclosure	Set	1
7	Supply: Unit reference price of GIS part item/ equipment- 420kV Voltage Transformer	1 Set= 1 No of each rating and type with enclosure	Set	1
8	Supply: Unit reference price of GIS part item/ equipment- Operating Mechanism for Circuit Breaker	1 Set= 1 No of each rating and type	Set	1
9	Supply: Unit reference price of GIS part item/ equipment- Operating Mechanism box for Disconnector switch	1 Set= 1 No of each rating and type	Set	1
10	Supply: Unit reference price of GIS part item/ equipment- Operating Mechanism box for Maintenance earthing switch	1 Set= 1 No of each rating and type	Set	1
11	Supply: Unit reference price of GIS part item/ equipment- Operating Mechanism for Fast acting make proof grounding switch/ High speed make proof grounding switch	1 Set= 1 No of each rating and type	Set	1
12	Supply: Unit reference price of GIS part item/ equipment- 420kV, 1-Phase bus bar conductor		Mtr	1

Sl.No.	Description	Detailed Description	Unit	Qty
13	Supply: Unit reference price of GIS part item/ equipment-420kV, 1-phase GIS metalic enclosure for bus bar/ any eqipment		Mtr	1
14	Supply: Unit reference price of GIS part item/ equipment-420kV, 1-Phase conductor for bus duct		Mtr	1
15	Supply: Unit reference price of GIS part item/ equipment-420kV, 1-phase GIS metalic enclosure for bus duct		Mtr	1
16	Supply: Unit reference price of GIS part item/ equipment-Gas permeable/ communication/ barrier type Insulator	1 Set= 1 No of each rating and type	Set	1
17	Supply: Unit reference price of GIS part item/ equipment-Gas non- permeable/ non - communication/ non-barrier type Insulator	1 Set= 1 No of each rating and type	Set	1
18	Supply: Unit reference price of GIS part item/ equipment-UHF PD sensor	1 Set= 1 No of each rating and type	Set	1
19	Supply: Unit reference price of GIS part item/ equipment-Pressure/ density monitor monitor device & Switch	1 Set= 1 No of each rating and type	Set	1
20	Supply: Unit reference price of GIS part item/ equipment-Pressure relief device	1 Set= 1 No of type	Set	1
21	Supply: Unit reference price of GIS part item/ equipment-Rupture disc	1 Set= 1 No of type	Set	1
22	Supply: Unit reference price of GIS part item/ equipment-Elbow/ bend/ cross and T section	1 Set= 1 No of type	Set	1
23	Supply: Unit reference price of GIS part item/ equipment-Expansion joint	1 Set= 1 No of type	Set	1
24	Supply: Unit reference price of GIS part item/ equipment-Flexible connection for conductor	1 Set= 1 No of type	Set	1
25	Supply: Unit reference price of GIS part item/ equipment-Gas seals	1 Set= 1 No of type	Set	1

Sl.No.	Description	Detailed Description	Unit	Qty
E	**Services: Supervision of Erection, Testing & Commissioning of 420kV GIS as per TS**			
1	Service: GIS- 420kV, Site visit for supervision of unloading & verification of 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
2	Service: GIS- 420kV, Supervision of erection of GIS bays including LCC	Supervision of complete GIS bays along with all bay equipment such as GIS extension module, GIS bus extension module, GIS to XLPE cable connection module, voltage transformer, LCC including structure, cabling, earthing & other associated activities shall be included in the scope. Consumables required for successful erection is included in bidder's scope. In case, complete GIS bays with LCC is not installed, due to reasons not attributable to vendor, Payment shall be made on prorata basis.	Lot	1
3	Service: GIS- 420kV, Supervision of erection of GIS- For 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. Consumables required for successful erection is included in bidder's scope. In case, complete gas insulated bus duct is not installed, due to reasons not attributable to vendor, Payment shall be made on actual measurement basis.	Mtr	375
4	Service: GIS- 420kV, Supervision of erection of GIS- Termination module for GIS bus duct and Oil to SF6 Bushing of Generator Transformer	Supervision of erection of GIS- SF6 to oil bushing/ connection module including support structure, earthing & other associated activities shall be included in the scope. In case, Termination module for GIS bus duct and Oil to SF6 Bushing of Generator Transformer is not installed, due to reasons not attributable to vendor, Payment shall be made on actual measurement basis.	No	12
5	Service: GIS- 420kV, Supervision of erection of GIS- Termination module for GIS bay module to XLPE cable	Supervision of erection of GIS- Termination module for GIS bay module to XLPE cable including support structure, earthing & other associated activities shall be included in the scope. In case, Termination module for GIS bay module to XLPE cable is not installed, due to reasons not attributable to vendor, Payment shall be made on actual measurement basis.	Nos.	6
6	Service: GIS- 420kV, Supervision of erection of GIS- GIS Surge Arrester Module with Surge Counter	Supervision of erection of GIS- GIS Surge Arrester Module with Surge Counter including support structure, earthing & other associated activities shall be included in the scope. In case, GIS Surge Arrester Module with Surge Counter is not installed, due to reasons not attributable to vendor, Payment shall be made on actual measurement basis.	Set	18
7	Service: GIS- 420kV, Testing & commissioning of 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. Testing & commissionng spares are included in bidder's scope. In case, complete GIS bays with LCC is not tested and commissioned, due to reasons not attributable to vendor, Payment shall be made on prorata basis.	Lot	1
8	Service: GIS- 420kV, Testing & commissioning of GIS- For 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. Testing & commissionng spares are included in bidder's scope. In case, complete gas insulated bus duct is not tested and commissioned, due to reasons not attributable to vendor, Payment shall be made on actual measurement basis.	Mtr	375
9	Service: GIS- 420kV, Testing & commissioning of GIS- Termination module for GIS bus duct and Oil to SF6 Bushing of Generator Transformer	Testing & commissioning of GIS- Termination module for GIS bus duct and Oil to SF6 Bushing of Generator Transformer including support structure, earthing & other associated activities shall be included in the scope. In case, Termination module for GIS bus duct and Oil to SF6 Bushing of Generator Transformer is not tested and commissioned, due to reasons not attributable to vendor, Payment shall be made on actual measurement basis.	No	12
10	Service: GIS- 420kV, Testing & commissioning of GIS- Termination module for GIS bay module to XLPE cable	Testing & commissioning of GIS- Termination module for GIS bay module to XLPE cable including support structure, earthing & other associated activities shall be included in the scope. In case, Termination module for GIS bay module to XLPE cable is not tested and commissioned, due to reasons not attributable to vendor, Payment shall be made on actual measurement basis.	Nos.	6
11	Service: GIS- 420kV,Testing & commissioning of GIS- GIS Surge Arrester Module with Surge Counter	Testing & commissioning of GIS- GIS Surge Arrester Module with Surge Counter support structure, earthing & other associated activities shall be included in the scope. In case, GIS Surge Arrester Module with Surge Counter is not tested and commissioned, due to reasons not attributable to vendor, Payment shall be made on actual measurement basis.	Set	18
12	Service: GIS- 420kV, Testing & commissioning of GIS- Final Successful High Voltage/ Power Frequency Testing of complate GIS	Carrying out successful HV/ Power Frequency Testing of GIS as per IEC including Arrangement of HV Test kit (on returnable basis) shall be in scope of bidder, which includes charges HV test kit with operator, accessories & tools required for completion of HV testing. Bays may be commissioned separately. No delay shall be permitted on account of the non availability of the HV test kit. Payment shall be made on the basis of site certification.	Lot	1
13	Service: GIS- 420kV- Insulation Co-ordination Studies including VFTO for GIS System	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. 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 of engineering certification.	Lot	1
14	Service: GIS- 420kV- Final Documentation	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
F	**Services: Training for 420kV GIS as per TS**			
1	Service: Training- Training for GIS of 6 nos. Engineers (4 nos. customer engineers+2 nos. BHEL engineers) for a period of at least 7 working days at Manufacturer's works	To and fro travelling charges, lodging and boarding charges of engineers shall be in BHEL/THDCIL scope. Only training shall be arranged at Manufacturer's works.	Lot	1
2	Service: Training- Training for GIS of 6 nos. Engineers (4 nos. customer engineers+2 nos. BHEL engineers) for a period of at least 7 working days at project site	To and fro travelling charges, lodging and boarding charges of engineers shall be in BHEL/THDCIL scope. Only training shall be arranged at project site.	Lot	1

Sl.No.	Description	Detailed Description	Unit	Qty
G	**Service: Unit reference price of GIS service item**	Reference unit prices for service of Individual Item/ Equipment for any addition/ deletion of equipment, due to damage, theft, additional requirement by customer, any other reasons not attributable to vendor during detailed engineering/ contract execution. The reference prices shall be considered for evaluation. Total charges for one visit of engineer shall include respective unit rate of item G.1/ G.2*man-day+ item of G.4.		
1	Service: Unit reference price of GIS service item- Services of supervision for Erection of 420kV GIS	Services of supervision for erection of any part equipment/ section of GIS, as and when required at site. This includes lodging and boarding charges of erection engineer also.	Man-day	1
2	Service: Unit reference price of GIS service item- Services of Testing & Commissioning of 420kV GIS	Services of Testing & Commissioning of any part equipment/ section of GIS, as and when required at site. This includes lodging and boarding charges of T&C engineer also.	Man-day	1
3	Service: Unit reference price of GIS service item- Hiring charges of HV test kit with operator	Additional HV test kit charges including charges of operator, HV test kit, accessories & tools required for completion of HV test (Dielectric Test after installation of GIS). HV test kit charges shall include HV testing of one or more bay at site as per requirements. This includes lodging and boarding charges of operator also.	Lot	1
4	Service: Unit reference price of GIS service item- To and fro travelling charges of vendor's engineer from the vendor's office/ factory to project site	To and fro travelling charges of vendor's engineer from the office/ factory to project site shall be provided by BHEL.	No. of Visit	1

Annexure B- Details for Technical Clearance for Manufacturing

PROJECT NAME **Vishnugad Pipalkoti Hydro Electric project (4X111MW)**

CUSTOMER **M/s THDC India Limited, Rishikesh, Uttarakhand**

Sl. No.	BHEL/ Customer Drawing/ Doc. No	Vendor Drawing/ Doc. No	Document Title	Approval Category (A- approval, I-Information)	Applicable for GIS items	Submission date	Remarks
1	TB-382-316-35-01	--	GIS Gas Single Line Diagram (SLD) and Gas Schematics	A	GIS Bays, GIB ducts and cable connection/ Oil connection module, LCC with gas monitoring system, CSD & PD monitoring system etc.		BHEL shall provide all the technical inputs requirements (e.g. Title Block, Master Drawing list, SLD, CT VT Parameters, Layout Plan & Section Drawings, interfacing drawings etc. as applicable) required for submission of drawings/ documents during detailed engineering stage, pendancy of any input from BHEL, if equired, bidder shall inform within two week time.
2	TB-382-316-35-02	--	GIS Layout, Plan & Section and Isometric view (overall GIS) with BOM of GIB duct	A	GIS Bays, GIB ducts and cable connection/ Oil connection module etc.		
3	TB-382-316-35-03	--	GIS Guaranteed Technical Particulars (GTP)	A	GIS Bays, GIB ducts and cable connection/ Oil connection module etc.		
4	TB-382-316-35-04	--	GIS Manufacturing Quality Plan	A/ I	GIS Bays, GIB ducts and cable connection/ Oil connection module, LCC with gas monitoring system, CSD & PD monitoring system, Maintenance Equipment etc.		
5	TB-382-316-35-05	--	GIS Type Test Reports	A/ I	GIS Bays, GIB ducts and cable connection/ Oil connection module etc.		
6	TB-382-316-35-06	--	GIS Interface Drawing for Cable connection Module/ Oil connection module	A	Cable connection/ Oil connection module etc.		
7	TB-382-516-35-07	--	GIS Secondary Engineering base Design (LCC Overview drawing and Interlock Logic Drawing)	A	LCC with gas monitoring system etc.		
8	TB-382-516-35-08	--	CSD Manual/ Catalog	I	CSD etc.		
9	TB-382-516-35-09	--	GIS LCC Schematics for GIS Bays	A	LCC with gas monitoring system etc.		
10	TB-382-316-35-10	--	GIS GA Drawing, GTP, Schematics of Gas Monitoring System	A	LCC with gas monitoring system etc.		
11	TB-382-316-35-11	--	GIS GA Drawing, GTP, Schematics of PD Monitoring System	A	PD monitoring system etc.		
12	TB-382-316-35-12	--	GIS Maintenance Equipment Catalouge & GTP	A	GIS Maintenance Equipment etc.		
13	TB-382-316-35-13	--	Insulation co-ordination study	A/ I	Surge Arrester etc., if applicable		
14	TB-382-316-35-14	--	GIS Quantification of Spares	A/ I	Spares etc.		
15	TB-382-316-35-15	--	GIS Earthing Layout Drawing with BOM and Design	A/ I	**Earthing materials etc.***		
16	TB-382-316-35-16	--	GIS Support Structure Layout Drawing with BOM and Design	A/ I	**Structure & harwares etc.***		
17	TB-382-316-35-17	--	GIS Civil Work Specification along Foundation loading and other interfacing details	A/ I	**Input for civil engineering activities***		
18	TB-382-316-35-18	--	GIS O&M Manual	A/ I	**GIS Manual***		
19	TB-382-316-35-19	--	GIS General and Special Tool List	A/ I	**GIS general & special tools list, as applicable***		
20	TB-382-316-35-20	--	Quantification of SF6 gas and Hydraulic Oil	A/ I	**SF6 gas, Hydraulic Oil, as applicable***		

GIS PO	BOQ Item Sr. No.	Remarks
PO-1	A.1, A.2, A.3, A.4, A.5, A.6, A.7, A.8, A.9, A.10, A.11, A.12, A.13, A.14, A.15, A.16, A.17, A.18 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	B	Based on engineering approval of drawing/ documents, as applicable technical clearance for part/ full quantity shall be provided.
PO-3	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 (A.9), Hydraulic oil (A.10), Structures & hardware (A.17), Earthing Material (A.18)** 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/ THDCIL, BHEL stamped drawing in category-1 shall be treated final to proceed further, commercial implication, if any shall be borne by BHEL.

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM.)

DRAWING No. TB-3-382-510-001

COMPUTER DRG. PATH NAME :

REF. DRG. No.

SIGN. & DATE

INVENTORY No.

420kV GIS

BUS VT

BUS-VTB

BUS-89BE

BUS-89B

420kV BUS-B 2000A, 40KA, 1Sec

420kV BUS-A 2000A, 40KA, 1Sec

401 89B
401 89AE
401 89A
401 CT1
401 52
401 CT2
401 89T1E1
401 89T1
401 89T1E2
401 LA

402 89B
402 89AE
402 89A
402 CT1
402 52
402 CT2
402 89T1E1
402 89T1
402 89T1E2
402 LA

403 89B
403 89BE
403 89AE
403 89A
403 CT1
403 52
403 CT2

489BE
489AE
BUS-89A
BUS-89AE
BUS-VTA

404 89B
404 89AE
404 89A
404 CT1
404 52
404 CT2
404 89T1E1
404 89T1
404 89T1E2
404 LA

405 89B
405 89AE
405 89A
405 CT1
405 52
405 CT2
405 89L1E1
405 89L1
405 89L1E2
405 LA1

406 89B
406 89AE
406 89A
406 CT1
406 52
406 CT2
406 89T1E1
406 89T1
406 89T1E2
406 LA

407 89B
407 89AE
407 89A
407 CT1
407 52
407 CT2
407 89L1E1
407 89L1
407 89L1E2
407 LA1

SF6 TO OIL BUSHING

GT-4
13.8kV/(420/SQRT3)
1PH., 46MVA x3
%Z 12.5±10%
YNd11

GT-3
13.8kV/(420/SQRT3)
1PH., 46MVA x3
%Z 12.5±10%
YNd11

GT-2
13.8kV/(420/SQRT3)
1PH., 46MVA x3
%Z 12.5±10%
YNd11

SF6,INDOOR CSE

CU/XLPE CABLE
400KV 800SQMM

OUTDOOR CSE

405 CTL
405 89L2E1
405 89L2
405 89L2E2
(2PH. ONLY)
405-WT
405-CVT
405-LA

GT-1
13.8kV/(420/SQRT3)
1PH., 46MVA x 3
%Z 12.5±10%
YNd11

407 CTL
407 89L2E1
407 89L2
407 89L2E2
(2PH. ONLY)
407-WT
407-CVT
407-LA

GT-4 | GT-3 | BUS COUPLER | BUS VT | GT-2 | LINE-2 | GT-1 | LINE-1

REV.	DATE		
06	28.07.20	ALTERED	SK
		CHECKED	MLK/SKS
		APPROVED	AG
ZONE	AS PER CUSTOMER CORRESPONDENCE		

REV.	DATE		
07	19.11.20	ALTERED	SK
		CHECKED	MLK/SKS
		APPROVED	AG
ZONE	AS PER CUSTOMER CORRESPONDENCE		

REV.	DATE		
05	03.05.19	ALTERED	SK
		CHECKED	MLK/SKS
		APPROVED	AG
ZONE	AS PER CUSTOMER LETTER DATED 01.05.2019		

REV.	DATE		
04	08.04.19	ALTERED	SK –SD–
		CHECKED	MLK/SKS –SD–
		APPROVED	AG –SD–
ZONE	AS PER CUSTOMER LETTER DATED 29.03.2019		

REV.	DATE		
03	28.01.19	ALTERED	
		CHECKED	SK/VK –SD–
		APPROVED	DM/AG –SD–
ZONE	1. DISCONNECTOR AND EARTH SWITCH INCLUDED IN GT CIRCUIT 2. BAY SEQUENCE CHANGED		

REV.	DATE		
02	04.05.16	ALTERED	
		CHECKED	SK/AA/VK –SD–
		APPROVED	AS/RS –SD–
ZONE	AS PER THDC COMMENT LETTER DATED 16.04.16		

REV.	DATE		
01	22.03.16	ALTERED	
		CHECKED	SK/AA/VK –SD–
		APPROVED	AS/RS –SD–
ZONE	AS PER THDC COMMENT LETTER DATED 15.02.16		

ADDITIONAL INFORMATION
W.O.No. 84008

STATUS OF DRAWING

DISTRIBUTION OF PRINTS

ग्राहक/परियोजना का नाम
NAME OF CUSTOMER/PROJECT

THDC INDIA LTD.
4X111MW VISHNUGAD PIPALKOTI H.E. PROJECT

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

	नाम /NAME	हस्ता./SIGN.	दि./DATE
बनाया DRAWN	DM	–SD–	19.01.16
जाँचा CHECKED	SK/AA/VK	–SD–	
स्वीकृत APPROVED	AS/SK	–SD–	

विभाग DEPT. TBEM
कोड CODE 422
अनुपात / SCALE --
कार्ड कोड CARD CODE –

शीर्षक/TITLE
SINGLE LINE DIAGRAM
OF 400KV GIS & POTHEAD

ड्राईंग क्र./DRAWING NO.
TB-3-382-510-001

पुनः/REV. 07

पृष्ठ क्र./SHEET No. 1 | अगला पृष्ठ/NEXT SHEET 3

A3 SIZE

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM.)

DRAWING No. TB-3-382-510-001

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

A. 400KV GIS LINE FEEDER CT PARAMETER (BAYS 405 & 407): CT1(Bus Side)

Core No.	Current Ratio	Accuracy Class	Min VA Burden at lowest Ratio	Min kPV (V)	Max RCT in Ohms	Max Im at kPV (mA)	Purpose
1	2000-1000-500 / 1	5P20	10	-	-	-	SPARE
2	2000-1000-500 / 1	PS	-	2000-1000-500	10-5-2.5	30-60-120	XLPE Cable Diff. Protection
3	2000-1000-500 / 1	PS	-	2000-1000-500	10-5-2.5	30-60-120	XLPE Cable Diff. Protection

B. 400KV GIS LINE FEEDER CT PARAMETER (BAYS 405 & 407): CT2 (Line Side)

6

Core No.	Current Ratio	Accuracy Class	Min VA Burden at lowest Ratio	Min kPV (V)	Max RCT in Ohms	Max Im at kPV (mA)	Purpose
1	2000-1000-500 / 1	0.2S ISF≤ 5	20	-	-	-	Metering
2	2000-1000-500 / 1	PS	-	2000-1000-500	10-5-2.5	30-60-120	Busbar Differential Protn/LBB
3	2000-1000-500 / 1	PS	-	2000-1000-500	10-5-2.5	30-60-120	Busbar Differential Protn/LBB
4.	2000-1000-500 / 1	PS	-	2000-1000-500	10-5-2.5	30-60-120	SPARE

C. 400KV GIS GT#1,2,3,4 CT PARAMETER (BAYS 401, 402, 404 & 406): CT1(Bus Side)

Core No.	Current Ratio	Accuracy Class	Min VA Burden at lowest Ratio	Min kPV (V)	Max RCT in Ohms	Max Im at kPV (mA)	Purpose
1	500 / 1	5P20	10	-	-	-	SPARE
2	500 / 1	PS	-	(160Rct+280)	-	120	SPARE
3	500 / 1	PS	-	(200Rct+470)	-	120	Transformer Overall Diff. Protn.

D. 400KV GIS GT#1,2,3,4 CT PARAMETER (BAYS 401, 402, 404 & 406): CT2 (GT Side)

6

Core No.	Current Ratio	Accuracy Class	Min VA Burden at lowest Ratio	Min kPV (V)	Max RCT in Ohms	Max Im at kPV (mA)	Purpose
1	2000-1000-500 / 1	PS	-	2000-1000-500	10-5-2.5	30-60-120	Busbar Differential Protn/LBB
2	2000-1000-500 / 1	PS	-	2000-1000-500	10-5-2.5	30-60-120	Busbar Differential Protn/LBB
3	500 / 1	0.2S ISF≤ 5	20	-	-	-	Metering
4.	500 / 1	PS	-	(160Rct+250)	-	120	GT REF Protn.
5.	500 / 1	PS	-	(160Rct+280)	-	120	Transformer Diff. Protection

E. 400KV GIS BUS COUPLER CT PARAMETER (BAYS403): CT1(Bus-B Side)

7

Core No.	Current Ratio	Accuracy Class	Min VA Burden at lowest Ratio	Min kPV (V)	Max RCT in Ohms	Max Im at kPV (mA)	Purpose
1	2000-1000-500 / 1	5P20	10VA	-	-	-	Overcurrent and Earth Fault
2	2000-1000-500 / 1	PS	-	2000-1000-500	10-5-2.5	30-60-120	Busbar Differential Protn/LBB
3	2000-1000-500 / 1	PS	-	2000-1000-500	10-5-2.5	30-60-120	Busbar Differential Protn/LBB

F. 400KV GIS BUS COUPLER CT PARAMETER (BAYS403): CT2(Bus-A Side)

Core No.	Current Ratio	Accuracy Class	Min VA Burden at lowest Ratio	Min kPV (V)	Max RCT in Ohms	Max Im at kPV (mA)	Purpose
1	2000-1000-500 / 1	0.2S ISF≤5	20	-	-	-	METERING.
2	2000-1000-500 / 1	PS	-	2000-1000-500	10-5-2.5	30-60-120	Busbar Differential Protn/LBB
3	2000-1000-500 / 1	PS	-	2000-1000-500	10-5-2.5	30-60-120	Busbar Differential Protn/LBB
4	2000-1000-500 / 1	PS	-	2000-1000-500	10-5-2.5	30-60-120	SPARE

G. 400KV POTHEAD YARD LINE BAY CT PARAMETER (BAYS405 & 407): CTL

6

Core No.	Current Ratio	Accuracy Class	Min VA Burden at lowest Ratio	Min kPV (V)	Max RCT in Ohms	Max Im at kPV (mA)	Purpose
1	2000-1000-500 / 1	PS	-	4000-2000-1000	10-5-2.5	30-60-120	Line Distance Protn.
2	2000-1000-500 / 1	PS	-	4000-2000-1000	10-5-2.5	30-60-120	Line Distance Protn.
3	2000-1000-500 / 1	0.2S ISF≤5	20VA	-	-	-	METERING
4	2000-1000-500 / 1	PS	-	2000-1000-500	10-5-2.5	30-60-120	XLPE Cable Diff. Protection
5	2000-1000-500 / 1	PS	-	2000-1000-500	10-5-2.5	30-60-120	XLPE Cable Diff. Protection

H. 400KV GIS BUS VT : VTA & VTB

6

Core No.	Ratio	Accuracy Class	Burden
1	400/√3 KV / 110/√ 3V	0.2	100VA
2	400/√3 KV / 110/√ 3V	3P	75VA
3	400/√3 KV / 110/√ 3V	3P	75VA

I. Outdoor 400kv Line CVT (Bay 405 & 407): 4400pF

6

Core No.	Ratio	Accuracy Class	Burden
1	400/√3 KV / 110/√ 3V	3P	200VA
2	400/√3 KV / 110/√ 3V	3P	200VA
3	400/√3 KV / 110/√ 3V	0.2	100VA

REV.	DATE	ALTERED / CHECKED / APPROVED	ZONE
05	03.05.19	ALTERED SK; CHECKED MLK/SKS; APPROVED AG -SD-	AS PER CUSTOMER LETTER DATED 01.05.2019
04	08.04.19	ALTERED SK -SD-; CHECKED MLK/SKS -SD-; APPROVED AG -SD-	AS PER CUSTOMER LETTER DATED 29.03.2019
03	28.01.19	CHECKED SK/VK -SD-; APPROVED DM/AG -SD-	1. DISCONNECTOR AND EARTH SWITCH INCLUDED IN GT CIRCUIT 2. BAY SEQUENCE CHANGED
02	04.05.16	CHECKED SK/AA/VK -SD-; APPROVED AS/RS -SD-	AS PER THDC COMMENT LETTER DATED 16.04.16
01	22.03.16	CHECKED SK/AA/VK -SD-; APPROVED AS/RS -SD-	AS PER THDC COMMENT LETTER DATED 15.02.16
07	19.11.20	ALTERED SK; CHECKED MLK/SKS; APPROVED AG	AS PER CUSTOMER CORRESPONDENCE
06	28.07.20	ALTERED SK; CHECKED MLK/SKS; APPROVED AG	AS PER CUSTOMER CORRESPONDENCE

ADDITIONAL INFORMATION
W.O.No. 84008
STATUS OF DRAWING
DISTRIBUTION OF PRINTS

ग्राहक/परियोजना का नाम
NAME OF CUSTOMER/PROJECT

THDC INDIA LTD.
4X111MW VISHNUGAD PIPALKOTI H.E. PROJECT

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

	नाम /NAME	हस्ता./SIGN.	दि./DATE
बनाया DRAWN	DM	-SD-	19.01.16
जाँचा CHECKED	SK/AA/VK	-SD-	
स्वीकृत APPROVED	AS/SK	-SD-	

विभाग DEPT. TBEM
कोड CODE 422
अनुपात / SCALE --
कार्ड कोड CARD CODE -

शीर्षक/TITLE
SINGLE LINE DIAGRAM OF 400KV GIS & POTHEAD

ड्राईंग क्र./DRAWING NO. TB-3-382-510-001
पुनः/REV. 07
पृष्ठ क्र./SHEET No. 2
अगला पृष्ठ/NEXT SHEET 3

A3 SIZE

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM.)

DRAWING No. TB-3-382-510-001

COMPUTER DRG. PATH NAME :

INVENTORY No. | SIGN. & DATE | REF. DRG. No.

420kV INDOOR GIS BILL OF QUANTITY (MAIN EQUIPMENT)

S.NOS.	DESCRIPTION	HIGHEST VOLT.	QTY. (NO.)	SYMBOLS
1.	2000A, 3–PH., 40KA FOR 1SEC SF6 CIRCUIT BREAKER SUITABLE FOR 1PH. AND 3PH. OPERATION AUTORECLOSING WITHOUT PRE– INSERTION RESISTOR.	420KV	2	C
2.	2000A, 3–PH., 40KA FOR 1SEC SF6 CIRCUIT BREAKER SUITABLE FOR 3PH. OPERATION OPERATION WITHOUT PRE – INSERTION RESISTOR.	420KV	5	
3.	2000A, 3–PH., 40KA FOR 1SEC DISCONNECTOR SWITCH GROUP OPERATED (220V DC MOTOR) AND MANUALLY OPERATED.	420KV	22	
4.	2000A, 3–PH., 40KA FOR 1SEC SAFETY GROUNDING SWITCH GROUP OPERATED (220V DC MOTOR) AND MANUALLY OPERATED.	420KV	16	
5.	2000A, 3–PH., 40KA FOR 1SEC HIGH SPEED GROUNDING SWITCH INDIVIDUAL POLE OPERATED (220V DC MOTOR).	420KV	8	
6.	2000A, 40KA FOR 1SEC, 1–PH., 4 CORE CT. (400KV GIS LINE FEEDER CT–LINE SIDE)	420KV	6	
7.	2000A, 40KA FOR 1SEC, 1–PH., 3 CORE CT. (400KV GIS LINE FEEDER CT–BUS SIDE)	420KV	6	
8.	500A, 40KA FOR 1SEC, 1–PH., 3 CORE CT. (400KV GIS GT FEEDER CT–BUS SIDE)	420KV	12	
9.	2000A, 40KA FOR 1SEC, 1–PH., 5 CORE CT. (400KV GIS GT FEEDER CT–GT SIDE)	420KV	12	
10.	2000A, 40KA FOR 1SEC, 1–PH., 4 CORE CT. (400KV GIS BUS COUPLER CT–BUS A SIDE)	420KV	3	
11.	2000A, 40KA FOR 1SEC, 1–PH., 3 CORE CT. (400KV GIS BUS COUPLER CT–BUS B SIDE)	420KV	3	
12.	1–PH., 3 CORE VT. (400KV GIS BUS VT)	420KV	6	
13.	1–PH., 20KA SURGE ARRESTOR & CLASS–4, RATED VOLTAGE 390kV	420KV	18	

420kV OUTDOOR POTHEAD BILL OF QUANTITY (MAIN EQUIPMENT)

S.NOS.	DESCRIPTION	HIGHEST VOLT.	QTY. (NO.)	SYMBOLS
20.	2000A, 3–PH., 40KA FOR 1SEC HDB ISOLATOR (ELECTRICALLY GANGED MOTOR OPERATED), WITH 2ES (MECHANICALLY GANGED MOTOR OPERATED)	420KV	2	
21.	2000A, 40KA FOR 1SEC, 1–PH., 5 CORE CT.	420KV	6	
22.	1–PH., 10KA, CLASS–3 SURGE ARRESTOR, RATED VOLTAGE 390KV.	420KV	6	
23.	1–PH., 3 CORE CVT. 4400PF	420KV	6	
24.	2000A, 1mH, 40KA FOR 1SEC, 1–PH. SUSPENSION TYPE WAVE TRAP.	420KV	4	
25.	OUTDOOR CABLE SEALING END (LOCATED IN POTHEAD)	420KV	6+1(SPARE CABLE)	
26.	SF6 INDOOR CABLE SEALING END (LOCATED IN GIS BUILDING)	420KV	6+1(SPARE CABLE)	

NOTE: –

1. SYSTEM FAULT LEVEL 40KA FOR 1 SEC. FOR 400KV.
2. SYSTEM SHALL BE SOLIDLY GROUNDED.
3. 400KV WAVE TRAP SHALL BE PROVIDED IN TWO PH. ONLY.
4. CREEPAGE 25MM/KV.
5. SF6 INDOOR CABLE SEALING END SHALL BE LOCATED INSIDE GIS BUILDING AND SHALL BE DIRECTLY CONNECTED WITH 400KV GIS.
6. OUTDOOR CABLE SEALING END SHALL BE LOCATED IN POTHEAD YARD AND SHALL BE CONNECTED WITH TWIN MOOSE ACSR CONDUCTOR.
7. SINGLE CORE 800SQMM CU/XLPE SPARE CABLE SHALL RUN BETWEEN GIS AND POTHEAD.
8. CT, VT AND CVT PARAMETERS ARE SUBJECT TO FINALIZATION OF ITS SIZING CALCULATIONS. IN CASE OF ANY CHANGES, THIS DOCUMENTS WILL BE UPDATED AND RESUBMITTED.
9. CT, VT AND CVT PARAMETERS ARE SUBJECT TO FINALIZATION OF GIS MANUFACTURER. IN CASE OF ANY CHANGES, THIS DOCUMENTS WILL BE UPDATED AND RESUBMITTED.
10. BAY SEQUENCE DETAILS SHALL BE FINALIZED BY GIS MANUFACTURER.
11. THE FINAL SURGE ARRESTOR CHARACTERISTICS, QUANTITY AND EXACT LOCATIONS ARE SUBJECT TO INSULATION COORDINATION STUDY.

REV.	DATE	ALTERED / CHECKED / APPROVED	ZONE
06	28.07.20	SK / MLK/SKS / AG	AS PER CUSTOMER CORRESPONDENCE
07	19.11.20	SK / MLK/SKS / AG	AS PER CUSTOMER CORRESPONDENCE

REV.	DATE	ALTERED / CHECKED / APPROVED	ZONE
05	03.05.19	SK / MLK/SKS / AG	AS PER CUSTOMER LETTER DATED 01.05.2019
04	08.04.19	SK –SD– / MLK/SKS –SD– / AG –SD–	AS PER CUSTOMER LETTER DATED 29.03.2019
03	28.01.19	SK/VK –SD– / DM/AG –SD–	1. DISCONNECTOR AND EARTH SWITCH INCLUDED IN GT CIRCUIT 2. BAY SEQUENCE CHANGED
02	04.05.16	SK/AA/VK –SD– / AS/RS –SD–	AS PER THDC COMMENT LETTER DATED 16.04.16
01	22.03.16	SK/AA/VK –SD– / AS/RS –SD–	AS PER THDC COMMENT LETTER DATED 15.02.16

ADDITIONAL INFORMATION
W.O.No. 84008

STATUS OF DRAWING

DISTRIBUTION OF PRINTS

ग्राहक/परियोजना का नाम
NAME OF CUSTOMER/PROJECT

THDC INDIA LTD.
4X111MW VISHNUGAD PIPALKOTI H.E. PROJECT

भारत हेवी इलेक्ट्रिकल्स लिमिटेड
पावरिंग आवाज समूह
BHARAT HEAVY ELECTRICALS LTD.
TRANSMISSION BUSINESS GROUP

	नाम /NAME	हस्ता./SIGN.	दि./DATE
बनाया DRAWN	DM	–SD–	19.01.16
जाँचा CHECKED	SK/AA/VK	–SD–	
स्वीकृत APPROVED	AS/SK	–SD–	

विभाग DEPT. TBEM | कोड CODE 422 | अनुपात / SCALE -- | कार्ड कोड CARD CODE –

शीर्षक/TITLE
SINGLE LINE DIAGRAM
OF 400KV GIS & POTHEAD S/S

ड्राईग.क./DRAWING NO. TB–3–382–510–001

पुनः/REV. 07

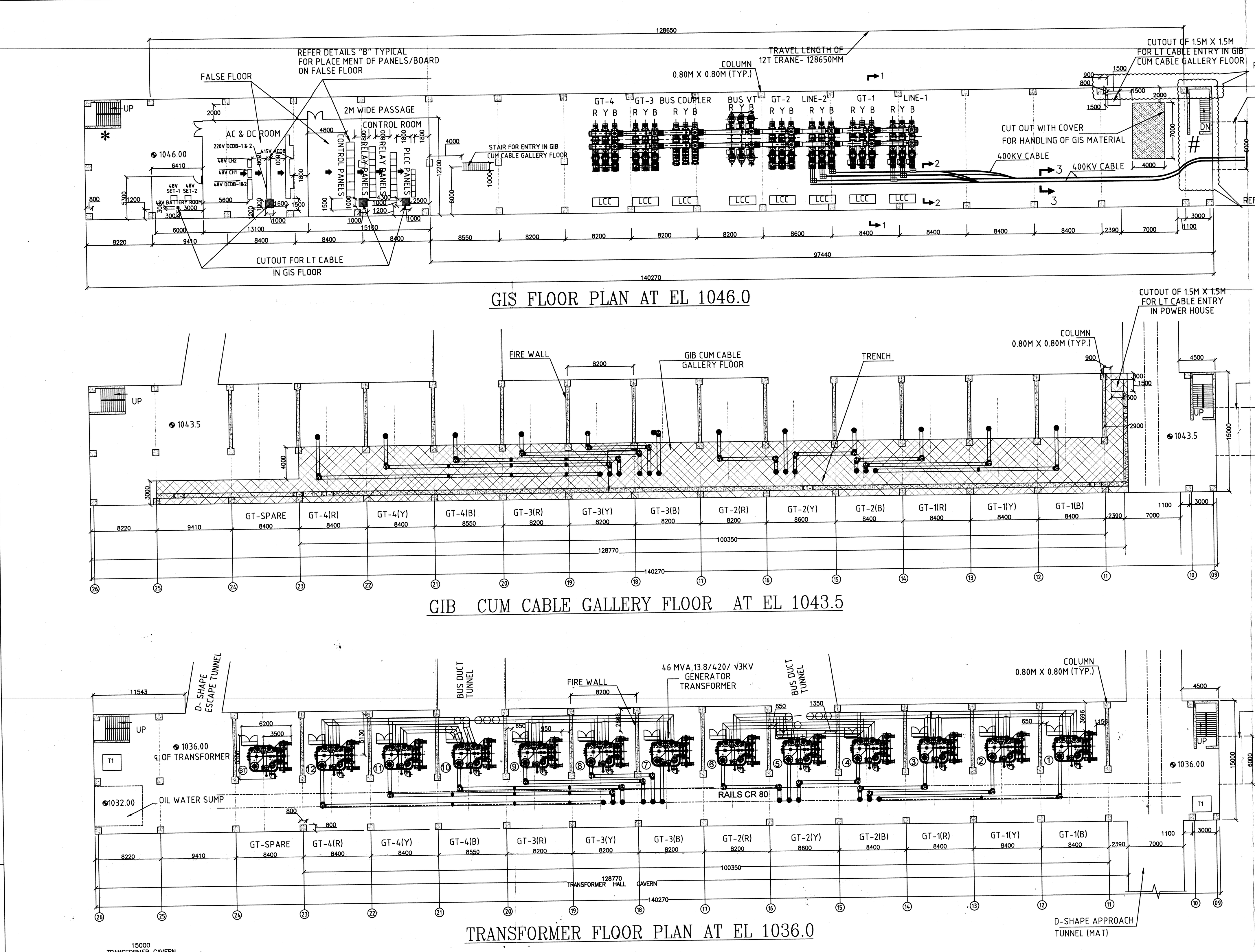
पृष्ठ क./SHEET No. 3 | अगला पृष्ठ/NEXT SHEET –

A3 SIZE

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM.)

DRAWING No. TB-0-382-316-014

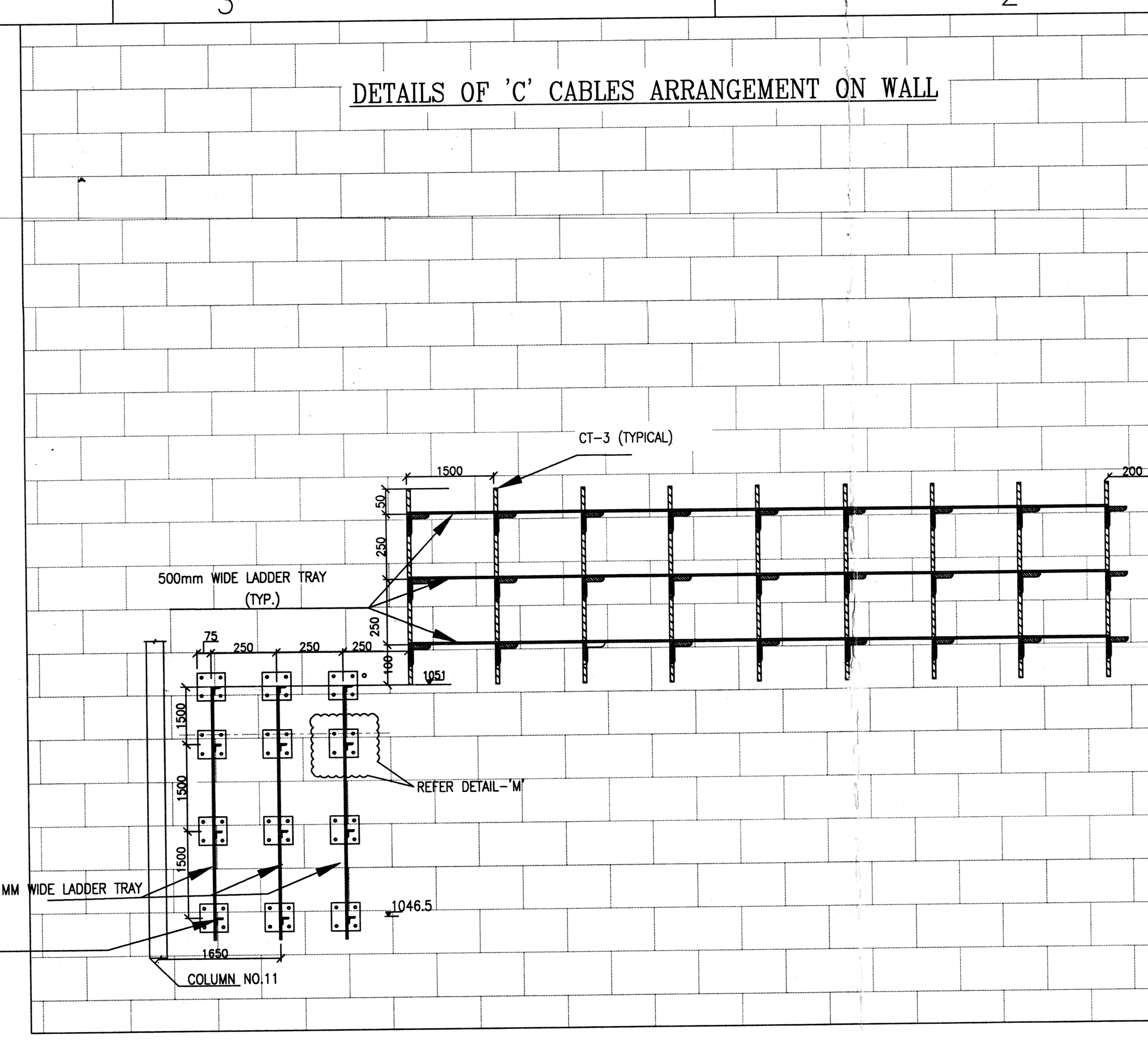
COMPUTER DRG. PATH NAME :



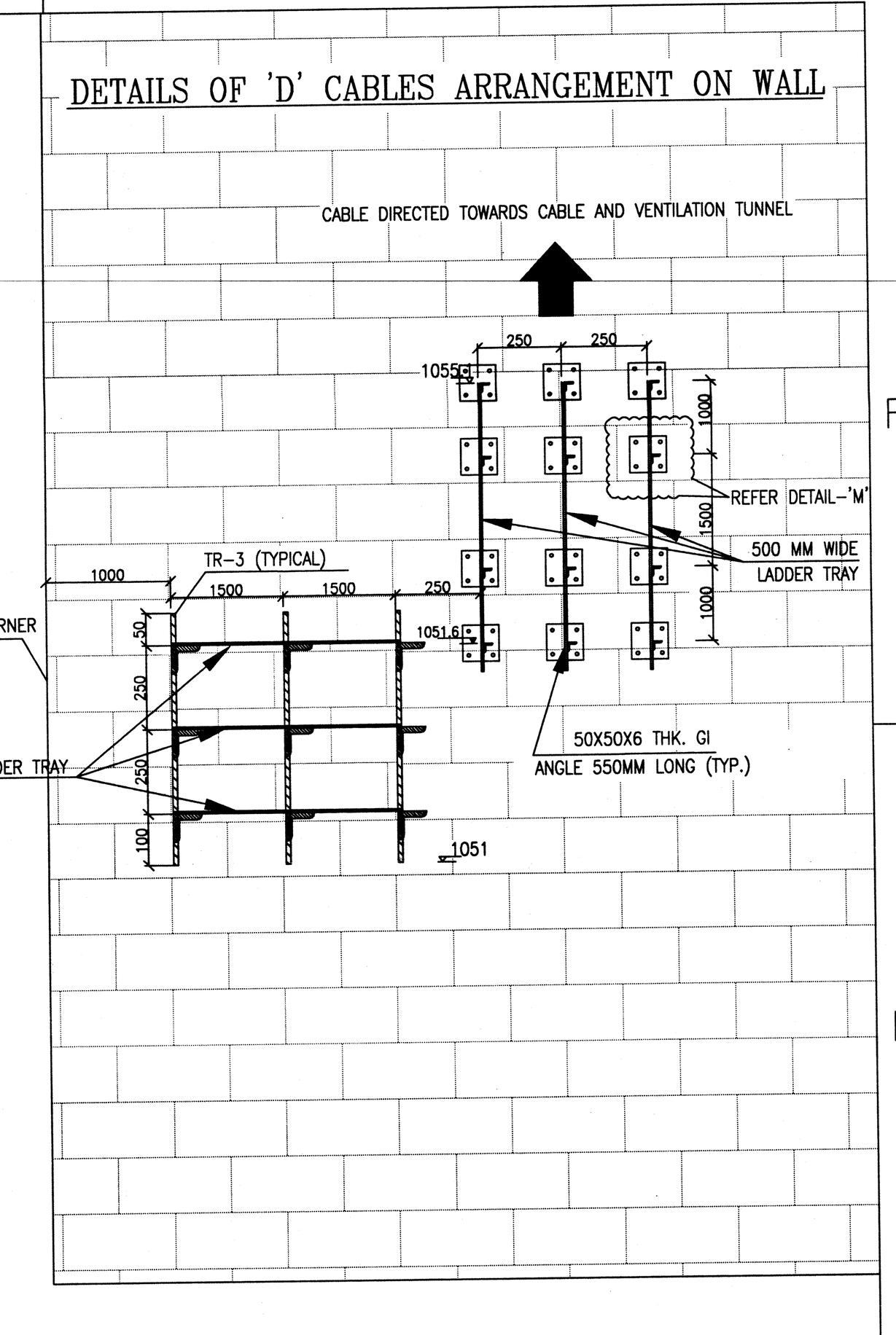
GIS FLOOR PLAN AT EL 1046.0

GIB CUM CABLE GALLERY FLOOR AT EL 1043.5

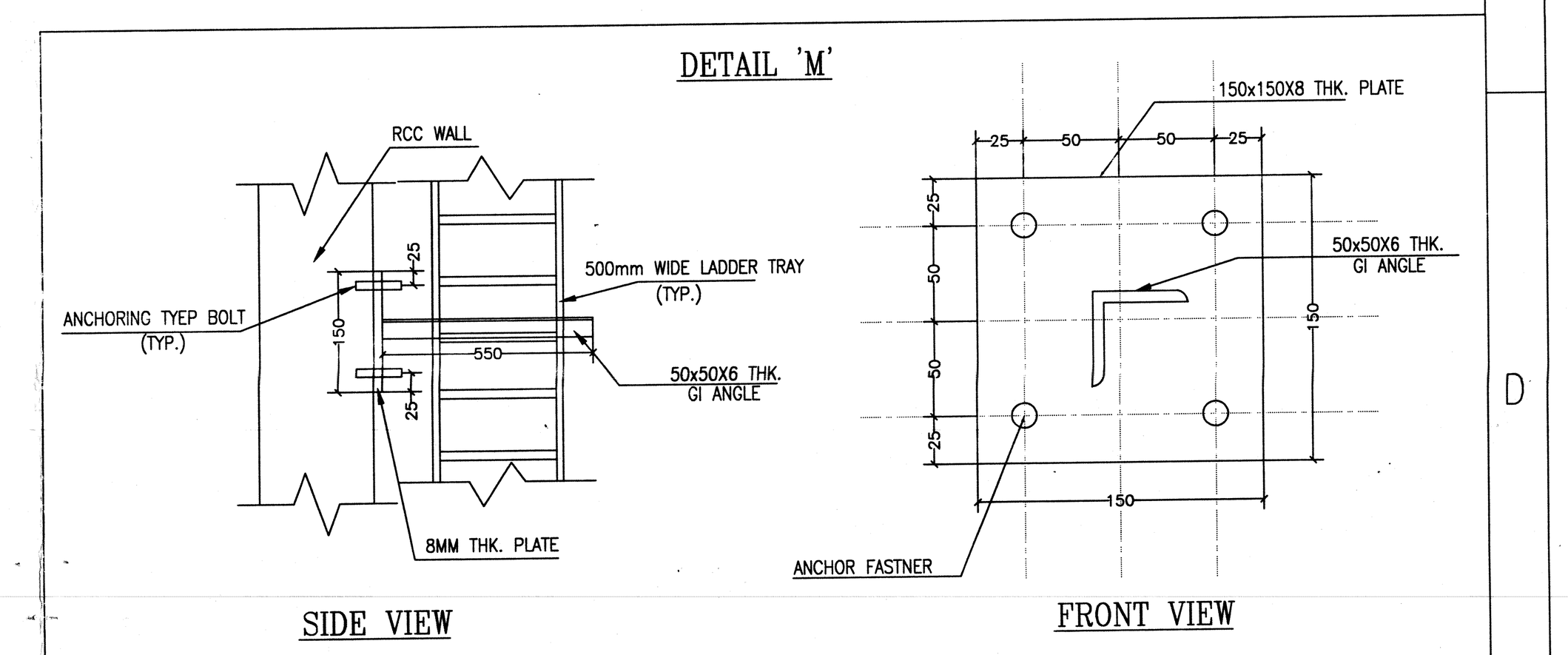
TRANSFORMER FLOOR PLAN AT EL 1036.0



DETAILS OF 'C' CABLES ARRANGEMENT ON WALL

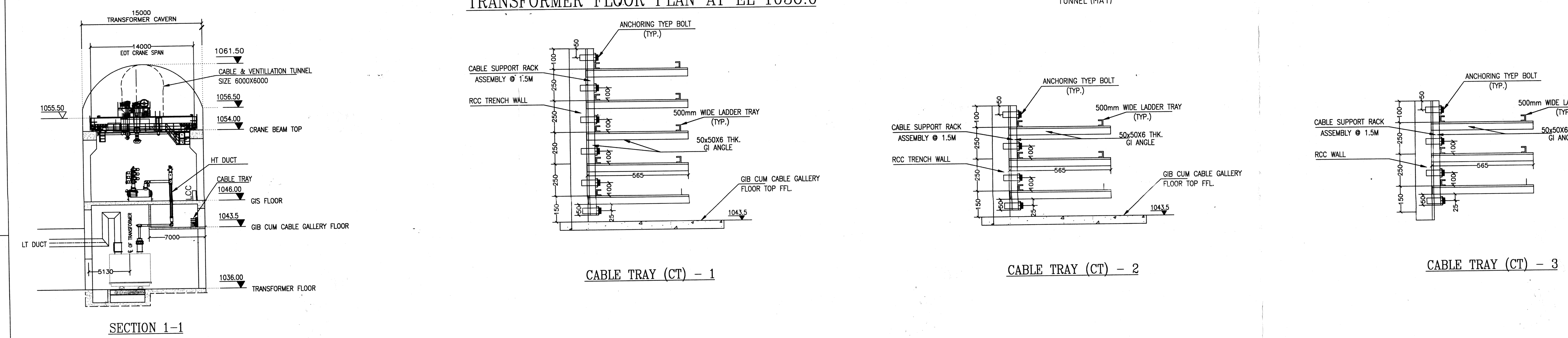


DETAILS OF 'D' CABLES ARRANGEMENT ON WALL



DETAIL 'M'

SIDE VIEW   FRONT VIEW

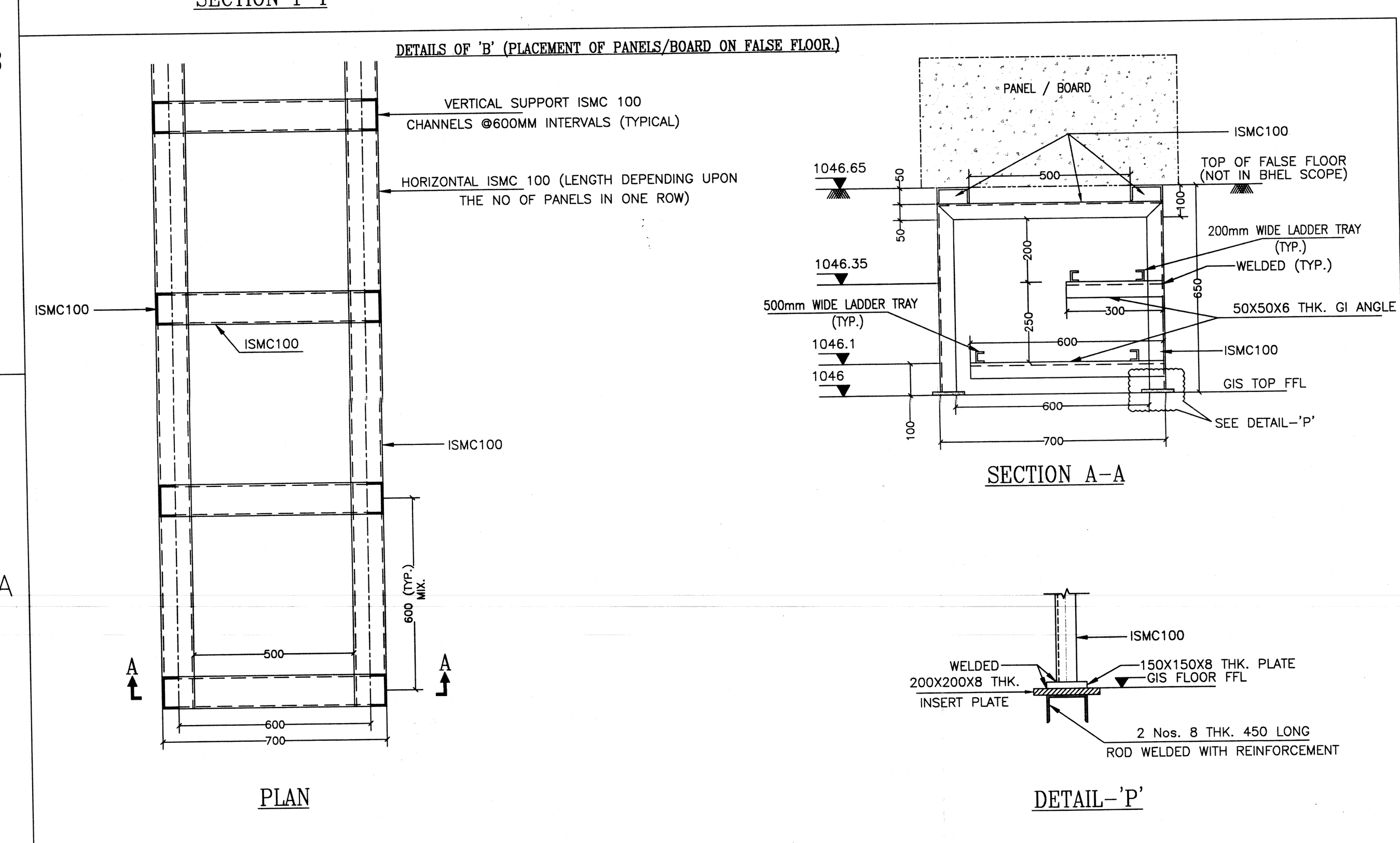


SECTION 1-1

CABLE TRAY (CT) - 1

CABLE TRAY (CT) - 2

CABLE TRAY (CT) - 3

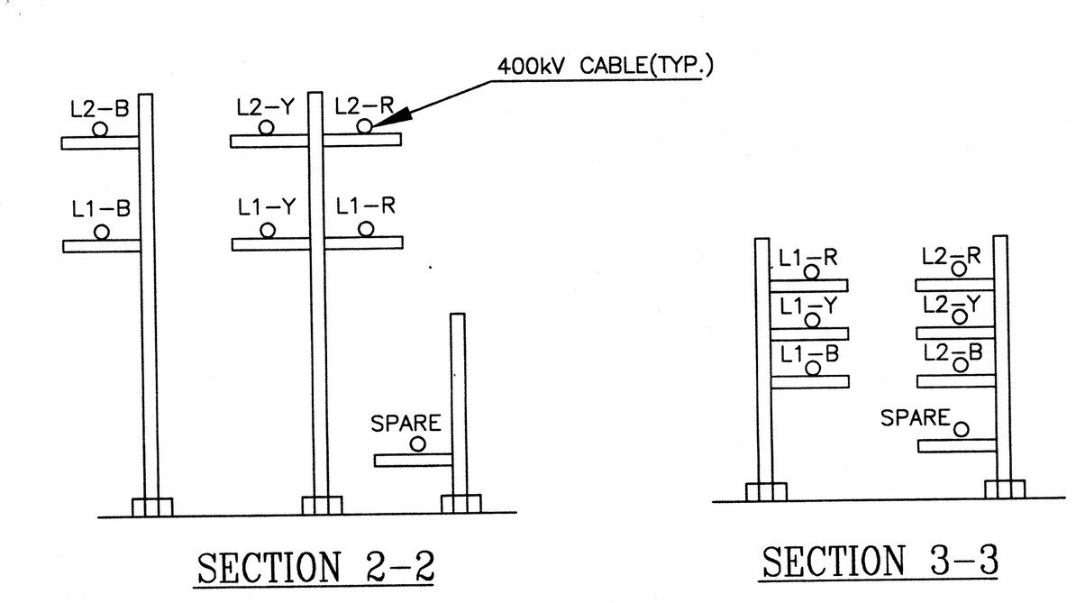


DETAILS OF 'H' (PLACEMENT OF PANELS/BOARD ON FALSE FLOOR)

PLAN

SECTION A-A

DETAIL-'P'



SECTION 2-2

SECTION 3-3

LEGEND.

- ➡ - FRONT SIDE OF PANEL
- * STAIR CASE AT EXTREME END OF TRANSOFRMER HALL SHOULD BE EXTENDED TILLL EL 1055.50 FOR ACCESS OF EOT PLATFORM.
- # STAIRCASE AT EXTREME END OF THE GIS FLOOR TOWARDS CABLE VENTILATION TUNNEL(CVT) IS TO BE EXTENDED AT GIS FLOOR AND A HELICAL STAIRCASE FROM GIS HALL TO EL1055.50 SHALL BE PROVIDED FOR EOT OPERATION AND MAINTENANCE.
- LCC LOCAL CONTROL CUBICLE
- FFL FINISH FLOOR LEVEL
- GIB CUM CABLE GALLERY FLOOR
- CABLE TRAY (5 TIER)
- CABLE TRAY (3 TIER)

NOTES.

1. ALL DIMENSION ARE IN MM.
2. DIMENSION AND ARRANGEMENT OF PANELS AND GIS INSIDE THE ROOM ARE INDICATIVE AND SHALL BE FINALIZED DURING DETAILED ENGINEERING.
3. ALL THE DIMENSION OF THE ROOM ARE FROM CENTER LINE OF WALL(THICKNESS OF WALL 230MM).
4. BENDING RADIUS OF 400 KV CABLE IS 20D (D IS OVERALL DIAMETER OF CABLE). BENDING RADIUS OF LT CABLE IS 15D (D IS OVERALL DIAMETER OF CABLE).
5. TWO NOS. 220V DCDB INCOMER FEEDER SUPPLY SHALL BE PROVIDED BY BHEL HSE BHOPAL FOR POTHEAD AND GIS APPLICATION.
6. TWO NOS. 415V AC INCOMER FEEDER SUPPLY SHALL BE PROVIDED BY BHEL HSE BHOPAL FOR POTHEAD AND GIS APPLICATION.
7. GIS BAY LOCATION ARE TENTATIVE AND SAME SHALL BE FINALIZED DURING DETAILED ENGINEERING BY GIS SUPPLIER.
8. THE HIEGHT OF THE WALL OF THE ROOMS LOCATED IN GIS HALL SHALL BE 4.5 METERS ABOVE GIS FFL AND ALL ROOMS SHALLBE OPEN AT TOP.
9. GIB CUM CABLE GALLERY FLOOR SHALL BE CLOSED.
10. FALSE FLOOR SHALL BE PROVIDED IN CONTROL ROOM AND AC & DC ROOM FOR PANEL/BOARD PLACEMENT. FALSE FLOOR SHALL BE IN CUSTOMER SCOPE.
11. SEPARATE DRAWING. (i.e. FOR POTHEAD AND GIS) SHALL BE SUBMITTED FOR FOLLOWING FACILITY.
   A. ILLUMINATION- BHEL PEM NOIDA
   B. EOT CRANE- BHEL PSNR NOIDA
   C. AIR CONDITIONING & VENTILATION SYSTEM- BHEL PSNR NOIDA
   D. FIRE FIGHTING- PE & SD BHEL HYDRABAD.
   E. 400KV XLPE CABLE- BHEL TBG NOIDA
12. EXACT LOCATIONS AND SIZES OF CUT-OUTS IN FLOORS WILL BE INDICATED IN DETAILED DRAWING.
13. CABLE COVER SHALL BE PROVIDED FOR EXPOSED CABLE LAID BETWEEN GIS FLOOR TO MAT.
14. SUPPLY AND INSTALLATION OF EMBEDMENT OF CABLE SUPPORT STRUCTURES SHALL BE IN BHEL SCOPE.
15. CABLE ROUTING (POWER CABLE, CONTROL CABLES AND COMMUNICATION CABLE) FROM GIS TO CONTROL ROOM/CABLE CONNECTING GALLERY THROUGH MAT AND FROM GIS TO POTHEAD YARD THROUGH CVT SHALL BE SUBMITTED IN A SEPARATE DRAWING.

REFERENCE DWG.

1. POWER HOUSE COMPLEX GENERAL ARRANGEMENT OPERATING FLOOR - 71.2754.08.010
2. SINGLE LINE DIAGRAM FOR 400KV GIS & POTHEAD - TB-3-382-510-001

संस्तुत
RECOMMENDED
15/1/19
आर. के. सेमवाल
(R. K. SEMWAL)
Addl. General Manager (EM-Design)
THDC INDIA Ltd., Rishikesh

अनुमोदित
APPROVED
एल. पी. जोशी 16/1/19
L.P. JOSHI
General Manager (Electro-Mech. Design)

Approval of this drawing/document does not absolve contractor of its responsibility for manufacturing of the equipment as per ER & GTP for the achievement of designed performance at site and completeness of the equipment.

ADDITIONAL INFORMATION W.O.No.	ग्राहक/परियोजना का नाम NAME OF CUSTOMER/PROJECT	THDC INDIA LTD. 4X111MW VISHNUGAD PIPALKOTI H.E. PROJECT
STATUS OF DRAWING		
DISTRIBUTION OF PRINTS	भारत हेवी इलेक्ट्रिकल्स लिमिटेड पारेषण व्यापार समूह BHARAT HEAVY ELECTRICALS LTD. TRANSMISSION BUSINESS GROUP	

	नाम /NAME	हस्ता./SIGN.	दि./DATE
बनाया DRAWN	SY	-SD-	28.10.16
जाँचा CHECKED	SK	-SD-	
स्वीकृत APPROVED	AS	-SD-	

REV.	DATE			
03	31.08.18	ALTERED SY / CHECKED SK / APPROVED DM/AG	ZONE	DRAWING REVISED AS PER CUSTOMER EMAIL DATED 19.07.18
02	28.06.18	ALTERED SY -SD- / CHECKED SK -SD- / APPROVED DM/RS -SD-	ZONE	DRAWING REVISED AS PER MOM DATED 25.05.18
01	22.05.18	ALTERED SY -SD- / CHECKED SK -SD- / APPROVED DM/RS -SD-	ZONE	DRAWING REVISED AS PER CUSTOMER COMMENTS DT. 01.12.16 AND MOM

विभाग DEPT.	TBEM	अनुपात / SCALE	--
कोड CODE	422	कार्ड कोड CARD CODE	-

शीर्षक/TITLE: CONCEPTUAL LAYOUT FOR GIS FLOOR

ड्राईग.क्र./DRAWING NO. TB-0-382-316-014   पुनः/REV. 03

पृष्ठ क्र./SHEET No. 1   अगला पृष्ठ /NEXT SHEET

INVENTORY No. | SIGN. & DATE | REF. DRG. No.

A0 SIZE

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM.)

DRAWING No. TB-3-382-316-002

COMPUTER DRG. PATH NAME :

REF. DRG. No.

SIGN. & DATE

INVENTORY No.

Approval of this drawing/document does not absolve contractor of its responsibility for manufacturing of the equipment as per ER & GTP for the achievement of designed performance at site and completeness of the equipment.

जाँची गई/CHECKED

अनिल रघुवंशी / Anil Raghuvanshi
वरि. प्रबन्धक (विद्युत परिकल्प)
Sr. Manager (EM-Design)
टीएचडीसी इंडिया लिमिटेड, ऋषिकेश
THDC India Limited, Rishikesh

16.09.22

1. SCHEDULE OF EQUIPMENT FOR POTHEAD YARD)

ITEM CODE	DESCRIPTION	SYMBOLS	UNITS	QUANTITY
1.	400kV, 2000A, 3-PHASE, 40 kA FOR 1 Sec. HDB ISOLATOR (ELECTRICALLY GANGED MOTOR OPERATED) WITH TWO E/S (MECHANICALLY GANGED MOTOR OPERATED)		Sets	2
2.	400kV, 2000A, 40kA FOR 1 Sec. 1-PHASE, 5 CORE CURRENT TRANSFORMER		Nos.	6
3	400kV, 4400 pF, $\frac{400}{\sqrt{3}} / \frac{0.110}{\sqrt{3}} / \frac{0.110}{\sqrt{3}} / \frac{0.110}{\sqrt{3}}$ kV 1-PHASE , 3 CORE CAPACITOR VOLTAGE TRANSFORMER		Nos.	6
4	390kV, 1-PHASE SURGE ARRESTORS, 10KA, CLASS-3		Nos.	6
5	400kV, 2000A, 1mH, 40 KA FOR 1 SEC. 1-PHASE WAVE TRAP (PEDESTAL TYPE)		Nos.	4
6	400kV, 40 KA FOR 1 SEC. 1-PHASE, OUTDOOR CABLE SEALING END		Nos.	7
7	400kV, BUS POST INSULATOR		Nos.	2

2. SYSTEM PARAMETERS

SL.NO.	DESCRIPTION	UNIT	AT EL:1000	AT EL:1101.10
1.	NOMINAL SYSTEM VOLTAGE	kV	400	400
2.	HIGHEST SYSTEM VOLTAGE	kV	As per IS/IEC	
3.	BASIC IMPULSE LEVEL	kVP	1425	1443
4.	POWER FREQUENCY WITHSTAND	kVrms	630	638
5.	SWITCHING IMPULSE WITHSTAND VOLTAGE	kVpeak	1050	1060
6.	CREEPAGE DISTANCE (MINIMUM)	mm/kV	25	25
7.	SYSTEM FAULT LEVEL (FOR 1 SEC)	kA	40	40

RECOMMENDED
संस्तुत

शैलेन्द्र सिंह पंवार
Shailendra Singh Panwar
उपमहाप्रबंधक (विद्युत यांत्रिक-परिकल्प)
Dy. General Manager (EM-Design)
टीएचडीसी इंडिया लिमिटेड, ऋषिकेश
THDC INDIA LTD., RISHIKESH

4. MINIMUM CLEARANCE TABLE (IN AIR)

3. CLEARANCE TABLE IN AIR (MIN.)

SL.NO.	DESCRIPTION	UNIT	AT EL:1000	AT EL:1101.10
1.	PHASE TO PHASE	mm	4200	4254
2.	PHASE TO EARTH	mm	3500	3545
3.	MINIMUM DISTANCE OF THE LOWEST EARTH PART OF INSULATOR SUPPORTING LIVE CONDUCTORS FROM TOP OF PLINTH LEVEL	mm	2550	2550
4.	SECTION CLEARANCE	mm	6500	6583
5.	HEIGHT OF COND. CENTER LINE OF FIRST LEVEL FROM FFL OF PLATFORM	mm	8300	8300

APPROVED
अनुमोदित

16/9/2022.

नीरज वर्मा / Neeraj Verma
महाप्रबन्धक (विद्युत परिकल्प)
General Manager (EM-Design)
टीएचडीसी इंडिया लिमिटेड, ऋषिकेश
THDC India Limited, Rishikesh

4. EQUIPMENT CONNECTION SCHEDULE

SL.NO.	DESCRIPTION	DESCRIPTION
1.	EQUIPMENT INTERCONNECTION	TWIN MOOSE ACSR
2.	JUMPER/ DROPPERS	TWIN MOOSE ACSR
3.	EARTH WIRE	7/3.66 (7/9 SWG) GS (10.98mm DIA)

NOTES:-

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
2. INSULATOR DATA
   A. 400KV SINGLE SUSPENSION STRING (SINGLE ANCHORING POINT) = 23 NOS. ANTI FOG TYPE DISC.
   B. ELECTRO-MECHANICAL FAILING LOAD PER DISC = 160 kN
   C. CREEPAGE DISTANCE OF INDIVIDUAL DISC = 470MM
3. ALL POTHEAD YARD EQUIPMENTS ARE PROTECTED FROM 7/3.66 GALVANISED STEEL WIRE.
4. SUPPLY AND STRINGING OF 400kV OUTGOING LINE CONDUCTOR, SHIELD WIRE, INSULATOR AND HARDWARE BETWEEN DEAD END TOWER AND POTHEAD YAED TERMINAL GANTRY ARE NOT IN BHEL SCOPE. HOWEVER, JUMPERING FOR THE RESPECTIVE EQUIPMENT SHIELDING REQUIREMENT FOR PROTECTION OF LIVE EQUIPMENT, JUMPERS & HARDWARE REQUIRED FOR JUMPERS ARE IN SCOPE OF BHEL.
5. ALL SWITCHYARD EQUIPMENTS & TOWER STRUCTURE SHALL BE LATTICE TYPE.
6. SEPARATE DRAWING SHALL BE REFERRED FOR ERECTION KEY DIAGRAM, TRENCH LAYOUT FOR LT & 400kV CABLE, EARTHMAT LAYOUT, TOWER/ BEAM, ILLUMINATION SYSTEM, FENCE & GATE ETC.
7. STATIC TENSION ON THE BUSES AND SHIELD WIRE SHALL BE SHOWN IN THE STRUCTURE LOADING DIAGRAM TO BE SUBMITTED SEPARATELY.
8. LOCATION OF DEAD END TRANSMISSION LINE TOWER OF OUTGOING LINE SHALL BE FINALISED BY CUSTOMER & INFORMED TO BHEL .
9. WAVE TRAP SHALL BE PROVIDED IN TWO PHASES AS PER PLCC REQUIREMENTS.
10. SURGE ARRESTOR PRESSURE RELIEF VALVE SHALL NOT BE TOWARDS ANY EQUIPMENT.
11. COMPLETE GROUNDING WORK LIKE INSTALLATION AND SUPPLY SHALL BE IN BHEL SCOPE.
12. CIVIL WORK OF POTHEADYARD, GIS AND CABLE TUNNEL SHALL BE IN CUSTOMER SCOPE, HOWEVER, ONLY DESIGN OF POTHEADYARD SHALL BE IN BHEL SCOPE.
13. ILLUMINATION OF POTHEADYARD SHALL BE IN BHEL PEM NOIDA SCOPE.
14. DG SET AND SWITCHGEAR SHALL BE IN BHEL BHOPAL SCOPE.
15. AIR CONDITIONING & VENTILATION SYSTEM SHALL BE IN BHEL PSNR NOIDA SCOPE.
16. FIRE FIGHTING SHALL BE IN PE&SD BHEL HYDRABAD SCOPE.
17. 400KV XLPE CABLE SHALL BE IN BHEL TBG NOIDA SCOPE.
18. 400KV SPARE CABLE AT POTHEAD YARD END SHALL BE PERMANENTLY CONNECTED WITH OUTDOOR CABLE SEALING END.

JUMPERING ARRANGEMENT AT 400KV CABLE SEALING END AND 400KV CT IN POTHEAD YARD

1. THE OVER HEAD ELECTRCIAL CONNECTION BETWEEN THE CSE(CABLE SEALING END) AND 400KV CTs SHALL BE AS SHOWN BY SOLID LINES. ———
2. HOWEVER IN CASE OF THE 400KV CABLE FAILURE THE HEALTHY CABLE SHALL BE CONNECTED IN SWYD AS SHOWN BY DOTTED LINE. — — —
3. ACCORDINGLY THE CABLE ADAPTER AT THE GIS END SHALL BE SWAPPED TO MAINTAIN THE PHASE SEQUENCE

REFERENCE

REV.	DATE			REV.	DATE			REV.	DATE			REV.	DATE			REV.	DATE		
09	16.09.22	ALTERED	SY -SD-	08	20.07.22	ALTERED	SY -SD-	07		ALTERED	VYOM -SD-	06		ALTERED	VYOM -SD-				
		CHECKED	DKS -SD-			CHECKED	DKS -SD-			CHECKED	JAI KUMAR -SD-			CHECKED	JAI KUMAR -SD-				
		APPROVED	VK -SD-			APPROVED	VK -SD-			APPROVED	VK -SD-			APPROVED	VK -SD-				
ZONE	AS PER CUSTOMER COMMENTS DATED 05.08.22			ZONE	DUE TO CHANGE IN THE LOCATION OF THE SWITCHYARD AS PER CUSTOMER EMAIL DATED xxxxx			ZONE	DUE TO CHANGE IN THE LOCATION OF THE SWITCHYARD AS PER CUSTOMER EMAIL DATED 12.04.2022			ZONE	DUE TO CHANGE IN THE LOCATION OF THE SWITCHYARD AS PER CUSTOMER EMAIL DATED xxxxx.04.2022						
REV.	DATE	ALTERED		REV.	DATE	ALTERED	PK	REV.	DATE	ALTERED	PK -SD-	REV.	DATE	ALTERED	DM -SD-	REV.	DATE	ALTERED	DM -SD-
		CHECKED	SK/SKS		06.06.19	CHECKED	SK/SKS	03	01.01.19	CHECKED	SK/DM -SD-	02	09.11.17	CHECKED	SK -SD-	01	19.01.17	CHECKED	SK -SD-
		APPROVED		04		APPROVED	AG			APPROVED	AG -SD-			APPROVED	RS/DM -SD-			APPROVED	RS/AS -SD-
ZONE	THE LAYOUT IS REVISED TO INCLUDE THE DETAILS FOR THE SPARE 400KV XLPE THDC/RKSH/EMD/VPHEP/401-6/2855			ZONE	AS PER MOM DATED 20.05.19			ZONE	AS PER CUSTOMER CUMMENT DATED 05.12.17			ZONE	AS PER CUSTOMER E-MAIL DATED 03.11.17			ZONE	AS PER CUSTOMER LETTER DATED 07.11.16		

ADDITIONAL INFORMATION
W.O.No.
STATUS OF DRAWING
DISTRIBUTION OF PRINTS

ग्राहक/परियोजना का नाम
NAME OF CUSTOMER/PROJECT
THDC INDIA LTD.
4X111MW VISHNUGAD PIPALKOTI H.E. PROJECT

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

	नाम /NAME	हस्ता./SIGN.	दि./DATE
बनाया DRAWN	PK	-SD-	07.10.16
जाँचा CHECKED	SK	-SD-	
स्वीकृत APPROVED	AS	-SD-	

विभाग DEPT. TBEM | कोड CODE 422 | अनुपात / SCALE | कार्ड कोड CARD CODE

शीर्षक/TITLE
LAYOUT PLAN & ELEVATION OF 400KV POTHEAD YARD

ड्राईंग क्र./DRAWING NO. TB-3-382-316-002

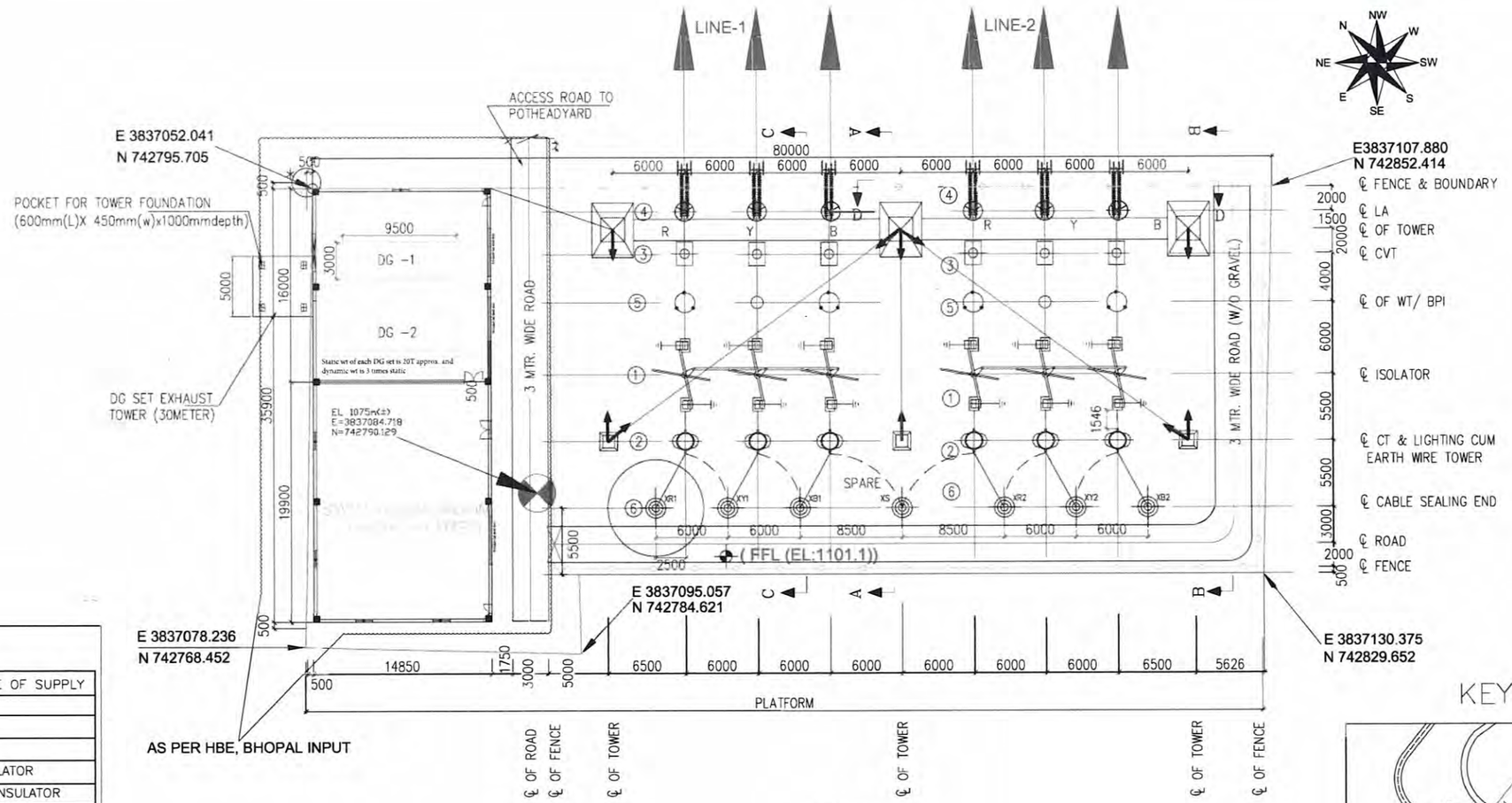
पुनः/REV. 09

पृष्ठ क्र./SHEET No. 01 | अगला पृष्ठ /NEXT SHEET 02

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM.)

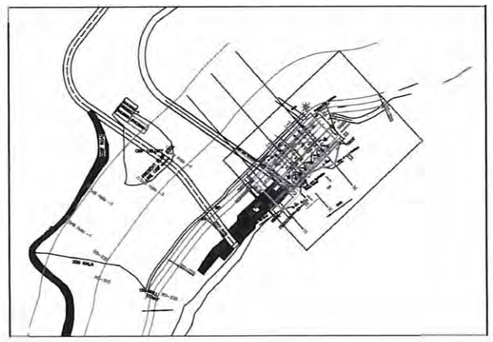
DRAWING No. TB-3-382-316-002

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



PLAN

KEY PLAN



LEGEND TABLE

———	PRESENT BHEL SCOPE OF SUPPLY
———	CUSTOMER SCOPE
←———	SHIELD WIRE
—○—	FENCE
▭	TENSION STRING INSULATOR
○	SUSPENSION STRING INSULATOR
▣	LIGHTING CUM EARTH WIRE TOWER
⊠	TOWER WITH PEAK
———	CONDUCTOR
⋈	GATE
▨	PLATFORM AREA
FFL	FINISHED FLOOR LEVEL OF PLATFORM

Ref. Drawings:

1. Key Plan– 5061149–C1001_[7]
   VPHEP Pothead yard Location
2. For Input details for DG set room Please refer BHEL,Bhopal mail Dtd.22.07.2022

REV.	DATE			ZONE
09	16.09.22	ALTERED	SY –SD–	AS PER CUSTOMER COMMENTS DATED 05.08.22
		CHECKED	DKS –SD–	
		APPROVED	VK –SD–	
08	20.07.22	ALTERED	SY –SD–	DUE TO CHANGE IN THE LOCATION OF THE SWITCHYARD AS PER CUSTOMER EMAIL DATED 27.06.2022
		CHECKED	DKS –SD–	
		APPROVED	VK –SD–	
07		ALTERED	VYOM –SD–	DUE TO CHANGE IN THE LOCATION OF THE SWITCHYARD AS PER CUSTOMER EMAIL DATED 12.04.2022
		CHECKED	JAI KUMAR –SD–	
		APPROVED	VK –SD–	
06		ALTERED	VYOM –SD–	DUE TO CHANGE IN THE LOCATION OF THE SWITCHYARD AS PER CUSTOMER COMMENTS
		CHECKED	JAI KUMAR –SD–	
		APPROVED	VK –SD–	
05	06.11.19	ALTERED	PK	THE LAYOUT IS REVISED TO INCLUDE THE DETAILS FOR THE SPARE 400KV XLPE CABLE UTILISATION . COMMENTS VIED LETTER No. THDC/RKSH/EMD/VPHEP/401–6/2855 DATED – 23/07/2019.
		CHECKED	SK/SKS	
		APPROVED	AG	
04	06.06.19	ALTERED	PK	AS PER MOM DATED 20.05.19
		CHECKED	SK/SKS	
		APPROVED	AG	
03	01.01.19	ALTERED	PK –SD–	AS PER CUSTOMER CUMMENT DATED 05.12.17
		CHECKED	SK/DM –SD–	
		APPROVED	AG –SD–	
02	09.11.17	ALTERED	DM –SD–	AS PER CUSTOMER E–MAIL DATED 03.11.17
		CHECKED	SK –SD–	
		APPROVED	RS/DM –SD–	
01	19.01.17	ALTERED	DM –SD–	AS PER CUSTOMER LETTER DATED 07.11.16
		CHECKED	SK –SD–	
		APPROVED	RS/AS –SD–	

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ड्राईग.क./DRAWING NO. TB-3-382-316-002
पुन:/REV. 09

पृष्ठ क./SHEET No. 02 अगला पृष्ठ/NEXT SHEET 03

A3 SIZE

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM.)

DRAWING No. TB-3-382-316-002

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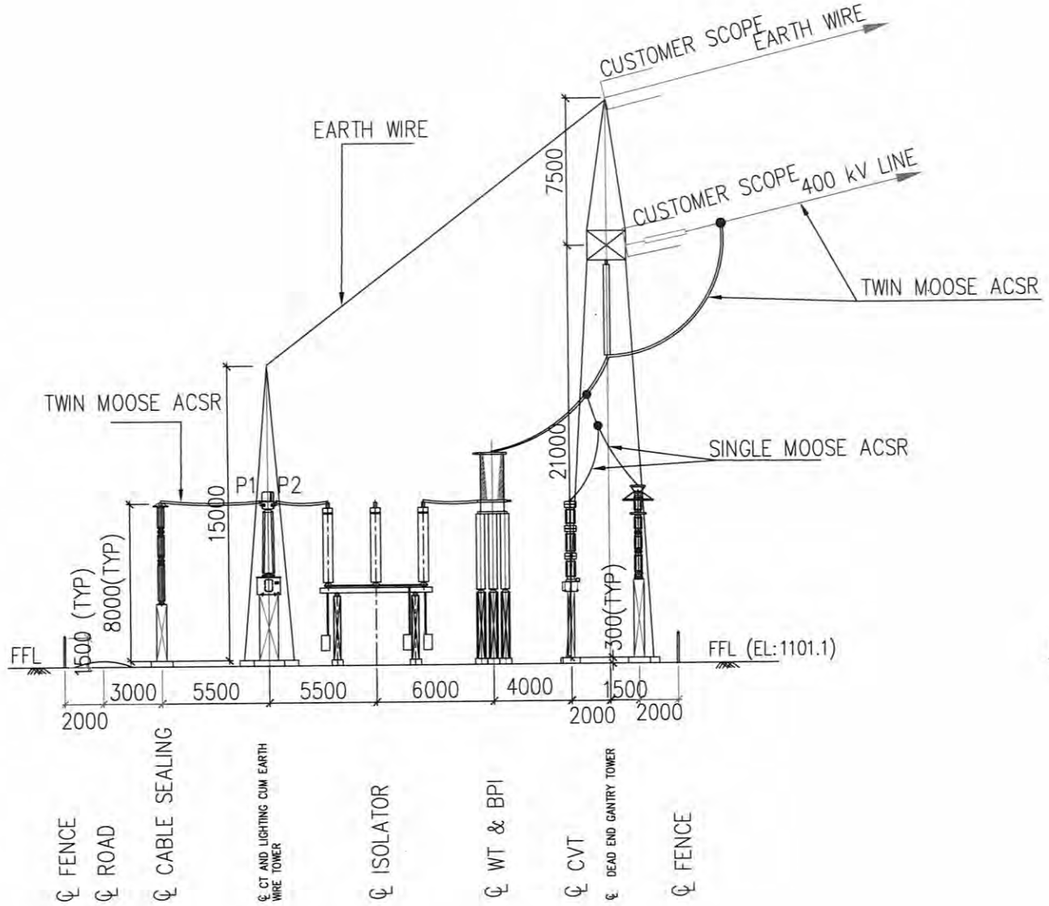
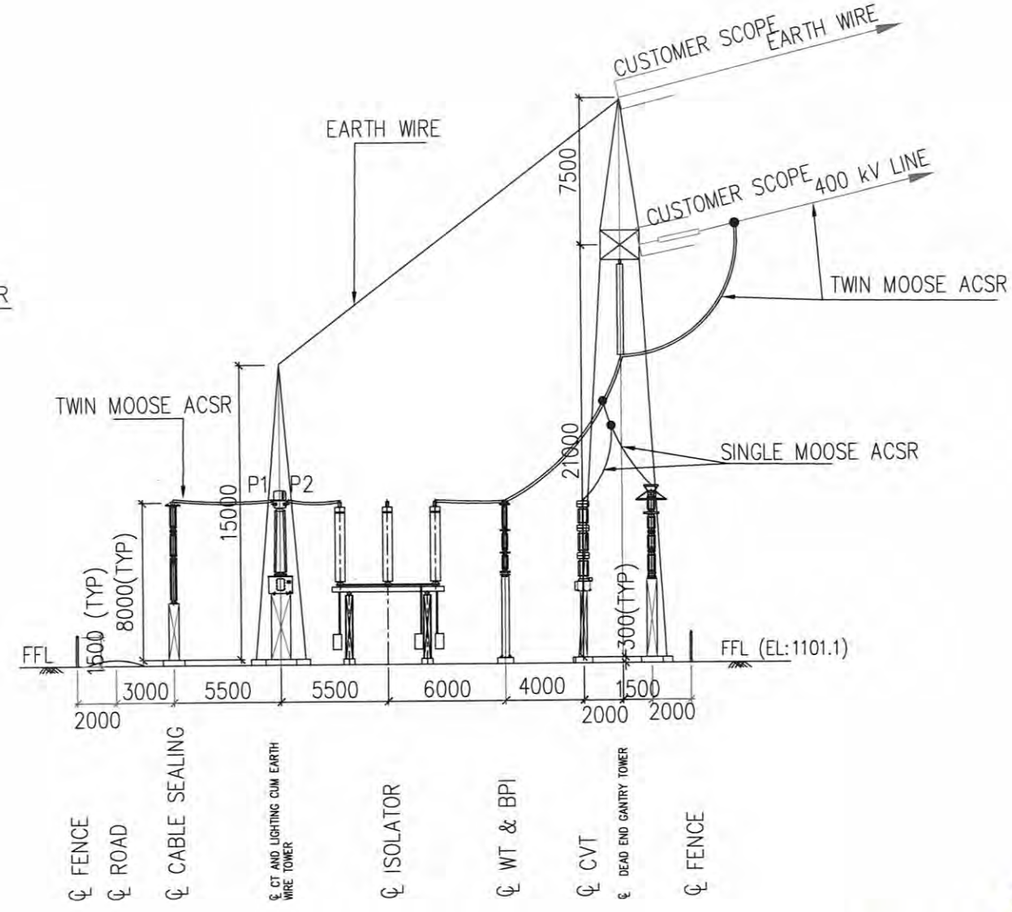


SECTION ''A-A'' & ''B-B''



SECTION ''C-C''

16.09.22

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REV.	DATE			
		ALTERED		
		CHECKED	SK/SKS	
		APPROVED		
ZONE	THE LAYOUT IS REVISED TO INCLUDE THE DETAILS FOR THE SPARE 400KV XLPE THDC/RKSH/EMD/VPHEP/401-6/2855			

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		APPROVED	VK	–SD–
ZONE	DUE TO CHANGE IN THE LOCATION OF THE SWITCHYARD AS PER CUSTOMER EMAIL DATED 27.06.2022			
REV.	DATE			
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		CHECKED	SK/SKS	
		APPROVED	AG	
ZONE	AS PER MOM DATED 20.05.19			

REV.	DATE			
07		ALTERED	VYOM	–SD–
		CHECKED	JAI KUMAR	–SD–
		APPROVED	VK	–SD–
ZONE	DUE TO CHANGE IN THE LOCATION OF THE SWITCHYARD AS PER CUSTOMER EMAIL DATED 12.04.2022			
REV.	DATE			
03	01.01.19	ALTERED	PK	–SD–
		CHECKED	SK/DM	–SD–
		APPROVED	AG	–SD–
ZONE	AS PER CUSTOMER CUMMENT DATED 05.12.17			

REV.	DATE			
06		ALTERED	VYOM	–SD–
		CHECKED	JAI KUMAR	–SD–
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ZONE	DUE TO CHANGE IN THE LOCATION OF THE SWITCHYARD AS PER CUSTOMER COMMENTS			
REV.	DATE			
02	09.11.17	ALTERED	DM	–SD–
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ZONE	AS PER CUSTOMER E-MAIL DATED 03.11.17			

REV.	DATE			
01	19.01.17	ALTERED	DM	–SD–
		CHECKED	SK	–SD–
		APPROVED	RS/AS	–SD–
ZONE	AS PER CUSTOMER LETTER DATED 07.11.16			

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LAYOUT PLAN & ELEVATION OF 400KV POTHEAD YARD

ड्राईग. क./DRAWING NO.
TB-3-382-316-002

पुनः/REV. 09

पृष्ठ क./SHEET No. 03 | अगला पृष्ठ /NEXT SHEET 04

A3 SIZE

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM.)

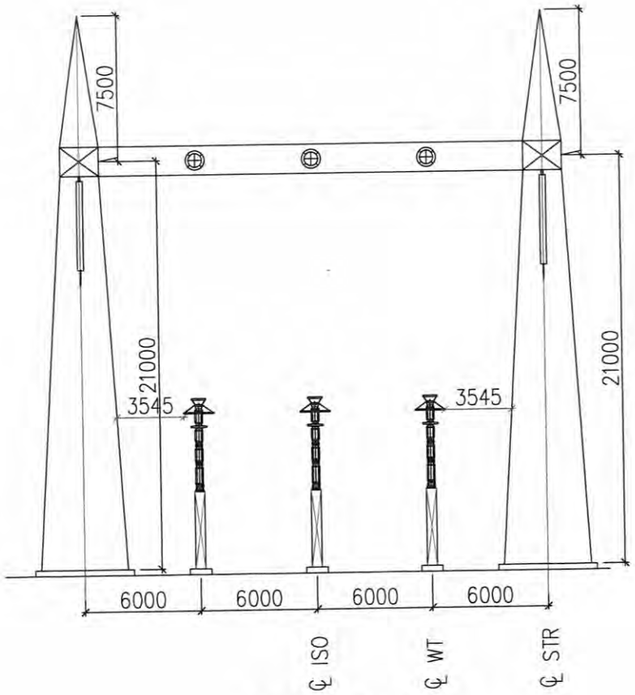
DRAWING No. TB-3-382-316-002

COMPUTER DRG. PATH NAME :

REF. DRG. No.

SIGN. & DATE

INVENTORY No.



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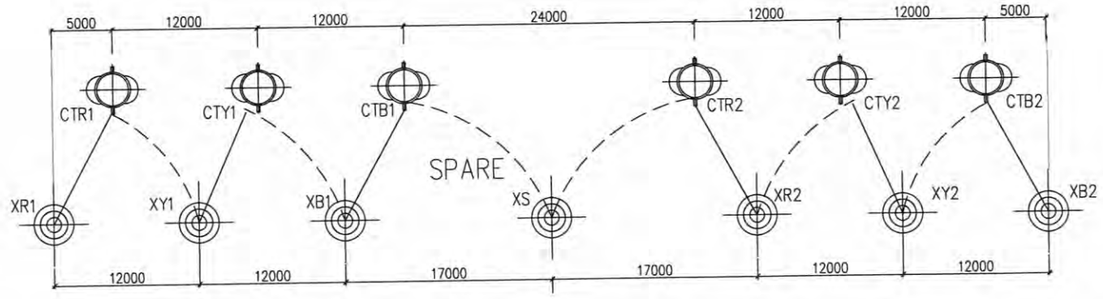

JUMPER SEQUENCE

S. NOS.	DESCRIPTION	CONNECTION DETAILS IN POTHEAD YARD
1.	NORMAL CONDITION INTERCONNECTION	XR1–CTR1 , XY1–CTY1 , XB1–CTB1 , XR2–CTR2 , XY2–CTY2 , XB2–CTB2
2.	R1 CABLE FAILURE INTERCONNECTION	XY1–CTR1 , XB1–CTY1 , XS–CTB1 , XR2–CTR2 , XY2–CTY2 , XB2–CTB2
3.	Y1 CABLE FAILURE INTERCONNECTION	XR1–CTR1 , XB1–CTY1 , XS–CTB1 , XR2–CTR2 , XY2–CTY2 , XB2–CTB2
4.	B1 CABLE FAILURE INTERCONNECTION	XR1–CTR1 , XY1–CTY1 , XS–CTB1 , XR2–CTR2 , XY2–CTY2 , XB2–CTB2
5.	R2 CABLE FAILURE INTERCONNECTION	XR1–CTR1 , XY1–CTY1 , XB1–CTB1 , XS–CTR2 , XY2–CTY2 , XB2–CTB2
6.	Y2 CABLE FAILURE INTERCONNECTION	XS–CTR1 , XY1–CTY1 , XB1–CTB1 , XS–CTR2 , XR2–CTY2 , XB2–CTB2
7.	B2 CABLE FAILURE INTERCONNECTION	XR1–CTR1 , XY1–CTY1 , XB1–CTB1 , XS–CTR2 , XR2–CTY2 , XY2–CTB2

NOTES:–

1. THE 400KV XLPE TERMINATION ON THE GIS SHALL ALSO BE SWAPPED TO RETAIN THE PHASE SEQUENCE OF THE 400KV SYSTEM .

16.09.22

REV.	DATE			REV.	DATE			REV.	DATE			REV.	DATE			REV.	DATE		
09	16.09.22	ALTERED	SY –SD–	08	20.07.22	ALTERED	SY –SD–	07		ALTERED	VYOM –SD–	06		ALTERED	VYOM –SD–			ALTERED	
		CHECKED	DKS –SD–			CHECKED	DKS –SD–			CHECKED	JAI KUMAR –SD–			CHECKED	JAI KUMAR –SD–			CHECKED	SK/SKS
		APPROVED	VK –SD–			APPROVED	VK –SD–			APPROVED	VK –SD–			APPROVED	VK –SD–			APPROVED	
ZONE	AS PER CUSTOMER COMMENTS DATED 05.08.22			ZONE	DUE TO CHANGE IN THE LOCATION OF THE SWITCHYARD AS PER CUSTOMER EMAIL DATED 27.06.2022			ZONE	DUE TO CHANGE IN THE LOCATION OF THE SWITCHYARD AS PER CUSTOMER EMAIL DATED 12.04.2022			ZONE	DUE TO CHANGE IN THE LOCATION OF THE SWITCHYARD AS PER CUSTOMER COMMENTS			ZONE			
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ZONE	THE LAYOUT IS REVISED TO INCLUDE THE DETAILS FOR THE SPARE 400KV XLPE THDC/RKSH/EMD/VPHEP/401–6/2855			ZONE	AS PER MOM DATED 20.05.19			ZONE	AS PER CUSTOMER CUMMENT DATED 05.12.17			ZONE	AS PER CUSTOMER E–MAIL DATED 03.11.17			ZONE	AS PER CUSTOMER LETTER DATED 07.11.16		

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4X111MW VISHNUGAD PIPALKOTI H.E. PROJECT

BHEL भारत हेवी इलेक्ट्रिकल्स लिमिटेड
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पुनः/REV. 09
पृष्ठ क्र./SHEET No. 04
अगला पृष्ठ/NEXT SHEET 05

A3 SIZE

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM.)

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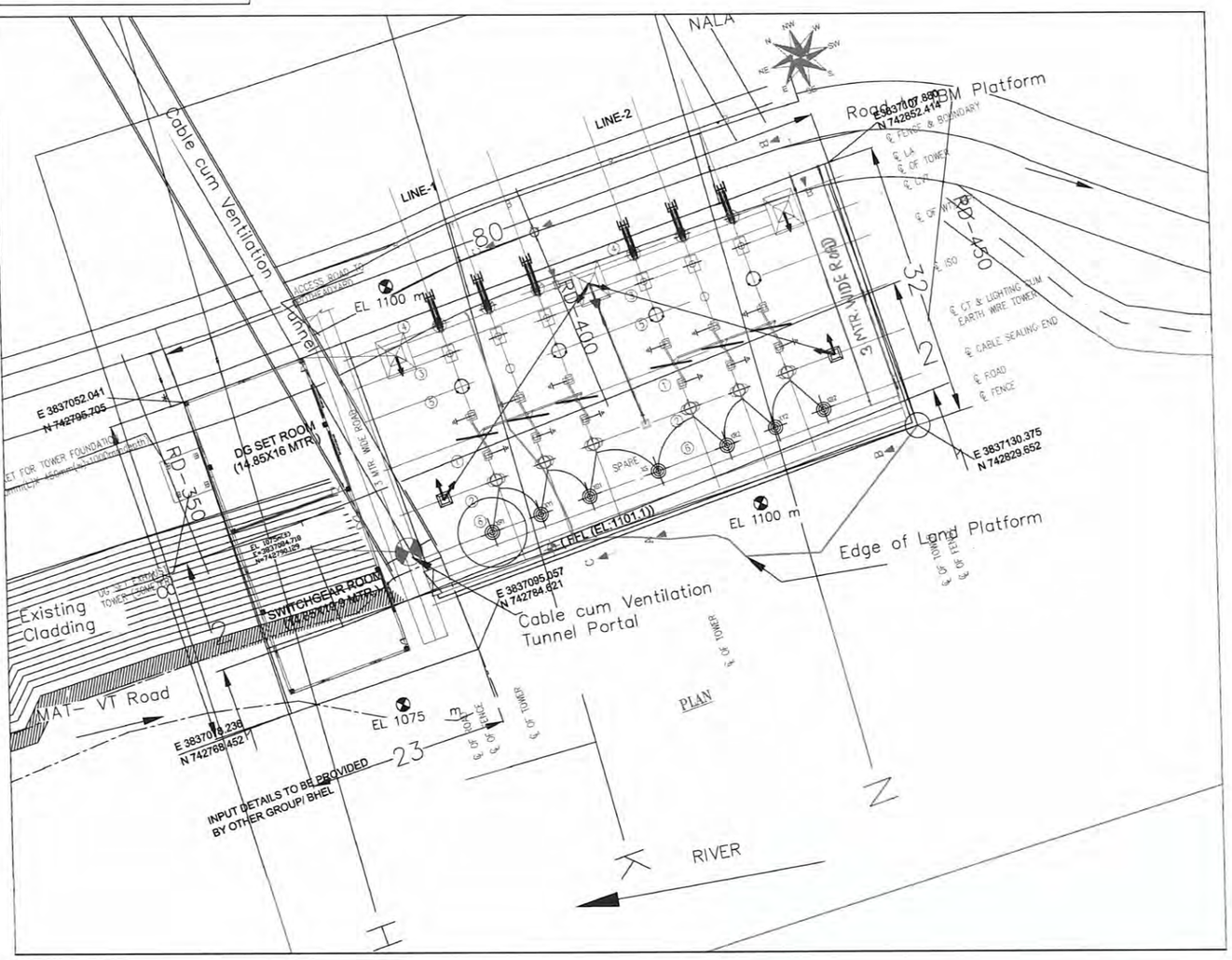

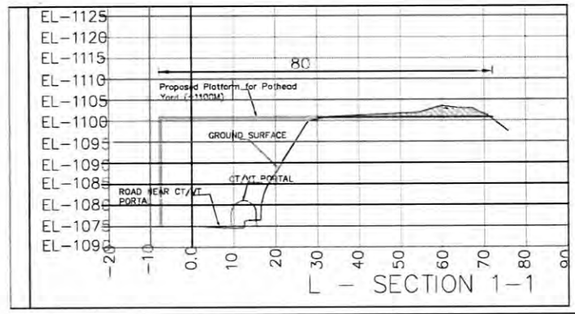

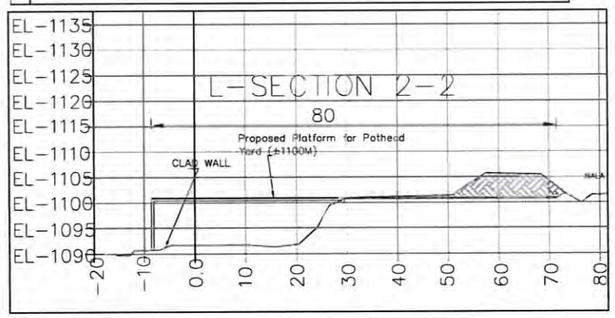

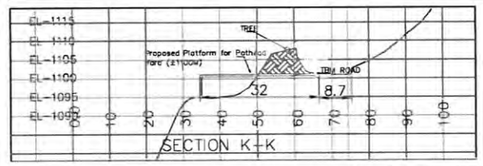

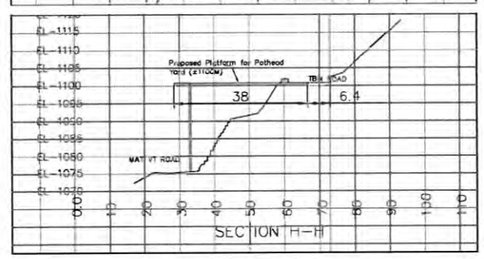

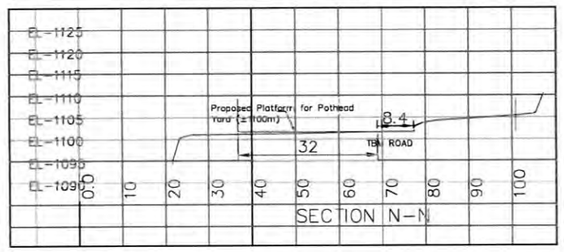

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REV.	DATE														
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पृष्ठ क./SHEET No. 05
अगला पृष्ठ/NEXT SHEET

A3 SIZE

Contents

SECTION 2:

EQUIPMENT SPECIFICATION UNDER SCOPE OF SUPPLIES/ SERVICE

1. DESIGN BASIS REPORT
2. CUSTOMER TECHNICAL SPECIFICATION

The precedence of order for documents shall be as per follows,

1. Design basis report
2. Customer Technical Specification

Approval of this drawing/document does not absolve contractor of its responsibility for manufacturing of the equipment as per ER & GTP for the achievement of designed performance at site and completeness of the equipment.

BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION PROJECTS ENGINEERING MANAGEMENT

DOCUMENT No.	**TB-382-316-056**	**Rev. 05**	Prepared	Checked	Approved
TYPE OF DOC.	**DESIGN BASIS REPORT**	**NAME**	**SK**	**SK**	**AS**
TITLE: **DESIGN BASIS REPORT of 420kV GIS & its accessories**		**SIGN**	-SD-	-SD-	-SD-
		DATE	27.09.16	27.09.16	27.09.16
		GROUP	TBEM	**W.O. No**	-
CUSTOMER:	**THDC INDIA LIMITED, UTTARAKHAND**				
PROJECT:	**4X111MW VISHNUGAD PIPALKOTI HYDRO ELECTRIC PROJECT**				

CONTENTS

Sec. No.	Description	
1.	Introduction	
2.	Basic arrangement and layout	
3.	Standard and codes	
4.	GIS parameters	
5.	General design and safety requirements	
6.	GIS Equipment's data	
7.	Schedule of requirements and quantities	
8.	Service continuity requirements	

Rev. No.	Date	Altered	Checked	Approved	REVISION DETAILS
05	**12.09.22**	**DK**	**VK**	**AG**	**As per THDCIL letter dtd. 01.09.22.**
04	29.08.22	DK	VK	AG	As per meeting held with THDCIL on dtd. 25-26.08.22.
03	15.07.22	DK	VK	AG	As per pre-bid confirmations and THDCIL requirement dtd. 23.01.19.
02	05.01.17	SK	SK	DM/RS	As per THDCIL letter dtd. 21.04.17.
01	05.01.17	SK	SK	AS/RS	As per THDCIL letter dtd. 07.11.16.

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		-	1	-	-	-

जाँची गई/CHECKED

संस्तुत
RECOMMENDED

अनुमोदित
APPROVED

Madhuri

13/9/2022.

1.0 INTRODUCTION:

420kV GIS is a part of 4X111MW Vishnugad Pipalkoti Hydro project and BHEL is the EPC contractor for this project.

The scope is based on technical specifications of M/s THDCIL and tender drawings. The scope of works envisaged for the 420kV GIS (gas insulated switchgear) shall be as described below.

Sl. No.	Description	Quantities
1.	420kV GT(Generator Transformer) Bay	4 Nos.
2.	420kV Line feeder Bays	2 Nos.
3.	420kV Bus coupler bay	1 No.

Note: All the circuit breakers of GIS bays shall be without PIR (pre-insertion resistor), however, line Circuit Breakers shall be equipped with CSD (Control Switching Device).

The Generator Transformers are at EL1036 & 420kV GIS at EL 1046 system are located in underground Transformer hall. 420kV outgoing GIS line feeder bays (GIS located in Transformer cavern) shall be connected to surface pothead yard by means of 420kV XLPE cables running inside the cable tunnel. 420kV GT shall be connected to GIS through gas insulated bus duct (GIB).

The scope shall comprise of EOT crane, Circuit Breakers, Bus Bars, Current Transformers, Voltage Transformers, Disconnectors, Safety Grounding Switches, High Speed Grounding Switches, Surge Arrestors, Interfacing module/ Transition work Bus Section between SF6 GIS and Oil to SF6 Bushings of Generator Transformers, Interfacing module/ Transition between SF6 GIS and XLPE Cable terminations, operating mechanism for each GIS equipment, Local control cubicles, Control cables, SF6 Gas and Hydraulic Oil (It is applicable for hydraulic operated mechanism GIS) for first filling plus **10% extra each**, SF6 Gas Processing Unit, Partial Discharge Monitoring System, supporting steel structures, embedments, ladders and walkways for erection & maintenance etc.

The purpose of DBR document is to elaborate the following for 420kV GIS.

a) Basic arrangement and layout

b) Standard and codes

c) GIS parameters

d) General design and safety requirements

e) GIS Equipment's data

f) Schedule of requirements and quantities

g) Service continuity Requirements

h) Training

2.0 BASIC ARRANGEMENT AND LAYOUT:

a) SF6 gas insulated switchgear (GIS) of double bus bar system shall be of rating 420kV, 2000 A, 40kA short circuit rating for 4 nos. incoming feeder, 2 nos. outgoing feeders and 01 nos. bus coupler bay.

b) Two nos. of outgoing 420kV feeder bays of GIS shall be connected by means of 420kV XLPE 800sqmm single core copper cables for each phase running inside the cable tunnel from transformer hall cavern to the 420kV pothead yard from where the power shall be evacuated through 2nos. of 420kV overhead lines. One spare single core 420kV XLPE 800sqmm copper cables shall run between GIS and pothead yard to meet the contingency requirements.

c) EOT Crane of 12T capacity shall be provided in GIS hall for managing the erection, testing, commissioning, operation and maintenance requirements.

d) The enclosure of the GIS shall be grounded at several points so that there shall be grounded cage around all the live parts. In general, 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,

3.0 STANDARD AND CODES:

The performance, testing and rating of the switchgear shall conform to the latest edition of the following IEC / IS publications:

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 60376	New sulphur hexafluoride
IEC 62271-100	High voltage alternating current Circuit breakers
IEC 62271-1	Common clauses for high voltage Switchgear and control-gear standards
IEC 62271-102	Alternating current disconnections (isolators) and earthing switches
IEC 60044-1	Current transformers
IEC 60044-2	Voltage transformers
IEC 60137	Bushings for alternating voltages above 1000 V
IEC 62271-209	Cable connections for gas-insulated switchgear
IEC 60480	Guide to checking of sulphur hexafluoride taken from electrical equipment
IEC 60099-1/4	Non-linear resistor type arresters for AC systems
IEC 60439	Factory-built assemblies of low-voltage switchgear and control Gear.
IEC 80 (2000)	IEEE Guide for Safety in AC Substation grounding.
CIGRE-44	Earthing of GIS- an application guide. (Electra no. 151, Dec'93).
IEC 61639	Direct connection between Power Transformers and gas insulated metal enclosed switchgear for rated voltage 72.5kV and above

4.0 GIS PARAMETERS:

i) Type of Switchgear: 420kV Single phase metal encapsulated, metal enclosed, SF6 gas insulated switchgear

ii) Location: Indoor

iii) Frequency: 50 ± 3% Hz

iv) Nominal/ Rated voltage, kVrms: 420

v) Highest System Voltage, kVrms: As per applicable IS/IEC

vi) Number of phases :3

vii) Rated lightning impulse withstand voltage (kVpeak)

a) Phase to Earth: 1425
b) Across open contacts: 1425+240 as per IEC 62271-100

viii) Rated switching impulse withstand voltage (kVpeak)

a) Phase to Earth: 1050
b) Phase to Phase: Not applicable for single phase encapsulated design
c) Across open contacts: 900+345 as per IEC 62271-100

ix) Rated one-minute power frequency with stand voltage (kVrms)

a) Phase to Earth: 520
b) Across open contacts: 610
System earthing: Effectively grounded

x) Rated normal current (Amps.): 2000A

xi) Rated short-time withstand current: 40kA, 1 sec. (symmetrical ampere, rms)

xii) Rated breaking capacity of circuit breaker: 40kArms

xiii) Partial discharge level at 1.1 Un/√ 3: 5 pico-coulombs or less

xiv) Material of enclosure: Aluminium alloy/ Non-magnetic material

xv) Material of bus bar: Aluminium alloy

xvi) Insulation medium: SF6 gas

xvii) SF6 relative pressure at 20 deg C- Filling, Alarm & Lock-out/Guaranteed pressure shall be as per OEM type tested design for all compartments including CB.

xviii) Rated voltage of control source: 220V DC

xviii)	Nos. of mechanical operation of CB of class M2 with maximum 3000A current before scheduled maintenance is required:	Mechanical endurance class M2 as per IEC 62271-100

5.0 GENERAL DESIGN AND SAFETY REQUIREMENTS:

The GIS assembly shall consist of completely separate pressurized sections in order to depressurize one gas compartment for inspection, maintenance or if necessary for repair while keeping the adjacent compartments in service. These compartments shall be such that maintenance on one feeder may be performed without de-energising the adjacent feeders. Stainless steel carbon impregnated or nickel plate rupture diaphragms with suitable deflectors shall be provided to prevent uncontrolled bursting pressures developing within the enclosures under worst operating conditions.

Each gas-filled compartment shall be equipped with static filters, density switches, filling valve and safety diaphragm. The filters shall be capable of absorbing any water vapour 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.

415V, 3 phase/ 240V single phase, 50 Hz, AC & 220 V DC auxiliary voltage supply for control, alarm, operating mechanism and space heaters with thermostat control shall be provided as per OEM type tested design.

GIS shall be of isolated phase type and each phase/ pole shall be housed in a separate enclosure. Wherever required, the heaters shall be provided for the equipment in order to ensure the proper functioning of the switchgear at specified ambient temperatures. The heaters shall be rated for 240V AC supply and shall be complete with thermostat, control switches and fuses, connected as a balanced 3-phase, 4-wire load.

The pressure relief type gas monitoring arrangement and sensors shall be provided in GIS.

Average leakage of SF6 gas from the GIS equipment shall be less than 0.5% per year.

6.0 EQUIPMENT DATA:

The materials and thickness of the enclosures shall confirm to the requirements of IEC 62271-203, under table 4. General technical particulars are given here under, however, the detailed technical particulars and drawings shall be submitted at later stage.

a) Circuit Breaker:

420kV, 2000A Circuit breaker shall be Single phase, metal enclosed, and SF6 gas insulated.

Rated operating duty cycle of line breaker is 0-0.3s-CO-3 min-CO. Rated operating duty cycle of Generator-transformer and bus coupler breakers is 0-3 min-CO-3 min-CO.

The circuit breaker operating mechanism shall be hydraulic or spring or a combination of spring and hydraulic mechanism.

The circuit breakers shall be provided with independent and reliable operating mechanism. The single phase circuit breaker in each bay module shall be of puffer type with two interrupting chambers per phase. They shall be designed for installation in SF6 gas insulated metal clad switchgear and shall use SF6 gas for both insulation & arc quenching.

b) Dis-connector:

The three pole group operated disconnectors shall be operated by electric motor suitable for use on 220V DC ungrounded system and shall be equipped with a **manual operating mechanism** for emergency use.

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

The disconnectors and safety grounding switches shall have a mechanical key (padlocking key) and electrical interlocks to prevent closing of the grounding switches when isolator switches are in the closed position and to prevent closing of the disconnectors when the grounding switch is in the closed position.

c) Safety Grounding Switches:

Three-pole, group **operated** safety grounding switches shall be operated by electric motor for use on 220V DC ungrounded system and shall be equipped with a **manual operating mechanism** for emergency use.

Each safety grounding switch shall be electrically interlocked with its associated disconnector and circuit breaker such that it can only be closed if both the circuit breaker and disconnector are in open position. Safety grounding switch shall be mechanically key interlocked with its associated disconnector.

d) High Speed Make Proof Grounding Switches:

High-speed Grounding switches make proof type and will be used to discharge the respective charging currents, in addition to their safety grounding function. These grounding switches shall also be capable of interrupting the inductive currents and to withstand the associated TRV.

Single phase switches shall be provided with operating mechanism for each phase suitable for operation from a 220V DC ungrounded supply.

High-speed ground switch operation shall be possible locally from the bay module control cabinet, or remotely from the control room.

The switches shall be provided with a stored energy closing system to provide fault making capability.

Mechanical endurance class for High speed Make Proof Grounding Switch shall be M1.

e) Current Transformer:

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

Refer single line diagram drawing no. TB-3-382-510-001 for detailed parameters of 420kV GIS CT.

The Current transformer parameters shall be as per approved CT sizing document no. TB-4-382-510-043 (subject to confirmation from the customer approved GIS supplier).

f) Bus Voltage Transformer:

The voltage transformers shall be of induction type non-resistant and shall be effectively shielded against high frequency electromagnetic transients. The voltage transformers shall have three secondary windings.

Refer single line diagram drawing no. TB-3-382-510-001 for detailed parameters of 420kV GIS VT.

The Voltage transformer parameters shall be as per approved VT sizing document no. TB-4-382-510-043043 (subject to confirmation from the customer approved GIS supplier).

g) Surge Arrestor:

390kV Surge Arresters shall be station type, heavy duty, SF6 gas-insulated, nonlinear zinc oxide gap-less type. Nominal discharge current and long duration discharge class shall be 20kA and class 4 respectively. The minimum energy handling capacity and pressure relief current of Surge arrester shall be 10kJ/kV and 40kA respectively.

h) SF6 GIS to XLPE Cable Termination/ Module:

The 420kV overhead line feeder emanating from surface pothead yard are to be connected to 420kV SF6 GIS by 420kV XLPE copper cables. The SF6 gas filled bushing compartments at GIS end shall be suitable for single run 800sqmm XLPE copper cables connection.

Termination module shall be provided with removable link which shall disconnect and isolate

the GIS section with 420kV XLPE cable during HV test/ other requirements.

i) SF6 GIS to Transformer Oil Bushings:

The connections between transformer HV terminal with oil bushing & SF6 bus duct of GIS are to be housed inside the enclosure.

j) Bus Bars:

The SF6 GIS bus-bars shall have continuous current rating of 2000A The conductors of the bus bars shall be fabricated from Aluminum tubular sections of cross- sectional area suitable to meet the current rating requirements.

The tubular bus section shall be housed in corrosion resistant Aluminum alloy or non-magnetic material enclosures, filled with pressurized SF6 gas. The conductors shall be supported from the enclosures by homogeneous epoxy resin insulators shaped to ensure uniform electrical field distribution and zero corona at rated voltage. Adequate provisions shall be made for absorption of the thermal expansions between the conductors and the enclosures.

k) Monitoring:

The gas density in each gas compartment shall be monitored by electrically isolated & independently adjustable temperature compensated density switches. Two level density switches shall be provided for each GIS bus compartment to initiate remote devices of Level-I alarm and level-II tripping.

l) On Line Partial Discharge Monitoring System:

One no.-On Line Partial discharge monitoring system with sufficient number of UHF couplers/ partial discharge sensors at different measuring locations, coaxial cable, spectrum analyser, microcomputer including the expert system for analysis & automatic interpretation of the measured values wherever applicable and RS232 optical fibre links etc. shall be provided.

UHF coupler for on line partial discharge monitoring shall be provided between GIS and generator transformer and between GIS and XLPE cable.

7.0 SCHEDULE OF REQUIREMENTS AND QUANTITIES:

7.1 Bay wise Supply quantities of GIS

A) Double Bus Bar System

Two (2) sets of, 3 single phase (isolated), SF6 gas insulated, metal-enclosed 2000A bus bars, each enclosed in three individual bus -enclosures running along the length of the switchgear to interconnect each of the circuit breaker bay module. Each bus bar set shall comprise of:

i) Three Nos.-Single phase SF6 insulated, voltage transformers with three secondary windings.

ii) One No.-Three pole group operated disconnector with grounding switch complete

with manual and motor driven operating mechanism for voltage transformer.

iii) One No.-Three pole group operated high speed fault making grounding switch complete with manual and motor driven operating mechanism.

iv) Local Control Cubicle (LCC)- This requirement shall be managed with Bus Coupler bay/ adjacent bay local control cubicle (LCC).

v) One lot- SF6 gas monitoring system for the complete bus, terminal boxes, interconnecting wires, piping and grounding, support structures, platforms, etc.

B) Bus Coupler Bay

One - 420kV bus coupler bay module comprising of:

i) One – Set of three single phase (isolated), 2000A, SF6 gas insulated circuit breaker complete with separate and reliable operating mechanism for each phase.

ii) Two sets - 4 core, 2000-1000-500/1A single phase current transformers/ Current Transformers as per approved CT VT parameters/ SLD

iii) Two Nos. -Three pole, 2000A, group operated disconnector switches complete with manual & motor driven operating mechanisms.

iv) Two Nos. - Three pole, group operated safety grounding switches, complete with manual and motor driven operating mechanism.

v) One No. -Local control cubicle including interconnecting wires, pipes, etc.

vi) One lot- SF6 gas monitoring system for the complete bay module.

C) Generator Transformer Bays

Four- 420kV, 2000A generator transformer feeder bay modules each comprising of:

i) One Set of three single phase (isolated), 2000A, SF6 gas insulated circuit breaker, complete with separate and reliable operating mechanism for each phase.

ii) Three Nos.-5 core, single phase current transformers with CT ratio of 2000-1000-500/1A for 2 cores and 500/1A for the remaining 3 cores/ Current Transformers as per approved CT VT parameters/ SLD

iii) Three Nos.-3 cores single phase current transformers with CT ratio of 500/1 A/ Current Transformers as per approved CT VT parameters/ SLD

iv) Two Nos. -Three pole, group operated bus bar disconnectors with common grounding switch, each complete with manual and motor driven operating mechanism.

v) One No.-Three pole, 2000A group operated feeder disconnector, complete with

manual and motor driven operating mechanism.

vi) One No.-Three pole, group operated, safety grounding switch, complete with manual and motor driven operating mechanism.

vii) One No. - Three pole group operated, high speed fault making grounding switch with link, complete with manual and motor driven operating mechanism.

viii) Three Nos. –390 kV rated voltage, Single phase, SF6 gas insulated, metal enclosed zinc oxide surge arrestors.

ix) Three Nos.–single phase gas insulated terminal connections for connecting generator transformer (oil/SF6) bushing with GIS through gas insulated interconnecting bus (2000 Amp rating).

x) One No. – Local control cubicle including interconnecting wires, pipes etc.

xi) One Lot-SF6 gas monitoring system for the complete bay module.

D) Line Feeder Bays

Two 420kV, 2000A transmission line feeder bay modules, each comprising of:

i) One set of three single phase (isolated), 2000A SF6 gas insulated circuit breaker without PIR (pre-insertion resistors) with CSD (Controlled Switching Device) complete with separate and reliable operating mechanisms for each phase.

ii) Three Nos.- 3 core single phase current transformers (2000-1000-500/1A)/ Current Transformers as per approved CT VT parameters/ SLD.

iii) Three Nos.- 4core single phase current transformers (2000-1000-500/1A)/ Current Transformers as per approved CT VT parameters/ SLD.

iv) Two Nos. - Three pole, 2000A, group operated bus bar disconnectors, with common grounding switch each complete with manual and motor driven operating mechanism.

v) One No.-Three pole, 2000A group operated feeder disconnector, complete with manual and motor driven operating mechanism.

vi) One No.-Three pole, group operated, safety grounding switch, complete with manual and motor driven operating mechanism.

vii) One No. - Three pole group operated high speed fault making grounding switch with link complete with manual and motor driven operating mechanism.

viii) Three Nos.- 390 KV rated voltage, single phase, SF6 gas insulated, metal enclosed zinc oxide surge arrestors.

ix) Three Nos.– Single phase SF6 gas insulated terminal connections for inter connection between GIS & XLPE cables of 800 sq. mm size through gas insulated bus ducts of 2000 A rating.

x) One No.-Local Control Cubicle including interconnecting wires, pipes etc.

xi) One Lot-SF6 gas monitoring system for the complete bay module.

7.2 The scope of supply shall also include the following,

A) First filling of SF6 gas & hydraulic oil for the equipment supplied plus an additional quantity sufficient for conducting all the tests on equipment at site before placing it into successful operation. **In addition, 10% of the total quantity of SF6 gas & hydraulic oil shall also be supplied.**

B) One nos. of Gas processing unit suitable for evacuating, liquefying, filling, drying and purifying SF6 gas during initial installation, subsequent maintenance and future extension of the GIS.

SF6 gas processing unit shall be model no. L170R01 of 300 litter storage capacity of DILO make or equivalent, suitable for evacuating, liquefying, filling, drying and purifying SF6 gas during initial installation, subsequent maintenance and future extension of the GIS.

C) One set of Special tools & tackles, testing instruments shall be provided to THDCIL for operation & maintenance requirements of 420kV GIS, and it shall not be used during erection, testing and commissioning of 420kV GIS. The list is as follows,

i) Portable gas leak detector = 1 No
ii) Portable dust counter= 1 No
iii) Special gas mask for GIS maintenance = 2 Nos.
iv) Power operated insulation tester= 1 Set
v) Tong tester for suitable range = 1 Set
vi) Portable SF6 gas analyser offline - 1 Set
vii) Dew point meter = 1 Nos.
viii) Ladder/ walkways/ mobile platform- 1 lot

D) However to meet the requirements of erection, testing and commissioning of 420kV GIS, all the general/ special tools and tackles, testing instruments & HV testing kit along with operator, required for successful testing and commissioning of 420KV GIS shall be arranged at site by manufacturer at site on returnable basis.

E) All materials & consumables for the complete installation, testing, commissioning and placing into successful operation of the equipment.

F) All supporting steel structures for the equipment including rails, transverse & longitudinal beams and supporting members with all necessary hardware & embedded

parts, terminal boxes, interconnecting wires, pipes etc.

G) All the ladders and walkways necessary for access to the equipment during erection & maintenance at site.

H) Complete installation/ erection, testing, commissioning and placing into successful operation of the equipment till handing over the same to the owner.

I) One set of ON line Partial discharge monitoring system with sufficient number of UHF couplers/ partial discharge sensors at different measuring locations, coaxial cable, spectrum analyser, micro computer including the expert system for analysis & automatic interpretation of the measured values wherever applicable and RS-232 optical fibre links etc. The requirement of UHF couplers, if any, for sections of interconnecting bus between GIS & generator transformer, and between GIS and XLPE cables shall also be included and integrated.

J) One nos. of Contact resistance metering desk with cables.

K) One nos. of **Circuit Breaker analyser** (i.e. DCRM kit having laptop with minimum 15 channel).

Note – Detailed break-up of above items shall be provided after ordering of GIS.

7.3 Recommended spare of GIS – Nil

7.4 Mandatory spare of GIS for the five years of successful operation

Sl. No.	Description	Quantities
1.	One pole of complete interrupter unit of circuit breaker with operating mechanism	2 set
2.	Complete drive mechanism including motor for disconnector switches and earthing switches	1 no.
3.	Complete drive mechanism including motor for fast acting earthing switches	1 no.
4.	Trip coils for circuit breakers	6 nos.
5.	Closing coils for circuit breakers	6 nos.
6.	Complete set of rupture disc	2 sets
7.	Pressure switch gas pressure transmitter	2 sets of each type
8.	Pressure Gauge	2 sets of each type

9.	Gas Density Relay	2 sets of each type
10.	Non-permeable Insulator/ Bushing	2 sets of each type
11.	Permeable Insulator/ Bushing	2 sets of each type

8.0 SERVICE CONTINUITY REQUIREMENTS:

GIS shall meet the following service requirements, which is in line with IEC 62271-100, Annexure-F (Informative),

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 (including bus bar dis-connector), maximum one bus bar and/or one feeder permitted out of service during repair and maintenance.

The typical drawing for gas schematics is attached for reference purpose (Annexure-AA).

9.0 TRAINING:

The scope of work shall also include training of THDCIL engineers at the works of manufacturer as well as at project site as per following details,

1	Training for GIS of 4nos. Engineers for a period of at least 7 working days at Manufacturer's works	Training shall be arranged at manufacturer works.	Lot	1
2	Training for GIS of 4nos. Engineers for a period of at least 7 working days at project site	Training shall be arranged at project site.	Lot	1

10.0 DOCUMENTS ATTAHED

1. Single Line Diagram for 420kV GIS & Pothead Yard
2. Typical drawing for gas schematics: Annexure-AA
3. Record notes of meeting held with THDCIL on dtd. 22-23.01.2019 & 25-26.08.2022
4. Comments Resolution Sheet

SECTION-15

420KV SF6 GAS INSULATED SWITCHGEARS

15.1 SCOPE

15.1.1 These specifications cover the technical requirements for the design, engineering manufacture, assembly, testing at manufacturer's works before despatch and services for supply, insurance, transportation, delivery at Project site, handling, storage and preservation at store / site, transport to place of installation, complete of site assembly, erection, testing at site & commissioning of 420 kV SF6 Gas Insulated Switchgear (GIS). The equipment shall comprise of Circuit Breakers, Bus Bars, Current Transformers, Voltage Transformers, Disconnectors, Safety Grounding Switches, High Speed Grounding Switches, Surge Arrestors, Transition work Bus Section between SF6 GIS and Oil to SF6 Bushings of Generator Transformers, Transition between SF6 GIS and XLPE Cable terminations, operating mechanism for each equipment, Local control cubicles, Control cables, SF6 Gas and Hydraulic Oil for first filling plus 10% extra each, SF6 Gas Processing Unit, Partial Discharge Monitoring System, supporting steel structures, embedments, ladders and walkways for erection & maintenance etc. Any other equipment not explicitly mentioned herein but are necessary for completeness of works specified shall also be included in the scope.

15.1.1 The supplier shall provide all the materials, labour, supervisory staff, plant, equipment & machinery and services necessary for accomplishing the work.

15.1.2 The scope of supply shall include all the mandatory spares and considered to be sufficient for normal operation of equipment for 5 years.

15.1.3 The scope of supply shall include all the special tools, tackles and slings required for assembly, disassembly and maintenance of the equipment. However, all other tools, tackles and slings required for erection, testing and commissioning of the entire equipment at site shall be arranged by the supplier.

15.1.4 All the Testing Instruments and Devices required for testing, commissioning and final acceptance tests of the entire equipment at site shall be arranged by the supplier.

15.1.5 The scope of work shall also include training of purchaser's/consultant's engineers at the works of manufacturer as per the provisions mentioned at General Technical Requirements.

15.1.6 In addition to the above the bidder shall design his equipment so as to be suitable for integration / Interfacing of Local Control Panels of GIS with Unit Control Board (UCB) & Computerised Control Systems (CCS).

15.1.7 The local control panel of GIS shall have provision for communication with computerized control system (CCS) being provided for the project. The signals for events and measurements including alarm & annunciation and control features to ensure complete control & monitoring of GIS system by the control room operator shall be brought upto Control & Metering Panel and UCB.

15.2 SYSTEM DETAILS

15.2.1 Vishnugad Pipalkoti H.E. Project envisages installation of 4 nos. of generating units of 111 MW each. The power generated by these units will be stepped up to 420 kV through 4 banks of generator transformers each comprising of three nos. single phase (3x46 MVA), 13.8/420/√3 kV generator transformers.

15.2.2 SF6 gas insulated switchgear (GIS) of double bus bar system shall be of rating 420 kV, 2000 A, 40 kA short circuit rating for 4 nos. incoming feeder, 2 nos. outgoing feeders and one bus coupler bay.

15.2.3 Two nos. of outgoing 400kV feeder bays of GIS shall be connected by means of 400 kV XLPE 800 mm^2 single core copper cables for each phase running inside the cable tunnel from transformer hall cavern to the 400kV potheadyard from where the power shall be evacuated through 2 nos. of 400kV single circuit lines.

15.2.4 EOT Crane of 10T capacity is proposed to be used for lifting of GIS equipment, the details of this have been provided in the technical specifications of EOT crane of this bidding document. A blockout of required size, which can be finalized during design stage is proposed to be provided in the GIS slab for lifting of GIS equipment from trucks / trailers. The bidder is required to keep the weight and size of the components accordingly.

15.3 STANDARDS

15.3.1 The switchgear specified herein shall operate satisfactorily in the climatic conditions specified in General Technical Requirements. The performance, testing and rating of the switchgear shall conform to the latest edition of the following IEC / IS publications:

IEC -56 : (Parts 1 to 6) - AC High Voltage circuit breaker
IEC- 68 Part III : Seismic test methods for equipments
IEC -71 : Insulation coordination.

IEC- 99-4	:	Metal Oxide Surge arresters without gaps for AC systems.
IEC -129	:	AC disconnectors and earthing switches
IEC- 137	:	Bushing particulars.
IEC –185	:	Current transformers
IEC –186	:	Voltage transformers
IEC -267	:	Guide to testing of circuit breakers
IEC –270	:	Partial discharge measurements.
IEC- Rec. 376	:	SF6 Gas
IEC- 427	:	Synthetic testing of high voltage AC circuit breaker.
IEC- 480	:	Guide to the checking of SF6 taken for electrical equipments.
IEC- 506	:	Switching impulse test on HV insulators.
IEC -517	:	Metal-enclosed switchgear above 72.5 kV
IEC- 694	:	Common clauses for HV switchgear
IEC- 859	:	Cable connections for gas insulated metal enclosed switchgear.
IEC -1128	:	Alternating current disconnectors
IEC -1129	:	AC earthing switches induced current switching.
IEC-1259	:	Requirement for switching of bus charging current by disconnectors.
IEC- 1639	:	Direct connection between power transformer & SF6 GIS
IS –2705	:	Current transformers
IS- 3156	:	Voltage transformers
ANSI/IEEE	:	Guide for safety in AC sub-station grounding (Std. 80-1986).

15.3.2 The proposed switchgear 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 alongwith the tender.

15.3.3 Compliance with the provisions of the specifications does not absolve the switchgear manufacturer from the responsibility of furnishing switchgear and accessories of proper design, electrically and mechanically suited to meet the operating guarantees at the specified service conditions.

15.3.4 If there are, in the opinion of the bidder, any contradictions between the above standards and these specifications, such contradictions shall be brought to the attention of the purchaser.

15.4 RATINGS

15.4.1 The ratings and general characteristics of the GIS shall be as follows:

i)	Type of Switchgear	420 kV Single phase, metal enclosed, SF6 gas insulated switchgear
ii)	Location	Indoor
iii)	Frequency	50 ± 3% Hz
iv)	Rated voltage, kV rms	420
v)	Highest System Voltage, kV rms	440
vi)	Number of phases	3
viii)	Rated lightning impulse withstand voltage (kV peak)	
a)	Phase to Earth	1425
b)	Across open contacts	1665
ix)	Rated switching impulse withstand voltage (kV peak)	
a)	Phase to Earth	1050
b)	Phase to Phase	1425
c)	Across open contacts	1245
x)	Rated one minute power frequency with stand voltage (kV rms)	
a)	Phase to Earth	520
b)	Across open contacts	610
xi)	System earthing	Effectively grounded
xii)	Rated normal current (Amps.)	2000 A
xiii)	Rated short-time withstand current (symmetrical ampere, rms)	40 kA, 1 sec.
xiv)	Rated breaking capacity of circuit breaker	40 kA rms
xv)	Partial discharge level at 1.1 Un/√ 3	5 pico coulombs or less

xvi)	Material of enclosure	Aluminium alloy or Non-magnetic material. Steel for line breaker with PIR
xvii)	Material of bus bar	Aluminium alloy
xviii)	Insulation medium	SF6 gas
xix)	SF6 relative pressure at 20 ^{0} C except for circuit breaker	
a)	Filling	5.3 bar
b)	Alarm	4.8 bar
c)	Minimum	4.5 bar
xx)	Rated voltage of control source	DC 220 V
xxi)	No.of mechanical operation with maximum 3000A current before scheduled maintenance is required:	12,000

15.4.2 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.

15.4.3 Thermal calculations shall be based on the climatic conditions described in General Technical Requirements. These calculations shall be submitted for review of the purchaser.

15.5 GENERAL DESIGN AND SAFETY REQUIREMENTS

15.5.1 The GIS assembly shall consist of completely separate pressurized sections in order to depressurize one gas compartment for inspection, maintenance or if necessary for repair while keeping the adjacent compartments in service. These compartments shall be such that maintenance on one feeder may be performed without de-energising 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. Stainless steel carbon impregnated or nickel plate rupture diaphragms with suitable deflectors shall be provided to prevent uncontrolled bursting pressures developing within the enclosures under worst operating conditions.

Sections of GIS shall be supplied filled with dry Nitrogen or SF6 gas at a positive pressure and hermetically sealed to protect the dielectric system during transportation.

15.5.2 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 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.

Gas barrier insulators and support insulators shall have the same basis of design.

Gas barrier insulators 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 1.5 times full rated pressure on one side while vacuum is exerted on the other side. 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 the pressurised 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.

15.5.3 The material and thickness of the enclosures shall be such as to withstand an internal flash over without burn through for a period long enough (500ms) till the backup relay protection clears the fault. 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.

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

15.5.5 The material used for manufacturing the switchgear equipment shall be of the corrosion- resistant type, composition and have physical properties best suited to their particular purposes and in accordance with the latest engineering practices. Surface treatment for the enclosures and built on components shall be such that it meets all anti corrosion requirements under humid conditions of the place of installation. All the conductors shall be fabricated of aluminum 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.

15.5.6 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 517.

15.5.7 The manufacturer shall guarantee that the pressure loss within each individual gas-filled compartment shall not be more than one percent per year.

15.5.8 Each gas-filled compartment shall be equipped with static filters, density switches, filling valve and safety diaphragm. The filters shall be capable of absorbing any water vapour 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.

15.5.9 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 upto the permissible servicing intervals under 100% rated & 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. Routine maintenance to any of its external components including the protective relays and instrument transformers shall not be required in less than five years intervals. The internal components shall be maintenance free for at least 10 years. Routine replacement of insulating gas shall not be required in intervals of less than ten years.

15.5.10 Bracings shall be provided for all mechanical components against the effects of short circuit currents. The arc faults shall be positively confined to the originating compartment and shall not spread to the other parts of switchgear.

15.5.11 The thermal rating of all current carrying parts shall be minimum for one sec. at 420 kV for the rated symmetrical short-circuit current. If the max. Short-circuit time is extended; the I^2t value shall remain constant.

15.5.12 415V 3 phase/ 240 V single phase, 50 Hz, A.C. & 220 V D.C. auxiliary voltage supply for control, alarm, operating mechanism and space heaters with thermostat control shall be provided by the supplier.

15.5.13 The switchgear shall be of the free standing, self-supporting with easy accessibility to all the parts during installation & maintenance, dead front design with all high-voltage equipment installed inside gas-

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

a) Busbars

b) Intermediate compartment

c) Circuit breakers

d) Bus / Line disconnectors

e) Gas insulated bus section between generator-transformer and GIS.

f) Current Transformers

g) Voltage Transformers

h) Surge Arrestors

i) Gas Insulated bus section between GIS and XLPE cable

GIS shall be of isolated phase type and each phase/pole shall be housed in a separate enclosure.

15.5.14 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.

15.5.15 It is required that the three phases of each switchgear bay be arranged side by side. Segregated phase blocks of equipment in which one phase of each switchgear bay is mounted in a separate block are not acceptable. The arrangement of the equipment offered must provide adequate access for operation, testing and maintenance.

15.5.16 The bay control cabinet shall be suitably placed in GIS Hall after finalization of layout.

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

15.5.18 The actual position of circuit breakers, disconnectors and grounding switches must be positively displayed by mechanical indicators visible from the operating position.

15.5.19 The tenderer shall furnish the following information regarding the loosely distributed metallic particles within the GIS encapsulation.

a) Calculations of critical field strength for specific particles of defined mass and geometry.

b) The methodology and all the equipment for electrical partial discharge (PD) detection.

15.5.20 The switchgear shall have provision for connection with ground mat risers to be inserted at the time casting of GIS slab. This provision shall consist of grounding pads to be connected to the ground mat riser in the vicinity of the equipment. The supplier shall furnish the details & drawings for ground mat requirement for GIS.

15.5.21 The ladders and walkways shall be provided wherever necessary for access to the equipment. The suitability of using a portable ladder with adjustable height may be provided.

15.5.21.1 Visible 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 visible corona. No corona shall be visible in complete darkness when the equipment is subjected to test voltage specified.

15.5.21.2 Elbows, bends and T-sections of interconnections shall include the insulator bearing the conductor at the change of direction to ensure that live parts remain perfectly centered and the electrical field is not increased at such points.

15.5.21.3 Conductors and live parts shall be supported by solid moulded epoxy--resin insulators. These insulators shall be designed to have high structural strength and dielectric properties and shall be shaped so as to provide long creepage distance, uniform field distribution and to minimize the effects of particle deposition either from migration of foreign particles within the enclosure or from the by-products of SF6 breakdown under arcing condition. Gas barrier and support insulators shall have the same basic design.

15.5.22 Wherever required, the heaters shall be provided for the equipment in order to ensure the proper functioning of the switchgear at specified ambient temperatures. The heaters shall be rated for 240V AC supply and shall be complete with thermostat, control switches and fuses, connected as a balanced 3-phase, 4-wire load.

15.5.23 Endometer arrangement shall be provided to visually observe the contact position of disconnecting switches and earth switches.

15.5.24 Alarm circuit shall not respond to faults for momentary conditions. The following indications including those required elsewhere in the specifications shall be generally provided in the alarm & indication circuits.

15.5.24.1 Gas Insulating System

a) Loss of gas density

b) Loss of heater power (if required)

c) Moisture in gas

d) Any other alarm necessary to indicate deterioration of the gas insulating system

15.5.24.2 Operating System

a) Low operating pressure.

b) Loss of Heater Power.

c) Loss of operating power.

d) Loss of control

e) Pole-disordance

15.5.25 The equipment will be operated as per ambient conditions specified at General Technical Requirements. In addition, indoor humidity will be about 70% where GIS system is to be installed and operated.

15.5.26 Bellows or Compensating units

Adequate provision shall be made to allow for the thermal expansion of the conductors and of differential thermal expansion between the conductors and the enclosures. The metallic bellows (preferably of stainless steel) of following types or other suitable equivalent arrangement shall be provided wherever necessary.

i) Lateral / vertical mounting units : These shall be inserted, as required, between sections of busbars, on transformer and XLPE cable termination. Provision of these shall enable sections of the switchgear to be removed and reinserted without interfering with adjacent parts. Lateral mounting shall be made possible by a sliding section of enclosure and tubular conductors.

i) Axial compensators : These shall be provided to accommodate changes in length of busbars due to temperature variations.

iii) Parallel compensators : These shall be provided to accommodate large linear expansions and angle tolerances.

iv) Tolerance compensators: These shall be provided for taking up manufacturing, site assembly & foundation tolerances.

v) Vibration compensators: These bellow compensators shall be provided for absorbing vibrations caused by the transformers and Shunt Reactor when connected to SF6 switchgear by oil -SF6 bushings.

15.5.27 Seismic Design Criteria

15.5.27.1 The equipment shall be designed for operation in seismic zone for earthquake resistance as per the seismic parameters indicated at General Technical Requirements. The seismic loads are due to the horizontal and vertical acceleration which may be assumed to act non concurrently. The copies of type test reports for similar rated equipment, if tested earlier, should be furnished along with the tender. If the equipment has not been type tested earlier, design calculations of simulated parameters should be furnished alongwith the offer.

15.6 PERFORMANCE GUARANTEES

15.6.1 The bidder shall guarantee that the goods to be supplied as per these specifications considering use of pure SF6 gas as insulating medium will be new, of most recent or current models and incorporates all recent improvements in design and material The bidder shall further guarantee that the goods shall have no defect arising from design, materials, workmanship, installation or from any act of omission of manufacturer that may develop under normal use in the conditions specified in these specifications as prevalent at site.

The bidder shall guarantee the maximum power losses in the conductor and enclosure of bus bar section in GIS at rated voltage and rated current at 20^0 C ambient temperature and the same shall be verified at the manufacturer's works / site.

15.7 CIRCUIT BREAKERS

15.7.1 Type & Rating

15.7.1.1 The power from Generating Units is proposed to be stepped to 420 kV by Generator Transformers.The Generator Transformers shall be connected to proposed 420 kV GIS which shall be connected to potheadyard through 400 KV XLPE cables. The power from potheadyard shall be evacuated through 2 Nos. single circuit transmission lines to nearest sub-station at

Kunwari Pass. The circuit breakers offered shall be suitable for operation with Generating Units, Generator Transformers and Transmission Lines. The relevant technical parameters of Generating Units, Generator Transformers and Transmission Lines are given below are indicative only, however actual values may be confirmed from the purchase before designing of the equipment.

a) Generating Units

i) Rated capacity - 4 units of 111 MW each

ii) Continuous overload capacity - 10%

iii) Reactance (The parameters are indicative only, however actual values may be confirmed from the Supplier of Generator before designing of the equipment)

- Synchronous Reactance
  a) Direct axis (X_d)
     - Saturated - 1.02 pu
     - Unsaturated - 1.04 pu

  b) Quadrature axis (X_q) - 0.65 pu

- Transient Reactances
  a) Direct axis (X_d')
     - Saturated - 0.24 pu
     - Unsaturated - 0.27 pu

  b) Quadrature axis (X_q') - 0.65 pu

- Sub-transient Reactances
  a) Direct axis (X_d'')
     - Saturated - 0.14 pu
     - Unstaurated - 0.165 pu

  b) Quadrature axis (X_q'') - 0.145 pu

iv) Negative Phase sequence Reactance (X_2)

- Saturated - 0.13 pu
- Unstaurated - 0.14 pu

v) Zero Phase sequence reactance (X_0) - 0.10 pu

vi) Armature leakage reactance - 0.10 pu

vii) Field leakage reactance - 0.21 pu

viii) Ratio of quadrature axis subtransient reactance to direct axis sub-transient reactance ($Xq" / X_d"$) - 1.03

b) Generator Transformers

i) No load Voltage
HV - 420 / √3 kV
LV - 13.8 kV

ii) Rating - Single phase, 46 MVA (Bank rating 138 MVA)

iii) % Impedance - 14.5 ±10%

c) Transmission Lines

i) Lengths - 3 Kms.
ii) Type of conductor- ACSR Moose (Twin Conductor Per Phase)

The circuit breakers shall be suitable for clearing all types of faults, for charging of lines and also for drooping when used on a 400 kV effectively grounded system.

iii) The parameters of the line per unit per km per circuit at 100 MVA base are given as under:

Positive Sequence

R	1.862 E-5
X	2.075 E-4
B	5.55 E-3

Zero Sequence

R	1.012 E-4
X	7.75 E-4
B	3.584 E-3

iv)Out-of-Phase Switching

The circuit breaker shall be capable of interrupting symmetrical short circuit current under out of phase switching conditions.

The above values are indicative only and successful bidder will have to obtain confirmation from the purchaser about the final values and design the equipment accordingly.

15.7.1.2 SF6 gas-insulated circuit breaker shall conform to IEC-56 and have the following performance characteristics and ratings.

i)	Type of breaker	420 KV Single phase, metal enclosed, SF6 gas insulated, hydraulically operated
ii)	Rated frequency	50 Hz
iii)	Rated normal current:-	2000 A
iv)	Number of poles	3
v)	Installation	Indoor
vi)	Temperature rise	As per IEC 694
vii)	Rated short time withstand current kA (rms value of ac component)	40 kA for 1 second.
viii)	Rated short circuit making current, kA(peak)	100 kA
ix)	Rated out-of phase breaking current(rms)	40kA
x)	Rated short circuit breaking current	
	- Rated short circuit current	40 kA (rms)
	- Percentage of D.C. component	>70%
xi)	System Earthing	Effectively earthed.
xii)	First-pole-to clear factor	> 1.3

xiii)	Rated duration of short circuits	1 sec
xiv)	Total break time for any current upto the rated breaking current	Not exceeding 40 ms
xv)	Closing time	< 100 ms
xvi)	Difference in the instants of closing / opening of contacts	
	- Within a pole	Not exceeding 5 ms
	- Between poles	Not exceeding 10 ms
xvii)	Rated transient recovery voltage for terminal faults	As per IEC 56- as per latest amendment
xviii)	Rated characteristics for short line faults	-do-
xix)	Standard values of rated line characteristics for short line faults	-do
xx)	Rated operating duty cycle	
	- Line breakers	0-0.3 s-CO-3 min-CO
	- Generator-transformer, and bus coupler breakers	0-3 min-CO-3 min-CO

Suitable provision of time delay relay shall be made to affect auto re-closing of the circuit breakers matching with line breaker operating duty cycle of transmission line which is 150 ms

xxi)	Auto reclosing (line breakers only)	Single-phase and 3-phase
xxii)	Control of switching surges (Line Breakers)	Switching surge over voltages while re-energising to be limited to 2.0 p.u.
xxiii)	Operating mechanism	Hydraulic operating mechanism

xxiv)	Radio interference voltage	Not exceeding 2500micro-volts at 266 KV (rms)
xxv)	Corona extinction voltage	320 kV (RMS)
xxvi)	Partial discharge level, (picocoulombs) at 1.1 Un/√3	5 or less
xxvii)	Rated supply voltage of closing and opening devices and auxiliary circuit	220 V dc, 240 V ac, 50Hz / 415 V ac, 50 Hz, 3-phase.
xxviii)	Number of auxiliary Contacts	12 NO and 12 NC on each pole wired to terminal blocks in control cabinet
xxix)	- Number of trip coils	2 per pole
	- Number of closing coils	2 per pole
xxx)	SF6 gas characteristics for SF6 circuit breaker	As per IEC 376
xxxi)	Main contact material	Copper-silver
xxxii)	Rated Line charging Breaking current A	500A with maximum permissible switching over voltage of 2.0 pu
xxxiii)	Rated small Inductive Breaking current	Any value from 0.5 A to 10A without switching over voltage exceeding 2.3 p.u

15.7.1.3 The governing data for the selection of circuit breakers shall not be limited to the above mentioned parameters but shall also take into account various provisions contained in these specifications and relevant standards. The circuit breakers to be supplied must be suitable for the intended services i.e. for no load, full load and fault service conditions.

15.7.2 Construction & Design

15.7.2.1 The single phase circuit breaker in each bay module shall be of puffer type with two interrupting chambers per phase. They shall be designed for installation in SF6 gas insulated metal clad switchgear and shall use SF6 gas for both insulation & arc quenching. Suitable means shall be

provided to ensure that all interrupters & secondary auxiliary switches open and close without loss of synchronism & are of adequate dielectric strength under all operating conditions including an open-close-open operation with zero external dead time delay. The interrupting duty shall be distributed uniformly between interrupters. There shall be two trip and two closing coils per pole for each breaker.

15.7.2.2 The circuit breakers shall be provided with independent and reliable hydraulic operating mechanism for each pole. Provision shall be made for simultaneous opening and closing of all the three poles of the circuit breakers. The full details of hydraulic operating mechanism and constructional & operational features must be described in the bid. The detailed drawings to illustrate the operational features shall be supplied by the bidder.

15.7.2.3 Short line Faults: Circuit breaker supplied shall be capable of interrupting short line faults on overhead transmission line.

15.7.2.4 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 charges and perform make & break operations as per the stipulated duty cycles satisfactorily. The breakers shall also be required to break small inductive currents without causing excessive over-voltages, line charging currents without restrikes, handle evolving faults and meet the requirements regarding partial discharge, radio interference and corona.

15.7.2.5 In-rush and magnetizing current associated with large power transformers (three single phase 46 MVA transformers) will have to be switched ON by the circuit breakers without re-striking and without causing excessive switching surges. Occasionally, a power transformer operating under Ferro resonant conditions and having non-sinusoidal current and voltage wave-forms with higher than normal peak values will have to be switched ON. The supplier shall provide proof test data and comment on breaker for such applications.

15.7.2.6 Insulation Co-ordination

i) The insulation strength across the open contacts of the circuit breaker for
lightning impulse, switching surges and power frequency withstand voltages shall be as per IEC 694.

ii) The circuit breaker and bus insulation shall be coordinated so that due to lightning impulse, switching surge and power frequency voltage no flashover shall take place. In case flashover takes place,

the same shall be confined in the bus rather than in the circuit breakers in either open or closed position.

15.7.2.7 The circuit breakers shall be vertical / horizontal mounted depending on manufacturer's preferred layout for the double bus system considering the space limitations indicated in the layout and taking into account the worst service conditions / forces imposed by the earthquake.

15.7.2.8 The circuit breakers shall be provided with pressure gauges and pressure relays for the operating mechanism.

15.7.2.9 All circuit breakers except line circuit breakers shall be designed for 3-phase tripping and closing. Only line circuit breakers shall have single-phase and 3-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.

15.7.2.10 All necessary interposing & interlocking control relays for circuit breaker tripping and closing shall be located in the control cabinets supplied by the supplier.

15.7.2.11 The disconnectors shall be interlocked electrically with the associated circuit breakers such that the disconnector cannot be operated unless the associated circuit breaker is opened. The interlocking shall prevent any incorrect switching sequence and enable the breakers to be operated without risks, either from the local bay module control cabinet or from the power house control room. The actuation of the manual operating device shall also be disabled to energise the electrical control circuits. Necessary interlocks shall be provided to prevent from hunting and other dangerous or undesirable operations of the circuit breaker.

15.7.2.12 The circuit breaker control system shall prevent closing of the circuit breaker when there is insufficient stored energy in the operating mechanism storage system and insufficient SF6 gas density / dielectric strength. It shall trip the breaker when the SF6 gas density drops below a minimum permissible level. The state of the breaker arc-quenching and insulating gas shall be monitored by a temperature-compensated pressure switch or density switch with two alarm levels. The first stage alarm shall be set well before any dangerous condition is reached, the second stage shall initiate breaker operation. In addition, the actual gas pressure shall be shown on a local control cubicle.

15.7.2.13 The circuit breaker shall be able to operate locally or from a remote point. 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 will be from the power house control room. The protection devices will remain operational in either remote or local control mode. When in the maintenance mode, all remote trip or close control signals will be blocked. The breaker controls shall operate from the two independent 220 V DC systems 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 movable contact system shall be provided to show the true position of the main breaker contacts. Operation counters shall be provided for each breaker pole or otherwise for each breaker. The two numbers of circuit breakers for the 400kV outgoing feeders shall be provided with preinsertion resistors. However, the requirement of preinsertion resistors will be decided at the detailed design stage.

15.7.2.14 Hydraulic controls are to be provided and such controls shall be interlocked to prevent the circuit breakers from being tripped under conditions which will not allow a complete and safe trip operation. A close operation shall also be blocked unless a complete close-open or trip-free operation can be safely carried out.

15.7.2.15 Control scheme for the circuit breakers shall be submitted by the supplier giving full details of operating mechanism and their advantages alongwith relevant drawings.

15.7.2.16 The control devices shall operate within the following voltage ranges:-

a) Breaker closing control 85% to 110%

b) Breaker tripping control 70% to 110%

c) A.C. control devices 85% to 110%

15.7.2.17 All DC coils (trip, close, auxiliary etc.) shall be equipped with surge suppression devices such as diodes across the coils to provide a discharge path for transient voltage. The provision of such devices shall neither extend the drop out time of coil nor shall interfere with normal operation of the circuit breaker.

15.7.2.18 Only line circuit breakers shall be designed for automatic reclosing duty cycles from remote devices as per duty envisaged in these specifications.

15.8 DISCONNECTORS

15.8.1 Type & Rating

15.8.1.1 Disconnectors shall be of the single phase, single-pole, group operated type, installed in the switchgear to provide electrical isolation of the circuit breakers from the generator transformers, double bus and transmission lines. The disconnectors shall conform to IEC-129 and shall have the following ratings and performance characteristics in addition to those stated in clause 15.5.

i)	Rated insulation level	Open contact	Phase to Earth
ii)	One minute Power frequency withstand voltage across open gap	610 kV (rms)	520 kV (rms)
iii)	Lightning Impulse voltage across isolating distance	1665 kVp	1425 kVp
iv)	Rated switching impulse withstand voltage across isolating distance	1245 kVp	1050 kVp
v)	Rated normal current	:	2000 A
vi)	Rated supply voltages of closing and opening devices & auxiliary circuits		220 V DC ungrounded 240 V, 50Hz, single phase AC & 415 V, 50 HZ, 3 phase AC.
vii)	Total operating time of disconnector alongwith its operating mechanism		Not to exceed 12 s
viii)	Rated capacitive breaking current		0.5 Amps.
x)	Partial discharge level at 1.1 Un/√3		≤5 pico coulombs
xi)	Corona extinction voltage		320 kV (rms)
xii)	Radio interference voltage at 266 kV (rms)		≤ 2,500 microvolts
xiii)	Total operating time of disconnector after the command is given.		Not to exceed 12 sec

15.8.1.2 The supplier shall offer only those disconnectors which are guarded against the effect of VFTs (Very Fast Transients)

15.8.2 Construction & Design

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

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

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

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

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

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

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

15.8.2.8 The disconnector operations shall be interlocked electrically with the associated circuit breakers in such a way that the disconnector control is inoperative if the circuit breaker is closed.

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

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

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

15.8.2.12 The disconnectors and safety grounding switches shall have a mechanical key (padlocking key) and electrical interlocks to prevent closing of the grounding switches when isolator switches are in the closed position and to prevent closing of the disconnectors when the grounding switch is in the closed position.

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

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

15.9 SAFETY GROUNDING SWITCHES

15.9.1 Three-pole, group operated, work in progress, safety grounding switches shall be operated by electric motor for use on 220V DC ungrounded system and shall be equipped with a manual operating mechanism for emergency use. The motor shall be protected against over current and short circuit.

15.9.2 In order to provide test facilities for CTs, transformers, cables etc., certain ground switches may require to be electrically insulated from the enclosures and have easily removable ground connections.

15.9.3 Each safety grounding switch shall be electrically interlocked with its associated disconnector and circuit breaker such that it can only be closed if both the circuit breaker and disconnector are in open position. Safety grounding switch shall however be mechanically key interlocked with its associated disconnector.

15.9.4 Each safety grounding switch shall have clearly identifiable local positive driven mechanical indicator together with position indicator on

the bay module control cabinet and provision for taking the signal to main control room.

15.9.5 Each ground switch shall be fitted with auxiliary switches having four normally open and four normally closed contacts for use by others over and above those required for local interlocking and position indication purposes.

15.9.6 Provision shall be made for padlocking the ground switches in either the open or closed position.

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

15.9.8 The safety grounding switches shall conform to the requirements of IEC 129.

15.10 HIGH SPEED MAKE PROOF GROUNDING SWITCHES

15.10.1 Grounding switches located at the beginning of the out going feeder bay modules shall be of the high-speed, make proof type and will be used to discharge the respective charging currents, in addition to their safety grounding function. These grounding switches shall also be capable of interrupting the inductive currents and to withstand the associated TRV.

15.10.2 Single phase switches shall be provided with operating mechanism for each phase suitable for operation from a 220V dc ungrounded supply.

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

15.10.4 The short circuit making current rating of each ground switch shall be at least equal to its peak withstand current rating of 100 KA. The switches shall have inductive / capacitive current switching capablity as per IEC-129.

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

15.10.6 High-speed ground switch operation should be possible locally from the bay module control cabinet, or remotely from the main control room in

conjunction with opening of the associated disconnector.

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

15.10.8 The high speed make proof grounding switches shall conform to the requirements of IEC-129.

15.11 CURRENT TRANSFORMERS

15.11.1 Type & Rating

15.11.1.1 The current transformers shall conform to IEC-185 and have the technical particulars, indicated below.

15.11.1.2 The particulars of the various cores may likely change within reasonable limits as per the requirements of protection relay supplier. The manufacturer is required to have these values confirmed from the purchaser before proceeding with design of the cores. The other characteristics of CTs shall be as given below:

i) Rated short time thermal current for 1s, kA(rms)	40
ii) Rated dynamic current kA(peak)	100
iii) Rated insulation levels	As per clause 6.5
iv) Power frequency over voltage withstand requirements for secondary windings	As per IEC 185
v) Limits of temperature rise	As per IEC 185
vi) Maximum radio interference voltage at 266 kV (rms)	Not exceeding 2500 micro volts
vii) Corona extinction voltage kV(rms)	320
viii) Partial discharge level, picocoulombs at 1.1 Un / √3	5 or less

15.11.2 Construction Details

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

15.11.2.2 A current .transformer marshalling terminal box shall be provided and located in an accessible position for connections of each phase. The marshalling box or CT terminal block located in the local control cubicle shall be used for the star/delta configuration and be equipped with terminals with circuit facility for the secondary circuits.

15.11.2.3 Provision shall be made for primary current injection testing of current transformers.

TECHNICAL PARTICULARS OF 420 KV CTs

S. NO.	CT NO./ LOCATION PURPOSE	CORE NO.	CURRENT RATIO	ACCURACY CLASS	KNEE-POINT VOLTAGE IN TERMS OF C.T.SEC. RESISTANCE, R_{CT} (Ω) V_K VOLTS (≥) NOMINAL AREA OF CONDUCTOR 6.Sq. MM	BURDEN VA	
1.		I	2000-1000-500/1 A	P S	(80 R_{CT} + 130)*	-	BUS BAR DIFFRENTIAL PROTN.
	GENERATOR TRANSF.	II	2000-1000-500/1 A	P S	(80 R_{CT} + 130)*	-	BUS BAR DIFFRENTIAL PROTN.
	CIRCUIT BAY	III	2000-1000-500/1 A	P S	(80 R_{CT} + 130)*	-	SPARE
		IV	500/1 A	P S	(160 R_{CT} + 250)	-	G.T. REF PROTN.
		V	500/1 A	5 P 20	-	5	GEN. IDMT O/C PROTN.
2.		I	500/1A	5 P 20	-	5	LOCAL BREAKER BACK-UP PROTN.
	GEN. TRANS. FEEDER	II	500/1A	P S	(160 R_{CT} + 280)	-	TRANSFORMER DIFF. PROTN.
	CKT. BAY	III	500/1A	PS	(200 R_{CT} + 470)	-	GEN. TRANS. OVERALL DIFF. PROTN.
3.		I	2000-1000-500/1A	5 P 20	-	5	LOCAL BREAKER BACK-UP PROTN.
	OUTGOING FEEDER BAY	II	2000-1000-500/1A	P S	(30 R_{CT} + 430)	-	XLPE CABLE DIFF. PROTN.
	(BUS-SIDE)	III	2000-1000-500/1A	P S	(30 R_{CT} + 430)	-	XLPE CABLE DIFF. PROTN.
4.		I	2000-1000-500/1A	0.2	-	35	METERING
	OUTGOING FEEDER BAY	II	2000-1000-500/1A	P S	(80 R_{CT} +130)*	-	BUS-BAR DIFF. PROTN.
	(BUS-SIDE)	III	2000-1000-500/1A	P S	(80 R_{CT} +130)*	-	BUS-BAR DIFF. PROTN.
		IV	2000-1000-500/1A	P S	(80R_{CT} + 130)*	-	SPARE
5.		I	2000-1000-500/1A	P S	(80 R_{CT} + 130)*	-	BUS BAR DIFF. PROTN.
	BUS COUPLER	II	2000-1000-500/1A	P S	(80 R_{CT} + 130)*	-	BUS BAR.DIFF..PROTN.
	BAY	III	2000-1000-500/1A	PS	(80 R_{CT} + 130)*	-	SPARE
6.		I	2000-1000-500/1A	5 P 20	-	5	LOCAL BREAKER BACK-UP PROTN.
	BUS COUPLER	II	2000-1000-500/1A	P S	(80 R_{CT} + 130)*	-	BUS BAR DIFF. PROTN.
	BAY	III	2000-1000-500/1A	P S	(80 R_{CT} + 130)*	-	BUS BAR DIFF. PROTN.

* For stepped CT cores, knee point voltage & burden indicated above is on lowest tap.

15.12 BUS VOLTAGE TRANSFORMERS

15.12.1 Type and Rating

15.12.1.1 The voltage transformers shall conform to IEC-186 and shall have the following ratings .

Parameter	*Winding-I*	*Winding-II*	*Winding-III*
Rated secondary voltage, V	110/√3	110/√3	110/√3
Rated secondary burden, VA (aaprox.)	75*	75*	75*
Accuracy class	0.5	3P	3P
Utilisation	Metering	Synchronizing	Protection
Transformation ratio for all windings	$\frac{400\ Kv/\sqrt{3}}{110\ V/\sqrt{3}}$		
Temperature	As per IEC 186		
Voltage factor	1.5 for 30 sec.		
Rated insulation level	As per clause 6.5		

* Note : The rated secondary burden is approximate only, however the exact burden requirement shall be finalized during design engineering stage**.**

15.12.2 Constructional Details

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

15.12.2.2 The voltage transformers shall be of induction type nonresistant and shall be effectively shielded against high frequency electromagnetic transients. The voltage transformers shall have three secondary windings.

15.12.2.3 The voltage transformer secondaries shall be wired by supplier to their associated secondary circuit breakers in the bay control cabinets. Wiring between the bay control cabinets and the line protection panels will be provided by others.

15.13 SF6 BUSHING CONNECTION

15.13.1 SF6 GIS to XLPE Cable Termination

15.13.1.1 The 400kV overhead lines emanating from surface potheadyard are to be connected to underground 420 kV SF6 GIS by the interfacing of XLPE copper cables of size as specified in the respective chapter of the technical specifications. The SF6 gas filled bushing compartments at GIS end suitable for making connections to XLPE copper cables shall be supplied by GIS manufacturer.

15.13.1.2 The bushing shall employ capacitive grading and divided into independent gas compartments by a barrier insulator with grading electrodes. The space surrounded by the porcelain insulator shall be filled with SF6 gas slightly above atmospheric pressure. In case the porcelain is damaged, this shall keep consequences down to a minimum. The gas space on the switchgear side of the barrier insulator shall have the same SF6 gas pressure as that of switchgear.

15.13.1.3 The SF6 GIS to air bushing for termination of XLPE cable shall conform to IEC-137 & IS -2099 (latest edition) and shall have the following ratings:

(a) Rated lightning impulse withstand voltage	1425kV(peak)
(b) Rated switching impulse withstand voltage	1050kV(peak)
(c) One minute power frequency withstand voltage	630kV (rms)

15.13.1.4 The provision shall be made for a removable link. The gap created when the link is removed should have sufficient electric strength to withstand the switchgear high voltage site tests. The supplier may suggest alternative arrangements to meet these requirements. The corona rings/stress shields for control of electrical field in the vicinity of the isolation gap shall be provided by the GIS manufacturer.

15.13.1.5 All supporting structures for the SF6 bus-duct connections between the XLPE cable sealing ends and the GIS shall be supplied by the GIS manufacturer.

15.13.1.6 The openings for access shall be provided in each phase terminal enclosures as necessary to permit removal of connectors to isolate

the XLPE cables to allow carrying out of insulation tests. The typical arrangement drawing of interconnecting bus-duct from GIS bay module to XLPE cable termination end shall be submitted alongwith offer.

15.13.1.7 All porcelain used in the bushings shall be manufactured by the wet process and shall be homogeneous, free from laminations, cavities or other flaws affecting its mechanical strength or dielectric quality, and shall be well vitrified, tough and impervious to moisture. The glazing of the porcelain parts shall be free from imperfections such as blisters and burns. All bushings shall be so designed that there will be no stressing of any parts due to temperature changes and' adequate means shall be provided within the support structures to accommodate bus-duct enclosure and conductor expansion.

15.13.1.8 All contact surfaces of external terminals shall be silver-plated using pure silver.

The bushing shall be hermetically sealed and be impervious to impurities and moisture during shipment and storage. Suitable supporting structures of galvanized steel for. the bushings and bimetallic terminal connectors for connecting overhead conductors (details will be furnished later) shall be provided by manufacturer.

The SF6-to-air bushings which shall be complete with suitable corona rings shall conform to IEC-137 & IEC-506 and shall have the following technical particulars, in addition to those stated in clause 15.4.1.

Rated current	2,000 Amps
Rated short time current (rms)	40 KA for 1 sec.
Frequency	50 Hz ± 3%
Temperature rise	As per IEC-137
Minimum creepage distance	10500 mm
Corona extinction voltage	320 KV (rms)
Radio interference level at 266 KV (rms)	Less than 2,500 Micro volts
Partial discharge level	< 5 pico-coulombs

15.13.2 Interface Between SF6 GIS to Transformer Oil Bushings

15.13.2.1 The interface section from oil to SF6 bushings of the generator transformers to the GIS system shall form a part of the supply by the GIS supplier and shall provide the transition section

between the enclosure of SF6 equipment and the SF6 bushing of the transformer as per IEC 1639. The ducts and the casing shall be suitable for the requirements for which it is designed. The supplier should specify the forces which shall be transmitted to the SF6 bushing of the transformer. The supplier shall have to supply all details for proper coordination with the transformer supplier. This interface section shall be designed in a manner which will allow ease of operation and maintenance.

15.13.2.2 The provision shall be made for a removable link. The gap created when the link is removed should have sufficient di-electric strength to withstand the switchgear high voltage site tests. The bidder may suggest alternative arrangements to meet these requirements. The corona rings/stress shields for control of electrical field in the vicinity of the isolation gap shall be provided by the GIS manufacturer.

15.13.2.3 The SF6 gas pressure within the termination compartment at the junction of the transformer bushing and the SF6 duct shall be within limit specified by the transformer manufacturer to ensure correct environment for the SF6 bushing termination.

15.13.2.4 Sufficient interconnecting bus shall be supplied to connect together the various items of equipment. Bus stubs with appropriate caps shall be provided.

15.13.2.5 The connection at transformer shall allow atleast 25mm of movement in any direction. The openings for access shall be provided in each phase terminal enclosures as necessary to permit removal of connectors to isolate the step-up transformer to carry out insulation tests. The typical arrangement drawing of interconnecting bus-duct from GIS bay module to step up transformer bushing housing shall be submitted alongwith offer. The interface equipment shall incorporate following features.

i) Housing to cover the transformer H.V side oil to SF6 bushing. This housing shall be filled with SF6 gas after assembly.

ii) Porcelain bushing with oil and SF6 gas separating barrier insulator and flexible connections between transformer H.V. terminal & SF6 bus duct conductor are to be housed inside the enclosure.

iii) The lateral mounting unit shall be suitable to allow axial assembly tolerances and to allow the transformers to be easily connected to or disconnected from the switchgear.

iv) Compensators shall be provided to avoid transfer of the transformer vibrations to the switchgear.

15.13.2.6 The SF6 manufacturer shall submit details along with the offer regarding the forces which shall be transferred on to the SF6 bushings of the transformers to enable proper co-ordination between the transformer and the GIS manufacturer.

15.13.2.7 All supporting structures for the SF6 duct connections between the transformer and the GIS shall be supplied by the GIS supplier. The supplier may specify alternative arrangements for approval by the purchaser.

15.13.2.8 Forces generated during the operation of Transformer, those generated in the enclosure and the conductors of the SF6 equipment shall not exceed the allowable limit specified by the Transformer manufacturer.

15.13.2.9 Precise positional alignment of the enclosures is of crucial importance. The location and tolerances for the connection between the transformer and the GIS equipment shall be specified by the transformer supplier. The GIS supplier is required to make provision for alignment and positional adjustment within the equipment.

15.14 SURGE ARRESTORS

15.14.1 Type & Rating

15.14.1.1 Each arrestor shall conform to IEC-99-4 for Gapless Arrester wherever applicable and shall have the following technical performance characteristics and ratings

i) Rated voltage of arrestor kV(rms) 390

ii) Class of arrestor — Station type, heavy duty, SF6 gas-insulated, non linear zinc oxide gap less

iii) Maximum continuous operating voltage capability, (L-N), kV rms — 303

iv) Maximum discharge current (8/20 microsecond wave)kA — 20

v) Maximum switching surge protective level, kV (Peak) — 840

vi) Maximum residual voltage — 760

(discharge voltage) at 10 kA (8/20 microsecond current wave), kV (peak).

vii) Maximum equivalent front-of wave protective level, kV (peak) (10 KA with voltage wave crest in 0.5 micro-second) 882

viii) Lightning impulse withstand voltage of equipment to be protected:

- Transformers, kV(peak) 1245
- GIS component, kV(peak) 1425

ix) Switching surge withstand voltage of equipment to be protected, kV(peak). 1050

x) Radio interference voltage at 266 kV(rms) Not exceeding 2500 micro-volts

xi) Partial discharge level at 1.1 Un /√3 5 or less Picocoulombs

xii) Corona extinction voltage kV (rms) 320 kV (rms)

xiii) Energy level 10 KJ/kV

xiv) Connection to system Phase to earth

xv)Type of equipment being protected Generator Transformer , and GIS equipments

15.14.1.2 The technical parameters and characteristics of the surge arrestor so as to obtain a security ratio of atleast 1.30 under all conditions of overvoltages and the basic insulation provided for the transformer winding. The bidder shall furnish a report containing the technical justification & calculations in support of the selection of the location and other technical parameters of the surge arrestor alongwith his bid.

15.14.1.3 The manufacturer shall perform an insulation co-ordination study to verify that protection of switchgear, main transformers against over voltages is adequate. The final surge arrestor characteristics, their numbers and exact locations of surge arrestors shall be decided after this study.

15.14.2 Construction Details

15.14.2.1 One SF6 gas insulated, metal enclosed surge arrestor of the gapless non linear zinc oxide, heavy duty, station type shall be located on H.V. side of each generator transformer and other one just before SF6 GIS XLPE cable termination on the each outgoing feeder bay (Line side).

15.14.2.2 The arrestor enclosure shall be vertically or horizontally mounted to suit the layout of the switchgear as suggested by the manufacturer and shall be fitted with a discharge counter located in an easily accessible position.

15.14.2.3 The main grounding connection from the surge arrestor to the earth shall be provided by the supplier. The size of the connecting conductor shall be such that all the energy is dissipated to the ground without getting overheated.

15.15 BUSBARS

15.15.1 The conductors of the bus bars shall be fabricated from aluminum tubular sections of cross- sectional area suitable to meet the current rating requirements. The tubular bus section shall be housed in corrosion resistant aluminum alloy or non-magnetic material enclosures, filled with pressurized SF6 gas. The conductors shall be supported from the enclosures by homogeneous epoxy resin insulators shaped to ensure uniform electrical field distribution and zero corona at rated voltage. Adequate provisions shall be made for absorption of the thermal expansions between the conductors and the enclosures. The metal bellow type compensators for adjusting tension 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. The induced voltages on the enclosures shall not be allowed to exceed reasonable limits of safety for operating personnel.

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

15.15.3 Each end of the main bus bars shall be designed for convenient future extension of the switchgear. The bus conductor end connectors

and enclosure flanges shall be designed accordingly.

15.15.4 All necessary indoor and outdoor galvanised steel supporting structures for the proper erection, levelling and alignment of the bus bars shall be provided by the supplier.

15.15.5 The interior of all the enclosures except cast flanges of aluminium / aluminum alloy shall not be painted.

15.15.6 The SF6 GIS bus-bars shall have continuous current rating of 2000 Amps.

15.15.7 The system employed shall be of the electrically continuous enclosure type, allowing free circulation of induced currents in the enclosures. The enclosures shall be cylindrical in shape and designed for maximum shielding to minimize electromagnetic forces caused by short circuit currents.

15.15.8 Where the interconnecting GIB bus passes through building walls, flooring or other enclosures, the supplier shall supply the wall plates, flanges and their fixtures.

15.15.9 Wherever necessary, to absorb expansion / contraction, relative movement between the various items of equipment and the earthquake forces, bellows or other means shall be provided. The bidder must submit details of the means deployed alongwith the offer.

15.15.10 The "Interface" requirements between the equipments shall be in the scope of GIS manufacturer.

15.15.11 Each gas compartment barrier shall be easily identifiable from the outside of the switchgear. The means of identification used shall be a black band, approx. 10mm wide, permanently affixed to the barrier insulator on the outer surface of the enclosure at the location of the barrier insulator. In case of leakage of the gas from any compartment, indication of respective compartments should be provided on the annunciator.

15.16 CONTROL EQUIPMENT

15.16.1 Circuit Breaker Accessories/Auxiliary Equipment

15.16.1.1 The accessories and auxiliary equipment to be supplied with the circuit breaker and other components of the same bay module shall include all parts necessary for proper functioning of the circuit breaker as well as the following items to be installed in the breaker control cabinet:

- Operation counter, electrically operated.

- One set of adequately rated thermostatically controlled, anti-condensation heater with provision for monitoring of heater failure, wired to terminal blocks.

- Pair of copper grounding terminals to be located near the control cable entrance.

- Operating mechanism, pressurising unit, gauges and switches.

- All motors shall have individual thermal over-current protection.

- Circuit breaker SF6 gas pressure monitoring unit and moisture detection unit.

- One vermin-proof sheet steel cabinet of class IP-54 and adequate size shall be provided for housing the operating mechanism, relays, control and auxiliary equipment and for terminating all control, alarm and auxiliary circuits in suitable terminal blocks. The control cabinet shall be provided with hinged doors with provision for locking and removable cable gland plates for bottom cable entry. The viewing windows shall be provided for observation of the instruments without opening the cabinet. Suitably engraved name plates shall be provided to identify all the equipment in the control cabinet.

15.16.1.2 All control wiring and terminations internal to the Switchgear and connecting the switchgear to the bay module control cabinets shall be provided by manufacturer.

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

15.16.1.4 Coaxial type cable glands suitable for use with shielded cables shall be used at each termination.

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

15.16.2 Bay Module Control Cabinets

15.16.2.1 Each switchgear bay module shall be supplied with a main control cabinet of the floor standing type. The cabinet shall have double, full height, hinged, gasketed, lockable doors. One door shall have a safety glass window through which the various switchgear controls can be viewed without opening the doors.

15.16.2.2 The cabinet will be utilized for the switchgear bay local control module and as the terminating center for all power supply, control annunciation and supervisory wiring interfacing with purchaser's systems. Two feeders of AC and two feeders of DC supply will be provided by the contractor for supplying power to each local control panel. Further distribution of AC and DC power supply shall be arranged by the supplier of GIS System.

15.16.2.3 The following equipments shall be mounted on the cabinet door :

- Remote/local control transfer switch for the circuit breakers and isolator switches.
- Normal operation/maintenance control transfer switch for isolation of remote electrical controls.
- Mimic diagram of the switchgear bay complete with semaphore indicators for the switchgear component position indication and local control switches for open / close or close-trip control of the circuit breaker, isolators and grounding switches.

The following equipments shall be mounted internally in the cabinet :

- All bay switchgear interlocking wiring and auxiliary relays.
- AC and DC power supply circuit breakers.
- All necessary incoming and outgoing terminal blocks.
- Space heaters
- All instruments and devices required for supervision & control of GIS

15.16.2.4 The bus voltage transformer secondary terminal circuit breaker will

be mounted with in the bus VT bay module control cabinet.

15.16.2.5 Mounted on the solid cabinet door shall be an annunciator panel having sufficient modules and lighted windows to annunciate all gas pressure/density and circuit breaker operating mechanism alarms and trips.

15.16.2.6 Each annunciator module shall have electrically separate changeover contacts for remote alarm indication. Each remote alarm contact shall be wired to terminal blocks. The annunciator panel shall be complete with an audible warning horn and acknowledge/reset horn silence and lamp test push buttons. Horn shall automatically silence if the acknowledge button is not operated within 1 minute of the alarm initiating. The lighted window of the fault point shall continue to flash until the acknowledge signal is given.

15.17 SUPPORTING STRUCTURE

15.17.1 The supplier shall design, fabricate and supply the equipment supporting framework including all rails, transverse & longitudinal beams and supporting members with all necessary hardware & embedded parts.

15.17.2 The floor of the switchgear building will be designed to support all the loads imposed by the equipment supporting framework. The supplier shall make provision in his designs to minimize transfer of forces resulting from thermal expansion or switchgear operation to the walls, floors of the switchgear building, to facilitate the design of floor of switchgear; the supplier shall supply details of static and dynamic loads along with the offer.

15.17.3 Non-corrosive metal or cadmium plated steel shall be used for bolts and nuts throughout the work when either or both are subjected to frequent adjustment or removal.

15.17.4 All steel structure members shall be hot dip galvanised.

15.18 SF6 GAS PROCESSING UNIT

15.18.1 Movable SF6 gas processing unit suitable for evacuating, liquefying, evaporating, filling, drying and purifying SF6 gas during the initial installation, subsequent maintenance shall be provided. The unit shall be provided with gas testing kit to measure the moisture contents of the gas and with pressure monitoring system. The instrument for the measurement of acidity shall also be provided alongwith nozzle etc.

15.18.2 The unit shall be self-contained (except for additional gas storage bottles) and fully equipped with at least an electric vacuum pump, gas compressor, gas drier, gas filter, refrigeration unit, evaporator, gas storage tank, full instrumentation for measuring vacuum on vacuum pump, 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 gas system and evacuating a second gas system using the vacuum pump.

(h) Pressure monitoring.

(i) Measurement of moisture content & acidity measurement. Separate portable instruments should be included in the offer

15.19 MONITORING

15.19.1 The gas density in each gas compartment shall be monitored by electrically isolated & independently adjustable temperature compensated density switches. The factory set density switches shall also be acceptable. The relative merits, however for such switches in place of adjustable density switches shall be indicated in the offer. Two level density switches shall be provided for each GIS bus compartment to initiate remote devices of level-I alarm and level-II tripping. The setting of level-I alarm and level – II tripping shall be such that the dielectric

strengths of SF6 gas are maintained. The necessary indication shall be provided at the circuit breaker control cabinet identifying the gas compartment from which a level-I alarm is initiated. Two level density switches shall be provided for each circuit breaker compartment to initiate the following:

a) Level-I — Remote alarm and prevent closing of the breaker in case it is open.

b) Level-II — Initiation of each circuit breaker 3-pole tripping plus isolation of the circuit breaker through automatic opening of the associated disconnecting switches.

The setting of the level-II initiation shall be such that the dielectric strength specified is maintained. Wiring for automatic circuit breaker tripping and isolation shall be in the scope of supplier. Wiring between the bus compartment gas density switches and the terminals in the circuit breaker control cabinet shall be supplied by the supplier and the continuous shielded cable shall be used.

15.19.2 Gas pressure monitoring devices shall be fitted with test valves such that field testing of the monitoring device can be performed without draining the main gas system.

15.19.3 Each gas section shall be fitted with a suitable valve for routine gas sampling.

15.19.4 The supplier shall satisfy the purchaser regarding accuracy limits of gas monitoring devices.

15.19.5 The equipment shall have provision to monitor the following parameters periodically to check anomalies and/or wear & tear of equipment.

a) Operation of mechanical components:

The parameters to be monitored are:

- Fluid pressure(oil) or hydraulic mechanism power reserve
- The displacement speed of the moving parts
- The travel of moving parts
- Friction of moving parts

b) Wear of circuit breakers interrupting chamber:
The parameters to be monitored are:

- Determination of contact closing position
- Accumulated effect of interrupted currents
- Decomposition products content in SF6 Gas

c) Insulation failure:
The parameters to be monitored are:
- SF6 gas density monitoring of all the compartments
- High frequency current detection for partial discharge detection
- Sonic detection

d) Safety bursting disc for each SF6 gas compartment.

15.20 ON LINE PARTIAL DISCHARGE MONITORING SYSTEM

One –On Line Partial discharge monitoring system with sufficient number of UHF couplers/ partial discharge sensors at different measuring locations, coaxial cable, spectrum analyser, micro computer including the expert system for analysis & automatic interpretation of the measured values wherever applicable and RS-232 optical fibre links etc. is required. The requirement of UHF couplers, if any, for sections of interconnecting bus between GIS & generator transformer and between GIS & XLPE cables shall also be included and integrated. The details like number of couplers, capacity and other technical particulars shall be given in the tender.

15.21 TECHNICAL REQUIREMENTS

15.21.1 Common Requirements

All the SF6 gas insulated circuit breakers, disconnectors, grounding switches and bus bars shall be of single isolated phase type.

15.21.2 Fire Retardancy

All components shall be fire retardant and shall be tested in accordance with IEC 695. Gas emmissivity when the material is heated shall be minimal.

15.21.3 Control cables in a grouped environment shall not catch fire flame or continue to burn when tested as per IEC 695.

15.21.4 Protective Finish

15.21.5 All the exterior surface shall be cleaned and painted, before leaving the factory with one coat of approved primer and two coats of approved paint on the equipment. The under-side of all painted surfaces bearing upon the concrete foundation shall be given two coats of approved primer. Supplier shall bring point for retouching at site after erection for any damages to finished/ painted surface.

15.21.6 Service Life

SF6 circuit breakers, disconnect switches and ground switches will be subjected to frequent, and occasionally repetitive, no load operations and switching of load, capacitive and inductive current within their ratings. In order to minimize maintenance and component replacement, the tenderer shall submit proof that all offered SF6 GIS equipment has withstood a 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 scheduled maintenance.

15.22 GROUNDING

15.22.1 The GIS manufacturer must supply the entire material for grounding bus of GIS viz conductor, clamps, joints, operating and safety platforms etc. The GIS manufacturer is also required to supply all the earthing connectors and associated hardware material for the following :

i) Connecting all GIS equipment, bus ducts, enclosures, control cabinets, supporting structure etc. to the ground bus of GIS.

ii) Connecting grounding bus of GIS to the groundmat riser in transformer / GIS cavern provided by the purchaser in the vicinity of the equipment.

15.22.2 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.

15.22.3 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.

15.22.4 The grounding connector shall be of sufficient mechanical strength to withstand electromagnetic forces as well as capable of carrying the anticipated maximum fault current without overheating. At least two grounding paths shall be provided to connect each point to the main grounding bus. Necessary precautions should be undertaken to prevent excessive currents from being induced into adjacent frames, structures of reinforcing steel and to avoid establishment of current loops via other station equipment. Care should be taken to prevent discontinuities in enclosure grounding path at the transformer connections to GIS to prevent circulating currents in the circuit breaker and transformer tank made of steel.

15.22.5 All flexible bonding leads shall be of tinned copper. All connectors, for attaching flexible bonding leads to grounding conductors and grounding conductors to support structures shall be tinned bronze with stainless steel or tinned bronze hardware.

15.22.6 The necessary information regarding the earthing system proposed to be provided by the purchaser will be furnished to the supplier. The supplier shall examine the same and shall advise suitably in the matter. The specific recommendations, if any, in respect of grounding shall be given by the GIS manufacturer so that the same could be taken care of by the purchaser.

15.22.7 The enclosure shall represent the main grounding interconnection between the several areas. At least two grounding conductors sized for maximum earth fault current shall be placed. The supplier shall present a detailed proposal for the whole grounding system for approval.

15.23 HIGH VOLTAGE TRANSIENTS

High voltage transients from switching operations and internal faults are coupled to the external enclosure of the GIS. Since the effects of these transients on people are not known, the operating personnel are required to avoid contact with the enclosure during switching operations. Such a restriction is

considered undesirable. The supplier is therefore required to furnish the details of the devices and techniques to be deployed by him for reducing transients to an acceptable level along with his offer.

15.24 INSPECTION AND TESTING

15.24.1 General

15.24.1.1 All the equipment, apparatus, materials and supplies provided by the manufacturer under this contract shall be subjected to tests in the shop and at the field in the presence of purchaser/consultant for conformity with the requirements of the specifications. The method and procedure of the tests shall be as specified for the particular item or shall be in conformity with the applicable recognized standards for making such test. The details of the test procedures and test equipment to be used should be intimated to the purchaser well in advance i.e. not less than three weeks before these tests are conducted. Unless otherwise specified , the manufacturer shall perform all shop and field tests.

15.24.1.2 The supplier shall submit a detailed quality assurance plan within 30 days after the contract commencement date intimating the testing program to the purchaser for approval. The testing of the related equipment shall be coordinated so that testing may proceed with minimum delay. The performance tests shall start, proceed, stop and be resumed in accordance with the approved schedule.

15.24.1.3 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 purchaser six signed copies of a report covering such tests.

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 along with testing procedure for the purchaser's approval well in advance.

The test report shall include, but not necessarily be limited to the following.

- A description of the test equipment with diagram showing arrangement of the test instruments and devices.
- Sample computation, where necessary or desirable to show the test values employed in the equations.
- Curves showing relation of tested quantities.
- Data in tabulated form
- Comparison of the test results with the guarantee requirements of the specification .

15.24.2 Shop Tests

15.24.2.1 All major parts of the equipment, especially those necessitating sub-division of parts for transport and subsequent reassembly at site, shall be match assembled in the factory and carefully match marked before dismantling. The dowel holes shall be provided with dowels to assist in reassembly. The accuracy of fitting has to be assured at site at all stages of assembly.

15.24.2.2 Each transport section of switchgear shall be shop tested.

15.24.2.3 Switchgear components forming part of GIS namely circuit breakers, disconnectors, grounding switches, current transformers, potential transformers, relays, surge arrestors & SF6 interface bushing, the routine tests of which have been covered under other relevant IEC standards and which do not form the part of tests specified below shall have these tests performed before being assembled into the switchgear. However, for electronic modules, equipment and individual components burn-in tests, temperature & voltage stress tests shall also be performed. Routine tests shall be conducted by automatic processes, wherever practicable particularly during testing of wiring. An example of the other tests referred to above would be as follows:

a) Verification of terminal markings and accuracy & composite error tests for current and potential transformers.

b) Routine and standard acceptance tests for surge arrestors specified in IEC 99-4 relevant to metal oxide type arrestors without gaps.

c) Routine tests (on transport section) :

i) Dry Power frequency voltage withstand tests on the main circuit.

ii) Dielectric tests on auxiliary and control circuit.

iii) Tests to verify the resistance of the main circuit

iv) Partial discharge tests

v) Pressure test on enclosures

vi) Gas tightness test.

vii) Mechanical operation tests.

viii) Tests of auxiliary, electrical and hydraulic devices.

ix) Check of wiring.

x) Power frequency voltage dry tests

xi) Voltage tests on auxiliary and control circuits

xii) Fluid leakage tests (where applicable)

The applicable standards for the above tests shall be IEC 517, IEC 56 and IEC 694.

In addition, corrosion protection tests at random on all equipment shall be performed.

15.24.2.4 Mechanical Tests

Mechanical tests shall be carried out as per respective IEC and also include the following.

(a) Mechanical operation of Circuit Breaker

- 25 open and close operations at rated voltage & rated pressure.
- 5 open and close operations at minimum voltage & minimum pressure.
- 5 open and close operations at maximum voltage & maximum pressure.
- 5 close - open cycles at rated voltage and rated pressure.
- 5 open-close-open cycles at rated voltage and rated pressure.

- 5 close open operating cycles with the tripping mechanism energised by the closing of the main contacts.
- 5 open-close sequences 0-0.3 sec-CO-3 min-CO for line breakers.
- 5 open- close sequences 0-3 min-CO-3 min-CO for generator transformers and bus coupler breakers.

(b) The operating times are to be recorded as follows:

- Opening time measured at rated supply voltage for each pole.
- Closing time measured at rated supply voltage for each pole.
- Recording of time travel diagram.
- Measure hydraulic mechanism recharging time after one opening and closing.

(c) Mechanical operation of Isolators and Ground Switches

- 5 open/close cycles at rated voltage.
- 5 open/close cycles at minimum voltage.
- 5 open/close cycles at maximum voltage.
- Ensure operation of interlocks in proper sequence.

(d) Gas tightness leak test on single pole assembly of switchgear module.

(e) Design and visual checks as per respective IEC.

15.24.2.5 Electrical Tests/Routine Tests

The electrical tests to be performed on the specified factory assemblies shall be as per respective IEC and shall include the following:

- Main circuit resistance measurement for each pole.
- Measurement of resistance of circuit breaker close and trip coils.
- Measurement of power consumption of motor operated mechanism at rated supply voltage.
- Ensure operation of electrical interlocks in proper sequence.

(a) Control cubicle

- Operation or functional checks of all circuits at rated supply voltage.

- Dielectric test of auxiliary circuits at 2000 V at 50 Hz for one minute.
- Operation test of all pressure density monitoring switches.
- Dielectric tests (in the following order) :
  - Power frequency withstand test
  - Partial discharge test

b) Current transformers (As perIS-2705 / IEC 185)

i) Verification of terminal marking & polarity.
ii) Power frequency dry withstand tests on primary windings
iii) Power frequency dry withstand tests on secondary windings
iv) Over voltage inter-turn test.
v) Determination of errors or other characteristics.
vi) Partial Discharge tests (as per IS: 11322)

For the protective current transformers the following additional tests shall be performed :

i) Knee point voltage test
ii) Exciting current test
iii) Secondary winding resistance tests
iv) Turns ratio test

For the protective current transformers (other than class PS type the following additional tests should be performed :

v) Current error & phase displacement
vi) Composite error test

c) Surge arrestors (As per IEC-99-4).

i) Measurement of reference voltage.
ii) Residual voltage test.
iii) Satisfactory absence from partial discharges & contact noise to be checked on each unit by any sensitive method adopted by manufacturer.
iv) A leakage check may be made on each unit by any sensitive method adopted by manufacturer in case of arrester unit with sealed housing.
v) Current distribution test for multi-column arrester.

d) Disconnectors & grounding switches (As per IEC-129)

i) Power frequency voltage withstand dry tests of the

main circuit and auxiliary circuits .
ii) Voltage withstand tests on auxiliary and control circuits.
iii) Measurement of the resistance of the main circuit.
iv) Mechanical operating tests.
v) Tests to prove as per IS:1818

e) Voltage transformers (As per IEC 186/IS 3156)

i) Verification of terminal marking.and polarity
ii) Power frequency dry withstand tests on primary and secondary windings.
iii) Determination of errors or other characteristics
iv) Partial discharge measurement as per IS:11322

f) Routine tests for circuit-breakers (as per IEC 56-4) :

i) Power frequency voltage withstand of dry tests on the main circuit

ii) Voltage withstand tests on control and auxiliary circuits

iii) Measurement of the resistance of the main circuit

iv) Mechanical operating tests

v) Design and visual checks

g) The routine tests for bus bars shall be as per the relevant IEC standard.

15.24.3 Type Tests

15.24.3.1 The following type tests shall be made on a complete single pole assembly of one typical switchgear bay module as per IEC 517. 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.

15.24.3.2 The complete type test certificates and data sheets for all types of equipments must be furnished by the bidder alongwith the bid. If the tests conducted would not be to the satisfaction of the Purchaser, the tests shall be reconducted by the supplier at his own expenses.

15.24.3.3 The tenderer shall furnish design test certification to demonstrate that the GIS has been type tested according to latest applicable IEC standards.

15.24.3.4 Should a similar switchgear bay module have been previously subjected to all of the type tests stated below, certified type test reports may be accepted in lieu of a repetition of such tests at purchaser's option:

a) Lightning impulse voltage dry tests.

b) Switching impulse voltage dry tests.

c) Power frequency voltage dry tests.

d) Thermal stability test.

e) Partial discharge tests.

f) Radio interference voltage tests.

g) Temperature rise tests.

h) Tests to verify the resistance of the main circuits.

i) Short-time current tests on main circuits.

j) Short-time current tests on grounding circuits.

k) Verification of making and breaking capacities.

l) Internal arc tests.

m) Mechanical operation tests.

n) Operation tests at temperature limits

o) Verification of degree of protection of auxiliary and control circuits.

p) Earthquake withstand test.

15.24.3.5 In case the manufacturer has not type tested a similar module for earthquake withstand test he shall supply supporting design calculations of simulated parameters of this test.

15.24.3.6 In addition, the following type tests on one piece each of related component parts of a single pole assembly of one typical switchgear bay module shall be made.

a) Circuit breakers (In accordance with IEC 56-4)

i) Dielectric test.
ii) Radio Interference Voltage tests.
iii) Temperature rise-tests.
iv) Measurement of Resistance of Main Circuit.
v) Short time withstand current & peak withstand current tests.
vi) Mechanical & environmental tests.
vii) Miscellaneous Provisions for making & breaking test.
viii) Test circuits for short circuit making & breaking tests.
ix) Short circuit test quantities.
x) Short circuit test procedure.
xi) Basic short circuit test duties.
xii) Critical current tests.
xiii) Single Phase short circuit tests.
xiv) Short line fault tests.
xv) Out of phase making & breaking tests.
xvi) Capacitive current switching tests.
xvii) Magnetising & small Inductive Current Switching tests.

b) Surge arrestors (In accordance with IEC 99-4)

i) Insulation withstand tests.
ii) Residual voltage tests.
iii) Long duration current impulse withstand test
iv) operating duty tests.
v) Pressure relief test.
vi) Tests of arrestor disconnectors.
vii) Artificial pollution test.
viii) Partial discharge test.
ix) Seal leakage test.
x) Current distribution test for multi column arrestor.

c) Disconnectors & Earth switches (In accordance with IEC 129)

i) Dielectric tests
ii) Radio interference voltage (r.i.v.) tests
iii) Temperature – rise tests
iv) Measurement of the resistance of the main circuit (for isolators)
v) Short-time and peak withstand current tests
vi) Tests to prove the short-circuit making performance of earthing switches
vii) Operating & mechanical endurance tests
viii) Operation at the temperature limits

d) CTs (As per IEC 185)

i) Short time current tests.
ii) Temperature rise test.
iii) Lightning impulse test for current transformers for service in electrically exposed installation
iv) Switching impulse voltage tests for CTs for 420 kV and above
v) Determination of errors or other characteristics

Special tests (optional)

i) Chopped lightning impulse test as a type test

e) Potential transformers (as per IEC 186)

Temperature – rise tests.
Lightning Impulse test.
Switching Impulse test.
Determination of errors.

Special tests (optional)

i) Chopped lightning impulse test as a type test
ii) Short circuit withstand capability test as a type test

15.24.3.7 Pressure vessel test

Test according to used pressure vessel code shall be performed on the enclosures.

15.24.4 Performance Tests

15.24.4.1 Performance tests will be required to prove that equipment meets the requirements of the specifications and the guarantees. All the tests shall be conducted by the manufacturer subject to purchaser's approval. The manufacturer shall supply all labour, consumables, materials, equipment, meters, gauges etc necessary for the performance of all the tests and recording the results of the tests. The manufacturer shall have full responsibility for the operation and safety of the equipment during all tests. The reports of all the tests shall be prepared by the manufacturer and incorporated in the final test report. The performance tests shall comprise of :

a) Field stage tests, to be carried out during erection, to demonstrate that the equipment or any component or

subassembly has been properly erected and functions correctly.

b) Commissioning tests, precedent to the acceptance of work, in respect of the equipment or any section of the equipment, to demonstrate proper operation.

c) Final acceptance tests, precedent to issue of a Final Acceptance Certificate, to prove compliance with performance guarantees.

15.24.4.2 Field Stage Tests :

From time to time at various stages of erection , tests of sub-assemblies of the equipment shall be carried out as instructed by the purchaser. The manufacturer shall make records of all measurements and shall make corrections or adjustments as required. A record of all stage tests shall be embodied in a report. These tests shall include, but not be limited to the following:

(a) Continuous testing of the properties of SF6 gas through the entire filling period.

(b) Test to check the continuity of wiring and correct operation of electrical systems.

(c) Testing of all current carrying & ground connections to all conductors and terminal pads, to determine the surfaces & all the bolted connections are tightly secured with lock washers; testing of all the flexible connections to ensure that sufficient slack is available for expansion.

(d) Individual inspection of pressure relief devices, pressure gauges, moisture detectors and all other auxiliary devices to examine their condition.

(e) Check of cabling between apparatus by the contractor, prior to acceptance tests. Written evidence shall be produced on these tests. Random checks shall be made in the presence of the Engineer.

(f) Measurement of the insulation resistance of the various measuring and control circuits, including cables, instruments and apparatus wherever practical and feasible.

(g) Operation checks of operating mechanism, all control, signaling, measuring, metering, recording and interlocking equipment to confirm complete conformity with designed data.

15.24.4.3 Commissioning Tests

On completion of the erection and installation, the manufacturer shall give the purchaser a written certificate stating that the equipment has been erected and installed in accordance with the specifications and approved drawings,thus giving notice of readiness to be carried out before the equipment is placed into regular service. The manufacturer shall demonstrate that all guarantees have been met and in addition, that the entire equipment, including all auxiliary equipments & accessories, are properly erected, installed and correctly adjusted.

The Following commissioning tests shall be performed as agreed between manufacturer & purchaser and as per IEC 517, CIGRE working Group 23.03: 1975-Electra No.42, 7-29.

(a) One minute power frequency withstand tests for the main circuits. As per IEC 517 Cl. 7.107.1.3.2 high voltage tests at site with lightning impulse and switching impulse voltages are also acceptable as alternative. The tenderer may carry out either of the above tests but relative merits of particular type of test over the other tests to be carried out by the bidder should be indicated in the offer.

(b) Partial discharge measurement tests.

(c) Voltage tests for the main circuits

(d) Voltage tests for the auxiliary and control circuits.

(e) Tests to verify the resistance of the main circuits.

(f) Operation tests for various components.

(g) Gas leakage tests.

(h) Calibration of SF6 gas pressure/density switches.

(i) Measurement of moisture.

After erection, a test shall be made to prove the absence of the dangerous voltages in the enclosure and other metal parts such as pipes and framework.

If the tests prove the existence of any fault or faults in the equipment, or any failure to meet the requirements of the specifications the purchaser may direct supplier to rectify the defects or repair, reconstruct or replace faulty work and supplier shall without delay, carry out the instructions of the purchaser in this respect.

Except as otherwise provided hereunder, responsibility for apparatus & test equipment and the control thereof shall be exercised by manufacturer subject to the over riding control of the purchaser.

Commissioning tests shall be as per the IEC standard and shall not be restricted to the tests stated above. The tenderer shall also recommend any additional commissioning tests.

15.24.4.4 Final Acceptance Tests

After commissioning tests have been satisfactorily completed, the manufacturer, in cooperation with and under the supervision of purchaser shall conduct the final acceptance tests listed below to determine whether all the manufacturer's guarantees and requirements of these specifications have been fulfilled:

a) SF6 GIS complete with all appurtenances, shall be operated at continuous rating and at such part loading as may be directed by the purchaser, continuously for 30 calendar days.

b) All shop tests included in the test report specified shall be deemed to be a part of the final acceptance tests. Routine tests may be repeated at the site, if, in the opinion of the purchaser, these are necessary to establish the conformity of the equipment with the guarantees and the specifications.

c) A record of all performance tests shall be embodied in a test report.

Successful completion of the final acceptance tests shall be a condition precedent to a final acceptance certificate for the equipment.

15.25 MANUFACTURER'S STANDARDS, DRAWINGS AND DESCRIPTIVE DATA TO BE SUBMITTED ALONG WITH TECHNICAL BID

15.25.1 The manufacturer shall furnish following documents alongwith the bid:

a) The copies of the English version of all the standards to which the Gas Insulated Switchgear and auxiliaries conform.

b) Drawings and photographs to show the general construction and overall dimensions of the equipment proposed. The drawings shall also show the location and general arrangement of all auxiliary devices and terminal arrangement. All dimensions shall be in mm.

c) Drawings, technical details and operational capabilities of the SF6 gas processing unit proposed for use with the proposed equipment.

d) Description of untanking procedure for circuit breakers and disassembly of other switchgear components, including extent of repairs which will be possible within the space available in the transformer hall cavern.

e) Details of circuit breaker interrupting chambers and operating mechanisms.

f) Details of isolators, grounding switches and associated operating mechanism.

g) Details of current and voltage transformer, including types of insulation materials used.

h) Outline drawing and the details of gas insulated surge arrestors.

i) Drawing of support and barrier insulators.

j) Outline drawing and details of SF6/air outdoor bushing to include details of mounting at support structure and arrangement for taking up thermal expansion of bus duct.

k) Details of gas pressure/monitoring system and devices.

l) Typical details of terminal and control cubicles.

m) Details of annunciation system proposed, including typical schematic or wiring diagram.

n) Typical details of electrical and mechanical interlocking system proposed.

o) Details of typical support structures.

p) Typical wall / floor crossing arrangement for SF6 module and cables.

q) Tables listing material specifications for various equipment components.

r) Painting systems, cleaning and application procedures.

s) Listing of applicable pressure vessel codes to which the pressurized enclosures conform.

t) Typical general arrangement, control schematics and alarm annunciation scheme drawings.

u) Drawing showing outline and mounting details for each type of relays and also for all loose equipments such as stabilizing resistors, non-linear resistors etc.

v) Diagrams of interconnection between modules for each type of relay.

w) Wherever applicable, a drawing showing the interconnection between the associated relays in a scheme of protection complete with all necessary polarity markings on relays, current transformers and voltage transformers.

x) If protection includes items which shall be separately mounted, then an outline mounting and wiring diagrams shall be included.

y) Description and diagram of proposed grounding system.

z) Insulation co-ordination study.

aa) Detailed drawing of expansion bellow.

bb) Detailed drawing of gasket.

cc) Detailed procedure for dismantling of bus bars and other equipment

dd) The technical literature / catalogue of the various components

used in the assembly shall be submitted

15.26 INSTALLATION, OPERATION AND MAINTENANCE MANUALS

15.26.1 The manufacturer shall prepare manuals covering the information and the instructions pertaining to the following sections for guidance during installation of the work and subsequently for guidance of the plant operating and maintenance staff :

- Handling
- Erection
- Site Testing
- Operation & Maintenance

The sectionwise details are given as under:

a) Handling Section

This shall contain detailed information as to the system of marking adopted to show slinging points of support, restrictions as to position of transport of any package & position of application of any cradles provided for use during transport, or site storage of any item, restrictive instructions, and the form in which such instruction is inscribed on the package. A full list of special slings, spreaders, cradles & other devices which have been provided, the purpose of each and the full instructions regarding the conditions of site storage to be observed shall also be furnished by the supplier.

b) Erection Section

This shall include full and detailed instructions regarding the procedures & precautions to be observed in erecting, assembling, gas processing and for initial filling, adjusting the equipment including the use of the erection equipment. It shall also include or be accompanied by drawings showing erection markings, match marking and shall include a full statement regarding the erection tolerances to be observed.

c) Site Testing Section

This shall include full detailed directions for the methods

& procedures to be followed, the quantities to be observed & recorded in checking the accuracy of erection and carrying out site tests as required by the specifications. It shall also include a description of all equipment & instruments including diagram provided for these tests and of their use.

d) Operation and Maintenance Section

This shall include complete instructions for the operation and maintenance of the equipment, not only during the period of the manufacturer's liability but more particularly during its operating life. The directions shall be set out simply, clearly and systematically. In particular, this volume shall include a full list of all routine checks and their timing, directions as to fault finding, details of all routine attentions (such as lubrication etc.) and recommendations for the observations which should be recorded.

e) Seven (7) copies of the manuals shall be submitted in draft form for review and comment by purchaser 4 months prior to the time the information is required at site. Twelve (12) suitably bound copies shall be provided to purchaser not later than 30 days after final review by the purchaser.
The manuals shall include a complete list of all drawings prepared by manufacturer, a list of spare parts and a list of parts for each components or item of equipment. The part list shall include manufacturer's name and serial numbers.

Soft copy of all the manuals and drawings is to be submitted as per ANNEXURE-I. 'NUMBER OF COPIES OF DRAWING AND DOCUMENTS' of Section-1 General Technical Requirement

The manuals shall include catalogue, data sheet for every single part of equipment installed in the switchgear.

15.27 TOOLS, TACKLES AND SLINGS FOR ERECTION, TESTING & COMMISSIONING

The supplier shall arrange testing instruments, tools, tackles and slings required for erection, testing and commissioning of the equipment at site in addition to the special tools, tackles and slings which are covered in the scope of supply. These special tools, tackles and slings can be provided to the supplier for erection, testing & commissioning of equipment at site. After commissioning, the special tools, tackles & slings are required to

be returned to the purchaser in working condition so that same can be used during maintenance of the equipment. The list of testing instruments, tools, tackles & slings required to be arranged by the supplier shall be submitted alongwith the bid.

15.28 SCHEDULE OF REQUIREMENTS

15.28.1 A) Double Bus Bar System

Two (2) sets of, 3 single phase(isolated), SF6 gas insulated, metal-enclosed 2000A busbars, each enclosed in three individual bus - enclosures running along the length of the switchgear to interconnect each of the circuit breaker bay module. Each bus bar set shall comprise of:

i) Three Nos.-Single phase SF6 insulated, voltage transformers with three secondary windings.

ii) One No.-Three pole group operated disconnector with grounding switch complete with manual and motor driven operating mechanism for voltage transformer.

iii) One No.-Three pole group operated high speed fault making grounding switch complete with manual and motor driven operating mechanism.

iv) One No. - Local control cubicle.

v) One lot- SF6 gas monitoring system for the complete bus, terminal boxes, interconnecting wires, piping and grounding, support structures, plateforms, etc.

Note: The manufacturer shall perform an insulation co-ordination study to verify that the protection of switchgear, generator-transformers against over voltage is adequate. The final characteristics of surge arrestors, their number and exact location shall be decided after this study. This study can be carried out after award of contract. The manufacturer shall furnish three copies of this study report to the purchaser.

B) Bus Coupler Bay

One - 420 kV bus coupler bay module comprising of:

i) One – Set of three single phase (isolated), 2000A, SF6 gas insulated circuit breaker complete with separate and

reliable operating mechanism for each phase.

ii) Two sets - 3 core, 2000-1000-500/1A single phase current transformers.

iii) Two Nos. - Three pole, 2000A, group operated disconnector switches complete with manual & motor driven operating mechanisms.

iv) Two Nos.- Three pole, group operated safety grounding switches, complete with manual and motor driven operating mechanism.

v) One No. -Local control cubicle including interconnecting wires, pipes, etc.

vi) One lot- SF6 gas monitoring system for the complete bay module.

C) Generator Transformer Bays

Four- 420 kV, 2000A generator transformer feeder bay modules each comprising of:

i) One Set of three single phase (isolated), 2000A, SF6 gas insulated circuit breaker, complete with separate and reliable operating mechanism for each phase.

ii) Three Nos.-5 core, single phase current transformers with CT ratio of 2000-1000-500/1A for 3 cores and 500/1A for the remaining 2 cores.

iii) Three Nos.-3 cores single phase current transformers with CT ratio of 500/1 A.

iv) Two Nos. -Three pole, group operated bus bar disconnectors with common grounding switch, each complete with manual and motor driven operating mechanism.

v) One No.- three pole group operated, high speed fault making grounding switch with link, complete with manual and motor driven operating mechanism.

vi) Three Nos. –390 kV rated voltage, Single phase, SF6 gas insulated, metal enclosed zinc oxide surge arrestors.

vii) Three Nos.–single phase gas insulated terminal connections for connecting generator transformer (oil/SF6) bushing with GIS through gas insulated interconnecting bus (2000 Amp rating).

viii) One No. – Local control cubicle including interconnecting wires, pipes etc.

ix) One Lot-SF6 gas monitoring system for the complete bay module.

D) Line Feeder Bays

Two 420 kV, 2000A transmission line feeder bay modules, each comprising of:

i) One set of three single phase (isolated), 2000A SF6 gas insulated circuit breaker with preinsertion resistors complete with separate and reliable operating mechanisms for each phase.

ii) Three Nos. -3 core single phase current transformers (2000-1000-500/1A).

iii) Three Nos. - 4 core, single phase current transformers with CT ratio of 3 cores as 2000-1000-500/1A and 1000-500/1A for the remaining core.

iv) Two Nos.- Three pole, 2000A, group operated bus bar disconnectors, with common grounding switch each complete with manual and motor driven operating mechanism.

v) One No.- Three pole, 2000A group operated feeder disconnector, complete with manual and motor driven operating mechanism.

vi) One No.-Three pole, group operated, safety grounding switch, complete with manual and motor driven operating mechanism.

vii) One No.- Three pole group operated high speed fault making grounding switch with link complete with manual and motor driven operating mechanism.

viii) Three Nos.- 390 KV rated voltage, single phase, SF6 gas

insulated, metal enclosed zinc oxide surge arrestors.

ix) Three Nos.– Single phase SF6 gas insulated terminal connections for inter connection between GIS & XLPE cables of 1000 mm^2 size through gas insulated bus ducts of 2000 A rating..

x) One No.-Local Control Cubicle including interconnecting wires, pipes etc.

xi) One Lot- SF6 gas monitoring system for the complete bay module.

15.28.2 The scope of supply shall also include

A) First filling of SF6 gas & hydraulic oil for the equipment supplied plus an additional quantity sufficient for conducting all the tests on equipment at site before placing it into successful operation. In addition 10% of the total quantity of SF6 gas & hydraulic oil shall also be supplied.

B) One - Gas processing unit suitable for evacuating, liquefying, filling, drying and purifying SF6 gas during initial installation, subsequent maintenance and future extension of the GIS.

C) One set – Special tools, tackles & slings required for assembly & maintenance of switchgear and auxiliary equipment.

D) All the testing instruments & devices required for successful testing and commissioning of the equipment at site.

E) All materials & consumables for the complete installation, testing, commissioning and placing into successful operation of the equipment.

F) All supporting steel structures for the equipment including rails, transverse & longitudinal beams and supporting members with all necessary hardware & embedded parts, terminal boxes, interconnecting wires, pipes etc.

G) All the ladders and walkways necessary for access to the equipment during erection & maintenance at site.

H) Complete installation/erection, testing, commissioning and placing into successful operation of the equipment till

handing over the same to the owner.

I) One – ON line Partial discharge monitoring system with sufficient number of UHF couplers / partial discharge sensors at different measuring locations, coaxial cable, spectrum analyser, micro computer including the expert system for analysis & automatic interpretation of the measured values wherever applicable and RS-232 optical fibre links etc. The requirement of UHF couplers, if any, for sections of interconnecting bus between GIS & generator transformer, and between GIS and XLPE cables shall also be included and integrated. The details like number of couplers, capacity and other technical particulars shall be given in the tender.

J) One – Contact resistance metering desk with cables.

K) One – Time measurement instrument (minimum 15 ways).

15.29 QUALITY CONTROL & ASSURANCE

The supplier has to supply the equipment for 420 kV SF6 Gas Insulated Switchgear of best quality. The supplier has to maintain quality control and assurance during the manufacturing of equipment as per the approved Owner's quality assurance plans. For details please refer quality assurance plan document.

15.30 GUARANTEED TECHNICAL PARTICULARS

Guaranteed and technical particulars as per Annexure-I shall be furnished alongwith the tender. In the absence of requisite data it may not be possible to evaluate the suitability and adequacy of the equipment and tender lacking in this respect shall be rejected. The particulars which are guaranteed shall be clearly marked

15.31 COMPLETENESS OF THE CONTRACT

Any fittings, accessories or apparatus which may not have been specifically mentioned in these specifications but which are usually necessary in the equipment shall be deemed to be included in the contract and shall be supplied by the supplier without extra charges. All plants and equipments

shall be complete in all respects even if the details regarding all the items are not mentioned in these specifications.

15.32 DEPUTATION OF ENGINEERS FOR WITNESSING THE TESTS, INSPECTION AND TRAINING

15.32.1 The requirements regarding the deputation of purchaser & consultant engineers for witnessing the tests, inspection and training at the works of the manufacturer shall be as mentioned at Section-1 of General Technical Requirements of the Technical Specifications.

15.32.2 The supplier shall bear all the expenses related to inspection, witnessing of tests and training viz. to & fro air fare, lodging , local transportation and daily allowance. The charges for inspection, witnessing of tests and training shall be quoted in price schedule.

15.33 CONSUMABLES

The tender shall include for all consumables that shall be required for the site assembly, erection, testing & commissioning of the 420 kV Gas Insulated Switchgear.

15.34 WORK SCHEDULE

The following Schedule of various activities shall be strictly adhered to in order to match with the commissioning of Vishnugad Pipalkoti HEP (4x111 MW).

S.No.	Activity	Completion Time (to be filled in by bidder)
1	Design & Engineering	
2	Manufacturing	
3	Test at works	
4	Shipment/Dispatch of goods	
5	Receipt of goods at project site	
6	Erection	
7	Testing & commissioning	

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS OF SF6 GAS INSULATED SWITCHGEAR

Sl. No	Particulars	To be Filled By Bidder
I	**Guaranteed Technical Particulars of complete GIS module**	
1	Name of manufacturer	
2	Place of manufacture, inspection & testing	
3	Manufacturer's type/designation	
4	Rated voltage	
5	System frequency	
6	Maximum (continuous) service rated voltage	
7	Normal current rating	
a)	Generator Transformer feeder circuit	
b)	Line feeder circuit	
c)	Bus coupler circuit	
8	Short time current rating	
a)	1 second rms	
b)	3 second rms	
9	Rated Lightning impulse withstand voltage	
a)	Phase to earth	
b)	Across open contacts	
10	Rated Switching impulse withstand voltage	
a)	Phase to earth	
b)	Phase to phase	
c)	Across open contacts	
11	Rated one minute power frequency withstand voltage	
a)	Phase to earth	
b)	Across open contacts	
12	Maximum temperature rise over ambient of 38°C	
13	Thermal rating of current carrying parts at 420kV for the rated symmetrical short circuit current	
14	Altitude upto which the switchgear shall operate satisfactorily	
15	Ambient conditions of the operation of the GIS	
16	Earthing details of enclosure	
17	Density and pressure of gas in various compartments of the enclosure	
	-Pressure of gas	

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS OF SF6 GAS INSULATED SWITCHGEAR

	-	Gas density	
18	a)	Features adopted for preventing burn through in the various enclosures of SF6 GIS	
	b)	Time to withstand an internal flashover without burn through	
19		Guaranteed life of the GIS	
20		Guaranteed number of loaded/unloaded operations of various equipments of SF6 GIS i.e. circuit breakers, disconnectors, grounding switches (please mention item wise).	
21	a)	Average leakage of SF6 gas from the equipment and percentage per year	
	b)	Quantity of SF6 gas required to completely charge the 3-pole equipment including any tank storage system	
	c)	Quantity of SF6 gas required for largest gas compartment	
	d)	Operating pressure	
	i)	Circuit breaker	
	ii)	Others	
22		Details of the features existing in the equipment to carry out PD measurements at works/site	
23		Details of the control wiring used in the equipment	
24		The extent of field welding required for site assembly, if any alongwith the procedure to be adopted by the firm at site	
25		Details of the documents, drawings & photographs enclosed showing the basic operating principles of the major components of the equipment, presenting a clear picture of the fundamental principle, general arrangements and operating mechanism.	
26		Details of the flow diagram/ drgs. enclosed showing all valves and pressures involved, for the hydraulic and gas system.	
27		Details of the test data enclosed including test data of the parts indicating the ability of the equipment (including high speed grounding switches)	

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS OF SF6 GAS INSULATED SWITCHGEAR

28		The values of resistors inserted in the line and shunt reactor circuit breaker during closing operations, if any, alongwith the length of time the resistors are left in the circuit	
29		Methods adopted to limit switching surges for breaker and disconnectors	
30		Values of maximum switching surges generated	
31		Heat generated in KW when the complete switchgear is operating at its rated capacity	
32		Noise level	
33		Material used in fabrication (Copper, Aluminum, Silver, Stainless Steel etc).	
	a)	Breaker main contact surfaces	
	b)	Disconnecting switch contact surfaces	
	c)	Grounding switch contact surfaces	
	d)	Internal bus	
	e)	Internal bus contact surfaces	
	f)	Bus enclosure	
	g)	Terminal pads	
	h)	Terminal pad contact surface	
	i)	Bellows or compensating units	
34		Operating Mechanism	
	a)	Breaker	
	b)	Disconnecting switch	
	c)	High speed fault making grounding switch	
	d)	Safety grounding switch	
35		Time required to recharge the operating system to a fully charged condition after four successive operations (without pumping action)	
36		Details of provisions made for movement of maintenance personnel on the equipment	
37		Capacitance per metre of the enclosed bus	
38		Surge impedance in ohms of the enclosed bus (The bidder should furnish the method used for the calculations of surge impedance and capacitance of insulated bus)	
39	a)	Electric resistance	

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS OF SF6 GAS INSULATED SWITCHGEAR

	i)	Internal bus at 75^{0}C	
	ii)	Internal bus at 20^{0}C	
	iii)	Bus enclosure at 75^{0}C	
b)		Data used for calculation of electric resistance in (a)	
	i)	Cross sectional area of bus conductor	
	ii)	Cross sectional area of bus enclosure	
	iii)	Conductivity of material of bus conductor	
	iv)	Conductivity of material of bus enclosure	
	v)	Current density in bus conductor	
40		Maximum power losses in the bus bar per single phase meter at rated voltage and current at 20°C	
a)		Enclosure	
b)		Conductor	
41		Temperature rise limits	
	i)	For Internal bus conductor	
	ii)	For Bus enclosure	
42		Dimensions	
a)		Bus enclosure outside diameter	
b)		Bus enclosure wall thickness	
c)		Internal bus, outside diameter	
d)		Internal bus thickness	
43		Weight	
		The weight of each assembled bay to be indicated separately	
II		***Equipments of GIS***	
A)		**Circuit Breaker**	
		(The following particulars for each type of breaker shall be furnished)	
1		Name plate data	
i)		Manufacturer's name	
ii)		Type/designation	
iii)		Rated frequency	
iv)		Rated voltage	
v)		Rated interrupting current	
vi)		Number of poles	
vii		Class (indoor)	
viii)		Number of interrupting chambers per pole	
ix)		Maximum Operating Voltage Breaking Capacity	

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS OF SF6 GAS INSULATED SWITCHGEAR

		Making & Breaking	
	a)	Breaking Capacity	
		i)	Rated breaking current
		ii)	Rated breaking MVA (Symmetrical) (kA rms)
		iii)	Breaking time
	b)	Making Capacity	
		i)	Rated making current
		ii)	Rated making MVA symmetrical
		iii)	Making time
2		Operating voltages of closing/opening coil	
	i)	Maximum operating voltage	
	ii)	Minimum operating voltage	
	iii)	Range factor	
3		Current ratings	
	i)	Rated continuous current at 38°C	
	ii)	Rated interrupting current for 1 second	
	iii)	Rated symmetrical interrupting current	
	iv)	Rated asymmetrical interrupting current	
	v)	Percentage DC component	
	vi)	Rated short circuit making current	
	4	Rated Insulation level	
	a)	Dry one minute power frequency withstand voltage	
		i)	To earth
		ii)	Across open contacts
	b)	1.2/50 microsecond full wave lightning impulse withstand voltage	
		i)	To ground
		ii)	Across the open contacts
	c)	250/2,500 micro-second switching impulse withstand voltage	
	d)	Line to ground power frequency withstand voltage at gas pressure equivalent to atmospheric pressure	
	e)	Minimum allowable moisture content in interrupting medium	
	f)	Total breaking time	
		i)	At 10% rated interrupting capacity
		ii)	At 60% rated interrupting capacity
		iii)	At 100%rated interrupting capacity
5		Maximum temperature rise above ambient at rated load and voltage for	

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS OF SF6 GAS INSULATED SWITCHGEAR

	i)	Contacts	
	ii)	Hottest part	
6		Operating data	
	i)	Rated operating duty cycle	
	a)	Line Breakers	
	b)	Generator Transformers& Bus Coupler Breakers	
	ii)	Reclosing duty cycle (Line Breakers)	
	iii)	Permissible tripping delay	
	iv)	Maximum arc duration at	
	a)	10% rated breaking current	
	b)	30% rated breaking current	
	c)	60% rated breaking current	
	d)	100% rated breaking current	
	v)	Closing time	
	vi)	Total breaking time at	
	a)	10% rated breaking current	
	b)	30% rated breaking current	
	c)	60% rated breaking current	
	d)	100% rated breaking current	
	e)	Arc duration from separation of arc at contact to instant of arc extinction for full rated interrupting capacity	
	vii)	Length of arc at	
	a)	10% rated breaking current	
	b)	30% rated breaking current	
	c)	60% rated breaking current	
	d)	100% rated breaking current	
	e)	Max. length of arc at lowest fault current	
	viii)	Longest time to interrupt current less than 25% of rated symmetrical short circuit current from energizing trip circuit	
	ix)	Minimum time from arc extinction to contact remake for auto reclosing	
	x)	Minimum dead time for	
	a)	3 phase reclosing	
	b)	1 phase reclosing	
	xi)	Maximum difference of time at opening of series contacts within one pole	
	xii)	Maximum difference of time at opening between phases	
	xiii)	Maximum difference of time at closing	

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS OF SF6 GAS INSULATED SWITCHGEAR

	between phases	
xiv)	Details of the curve enclosed for maximum opening time vs. 3 phase fault current	
xv)	Number of interruptions before scheduled maintenance is required	
xvi)	Number of mechanical operations before scheduled maintenance is required	
xvii)	Number of interruptions at rated SC current with associated TRV without changing any parts	
xviii)	Description and frequency of scheduled maintenance required	
xix)	Time interval between the issue of trip command and the instance of opening of breaker contact	
xx)	Recovery voltage rate of rise at	
a)	Rated symmetrical interrupting current	
b)	60% of rated symmetrical interrupting current	
c)	30%of rated symmetrical interrupting current	
d)	10%of rated symmetrical interrupting current	
xxi)	Amplitude factor	
xxii)	Phase factor	
xxiii)	Natural frequency	
xxiv)	Devices used for controlling RRRV	
xxv)	Devices used for uniform voltage distribution	
xxvi)	Distribution of voltage across breaks	
xxvii)	Details of Switching resistors required	
a)	Pre-insertion (on closing)	
b)	Pre-insertion time	
c)	Tripping (ohm)	
xxviii)	Recovery voltage distribution between breaks in percent of rated voltage	
a)	Single line to ground fault	
b)	Interruption of short lines	
c)	Switching off an unloaded transformer	
7	Details of the operating mechanism	
i)	Tripping coil	
ii)	Closing coil	
iii)	Number of closing coils	
iv)	Number of tripping coils	

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS OF SF6 GAS INSULATED SWITCHGEAR

8		Hydraulic fluid supply system for mechanical operation	
	i)	Pump, motor, hp, voltage/phase and quantity of motors	
	ii)	Storage compartment pressure	
	iii)	Minimum oil pressure required for successful interruption, breaker rating	
	iv)	No of stored close-open operation without pumps operation	
	v)	Quantity of oil required for one close-open operation	
9		SF6 gas system	
	i)	Normal operating pressure	
	ii)	Normal operating density	
	iii)	Weight of gas per breaker	
	iv)	Lockout pressure	
	v)	Alarm pressure	
	vi)	Whether breakers work at single pressure or dual pressure	
	vii)	Type of SF6 gas flow (axial or radial)	
	viii)	Type of nozzles (single flow or double flow)	
	ix)	Compression ratio for puffer action	
	x)	Quantity of compressed gas for puffer action	
	xi)	Total volume of SF6 gas required per circuit breaker at operating pressure	
10		Control power requirement	
	i)	Tripping (3poles) current at rated supply voltage (220V DC)	
	ii)	Tripping (3poles) current at 70% of rated supply voltage (220V DC)	
	iii)	Closing (3 poles) current at rated supply voltage (220V DC)	
	iv)	Closing (3 poles) current at 85% of supply voltage (220V DC)	
	v)	Tripping voltage range percent	
	vi)	Closing voltage range percent	
11		Heaters	
	i)	Continuously current rating	
	ii)	Thermostat power rating	
12		Noise performance (circuit breaker operation)	

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS OF SF6 GAS INSULATED SWITCHGEAR

i)	Measurement standard	
ii)	Noise level	
iii)	Distance	
13	Interrupters	
i)	Type of main contacts, arcing contacts & auxiliary contacts	
ii)	Material of main contacts/arcing contacts, silver coated or not	
iii)	Contact pressure	
iv)	Number of interrupters per pole	
v)	Break length of an interrupter	
vi)	Length of contact travel	
vii)	Rate of contact travel at tripping	
viii)	Rate of contact travel at closing	
14	First pole to clear factor	
15	Whether fixed trip or trip free	
16	Details of anti-pumping device	
17	Rated line charging breaking current	
18	Rated small capacitive breaking current	
19	Rated small inductive breaking current	
i)	Generator transformer, Line & Bus coupler breakers	
20	Rated characteristics for short line fault	
21a)	Rated transient recovery voltage for terminal faults	
b)	Parameters as per IEC	
22	Rated value of phase making current	
23	Maximum interrupting capacity under phase opposition conditions	
24	Capacity for interrupting in-rush current of transformer	
25	Max. over voltage factor of the circuit breaker when switching off	
i)	Unloaded transformer	
ii)	Loaded transformer	
iii)	Open circuited lines	
iv)	Synchronous system	
26	Details of operation counter	
27	No. of auxiliary contacts, their continuous rating and breaking capacities, including those used for circuit breaker operation and interlocking	

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS OF SF6 GAS INSULATED SWITCHGEAR

a)	Those closed when breaker is closed	
b)	Those open when breaker is open	
c)	Those adjustable w.r.t. the position of main contacts	
28	Partial discharge level at 1.1 Un/√3	
29	Radio interference level at 266kV rms	
30	Corona extinction voltage	
31	Maximum impact loading on foundation during breaker opening and closing operations under fault conditions	
32	Seismic withstand value (horizontal and vertical)	
33	Tests to be conducted by the supplier at works (All details to be given)	
i)	Type tests	
ii)	Routine tests	
34	Tests to be conducted at site	
35	Overall dimensions (L x B x H)	
36	Weight of breaker complete with operating mechanism, bushing, frame work	
a)	with SF6 gas	
b)	without SF6 gas	
37	Descriptive bulletins and drawings of the circuit breakers giving general details of construction	
38	Out of phase switching capability of the circuit breaker	
39	Comments regarding the suitability of the circuit breaker for restrike free operation of power transformer carrying full load current	
40	Guaranteed time difference between the first pole and last pole operation timing	
41	Details of the standard accessories to be supplied alongwith the breaker	
42	No. of the enclosed drg. showing the control scheme of circuit breaker	
43	Details of the provision to be made on GIS to reduce HV transients to acceptable values	
44	Guaranteed degraded values of BIL switching surges and 50Hz rated values during the life of equipment (Test data to support this guarantee to be enclosed by	

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS OF SF6 GAS INSULATED SWITCHGEAR

		the bidder)	
B)		**Disconnectors/Grounding Switches**	
B-I)		**Disconnector Switches**	
1		Manufacturer's name	
2		Type & designation	
3		Rated voltage	
	a)	Rated	
	b)	Maximum permissible	
4		1.2/50 microsecond lightning impulse withstand voltage	
	i)	Between line terminals and ground	
	ii)	Between terminals with disconnecting switch in open position	
5		250/2,500 microsecond switching impulse withstand voltage	
	i)	Between line terminals and ground	
	ii)	Between terminals with disconnecting switch in open position	
6		Dry one minute power frequency withstand voltage	
	i)	Between line terminals and ground	
	ii)	Between terminals with disconnecting switch in open position	
7		Rated frequency	
8		Rated normal current	
	i)	Generator Transformer module	
	ii)	Line module	
	iii)	Bus coupler module	
	iv)	Shunt Reactor module	
9		Rated peak short circuit current	
10		Interruption of loop current	
11		Rated short time current	
	i)	1 second	
	ii)	3 seconds	
12		Rated peak withstand current	
13		Rated inductive breaking current	
14		TRV caused by breaking/making inductive current	
15		Rated capacitive breaking current	
16		TRV caused by breaking/making capacitive current	

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS OF SF6 GAS INSULATED SWITCHGEAR

17		Rated insulation level	
	i)	1 minute power frequency withstand voltage	
	ii)	1.2/50 microsecond lightning impulse withstand voltage	
	iii)	250/2,500 microsecond switching impulse withstand voltage	
18		Maximum temperature rise above ambient at rated current	
	i)	Contacts	
	ii)	Hottest part	
19		Motor operating mechanism	
	i)	Current during closing	
	ii)	Current during opening	
	iii)	Closing time	
	iv)	Opening time	
	v)	Operating voltage and range	
20		Design data	
	i)	Type of contacts	
	ii)	Contact area	
	iii)	Contact pressure	
	iv)	Surface treatment and thickness of surface coating/silver electrolytic plating	
	v)	Over travel distance after making of contacts	
	vi)	Distance between the contacts in the fully open position	
	vii)	Current density at the minimum cross section of switch blade	
	viii)	Speed of break	
21		Partial discharge level at 1.1 Un /√3	
22		Corona extinction voltage	
23		Radio interference level at 266kV rms	
24		Total operating time of disconnector along with its operating mechanism	
25		Total operating time of disconnector after the command is given	
26		Auxiliary switches	
	i)	No. of NO and NC contacts	
	ii)	Rated voltage	
	iii)	Rated current	

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS OF SF6 GAS INSULATED SWITCHGEAR

iv)	Test voltage	
27	No. of operations the switch can withstand without any need for inspection	
28	Type of mounting	
29	No. of poles per phase	
30	Safety factor taken into account while designing the disconnector	
31	Type and material used for arcing contacts, if provided	
32	Weight of 3 pole isolating switch	
i)	with earthing blades	
ii)	without earthing blades	
33	Type of interlock between main isolator and earthing switch	
34	Details of the type test reports enclosed and the standards as per which these tests have been carried out	
35	Rated maximum time duration of short circuit	
36	Rated mechanical terminal load	
37	Rated supply voltage of operating devices and auxiliary circuits	
38	Rated pressure of SF6 gas	
39	Minimum distance between poles with regard to insulation and forces caused by short circuit currents	
40	Tests to be conducted by the manufacturer at Works	
i)	Type tests	
ii)	Routine tests	
41	Tests to be conducted at site	
B-II	**Safety Grounding Switches**	
1	Manufacturer's name	
2	Type/designation	
3	Maximum permissible operating voltage	
4	Maximum make and carry current for one second	
5	Rated inductive breaking current (A)	
6	TRV caused by breaking/making inductive current (kV)	
7	Rated capacitive breaking current (A)	
8	TRV caused by breaking/making capacitive current (kV)	

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS OF SF6 GAS INSULATED SWITCHGEAR

9	Details of motor operating mechanism provided	
10	Closing current	
11	Closing time	
12	Opening current	
13	Opening time	
14	Operating voltage range & rated voltage	
15	Ground connection insulation	
16	Type of contacts	
17	Over travel distance	
18	Distance of fully open contacts	
19	Size of the removable link	
20	Speed of make	
21	Partial discharge level at 1.1 Un/√3	
22	Corona extinction voltage	
23	Radio interference level at 266kV rms (micro volt)	
24	Details of type test reports enclosed and the standards as per which these tests have been carried out	
25	No. of NO and NC contacts, its rated voltage and current	
B-III	**High Speed Fault Making Grounding Switch**	
1	Manufacturer's name	
2	Type/designation	
3	Maximum permissible operating voltage	
4	Maximum make and carry current for 1 second	
5	Rated inductive breaking current	
6	TRV caused by breaking/making inductive current	
7	Rated capacitive breaking current	
8	TRV caused by breaking/making capacitive current	
9	Motor operating mechanism	
10	Making current	
11	Induced current switching capability	
12	Closing current	
13	Closing time	
14	Opening current	
15	Opening time	
16	Operating voltage range, rated voltage	

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS OF SF6 GAS INSULATED SWITCHGEAR

17	Design data	
18	Ground connection insulation	
19	Type of contacts	
20	Over travel distance	
21	Distance of fully open contacts	
22	Size of the removable link	
23	Speed of make	
24	Partial discharge level at 1.1 Un/√3	
25	Corona extinction voltage	
26	Radio interference level at 266kV	
27	Has equipment been type tested and to which standards?	
28	No. of NO and NC contacts, its rated voltage and current	
29	Total operating time of switch alongwith its operating mechanism	
30	Total operating time of switch after the command is given	
C)	**CURRENT TRANSFORMERS** (Particulars for all groups of CT's to be indicated either here or on separate sheet)	
1	Name of manufacturer	
2	Type	
3	Manufacturer's type/designation	
4	Rated voltage	
5	Normal continuous rating	
6	Normal ratio of transformation	
7	Rated primary current	
8	Rated secondary current	
9	Numbers of cores	
10	Particulars of for each type of CT	
11	One second over current factor & corresponding value of current	
12	Rated dynamic current (peak value) in amps	
13	Rated continuous thermal current temperature rise over ambient	
14	One minute power frequency dry withstand test voltage	
15	One minute power frequency wet withstand test voltage	

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS OF SF6 GAS INSULATED SWITCHGEAR

16		1.2/50 microsecond lightning impulse withstand test voltage	
17		One minute power frequency withstand test voltage on secondaries	
18		Partial discharge level at 1.1 Un/√3	
19		Radio Interference voltage at 266kV rms	
20		Corona extinction voltage	
21		Total weight	
22		Magnetization curves of CT cores	
23		Mounting details	
24		Overall dimensions	
25		Tests proposed to be conducted by the manufacturer at works	
	i)	Type tests	
	ii)	Routine tests	
26		Tests proposed to be conducted at site	
D)		**VOLTAGE TRANSFORMERS**	
1		Name of manufacturer	
2		Type designation	
3		Rated primary voltage (kV)	
4		Rated secondary voltage (V)	
5		Rated output per phase (VA)	
6		Rated burden (VA)	
7		Rated frequency (Hz)	
8		Standard values of rated voltage factor	
9		Limits of temperature rise	
10		One-minute power frequency withstand voltage	
11		1.2/50 microsecond lightning impulse withstand voltage	
12		Total weight and dimensions	
13		Limits of voltage error and phase displacement in %	
14		Error angle	
15		Voltage error	
16		Accuracy class at rated burden	
17		Voltage factor and rated time	
18		Details of the tests to be conducted by the manufacturer at works	
	i)	Type tests	
	ii)	Routine tests	
19		Tests to be conducted at site	

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS OF SF6 GAS INSULATED SWITCHGEAR

E)	**SF6 GAS**	
1	Name of manufacturer	
2	Electrical properties (please give details)	
3	Compatibility with material used in switchgear	
4	Impurities in percentage (please mention details of impurities)	
5	Size of the cylinder in which gas is proposed to be supplied	
6	Condensation temperature	
7	Physical properties (please give details)	
8	Certification that gas meets the requirement of all the properties	
9	Tests to be conducted by the manufacturer at works	
10	Tests proposed to be conducted at site to detect and limit the moisture content in gas compartments	
11	Other details:	
i)	Normal pressure	
ii)	Maximum pressure	
iii)	Normal operating density	
iv)	Maximum gas density	
v)	Minimum pressure to maintain dielectric insulation for 420kV	
vi)	Maximum leakage rate per year at normal pressure in percentage	
vii)	Maximum permissible moisture content by weight	
viii)	Permissible variation in ambient temperature	
ix)	Details of gas filters	
x)	Effective life of filters	
xi)	Test pressure for gas system	
xii)	Constituents of gas in percent of weight and volume of SF6, air, CH4, H2	
12	Alarm levels	
i)	First alarm level for circuit breakers	
ii)	Alarm level for circuit breaker	
iii)	First alarm level for all other components	
iv)	Second alarm level for all other components	

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS OF SF6 GAS INSULATED SWITCHGEAR

13	Gas Monitoring Devices	
	(Details of the sketches enclosed showing the type and location of gas density, gas pressure, gas moisture content and other fault monitoring devices to be supplied)	
14	Pressure Relief Devices	
i)	Rupturing pressure	
ii)	Time to rupture	
iii)	Details of the sketches enclosed showing the location and quantity of pressure relief devices used	
F)	**SURGE ARRESTORS**	
1	Manufacturer	
2	Type designation	
3	Class of arrestor	
4	Rated Voltage of Arrestor	
5	Maximum continuous operating voltage (MCOV)	
6	Maximum discharge current (8/20 microsecond wave)	
7	Maximum 0.5 microsecond discharge voltage	
8	Residual voltage at 10kA (8/20 microsecond current wave)	
9	Residual voltage at 20kA, 8/20 microsecond current wave	
10	Maximum switching surge protective voltage	
11	Partial discharge level at 1.1 Un/√3	
12	Corona extinction voltage	
13	Radio interference level at 266kV rms	
14	High current short duration test value	
15	Short circuit capability & class of pressure relief device	
16	Line discharge class	
17	Protective level provided by surge arrestor	
18	Energy level	
19	Details of the type test reports enclosed and the standards as per these tests have been carried out	
G)	**SF6-TO-AIR BUSHING**	
1	Manufacturer , Type designation	
2	Location of manufacturing plant	
3	Material	
4	Rated Voltage(kV)	

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS OF SF6 GAS INSULATED SWITCHGEAR

5	Rated continuous current(A)	
6	Rated short time current for 1 sec(kA)	
7	Rated insulation level	
i)	Dry and wet power frequency withstand voltage(kV (rms))	
ii)	1.2/50 microsecond lightning impulse withstand voltage(kV (rms))	
iii)	250/2,500 microsecond switching impulse withstand voltage (kV (peak))	
8	Corona extinction voltage(kV (rms))	
9	External strike distance	
	-Phase to ground(mm)	
	-Phase to phase(mm)	
10	External creep distance (mm)	
11	Cantilever strength(Nm)	
12	Acceptable terminal load(N)	
13	Weight of single phase bushing(kg)	
15	Explain how the dielectric stress is controlled at the top and at the bottom	
16	Partial charge level (pc)	
17	Radio interface level (micro volt)	
18	Has equipment been type tested and to which standards.	
19	Dimensions of single phase bushing (mm)	
20	Description of mounting steel structures for bushings.	
H)	**SUPPORT & BARRIER INSULATORS**	
	(Details for each type of insulator used to be indicated separately)	
1	Manufacturer	
2	Type of insulators used	
3	One-minute power frequency dry withstand test voltage	
4	Dry flashover value	
5	Wet flashover value	
6	1.2/50 microsecond lightning impulse withstand test voltage	
7	Creepage distance	
8	Puncture value of insulator in SF6 gas	
9	Weight of insulators in the SF6 GIS enclosure	

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS OF SF6 GAS INSULATED SWITCHGEAR

I)	**GAS PROCESSING UNIT**	
1	Name of the manufacturer	
2	Capacity	
3	Dimensions of unit	
4	Weight of the unit	
5	Purity of gas obtainable (%)	
J)	**PARTIAL DISCHARGE MONITORING SYSTEM**	
1	Name of the manufacturer	
2	No of couplers	
3	Capacity	
4	Type of sensors	
5	Details of Spectrum Analyser	
K)	**GROUNDING CONNECTION**	
1	Type of conductor	
2	Arrangement for connecting conductor to ground	
3	Type of painting, if any required to be carried out at end points of ground riser	
L)	**DESIGN CLEARANCE**	
	Minimum insulating clearances at nominal rated SF6 gas pressure and rated voltage/BIL voltage for the following:	
a)	Main bus to ground	
b)	Circuit breaker	
i)	Contact to ground	
ii)	Across the contacts	
c)	Isolator switches	
i)	Contact to ground	
ii)	Across the contacts	
d)	Safety grounding switches	
i)	Contact to ground	
ii)	Across the contacts	
e)	High speed make proof grounding switches	
i)	Contact to ground	
ii)	Across the contacts	
e)	SF6 to Air Bushing	

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS OF SF6 GAS INSULATED SWITCHGEAR

M	**STEEL SUPPORT STRUCTURES**	
a)	Structural steel	
i)	Minimum guaranteed yield point (Kg/cm sq.)	
ii)	Ultimate tensile strength (Kg/cm sq.)	
b)	Bolts and nuts	
i)	Minimum tensile strength of bolts (Kg/cm sq.)	
ii)	Proof load on nuts (Kg)	
c)	Manufacturer	
N)	**WEIGHTS & DIMENSIONS**	
1	Shipping weight of heaviest package	
2	Dimensions of largest package	
3	Shipping weight of all special lifting devices wrenches and tools etc.	
4	Shipping weight of SF6 gas treatment unit	
5	Weight of each type of switchgear bay module	
i)	Transmission line feeder	
ii)	Generator transformer incoming feeder	
iii)	Bus coupler bay module	
6	Untanking height (i.e. height under hook required)	
7	Shipping weight of SF6 gas cylinders required for first filling and testing	
8	Approximate shipping dimensions of all gas cylinders	
9	Clearance required between max hook reach & highest point of equipment	
O)	**TOLERANCES**	
1	Tolerance (vertical & horizontal) and at interface of SF6 to Transformer oil bushing	
2	Tolerance (vertical & horizontal) and at interface of SF6 to GIS bus Reactor bushing	

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SECTION 3:
PROJECT DETAILS & GENERAL TECHNICAL REQUIREMENTS
(FOR ALL EQUIPMENT UNDER PROJECT)

1. GENERAL

1. This section stipulates the General Technical Requirements under the Contract and will form an integral part of the Technical Specification.
2. The provisions under this section are intended to supplement general requirements for the materials, equipment's and services covered under other respective sections and are not exclusive. However, in case of conflict between the requirements specified in this section and requirements specified under other sections, the requirements specified under respective sections shall hold good.

2. PROJECT INFORMATION AND SYSTEM PARAMETERS

Project information and System parameters shall be as follows,

A.	**Project Information**	
a)	Customer/ Purchaser/ Owner	THDC India Ltd., Rishikesh, Uttarakhand
b)	Consultant/ THDCIL	SMEC
c)	Project Title	Vishnugad Pipalkoti Hydro Electric Project (4X111MW)
d)	Location	The Vishnugad Pipalkoti Hydro Electric Project (4 x 111 MW) is located on Alaknanda River, a major tributary of river Ganga, in district Chamoli in the state of Uttarakhand.
e)	Transport Facilities	The nearest railhead is Rishikesh (225 Km) and the nearest Airport is Jolly Grant, Dehradun (240 Km). The project is approachable by an all-weather road (National Highway No. 58).
f)	Postal Address	It shall be provided separately
B. Site Conditions		
a)	Maximum ambient Temperature	40^0C
b)	Minimum ambient Temperature	-7^0C

c)	Design ambient temperature for electrical equipment design	40^0C
d)	Relative humidity	100%
e)	Pollution Severity	Heavily Polluted
f)	Seismic zone	IV
g)	Seismic Coefficient	0.38g (In horizontal direction), 0.19g (In vertical direction) for design purpose
h)	Basic Wind speed	39m/sec
i)	Maximum rainfall	293.3mm in 24 hours
C. System Parameters and Clearances (At EL 1000)		
i)	Nominal system Voltage	400kV
ii)	Highest system voltage	440kV
iii)	Rated short time current	40kA for 1 sec
iv)	Frequency	50Hz±3 %
v)	Normal Current	2000A
vi)	Lightning impulse withstand voltage	1425kVp
vii)	Switching Impulse voltage	1050kVp
viii)	Power frequency withstand Voltage	630kVrms
ix)	Minimum creepage Distance	25mm/kV
x)	System earthing	Solidly earthed
xi)	Phase to phase Clearance	4200mm
xii)	Phase to Earth Clearance	3500mm
xiii)	Sectional Clearance	6500mm
D. Auxiliary Power Supply		

i)	3 phase A.C power supply	415V ± 10%, 50 Hz ± 3%, 3-phase 4 wire, solidly earthed , Frequency variation under extreme condition ± 5%
ii)	1 phase A.C power supply	240V ± 10%, 50 Hz ± 3%, 1-phase , 2 wire , AC supply , Frequency variation under extreme condition ± 5%
iii)	D.C. power supply	220V + 20% to -25%, 2-wire ungrounded 48V + 20% to -25% , 2 wire system positively earthed
iv)	Combined variation of voltage ± 10%, and frequency ± 5%,	

3. GENERAL TECHNICAL REQUIREMENTS

i. Type Tests

All equipment/systems to be supplied shall conform to type tests as per relevant standards and proven type. The Bidder / vendor shall furnish the reports of all the type tests carried out within last ten years from the date of signing of contract (i.e. 18.11.2014) as listed in relevant clauses in respective electrical specification and relevant standards for all components / equipment / systems. These reports should be for the tests conducted on identical/ similar components /equipment/systems to those offered / proposed to be supplied under this contract.

Type tests done in an independent government laboratory or in the presence of representative of State Electricity Board or other reputed public undertakings, the type test reports of the same shall be submitted for scrutiny /approval. If these are found suitable and technically acceptable, conducting of type tests shall be waived off.

In case Vendor is not able to submit report of type test(s) conducted in last ten years, or in case type test report(s) are not found to be meeting the specification/relevant standard requirements, then all such tests shall be conducted under this contract by the Bidder free of cost to Employer/Purchaser, and reports shall be submitted for approval. No charges shall be paid under this contract. All acceptance and routine tests as per relevant standards and specification shall be deemed to be included in the bid price.

ii. Codes and Standards

All materials and equipment shall generally comply in all respect with the latest edition of relevant international electro-technical commission (IEC) or any other internationally accepted standard which ensure equal or better quality or relevant Indian standard(IS) mentioned against each equipment and this specification. Other International/National standard such as DIN, VDI, BS etc. shall be accepted for only material codes and manufacturing standards, subject to the employer's approval.

ASTM (American Society for Testing Materials), AISI (American Iron and Steel Institute), DIN (German Industrial Standards) and BSI (British Standards) are approved standards for the supply of Materials.

Material tests according to DIN 50049-3.1 C shall be provided for all important parts of the equipment such as: steel plates for parts under hydraulic pressure, all major castings (runner, shutoff valve, etc.), large forgings (turbine and generator shaft etc.), high stressed large bolts etc.

For less important parts, certificates according to DIN 50049-2.3 are acceptable.

Materials shall be new and of first-class quality, suitable for the purpose, free from defects and imperfections, and the classifications and grades in conformance with the latest issue of the respective ASTM, AISI, DIN or BS standard. Material to other standards may be used if approval by the Owner has been obtained. Material specifications, including grade or class data, shall be shown on the appropriate detail drawings submitted for review.

The vendor shall indicate in the Technical Data Schedules, the materials and applicable standards for all major parts of the supply.

The materials shall be carefully selected for the intended purpose and due consideration of the site conditions and the tropical environment. Higher grade material shall be used where ordinary material is insufficient.

"Not withstanding reference made to various standards all equipment and works as per provisions and requirements of relevant and latest Indian Standards shall be acceptable".

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.

The international SI-system of units shall be used for documents, calculations, correspondence, drawings etc.

4. MATERIAL/ WORKMANSHIP

i. General Requirement

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

The design of the Works shall be such that installation, future expansions, replacements and general maintenance may be undertaken with a minimum of time and expenses. Each component shall be designed to be consistent with its duty and suitable factors of safety, subject to mutual agreements and shall be used throughout the design. All joints and fastenings shall be devised, constructed and documented so that the component parts

shall be accurately positioned and restrained to fulfil their required function. In general screw threads shall be standard metric threads. The use of other thread forms will only be permitted when prior approval has been obtained from purchaser.

Whenever possible, all similar part of the Works shall be made to gauge and shall also be made interchangeable with similar parts. All spare parts shall be interchangeable with, and shall be made of the same materials and workmanship as the corresponding parts of the Equipment supplied under the Specification. Where feasible, common component units shall be employed in different pieces of equipment in order to minimize spare parts stocking requirements. All equipment of the same type and rating shall be physically and electrically interchangeable.

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

The vendor/ contractor shall apply oil and grease of the proper specification to suit the machinery, as is necessary for the installation of the equipment. Lubricants used for installation purposes shall be drained out and the system flushed through where necessary for applying the lubricant required for operation. The vendor/ contractor shall apply all operational lubricants to the equipment installed by him.

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

The vendor/ contractor shall furnish the following:

- All oil for initial filling of all equipment supplied, plus 10% additional.
- Grease if required for initial filling of all of the equipment, plus 10% additional.

- Flushing fluids to flush and clean all systems.

ii. 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 favourable to the growth of fungi and mildew. The indoor equipment's located in non-air conditioned areas shall also be of same type.

5. COLOUR SCHEME AND CODES FOR PIPE SERVICE/ PANELS

All internal equipment and wiring shall be neatly and clearly marked as indicated on the schematic and wiring diagrams. Internal wiring and cables shall be marked with sleeve type engraved marking. Marking system and marking material shall be subject to approval by Owner. Identification of the respective conductors shall be in accordance with the requirements of IEC publication 204. In cable having 5 conductors or more the individual conductors shall be numbered throughout the entire length. In cables having less than 5 conductors colour coding in accordance with IEC Recommendations 204 shall be used.

The vendor/ contractor shall propose a colour scheme for those equipment/Items for which the colour scheme has not been specified in the specification for the approval of purchaser. The decision of purchaser shall be final. The scheme shall include,

Live parts of electrical connections shall be colour coded as follows,

Conductor Designation	Coding Alphanumeric	Symbol	Colour
AC network 3 phase	Phase 1	R	Red
	Phase 2	Y	Yellow
	Phase 3	B	Blue
	Neutral	N	Black
AC single phase	Phase	P	Red
	Neutral	N	Black
	Earth	E	Green yellow
DC network	Positive	a	Red
	Negative	b	Black

Colour Coding for Mimic Diagrams

Mimic diagrams to be arranged on switchgear cubicles, control panels/desks, etc., shall be colour coded as follows,

420kV	Gold
13.8kV	Signal red
415V	Black
220V DC	Violet
48V DC	White

All the steel works shall be thoroughly cleaned of rust, scale, oil, grease, dirt and scarf by pickling, emulsion cleaning, etc. The sheet steel shall be phosphated /oven dried and then painted with two coats of zinc rich primer paints. After application of the primer, two coats of finished synthetic enamel paint shall be applied. The colour of the finished coats inside shall be glossy white and exterior of the treated sheet steel shall be shade 631 of IS 5 /RAL 7032 for all switchboard /MCC/distribution board, control panels etc.

Sufficient quantities of touch paint shall be furnished for application at site. All the indoor cubicles shall be the same as exterior surface and for other miscellaneous items, colour scheme will be approved by the purchaser.

6. PROTECTION

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

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

7. FUNGI-STATIC VARNISH

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

8. SURFACE FINISH

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

All metal surfaces exposed to atmosphere shall be given two primer coats of zinc chromate and two coats of epoxy paint with epoxy base thinner. All metal parts not accessible for painting shall be made of corrosion resisting material. All machine finished or bright surfaces shall be coated with a suitable preventive compound and suitably wrapped or otherwise protected. All paints shall be carefully selected to withstand tropical heat and extremes of weather within the limit specified. The paint shall not scale off or wrinkle or be removed by abrasion due to normal handling.

9. GALVANIZING

The minimum weight of the zinc coating shall be 610 gm/sq.m and minimum average thickness of coating shall be 86 microns for all items having thickness 6mm and above. For items lower than 6mm thickness requirement of coating thickness shall be as per relevant ASTM. For surface which shall be embedded in concrete, the zinc coating shall be 610 gm/sqm minimum.

10. TRANSPORT AND PACKING

i. Packing

The bidder is advised to have a total study of all aspects of transportation of equipment's to site and should make schedule of transportation in accordance with the prevailing conditions at site. The bidder shall specifically understand that the Purchaser will do the general co-ordination of storage and erection works as well as civil engineering works of power house. An appropriate Period for transportation shall be considered accordingly.

The delivery dates, transportation and erection periods and for all other associated activities indicated in the Contract Documents shall be strictly adhered to. Changes, which are unavoidable or necessary, will be regulated in accordance with the stipulations laid down in the General Conditions of Contract.

From the time of manufacturing until commissioning all parts of the plant shall be protected and insured at the vendor/ contractor's expense against loss & damage of any kind. Parts, which are damaged during transport, storage, erection or trial operation, shall be replaced at the vendor/ contractor's expense.

ii. Packing and Marking

The vendor/ contractor shall prepare all plant, devices and materials for shipment to protect them from damage in transit, and shall be responsible for and make good all damages due to improper preparations, loading or shipment.

After the workshop assembly and prior to dismantling for shipment to the Site, all items of machinery and plant shall be carefully marked to facilitate site erection. Wherever applicable, these markings shall be punched or painted so that are clearly visible.

Dismantling shall be done into convenient sections, so that the weights and sizes are suitable for transport to Site and for handling on the Site under the special conditions of the Project.

All individual pieces shall be marked with the correct designation shown on the vendor/ contractor's detailed drawings and other documents (packing, lists, spare part lists, in Operating and Maintenance Instructions, etc.).

Each piece, separately shipped, or smaller parts packed within the same case or box, shall be legibly, marked to show the unit to which it is a part and match-marked to show its relative Position in the unit.

Unit marks and match-marks shall be done preferably by punching the marks into the metal before painting, galvanizing, etc., and shall be clearly legible after painting, galvanizing etc. In labelling, the vendor/ contractor shall endeavour to use as few designations as possible, and each part of identical size and detail shall have the same designation, regardless of its final position in the plant.

All parts of the plant shall be packed at the place of manufacture; the packing shall be suitable for shipment by sea and for all special requirements of the transportation to Site. Where necessary, double packing shall be used in order to prevent damage and corrosion during intermediate storage.

All identical members shall be packed together, if reasonably possible, in a form convenient for shipment and handling.

Small items shall be packed in boxes and large items shall be protected where necessary, by timber, straw and sacking. Drums shall be used for electric cables, steel ropes, steel wire and similar materials. All bolts, nuts, washers. etc., shall be packed in containers. Each container shall include only bolts, nuts or washers of identical size.

All parts shall be suitable protected against corrosion, water, sand, heat, atmospheric conditions, shocks, impact, vibrations, etc.

All electrical parts shall be carefully protected from damage by sand, moisture, heat or humid atmospheric conditions by packing them in high pressure polyethylene foil. Where parts may be affected by vibration, they shall be carefully protected and packed to ensure that no damage will occur while they are being transported and handled.

Spare parts shall be packed separately and designated as specified and shall be delivered properly and adequately packed for several years' storage. All packing costs shall be included in the scope of Work.

iii. Shipping marks

The vendor/ contractor shall mark all containers with the implementing document number pertinent to the shipment. Each shipping container shall also be clearly marked on at least two sides as follows,

Consignee:

Contract No.:

Port of destination:

Item number (if applicable):

Package number, in sequence:

Quantity per package:

Description of Work:

Net and gross weight, volume, Dimensions:

iv. Packing lists

The vendor/ contractor shall provide the Purchaser with one (1) original and two (2) copies of all shipping documents and relevant packing lists of each shipment of equipment items after the same has been shipped. One copy (1) of the packing list shall sent to the Purchaser's Representative. All packing lists shall contain the name of the vendor/ contractor or supplier and shall show the complete markings on each packed box or crate that has been shipped. Separate packing lists shall be prepared for each and all shipments made. One copy of the packing list shall be placed inside each box or crate, and one copy inserted in a weatherproof envelope affixed to the outside of each box or crate.

11. HANDLING, STORING AND INSTALLATION

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

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

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

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

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

12. DEGREE OF PROTECTION

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

a) Installed out door: IP-55

b) Installed indoor in air conditioned area: IP-42

c) Installed in covered area IP:52

d) For LT switchgear (AC & DC distribution Boards): IP-54

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

13. RATING PLATES, NAME PLATES AND LABELS

Each major and auxiliary item of equipment shall have a nameplate permanently affixed thereto, or as directed, showing in a legible and durable manner the serial number, name and address of the manufacture, rated capacity, speed, electrical characteristics, and other significant information, as applicable. Nameplates of distributing agents only will not be acceptable. Nameplates shall also be provided for identification of all panels, cubicles and other enclosures as well as for panel-mounted devices, dials, gauges instruments and control devices. Nameplates shall be marked with the nomenclature and units of measurement used in the metric system (SI- units), and a schedule of such markings shall be submitted for review. Type of nameplates and wording on identification nameplates shall be submitted in **English for approval**. The Owner will translate the text if needed and the vendor/ contractor shall furnish and attach the nameplates.

Cautionary signs: English shall be used as prime language on nameplates required for caution or warning signs, identification plates for control devices, and instruction plates.

Other nameplates: Nameplates which are not required for the operation of the equipment and are not of a cautionary or warning nature required for the safety of personnel, i.e. showing motor speeds, horsepower, electrical characteristics, name and address of manufacturer and other information necessary for maintenance and repair work are to be in English.

14. EARTHING

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

All equipment such as cubicles, motors, etc. shall be connected directly to the grounding system using copper wire of area not less than 50 mm2 at two different points. In general all iron parts such as supports, covers, railing, etc. shall be connected to the grounding system. Each conductor shall have its own separate connection point. Pressed on closed shoes shall be used for connections to bars.

15. TERMINAL BLOCKS AND WIRING

i. Wiring

Wiring within cubicles and equipment enclosures shall conform to requirements of this section unless otherwise specified. Control wiring shall be stranded copper and shall be not smaller than 2.5 mm2, except as otherwise agreed by the Owner. Larger size wiring shall be used where needed for the current carrying capacity requirements.

Cables shall have at least 1100 V PVC insulation except for 220V DC and telemetering or communication system equipment for which 650V and 300V rating respectively are acceptable.

For current and potential transformer secondary circuits the cross section of the conductors shall not be less than 6 mm2 and 4 mm2 respectively.

Wiring shall terminate at terminal blocks at one side only. Where tap connections are required they shall be made on terminal blocks. Wiring shall be neatly arranged and laid in conduits accessible from the front door. The conduits shall not be filled more than 70%.

Each cubicle shall be provided with an earthing bar (PE) of sufficient cross section carrying any possible fault current without undue heating. All metallic parts of the cubicle not forming part of the live circuits, all instrument transformer terminals to be earthed and

other earthing terminals as well as all cable screens and PE-wires shall be connected to the earthing bar.

ii. Terminal blocks

The terminal blocks shall be located to allow a neat and easy connection work and shall be safely accessible while the equipment is in service. Control circuits and power circuits shall be completely separated by use of divided or separate terminal blocks. Power terminal blocks shall be rated in accordance with applicable standards, and shall be provided with covers. Control wiring terminal shall be equipped with facilities for opening the circuit. It shall be possible to interchange a single terminal block for a new one without dismantling a whole row. Current transformer terminal blocks shall have provisions for short circuiting. Not more than two wires shall be connected to any one terminal. Terminal blocks using screws acting directly on the wire will not be accepted. At least 20% spare terminals shall be provided. Terminals shall be marked with printed labels.

But preferably the terminal blocks shall be **non-disconnecting stud type equivalent to Elmex type CATM4, Phoenix cage clamp type of Wedge** or equivalent. The Insulating material of terminal block shall be nylon 6.6 which shall be free of halogens, fluorocarbons etc.

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

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

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

16. ELECTRICAL EQUIPMENT ENCLOSURE

i. General

All electrical equipment, apparatus and devices shall be of suitable design for satisfactory operation under the conditions prevailing at the Site. The equipment shall operate satisfactorily under normal load and voltage variations in accordance with IEC Publications.

The design shall also include all necessary provisions ensuring the safety of the operating and maintenance personnel.

All electrical connections and contacts shall be of ample cross section and capacity for carrying continuously the specified currents without undue heating and shall be secured by bolts or set-screws of ample size, fitted with locknuts or lock washers of approved types.

Unless otherwise expressly stated, conductors and all other current carrying parts shall be electrolytic copper in accordance with approved, applicable standards.

Cubicles and other enclosures containing electrical equipment shall be especially treated to prevent corrosion. All cubicles shall be provided with a door switched lighting fixture and a single phase socket for power outlet.

All interior surfaces of electrical apparatus, enclosures etc. including contactors, relays, coils, etc., shall be treated in an approved manner to prevent mould growth. Such treatment shall in no way interfere with the proper operation of the equipment either electrically or mechanically.

Bigger assemblies such as switchboards, etc., shall be designed to present suitable transportation divisions adapted to the local conditions within the plant.

Unless otherwise specifically called for or described in these Contract Documents all electrical appliances shall conform to the applicable IEC Publications.

ii. Construction requirements

All cubicles and enclosures shall be of good quality standard production subject to approval by the Owner. Cubicles shall be free floor standing type, of rigid frame covered with removable steel sheets. The frame shall be bolted to the floor. There shall be provision and enough space for entrance of cables from above or below as necessary. The cubicles shall be ventilated if needed; in this case removable filter inserts shall be fitted to the air entrance openings. Provision for cable fastening shall be inside the cubicles and enclosures, and sufficient space from cable fastenings to nearest terminal. All control and indicating instruments such as contactors, circuit breakers, auxiliary relays, indicating instruments, switches etc., shall be functionally displayed in appropriate location. All indicating devices shall be visible with the door closed. The layout is subject to the approval of the Owner.

If required, flush mounted hinged steel doors with latches shall be available: doors shall be with approved locks. The locks shall be of the same type throughout the plant. All panels and cubicles shall have a uniform appearance.

The cubicles and enclosures shall be of protection class IP 54 or higher according to their location, unless otherwise, there are constraints which may prevent to maintain above protection class and same shall be justified by the vendor/ contractor and approval shall be taken from the owner for the deviation. All cubicles shall be equipped with automatically controlled heating elements for protection against internal condensation and moisture.

All panels/cubicles shall have approximately 20% space for mounting of future devices.

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

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

17. SPACE HEATERS

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

One or more adequately rated, thermostatically connected heaters shall be supplied to prevent condensation in any compartment.

18. QUALITY

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 vendor/ contractor for some of the major items is given in the respective technical specification. This is, however, not intended to form a comprehensive programme as it is the vendor/ contractor's responsibility to draw up and implement such programme duly approved by the Employer. The detailed Quality Plans for manufacturing and field activities shall be drawn up by the Bidder and will be submitted to Employer for approval. Schedule of finalisation of such quality plans will be finalised before award.

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 vendor/ contractor'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 and approval. After approval the same shall be submitted in compiled form on CD-ROM.

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

The Bidder shall also furnish copies of the reference documents/plant standards/ acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality Plans and reference documents/ standards etc. will be subject to Employer's approval without which manufacturer shall not proceed. These approved documents shall form a part of the contract. In these approved Quality Plans, Employer shall identify customer hold points i.e. test/checks which shall be carried out in presence of the Employer's Project Manager or his authorised representative and beyond which the work will not proceed without consent of Employer in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Employer along with technical justification for approval.

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

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

The vendor/ contractor shall submit to the Employer Field/ Site Welding Schedule for field welding activities. The field/site welding schedule shall be submitted to the Employer along with all supporting documents, like welding procedures, heat treatment procedures, procedures etc. at least ninety days before schedule start of erection work at site.

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 Employer.

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

All brazers, welders and welding operators employed on any part of the contract either in vendor/ contractor's/ 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 Employer.

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

Any other statutory requirements for the equipment/systems shall also be complied with. On all back-gauged welds MPI/LPI shall be carried before seal welding.

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

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

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

The vendor/ contractor shall list out all major items/ equipment/ components to be manufactured in house as well as procured from sub-contractors (BOI). All the sub-contractor proposed by the vendor/ 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 vendor/ contractor and finalised with the Employer, shall be subject to Employer's approval. The vendor/ contractor's proposal shall include vendor's facilities established at the respective works, the process capability, process stabilization, QC systems followed, experience list, etc. along with his own technical evaluation for identified sub-contractors enclosed and shall be submitted to the Employer for approval within the period agreed at the time of pre-awards discussion.

For components/equipment procured by the vendor/ contractors for the purpose of the contract, after obtaining the written approval of the Employer, the vendor/ contractor's purchase specifications and inquiries shall call for quality plans to be submitted by the suppliers. The quality plans called for from the sub-contractor shall set out, during the various stages of manufacture and installation, the quality practices and procedures followed by the vendor's quality control organisation, the relevant reference documents/standards used, acceptance level, inspection of documentation raised, etc. Such quality plans of the successful vendors shall be finalised with the Employer and such approved Quality Plans shall form a part of the purchase order/ contract between the vendor/ contractor and sub-contractor. Within three weeks of the release of the purchase orders /contracts for such bought out items /components, a copy of the same without price details but together with the detailed purchase specifications, quality plans and delivery

conditions shall be furnished to the Employer on the monthly basis by the vendor/ contractor.

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

The vendor/ contractor shall carry out an inspection and testing programme during manufacture in his work and that of his subcontractor'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. Vendor/ contractor shall carry out all tests/inspection required to establish that the items/equipment conform to requirements of the specification and the relevant codes/standards specified in the specification, in addition to carrying out tests as per the approved quality plan.

Quality audit/surveillance/approval of the results of the tests and inspection will not, however, prejudice the right of the 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 vendor/ contractor in ensuring complete conformance of the materials/equipment supplied to relevant specification, standard, data sheets, drawings, etc.

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

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

19. DOCUMENTATION

i. List of Documents

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

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

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

ii. Drawings

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

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

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

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

iii. Approval Procedure

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

i.	Approval/comments/by employer on Initial submission	Within 3 weeks of receipt
ii.	Resubmission	Within 2 (two) weeks (whenever from date of comments required) Including both ways postal time.
iii.	Approval or comments	Within 2 weeks of receipt of resubmission
iv.	Furnishing of distribution copies	2 weeks from the date of last approval.

Note: The vendor/ contractor may please note that all resubmissions must incorporate, all comments given in the submission by the Employer failing which the submission of documents is likely to be returned. Every revision shall be a revision number, date and subject, in a revision block provided in the drawing, clearly marking the changes incorporated.

The title block of drawings shall contain the following information incorporated in all contract drawings. Please refer below mention Title block for Submission of Documents.

Title Block

Customer	M/s THDC India Ltd., Rishikesh, Uttarakhand
Project:	Vishnugad Pipalkoti Hydro Electric Project (4X111MW)
Vendor/ contractor:	Bharat Heavy Electricals Ltd.

iv. Documents to be Submitted along with Offer

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

v. Documentation Schedule

Sl. No.	Description	Tender Stage	Contract stage for approval	Final Documentation	
			Prints	Prints	CDs
1	Drawings and Data Sheets	1	5	10	-
2	Drawings "As Built "	-	-	10	04
3	Type Test Reports	1	2	3	-
4	Erection Manuals	-	2	4	-
5	Operation and Maintenance Manuals	-	2	4	-
6	Manufacturing Quality Plan	1	2	4	-
7	Field Quality Plan	1	2	4	-
8	Inspection Test Reports	-	-	4	-

Soft copies of drawings at contract stage shall also be submitted in **PDF format**. Drawings will also be submitted in CD in **AUTOCAD** package for all major items. Final Documentation shall be submitted in bound volumes with Customer & Project etc. written on top.

20. ELECTRICAL MEASUREMENTS

All Electrical instruments shall be of flush mounted design, dust and moisture-proof. AC Ammeter and Voltmeters shall have moving iron system of not less than 1.5 accuracy class for connection to the secondary side of instruments transformer.

The indicating elements of each digital indicator shall be seven segment LED illumination type. The number of digits of each digital indicator shall be selectable to be sent the required indication. The watt and the var indicators for the circuits where direction of power flow may be changed, shall be provided with "+" and "- "signs.

All transducers shall be solid –state type with an output signal range of 4-20mA DC OR 1 to 5V DC, unless otherwise specified.

All wells for capillary type thermometers, resistance temperature sensors and thermocouples shall be of the weld-in type. Wells for thermometers and temperature sensors of the screw-in type shall be restricted to measuring points for lubrication oil, and to such measuring points where welding is not suitable, e.g., at cast-iron parts. Shop-welded thermometer wells be covered by screw caps for protection during transportation and erection.

Resistance thermometers and thermocouples shall be equipped with waterproof connection heads. Thermometer arrangements shall be such that the connection heads do not become warmer than 80OC, and the measuring inserts are easily exchangeable.

The temperature sensors shall be selected in such a way to minimize the number of different spare inserts.

Contents

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ANNEXURE-D: Technical Checklist 4

ANNEXURE-A: Compliance Certificate of Technical Specification

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

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

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

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

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

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

Date: Bidder's Stamp & Signature

ANNEXURE-B: Deviation/ Change Request of Technical Specification

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

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

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

Date: Bidder's Stamp & Signature

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS OF SF6 GAS INSULATED SWITCHGEAR

Sl. No	Particulars	To be Filled By Bidder
I	**Guaranteed Technical Particulars of complete GIS module**	
1	Name of manufacturer	
2	Place of manufacture, inspection & testing	
3	Manufacturer's type/designation	
4	Rated voltage	
5	System frequency	
6	Maximum (continuous) service rated voltage	
7	Normal current rating	
a)	Generator Transformer feeder circuit	
b)	Line feeder circuit	
c)	Bus coupler circuit	
8	Short time current rating	
a)	1 second rms	
b)	3 second rms	
9	Rated Lightning impulse withstand voltage	
a)	Phase to earth	
b)	Across open contacts	
10	Rated Switching impulse withstand voltage	
a)	Phase to earth	
b)	Phase to phase	
c)	Across open contacts	
11	Rated one minute power frequency withstand voltage	
a)	Phase to earth	
b)	Across open contacts	
12	Maximum temperature rise over ambient of 38°C	
13	Thermal rating of current carrying parts at 420kV for the rated symmetrical short circuit current	
14	Altitude upto which the switchgear shall operate satisfactorily	
15	Ambient conditions of the operation of the GIS	
16	Earthing details of enclosure	
17	Density and pressure of gas in various compartments of the enclosure	
	-Pressure of gas	

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS OF SF6 GAS INSULATED SWITCHGEAR

	-	Gas density	
18	a)	Features adopted for preventing burn through in the various enclosures of SF6 GIS	
	b)	Time to withstand an internal flashover without burn through	
19		Guaranteed life of the GIS	
20		Guaranteed number of loaded/unloaded operations of various equipments of SF6 GIS i.e. circuit breakers, disconnectors, grounding switches (please mention item wise).	
21	a)	Average leakage of SF6 gas from the equipment and percentage per year	
	b)	Quantity of SF6 gas required to completely charge the 3-pole equipment including any tank storage system	
	c)	Quantity of SF6 gas required for largest gas compartment	
	d)	Operating pressure	
	i)	Circuit breaker	
	ii)	Others	
22		Details of the features existing in the equipment to carry out PD measurements at works/site	
23		Details of the control wiring used in the equipment	
24		The extent of field welding required for site assembly, if any alongwith the procedure to be adopted by the firm at site	
25		Details of the documents, drawings & photographs enclosed showing the basic operating principles of the major components of the equipment, presenting a clear picture of the fundamental principle, general arrangements and operating mechanism.	
26		Details of the flow diagram/ drgs. enclosed showing all valves and pressures involved, for the hydraulic and gas system.	
27		Details of the test data enclosed including test data of the parts indicating the ability of the equipment (including high speed grounding switches)	

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS OF SF6 GAS INSULATED SWITCHGEAR

28		The values of resistors inserted in the line and shunt reactor circuit breaker during closing operations, if any, alongwith the length of time the resistors are left in the circuit	
29		Methods adopted to limit switching surges for breaker and disconnectors	
30		Values of maximum switching surges generated	
31		Heat generated in KW when the complete switchgear is operating at its rated capacity	
32		Noise level	
33		Material used in fabrication (Copper, Aluminum, Silver, Stainless Steel etc).	
	a)	Breaker main contact surfaces	
	b)	Disconnecting switch contact surfaces	
	c)	Grounding switch contact surfaces	
	d)	Internal bus	
	e)	Internal bus contact surfaces	
	f)	Bus enclosure	
	g)	Terminal pads	
	h)	Terminal pad contact surface	
	i)	Bellows or compensating units	
34		Operating Mechanism	
	a)	Breaker	
	b)	Disconnecting switch	
	c)	High speed fault making grounding switch	
	d)	Safety grounding switch	
35		Time required to recharge the operating system to a fully charged condition after four successive operations (without pumping action)	
36		Details of provisions made for movement of maintenance personnel on the equipment	
37		Capacitance per metre of the enclosed bus	
38		Surge impedance in ohms of the enclosed bus (The bidder should furnish the method used for the calculations of surge impedance and capacitance of insulated bus)	
39	a)	Electric resistance	

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS OF SF6 GAS INSULATED SWITCHGEAR

	i)	Internal bus at 75^{0}C	
	ii)	Internal bus at 20^{0}C	
	iii)	Bus enclosure at 75^{0}C	
b)		Data used for calculation of electric resistance in (a)	
	i)	Cross sectional area of bus conductor	
	ii)	Cross sectional area of bus enclosure	
	iii)	Conductivity of material of bus conductor	
	iv)	Conductivity of material of bus enclosure	
	v)	Current density in bus conductor	
40		Maximum power losses in the bus bar per single phase meter at rated voltage and current at 20°C	
a)		Enclosure	
b)		Conductor	
41		Temperature rise limits	
	i)	For Internal bus conductor	
	ii)	For Bus enclosure	
42		Dimensions	
a)		Bus enclosure outside diameter	
b)		Bus enclosure wall thickness	
c)		Internal bus, outside diameter	
d)		Internal bus thickness	
43		Weight	
		The weight of each assembled bay to be indicated separately	
II		***Equipments of GIS***	
A)		**Circuit Breaker**	
		(The following particulars for each type of breaker shall be furnished)	
1		Name plate data	
i)		Manufacturer's name	
ii)		Type/designation	
iii)		Rated frequency	
iv)		Rated voltage	
v)		Rated interrupting current	
vi)		Number of poles	
vii		Class (indoor)	
viii)		Number of interrupting chambers per pole	
ix)		Maximum Operating Voltage Breaking Capacity	

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS OF SF6 GAS INSULATED SWITCHGEAR

		Making & Breaking	
	a)	Breaking Capacity	
		i)	Rated breaking current
		ii)	Rated breaking MVA (Symmetrical) (kA rms)
		iii)	Breaking time
	b)	Making Capacity	
		i)	Rated making current
		ii)	Rated making MVA symmetrical
		iii)	Making time
2		Operating voltages of closing/opening coil	
	i)	Maximum operating voltage	
	ii)	Minimum operating voltage	
	iii)	Range factor	
3		Current ratings	
	i)	Rated continuous current at 38°C	
	ii)	Rated interrupting current for 1 second	
	iii)	Rated symmetrical interrupting current	
	iv)	Rated asymmetrical interrupting current	
	v)	Percentage DC component	
	vi)	Rated short circuit making current	
	4	Rated Insulation level	
	a)	Dry one minute power frequency withstand voltage	
		i)	To earth
		ii)	Across open contacts
	b)	1.2/50 microsecond full wave lightning impulse withstand voltage	
		i)	To ground
		ii)	Across the open contacts
	c)	250/2,500 micro-second switching impulse withstand voltage	
	d)	Line to ground power frequency withstand voltage at gas pressure equivalent to atmospheric pressure	
	e)	Minimum allowable moisture content in interrupting medium	
	f)	Total breaking time	
		i)	At 10% rated interrupting capacity
		ii)	At 60% rated interrupting capacity
		iii)	At 100%rated interrupting capacity
5		Maximum temperature rise above ambient at rated load and voltage for	

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS OF SF6 GAS INSULATED SWITCHGEAR

	i)	Contacts	
	ii)	Hottest part	
6		Operating data	
	i)	Rated operating duty cycle	
	a)	Line Breakers	
	b)	Generator Transformers& Bus Coupler Breakers	
	ii)	Reclosing duty cycle (Line Breakers)	
	iii)	Permissible tripping delay	
	iv)	Maximum arc duration at	
	a)	10% rated breaking current	
	b)	30% rated breaking current	
	c)	60% rated breaking current	
	d)	100% rated breaking current	
	v)	Closing time	
	vi)	Total breaking time at	
	a)	10% rated breaking current	
	b)	30% rated breaking current	
	c)	60% rated breaking current	
	d)	100% rated breaking current	
	e)	Arc duration from separation of arc at contact to instant of arc extinction for full rated interrupting capacity	
	vii)	Length of arc at	
	a)	10% rated breaking current	
	b)	30% rated breaking current	
	c)	60% rated breaking current	
	d)	100% rated breaking current	
	e)	Max. length of arc at lowest fault current	
	viii)	Longest time to interrupt current less than 25% of rated symmetrical short circuit current from energizing trip circuit	
	ix)	Minimum time from arc extinction to contact remake for auto reclosing	
	x)	Minimum dead time for	
	a)	3 phase reclosing	
	b)	1 phase reclosing	
	xi)	Maximum difference of time at opening of series contacts within one pole	
	xii)	Maximum difference of time at opening between phases	
	xiii)	Maximum difference of time at closing	

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS OF SF6 GAS INSULATED SWITCHGEAR

	between phases	
xiv)	Details of the curve enclosed for maximum opening time vs. 3 phase fault current	
xv)	Number of interruptions before scheduled maintenance is required	
xvi)	Number of mechanical operations before scheduled maintenance is required	
xvii)	Number of interruptions at rated SC current with associated TRV without changing any parts	
xviii)	Description and frequency of scheduled maintenance required	
xix)	Time interval between the issue of trip command and the instance of opening of breaker contact	
xx)	Recovery voltage rate of rise at	
a)	Rated symmetrical interrupting current	
b)	60% of rated symmetrical interrupting current	
c)	30%of rated symmetrical interrupting current	
d)	10%of rated symmetrical interrupting current	
xxi)	Amplitude factor	
xxii)	Phase factor	
xxiii)	Natural frequency	
xxiv)	Devices used for controlling RRRV	
xxv)	Devices used for uniform voltage distribution	
xxvi)	Distribution of voltage across breaks	
xxvii)	Details of Switching resistors required	
a)	Pre-insertion (on closing)	
b)	Pre-insertion time	
c)	Tripping (ohm)	
xxviii)	Recovery voltage distribution between breaks in percent of rated voltage	
a)	Single line to ground fault	
b)	Interruption of short lines	
c)	Switching off an unloaded transformer	
7	Details of the operating mechanism	
i)	Tripping coil	
ii)	Closing coil	
iii)	Number of closing coils	
iv)	Number of tripping coils	

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS OF SF6 GAS INSULATED SWITCHGEAR

8		Hydraulic fluid supply system for mechanical operation	
	i)	Pump, motor, hp, voltage/phase and quantity of motors	
	ii)	Storage compartment pressure	
	iii)	Minimum oil pressure required for successful interruption, breaker rating	
	iv)	No of stored close-open operation without pumps operation	
	v)	Quantity of oil required for one close-open operation	
9		SF6 gas system	
	i)	Normal operating pressure	
	ii)	Normal operating density	
	iii)	Weight of gas per breaker	
	iv)	Lockout pressure	
	v)	Alarm pressure	
	vi)	Whether breakers work at single pressure or dual pressure	
	vii)	Type of SF6 gas flow (axial or radial)	
	viii)	Type of nozzles (single flow or double flow)	
	ix)	Compression ratio for puffer action	
	x)	Quantity of compressed gas for puffer action	
	xi)	Total volume of SF6 gas required per circuit breaker at operating pressure	
10		Control power requirement	
	i)	Tripping (3poles) current at rated supply voltage (220V DC)	
	ii)	Tripping (3poles) current at 70% of rated supply voltage (220V DC)	
	iii)	Closing (3 poles) current at rated supply voltage (220V DC)	
	iv)	Closing (3 poles) current at 85% of supply voltage (220V DC)	
	v)	Tripping voltage range percent	
	vi)	Closing voltage range percent	
11		Heaters	
	i)	Continuously current rating	
	ii)	Thermostat power rating	
12		Noise performance (circuit breaker operation)	

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS OF SF6 GAS INSULATED SWITCHGEAR

i)	Measurement standard	
ii)	Noise level	
iii)	Distance	
13	Interrupters	
i)	Type of main contacts, arcing contacts & auxiliary contacts	
ii)	Material of main contacts/arcing contacts, silver coated or not	
iii)	Contact pressure	
iv)	Number of interrupters per pole	
v)	Break length of an interrupter	
vi)	Length of contact travel	
vii)	Rate of contact travel at tripping	
viii)	Rate of contact travel at closing	
14	First pole to clear factor	
15	Whether fixed trip or trip free	
16	Details of anti-pumping device	
17	Rated line charging breaking current	
18	Rated small capacitive breaking current	
19	Rated small inductive breaking current	
i)	Generator transformer, Line & Bus coupler breakers	
20	Rated characteristics for short line fault	
21a)	Rated transient recovery voltage for terminal faults	
b)	Parameters as per IEC	
22	Rated value of phase making current	
23	Maximum interrupting capacity under phase opposition conditions	
24	Capacity for interrupting in-rush current of transformer	
25	Max. over voltage factor of the circuit breaker when switching off	
i)	Unloaded transformer	
ii)	Loaded transformer	
iii)	Open circuited lines	
iv)	Synchronous system	
26	Details of operation counter	
27	No. of auxiliary contacts, their continuous rating and breaking capacities, including those used for circuit breaker operation and interlocking	

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a)	Those closed when breaker is closed	
b)	Those open when breaker is open	
c)	Those adjustable w.r.t. the position of main contacts	
28	Partial discharge level at 1.1 Un/√3	
29	Radio interference level at 266kV rms	
30	Corona extinction voltage	
31	Maximum impact loading on foundation during breaker opening and closing operations under fault conditions	
32	Seismic withstand value (horizontal and vertical)	
33	Tests to be conducted by the supplier at works (All details to be given)	
i)	Type tests	
ii)	Routine tests	
34	Tests to be conducted at site	
35	Overall dimensions (L x B x H)	
36	Weight of breaker complete with operating mechanism, bushing, frame work	
a)	with SF6 gas	
b)	without SF6 gas	
37	Descriptive bulletins and drawings of the circuit breakers giving general details of construction	
38	Out of phase switching capability of the circuit breaker	
39	Comments regarding the suitability of the circuit breaker for restrike free operation of power transformer carrying full load current	
40	Guaranteed time difference between the first pole and last pole operation timing	
41	Details of the standard accessories to be supplied alongwith the breaker	
42	No. of the enclosed drg. showing the control scheme of circuit breaker	
43	Details of the provision to be made on GIS to reduce HV transients to acceptable values	
44	Guaranteed degraded values of BIL switching surges and 50Hz rated values during the life of equipment (Test data to support this guarantee to be enclosed by	

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		the bidder)	
B)		**Disconnectors/Grounding Switches**	
B-I)		**Disconnector Switches**	
1		Manufacturer's name	
2		Type & designation	
3		Rated voltage	
	a)	Rated	
	b)	Maximum permissible	
4		1.2/50 microsecond lightning impulse withstand voltage	
	i)	Between line terminals and ground	
	ii)	Between terminals with disconnecting switch in open position	
5		250/2,500 microsecond switching impulse withstand voltage	
	i)	Between line terminals and ground	
	ii)	Between terminals with disconnecting switch in open position	
6		Dry one minute power frequency withstand voltage	
	i)	Between line terminals and ground	
	ii)	Between terminals with disconnecting switch in open position	
7		Rated frequency	
8		Rated normal current	
	i)	Generator Transformer module	
	ii)	Line module	
	iii)	Bus coupler module	
	iv)	Shunt Reactor module	
9		Rated peak short circuit current	
10		Interruption of loop current	
11		Rated short time current	
	i)	1 second	
	ii)	3 seconds	
12		Rated peak withstand current	
13		Rated inductive breaking current	
14		TRV caused by breaking/making inductive current	
15		Rated capacitive breaking current	
16		TRV caused by breaking/making capacitive current	

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17		Rated insulation level	
	i)	1 minute power frequency withstand voltage	
	ii)	1.2/50 microsecond lightning impulse withstand voltage	
	iii)	250/2,500 microsecond switching impulse withstand voltage	
18		Maximum temperature rise above ambient at rated current	
	i)	Contacts	
	ii)	Hottest part	
19		Motor operating mechanism	
	i)	Current during closing	
	ii)	Current during opening	
	iii)	Closing time	
	iv)	Opening time	
	v)	Operating voltage and range	
20		Design data	
	i)	Type of contacts	
	ii)	Contact area	
	iii)	Contact pressure	
	iv)	Surface treatment and thickness of surface coating/silver electrolytic plating	
	v)	Over travel distance after making of contacts	
	vi)	Distance between the contacts in the fully open position	
	vii)	Current density at the minimum cross section of switch blade	
	viii)	Speed of break	
21		Partial discharge level at 1.1 Un /√3	
22		Corona extinction voltage	
23		Radio interference level at 266kV rms	
24		Total operating time of disconnector along with its operating mechanism	
25		Total operating time of disconnector after the command is given	
26		Auxiliary switches	
	i)	No. of NO and NC contacts	
	ii)	Rated voltage	
	iii)	Rated current	

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iv)	Test voltage	
27	No. of operations the switch can withstand without any need for inspection	
28	Type of mounting	
29	No. of poles per phase	
30	Safety factor taken into account while designing the disconnector	
31	Type and material used for arcing contacts, if provided	
32	Weight of 3 pole isolating switch	
i)	with earthing blades	
ii)	without earthing blades	
33	Type of interlock between main isolator and earthing switch	
34	Details of the type test reports enclosed and the standards as per which these tests have been carried out	
35	Rated maximum time duration of short circuit	
36	Rated mechanical terminal load	
37	Rated supply voltage of operating devices and auxiliary circuits	
38	Rated pressure of SF6 gas	
39	Minimum distance between poles with regard to insulation and forces caused by short circuit currents	
40	Tests to be conducted by the manufacturer at Works	
i)	Type tests	
ii)	Routine tests	
41	Tests to be conducted at site	
B-II	**Safety Grounding Switches**	
1	Manufacturer's name	
2	Type/designation	
3	Maximum permissible operating voltage	
4	Maximum make and carry current for one second	
5	Rated inductive breaking current (A)	
6	TRV caused by breaking/making inductive current (kV)	
7	Rated capacitive breaking current (A)	
8	TRV caused by breaking/making capacitive current (kV)	

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9	Details of motor operating mechanism provided	
10	Closing current	
11	Closing time	
12	Opening current	
13	Opening time	
14	Operating voltage range & rated voltage	
15	Ground connection insulation	
16	Type of contacts	
17	Over travel distance	
18	Distance of fully open contacts	
19	Size of the removable link	
20	Speed of make	
21	Partial discharge level at 1.1 Un/√3	
22	Corona extinction voltage	
23	Radio interference level at 266kV rms (micro volt)	
24	Details of type test reports enclosed and the standards as per which these tests have been carried out	
25	No. of NO and NC contacts, its rated voltage and current	
B-III	**High Speed Fault Making Grounding Switch**	
1	Manufacturer's name	
2	Type/designation	
3	Maximum permissible operating voltage	
4	Maximum make and carry current for 1 second	
5	Rated inductive breaking current	
6	TRV caused by breaking/making inductive current	
7	Rated capacitive breaking current	
8	TRV caused by breaking/making capacitive current	
9	Motor operating mechanism	
10	Making current	
11	Induced current switching capability	
12	Closing current	
13	Closing time	
14	Opening current	
15	Opening time	
16	Operating voltage range, rated voltage	

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS OF SF6 GAS INSULATED SWITCHGEAR

17	Design data	
18	Ground connection insulation	
19	Type of contacts	
20	Over travel distance	
21	Distance of fully open contacts	
22	Size of the removable link	
23	Speed of make	
24	Partial discharge level at 1.1 Un/√3	
25	Corona extinction voltage	
26	Radio interference level at 266kV	
27	Has equipment been type tested and to which standards?	
28	No. of NO and NC contacts, its rated voltage and current	
29	Total operating time of switch alongwith its operating mechanism	
30	Total operating time of switch after the command is given	
C)	**CURRENT TRANSFORMERS** (Particulars for all groups of CT's to be indicated either here or on separate sheet)	
1	Name of manufacturer	
2	Type	
3	Manufacturer's type/designation	
4	Rated voltage	
5	Normal continuous rating	
6	Normal ratio of transformation	
7	Rated primary current	
8	Rated secondary current	
9	Numbers of cores	
10	Particulars of for each type of CT	
11	One second over current factor & corresponding value of current	
12	Rated dynamic current (peak value) in amps	
13	Rated continuous thermal current temperature rise over ambient	
14	One minute power frequency dry withstand test voltage	
15	One minute power frequency wet withstand test voltage	

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS OF SF6 GAS INSULATED SWITCHGEAR

16		1.2/50 microsecond lightning impulse withstand test voltage	
17		One minute power frequency withstand test voltage on secondaries	
18		Partial discharge level at 1.1 Un/√3	
19		Radio Interference voltage at 266kV rms	
20		Corona extinction voltage	
21		Total weight	
22		Magnetization curves of CT cores	
23		Mounting details	
24		Overall dimensions	
25		Tests proposed to be conducted by the manufacturer at works	
	i)	Type tests	
	ii)	Routine tests	
26		Tests proposed to be conducted at site	
D)		**VOLTAGE TRANSFORMERS**	
1		Name of manufacturer	
2		Type designation	
3		Rated primary voltage (kV)	
4		Rated secondary voltage (V)	
5		Rated output per phase (VA)	
6		Rated burden (VA)	
7		Rated frequency (Hz)	
8		Standard values of rated voltage factor	
9		Limits of temperature rise	
10		One-minute power frequency withstand voltage	
11		1.2/50 microsecond lightning impulse withstand voltage	
12		Total weight and dimensions	
13		Limits of voltage error and phase displacement in %	
14		Error angle	
15		Voltage error	
16		Accuracy class at rated burden	
17		Voltage factor and rated time	
18		Details of the tests to be conducted by the manufacturer at works	
	i)	Type tests	
	ii)	Routine tests	
19		Tests to be conducted at site	

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E)	**SF6 GAS**	
1	Name of manufacturer	
2	Electrical properties (please give details)	
3	Compatibility with material used in switchgear	
4	Impurities in percentage (please mention details of impurities)	
5	Size of the cylinder in which gas is proposed to be supplied	
6	Condensation temperature	
7	Physical properties (please give details)	
8	Certification that gas meets the requirement of all the properties	
9	Tests to be conducted by the manufacturer at works	
10	Tests proposed to be conducted at site to detect and limit the moisture content in gas compartments	
11	Other details:	
i)	Normal pressure	
ii)	Maximum pressure	
iii)	Normal operating density	
iv)	Maximum gas density	
v)	Minimum pressure to maintain dielectric insulation for 420kV	
vi)	Maximum leakage rate per year at normal pressure in percentage	
vii)	Maximum permissible moisture content by weight	
viii)	Permissible variation in ambient temperature	
ix)	Details of gas filters	
x)	Effective life of filters	
xi)	Test pressure for gas system	
xii)	Constituents of gas in percent of weight and volume of SF6, air, CH4, H2	
12	Alarm levels	
i)	First alarm level for circuit breakers	
ii)	Alarm level for circuit breaker	
iii)	First alarm level for all other components	
iv)	Second alarm level for all other components	

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13	Gas Monitoring Devices	
	(Details of the sketches enclosed showing the type and location of gas density, gas pressure, gas moisture content and other fault monitoring devices to be supplied)	
14	Pressure Relief Devices	
i)	Rupturing pressure	
ii)	Time to rupture	
iii)	Details of the sketches enclosed showing the location and quantity of pressure relief devices used	
F)	**SURGE ARRESTORS**	
1	Manufacturer	
2	Type designation	
3	Class of arrestor	
4	Rated Voltage of Arrestor	
5	Maximum continuous operating voltage (MCOV)	
6	Maximum discharge current (8/20 microsecond wave)	
7	Maximum 0.5 microsecond discharge voltage	
8	Residual voltage at 10kA (8/20 microsecond current wave)	
9	Residual voltage at 20kA, 8/20 microsecond current wave	
10	Maximum switching surge protective voltage	
11	Partial discharge level at 1.1 Un/√3	
12	Corona extinction voltage	
13	Radio interference level at 266kV rms	
14	High current short duration test value	
15	Short circuit capability & class of pressure relief device	
16	Line discharge class	
17	Protective level provided by surge arrestor	
18	Energy level	
19	Details of the type test reports enclosed and the standards as per these tests have been carried out	
G)	**SF6-TO-AIR BUSHING**	
1	Manufacturer , Type designation	
2	Location of manufacturing plant	
3	Material	
4	Rated Voltage(kV)	

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5	Rated continuous current(A)	
6	Rated short time current for 1 sec(kA)	
7	Rated insulation level	
i)	Dry and wet power frequency withstand voltage(kV (rms))	
ii)	1.2/50 microsecond lightning impulse withstand voltage(kV (rms))	
iii)	250/2,500 microsecond switching impulse withstand voltage (kV (peak))	
8	Corona extinction voltage(kV (rms))	
9	External strike distance	
	-Phase to ground(mm)	
	-Phase to phase(mm)	
10	External creep distance (mm)	
11	Cantilever strength(Nm)	
12	Acceptable terminal load(N)	
13	Weight of single phase bushing(kg)	
15	Explain how the dielectric stress is controlled at the top and at the bottom	
16	Partial charge level (pc)	
17	Radio interface level (micro volt)	
18	Has equipment been type tested and to which standards.	
19	Dimensions of single phase bushing (mm)	
20	Description of mounting steel structures for bushings.	
H)	**SUPPORT & BARRIER INSULATORS**	
	(Details for each type of insulator used to be indicated separately)	
1	Manufacturer	
2	Type of insulators used	
3	One-minute power frequency dry withstand test voltage	
4	Dry flashover value	
5	Wet flashover value	
6	1.2/50 microsecond lightning impulse withstand test voltage	
7	Creepage distance	
8	Puncture value of insulator in SF6 gas	
9	Weight of insulators in the SF6 GIS enclosure	

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I)	**GAS PROCESSING UNIT**	
1	Name of the manufacturer	
2	Capacity	
3	Dimensions of unit	
4	Weight of the unit	
5	Purity of gas obtainable (%)	
J)	**PARTIAL DISCHARGE MONITORING SYSTEM**	
1	Name of the manufacturer	
2	No of couplers	
3	Capacity	
4	Type of sensors	
5	Details of Spectrum Analyser	
K)	**GROUNDING CONNECTION**	
1	Type of conductor	
2	Arrangement for connecting conductor to ground	
3	Type of painting, if any required to be carried out at end points of ground riser	
L)	**DESIGN CLEARANCE**	
	Minimum insulating clearances at nominal rated SF6 gas pressure and rated voltage/BIL voltage for the following:	
a)	Main bus to ground	
b)	Circuit breaker	
i)	Contact to ground	
ii)	Across the contacts	
c)	Isolator switches	
i)	Contact to ground	
ii)	Across the contacts	
d)	Safety grounding switches	
i)	Contact to ground	
ii)	Across the contacts	
e)	High speed make proof grounding switches	
i)	Contact to ground	
ii)	Across the contacts	
e)	SF6 to Air Bushing	

ANNEXURE-D: Technical Checklist

Sl. No.	Particulars	Confirmation by Bidder	
1	**Technical Qualifying Requirement**		
1.1	The bidder to furnish relevant documents for meeting the qualifying requirement. Performance certificates shall be submitted in English. Translated pages should be attested by the ultimate customer, if attested only by the bidder it shall be notarized.	Confirmed	Yes/ No
1.2	The technical bid shall be submitted by the Manufacturer of GIS & its accessories in case of Indian Manufacturer; however, agent may submit the technical offer in case of foreign manufacturer. The bidder's scope includes supply and services such as -Supervision of installation, -Testing and commissioning.	Confirmed	Yes/ No
1.3	All the documents shall be submitted in English. Translated pages should be attested by the ultimate customer, if attested only by the bidder it shall be notarized.	Confirmed	Yes/ No
2	**Un-priced BOQ**		
2.1	Confirm that all items is quoted separately. (If any item is not quoted, the same shall be specifically brought out with technical reasons thereof, else offer shall be liable for rejection).	Confirmed	Yes/ No
2.2	Any other supply/ service required for the execution for the complete work of GIS & its accessories is deemed to be included in the offer in line with technical specification, whether specifically mentioned in BOQ or not. Bidder to submit list of items along with their respective quantities required for completeness of GIS & its accessories. List is to be provided by bidder.	Confirmed	Yes/ No
2.3	Building for GIS shall be constructed by Customer/THDCIL based on the input (configuration, structure loads and other interfacing details etc.) provided by bidder. The supply of all structural material to be embedded including foundation bolts, plates etc. as well as consumables like grouting material etc. shall be in bidder's scope. The erection of structure shall be done by BHEL/ THDCIL under supervision of bidder.	Confirmed	Yes/ No
2.4	Bidder shall provide the details for Cable Connection module,	Confirmed	Yes/ No

	and SF6 to Oil connection etc. and hence, interfacing details for connection with other parts shall be provided by the bidder. Details are to be submitted by bidder.		
2.5	Bidder shall submit list of consumables with shelf life of less than six months and same shall be dispatched just before the erection and only after specific clearance from BHEL/ THDCIL.	Confirmed (List is to be submitted.)	Yes/ No
2.6	Commissioning spares for testing & commissioning of GIS till handing over shall be under bidder's scope.	Confirmed	Yes/ No
2.7	Special Tools & tackle & Testing Equipment are to be provided at site on returnable basis.	Confirmed (List is to be submitted.)	Yes/ No
2.7	Detailed list of General Tools & tackle & Testing Equipment to be provided by bidder, however same shall be arranged by BEL/its contractor.	List attached	Yes/ No
2.8	GIS shall be complete with all necessary terminal boxes, SF6 gas filling, interconnecting cabling & wiring, grounding connections, gas monitoring equipment and piping, support structures erection and mounting hardware etc.	Confirmed	Yes/ No
2.9	Design philosophy of earthing submitted with the bid	Confirmed	Yes/ No
2.10	Design of Earthing of GIS shall be in bidder scope. The items and accessories required for completeness of earthing shall be in bidder's scope. Mesh on floor shall be provided by BHEL as per bidder's design.	Confirmed	Yes/ No
3	**Technical**		
3.1	GIS building shall have an EOT (Electric overhead travel) crane of capacity 12T, which shall be provided by BHEL/ THDCIL, 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.	Confirmed	Yes/ No
3.2	Bidder shall provide AC and DC auxiliary loads for GIS.	Confirmed (Enclosed with bid)	Yes/ No
3.3	Catalogues of GIS	Confirmed (Enclosed with bid)	Yes/ No
3.4	Catalogues of all Maintenance equipment. Bidder to confirm that offered equipment meets the requirements of specification.	Confirmed (Enclosed with bid)	Yes/ No

4	**Calculations**		
4.1	The design of the equipment shall be such that the agreed permitted movement of foundations and mechanical or thermal effects do not impair the assigned performance of the equipment.	Confirmed	Yes/ No
4.2	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.	Confirmed	Yes/ No
4.3	Bidder shall check and ensure adequacy of system protection for successful operation of GIS. After checking of system by bidder, GIS shall be installed and if any failure, malfunction of any part occurs after/ during commissioning, same shall be replaced immediately without any extra cost.	Confirmed	Yes/No
5	**Technical Deviations**		
5.1	Confirm that the Complete systems have been offered as per the requirements of Technical Specification and Technical Deviation sheet has been submitted. Deviations mentioned elsewhere in the bid will not be considered.	Confirmed	Yes/ No
6	**Bar-chart**		
6.1	Bidder will submit detailed bar chart indicating all the milestones from Engineering till manufacturing/ testing, dispatch to site and commissioning based on the drawing & document schedule attached in section1.	Confirmed	Yes/ No
7	**Conditions**		
7.1	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
8	**Site Test**		
8.1	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.	Confirmed	Yes/ No
8.2	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.	Confirmed	Yes/ No
8.3	GIS bays may be commissioned at different point of time	Confirmed	Yes/ No

	depending on the site conditions and as per L2 schedule for the project, and hence deployment the resources at multiple times at site by bidder in line with actual requirement is envisaged.		
9	**Type Test Requirements**		
9.1	Bidder shall ensure that the electrical equipment (420kV Gas Insulated Switchgear & its accessories) being procured have valid type test certificates as specified in IEC standard 62271 - 203 & 62271-100 (amended up to date) at any NABL accredited laboratories/ any authorized testing lab in line with applicable IS/IEC.	Confirmed	Yes/ No
9.2	The validity of type test reports shall be as per the latest CEA guidelines (amended time to time) as on the original scheduled date bid submission for BHEL tender. In case, where type test certificates are older than period as per latest CEA guidelines (amended time to time), bidder/ manufacturer shall carry out the type tests prior to dispatch of equipment without any commercial implication on BHEL/ THDCIL.	Confirmed	Yes/ No
9.3	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/ THDCIL.	Confirmed and enclosed with bid	Yes/ No

Date: Bidder's Stamp & Signature