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BHARAT HEAVY ELECTRICALS LIMITED

TRANSMISSION BUSINESS HVDC ENGINEERING & SYSTEMS

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		GROUP	HVDC	W.O. No	87009	
CUSTOMER	Patratu Vidyut Utpadan Nigam Ltd. (PVUNL) (A Subsidiary of NTPC in Joint Venture with JBVNL)					
PROJECT	400kV GIS at Patratu Super Thermal Power Project Expansion Phase-I (3 X 800 MW)					
NOA NO.	01/PVUNL-CS-9585-001-2/NOA-FC Dated 08-Mar-2018					
Station	Patratu, Jharkhand					
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Section – 1

1. SCOPE, SPECIFIC TECHNICAL REQUIREMENT, BILL OF QUANTITIES

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

The scope also includes testing and commissioning at site of complete 400kV Gas Insulated Substation (GIS).

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

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

Statutory Regulations
Section-1
Section -2: NTPC Specification
Section - 3
International standards

1.1 PROJECT INFORMATION:

a)	Project	400kV GIS at Patratu Super Thermal Power Project Expansion Phase –I (3X800 MW)
b)	Customer	Patratu Vidyut Utpadan Nigam Ltd. (PVUNL) (A Subsidiary of NTPC in Joint Venture with JBVNL)
c)	Main Contractor	BHEL



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The 400 KV GIS shall have three single phase construction, one and half breaker arrangement (I-Type) having the following bays:

- a) Three (3) fully equipped Generator Transformer Bays having controlled switching facility.
- b) Three (3) fully equipped Station Transformer Bays having controlled switching facility.
- c) Six (6) fully equipped Line Bays.
- d) Two (2) fully equipped Bus Reactor Bays having controlled switching facility.
- e) Four (4) fully equipped Tie Bays having controlled switching facility.
- f) Three (3) fully equipped Tie Bays.
- g) Two (2) fully equipped Bus Voltage Transformer Bays with Bus Isolator and Grounding Switches.
- h) Two (2) Bus Surge Arrester Bays.

This is the brief description of 400kV GIS to be supplied, however same is to be supplied as per detailed bill of quantities (BOQ) enclosed as Annexure 1 of Section 1.



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1.2 SPECIFIC TECHNICAL REQUIREMENTS

S.No.	Technical Parameter	Unit	Value
1	Type of GIS	Indoor Type	
2	Location	Place: Patratu District: Ramgarh State: Jharkhand	
3	Design Ambient Temperature	°C	50
4	Design relative humidity	%	95
5	Nominal Voltage Class, RMS	kV _{rms}	400
6	Maximum System Voltage, RMS	kV _{rms}	420
7	Rated Frequency	Hz	50
8	Number of Phases	Nos	3
9	Lightning Impulse Withstand Voltage, Peak	kV _{peak}	±1425
10	Switching Impulse Withstand Voltage, Peak	kV _{peak}	±1050
11	Power Frequency Withstand (for 1 min r.m.s) Phase to Earth & Between Phases	kV _{rms}	650
12	Maximum Fault Level (1 second)	kA	63
13	Dynamic Withstand Current, peak	kA _{peak}	157.5
14	Rated Continuous Current Capacity (Bay)	A	3150
15	Rated Continuous Current Capacity (Bus), Minimum	A	4000
16	Leakage Rate of SF ₆ Per Annum for Each Compartment Individually as well as Complete Installation, Maximum	%	0.5
17	PD Level for GIS	picoCoulomb	Less Than 5
18	Minimum Total Creepage Distance For Outdoor Equipment	mm	10500
19	Type of Earthing	Solidly grounded	
20	Duty Cycle of Circuit Breaker	O – 0.3 sec – CO – 3 min - CO	
21	Operating Mechanism of Circuit Breaker	Pneumatic/Spring/Hydraulic/Or a Combination of These	
22	LT Auxiliary Supply		
22.1	AC	415 V (±10%, 3 Phase, 4 Wire, Solidly Earthed)	
22.2	DC	220 V {(+) 10% to (-) 15%, DC, 2 Wire, Unearthed}	
23	Permissible Frequency Variation	%	+3 to -5
24	Combined Variation of Voltage and Frequency	%	10



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1.3 BILL OF QUANTITIES: As per Annexure – 1.

1.4 SITE INFORMATION: Refer Section-3 for site information and meteorological data.

1.5 ADDITIONAL INFORMATION AND REQUIREMENTS:

- 1.5.1 Project site Patratu is located just outside the coal belt of South Karanpura in Ramgarh District of Jharkhand State. Hence the design, material selection and construction of the GIS should be suitable for the climate/meteorological conditions as mentioned here and in Section-3.
- 1.5.2 GIS will be placed in a non-air conditioned building during service.
- 1.5.3 The GIS shall be supplied in packing to avoid contamination of material due to dust/moisture and temperature during transit and storage. All packing shall be of durable quality and shall be suitable for long term (minimum 2 years) storage of GIS in give environmental conditions. The compartments of GIS assemblies shall be supplied filled with nitrogen/ air or dry SF₆ gas at a positive pressure and hermetically sealed to protect the dielectric system during transportation.
- 1.5.4 Bidder to submit list of consumables. These shall be supplied by bidder before erection, after clearance from BHEL.
- 1.5.5 Bidder to submit a detailed bar chart indicating all the milestones from engineering till manufacturing/testing, dispatch to site and commissioning.
- 1.5.6 Bar Chart shall be approved by BHEL before commencement of work. Tentative bar chart to be submitted by bidder in tender stage.
- 1.5.7 For system details and transport limitation refer Project Information in Section-3.
- 1.5.8 Bidder shall offer their latest type tested compact model to minimize the building size requirement.
- 1.5.9 Spacing between bays, if required to be changed to adjust with building column and beams, shall be done without any cost implication to BHEL at contract stage only.
- 1.5.10 Bidder shall conduct system studies, insulation coordination for establishing Surge Arrester's rating and any other requirement for successful operation of GIS and cost of same shall be deemed included in scope of supply. Any additional item/surge arrester as required as per the study is to be provided by the Bidder. The report shall be submitted for approval.



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- 1.5.11 Successful bidder shall submit 3D and 2D OGA drawing for complete GIS and section drawing of each equipment. OGA drawings shall be furnished in Auto-CAD file format. The 3D drawing file format should be such that it is compatible to operate/link with reputed 3D modelling software.
- 1.5.12 Bidder shall check and ensure adequacy of the system protection for successful operation of GIS. After checking of system/site by bidder, GIS shall be installed and if any failure, malfunction of any part occurs after commissioning bidder shall replace the part unconditionally within 15 days. Further root cause analysis (RCA) shall be submitted and necessary changes to be done as per the RCA report wherever required.
- 1.5.13 No support structure shall be placed within 3 meters around the GIS building periphery.

1.6 EARTHING/GROUNDING OF GIS:

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

- 1.6.1 The grounding system shall be designed and provided as per IEEE-80-2000 and CIGRE-44 to protect operating staff against any hazardous touch voltages and electro-mechanical interferences.
- 1.6.2 The Bidder shall define clearly what constitutes the main grounding bus of the GIS. The Bidder must supply, commission the entire grounding work of GIS viz conductor, clamps, joints, bimetallic strips (for connection between different type of earthing materials), operating and safety platforms etc.
- 1.6.3 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.
- 1.6.4 The enclosure grounding system shall be designed to minimize circulating currents



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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.

1.6.5 The Bidder shall provide suitable measure to mitigate transient enclosure voltage caused by high frequency currents caused by lightning strikes, operation of surge arrester, phase/earth fault and discharges between contracts during switching operation. The grounding system shall ensure safe touch & step voltages in all the enclosures. The Bidder shall provide suitable barrier of non-liner resistor/counter discontinued SF6/Transformer and SF6/ HV cable bushing etc. to mitigate transient enclosure voltage.

1.6.6 Only supply of MS Rod (40mm diameter for outdoor below ground earth mat) and GI Flat of 75x12mm, as recommended by bidder (for earth mesh on floor), shall be in BHEL's scope. Any other earthing material, if required, shall be in bidder's scope of supply and erection.
GIS earthing mesh shall be extended suitably to enable connection to the outdoor switchyard earthmat.

Details of earthing system:

Item	Size	Material
Main Earthing conductor	40mm dia rod	Mild steel
Conductor above ground & earthing leads (for equipment)	75 x 12/ 50 x 6	G.S. Flat Galvanized steel
Rod Electrode	40mm dia, 3000mm	Mild steel
G.I. Earthwire	7/8 SWG	GI

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

For Step and Touch Potential the following parameters shall be considered

- Current distribution factor – 1 (one)
- Duration of fault current – 0.5 sec
- Human body weight – 50kg

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



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1.7 QUALIFYING REQUIREMENT:

For the purpose of qualification of the bidders, experience shall be reckoned as on the date of technical bid opening but not later than 07-Sep-2018 unless otherwise specified.

- 1.7.1 The bidder should have designed, manufactured, erected/supervised erection, tested/supervised testing and commissioned /supervised commissioning of one (1) Gas Insulated Switchgear (GIS) equipment (s) installation having at least six (6) bays of 400 kV or above voltage class with short circuit current of not less than 40 kA for 1 second, which should have been in successful operation for minimum two (2) years.

AND

- 1.7.2 The Bidder associates with a GIS manufacturer for sourcing of GIS equipments who meets the requirement indicated at 1.7.1 above. The associate will also be fully responsible for the performance of the GIS portion of the contract.

In such an event the Bidder shall arrange a Deed of Joint Undertaking to this effect jointly executed by Bidder and its Associate as per the format enclosed in the bidding document – Attachment 3K. This Deed of Joint Undertaking should be submitted prior to the placement of order on approved vendor. In case of award, the Associate of the Bidder will be required to furnish an on demand Bank Guarantee for **INR 49 Million (Indian Rupees Forty Nine Million only)**.

AND

- 1.7.3 The Bidder should have established manufacturing facilities for GIS equipment in India based on technological support of an associate (who meets the requirement at 1.7.1 above) and Bidder should have designed, manufactured, erected/ supervised erection, tested/ supervised testing and commissioned/ supervised commissioning of at least one (1) Gas Insulated Switchgear (GIS) equipment(s) installation having at least six (6) bays of 400kV or above voltage class with short circuit current of not less than 40 kA for 1 second. The associate will be fully responsible for the performance of the GIS portion of the contract.

In such an event the Bidder shall arrange a Deed of Joint Undertaking to this effect jointly executed by Bidder and its Associate as per the format enclosed in the bidding document – Attachment 3K. This Deed of Joint Undertaking should be submitted prior to the placement of order on approved vendor. In case of award, the Associate of the Bidder / Sub Vendor will be required to furnish an on demand Bank



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Guarantee for **INR 49 Million (Indian Rupees Forty Nine Million only)**.

OR

- 1.7.4 The Bidder should have established manufacturing facilities for GIS in India based on technological support of parent company who meets the requirement indicated at 1.7.1 above. The parent company will be fully responsible for the performance of the GIS portion of the contract.

In such an event the Bidder shall arrange a Deed of Joint Undertaking to this effect jointly executed by Bidder and its parent company as per the format enclosed in the bidding document – Attachment 3K. This Deed of Joint Undertaking should be submitted prior to the placement of order on approved vendor. In case of award, the parent company of the Bidder / Sub Vendor will be required to furnish an on-demand Bank Guarantee for **INR 49 Million (Indian Rupees Forty Nine Million only)**.

NOTE:

- a. Foreign GIS manufacturers supplying GIS under Cl. No. 1.7.1 and 1.7.2 above can establish GIS manufacturing facilities in India (if already not established) and can supply upto twelve (12) 400 kV GIS Bays from his Indian GIS manufacturing facilities. Bidder shall ensure that critical manufacturing processes of these equipments are done under supervision of Foreign GIS manufacturer and manufacturing, testing facilities including quality systems at Indian works are adequately upgraded. An undertaking by bidder shall be submitted prior to the placement of order on approved vendor to this effect backed up by a letter of commitment from the Foreign GIS manufacturer for the same.
- b. Indian bidder/Sub vendor qualifying based on parent company as per Cl. No. 1.7.4 of qualifying requirements, shall necessarily supply all the GIS manufactured by respective parent company only except for upto twelve (12) 400 kV GIS Bay which bidder may at his option manufacture at their works in India. Bidder/Sub vendor shall ensure that critical manufacturing processes of these equipments are done under supervision of parent company and manufacturing, testing facilities including quality systems at Indian works are adequately upgraded. An undertaking by bidder shall be submitted prior to the placement of order on approved vendor to this effect backed up by a letter of commitment from the parent company for the same.



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- c. For the purpose of qualifying requirement, one no. of bay shall be considered as comprising of at least one circuit breaker, two disconnectors and single phase current transformers.

1.8 TYPE TESTING:

- a. The Bidder shall carry out the type tests as listed in this specification on the equipment to be supplied under this contract. The Bidder shall indicate the charges for each of these type tests separately in the relevant schedule of BPS and the same shall be considered for the evaluation of bids. The type test charges shall be paid only for the test(s) actually conducted successfully under the contract and upon certification by the Customer's engineer.
- b. The type tests shall be carried out in the presence of the Customer's representative, for which minimum 30 days' notice shall be given by the Bidder. The Bidder shall obtain the Customer's approval for the type test procedure before conducting the type test. The type test procedure shall clearly specify the test set up, instrument to be used, procedure, acceptance norms, recording of various parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.
- c. In case the Bidder has conducted such specified type test(s) according to the relevant standard and / or specification not earlier than ten years prior to the date of techno-commercial bid opening i.e 03-Mar-2017, he may submit the type test reports to the Customer for waiver of conductance of such type test(s). These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a Customer. The Customer reserves the right to waive conducting of any or all the specified type tests(s) under this contract. In case the type tests are waived, the type test charges shall not be payable to the Bidder. However if any type test report is found not meeting the specification requirements, bidder shall conduct all such type tests successfully according to relevant standards without any cost and delivery implication to BHEL.

1.9 COMMON REQUIREMENTS – FOR GIS:

- a. The Customer will have the right of getting any test of reasonable nature carried out on any component or completely assembled equipment at Bidder's premises or at site or in any other place in addition to the aforesaid type and routine tests, to satisfy that the materials/equipment comply with the specification.
- b. Failure of any equipment to meet the specified requirements of tests carried out at works or at site shall be sufficient cause for rejection of the equipment. Rejection of any equipment will not be held as a valid reason for delay in the completion of the works as



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per schedule. Bidder shall be responsible for removing all deficiencies, and supplying the equipment that meet the requirement.

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

The offered GIS equipments shall confirm to the type tests as per IEC 62271-203. The list of the type tests shall be as follows:

- i. Lightning impulse voltage dry tests.
- ii. Switching impulse voltage dry tests.
- iii. Power frequency voltage dry tests.
- iv. Partial discharge tests.
- v. Radio Interference Voltage test
- vi. Test to prove the temperature rise of any part of the equipment and measurement of the resistance of the main circuit.
- vii. Test to prove the ability of the main circuit and earthing circuit to carry the rated peak and the rated short time withstand current.
- viii. Test to verify the making and breaking capacity of the included switching devices.
- ix. Test for satisfactory operation of the included switching devices.
- x. Test to prove the strength of enclosures.
- xi. Gas tightness test
- xii. Electromagnetic capability test (if applicable)
- xiii. Test on partitions
- xiv. Internal arc tests.
- xv. Mechanical operation tests.



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- xvi. Test to prove the satisfactory operation at limit temperature.
- xvii. Verification of degree of protection of auxiliary and control circuits.
- xviii. Test to prove performance under thermal cycling and gas tightness test on gas barrier insulators
- xix. Capacitive Current switching test
- xx. Shunt reactor current switching test

The components forming parts of the GIS which are covered by other standards shall comply with and shall be type tested according to those standards.

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

Surge Arresters (As per IEC 60099-4)

- i. Insulation withstand test on housing
- ii. Residual Voltage Test
- iii. Long duration current impulse withstand test
- iv. Operating duty test
- v. Partial Discharge Test
- vi. Leakage Test

Bus VT (As per IEC 60044-2)

- i. Temperature rise test
- ii. Lighting Impulse test
- iii. Switching Impulse
- iv. Determination of errors
- v. Short circuit withstand capability
- vi. Chopped lighting impulse test

1.10 INSPECTION & TESTING

All the equipment, apparatus, materials and supplies provided by the Bidder under the contract shall be subjected to tests in the shop and at the field in the presence of Customer for conformity with the requirements of the specifications. 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 Customer well in advance i.e. no less than 30



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days before these tests are conducted. Unless otherwise specified, the Bidder shall perform all shop and field tests.
Refer Section-2 for further details.

1.11 TRAINING

GIS manufacturer shall provide training to the Customer/BHEL's personnel as per the details given below:

Sl. No	Description of Training	Training Duration (Days)	Place of Training	Number of Trainees	Boarding & Lodging
a)	GIS equipments including system description, Basic Design and engineering , Quality Assurance concepts, Erection and operational aspects for the offered equipments	5 days	Manufacturers works	8 (Customer) + 5 (BHEL)	To be provided by bidder for Customer's Engineers only.
b)	Operation, Maintenance , Site Testing and Trouble shooting for GIS	5 days	Site	6 (Customer) + 5 (BHEL)	

1.12 QUALITY PLAN

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



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

1.13 DRAWINGS ENCLOSED FOR REFERENCE

Sl. No.	Ref. Drawing No.	Drawing Title	Rev
1.	TB-2-397-316-001 REV 00	400kV GIS Switchyard Single Line Diagram	00
2.	9585-999-POE-J-002 REV C	400kV GIS Switchyard Single Line Diagram (STATION TRANSFORMER SCHEME)	C
3.	TB-0-397-316-002 Rev 00	Layout drawing for 400 kV GIS at Patratu Super Thermal Power Station Expansion phase –I (3 X800 MW)	00

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

1.14 INFORMATION TO BE FURNISHED BY THE BIDDER

1. Technical Information/ documents to be furnished at the TENDER STAGE shall be as per Section-6.
2. Bidder to submit list of tools, tackle, slings, spanners, gauges, slings and other lifting devices, drills, instruments and appliances necessary for the complete assembly and erection at site of the GIS, required for installation, gas filling, maintenance, site testing of the GIS which shall be arranged by BHEL.



Section – 2

2. EQUIPMENT SPECIFICATION – REQUIREMENTS FOR GIS

2.1 GENERAL

- 2.1.1 The GIS shall comply with IEC – 62271-203. The general requirements and special requirements for Gas Insulated Switchgear (GIS) are given in this chapter. GIS shall also meet other requirements specified under switchyard for various equipments as applicable. Materials and components not specifically stated in this specification but are necessary for the satisfactory operation of the equipment shall be deemed to be included unless specifically excluded and shall be supplied at no extra cost.
- 2.1.2 The GIS shall be modular in structure and shall be housed indoor. The modules shall be single phase encapsulated and provided with hooks for handling by EOT cranes to be provided in the building. The modular design shall be capable of extension on either side without any major dismantling.
- 2.1.3 The GIS equipments shall be housed in separate GIS building of overall height and width determined by the layout arrangement.
- 2.1.4 The bus bars shall be rated for the duty specified and current rating shall be derived considering maximum possibilities

2.2 TECHNICAL REQUIREMENTS:

- 2.2.1 The VT's for GIS shall be installed within the GIS enclosure and shall be SF6 gas insulated or cast resin type. The secondary terminals shall be brought out in a dust proof enclosure suitably.
- 2.2.2 The Surge arrestors for main buses shall be of GIS type only.
- 2.2.3 The earthing of the GIS shall be carried out considering the safety requirements as per relevant standards. All parts to which access is required for maintenance work shall have provision for earthing. In addition after opening of enclosure it shall be possible to have continuity of earth for the duration of work. The continuity of earthing shall be ensured considering electrical and thermal stresses caused by current they may have to carry.



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- 2.2.4 Each section & phase of the GIS enclosure shall be monitored for leakage of SF6 gas and suitable indication shall be provided in the control room.
- 2.2.5 All components of the same rating and construction shall be interchangeable.
- 2.2.6 Each breaker module of the GIS shall have a local control cabinet suitably located and shall be ground mounted meeting the requirements specified elsewhere for cabinets. Suitable interlocking arrangements shall be provided for the entire GIS.
- 2.2.7 All the SF6 gas insulated circuit breakers, dis-connectors, grounding switches and bus bars shall be of single phase isolated type.
- 2.2.8 Protective Finish –Preferable

All the exterior surfaces shall be cleaned and painted before leaving the factory with one coat of approved primer and two coats of water resistant 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. Extra paint for retouching at site shall be made available by the Bidder.

2.2.9 Fire Retardancy

All components shall be fire retardant and shall be tested in accordance with IEC-695.

2.3 DESIGN AND SAFETY REQUIREMENT:

- 2.3.1 The GIS assembly shall be as per switching arrangement indicated under single line diagram and consist of separate modular compartments e.g. Circuit Breaker compartment, Bus bar compartment filled SF6 gas and separated gas tight partitions so as to minimize risk to human life, allow ease of maintenance and limit the effects of gas leaks failures & internal arcs etc. These compartments shall be such that maintenance on one feeder may be performed without de-energizing the adjacent feeders. These compartments shall be designed to minimize the risk of damage to adjacent sections and protection of personnel in the event of a failure occurring within the compartments. Rupture diaphragms with suitable deflectors shall be provided to prevent uncontrolled bursting pressures developing within the enclosures under worst operating conditions. The compartments of GIS assemblies shall be supplied filled with nitrogen/ air or dry SF6 gas at a positive pressure and hermetically sealed to protect the dielectric system during transportation.



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- 2.3.2 The workmanship shall be of the highest quality and shall conform to the latest modern practices for the manufacture of high technology machinery and electrical switchgear.
- 2.3.3 The switchgear shall be of modular design. The conductors and the live parts shall be mounted on 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.
- 2.3.4 Gas barrier insulators and support insulators shall have the same basis of design. The support insulators shall have holes on both sides for proper flow of gas.
- 2.3.5 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 pressurized equipment, whenever the pressure of the adjacent gas compartment is reduced, it should be ensured by the bidder that adjacent compartment would remain in service with reduced pressure. The gas tight barriers shall be clearly marked on the outside of the enclosures.
- 2.3.6 The material and thickness of the enclosures shall be such as to withstand an internal flash over without burn through for a period of 300ms at rated short time withstand current. The material shall be such that it has no effect of environment as well as from the by-products of SF6 breakdown under arcing condition.
- 2.3.7 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.
- 2.3.8 The material used for manufacturing the switchgear equipment shall be of the type, composition and have physical properties best suited to their particular purposes and in accordance with the latest engineering practices. All the conductors shall be fabricated of aluminum/ copper tubes of cross sectional area suitable to meet the normal and short circuit current rating requirements. The finish of the conductors shall be smooth so as to prevent any electrical discharge. The conductor ends shall be silver plated and fitted into finger contacts or tulip contacts. The contacts shall be of sliding type to allow the conductors to expand or contract axially due to temperature variation without imposing any mechanical stress on supporting



insulators.

- 2.3.9 Each pressure filled enclosure shall be designed and fabricated to comply with the requirements of the applicable pressure vessel codes and based on the design temperature and design pressures as defined in IEC -62271-203 .
- 2.3.10 The maximum SF6 gas leakage shall not exceed half percent (0.5%) per year for the whole equipments and for any individual gas compartment separately.
- 2.3.11 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 nonreturn valve connectors for evacuating & filling the gas and checking the gas pressure etc.
- 2.3.12 The switchgear line-up when installed and operating under the ambient conditions shall perform satisfactorily and safely under all normal and fault conditions. Even repeated operations up to the permissible servicing intervals under 100% rated & 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.
- 2.3.13 The thermal rating of all current carrying parts shall be minimum for one sec. for the rated symmetrical short-circuits current.
- 2.3.14 The Switchgear shall be of the free standing, self-supporting with easy accessibility to all the parts during installation & maintenance 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) Bus bars
 - b) Intermediate compartment
 - c) Circuit breakers
 - d) Bus / Line disconnections
 - e) Gas insulated bus duct sections
 - f) Voltage Transformers
 - g) Surge Arrestors

The bus enclosure should be sectionalized in a manner that maintenance work can be carried out by isolating and evacuating the small effected section and not the entire bus.



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The design of the one and half breaker scheme GIS shall be such that in case one circuit breaker module is removed for maintenance, there is no disruption in the power flow in any of the two circuits in a diameter.

The design of double bus scheme shall be such that the common point of the two bus bars along with the earth switch shall be designed and housed in a separate compartments so as to avoid complete shutdown of the system in case of maintenance required in any bus disconnector. Further maintenance on one bus disconnector should be possible when the feeder is live through other disconnector.

- 2.3.15 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.
- 2.3.16 It is required that the three phases of each switchgear bay be arranged side by side. The arrangement of the equipment offered must provide adequate access for operation, testing and maintenance.
- 2.3.17 The arrangement of gas section or compartments shall be such as to facilitate extension of any make on either end without any drilling, cutting or welding on existing equipments. The GIS shall be designed such that a future requirement as per single line diagram can be extended with-out any necessity to move or dislocate the existing switchgear bays. It shall be kept in view that very little shutdown time is needed for adding future requirement.
- 2.3.18 All the elements shall be accessible without removing support structures for routine inspections and possible repairs. The removal of individual enclosure part or entire breaker bays shall be possible without disturbing the enclosures of neighbouring bays. It should be impossible to unwillingly touch live parts of the switchgear or to perform operations that lead to arcing faults without the use of tools or brute force.
- 2.3.19 All interlocks that prevent potentially dangerous mal-operations shall be constructed such that they cannot be operated easily, i.e. the operator must use tools or brute force to over-ride them.
- 2.3.20 The actual position of circuit breakers, disconnectors and grounding switches must be positively displayed by mechanical indicators visible from the operating position.
- 2.3.21 In general the contours of energized metal parts of the GIS and any other accessory shall be such, so as to eliminate areas or points of high electrostatic flux concentrations. The surfaces shall be smooth with no projection or irregularities which may cause visible discharges. There shall be no radio interference from the energized switchgear at rated voltage.
- 2.3.22 The fabricated metal enclosures shall be of Aluminum alloy and have high



resistance to corrosion, low electrical losses and negligible magnetic losses. All jointed surfaces shall be machined and all castings shall be spot faced for all bolt heads or nuts and washers. All screws, bolts, studs and nuts shall conform to metric system.

- 2.3.23 The breaker enclosure shall have provision for easy withdrawal of the interrupter assemblies/complete CB pole.
- 2.3.24 The enclosures of the same phase shall be electrically interconnected and at proper points they shall be connected to the other phases thus entailing a return current almost equal to the current circulating in the conductors.
- 2.3.25 The enclosure shall be designed to practically eliminate the external electromagnetic field and thereby electrodynamic stresses even under short circuit conditions.
- 2.3.26 The elbows, bends, cross and T-sections of interconnections shall include the insulators bearing the conductor when the direction changes take place in order to ensure that live parts remain perfectly centered and the electrical field is not increased at such points.
- 2.3.27 The switchgear shall have provision for connection with ground mat risers. This provision shall consist of grounding pads to be connected to the ground mat riser in the vicinity of the equipment. The connection between the grounding pads of switchgear and ground mat risers shall be provided by the bidder. The Bidder shall furnish the design details & drawings for ground mat for GIS.
- 2.3.28 The ladders and walkways shall be provided wherever necessary for access to the equipment.
- 2.3.29 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 balanced 3-phase, 4-wire load.
- 2.3.30 Arrangement shall be provided to visually observe the contact position of disconnecting switches and earth switches.
- 2.3.31 The enclosure & support structure shall be designed that a mechanic 1780mm in height and 80 Kg in weight shall be able to climb on the equipment for maintenance.
- 2.3.32 The sealing provided between flanges of two modules / enclosures shall be such that long term tightness is achieved.



2.3.33 Alarm circuit shall not respond to faults for momentary conditions. The following indications in addition to those required elsewhere in the specifications shall be provided in the alarm & indication circuits in Bay Module Control Cabinets:

- I) Gas Insulating System
 - a) Loss of gas density
 - b) Loss of heater power (if required)
 - c) Any other alarm necessary to indicate deterioration of the gas insulating system
- II) Operating System
 - a) Low operating pressure.
 - b) Loss of Heater Power.
 - c) Loss of operating power.
 - d) Loss of control
 - e) Pole-disordance

In addition, all the above alarms shall also be hooked up to the Substation Automation system.

2.3.34 Each gas compartment barrier shall be easily identifiable from the outside of the switchgear.

2.3.35 Maximum weight of gas in gas tight section of GIS duct shall not exceed 400 kg.

2.3.36 The equipment shall be suitable for operation under the ambient conditions prevailing at project site. Section 3 may please be referred. The prevailing conditions shall be taken into account by the Bidder in the design of the equipment.

2.4 MANDATORY MAINTENANCE EQUIPMENTS:

2.4.1 The maintenance equipment necessary for the operation and maintenance of GIS shall be supplied. The requirement of such equipments is enclosed at Annexure-C of this section.

2.5 MANDATOIRY MONITORING EQUIPMENTS:

2.5.1 The monitoring equipment necessary for the operation and maintenance of GIS shall be supplied. A list of such equipments is enclosed at Annexure-D of this section.



2.6 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 arrangement shall be provided wherever necessary:

- a. To enable sections of the switchgear to be removed and reinserted without interfering with adjacent parts
- b. To accommodate changes in length of bus bars due to temperature variations.
- c. To accommodate large linear expansions and angle tolerances.
- d. For taking up manufacturing, site assembly & foundation tolerances.
- e. For absorbing vibrations caused by the transformers when connected to SF6 switchgear by oil / SF6 bushings.

2.7 INDICATION AND VERIFICATION OF SWITCH POSITIONS:

Indicators shall be provided on all circuit breakers, Disconnectors and earth switches, which shall clearly show whether the switches are open or closed. The indicators shall be mechanically coupled directly to the main contact operating drive rod or linkage and shall be mounted in a position where they are clearly visible through glass windows.

2.8 PRESSURE RELIEF:

Pressure relief devices shall be provided in the gas sections to protect the main gas enclosures from damage or distortion during the occurrence of abnormal pressure increase or shock waves generated by internal electrical fault arcs (preferably) in downward direction).

Pressure relief devices shall be achieved either by means of diaphragms or plugs venting directly into the atmosphere in a controlled direction.

If the pressure relief devices vent directly into the atmosphere, suitable guards and deflectors shall be provided. Bidder shall submit to the owner the detailed criteria design regarding location of pressure relief devices/rupture diaphragms.



2.9 PRESSURE VESSEL REQUIREMENTS:

The enclosure shall be designed for the mechanical and thermal loads to which it is subjected in service. The enclosure shall be manufactured and tested according to the pressure vessel code (ASME/CENELEC code for pressure Vessel.)

The bursting strength of Aluminium casting has to be at least 5 times the design pressure. A bursting pressure test shall be carried out at 5 times the design pressure as a type test on each type of enclosure.

Each enclosure has to be tested as a routine test at 1.5 times the design pressure for one minute.

2.10 BUSBARS:

2.10.1 The conductors of the bus bars shall be fabricated from aluminum/copper tubular sections of cross- sectional area suitable to meet the current rating requirements. The tubular bus section shall be housed in corrosion resistant aluminum enclosures, filled with pressurized SF6 gas. The conductors shall be supported from the enclosures by 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 ever 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.

2.10.2 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.

2.10.3 The Main bus bars shall be designed to have future extension bay if any as indicated in the single line diagram. The bus conductor end connectors and enclosure flanges shall be designed accordingly.

2.10.4 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 Bidder.

2.10.5 The SF6 GIS bus-bars shall have continuous current rating as shown in the single line diagram or as required for the system.

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- 2.10.6 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 SF6 GIS bus-bars shall have continuous current rating as shown in the single line diagram or as required for the system.
- 2.10.7 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 along with the offer.

2.11 BAY MODULE CONTROL CABINETS:

- 2.11.1 Each switchgear bay module shall be suitable for local control and remote control. The Bidder shall supply the main control cabinet of the floor standing type along with GIS equipments. 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.
- 2.11.2 The cabinet will be utilized for the switchgear bay local control module and as the terminating centre for all power supply, control annunciation and supervisory wiring interfacing with Customer's systems.
- 2.11.3 The following equipments shall be mounted on the cabinet door:
- Remote/local control transfer switch for the circuit breakers and disconnector switches.
 - Normal operation/maintenance control transfer switch for disconnector 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.



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2.11.4 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

2.11.5 The annunciator system shall have sufficient modules and illuminated windows for providing annunciation for low / high gas pressure / density, alarms & trips for circuit breaker operating mechanism and all other abnormal conditions.

2.11.6 Each annunciator panel shall be complete with an audible warning horn, acknowledge/reset for horn silence and lamp test push buttons. Apart from annunciator system in LCC, alarm contacts for remote alarm indication shall have to be wired separately in LCC terminal block.

2.11.7 The control cabinets shall be suitable for bottom entry of cables.

2.12 SUPPORTING STRUCTURES:

2.12.1 The Bidder shall design, fabricate and supply the equipment supporting framework including all rails, transverse & longitudinal beams and supporting members with all necessary hardware & embedded parts. General structural designs and structural details shall be subject to the approval of the Customer.

2.12.2 The floor of the switchgear building will be designed to support all the loads imposed by the equipment supporting framework. The Bidder 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 Bidder shall supply the details of static and dynamic loads to be supported by the slab along with the offer.

2.12.3 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.

2.12.4 All steel structure members shall be hot dip galvanised.



2.12.5 All supporting structures shall be designed in such a way so as to allow dismantling for the addition of further switchgear components or maintenance of existing equipment without requiring temporary supports.

2.12.6 The supporting arrangements for the GIS duct outside the building shall have adequate provision for thermal expansion/seismic forces etc.

2.13 MONITORING:

2.13.1 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:

- i) Level-I- Remote alarm and prevent closing of the breaker in case it is open.
- ii) Level-II- Initiation of Zone trip, Contact shall be in accordance with the requirement.

2.13.2 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.

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

2.13.4 The Bidder shall satisfy the Customer regarding accuracy limits of gas monitoring devices.

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

- i. 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



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ii) 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

iii) 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

iv) Safety bursting disc for each SF6 gas compartment.

2.14 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. The Bidder is therefore required to establish that the reduced transient levels are within acceptable level.

2.15 BURN THROUGH PREVENTION

The Bidder shall furnish the details regarding the design features of their equipment which are intended to prevent burn through when an internal arc occurs.

2.16 HEATERS

All the heaters shall be suitable for connection to a 240V AC, single phase, 50 Hz supply. The heater in the mechanism housing shall be connected inside the housing to this supply and shall be thermostatically controlled. The leads to the tank heaters shall be enclosed in a conduit.

All the thermostats and the temperature indicating devices shall be calibrated in metric units.



2.17 SERVICE LIFE

SF6 circuit breakers, disconnecting switches and grounding switches will be subjected to frequent and occasionally repetitive, no load / full load operations and switching off short circuit currents, capacitive and inductive currents within their ratings. The Bidder shall propose the recommended period for scheduled maintenance.

2.18 SEISMIC DESIGN CRITERIA

a) The equipment shall be designed for operation in seismic zone for earthquake resistance. The seismic loads are due to the horizontal and vertical acceleration which may be assumed to act on concurrently. Seismic Qualification requirements shall be as per IEC 62271-207 for the design of equipment. The equipment along with its parts shall be strong enough and sufficiently well connected to resist total operating stresses resulting from the forces in normal operation, but in case of abnormal condition shall also resist with forces superimposed due to earthquakes.

The copies of type test reports for similar rated equipment, if tested earlier, should be furnished. If the equipment has not been type tested earlier, Test Report/Analysis Report should be furnished.

b) To prevent the movement of GIS sub-assemblies i.e. various bay modules during the earthquake, suitable devices shall be provided for fixing the sub-assemblies to the foundation. The Bidder shall supply necessary bolts for embedding in the concrete foundation. The fixing of GIS sub-assemblies to the foundation shall be designed to withstand the seismic events. It will also be ensured that the special devices as well as bolts shall not be over stressed. The details of the devices used and the calculations for establishing the adequacy shall be furnished by the Bidder and shall be subject to the Customer's approval.

2.19 INSPECTION AND TESTING

2.19.1 All the equipment, apparatus, materials and supplies provided by the Bidder under the contract shall be subjected to tests in the shop and at the field in the presence of Customer for conformity with the requirements of the specifications. 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 Customer well in advance i.e. no less than 30 days before these tests are conducted. Unless otherwise specified, the Bidder shall perform all shop and field tests.

2.19.2 The Bidder shall submit a detailed quality assurance plan with 30 days after the commencement date intimating the testing program to the Customer for testing



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may proceed with minimum delay. The performances tests shall start, proceed, stop and be resumed in accordance with the approved schedule.

2.19.3 The Bidder shall, at its own expense, promptly make good all defects evident by testing or made apparent in any other ways. After defects in the equipment have been rectified, the equipment is proved to be in satisfactory operation.

2.19.4 Within 30 days of completion of each and every specified test, including commissioning tests, the Bidder shall submit six signed copies of the test reports to the Customer.

2.19.5 The test reports shall indicate the tests performed, the result obtained, instruments used, names of personnel carrying out the tests and provisions for signature of witnesses. They shall also show the number and date. The format of these reports shall be submitted along with testing procedure for the Customer's approval well in advance.

2.19.6 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 computations, wherever necessary or desirable to show the test values employed in the equations.
- Curves showing relation of tested quantities
- Data in tabulated form

The comparison of the test results with the guaranteed requirements of the specification and explanation of deviations, if any.

2.20 SHOP TEST

2.20.1 All major part of equipment, is essentially those necessitating subdivision of parts are transport and subsequent and reassembly at site, shall be matched, assembled in the factory and carefully marked before dismantling. The dowel holes shall be provided with dowels to assist reassembly. The accuracy of fitting has to be assured at site at all stages of assembly.

2.20.2 Each transport section of switchgear shall be shop tested.

2.20.3 Switchgear components forming part of GIS namely circuit breakers, disconnectors, grounding switches, current transformers, Voltage transformers, 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



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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 IEC60099-4 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 62271-203, IEC 62271-100 and IEC 62271-1.

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



2.21 TYPE TEST

For Type Test requirement, Please refer clause 1.8 and 1.9 under Section-1.

2.22 PERFORMANCE TESTS

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 Bidder subject to Customer's approval. The Bidder 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 Bidder shall assume full responsibility for the operation and safety of the equipment during all tests. The reports of all the tests shall be prepared by the Bidder 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.

2.23 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 Customer. The Bidder 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 that 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) Checking of cabling between apparatus by the Bidder, prior to acceptance tests. Written evidence shall be produced on these tests. Random checks shall be made in the presence of the Engineer.



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(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.

Prior to commencement of these tests, the Bidder shall submit a detailed programme to Customer's for approval. Detailed records, including all the details of tests performed and the results obtained shall be prepared by the Bidder and furnished to the Customer.

2.24 COMMISSIONING TESTS

On completion of the erection and installation, following commissioning tests shall be performed as per IEC 62271-203, 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 62271-203 high voltage tests at site with lightning impulse and switching impulse voltages are also acceptable as alternative. The Bidder 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/checking of SF6 gas pressure/density switches.

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 Customer may direct Bidder to rectify the



defects or repair, reconstruct or replace faulty work and Bidder shall without delay, carry out the instructions of the Customer in this respect.

Except as otherwise provided hereunder, responsibility for apparatus & test equipment and the control thereof shall be exercised by Bidder subject to the overriding control of the Customer.

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

2.25 FINAL ACCEPTANCE TESTS

After commissioning tests have been satisfactorily completed, the Bidder shall carry out tests as per relevant standards.

2.26 TEST REPORTS

The Bidder shall record all the relevant facts and the quantities on the basis of which a final test report shall be prepared. Such reports will be prepared in a form approved by the Customer and reproduced at the expense of the Bidder in six copies for submission to the Customer.



Annexure-C

SPECIFICATION OF MANDATORY MAINTENANCE EQUIPMENT

1.0 SF6 Gas Handling Plants:-

a) SF6 gas filling and evacuating equipment (Portable)

The capacity of this plant shall be such that it shall not take appreciable time for filling or evacuating of largest compartment. The required vacuum for complete evacuation shall be attained with the help of this plant.

b) SF6 gas filtering, drying, storage and recycling plant:

- The plant shall be complete with accessories and fittings so that SF6 gas from the breaker can be directly filled in the plant storage reservoir.
- In case purging of the equipment before filling with SF6 gas is desirable, then the required equipment for dry gases etc. shall be furnished as a part of the plant.
- For heavy items within the plant, the lifting hooks shall be provided for lifting and moving with the overhead cranes.
- The capacity of the plant shall be such as to handle and store the maximum quantity of gas that could be removed from atleast one phase of complete one bay.

Note:

- i) These SF6 gas handling plants shall be complete with all the necessary pipes, couplings flexible tubes and valves for coupling to the equipment.
- ii) The design and construction of the plant, valves, couplings, and connections shall be such that leakage of SF6 gas shall be minimum. Similarly valves, couplings and pipe work shall be so arranged that accidental loss of gas to the atmosphere shall be minimum.

2.0 SF6 Gas Analyzer

The SF6 gas analyser should be portable type and instrument should have following features:

- a. Sensitivity of the equipment shall not be affected by any atmospheric conditions like dust, humidity, heat, wind etc.
- b. Equipment should be equipped with pumped back facilities so that no SF6 gas is wasted.



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c. Equipment shall be supplied with suitable regulator which can be used to connect SF6 cylinder if required.

d. Following acidic/impurities products should be detected as per IEC 60480 and IEC 60376

- i) SF6 purity – Range: 0-100 %
- ii) Dew point - Range: -60 to +20 deg C
- iii) SO2 - Range: 0-150 ppm
- iv) CF4 – Range: 0-60% vol
- v) HF - Range: 0-25 µl/l

e. Instrument should work on AC source as well as on rechargeable battery

f. Input pressure: upto 10 bar

g. It should be housed in a robust IP67 case with wheels

3.0 SF6 Gas Leak Detector –

The SF6 gas leak detector shall meet the following requirements:

- a) The detector shall be free from induced voltage effects.
- b) The sensing probe shall be such that it can reach all the points on the GIS where leakage is to be sensed.
- c) The accuracy of the equipment shall be at least 10 ppm.

4.0 Operational Analyser with DCRM kit-

The operational analyser shall meet the following requirements:

- a) Operational analyser shall be one complete system, which once installed should record all the parameters, as laid down in subsequent clauses.
- b) It shall have facility to record the breaker contact movement during opening, closing, auto reclosing and make-break operation, the speed of contacts at various stages of operation, travel of contacts, opening time, closing time and make break time ,etc.
- c) The analyser shall have provisions for recording atleast 12 different functions of the circuit breaker. All necessary transducers (i.e. three nos. for complete 3 phase speed and travel record of breaker), cables, pickups, attachments required for the breaker shall be supplied with the analyser.



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The cables supplied shall be sufficient enough for recordings at site on a completely assembled and erected breaker.

- d) The analyser shall be suitable for operation outdoor and shall be suitably shielded against induced charges.
- e) The output of the analyser shall be on a plain paper or any paper having infinite shelf life and the output thus obtained shall have a long life and shall not require any special storage facility. Photographic paper is not acceptable.
- f) All the necessary catalogues, write up for operation and maintenance of the analyser shall be furnished alongwith each analyser and peripheral system.
- g) Demonstration at manufacturer's premises for functional/operational check and compatibility with breaker.
- h) The necessary equipments for monitoring various parameters of circuit breaker termed as signature analysing shall be supplied along with all softwares, laptop computer, devices etc. with the breaker. The same shall be demonstrated at site on a fully assembled breaker.

5.0 All above maintenance equipments shall be demonstrated at site during handover.



Annexure-D

MANDATORY MONITORING EQUIPMENTS

1.0 Dew Point Meter

i) The meter shall be capable of measuring the dew point of SF6 Gas of the Circuit Breaker/GIS equipment. It should be portable and adequately protected for outdoor use. The meter shall be provided with dew point hygrometer with digital indication to display the dew point temperature in degree C. or PPM. It should be capable of measuring the corresponding pressure at which dew point is being measured.

The measurement and use of the instrument must be simple, direct without the use of any other material/chemical like dry ice/acetone etc. It should be battery operated with rechargeable batteries.

ii) The equipments should have the following parameters

- a. Measuring range: Up to -100 degree C Dew Point
- b. Accuracy: + 2 degree C.
- c. Display: 4 digit LCD, inch. High

2.0 PORTABLE PD MONITORING SYSTEM FOR GAS INSULATED SWITCHGEAR

i) The equipment shall be used for detecting different types of defects in Gas Insulated Stations (GIS) such as Particles, Loose shields and Partial Discharges as well as for detection of Partial discharges in other types of equipment such as Cable Joints, CTs and PTs.

ii) It shall be capable for measuring PD in charged GIS environment as EHV which shall have bandwidth in order of 10 KHz – 500 KHz with possibility to select a wide range of intermediate bandwidths for best measurement results. The principle of operation and the method of measurement shall be non-intrusive. The instrument is able to detect partial discharges in cable joints, terminations, CTs and VTs etc., with the hot sticks.

iii) Detection and measurement of PD and bouncing particles shall be displayed on built in large LCD display and the measurement shall be stored in the instrument and further downloadable to a PC for further analysis to locate actual source of PD such as free conducting particles, floating components, voids in spacers, particle on spacer surfaces etc.

iv) The equipments should have the following parameters:

- a) Measurement shall be possible in noisy environment.
- b) Stable reading shall be possible in presence of vibrations within complex GIS assemblies, which can produce signals similar to PD.
- c) Environment should have necessary synchronizing circuits to obtain PD correlation with power cycle and power frequency.



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d) The equipment shall be battery operated with built-in battery charger. It shall also be suitable for 230V AVC/50 Hz input.

e) Measurement shall be possible in the charged switchyard in the presence of EMI/EMC. Supplier should have supplied similar detector for GIS application to other utilities. Performance certificate and the list of users shall be supplied along with the offer.

f) Instrument shall be supplied with standard accessories i.e. connecting cables (duly screened) to sensors, Lap-top PC, diagnostic software, carrying case, rechargeable battery pack with charger suitable for 230V AC, 50 Hz supply connecting cables (duly screened) to view in storage.

Bidder shall provide adequate number of sensors in the offered GIS for detection of Partial discharge, the number and location of these sensor shall be subject to approval of the Customer.

g) The function of software shall cover the following:

- Data recording, storage and retrieval in computer
- Data base analysis
- Template analysis for easy location of fault inside the GIS
- Evaluation of PD measurement i.e., Amplitude, Phase Synchronisation etc.
- Evaluation of bouncing/loose particles with flight time and estimation on size of particle.
- Report generation

h) To prove the suitability of working in charged switchyard condition, practical demonstration shall be conducted before acceptance.

i) Supplier shall have "Adequate after sales service" facility in India.

j) Necessary training may be accorded to personnel to make use of the kit for locating PD sources inside the GIS.

k) Instrument shall be robust and conform to relevant standard.

l) Adequate number of UHF sensors shall be provided in the offered GIS for detection of Partial discharge as per IEC 60270 through Partial Discharge (PD) monitoring system and the number and location of these sensors shall be subject to approval of the Customer. Pulse generator for UHF sensor sensitivity test shall also be supplied as a standard accessory.



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2.27 CIRCUIT BREAKER

2.27.1 GENERAL

Circuit Breakers shall be metal enclosed SF6 gas insulated, single phase encapsulated for GIS and outdoor type Sf6 gas insulated for AIS, both comprising three identical single pole units, complete in all respects with all fittings and wiring. The circuit breakers and accessories shall conform to relevant standard.

The controlled switching device for circuit breakers (as indicated in single line diagram) shall meet the requirements as specified in annexure-I.

2.27.2 DUTY REQUIREMENTS

2.27.2.1 Circuit breaker shall be restrike free under all duty conditions and shall be capable of performing their duties without opening resistor. The circuit breaker shall meet the duty requirement of any type of fault or fault location and shall be suitable for line charging and dropping when used on 400kV effectively grounded or ungrounded systems and perform make and break operations as per the stipulated duty cycles satisfactorily. The circuit breaker shall meet the requirements of C2/ M1 type of duty as per IEC for 400kV.

2.27.2.2 The Bidder may note that total break time of the breaker shall not be exceeded under any duty conditions specified such as with the combined variation of the trip coil voltage, pneumatic/hydraulic pressure and arc extinguishing medium pressure, etc. While furnishing the proof of the total break time of complete circuit breaker, the Bidder may specifically bring out the effect of non-simultaneity between same pole and poles and show how it is covered in the guaranteed total break time.

2.27.3 CONSTRUCTIONAL FEATURES

2.27.3.1 All the three poles of the breaker shall be linked together either electrically/pneumatically or electro hydraulically.

2.27.3.2 Circuit breakers shall be provided with two (2) independent trip coils, suitable for trip circuit supervision. The trip circuit supervision relay would also be provided. Necessary terminals shall be provided in the central control cabinet of the circuit breaker.

2.27.4 SULPHUR HEXAFLORIDE (SF6) GAS CIRCUIT BREAKER

2.27.4.1 Circuit breakers shall be single pressure type.

2.27.4.2 Each pole shall form an enclosure filled with SF6 gas independent of two other poles. Common monitoring of SF6 gas can be provided for the three poles of circuit breaker having a common drive. The interconnecting pipes in this case shall



be such that the SF6 gas from one pole could be removed for maintenance purposes.

2.27.4.3 Sufficient SF6 gas shall be supplied to fill all the circuit breakers installed plus an additional 20% of the quantity as spare.

2.27.5 OPERATING MECHANISM

2.27.5.1 Circuit breaker shall be operated by pneumatic mechanism or electrically spring charged mechanism or electro-hydraulic mechanism or a combination of these. It shall be gang operated in case of 3-phase reclosing operation as applicable.

2.27.5.2 The pneumatically operated mechanism shall offer unit compressor with each circuit breaker with the breaker local air receivers having a capacity for two 'CO' operations of the breaker at the lowest pressure for reclose duty without refilling.

2.27.5.3 The Spring operated mechanism shall be complete with motor, opening spring & closing spring with limit switch for automatic charging and other necessary accessories to make the mechanism a complete operating unit. As long as power is available to the motor, a continuous sequence of closing and opening operations shall be possible. The motor shall have adequate thermal rating for this duty. After failure of power supply to the motor, one close-open operation shall be possible with the energy contained in the operating mechanism. Motor ratings shall be such that it requires not more than 30 seconds for fully charging the closing spring.

2.27.5.4 The hydraulic mechanism shall be suitable for at least two close open operations after failure of ac supply to the motor starting at pressure equal to lowest pressure of auto-reclose duty. All hydraulic joints shall have no oil leakage under the site conditions and joints shall be tested at factory against oil leakage at a minimum of 1.5 times maximum working pressure.

2.27.6 FITTINGS AND ACCESSORIES

2.27.6.1 The insulators and terminal connectors shall conform to requirements stipulated elsewhere. All routine tests shall be conducted on the insulators as per relevant IEC.

2.27.6.2 UNIT COMPRESSED AIR SYSTEM

a) The unit compressed air system for each breaker shall be provided with compressed air piping, piping accessories, control and non-return valves, filters, coolers of adequate capacity, pressure reducing valves(if any), isolating valves, drain ports, etc. The air compressor shall be driven by automatically controlled motor. It shall be of air cooled type complete with preferably oil-less cylinder lubrication. The compressors or pumps shall be mounted within the operating mechanism housing or



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a separate weather-proof and dust-proof housing. Each compressor shall be equipped with a time totaliser.

b) The compressor size shall be such that it is capable of performing following operations satisfactorily :

i) Total running time of compressor not exceeding 45 minutes per day, considering 2% leakage and 2 CO-operations.

ii) Air charging time not exceeding 20 minutes after one CO operation of the breaker.

c) Air Receivers:

i) The capacity of receivers shall be sufficient for two (2) CO operations of the breaker.

ii) Air receiver shall be designed in accordance with the latest edition of the ASME Code for Pressure Vessel - Section VIII of BS:5179. A corrosion allowance of 3.0 mm shall be provided for shell and dished ends. Receivers shall be hot dip galvanized.

d) Controls and Control Equipment:

i) The compressor control shall be of automatic start stop type initiated by pressure switches on the receiver. Supplementary manual control shall also be provided.

ii) All control equipment shall be housed in a totally enclosed cabinet. Pressure gauges and other indicating devices, control switches shall be mounted on the control cabinet.

iii) Facility to annunciate failure of power supply to the compressor control shall also be provided.

e) Compressed Air Piping, Valves and Fittings:

i) The flow capacity of all valves shall be at least 20% greater than the compressor capacity.

ii) The high pressure system shall be such that after one 0 - 0.3 Sec - CO operation, the breaker shall be capable of performing one CO operation within 3 minutes.

iii) All compressed air piping shall be bright annealed, seamless phosphorous

Deoxidized Non-Arsenical Copper alloy or stainless steel pipe (C-106 of BS: 2871).



2.27.7 TESTS

2.27.7.1 Type Test

GIS circuit breaker shall be type tested in accordance with the requirement stipulated under clause no. 1.8 and 1.9 of Section 1.

2.27.7.2 Routine Tests

Routine tests as per IEC on the complete breaker/ pole along with its own operating mechanism and pole column shall be performed on all circuit breakers.

2.27.7.3 SITE TESTS

All routine tests except power frequency voltage dry withstand test on breaker shall be repeated on the completely assembled breaker at site.

2.27.8 PARAMETERS

2.27.8.1 General

a) Type of circuit breaker	SF6 insulated
b) Number of poles	Three (3)
c) Rated operating duty cycle	O - 0.3 sec. - CO - 3min. – CO
d) Reclosing	Single and three phase high speed auto reclosing(as required)
e) Total closing time Not more than	150 ms.
f) Maximum difference in the instants of closing/opening of contacts	As per IEC
g) Trip and closing coil voltage	220V DC
h) Auxiliary contacts	As required plus 10 NO and 10 NC contacts perbreaker as spare. The contacts shall have continuous rating of 10A and breaking capacity of 2A with circuit time constant of minimum 20 millisecond at 220V DC.
i) Noise level Maximum	140dB at 50m distance from base of circuit breaker



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- j) Rated terminal load Adequate to withstand 100kg static load as well as wind, seismic and short circuit forces without impairing reliability or current carrying capacity.
- k) Type of operating mechanism Pneumatic/spring/hydraulic/or a combination of these.

2.27.8.2 400kV Class Circuit Breakers (GIS)

- a) Rated voltage 420 kV rms
- b) Rated continuous current current capacity As per SLD
- c) Rated short circuit breaking current at rated voltage 63kA with percentage of DC component as per IEC corresponding to minimum opening time under operating conditions specified.
- d) Symmetrical interrupting Capability 63 kA rms
- e) Short time current carrying Capability 63 kA rms for One (1) second
- f) Short circuit making current Capability 157.5 kAp
- g) Rated out-of-phase breaking 15.75 kA rms
- h) Rated line charging breaking Current (voltage factor of 1.4). 600A at 90° C leading power factor with maximum permissible switching overvoltage of 2.3 pu
- i) Rated small inductive current Breaking Capacity As per IEC
- j) First pole to clear factor 1.3
- k) Rated break time
- i) 40 ms under test duties 2, 3 & 4 at rated values
 - ii) 45 ms under test duties 1 to 5 and short line fault test duties and combined variation of trip coil voltage, operating pressure and quenching media pressure, etc.



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l) Rated one minute power
frequency withstand voltage

i) 650 kV rms between live terminals
and earth.

ii) 815 kV rms across isolating distance
and/ or across open switching device

m) Rated lightning impulse
withstand voltage

i) ± 1425 kVp between live terminals and
earth.

ii) ± 1425 kVp impulse on one terminal
and 240 kVp power freq. voltage of
opposite polarity on other terminal
(across isolating distance).

n) Rated switching impulse
withstand voltage

i) ± 1050 kVp between live terminals
and earth

ii) ± 900 kVp impulse on one terminal
and 345 kVp power freq. voltage of
opposite polarity on other terminal
(across isolating distance).

o) Partial discharge level

5 Pico coulombs max.



ANNEXURE-I

Requirement of Controlled Switching Device for Circuit Breaker

The circuit breaker with controlled switching as indicated in single line diagram shall meet the following requirement:

1. The Switching controlled Device shall be used to reduce increased over voltages, re-ignition between circuit breaker contacts that may be caused by normal switching of high voltage circuit breakers and hence optimize the stresses on circuit breaker while switching the circuit. The switching controlled device will be called device henceforth.
2. The device shall be such that only switching commands (for operating purpose) are processed in the device. Open command triggered by protection on fault shall be forwarded directly to the breaker. In these cases switching instance is not controlled.
3. Circuit breaker should be able to be switched while switching controlled device is not in operation e.g. during maintenance work or power supply is not connected, a bypass shall be provided to the device. In these cases the switching commands will then be forwarded directly to the circuit breaker via this Bypass. The switching time will not be controlled with these switching operations.
4. The device shall have functions for switching ON & OFF the circuit breakers.
5. The controller shall get command to operate the breakers manually or through auto re-close relay at random. The controller shall be able to analyze the current and voltage waves available through the signals from secondaries of CTs & CVTs for the purpose of calculation of optimum moment of the switching the circuit breaker and issue command to circuit breaker to operate.
6. The device shall also have an adaptive control feature to consider the next operating time of the breaker in calculation of optimum time of issuing the switching command and optimize the switching behavior as necessary. In calculation of next operating time of the breaker the controller must consider all factors that may affect the operating time of the breaker.
7. The device should have display facility at the front for the settings and measured values, alternatively a laptop shall be supplied with each CSD to facilitate display at the front for the setting and measured values.
8. The device shall have self-monitoring facility.
9. The device shall be suitable for operation considering transient and dynamic state values of the current and voltage from the secondary of the CTs and CVTs
10. During the switching operations, current and voltage waveforms and other parameters shall be recorded and saved together with calculated values. The control switching device provided shall be networked to an Engineering work station (EWS) located in the switchyard control room. It shall be



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possible to extract the switching oscillographic records and also to do CSD parameterization from this EWS. All necessary software & hardware shall be in bidder's scope.

11. It shall have self monitoring facilities. Faults which impair the functioning of the device or peripheral components, failure of trip voltage or sensors shall be displayed visually and shall give alarm.

12. The device shall be designed to operate correctly and satisfactorily with the excursion of auxiliary A/C & DC voltages and frequency as specified elsewhere in the specification.

13. The device shall have time setting resolution of 0.1 ms or better.

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

15. Supply of all the necessary accessories required for the successful operation of controlled switching device shall be in the scope of supplier of the device.

16. Test reports for the following type tests shall be submitted:

a. Dielectric withstand test as per IEC 60255-27.

b. High voltage Impulse test as per IEC 60255-27.

c. Slow damped oscillatory wave test as per IEC 60255-26

d. Fast transient test as per IEC 60255-26 (class 4 installation as per base standard IEC 61000-4-4)

e. Electrostatic Discharge test as per IEC 60255-26 (class 4 installation as per base standard IEC 61000-4-2)

f. Surge Immunity test as per IEC 60255-26 (class 4 installation as per base standard IEC 61000-4-5)

g. Power frequency magnetic field test as per IEC 60255-26 (class 5 installation as per base standard IEC 61000-4-8)

h. Radiated radio frequency electromagnetic field test as per IEC 60255-26 (class 4 installation as per base standard IEC 61000-4-3)

i. Conducted disturbance induced by radio frequency field as as per IEC 60255-26 (class 4 installation as per base standard IEC 61000-4-6)

j. Power frequency immunity test on binary input as per IEC 60255-26 (class 4 installation as per base standard IEC 61000-4-16)



2.28 DISCONNECTOR

2.28.1 GENERAL

2.28.1.1 The isolators and accessories shall conform in general to relevant IEC 62271-102 (or equivalent Indian Standard) except to the extent explicitly modified in specification.

2.28.1.2 Earth switches shall be provided on isolators as marked on SLD.

2.28.1.3 The isolators and earth switches shall be A. C. motor operated.

2.28.1.4 Complete disconnecter with all the necessary items for successful operation shall be supplied.

2.28.2 DUTY REQUIREMENTS

2.28.2.1 Thermal effects of the maximum possible short circuit current of the Isolators and earth switches shall be capable of withstanding the dynamic system in their closed position. They shall be constructed such that they do not open under influence of short circuit current, wind pressure and other mechanical loads together. The earth switches wherever provided shall be constructional interlocked so that the earth switches can be operated only when the isolator is open and vice-versa.

2.28.2.2 In addition to the constructional interlock, isolator and earth switches shall have provision to prevent their electrical and manual operation unless the associated and other interlocking conditions are met. All these interlocks shall be of fail safe type. Suitable individual interlocking coil arrangements shall be provided. The interlocking coil shall be suitable for continuous operation from DC supply and within a variation range as stipulated in relevant section. The interlock coil shall be provided with adequate contacts for facilitating permissive logic for 'DC' control scheme of the isolator as well as for AC/DC circuit of the motor to prevent opening or closing of isolators when the interlocking coil is not energised.

2.28.2.3 The earthing switches shall be capable of discharging trapped charges of the associated lines. Isolator and earth switches shall be able to bear on the terminals the total forces including wind loading and electrodynamic forces on the attached conductor without impairing reliability or current carrying capacity.

2.28.3 CONSTRUCTIONAL FEATURES

a) The three pole/ Single pole group operated disconnectors shall be operated by electric motor suitable for use on 220 V DC ungrounded system/415V AC system and shall be equipped with a manual operating mechanism for emergency use. The



motor shall be protected against over current & short circuit.

b) 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.

c) 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.

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

e) 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.

f) 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.

g) Remote control of the disconnectors from the BCU in Relay room & power house control room shall be made through remote / local transfer switch.

h) 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.

i) Each disconnector shall be supplied with auxiliary switch having eight normally open and eight normally closed contacts for use by others over and above those required for disconnector operation 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. Additionally MBB contact as required shall also be provided.

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



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

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

m) 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.

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

o) The local control of the disconnector 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.

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

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

Sign	Back ground	Colour
Open position	Open	Green
Closed position	Closed	Red

r) All the disconnector and earth switches shall be provided with inspection window so that the travel of the switch contacts in both open and close positions can be verified by visual inspection.

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

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



2.28.4 SAFETY GROUNDING SWITCHES

a) Three-pole/ Single 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. The motor shall be protected against over current and short circuit.

b) 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.

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

d) 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 Power House Control Room.

e) The details of the inscription and colouring for the indicator are given as under:

Sign	Background	Colour
Open position	Open	Green
Closed position	Closed	Red

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

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

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

i) All portions of the grounding switch and operating mechanism required for grounding shall be connected together utilizing flexible copper conductors having a minimum cross-sectional area of 50 mm².

j) 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.



k) The safety grounding switches shall conform to the requirements of IEC 62271-102

l) Mechanical position indication shall be provided locally at each switch along with remote indication at each bay module control cabinet & in the power house control room.

2.28.5 HIGH SPEED GROUNDING SWITCHES

a) Grounding switches located at the beginning of the Feeder bay modules shall be of the high-speed 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.

b) Single phase switches shall be provided with individual/group operated mechanism operating mechanism for each phase suitable for operation from a 220V DC ungrounded supply.

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

d) The short circuit making current rating of each ground switch shall be at least equal to its peak withstand current rating of 157.5 KA. The switches shall have inductive / capacitive current switching capability as per IEC-62271-102.

e) Each high speed make proof 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 Power House Control Room.

f) The details of the inscription & coloring for the indicator shall be as under:

Sign	Background	Colour
Open position	Open	Green
Closed position	Closed	Red

g) High-speed ground switch operation should be possible locally from the bay module control cabinet, or remotely from the relay room & power house control room in conjunction with opening of the associated disconnecter.

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

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

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- j) Each high speed ground switch shall be fitted with auxiliary switches having six normally open(NO) and six normally closed (NC) auxiliary contacts for use by others, over and above those required for local interlocking and position indication. All contacts shall be wired to terminal blocks in the local bay control cabinet. Provision shall be made for padlocking the grounding switches in either the open or closed position.
- k) All portion of the grounding switches and operating mechanism required for connection to ground shall be connected together utilizing flexible copper conductor having minimum cross-sectional area of 50 sq mm.
- l) The main grounding connection on each grounding switch shall be rated to carry the peak withstand current rating of the switch for 1 sec and shall be equipped with a silver-plated terminal connector suitable for steel strap of adequate design for connection to the grounding grid.
- m) The high speed grounding switches shall conform to the requirements of IEC-62271-102.

2.28.6 TESTS

The GIS disconnector shall be type tested in accordance with the requirement stipulated under clause no 1.8 and 1.9 of Section 1.

2.28.7 PARAMETERS

2.28.7.1 General

a) Type of isolator	Metal enclosed, SF6 Gas Insulated (For GIS)
b) Number of poles	Three (3)
c) Operating time	Not more than 12 sec.
d) Control voltage	220V DC
e) Auxiliary contacts on Isolator	Minimum 8NO and 8NC contacts per pole/isolator shall be provided. The contacts shall have continuous rating of 10A and breaking capacity of 2A with circuit time constant of minimum 20 millisecond at 220V dc. Additionally MBB contacts as required shall also be provided.



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f) Auxiliary contacts on earth switch/
safety grounding switch/high speed
fault making switch

Total 6NO and 6NC

g) Temperature rise over
ambient

As per IEC:62271-102

j) Operating mechanism of isolator
and earth switch

AC/DC/Universal motor operated

2.8.7.2 400kV Class Isolators (GIS)

a) Rated voltage

420 kV rms

b) Rated continuous current

As per SLD

c) Rated short time withstand current
of isolator and earth switch

63 kA rms for One (1) second

d) Rated dynamic short circuit withstand
current of isolator and earth switch

157.5 kAp

e) Rated Insulation levels

i. Rated one minute power
Frequency withstand voltage.

i) 650 kV rms between phase to
earth & between phases.

ii) 815 kV rms across isolating
distance and/or open switching
device

ii. Rated lightning impulse
Withstand voltage

i) ± 1425 kVp between live
terminals and earth.

ii) ± 1425 kVp impulse on one
terminal and 240kVp power freq.
Voltage of opposite polarity on
other terminal (across isolating
distance).



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iii. Rated switching impulse

Withstand voltage

i) ± 1050 kVp between live terminals and earth.

ii) ± 900 kVp impulse on one terminal and 345 kVp power freq. voltage of opposite polarity on other terminal (across isolating distance).

f) Partial discharge level at
1.1 $U_n/\sqrt{3}$

5 pico coulombs

2.29 INSTRUMENT TRANSFORMER

2.29.1 CODES AND STANDARDS

Current transformers

IEC 61869-2, BS: 3938, IS: 2705

Voltage transformers

IEC 60044-2&5, IEC 60358, IS: 3156

Insulating oil

IS: 335

2.29.2 GENERAL REQUIREMENTS (FOR GIS)

a) The current transformers and accessories shall conform to IEC-61869-2 and other relevant standards except to the extent explicitly mentioned in the specification.

b) The instrument transformers i.e. current and voltage transformers shall be single phase transformer units.

c) Polarity marks shall indelibly be marked on each instrument transformer and at the lead terminals at the associated terminal block.

d) The particulars of the various cores are given here for tender purpose and may change within reasonable limits as per the requirements of protection relays. The Bidder is required to submit the VA burden calculations and obtain approval from the Customer before proceeding with design of the cores. The other characteristics of CTs shall be as given below:

2.29.3 PARAMETERS AND CONSTRUCTION DETAILS (GIS)

2.29.3.1 GENERAL FOR CURRENT TRANSFORMER (GIS)

(a) One minute power frequency
Withstand voltage between
Secondary terminal and earth

5 kV



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(b) Partial discharge level	10 pico Coulombs max.
(c) Temperature rise	As per IEC
(d) Type of insulation	Class A
(e) Number of cores	Details are given in table I below
(f) Rated frequency	50 Hz
(g) System neutral earthing	Effectively earthed
(h) Number of terminals in box	All terminals of control circuits wired marshalling up to marshalling box plus 20 terminals spare.
(i) Rated extended primary current	120% of rated primary current

2.29.3.2 400 kV Current Transformers (GIS)

(a) Rated dynamic current	157.5 kA (peak)
(b) Rated short time thermal current	63 kA for 1 sec.
(c) Rated system voltage (Um)	420 kV (rms)

2.29.4 Construction Details

a) The current transformers incorporated into the GIS will be used for protective relaying and metering. The secondary windings shall be air/gas insulated. All the current transformers shall have effective electromagnetic shields to protect against high frequency transients.

b) Each current transformer shall be equipped with a marshalling box with terminals for the secondary circuits, which are connected to the local control cubicle. The star / delta configuration and the inter connection to the line protection panels will be done at the CT terminal block located in the local control cubicle.

c) Rating and Diagram Plates shall be as specified in the IEC specification incorporating the year of manufacture. The rated extended current rating voltage and rated thermal current shall also be marked on the name plate. The diagram plate shall show the terminal markings and relative physical arrangement of the current transformer cores with respect to the primary terminals(P1 & P2)



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- d) The position of each primary terminal in the current transformer SF₆ gas section shall be clearly marked by two plates fixed to the enclosure at each end of the current transformer.
- e) Current transformers guaranteed burdens and accuracy class are to be intended as simultaneous for all cores.
- f) The current transformers shall be suitable for high speed auto reclosing.
- g) Electro magnetic shields to be provided against high frequency transients typically 1-30 MHz.
- h) The wiring between each CT and bay module control cabinet shall be included in the scope of supply.
- i) Provision shall be made for primary current injection testing of current transformers.

2.29.5 BUS VOLTAGE TRANSFORMERS (GIS)

2.29.5.1 GENERAL

- a) The voltage transformers and accessories shall conform to IEC and other relevant standards except to the extent explicitly mentioned in the specification.
- b) Voltage transformers shall be of the electro magnetic type with SF₆ gas insulation. The earth end of high voltage winding and the ends of secondary winding shall be brought out in the terminal box.
- c) The rating and diagram plate shall be provided complying with the requirement of IEC specification incorporating the year of manufacture and including turn's ratio, voltage ratio, burden, connection diagram etc.
- d) The beginning and end of each secondary winding shall be wired to suitable terminals accommodated in a terminal box mounted directly on the voltage transformer section of SF₆ switchgear.
- e) All terminals shall be stamped or otherwise marked to correspond with the marking on the diagram plate. Provision shall be made for earthing of the secondary windings inside the terminal box.
- f) The transformer shall be able to sustain full line voltage without saturation of transformer.
- g) Core details are given in table II.



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2.29.5.2 CONSTRUCTONAL DETAILS

a) 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.

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

The voltage transformer secondaries shall be wired by Bidder to their associated bay control cabinets.

2.29.6 TESTS

a) GIS Instrument transformer shall be type tested in accordance with the requirement stipulated under clause no 1.8 and 1.9 of Section 1.



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Table I – Core Details 400kV CTs

CORE DETAILS OF 400kV CTs – 3000A (Set - 1)						TABLE – IVA	
CT No.	Application	Current Ratio (A)	Output Burden (VA)	Accuracy Class as per IEC	Min Knee Point Voltage (Vk)	Max CT Sec Winding Res. (Ohm)	Max Exciting Current in mA at Vk
1	Bus Differential	3000/ 2000/ 1000/1	-----	PS	3000/ 2000/ 1000V	15/ 10/ 5 Ohm	20/ 30/ 60
2	Bus Differential	3000/ 2000/ 1000/1	-----	PS	3000/ 2000/ 1000V	15/ 10/ 5 Ohm	20/ 30/ 60
CORE DETAILS OF 400kV CTs – 3000A (Set - 2)						TABLE – IVB	
CT No.	Application	Current Ratio (A)	Output Burden (VA)	Accuracy Class as per IEC	Min Knee Point Voltage (Vk)	Max CT Sec Winding Res. (Ohm)	Max Exciting Current in mA at Vk
1	Metering & Synchronising	3000/ 2000/ 1000/ 500/1	20 / 20 / 20 / 20	0.2S	-----	-----	-----
2	Transf. backup/ Line Protection	3000/ 2000/ 1000/ 500/1	-----	PS	6000/400 0/2000/ 1000V	15/ 10/ 5/ 2.5 Ohm	20/ 30/ 60/ 120
3	Transf. backup/ Line Protection	3000/ 2000/ 1000/ 500/1	-----	PS	6000/400 0/2000/ 1000V	15/ 10/ 5/ 2.5 Ohm	20/ 30/ 60/ 120
ISF for metering core should be less than 5. The rated extended primary current of the CTs shall be 120% continuous of 3000A. Physical arrangement of CTs shall be as per Protection SLD.							

Table II – Core Details of 400kV VTs

CORE DETAILS OF 400kV VTs (GIS)				TABLE – V
Secondary Winding	Application	Rated Secondary Voltage (V)	Accuracy	Rated Secondary Burden (min) VA*
I	Protection	110/v3	3P	75 VA
II	Protection	110/v3	3P	75 VA
III	Metering	110/v3	0.2	75 VA
The accuracy of 0.2 on secondary III should be maintained through the entire burden range up to total simultaneous burden 150 VA on all the three windings without any adjustments during operation.				
* This is minimum burden specified, however bidder to consider VA burden to suit the requirement of the offered system. The supporting calculation to be furnished during detail engineering.				



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2.30 SURGE ARRESTOR

2.30.1 GENERAL

2.30.1.1 The surge arrestors shall conform in general to IEC-60099-4 and IS: 3070 except to the extent modified in the specification.

2.30.1.2 Arrestors shall be hermetically sealed units, self-supporting construction, suitable for mounting on lattice/tubular type support structures.

2.30.2 DUTY REQUIREMENTS

2.30.2.1 The Surge Arresters (SAs) shall be capable of discharging over-voltages occurring due to switching of unloaded transformers, reactors and long lines.

2.30.2.2 The reference current of SAs shall be high enough to eliminate the influence of grading and stray capacitance on the measured reference voltage.

2.30.2.3 The SAs shall be capable of withstanding meteorological and short circuit forces under site conditions.

2.30.3 CONSTRUCTIONAL FEATURES FOR GIS SURGE ARRESTOR

a) It will be SF6 gas insulated, metal enclosed surge arrestor of the gapless non linear zinc oxide, heavy duty, station type.

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

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

20.30.4 PARAMETERS

20.30.4.1 GENERAL

a) System neutral earthing	Effectively earthed
b) Installation	Indoor for GIS/Outdoor
c) (i) Nominal discharge current	20kA of 8/20 microsec. Wave



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(ii) Discharge current at which insulation coord. is done	20 kA of 8/20 microsec. wave
d) Rated frequency	50 Hz
e) Current for pressure relief test	63 kArms
f) Prospective symmetrical fault current	63 kArms for 1 second
g) Low current long duration test value (2000 micro sec.)	As per IEC
h) Pressure relief class	Class A of Table VII of IS: 3070 or equivalent IEC
i) Partial discharge at 1.05 MCOV (Continuous operating voltage)	Not more than 50 p.C.
j) Siesmic acceleration	0.3 g horizontal
k) Reference ambient temp.	50 deg. C
l) Minimum total creepage distance (mm)	10500
20.30.4.2 400 kV CLASS SURGE ARRESTOR	
a) Rated system voltage	420 Kv
b) Rated arrestor voltage	336 kV
c) Minimum discharge capability	12kJ/kV or corresponding to minimum discharge characteristics given in clause m) below whichever is higher.
d) Continuous operating voltage (COV) at 50 deg. C	267 kV rms
e) Min. Switching surge residual voltage at 2 kA	670 kVp
f) Max. Switching Surge voltage at 500A	650 kVp



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g) Maximum residual voltage at

i) 10kA nominal discharge current	800 kVp
ii) 20kA nominal discharge current	850 kVp

h) Steep fronted wave residual voltage at 10kA 925 kVp

i) High current short duration test value (4/10 microsec. wave) 100 kAp

j) One minute dry/wet power frequency withstand voltage of arrester housing 630 kV (rms)

k) Impulse withstand voltage of arrester Housing with 1.2/50 micro sec. wave. 1425 kVp

l) RIV at 266 kV (rms) Less than 1000 micro volts

m) Long duration discharge class 4

Note:

The number of Surge Arrestors indicated in the SLD and their ratings are tentative and the same shall be decided based on the Insulation Coordination/Transient analysis studies.

However the number of surge arrestors indicated in the SLD are the minimum numbers of surge arresters to be provided by the Bidder.

The Surge arrestors for main buses shall be of GIS type only.

20.30.5 TESTS

20.30.5.1 Surge arrester (GIS) shall be type tested in accordance with clause no. 1.8 & 1.9 under Section-1.



2.31 SF6 / AIR BUSHING

a) Rated Voltage (kVrms)	420kVrms
b) Rated Current (Amp)	As per SLD
c) 1.2/ 50 micro second Impulse voltage (L/I Withstand voltage)	± 1425kVp
d) 250/2500 micro second switching Impulse voltage	± 1050kVp
e) One minute power Frequency withstand Voltage	650kVrms
f) Minimum total Creepage Distance (mm)	10500
g) Minimum Cantilever Strength (kN)	10

- Bushings shall be designed to have ample insulation, mechanical strength and rigidity for the conditions under which they will be used.
- In accordance with the requirements stipulated elsewhere, bushings shall conform to type tests and shall be subjected to routine tests and acceptance test/ sample test in accordance with relevant standards.



2.32 SITE TESTING AND COMMISSIONING

20.31.1 INTRODUCTION

An indicative list of tests as applicable is given below. Bidder shall perform any additional test based on specialties of the items as per the field QP/ instructions of the equipment supplier or Customer without any extra cost to the Customer /BHEL. The Bidder shall arrange all instruments required for conducting these tests along with calibration certificates and shall get the list of instruments approved from the Customer.

20.31.2 GENERAL CHECKS

- a) Check for physical damage.
- b) Visual examination of zinc coating/ plating
- c) Check from name plate that all items are as per older/ specification.
- d) Check tightness of all bolts, clamps and connecting terminals using torque wrenches.
- e) For oil filled equipment check for oil leakage, if any. Also check oil level and top up.
- f) Check ground connections for quality of weld and application of zinc rich paint overweld joint of galvanized surfaces.
- g) Check cleanliness of insulator and bushings.
- h) All checks and tests specified by the manufactures in their drawings and manuals aswell as all tests specified in the relevant code of erection.
- i) Check for surface finish of grading rings (corona control ring.)
- j) Pressure test on all pneumatic lines at 1.5 times the rated pressure shall be conducted.

20.31.3 CIRCUIT BREAKERS

- a) Insulation resistance of each pole.
- b) Check adjustments, if any, suggested by manufacturer.



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- c) Breaker closing and tripping time.
- d) Slow and power closing operation and opening
- e) Trip free and anti pumping operation.
- f) Minimum pick up volts of coils
- g) Contact resistance
- h) Functional checking of compressed air plant and all accessories
- i) Functional checking of control circuits, interlocks, tripping through protective relays and auto-reclose operation.
- i) Insulation resistance of control circuits, motor etc.
- j) Resistance of closing and tripping coils

20.31.4 ISOLATORS

- a) Insulation resistance of each pole
- b) Manual and electrical operation on interlocks
- c) Insulation resistance of control circuits and motors.
- d) Ground connections
- e) Contact resistance
- f) Proper alignment to minimise the vibration to the extreme possible during operation.
- g) Measurement of operating torque for isolator and Earth switch
- h) Resistance of operating and interlocking coils.

20.31.5 CURRENT TRANSFORMERS

- a) Insulation Resistance Test
- b) Polarity test.



- c) Ratio identification test-checking of all ratios on all cores by primary injection of current.
- d) Dielectric test of oil (wherever applicable).
- e) Magnetizing characteristics test.
- f) Capacitance and tan delta measurement at minimum 10kV.

20.31.6 VOLTAGE TRANSFORMERS/CAPACITOR VOLTAGE TRANSFORMER

- a) Insulation resistance test.
- b) Polarity test.
- c) Ratio test.
- d) Dielectric test of oil (if applicable).
- e) Capacitance and tan delta measurement at minimum 10kV.

20.31.7 SURGE ARRESTOR

- a) Grading leakage current.
- b) Resistance of ground connection.
- c) Resistive current drawn at rated voltage after energisation.

20.31.8 PHASING OUT

The phasing out of all supplies in the station system shall be carried out.

20.31.9 STATION EARTHING

- a) Check soil resistivity
- b) Check continuity of grid wires
- c) Check earth resistance of the entire grid as well as various sections of the same.
- d) Check for weld joint and application of zinc rich paint on galvanised surface.
- e) Dip test on earth conductor prior to use.

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SECTION- 3

PROJECT DETAILS AND GENERAL SPECIFICATIONS

3.0 GENERAL

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

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

3.1 PROJECT DETAILS

	Particular	Details															
a)	Customer	Patratu Vidyut Utpadan Nigam Ltd (PVUNL) – A Subsidiary of NTPC in Joint Venture with JBVNL.															
b)	Engineer/Consultant/ Inspector	NTPC Ltd.															
c)	Project Title	Patratu Super Thermal Power Project Expansion Phase – I (3X 800MW) – 400kV GIS Switchyard at Patratu STPP															
d)	Project Location	Place: Patratu District: Ramgarh State: Jharkhand															
e)	Latitude & Longitude	Latitudes and Longitudes of the site are as follows: <table border="1"> <thead> <tr> <th>Corner name</th><th>Latitude</th><th>Longitude</th></tr> </thead> <tbody> <tr> <td>Top Corner</td><td>23° 38' 60" N</td><td>85° 17' 51.5" E</td></tr> <tr> <td>Bottom Corner</td><td>23° 38' 12.5" N</td><td>85° 17' 27" E</td></tr> <tr> <td>Left Corner</td><td>23° 38' 22.5" N</td><td>85° 17' 10.6" E</td></tr> <tr> <td>Right Corner</td><td>23° 38' 40" N</td><td>85° 17' 57" E</td></tr> </tbody> </table>	Corner name	Latitude	Longitude	Top Corner	23° 38' 60" N	85° 17' 51.5" E	Bottom Corner	23° 38' 12.5" N	85° 17' 27" E	Left Corner	23° 38' 22.5" N	85° 17' 10.6" E	Right Corner	23° 38' 40" N	85° 17' 57" E
Corner name	Latitude	Longitude															
Top Corner	23° 38' 60" N	85° 17' 51.5" E															
Bottom Corner	23° 38' 12.5" N	85° 17' 27" E															
Left Corner	23° 38' 22.5" N	85° 17' 10.6" E															
Right Corner	23° 38' 40" N	85° 17' 57" E															
f)	Nearest Railway Station	Patratu – At a distance of about 4 km on Barkakhana-Barwadih Railway Line.															
g)	Distance of project location from the Railway station	4 km (approx.)															
h)	Nearest Major Town	Ranchi															
i)	Distance of the town from the project site	45 km															
j)	Nearest commercial airport	Birsa Munda Airport, Ranchi.															
k)	Distance of airport from the project site	45 km															
<u>SITE CONDITIONS</u> (for design purposes)																	
a)	Design ambient temperature	50°C															
b)	Maximum Relative humidity	95 %															
c)	Height above mean sea level	Less than 1000 meters															
d)	Pollution Severity	Heavily polluted															

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e)	Criteria for Wind Resistant design of structures and equipment	Standard Applicable - IS 875 (Part 3)
f)	Basic Wind speed "Vb" at ten meters above the mean ground level.	39 m/ sec
g)	Category of terrain	Cat -2
h)	Risk Coefficient "K1"	1.06

3.1.1 SYSTEM PARAMETERS:

Sl.No.	Parameters	400 kV
1	Highest system voltage	420 kV rms
2	Lightning Impulse voltage	±1425kVp
3	Switching impulse voltage	±1050kVp
4	Power frequency withstand for 1 min (rms)	650 kV(rms)
5	Max. fault level (1 sec.)	63 kA
6	Minimum creepage distance	10500 mm

3.1.2 AUXILIARY POWER:

Sl.No.	Nominal Connection Voltage	Variations in Voltage	Frequency	Phase	Neutral
1	415V	±10%	50 (+3% -5%)	3Phase , 4 Wire	Solidly Earthed
2	240V	±10%	50 (+3% -5%)	1 phase	Solidly Earthed

Combined variation of voltage and frequency shall be + 10%. Design fault level of 415V system shall be restricted to 50kA rms for 1 second.

The operational limits for variation of DC voltage are (+) 10% to (-) 15%.

3.1.3 The various minimum heights of the AIS switchyard shall be as given below from plinth level:

Voltage	Equipment /1st Level	Line Take Off Gantry Height	Peak
400kV	8000mm	23000mm	8500mm

The minimum vertical distance from the bottom of the lowest porcelain part of the bushing, porcelain enclosures or support insulators to the bottom of the equipment structure, where it rests on the foundation pad shall be 2550mm.

The minimum height of intermediate gantry tower for 400kV wherever required shall be 25 m and the peak (s) shall be of 8.5 m. The gantry width for 400kV AIS shall be minimum 27m or as required to meet the specified clearances.

3.1.4 The minimum clearances for 400kV switchyards shall be as given below:

	400kV
Phase to earth clearance	3500 mm
Phase to phase clearance	4000 mm
Section clearance	6500 mm

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3.2 INSTRUCTION TO BIDDERS:

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

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

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

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

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

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

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

3.3 CODES AND STANDARDS

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

a) Indian Electricity Act

b) Indian Electricity Rules

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- c) Indian Explosives Act
- d) Indian Factories Act and State Factories Act
- e) Indian Boiler Regulations (IBR)
- f) Regulations of the Central Pollution Control Board, India
- g) Regulations of the Ministry of Environment & Forest (MoEF), Government of India
- h) Pollution Control Regulations of Department of Environment, Government of India
- i) State Pollution Control Board.
- (j.) Rules for Electrical installation by Tariff Advisory Committee (TAC).
- (k.) Building and other construction workers (Regulation of Employment and Conditions of services) Act, 1996
- (l.) Building and other construction workers (Regulation of Employment and Conditions of services) Central Rules, 1998
- (m.) Explosive Rules, 1983
- (n.) Petroleum Act, 1984
- (o.) Petroleum Rules, 1976,
- (p.) Gas Cylinder Rules, 1981
- (q.) Static and Mobile Pressure Vessels (Unified) Rules, 1981 .
- (r.) Workmen's Compensation Act, 1923
- (s.) Workmen's Compensation Rules, 1924
- (t.) NTPC Safety Rules for Construction and Erection
- (u.) NTPC Safety Policy
- (v.) Any other statutory codes / standards / regulations, as may be applicable.

Unless covered otherwise in the specifications, the latest editions (as applicable as on date of bid opening: 03-March-2017), of the codes and standards given below shall also apply:

- a) Bureau of Indian standards (BIS)
- b) Japanese Industrial Standards (JIS)
- c) American National Standards Institute (ANSI)
- d) American Society of Testing and Materials (ASTM)
- e) American Society of Mechanical Engineers (ASME)

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- f) American Petroleum Institute (API)
- g) Standards of the Hydraulic Institute , U.S.A.
- h) International Organization for Standardization (ISO)
- i) Tubular Exchanger Manufacturer's Association (TEMA)
- j) American Welding Society (AWS)
- k) National Electrical Manufacturers Association (NEMA)
- l) National Fire Protection Association (NFPA)
- m) International Electro-Technical Commission (IEC)
- n) Expansion Joint Manufacturers Association (EJMA)
- o) Heat Exchange Institute (HEI)
- p) IEEE standard
- q) JEC standard

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

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

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.

In case of any change in codes, standards & regulations between 03-March-2017 and the date when vendors proceed with fabrication, the Employer shall have the option to incorporate the changed requirements or to retain the original standard. It shall be the responsibility of the Contractor to bring to the notice of the Employer such changes and advise Employer of the resulting effect.

3.4 SERVICES TO BE PERFORMED BY THE EQUIPMENT BEING FURNISHED

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

All equipment shall also perform satisfactorily under various other electrical, electromechanical and meteorological conditions of the site of installation. All equipment shall be able to withstand all

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external and internal mechanical, thermal and electromechanical forces due to various factors like wind load, temperature variation, ice & snow (not applicable for this project), short circuit etc for the equipment.

3.5 ENGINEERING DATA

3.5.1 Drawings

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

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

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

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

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

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

3.5.2 Bidder's Drawing Submission and Approval Procedure

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

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

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

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

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

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

3.5.3 Erection Drawings.

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

3.5.4 Instruction Manual

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

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The Instruction Manuals shall comprise of the following:

3.5.4.1 Erection Manuals

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

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

3.5.4.2 Operation and Maintenance Manuals

- a) The manual shall be a two rim PVC bound stiff sided binder able to withstand constant usage or where a thicker type is required it shall have locking steel pins, the size of the manual shall not be larger than international size A3. The cover shall be printed with the Project Name, Services covered and Volume / Book number Each section of the manual shall be divided by a stiff divider of the same size as the holder. The dividers shall clearly state the section number and title. All written instructions within the manual not provided by the manufacturers shall be typewritten with a margin on the left hand side.
- b) The arrangement and contents of O & M manuals shall be as follows :
 - 1) Chapter 1 - Plant Description : To contain the following sections specific to the equipment/system supplied
 - (a) Description of operating principle of equipment / system with schematic drawing / layouts.
 - (b) Functional description of associated accessories / controls. Control interlock protection write up.

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- (c) Integrated operation of the equipment along-with the intended system. (This is to be given by the supplier of the Main equipment by taking into account the operating instruction given by the associated suppliers).
 - (d) Exploded view of the main equipment, associated accessories and auxiliaries with description. Schematic drawing of the equipment along-with its accessories and auxiliaries.
 - (e) Design data against which the plant performance will be compared.
 - (f) Master list of equipment, Technical specification of the equipment/ system and approved data sheets.
 - (g) Identification system adopted for the various components, (it will be of a simple process linked tagging system).
 - (h) Master list of drawings (as built drawing - Drawings to be enclosed in a separate volume).
- 2) Chapter 2 - Plant Operation : To contain the following sections specific to the equipment supplied
- (a) Protection logics provided for the equipment along-with brief philosophy behind the logic, Drawings etc.
 - (b) Limiting values of all protection settings.
 - (c) Various settings of annunciation/interlocks provided.
 - (d) Start-up and shut down procedure for equipment along-with the associated systems in step mode.
 - (e) Do's and Don'ts related to operation of the equipment.
 - (f) Safety precautions to be taken during normal operation. Emergency instruction on total power failure condition/lubrication failure/any other conditions.
 - (g) Parameters to be monitored with normal value and limiting values.
 - (h) Equipment isolating procedures.
 - (i) Trouble shooting with causes and remedial measures.
 - (j) Routine testing procedure to ascertain healthiness of the safety devices along-with schedule of testing.
 - (k) Routine Operational Checks, Recommended Logs and Records
 - (l) Change over schedule if more than one auxiliary for the same purpose is given.
 - (m) Preservation procedure on long shut down.
 - (n) System/plant commissioning procedure.

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3) Chapter 3 - Plant Maintenance : To contain the following sections specific to the equipment supplied

- (a) Exploded view of each of the equipments. Drawings along-with bill of materials including name, code no. & population.
- (b) Exploded view of the spare parts and critical components with dimensional drawings (In case of Electronic cards, the circuit diagram to be given) and spare parts catalogue for each equipment.
- (c) List of Special T/ P required for Overhauling /Trouble shooting including special testing equipment required for calibration etc.
- (d) Stepwise dismantling and assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained etc. Clearance to be maintained etc.
- (e) Preventive Maintenance schedules linked with running hours/calendar period along-with checks to be carried out.
- (f) Overhauling schedules linked with running hours/calendar period along-with checks to be done.
- (g) Long term maintenance schedules
- (h) Consumables list along-with the estimated quantity required during normal running and during maintenance like Preventive Maintenance and Overhauling.
- (i) List of lubricants with their Indian equivalent, Lubrication Schedule including charts showing lubrication checking, testing and replacement procedure to be carried daily, weekly, monthly & at longer intervals to ensure trouble free operation and quantity required for complete replacement.
- (j) Tolerance for fitment of various components.
- (k) Details of sub vendors with their part no. in case of bought out items.
- (l) List of spare parts with their Part No, total population, life expediency & their interchangeability with already supplied spares to NTPC.
- (m) List of mandatory and recommended spare list along with manufacturing drawings, material specification & quality plan for fast moving consumable spares.
- (n) Lead time required for ordering of spares from the equipment supplier, instructions for storage and preservation of spares.
- (o) General information on the equipment such as modification carried out in the equipment from its inception, equipment population in the country / foreign country and list of utilities where similar equipments have been supplied.

After finalization and approval of the Employer, the O & M Manuals shall be submitted as indicated in table below. The Contract shall not be considered to be completed for purposes of taking over until the final Instructions manuals (both erection and O & M manuals have been supplied to the Employer.

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If after the commissioning and initial operation of the plant, the instruction manuals (Erection and /or O & M manuals) require modifications/additions/ changes, the same shall be incorporated and the updated final instruction manuals shall be submitted by the Contractor to the Employer for records and number of copies shall be as mentioned in table below:

S.No.	Description of Drgs/Docs	No. of Prints	No. of CD ROMs/DVDs/Portable Hard Disk
1	Erection Manual	4 Sets	2
2	Operation & Maintenance manual	1 Set	1
	i) First Submission		
	ii) Final Submission	4 Sets	2

3.5.5 Final Submission of drawings and documents:

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

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

3.5.6 TEST REPORTS

Two (2) copies of all test reports shall be supplied for approval before shipment of Equipment. The report shall indicate clearly the standard value specified for each test to facilitate checking of the reports. After final approval six (6) bound copies and two (2) sets of CD-ROMs/ DVD/Portable hard disk of all type and routine test reports shall be submitted to Employer.

3.6 MATERIAL /WORKMANSHIP

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

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

The design of the Works shall be such that installation, future expansions, replacements and general maintenance may be undertaken with a minimum of time and expenses. Each component shall be

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designed to be consistent with its duty and suitable factors of safety subject to mutual agreements. All joints and fastenings shall be devised, constructed and documented so that the component parts shall be accurately positioned and restrained to fulfill their required function. In general, screw threads shall be standard metric threads. The use of other thread forms will only be permitted when prior approval has been obtained from the Purchaser.

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

The equipment offered in the bid only shall be accepted for supply, with the minimum modifications as agreed/accepted.

3.7 PROVISIONS FOR EXPOSURE TO HOT AND HUMID CLIMATE

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

SPACE HEATERS

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

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

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

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

FUNGI STATIC VARNISH

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

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Ventilation opening

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

Degree of Protection

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

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

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

PRESERVATIVE SHOP COATING

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

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

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

3.8 RATING PLATES, NAME PLATES AND LABELS

- 3.8.1 Each equipment shall have permanently attached to it in a conspicuous position, a rating plate of non-corrosive material upon which shall be engraved manufacturer's name, equipment, type or serial number together with details of the ratings, service conditions under which the item of plant in question has been designed to operate, and such diagram plates as may be required by the Employer.
- 3.8.2 Such nameplates or labels shall be of white non-hygroscopic material with engraved black lettering or alternately, in the case of indoor circuit breakers, starters, etc. of transparent plastic material with suitably coloured lettering engraved on the back.
- 3.8.3 Each equipment shall be provided with nameplate or label designating the service of the particular equipment. The inscriptions shall be approved by the Employer or as detailed in appropriate section of the technical specifications.

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- 3.8.4 The rated current, extended current rating and rated thermal current shall be clearly indicated in the name plate in case of current transformer.
- 3.8.5 Rated voltage, voltage factor and intermediate voltage shall be clearly indicated on the nameplate in case of capacitor voltage transformer.
- 3.8.6 Each switch shall have a clear inscription identifying its function. Switches shall also have a clear inscription of each position indication.
- 3.8.7 All such plates, instruction plates, etc. shall be bilingual with Hindi inscription first, followed by English. Alternatively, two separate plates one with Hindi and the other with English inscriptions may be provided.
- 3.8.8 All segregated phases of conductors or bus ducts, indoor or outdoor, shall be provided with coloured phase plates to clearly identify the phase of the system.

3.9 GALVANISING:

- 3.9.1 All exposed ferrous parts shall be hot dip galvanised as per IS:2629 & IS:2633, Galvanising shall be uniform, clean, smooth continuous and free from acid spots. Should the galvanising of the sample be found defective, the entire batch of steel shall have to be re-galvanised at bidder's cost.
- 3.9.2 The amount of zinc deposit over threaded portion of the bolts, nuts and screws shall not be less than 300 gms. per sq. meter of surface area. The amount of zinc deposit on washers shall not be less than 340 gms. per sq. meter of surface area or a minimum of 30 microns. The threads shall have extra deposit of zinc which shall be removed by die cutting after the completion of galvanising. The removal of extra zinc shall be carefully done so that threads shall have the required deposits of zinc on them as specified.

3.10 PAINTING

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

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

3.11 QUALITY ASSURANCE PROGRAMME

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

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

- i. His organisation structure for the management and implementation of the proposed quality assurance programme.
- ii. Quality System Manual

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

3.12 GENERAL REQUIREMENTS - QUALITY ASSURANCE

- 3.12.1 All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the Bidder for some of the major items is given in the respective technical specification. This is, however, not intended to form a comprehensive programme as it is the Bidder's responsibility to draw up and implement such programme duly approved by the Employer. The detailed Quality Plans for manufacturing and field activities should be drawn up by the Bidder and will be submitted to Employer for approval.
- 3.12.2 Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Bidder's/ Sub-contractor's/ sub-supplier's Quality Control Organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing. The Quality Plan shall be submitted on electronic media e.g. E-mail in addition to hard copy, for review. Once the same is finalised, hard copies shall be submitted for approval. After approval the same shall be submitted in compiled form on CD ROM.
- 3.12.3 The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality Plans and reference documents/standards etc. will be subject to Employer's approval without which manufacturer shall not proceed.
- 3.12.4 These approved documents shall form a part of the contract. In these approved Quality Plans, Employer shall identify customer hold points (CHP), 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/Authorised representative 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 and dispositioning.

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- 3.12.5 No material shall be despatched from the manufacturer's works before the same is accepted subsequent to pre-despatch final inspection including verification of records of all previous tests/inspections by Employer's Project Manager/Authorised representative and duly authorised for despatch by issuance of Material Dispatch Clearance Certificate (MDCC).
- 3.12.6 All material used for equipment manufacture including casting and forging etc. shall be of tested quality as per relevant codes/standards. Details of results of the tests conducted to determine the mechanical properties, chemical analysis and details of heat treatment procedure recommended and actually followed shall be recorded on certificates and time temperature chart. Tests shall be carried out as per applicable material standards and/or agreed details.
- 3.12.7 All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section IX/BS-4870 or other International equivalent standard acceptable to the Employer.
- 3.12.8 All welding/brazing procedures shall be submitted to the Employer or its authorised representative for approval prior to carrying out the welding/brazing.
- 3.12.9 All brazers, welders and welding operators employed on any part of the contract either in Bidder's/his sub-contractor's works or at site or elsewhere shall be qualified as per ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the Employer.
- 3.12.10 Test results or qualification tests and specimen testing shall be furnished to the Employer for approval. However, where required by the Employer, tests shall be conducted in presence of Employer/authorised representative.
- 3.12.11 For all pressure parts and high pressure piping welding, the latest applicable requirements of the IBR (Indian Boiler Regulations) shall also be essentially complied with. Similarly, any other statutory requirements for the equipments/systems shall also be complied with. On all back-gauged welds MPI/LPI shall be carried before seal welding.
- 3.12.12 All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.
- 3.12.13 No welding shall be carried out on cast iron components for repair.
- 3.12.14 Unless otherwise proven and specifically agreed with the Employer, welding of dissimilar materials and high alloy materials shall be carried out at shop only.
- 3.12.15 All non-destructive examination shall be performed in accordance with written procedures as per International Standards. The NDT operator shall be qualified as per SNT-TC-IA (of the American Society of non-destructive examination). NDT shall be recorded in a report which includes details of methods and equipment used, result/evaluation, job data and identification of personnel employed and details of co-relation of the test report with the job. In general all plates of thickness greater than 40mm & for pressure parts plates of thickness equal to or greater than 25mm shall be ultrasonically tested otherwise as specified in respective equipment specification. All bar stock/Forging of diameter equal to or greater than 40mm shall be ultrasonically tested.
- 3.12.16 The Bidder shall list out all major items/ equipment/ components to be manufactured in house as well as procured from sub-contractors (BOI). All the subcontractor proposed by the Contractor for procurement of major bought out items including castings, forging, semi-finished and finished components/equipment etc., list of which shall be drawn up by the Bidder and finalised with the Employer, shall be subject to Employer's approval. The Bidder's proposal shall include vendor's facilities established at the respective works, the process

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capability, process stabilization, QC systems followed, experience list, etc. along with his own technical evaluation for identified subcontractors enclosed and shall be submitted to the Employer for approval within the period agreed at the time of pre-awards discussion and identified in "DR" category prior to any procurement. Such vendor approval shall not relieve the Bidder from any obligation, duty or responsibility under the contract.

- 3.12.17 For components/equipment procured by the Bidders for the purpose of the contract, after obtaining the written approval of the Employer, the Bidder's purchase specifications and inquiries shall call for quality plans to be submitted by the suppliers. The quality plans called for from the subcontractor shall set out, during the various stages of manufacture and installation, the quality practices and procedures followed by the vendor's quality control organisation, the relevant reference documents/standards used, acceptance level, inspection of documentation raised, etc.
- 3.12.18 Employer reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Bidder's or their sub-contractor's quality management and control activities. The Bidder shall provide all necessary assistance to enable the Employer carry out such audit and surveillance.
- 3.12.19 The Bidder shall carry out an inspection and testing programme during manufacture in his work and that of his sub-contractor's and at site to ensure the mechanical accuracy of components, compliance with drawings, conformance to functional and performance requirements, identity and acceptability of all materials parts and equipment. Bidder shall carry out all tests/inspection required to establish that the items/equipments conform to requirements of the specification and the relevant codes/standards specified in the specification, in addition to carrying out tests as per the approved quality plan.
- 3.12.20 Quality audit/surveillance/approval of the results of the tests and inspection will not, however, prejudice the right of the Employer to reject the equipment if it does not comply with the specification when erected or does not give complete satisfaction in service and the above shall in no way limit the liabilities and responsibilities of the Bidder in ensuring complete conformance of the materials/equipment supplied to relevant specification, standard, data sheets, drawings, etc.
- 3.12.21 For all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable.
- 3.12.22 Repair/rectification procedures to be adopted to make the job acceptable shall be subject to the approval of the Employer/ authorised representative.
- 3.12.23 Environmental Stress Screening

All solid state electronic system / equipment / sub assembly shall be free from infant mortile components. For establishing the compliance to this requirement, the Bidder / sub – contractor should meet the following.

1. The Bidder / Sub – contractor shall furnish the established procedure being followed for eliminating infant mortile components. The procedure followed by the Contractor / Sub – contractor should be substantiated along with the statistical figures to validate the procedure being followed. The necessary details as required under this clause shall be furnished at the stage of QP finalization.

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In case the Bidder / Sub – contractor do not have any established procedure to eliminate infant mortile components then two or 10% whichever is less, most densely populated Panels shall be tested for Elevated Temperature Cycle Test as per the following procedure.

Elevated Temperature Test Cycle

During the elevated temperature test which shall be for 48 hours, the ambient temperature shall be maintained at 50° C. The equipment shall be interconnected with devices and kept under energized conditions so as to repeatedly perform all operations it is expected to perform in actual service with load on various components being equal to those which will be experienced in actual service.

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

In case of any failure during the test cycle, the further course of action should be mutually discussed for demonstrating the intent of the above requirement.

Burn In Test Cycle

The test shall be conducted on all the panels fully assembled and wired including the panels having undergone the above mentioned elevated temperature test.

The period of Burn in Test Cycle shall be 120 hrs and process shall be similar to the elevated temperature test as above except that the temperature shall be reduced to the ambient temperature prevalent at that time.

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

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

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

3.13 QUALITY ASSURANCE DOCUMENTS

The Contractor shall be required to submit two hard copies and two sets on CDROM of the following Quality Assurance Documents as identified in respective quality plan with tick (✓) mark.

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

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

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

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

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

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

- i) If the result of the review carried out by the Inspector of the Quality document (or applicable section) is satisfactory, the Inspector shall stamp the quality document (or applicable section) for release.
- ii) If the quality document is unsatisfactory, the Supplier shall endeavour to correct the incompleteness, thus allowing to finalize the quality document (or applicable section) by time compatible with the requirements as per contract documents. When it is done, the quality document (or applicable section) is stamped by the Inspector.
- iii) If a decision is made for dispatch, whereas all outstanding actions cannot be readily cleared for the release of the quality document by that time, the supplier shall immediately, upon shipment of the equipment, send a copy of the quality document Review Status signed by the Supplier Representative to the Inspector and notify of the committed date for the completion of all outstanding actions & submission. The Inspector shall stamp the quality document for applicable section when it is effectively completed. The submission of QA documentation package shall not be later than 3 weeks after the dispatch of equipment.

3.14 TRANSMISSION OF QUALITY DOCUMENTS

As a general rule, two hard copies of the quality document and Two CD ROMs shall be issued to the Employer on release of QA Documentation by Inspector. One set of quality document

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shall be forwarded to Corporate Quality Assurance Department and other set to respective Site.

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

3.15 INSPECTION, TESTING & INSPECTION CERTIFICATE

- 3.15.1 The word 'Inspector' shall mean the Project Manager and/or his authorised representative and/or an outside inspection agency acting on behalf of the Employer to inspect and examine the materials and workmanship of the works during its manufacture or erection.
- 3.15.2 The Project Manager or his duly authorised representative and/or an outside inspection agency acting on behalf of the Employer shall have access at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the Bidder shall obtain for the Project Manager and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Bidder's own premises or works.
- 3.15.3 The Bidder shall give the Project Manager/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Bidder's account except for the expenses of the Inspector's. The Project Manager/Inspector, unless the witnessing of the tests is virtually waived and confirmed in writing, will attend such tests within fifteen (15) days of the date on which the equipment is noticed as being ready for test/inspection failing which the Bidder may proceed with test which shall be deemed to have been made in the inspector's presence and he shall forthwith forward to the inspector duly certified copies of test reports in two (2) copies.
- 3.15.4 The Project Manager or Inspector shall within fifteen (15) days from the date of inspection as defined herein give notice in writing to the Bidder, or any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract. The Bidder shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall inform in writing to the Project Manager/Inspector giving reasons therein, that no modifications are necessary to comply with the contract.
- 3.15.5 When the factory tests have been completed at the Bidder's or subcontractor's works, the Project Manager /Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests but if the tests are not witnessed by the Project Manager /Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Contractor's test certificate by the Project Manager /Inspector. Project Manager /Inspector to issue such a certificate shall not prevent the Bidder from proceeding with the works. The completion of these tests or the issue of the certificates shall not bind the Employer to accept the equipment should it, on further tests after erection be found not to comply with the contract.
- 3.15.6 In all cases where the contract provides for tests whether at the premises or works of the Bidder or any sub-contractor, the Bidder, except where otherwise specified shall provide free of charge such items as labour, material, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Project Manager /Inspector or his authorised representatives to carry out effectively such tests on the equipment in accordance with the Bidder and shall give facilities to the Project Manager/Inspector or to his authorised representative to accomplish testing.

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- 3.15.7 The inspection by Project Manager / Inspector and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed Quality Assurance Programme forming a part of the contract.
- 3.15.8 To facilitate advance planning of inspection in addition to giving inspection notice, the Bidder shall furnish quarterly inspection programme indicating schedule dates of inspection at Customer Hold Point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.
- 3.15.9 All inspection, measuring and test equipments used by contractor shall be calibrated periodically depending on its use and criticality of the test/measurement to be done. The Bidder shall maintain all the relevant records of periodic calibration and instrument identification, and shall produce the same for inspection by NTPC. Wherever asked specifically, the contractor shall re-calibrate the measuring/test equipments in the presence of Project Manager / Inspector.

3.16 PACKAGING & TRANSPORTATION

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

3.17 CLAMPS AND CONNECTORS INCLUDING TERMINAL CONNECTORS

- 3.17.1 The material of clamps and connectors shall be Aluminium alloy casting conforming to designation A6 of IS:617 for connecting to equipment terminals and conductors of aluminium. In case the terminals are of copper, the same clamps/connectors shall be used with 2mm thick bimetallic liner.
- 3.17.2 The material of clamps and connectors shall be Galvanised mild steel for connecting to shield wire.
- 3.17.3 Bolts, nuts and plain washers shall be hot dip galvanised mild steel for sizes M12 and above. For sizes below M12, they shall be electro-galvanised mild steel. The spring washers shall be electro-galvanised mild steel.
- 3.17.4 All castings shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be rounded off to meet specified corona and radio interference requirements.
- 3.17.5 They shall have same current rating as that of the connected equipment. All current carrying parts shall be at least 10 mm thick. The connectors shall be manufactured to have minimum contact resistance.

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- 3.17.6 Flexible connectors, braids or laminated strips shall be made up of copper/aluminium.
- 3.17.7 Current rating and size of terminal/conductor for which connector is suitable shall be put on a suitable sticker on each component which should last atleast till erection time.

3.18 SPACERS

- 3.18.1 Spacers shall conform to IS: 10162. They shall be of non-magnetic material except nuts and bolts, which shall be of hot dip galvanised mild steel.
- 3.18.2 Spacers shall generally meet the requirements of clamps and connectors as specified above. Its design shall take care of fixing and removing during installation and maintenance.
- 3.18.3 In addition to the type tests as per IS: 10162, clamp slip test should have been conducted. In this test the sample shall be installed on test span of twin/quad bundle string at a tension of 44.2kN (4500 kg). One of the clamps when subjected to a longitudinal pull of 2.5kN (250 kg) parallel to the axis of conductor shall not slip, i.e. permanent displacement between conductor and clamp after test shall not exceed 1.0 mm. This test should have been performed on all other clamps of the sample.

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

- 3.19.1 Bushings shall be manufactured and tested in accordance with IS: 2099 & IEC: 60137 while hollow column insulators shall be manufactured and tested in accordance with IEC62155/IS 5284. The support insulators shall be manufactured and tested as per IS: 2544/IEC 60168/IEC 60273. The insulators shall also conform to IEC 60815 as applicable having alternate long and short sheds.
Support insulators/ bushings/ hollow column insulators shall be designed to have ample insulation, mechanical strength and rigidity for the conditions under which they will be used.
- 3.19.2 Porcelain used shall be homogenous, free from laminations, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified, tough and impervious to moisture.
- 3.19.3 Glazing of the porcelain shall be uniform brown in colour, free from blisters, burns and other similar defects.
- 3.19.4 The design of the insulator shall be such that stresses due to expansion and contraction in any part of the insulator shall be lead to deterioration. All ferrous parts shall be hot dip galvanised.
- 3.19.5 Post type insulators shall consist of a porcelain part permanently secured in metal base to be mounted on supporting structures. They shall be capable of being mounted upright. They shall be designed to withstand all shocks to which they may be subjected to during operation of the associated equipment.
- 3.19.6 Bushing porcelain shall be robust and capable of withstanding the internal pressures likely to occur in service. The design and location of clamps, the shape and the strength of the porcelain flange securing the bushing to the tank shall be such that there is no risk of fracture. All portions of the assembled porcelain enclosures and supports other than gaskets, which may in any way be exposed to the atmosphere shall be composed of completely non hygroscopic material such as metal or glazed porcelain.

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- 3.19.7 All iron parts shall be hot dip galvanised and all joints shall be air tight. Surface of joints shall be trued, porcelain parts by grinding and metal parts by machining. Insulator/ bushing design shall be such as to ensure a uniform compressive pressure on the joints.
- 3.19.8 In accordance with the requirement stipulated elsewhere, bushing, hollow column insulators and support insulators shall conform to type tests and shall be subjected to routine tests and acceptance test/sample test in accordance with relevant standards.

3.20 CONTROL CABINETS, JUNCTION BOXES, TERMINAL BOXES & MARSHALLING BOXES FOR OUTDOOR EQUIPMENT.

- 3.20.1 All types of control cabinets, junction boxes, marshaling boxes, lighting panels, terminal boxes, operating mechanism boxes, Kiosks etc. shall generally conform to IS:5039, IS:8623 and IEC:60439 as applicable.
- 3.20.2 They shall be of Stainless steel or Aluminium. The thickness of Stainless steel shall be minimum 1 mm. The thickness of aluminium shall be minimum 3 mm and shall provide rigidity. Top of the boxes shall be sloped towards the rear of the box.

3.20.3 BAY MARSHALLING BOX

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

It shall have three separate distinct compartments for following purposes:

- To receive two incoming 415V, three phase, AC supplies controlled by 100A four pole MCBs with auto changeover provision, and to distribute five (5) three phase ac supplies controlled by 32A four pole MCBs. It shall also be provided with 63A, 3 phase 4 pin industrial grade receptacle with rotary switch.
- To receive three phase incoming from first compartment and to distribute ten (10) single phase ac supplies controlled by 16A two pole MCBs.
- 150 nos. terminal blocks in vertical formation for interlocking facility.

3.20.4 AUXILIARY SWITCH

The auxiliary switch shall conform of following type tests:

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

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3.21 CABLE GLANDS AND LUGS/FERRULES

- 3.21.1 Cable shall be terminated using double compression type cable glands. Testing requirements of Cable glands shall conform to BS:6121 and gland shall be of robust construction capable of clamping cable and cable armour (for armoured cables) firmly without injury to insulation. Cable glands shall be made of heavy duty brass machine finished and nickel chrome plated. Thickness of plating shall not be less than 10 micron. All washers and hardware shall also be made of brass with nickel chrome plating Rubber components shall be of neoprene or better synthetic material and of tested quality. Cable glands shall be suitable for the sizes of cable supplied/erected.
- 3.21.2 Cable lugs/ferrules for power cables shall be tinned copper solderless crimping type suitable for aluminium compacted conductor cables. Cable lugs and ferrules for control cables shall be tinned copper type. The cable lugs for control cables shall be provided with insulating sleeve and shall suit the type of terminals provided on the equipments. Cable lugs and ferrule shall conform to DIN standards.

3.22 CONDUITS, PIPES AND ACCESSORIES

- 3.22.1 The bidder shall supply and install all rigid conduits, mild steel pipes, flexible conduits, hume pipes, etc. including all necessary sundry materials, such as tees, elbows, check nuts, bushing reduces, enlargers, wooden plugs, coupling caps, nipples, gland sealing fittings, pull boxes, etc.
- 3.22.2 The size of the conduit/pipe shall be selected to limit the fill to a maximum of 40%. All conduits/pipes shall have their ends closed by caps until cables are pulled. After cables are pulled, the ends of conduits/pipes shall be sealed in an approved manner to prevent damage to threaded portions and entrance of moisture and foreign materials.
- 3.22.3 PVC conduits shall be of high impact, heavy gauge (at least class 2) conduit conforming to BS-4607.
- 3.22.4 The outer surface of the steel conduits shall be coated with hot-dip zinc and chromate conversion coatings. The inner surface shall have silicone epoxy ester coating for easy cable pulling. Mild steel pipes shall be hot-dip galvanized. All rigid conduits/pipes shall be of a reputed make.
- 3.22.5 The hume pipes and accessories shall be of reinforced concrete conforming to class NP2 of IS-458. All tests on hume pipes shall be conducted as per IS-458.
- 3.22.6 Flexible conduits shall be of heat-resistant lead coated steel, water-leak, fire and rust proof.

3.23 MOTORS

The voltage level for motors shall be as follows:

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

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

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

- 3.23.1 All motors shall conform to IEC-60034-5 / IS Standard and with principal dimensions in accordance with IEC 60072-1 (1991), IEC 60072-2 (1990) and IEC 60072-3 (1994).
- 3.23.2 All equipment shall be suitable for rated frequency of 50 Hz with a variation of +3% & -5%, and 10% combined variation of voltage and frequency unless specifically brought out in the specification
- 3.23.3 Paint shade shall be as per RAL 5012 (Blue) for indoor and outdoor equipment.
- 3.23.4 Degree of Protection

Degree of protection for various enclosures as per IEC60034-05 shall be as follows:

Indoor motors - IP 54
 Outdoor motors - IP 55
 Cable box-indoor area - IP 54
 Cable box-Outdoor area - IP 55

- 3.23.5 Type:

AC Motors:

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

DC Motors Shunt wound

3.24 AUXILIARY SWITCH

The auxiliary switch shall conform of following type tests:

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

3.25 LAMPS AND SOCKETS

3.25.1 Lamps:

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

3.25.2 Sockets

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

3.25.3 Hand Lamp:

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

3.26 SWITCHES & FUSES:

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

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

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

3.27 TYPE, ROUTINE & ACCEPTANCE TESTS:

3.10.1 TYPE TEST REQUIREMENTS FOR EQUIPMENTS OTHER THAN GIS

- a) All equipments to be supplied shall be of type tested design. During detail engineering, the bidder shall submit for Owner's approval the reports of all the type tests as listed in this specification and carried out not earlier than ten years prior to the date of techno-commercial bid opening (03-March-2017). These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a Client.
- b) However if contractor is not able to submit report of the type test(s) conducted not earlier than ten years prior to the date of techno-commercial bid opening (03-March-2017), or in the case of type test report(s) are not found to be meeting the specification requirements, the bidder shall conduct all such tests under this contract at no additional cost to the owner either at third party lab or in presence of client/ owners representative and submit the reports for approval.
- c) All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.

3.28 CORONA AND RIV TESTS AND SEISMIC WITHSTAND TEST:

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

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3.29 Enclosures:

1. ANNEXURE- A - CORONA AND RADIO INTERFERENCE VOLTAGE (RIV) TEST
2. ANNEXURE- B - SEISMIC WITHSTAND TEST
3. ANNEXURE- I – MQP (NTPC format)
4. ANNEXURE- II – QUALITY ASSURANCE FOR SWITCHYARD

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ANNEXURE – A

CORONA AND RADIO INTERFERENCE VOLTAGE (RIV) TEST

1.0 General

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

2.0 Test Levels

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

3.0 Test Methods for RIV (400kV):

- 3.1** RIV tests shall be made according to measuring circuit as per International Special committee on Radio Interference (CISPR) Publication 16 -1 (1993) Part – I. The measuring circuit shall preferably be tuned to frequency with 10 % of 0.5 MHz but other frequencies in the range of 0.5 MHZ to 2 MHz may be used, the measuring frequency being recorded. The result shall be in microvolts.
- 3.2** Alternatively, RIV tests shall be in accordance with NEMA standard Publication No. 107 – 1964 except otherwise noted herein.
- 3.3** In measurement of RIV temporary additional external corona shielding may be provided. In measurement of RIV only standard fittings of identical type supplied with the equipment and a simulation of the connections as used in the actual installation will be permitted in the vicinity within 3.5 meters of terminals.
- 3.4** Ambient noise shall be measured before and after each series of tests to ensure that there is no variation in ambient noise level. If variation is present, the lowest ambient noise level will form basis for the measurements. RIV levels shall be measured at increasing and decreasing voltages of 85%, 100%, 115% and 130% for the specified RIV test voltage for all equipment unless otherwise specified. The specified RIV test voltage for 765kV, 400kV, 220kV & 132kV is listed in the detailed specification together with maximum permissible RIV level in microvolts.
- 3.5** The metering instruments shall be as per CISPR recommendations or equivalent device so long as it has been used by other testing authorities.
- 3.6** The RIV measurement may be made with a noise meter. A calibration procedure of the frequency to which noise meter shall be tuned shall establish the ratio of voltage at the high voltage terminal to the voltage read by the noise meter.

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

The purpose of this test is to determine the corona extinction voltage of the apparatus, connectors etc. The test shall be carried out in the same manner as RIV test described above with the exception that RIV measurements are not required during test and a search technique shall be used near the onset and extinction voltage, when the test voltage is raised and lowered to determine their precise values. The test voltage shall be raised to 130 % of RIV test voltage

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ANNEXURE – A

and maintained there for five minutes. In case corona inception does not take place at 130 %, the voltage level shall be raised till inception of corona or rated voltage whichever is lower. The voltage will then be decreased slowly until all visible corona disappears. The test procedure shall be repeated at least 4 times with corona inception and extinction voltage recorded each time. The corona extinction voltage for purposes of determining compliance with the specification shall be the lowest of the four values at which the visible corona (negative or positive polarity) disappears.

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ANNEXURE – B

SEISMIC WITHSTAND TEST (400kV AIS only)

- a.) The seismic withstand test on the complete equipment (except BPI) shall be carried out along with supporting structure.
- b.) The supplier shall arrange to transport the structure from his purchaser's premises / owner's sites for purpose of seismic withstand test only.
- c.) The seismic level specified shall be applied at the base of the structure. The accelerometers shall be provided at the terminal pad of the equipment and at any other point as agreed by the owner. The seismic test shall be carried out in all possible combinations of the equipment. The seismic test procedure shall be furnished for approval of the purchaser.

SUPPLIER'S LOGO	SUPPLIER'S NAME AND ADDRESS		FIELD QUALITY PLAN				PROJECT :			
							PACKAGE :			
			ITEM :		QP NO.:		CONTRACT NO.:			
			SUB-SYSTEM:		REV. NO.:		MAIN-SUPPLIER:			
		DATE:		PAGE: OF						

SL. NO	ACTIVITY AND OPERATION	CHARACTERISTICS / INSTRUMENTS	CLASS OF CHECK #	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	REMARKS
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.

MANUFACTURER/ SUB-SUPPLIER	SIGNATURE	LEGEND: * RECORDS, IDENTIFIED WITH "TICK" (✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. LEGEND TO BE USED: CLASS # : A = CRITICAL, B=MAJOR, C=MINOR; 'A' SHALL BE WITNESSED BY NTPC FQA, 'B' SHALL BE WITNESSED BY NTPC ERECTION / CONSTRUCTION DEPTT. AND 'C' SHALL BE WITNESSED BY MAIN SUPPLIER (A & B CHECK SHALL BE NTPC CHP STAGE)		DOC. NO.:		REV.....	
				FOR NTPC USE		APPROVED BY		APPROVAL SEAL

FORMAT NO.: QS-01-QAI-P-09/F2-R1

1/1

ENGG. DIV./QA&I

EPC PACKAGE FOR PATRATU SUPER THERMAL POWER STATION EXPANSION PHASE-I (3X800MW)	TECHNICAL SPECIFICATION SECTION - VI, PART-C BID DOC.NO.: CS-9585-001-2	GENERAL TECHNICAL REQUIREMENT	PAGE 79 OF111
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SECTION -4
TB-397-316-003 REV 00

SUB-SECTION-DB13

GAS INSULATED SWITCHGEAR

PAGES 39 TO 71 ARE
DELETED AS THEY ARE
NOT RELEVANT.

EPC PACKAGE FOR
PATRATU SUPER THERMAL POWER STATION EXPANSION
PHASE -I (3X 800MW)

TECHNICAL SPECIFICATION
SECTION – VI, PART-G
BID DOC NO. : CS-9585-001-2

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CLAUSE NO	GAS INSULATED SWITCHGEAR .	
I.	Bidder's Name:	
	GIS MODULE	
	The bidder shall submit with his bid the following technical particulars for the Each ' gas-insulated switchgear and accessories, complete with any additional data which, in bidder's opinion, will describe the merits of the equipment offered.	
	1. Name of manufacturer & address	.....
	2. Place of manufacture, inspection & testing	.....
	3. Manufacturer's type / designation	.....
	4. Standard applicable	.....
	5. Rated voltage	.....
	6. System frequency	.....
	7. Maximum (continuous) service rated voltage	.....
	8. Single phase or three phase design	.....
	9. Normal current rating	
	i) Generator Transformer feeder circuit	Amp.
	ii) Line feeder circuit	Amp.
	iii) Bus coupler circuit	Amp.
iv) Bus bars	Amp.	
10. Rated peak withstand current	KA	
11. Short time current rating		
- 1 second rms.	kA	
- 3 second rms.	kA	
12. Rated Lightning impulse withstand voltage	kV (peak)	
13. Rated Switching impulse withstand voltage	kV (peak)	

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CLAUSE NO	GAS INSULATED SWITCHGEAR .	
	Bidder's Name: 14. Rated one minute power frequency withstand voltagekV (peak) 15. Maximum temperature rise over 50 deg. ambient deg. C. 16. Thermal rating of current carrying parts at 420 kV for the rated symmetrical short circuit current Sec 17. a. Features adopted for preventing burn through in the various enclosures of SF6 GIS b. Time in m sec to withstand an internal flashover without burn through 18. Design pressure of the enclosures for a) Circuit breakers b) Disconnectors c) Surge arresters etc. d) GIS duct e) VT f) CT 19. No of gas compartments a) Each line bay b) Each Generator bay c) Bus coupler bay 20. a) Average leakage rate of SF6 gas%/year b) Quantity of SF6 gas required to completely charge the 3-pole equipment(Kg)	

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CLAUSE NO	GAS INSULATED SWITCHGEAR	
	Bidder's Name:	
	c) Quantity of SF6 gas required for largest gas compartment	 (Kg).....Compartment
	d) Operating pressure(bar)	
	- Circuit breaker	.....
	- GIS Duct	.....
	- CT	.....
	- VT	.....
	- Disconnecter	.....
	- SA	.....
	21. Creepage distance adopted for GIS/AIS termination (mm)	.....
	22. Heat generated in K.W. when the complete switchgear is operating at its rated capacity	.....
	23. a) Seismic level for which GIS is designed	.....
	b) Noise level in (dB) at distance of (m)	
	i) 0	.....
	ii) 50	.....
	iii) 100	.....
	iv) 150	.....
	24. Type and Material of	
	a) Breaker main contact.	
	b) Disconnecting switch contact	

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CLAUSE NO	GAS INSULATED SWITCHGEAR	एनटीपीसी NTPC
	Bidder's Name:	
	c) Grounding switch contact	
	d) Busbars	
	e) Internal bus contact.	
	f) Enclosure.	
	g) Terminal pads.	
25.	Dimensions	
	a) Bus enclosure outside diameter .....(mm)	
	b) Bus enclosure wall thickness (mm)	
	c) Internal bus, outside diameter (mm)	
	d) Internal bus thickness (mm)	
26.	Whether GIS are despatched filled with SF6 or required to be filled at site	
27.	Capacity of EOT crane in GIS building	
28.	Type and make of SF6 pipe coupling used	
29.	Type and make of mandatory maintenance equipment to be supplied	
	i) SF6 gas filling and evacuation plant (portable)	
	ii) SF6 gas filtering, drying, storage and recycling plant	
	iii) Operation analyzer with DCRM KIT	
	iv) SF6 gas leak detector	
	v) Gas analyzing equipments	
30.	Whether the following are enclosed	
	a) Type test reports Yes/No	

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CLAUSE NO	GAS INSULATED SWITCHGEAR (		
	Bidder's Name:		
	b)	Operation manual for equipments	Yes/No
	c)	Leaflets & literature bringing out salient features of equipment offered	Yes/No
	d)	The details of control room building	Yes/No
	e)	The details of GIS building	Yes/No
	31.	Details of equipments and procedure for conducting site test (including power frequency test) of the bay module as per IEC	
	32.	Weight of the heaviest piece of equipment to be handled during installation on site.	 Kg
	33.	SF6 GAS	
	a.	Name of manufacturer & address	.....
	b.	standard applicable	.....
	34.	Whether the common point of bus disconnectors alongwith Earth Switch has been brought out in a separate compartment	Yes/No
	35.	Whether provision exists for extension of busbars on both ends	Yes/No
	36.	Details of arrangement provided to account for thermal expansion for busbars enclosed	Yes/No
	37.	Details of earthing arrangement adopted for the GIS enclosed	Yes/No
	38.	Whether layout plan sections of each bay/equipment of GIS/AIS indicating the complete arrangement enclosed	Yes/No

CLAUSE NO	GAS INSULATED SWITCHGEAR	
	Bidder's Name:	
II.	EQUIPMENTS INCLUDED IN GIS A. Circuit Breaker 1. Name plate data a. Manufacturer's name b. Type / designation c. Standard applicable d. Rated frequency Hz e. Rated voltage kV f. Rated current i) Under normal condition kA ii) Under site condition KA g. Number of poles per unit h. Class (indoors) i. Number of interrupting chambers per pole (No of breaks per pole) j. Whether 3 pole or single pole design k. Maximum Operating Voltage for guaranteed Breaking Capacity kV l. Duty cycle as per IEC M1/M2&C1/C2	
III.	GUARANTEED RATINGS A) Making & Breaking 1. Breaking Capacity - Rated short circuit breaking Current KA(rms) KA - Symmetrical component at KA	

CLAUSE NO	GAS INSULATED SWITCHGEAR .	
	Bidder's Name:	
	highest system voltage	
	- DC Component (%)	.....
	- Asymmetrical breaking current at highest system voltage	 KA
	- Rated breaking MVA (Symmetrical)	kA(rms)
	- Breaking time	secs.
	b) Making Capacity	
	- Rated making current	kA
	- Rated making MVA symmetrical	.....
	- Making time	secs
	2. Operating voltages of closing/opening coil	
	- Maximum operating voltage	V
	- Minimum operating voltage	V
	3. Current ratings	
	- Rated continuous current at 27 ⁰ C ambient temp.	A
	- Rated interrupting current for 1s,	kA
	- Rated symmetrical interrupting current	kA
	- Rated asymmetrical interrupting current	kA
	- Rated short circuit making current	kA (peak)
	4. Rated Insulation level	
	a) One minute dry power	

CLAUSE NO	GAS INSULATED SWITCHGEAR	
	Bidder's Name:	
	frequency withstand voltage	
	i) Between live terminal and ground (kV rms)	
	ii) Between terminals with breaker contacts open (kV rms)	
	b) 1.2/50 micro second impulse withstand test voltage	
	i) Between live terminal and ground (kV peak)	
	ii) Between terminals with breaker contacts open (kV peak)	
	c) 250/2500 micro second impulse switching surge withstand test voltage	
	i) Between live terminal and ground (kV peak)	
	ii) Between terminals with breaker contacts open (kV peak)	
	d) Line to ground power frequency withstand voltage at gas pressure equivalent to atmospheric pressure .....kV	
	e) Minimum allowable moisture content in interrupting medium .....ppm/vol.	
	f) Maximum total break time for any current upto rated breaking current (ms)	
	i) For Test duties 2,3 & 4 at rated values	
	ii) For other duties at limiting conditions of voltage and pressure	

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CLAUSE NO	GAS INSULATED SWITCHGEAR	
	Bidder's Name:	
	g) Closing time	
	h) Minimum opening time under any condition with limiting voltage and pressure (ms)	
	i) Maximum opening time under any condition with limiting voltage and pressure (ms)	.....
	j) First pole to clear factor	.....
5.	Maximum temperature rise above ambient at rated load and voltage for	
	- Contacts	deg C
	- Hottest part	deg C
6.	Operating data	
	- Rated operating duty cycle	
	a) Line Breakers	.....
	b) Generator Transformers, & Bus Coupler Breakers	.....
	- Reclosing duty cycle (Line Breakers)	.....
	- Permissible tripping delay	ms
	- Maximum arc duration at	
	a) 10% rated breaking current	ms
	b) 30% — do—	ms
	c) 60% — do—	ms
	d) 100% — do—	ms
	- Closing time,	ms
	- Total breaking time at	ms

CLAUSE NO	GAS INSULATED SWITCHGEAR	
	Bidder's Name: a) 10% rated breaking current .....ms b) 30% — do— .....ms c) 60% — do— .....ms d) 100% — do— .....ms e) Arc duration from separation of arc at contact to instant of arc extinction for full rated interrupting capacity. ....ms - Longest time to interrupt current less than 25% of rated symmetrical short circuit current from energizing trip circuit .....ms - Minimum time from arc extinction to contact remake for auto reclosing. ....ms - Minimum dead time for a) 3 phase reclosing .....ms b) 1 phase reclosing .....ms - Maximum difference of time at opening of series contacts within one pole .....ms - Maximum difference of time at opening between phases .....ms - Maximum difference of time at closing between phases .....ms - Details of the curve enclosed for maximum opening time vs. 3 phase fault current - Number of interruptions before scheduled maintenance is required - Number of mechanical operations before scheduled maintenance is required	

CLAUSE NO	GAS INSULATED SWITCHGEAR 
	Bidder's Name: - Number of interruptions at rated S.C. current with associated TRV without changing any parts. - Description and frequency of scheduled maintenance required - Recovery voltage rate of rise at a) Rated symmetrical interrupting current .....kV/ms b) 60 percent of rated symmetrical interrupting current .....kV/ms c) 30 percent of rated symmetrical interrupting current .....kV/ms d) 10 percent of rated symmetrical interrupting current .....kV/ms data for Restrike voltage - Amplitude factor - Phase factor - Natural frequency .....(Hz) - Rate of rise of restriking voltage - Devices used for controlling RRRV - Devices used for uniform voltage distribution - Distribution of voltage across breaks - Pre-insertion resistor (if applicable) i) Value / pole (Ohms)/with tolerance ii) Minimum and maximum duration of insertion per pole (ms) iii) Thermal rating for the C-1m-0-CO-2m-C-1m-O-CO for terminal fault considering

CLAUSE NO	GAS INSULATED SWITCHGEAR .	
	Bidder's Name: maximum resistance and time setting - 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. Operating Mechanism a) Type of operating mechanism for i) Closing ii) Opening b) Normal power consumption (w) at rated voltage of i) Trip coil ii) Closing coil 7.1. Pneumatic operating mechanism a) Rated operating pressure (kg/sq.cm) b) Rated of pressure for (kg/sq.cm) i) Closing ii) Opening c) Air Consumption at rated pressure for i) Closing (m³)	

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CLAUSE NO	GAS INSULATED SWITCHGEAR .	
	Bidder's Name:	
	ii) Opening (m ³)	
	iii) Close -Open (m ³)	
	d) Pressure drop/metre length of piping	
	e) Number and Capacity (m ³) of breaker local air storage receivers	
	f) No. of close operations for which sufficient air as available in local receiver	
	g) Capacity of compressor (m ³ /hr) and working pressure (kg/cm ²)	
	h) Maximum time for which compressor can operate continuously (Minutes)	
	i) Time to fill	
	i) Air receiver after one C-O operation (Minutes)	
	ii) For making up of losses occurring in 4 hours (Minutes)	
	j) Pressure at which compressor	
	i) Starts (kg/cm ²)	
	ii) Stops (Kg/cm ²)	
	k) Material of compressed air piping	
	l) Inner & outer dia of piping (mm)	
	m) Whether time totaliser for the compressor provided	

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CLAUSE NO	GAS INSULATED SWITCHGEAR .	
	Bidder's Name: n) Safety valve blow off at (Kg/Cm²) o) Alarm switch closes (Kg/Cm²) i) Closing ii) Opening iii) Auto reclose 7.2 Hydraulic operating mechanism a) Rated pressure of oil in operating cylinder (Kg/cm²) b) Limits of pressure (Kg/cm²) c) Quantity of oil (litre) d) Details of monitoring arrangement for hydraulic pressure e) No. of close-open operation possible after loss of AC supply to drive motor f) Pressure drop starting from lowest pressure at which motor starts for i) C-operation ii) O-operation iii) CO-operation iv) O-CO-operation v) 2CO-operation g) Time required to make up pressure upto loss of nitrogen pressure after i) C-operation	

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CLAUSE NO	GAS INSULATED SWITCHGEAR	
	Bidder's Name:	
	i) O-operation	
	iii) CO-operation	
	iv) O-CO-operation	.....
	v) 2CO-operation	.....
	h) Life expectancy & guaranteed leakage rate of nitrogen accumulators	.....
	7.3 Spring charged mechanism	.....
	a) Number of close open operations possible after failure of AC supply to motor	.....
	b) Time required for motor to charge the closing spring (minutes)	.....
	c) Whether indication of spring charged condition provided in central control cabinet	.....
	8. Motor Data	
	a) Type	.....
	b) Rating at site conditions (kW)	.....
	c) Rated voltage (V)	.....
	d) Full load current (A)	.....
	9. SF6 gas system	
	- Normal operating pressure	bar
	- Normal operating density	g/cc
	- Weight of gas per breaker	Kg
	- Lockout pressure	bar
	- Alarm pressure	bar

CLAUSE NO	GAS INSULATED SWITCHGEAR .	
	Bidder's Name:	
	- Whether breakers work at single pressure or dual pressure - Type of SF6 gas flow(axial or radial) - Type of nozzles (single flow or double flow) - Compression ratio for puffer action - Quantity of compressed gas for puffer action - Total volume of SF6 gas required per circuit breaker at operating pressure.	
	10. Control power requirement	
	- Tripping(3poles)current at rated supply voltage (220 V.D.C.) - Closing(3 poles) current at rated supply voltage (220 VDC) - Tripping voltage range (percent) - Closing voltage range (percent)	A A
	11. Heaters	
	- Continuously current rating - Thermostat power rating	A A
	12. Noise level in (dB) at distance of (m)	
	i) 0	
	ii) 50	
	iii) 100	
	iv) 150	
	13. Interrupters	
	- Type of main contacts, arcing	

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CLAUSE NO	GAS INSULATED SWITCHGEAR	
	Bidder's Name:	
	contacts & Aux. contacts.	
	- Material of main contacts/arcng contacts, silver coated or not	
	- Contact pressure (Kg/sq mm)	.....
	- Number of interrupters per pole	.....
	- Length of contact travel	mm
	- Rate of contact travel at tripping	m/sec
	- Rate of contact travel at closing	m/sec
14.	Whether fixed trip or trip free	.....
15.	Details of anti pumping device	.....
16.	Maximum line charging breaking current with temporary over voltage up to 1.4 p.u. (kA)	.....
17.	Rated capacitive breaking current	.....
18.	Rated small inductive breaking current	.....
	- Generator transformer, Line & Bus coupler breakers	.....
19.	Rated characteristics for short line fault	.....
20.	a) Rated transient recovery voltage for terminal faults	.....
	b) Parameters as per IEC	.....
21.	Rated value of phase making current	kA(rms)
22.	Max. interrupting capacity under phase opposition conditions	.....
23.	Maximum breaking Capacity under Kilometric faults and rated TRV characteristic (kA peak)	.....
24.	Maximum period between closing	

CLAUSE NO	GAS INSULATED SWITCHGEAR	
	Bidder's Name: of first contact & last contact in a pole (ms) 25. Maximum pole discrepancy (ms) 26. Capacity for interrupting in-rush current of transformer 27. Max. over voltage factor of the circuit breaker when switching off a) Unloaded transformer b) Loaded transformer c) Open circuited lines d) Synchronous system 28. Details of operation counter 29. a) Number of auxiliary contacts per pole provided i) NO ii) NC iii) Adjustable b) Rated voltage of auxiliary contacts (V) c) Current capacity of Aux. contacts i) Continuous (Amps) ii) DC breaking with 20 ms time constant (A) 30. Partial discharge level at $1.1 U_n/\sqrt{3}$Pico-coulombs 31. Radio interference level at 266 kV (rms) microvolt 32. Maximum impact loading on foundation during breaker operations under Kg	

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CLAUSE NO	GAS INSULATED SWITCHGEAR	
	Bidder's Name:	
	fault conditions.	
	i) Closed conditions	
	ii) Open conditions	.....
33.	Seismic withstand value	.....
	i) Vertical	.....
	ii) Horizontal	.....
34.	Tests to be conducted by the supplier at works (whether enclosed)	.....
	a) Type tests	yes/no
	b) Routine tests	yes/no
	c) Tests to be conducted at site	yes/no
35.	Overall dimensions (LxBxH),	m
36.	Weight of breaker complete with operating mechanism, bushing, frame work,	Kg
	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.	 ms

CLAUSE NO	GAS INSULATED SWITCHGEAR (.	
	Bidder's Name:	
	41. Data on operating Coils (a) No. of trip coils/pole (No.) (b) No. of close coils/pole (No.) 42. Details of the standard accessories to be supplied alongwith the breaker 43. No. of the enclosed drg. showing the control scheme of circuit breaker 44. Details of the provision to be made on GIS to reduce H.V. transients to acceptable values. 45. Guaranteed degraded values of B.I.L. switching surges and 50 Hz rated values during the life of equipment (Test data to support this guarantee to be enclosed by the bidder). 46. Whether the following are enclosed a) Type test reports Yes/No b) Operation manual for breaker Yes/No c) OGA drawing of breaker Yes/No B) Disconnectors/Grounding Switches B-I Disconnecting Switches 1. Manufacturer's name & address 2. Type & designation 3. Standard applicable and duty M1/M2 4. Rated Frequency 5. Whether all the 3 poles are gang operated 6. Rated voltage	

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CLAUSE NO	GAS INSULATED SWITCHGEAR	
	Bidder's Name:	
	i) Rated	kV
	ii) Max. permissible	
7.	Dielectric with-stand capacity of Completely assembled DS and earth switch	
	a) One minute power frequency withstand test voltage (kV) rms	
	i) against ground (kV peak)	.....
	- dry (kV rms)	.....
	b) 1.2/50 micro second impulse withstand test voltage	.....
	i) against ground (kV peak)	.....
	ii) across open contacts (kV peak)	.....
	c) 250/2500 micro second switching surge withstand test voltage (dry)	
	i) against ground (kV peak)	.....
	ii) across open contacts (kV peak)	.....
	d) Radio interference level at $1.1 \times U_m/\sqrt{3}$ (in micro volts) for frequency between 0.5 MHz to 2.0 MHz	-----
8.	Rated normal current	
	- Generator Transformer module	A
	- Line module	A
	- Bus coupler module	A

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CLAUSE NO	GAS INSULATED SWITCHGEAR		
	Bidder's Name:		
9.	Rated peak short circuit current	kA	
10.	Interruption of loop current	A/V	
11.	a) Rated short time current of DS	.....	
	i) for 1 sec. (kA rms)	.....	
	ii) for 3 sec. (kA rms)	.....	
	iii) Dynamic current	.....	
	b) Opening time of	.....	
	i) DS (sec)	.....	
	ii) Earth switch (sec)	.....	
	c) Closing time of	.....	
	i) DS (sec)	.....	
	ii) Earth switch (sec)	.....	
	d) Temperature rise over 50°C ambient temperature corresponding to maximum continuous current (°C)	.....	
12.	Rated peak withstand current	kA (peak)	
13.	Rated inductive breaking current	A	
14.	TRV caused by breaking/making inductive current	kV	
15.	Rated capacitive breaking current	A	
16.	TRV caused by breaking/making capacitive current	kV	
17.	Maximum temperature rise above ambient at rated current		

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CLAUSE NO	GAS INSULATED SWITCHGEAR . 
	Bidder's Name: - Contacts,Deg. C - Hottest partDeg. C 18. Operating Mechanism a) Rated torque of the mechanism b) Type and rating (KW) of motor c) Rated voltage of motor d) Full load current (A) 19. Interlockings a) Whether mechanical/ constructional interlock between DS and Earth switch provided Yes/No b) Details of electrical interlock enclosed for i) DS ii) Earth Switch c) Arrangement provided to prevent electrical or manual operation unless interlock conditions are satisfied d) Whether interlock coil is continuously rated e) Rated D.C. control voltage and variation allowed f) Power consumption (watts) 20. Controls a) Rated D. C. control

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CLAUSE NO	GAS INSULATED SWITCHGEAR		
	Bidder's Name:		
		voltage (Volts)	
	b)	Limits of voltage	
	c)	Power consumption of control coils (W)	.....
21	Constructional Features		
	a)	Whether position of earth switch can be interchanged at site to either side of pole	Yes/No
	b)	Main contacts	.....
	i)	Type of contacts	.....
	ii)	Contact area (cm ²)	.....
	iii)	Material of contacts	.....
	iv)	Contact pressure (Kg/cm ²)	.....
	v)	Maximum current density under normal current carrying capacity (Amp/cm ²)	.....
	vi)	Thickness of silver plating	.....
	c)	Auxiliary contacts on Disconnecting switch	.....
	i)	Total number	.....
	ii)	NO	.....
	iii)	NC	.....
	iv)	Adjustable	.....
	v)	Make before break	.....
	vi)	Rated voltage (volts)	.....

CLAUSE NO	GAS INSULATED SWITCHGEAR . .	
	Bidder's Name:	
	vii) Rated continuous current (Amps)	.....
	viii) Rated DC breaking current with 20 ms time constant (A)	.....
	d) Auxiliary contacts on earth switch	.....
	i) Total number	.....
	ii) NO	.....
	iii) NC	.....
	iv) Adjustable	.....
	v) Rated voltage (volts)	.....
	vi) Rated continuous current (Amps)	.....
	vii) Rated DC breaking current with 20 ms time constant (A)	.....
	e) Whether counter balance spring provided for isolator and earth switch	.....
22.	Design data	
	- Type of contacts	.....
	- Contact area	.....
	- Contact pressure	.....
	- Surface treatment and thickness of surface coating/ silver electrolytic plating.	.....
	- Overtravel distance after making of contacts	mm

CLAUSE NO	GAS INSULATED SWITCHGEAR	
	Bidder's Name:	
	- Distance between the contacts in the fully open position	mm
	- Current density at the minimum cross section of switch blade	A/mm ²
	- Speed of operation	m/s
23.	Partial discharge level at $1.1 U_n / \sqrt{3}$	pico-coulombs
24.	a) Total operating time of disconnecter along with its operating mechanism	secs.
	b) Total operating time of disconnecter after the command is given	secs.
25.	No. of operations the switch can withstand without any need for inspection	.....
26.	Type of mounting	.....
27.	No. of poles per phase	.....
28.	Safety factor taken into account while designing the disconnecter.	.....
29.	Type and material used for arcing contacts, if provided	.....
30.	Weight of 3 pole isolating switch	
	- with earthing blades	Kg
	- without earthing blades	Kg
31.	Type of interlock between main isolator and earthing switch	.....
32.	Details of the type test reports enclosed and the standards as per which these tests have been carried out	.....
33.	Rated maximum time duration of short circuit	ms
34.	Rated mechanical terminal load.	Kg

CLAUSE NO	GAS INSULATED SWITCHGEAR		
	Bidder's Name:		
35.	Rated supply voltage of operating devices and auxiliary circuits.	V	
36.	Rated pressure of SF6 gas	bar	
37.	Minimum pole discrepancy between poles with regard to insulation and forces caused by short circuit currents.	ms	
38.	Tests to be conducted at site Whether the following are enclosed:	.....	
	a) Type test reports	Yes/No	
	b) OGA drawing for disconnecting switches with & without earth switches	Yes/No	
	c) Operation manual	Yes/No	
	d) Details of motor operating mechanism	Yes/No	
	e) Leaflets & literature bringing out salient features of equipment offered	Yes/No	
	f) Whether details of constructional interlock enclosed	Yes/No	
B- II	Safety Grounding Switches		
1.	Manufacturer's name & address	.....	
2.	Type / designation	.....	
3.	Standard applicable	.....	
4.	Maximum permissible operating voltage	kV	
5.	Maximum make and carry current for one sec.	kA (peak)	
6.	Rated inductive breaking current	A	
7.	TRV caused by breaking/making inductive current	kV	

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CLAUSE NO	GAS INSULATED SWITCHGEAR	
	Bidder's Name:	
	8. Rated capacitive breaking current	A
	9. TRV caused by breaking/making capacitive current	kV
	10. Operating Mechanism	.....
	a) Rated torque of the mechanism	.....
	b) Type and rating (KW) of motor	.....
	c) Rated voltage of motor	.....
	d) Full load current (A)	.....
	11. Operating voltage range & rated voltage	V
	12. Ground connection insulation	kV
	13. Type of contacts	.....
	14. Over travel distance	mm
	15. Distance of fully open contacts	mm
	16. Size of the removable link	.....
	17. Speed of make	m/s
	18. Partial discharge level at $1.1 U_n / \sqrt{3}$	pico-coulomb
	19. Radio interference level at 266 kV (rms)	microvolt
	20. Details of type test reports enclosed and the standards as per which these tests have been carried out	
	21. Auxiliary contacts on earth switch	
	i) Total number	
	i) NO	

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CLAUSE NO	GAS INSULATED SWITCHGEAR		
	Bidder's Name:		
	iii)	NC	
	iv)	Adjustable	
	v)	Rated voltage (volts)	
	vi)	Rated continuous current (Amps)	.....
22.	Whether the following are enclosed:		
	a)	Type test reports	Yes/No
	b)	OGA drawing for disconnecting switches with & without earth switches	Yes/No
B-III	High Speed Fault Making Grounding Switch		
	1.	Manufacturer's name &c address	.....
	2.	Type/ designation	.....
	3.	Standard applicable	
	4.	Maximum permissible operating voltage	kV
	5.	Maximum make and carry current for 1 sec.	kA (peak)
	6.	Rated inductive breaking current	A
	7.	TRV caused by breaking/making inductive current	kV
	8.	Rated capacitive breaking current	A
	9.	TRV caused by breaking/making capacitive current	kV
	10.	Operating Mechanism	
	a)	Rated torque of the mechanism	

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CLAUSE NO	GAS INSULATED SWITCHGEAR .	
	Bidder's Name:	
	b) Type and rating (KW) of motor	
	c) Rated voltage of motor	.....
	d) Full load current (A)	.....
11.	Making current	kA
12.	Induced current switching capability	.....
13.	Closing current	A
14.	Closing time	S
15.	Opening current	A
16.	Opening time	S
17.	Operating voltage range & rated voltage	V
18.	Ground connection insulation	kV
19.	Type of contacts	.....
20.	Over travel distance	mm
21.	Distance of fully open contacts	mm
22.	Size of the removable link	.....
23.	Speed of make	m/s
24.	Partial discharge level at $1.1 U_n / \sqrt{3}$	pico-coulomb
25.	Radio interference level at 266 kV	microvolt
26.	Has equipment been type tested and to which standards ?	
27.	Auxiliary contacts on earth switch	
	i) Total number	
	ii) NO	
	iii) NC	

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CLAUSE NO	GAS INSULATED SWITCHGEAR .	
	Bidder's Name:	
	iv) Adjustable	
	v) Rated voltage (volts)	
	vi) Rated continuous current (Amps)	.....
	28. Total operating time of switch alongwith its operating mechanism	s
	29. Total operating time of switch after the command is given.	s
	30. Operating Mechanism	
	a) Rated torque of the mechanism	.....
	b) Type and rating (KW) of motor	.....
	c) Rated voltage of motor	.....
	d) Full load current (A)	.....
	C) CURRENT TRANSFORMERS (Bidder to fill up date separately for each type of CT)	
	1. Name of manufacturer	.....
	2. Type	.....
	3. Manufacturer's type / designation	.....
	4. Standard applicable	.....
	5. Mounted inside/outside SF6 Gas enclosure	.....
	6. Rated frequency	.....
	Rated continuous normal current (A)	
	7. Short time current withstand for 1 sec. (kA)	
	8. Dynamic current withstand	

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CLAUSE NO	GAS INSULATED SWITCHGEAR .						
	Bidder's Name:						
	(kA peak)						
	9.	Transformation Ratio					
	10.	Rated primary current					.....
	11.	Rated secondary current					.....
	12.	Numbers of cores.					.....
	13.	Number of secondary turns					.....
	14.	Particulars of for each type of C.T.					.....
	1.	2	3	4	5	6	7
C O R E	Rated output (VA)	Class of accuracy	Accuracy limit	Current error at rated primary current (%)	Phase displa- cement at rated primary current (minutes)	Composite errors at cement rated accuracy limited it primary current.	
I							
II							
III							
IV							
V							
	8	9	10	11	12		
C O R E	Knee point voltage (V) (Volts)	Secondary limiting voltage	Secondary winding resistance (ohm)	Magnetising current (mA) at knee point voltage	Instrument security factor		
I							
II							
III							
IV							

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CLAUSE NO	GAS INSULATED SWITCHGEAR		
	Bidder's Name:		
	V		
	15.	One second over current factor & corresponding value of current.	kA
	16.	Rated dynamic current (peak value) in amps.	kA
	17.	Rated continuous thermal current temperature rise over ambient.	Deg C
	18.	Partial discharge level at $1.1 U_n/\sqrt{3}$	Pico-coulomb
	19.	Radio Interference voltage at 266 kV (rms)	micro-volt
	20.	Total weight	Kg
	21.	Magnetisation curves of CT cores	.....
	22.	Mounting details	.....
	23.	Overall dimensions	.....
	24.	Temperature rise over an ambient temp. of 50 °C (°C)	.....
	25.	Whether CT characteristic curves enclosed	Yes/No
	26.	Type Test Reports enclosed	Yes/No
	27.	OGA drawing enclosed	Yes/no
	28.	Tests proposed to be conducted at site.	.....
	D) VOLTAGE TRANSFORMERS		
	1	Name of manufacturer	
	2.	Type designation	
	3.	Standard applicable	

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CLAUSE NO	GAS INSULATED SWITCHGEAR			
	Bidder's Name:			
		Wdg - I	Wdg - II	Wdg - III
4.	Rated primary voltage			kV
5.	Rated secondary voltage			 V
6.	Rated output per phase			VA
7.	Rated burden			VA
8.	Rated frequency			 Hz
9.	Standard values of rated voltage factor			.....
10.	Limits of temperature rise			.....
11.	One-minute power frequency withstand voltage			kV(rms)
12.	1.2/50 microsecond lightning impulse withstand voltage			kV(peak)
13.	250/2500 micro second impulse switching surge withstand test voltage of capacitor (dry wet) (kV peak)			.....
14.	Total weight and dimensions			Kg
15.	Limits of voltage error and phase displacement in %			.....
16.	Phase angle error			.....
17.	Voltage error			.....
18.	Accuracy class at rated burden			.....
19.	Voltage factor and rated time			.....
20.	Total weight			.....
21.	Details of the tests to be conducted by the manufacturer at works			
	i) Type tests			

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CLAUSE NO	GAS INSULATED SWITCHGEAR (	
	Bidder's Name:	
	ii) Routine tests	
	22. Tests to be conducted at site	
	E) SURGE ARRESTORS	
	1. Manufacturer	.....
	2. Type designation	.....
	3. Arrestor Class & Type	.....
	4. Rated Voltage of Arrestor	kV
	5. Normal continuous operating voltage (MCOV)	kV
	6. i) Minimum discharge capability (kJ/kV) referred to rated voltage at minimum of discharge characteristics	.....
	ii) Line Discharge class, as per IEC	.....
	7. Maximum discharge current (8/20 microsecond wave)	kA
	8. Maximum 0.5 microsecond discharge voltage	kV
	9. Maximum residual voltage for 8/20 micro sec current wave	.....
	i) at 50% nominal discharge current (kVp)	.....
	ii) at 100% nominal discharge current (kVp)	.....
	iii) at 200% nominal discharge current (kVp)	.....
	10. Maximum switching surge protective voltage	kV(peak)
	11. a) One minute power frequency (dry) withstand voltage of arrester (kVrms)	

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CLAUSE NO	GAS INSULATED SWITCHGEAR	
	Bidder's Name: b) Impulse withstand test voltage of arrester housing with 1.2/50 micro sec wave, (kVp) c) Impulse current withstand i) High current short duration (4/10 micro sec. wave) kAp ii) Low current short duration (A peak) 12. Partial discharge level at $1.1 U_n/\sqrt{3}$ pico-coulomb 13. Radio interference level at 266 KV (rms) Microvolts 14. High current short duration test value 15. Short circuit capability & class of pressure relief device 16. I)Maximum internal ionisation at 50 Hz voltage equal to i) 1.05 COV ii) 1.0 COV 17. a) Reference voltage and corresponding reference current of arrester b) Maximum internal leakage current at (mA) i) COV ii) 1.1 COV iii) COV at 150 deg. C iv) Reference voltage c) Pressure relief class	

CLAUSE NO	GAS INSULATED SWITCHGEAR		
	Bidder's Name:		
	18.	Protective level provided by surge arrestor	
	19.	Energy level	kJ/kV
	20.	Details of the type test reports enclosed and the standards as per these tests have been carried out.	
	21.	Whether SF6 Gas insulated	Yes/No
	G)	SUPPORT & BARRIER INSULATORS (Details for each type of insulator used to be indicated separately)	Support Barrier
	1.	Manufacturer & address	.....
	2.	Type of insulators used	.....
	3.	One-minute power frequency dry withstand test voltage	kV
	4.	Dry flashover value	kV(rms)
	5.	Wet flashover value	kV(rms)
	6.	1.2/50 microsecond lightning impulse withstand test voltage	kV(peak)
	7.	Creepage distance	mm
	8.	Puncture value of insulator in SF6 gas	kV
	9.	Weight of insulators in the SF6 GIS enclosure.	Kg
	H)	GROUNDING CONNECTION	
	a.	Type of conductor	.....
	b.	Arrangement for connecting conductor to ground	.....
	c.	Type of painting, if any required to be carried out at end points of ground riser	
	I)	DESIGN CLEARANCE	

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CLAUSE NO	GAS INSULATED SWITCHGEAR 
	Bidder's Name: 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 - Contact to ground - Across the contacts c) Isolator switches - Contact to ground - Across the contacts d) Safety grounding switches - Contact to ground - Across the contacts J) 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 SIGNATURE AND SEAL OF BIDDER

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CLAUSE NO.	BIDDER'S NAME	AS APPLICABLE
	EHV INSULATORS	
A.	BUSHING / HOLLOW INSULATORS	
	(Bidder shall furnish these data for each equipment separately i.e. for circuit Breakers, Instrument Transformer, Surge Arrestors, etc.)	
	1. Manufacturer's Name	.....
	2. Country of Manufacturer	.....
	3. Type	.....
	4. Applicable Standards	.....
	5. i) Height	.....
	ii) Diameter (Top)	.....
	iii) Diameter (Bottom)	.....
	6. Creepage distance	.....
	a) Total (mm)	.....
	7. Rated Voltage	.....
	8. Power frequency withstand voltage for 1 min. (kv rms)	.....
	i) Dry	.....
	ii) Wet	.....
	9. 1.2/50 micro sec. impulse withstand voltage (kVp)	.....
	10. 250/2500 Micro sec. switching impulse withstand voltage (kVp)	
	i) Dry	
	ii) Wet	

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CLAUSE NO.	BIDDER'S NAME	
	11. Weight (Kg)	
	12. Cantilever Strength (Kg)	
	13. OGA drawing enclosed	Yes/No
B.	BUS POST INSULATOR	
	(Bidder shall furnish these data for solid core Insulators for Disconnecting switches, bus support, etc. separately)	
	1. Manufacturer's Name	.....
	2. Country of Manufacturer	.....
	3. Type of Insulator (Product No.)	.....
	4. Applicable Standards	.....
	5. No. of units per Stack	.....
	6. Diameter & No. of Bolts	.....
	ii) Top	.....
	ii) Bottom	.....
	7. Bolt circle diameter (mm)	.....
	ii) Top	.....
	iii) Bottom	.....
	8. Height of complete stack (mm)	.....
	9. Total Creepage distance (mm)	.....
	10. Power frequency withstand voltage of insulator with corona ring	
	i) Dry (kV rms)	
	ii) Wet (kV rms)	

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CLAUSE NO.	BIDDER'S NAME	
11.	1.2/50 micro sec. impulse withstand voltage (kVp) of insulator with corona ring	
	i) Dry (kV rms)	.....
	ii) Wet (kV rms)	.....
12.	Min. Corona Extinction Voltage (kV)	.....
13.	Radio Interference Voltage at $1.1 U_m/\sqrt{3}$ (micro volts) for frequency between 0.5 to 2.0 MHz	.....
14.	Weight of complete stack (kg)	.....
15.	Cantilever strength	.....
	i) Upright (kg)	.....
	ii) Under (kg)	.....
16.	Tensile Strength (kg)	.....
17.	Torsional strength (kg/m)	.....
18.	Compression strength (kg)	.....
19.	OGA drawing enclosed	Yes/No
20.	Type test report enclosed	Yes/No
C.	STRING INSULATOR	
	(Bidder shall furnish this data separately for each voltage rating)	
1.	Manufacturer	
	a) Insulator	
	b) Hardware	
2.	Applicable Standards	
3.	Type of Insulator	

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CLAUSE NO.	BIDDER'S NAME	
	a) Ball & Socket/other	
	b) Normal/artifog	
4.	Insulating Material	
5.	No. of units per String	.....
6.	Size of each unit	.....
	a) Diameter of disc (mm)	.....
	b) Spacing between adjacent Units (mm)	.....
7.	Weight	.....
	a) Each Disc (Kg)	.....
	b) Complete String (Kg)	.....
8.	Creepage distance	.....
	a) Each Disc (Kg)	.....
	b) Complete String (Kg)	.....
9.	Power frequency withstand voltage	
	a) Each Disc	
	i) Dry (kV)	
	ii) Wet (kV)	
	b) Complete String (Kg)	
	i) Dry (kV)	
	ii) Wet (kV)	

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CLAUSE NO.	BIDDER'S NAME	
10.	Impulse withstand voltage	
	a) Each Disc	
	i) Positive (kVp)	
	ii) Negative (kVp)	.....
	b) Complete String (Kg)	.....
	i) Positive (kVp)	.....
	ii) Negative (kVp)	.....
11.	Switching Surge Withstand	.....
	a) Each Disc (kVp)	.....
	b) Complete String (kVp)	.....
12.	Power Frequency Puncture withstand voltage of each disc (kV rms)	.....
13.	Elector Mechanical Strength	Yes/No
	a) Each Disc (Kg)	.....
	b) Complete String (Kg)	.....
	i) Single tension	.....
	ii) Double tension	
14.	OGA drawing enclosed	Yes/No
15.	Type test report enclosed	Yes/No

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CLAUSE NO.	BIDDER'S NAME	AS APPLICABLE
1.	MOTORS (Bidder shall fill up the data for Circuit breakers and Disconnectors/Isolator and earth switches/High speed earth switches separately) a) Manufacturer b) Equipment c) Motor type d) Frame size & type designation e) Applicable standard to which motor conforms f) Rated output at 50 deg. C outside air ambient temperature (KW) g) Max. power input to the driven equipment at design duty point (KW) h) Max. power input to the driven equipment (KW) over entire operating range. i) At rated speed ii) AT 103% speed i) Class and type of insulation j) Type of enclosure, and method of cooling k) Degree of protection l) Rated voltage and frequency (HZ) m) Rated speed n) Efficiency at design duty point (without -ve tolerance)	

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CLAUSE NO.	BIDDER'S NAME	
	o) Power factor at design duty point p) Type of mounting q) Type of terminal box for stator leads r) Bearing type	



400kV GIS at Patratu Super Thermal Power Project Expansion Phase-I
(3 X 800 MW)

400kV Gas Insulated Switchgear
Doc. No. : TB-397-316-003 Rev. 00

SECTION - 5

SCHEDULE OF DEVIATIONS

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

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

Date :

Signature :

Name:

Designation :

Company:



**400kV GIS at Patratu Super Thermal Power Project Expansion Phase-I
(3 X 800 MW)**

**400kV Gas Insulated Switchgear
Doc. No. : TB-397-316-003 Rev. 00**

SECTION-6

CHECK LIST FOR 400KV GIS

Sl.	Particulars	Reply by bidder	
1	TECHNICAL QUALIFYING REQUIREMENT		
1.1	The bidder should comply with Technical Qualifying requirement furnish the relevant documents.	Confirmed	Yes/No
1.2	The bid shall be submitted by the Manufacturer of GIS. The bidder's scope includes supply and services like • supervision of erection, • testing and commissioning. Bids submitted by agents will not be considered.	Confirmed	Yes/No
1.3	All the documents shall be submitted in English. Translated pages should be attested by the bidder.	Confirmed	Yes/No
2	Un-priced Offer -.		
2.1.	Confirm that all items have been quoted. (If any item has not been quoted, the same shall be specifically brought out)	Confirmed	Yes/No
2.2.	Any other item /service required for the execution for the complete job is deemed to be included in the offer, whether specifically mentioned in the specification or not. List of items along with their respective quantities required for completeness (Attach list, if required).	List of Additional items required attached	Yes/No
2.3.	Foundation for GIS shall be constructed by Civil contractor based on the input (configuration, loads etc) provided by bidder. The supply of all structural material to be embedded like foundation bolts as well as consumables like grouting material shall be in scope of bidder. The erection of structure shall be done by BHEL.	Confirmed	Yes/No
2.4.	SF6-GIS to Air bushing - Interface for connecting GT/ST/LINE/REACTOR with bus duct shall be complete with structures etc shall be provided by the bidder. Limit of supply as per technical specification and as per IEC 61639.	Confirmed	Yes/No
2.5.	Confirm that the consumables (list to be enclosed by bidder during contract stage) shall be supplied before erection after clearance from BHEL.	Confirmed	Yes/No
2.6.	Detailed list of Commissioning spares for testing & commissioning of GIS till handing over	Attached	Yes/No
2.7.	Detailed list of Tools & tackle & Testing Equipment	Attached	Yes/No
2.8.	Detailed list of Recommended Spares/operation & maintenance spare	Attached	Yes/No
2.9.	The Switchgear shall be complete with all necessary terminal	Confirmed	Yes/No



**400kV GIS at Patratu Super Thermal Power Project Expansion Phase-I
(3 X 800 MW)**

400kV Gas Insulated Switchgear

Doc. No. : TB-397-316-003 Rev. 00

Sl.	Particulars	Reply by bidder	
	boxes, SF6 gas filling, and interconnecting power and control Cables (between GIS to GIS/GIS to LCC/ LCC TO LCC), grounding connections (GIS to GIS and GIS to Earth Mesh on Floor), gas monitoring System and piping, support structures.		
2.10.	The scope of supply shall also include all erection and mounting hardware and interconnecting cables within GIS.	Confirmed	Yes/No
2.11.	Design philosophy of earthing submitted with the bid	Confirmed	Yes/No
2.12.	Tentative GIS Hall PLAN & SECTION Layout submitted with the bid	Confirmed	Yes/No
2.13.	Tentative Pothead yard PLAN & SECTION Layout submitted with the bid	Confirmed	Yes/No
2.14.	Technical Requirement of EOT Crane capacity & hook height mentioned in GIS Hall Layout	Confirmed	Yes/No
2.15.	Tentative / estimated AC / DC Load requirement for GIS submitted with bid	Confirmed	Yes/No
2.16.	Earthing material as per Section 1, Clause 1.6	Confirmed	Yes/No
2.17.	Length of bus duct shall be estimated by the bidder based on drawings provided in the bid. Any change in bay pitch (distance between bays) as per civil requirement for foundation layout during detailed engineering stage shall be incorporated by bidder as per item of Expansion Joints and bellows of BOQ.	Confirmed	Yes/No
2.18.	Tentative PLAN & Section drawing of bus duct submitted with bid	Confirmed	Yes/No
3	Technical		
3. 1	Location of site: <i>Project site is Patratu, design and construction of GIS should be suitable for the climate/ Meteorological Condition as mentioned in Section-1 and in section-3.</i> <i>Bidder to inform what measures shall be taken to ensure the same at bid stage.</i>	Writeup attached with bid.	Yes/No
3. 2	Details regarding the design features of equipment which are intended to prevent burn through when an internal arc occurs.	Enclosed with bid	Yes/No
3. 3	Material of enclosure – Non Magnetic	Confirmed	Yes/No
3. 4	Material of bus bar - Non Magnetic	Confirmed	Yes/No
3. 5	Requirement of AC and DC auxiliary loads	Enclosed with bid	Yes/No
3. 6	Catalogues of GIS	Enclosed with bid	Yes/No
3. 7	Catalogues of all Maintenance equipment. Bidder to confirm that offered equipment meets the requirements of specification.	Enclosed with bid	Yes/No
3. 8	Approved makes – Bidder to confirm that the offered Maintenance equipment are of approved make	Confirmed	Yes/No
4	Calculations		
4.1	All calculations including Thermal calculations based on the climatic conditions indicated in Section 3 shall be submitted during detailed	Confirmed	Yes/No



**400kV GIS at Patratu Super Thermal Power Project Expansion Phase-I
(3 X 800 MW)**

**400kV Gas Insulated Switchgear
Doc. No. : TB-397-316-003 Rev. 00**

Sl.	Particulars	Reply by bidder	
	engineering stage.		
4.2	Devices or techniques deployed for reducing transients to an acceptable level alongwith offer.	Enclosed with bid	Yes/No
4.3	The design of the equipment shall be such that the agreed permitted movement of foundations and mechanical or thermal effects do not impair the assigned performance of the equipment.	Confirmed	Yes/No
4.4	Insulation co-ordination study shall be conducted and based on the same the <i>Rating</i> , numbers & location of surge arresters shall be decided. The <i>Rating</i> , number and location of surge arresters shall be indicated with the bid. Any increase in quantity at the time of detailed engineering shall be on bidder's account.	Confirmed	Yes/No
4.5	Measures to limit external overvoltages (e.g. surge arresters) should be considered and detailed out based on the site conditions of altitude etc.	Enclosed with bid	Yes/No
5	Technical Deviations		
5.1	Confirm that the Complete systems have been offered as per the requirements of Technical Specification and Technical Deviation sheet has been submitted. Deviations mentioned elsewhere in the bid will not be considered.	Confirmed	Yes/No
5.2	Technical Deviation sheet has been submitted.	Confirmed	Yes/No
6	Barchart		
6.1	Bidder will submit detailed bar chart indicating all the milestones from Engineering till manufacturing/ testing, dispatch to site and commissioning based on the drawing & document schedule attached in section1.	Confirmed	Yes/No
7	Conditions		
7.1	Store shall be provided by BHEL for GIS and accessories. Confirm that the space required for the material being supplied, both indoor and outdoor has been indicated.	Details given with the bid.	Yes/No
7	Site Test		
7.1	Bidder to supply Only special tools. For other tools Bidder to submit list of tools, tackle, slings, spanners, gauges, slings and other lifting devices, drills, instruments and appliances necessary for the complete assembly and erection at site of the GIS, required for installation, gas filling, maintenance, site testing of the GIS which shall be arranged by BHEL. EOT crane of shall be provided by BHEL in GIS cavern. Capacity of EOT Crane shall be as per recommendation of GIS Manufacturer. HV Test kit shall be in scope of bidder.	Confirmed	Yes/No
7.2	Bidder to furnish detailed BOQ for non-returnable Tools and Tackles along with unit prices to be handed over to ultimate customer.	Details given with the bid.	Yes/No
7.3	All field tests including tests during installation, pre-commissioning, commissioning, field acceptance tests shall be conducted by the Contractor, in presence of representative of the Employer. No separate site test will be conducted by BHEL/Customer	Confirmed	Yes/No



**400kV GIS at Patratu Super Thermal Power Project Expansion Phase-I
(3 X 800 MW)**

**400kV Gas Insulated Switchgear
Doc. No. : TB-397-316-003 Rev. 00**

Sl.	Particulars	Reply by bidder	
8	TYPE TESTS REQUIREMENTS		
8.1	The Bidder shall carry out the type tests as listed in this specification on the equipment to be supplied under this contract. The Bidder shall indicate the charges for each of these type tests separately in the relevant schedule of BPS and the same shall be considered for the evaluation of bids. The type test charges shall be paid only for the test(s) actually conducted successfully under the contract and upon certification by the Customer's engineer.	Confirmed	Yes/No
8.2	The type tests shall be carried out in the presence of the Customer's representative, for which minimum 30 days' notice shall be given by the Bidder. The Bidder shall obtain the Customer's approval for the type test procedure before conducting the type test. The type test procedure shall clearly specify the test set up, instrument to be used, procedure, acceptance norms, recording of various parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out	Confirmed	Yes/No
8.3	In case the Bidder has conducted such specified type test(s) according to the relevant standard and / or specification not earlier than ten years prior to the date of techno-commercial bid opening i.e 03-Mar-2017, he may submit the type test reports to the Customer for waiver of conductance of such type test(s). These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a Customer. The Customer reserves the right to waive conducting of any or all the specified type tests(s) under this contract. In case the type tests are waived, the type test charges shall not be payable to the Bidder. However if any type test report is found not meeting the specification requirements, bidder shall conduct all such type tests successfully according to relevant standards without any cost and delivery implication to BHEL.	Confirmed	Yes/No
8.4	Type test report for 400 kV GIS shall be submitted alongwith the bid. Differences, if any, in the items offered and those which have been type tested shall be clearly brought out alongwith explanation for suitability. Type Tests Reports Submitted along the bid shall be subject to review and approval at contract stage.	Confirmed and enclosed with bid	Yes/No

2. TYPE TESTS:

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

Type Tests for following Tests to be submitted:

As per clause 1.8 and 1.9 of Section 1.

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Project : 400kV GIS at 3 X 800MW Patratu STPS (Stage-I)
Technical Specification for 400 kV Gas Insulated Switchgear

SL	Description	Remarks_Long_Description	Unit	Quantity
A	Supply Item - 400kV GIS as per enclosed SLD with One and Half Breaker scheme comprising of Items A1-A19	The 400 KV SF6 gas insulated switch gear shall have three single phase construction, one and half breaker arrangement (1-Type) having the following bays:- a) Three (3) fully equipped Generator Transformer Bays having controlled switching facility. b) Three (3) fully equipped Station Transformer Bays having controlled switching facility. c) Six (6) fully equipped Line Bays. d) Two (2) fully equipped Bus Reactor Bays having controlled switching facility. e) Four (4) fully equipped Tie Bays having controlled switching facility. f) Three (3) fully equipped Tie Bays. g) Two (2) fully equipped Bus Voltage Transformer Bays with Bus Isolator and Grounding Switches. h) Two (2) Bus Surge Arrester Bays. The Switchgear shall be complete with all necessary terminal boxes, inspection window, SF6 gas filling, interconnecting power and control wiring, grounding connections, gas monitoring equipment and piping, support structures etc. Any other item required for completion of project and not covered above - Complete List to be provided by bidder along with unit prices. The scope of supply shall also include all erection and mounting hardware and interconnecting power and control cables between GIS to LCC and between LCC to LCC including cable tray, glands, lugs, ferrules etc.	lot	1
A1	Fully equipped 400kV, 63kA for 1 second, SF6 GIS GT bay Module	400kV, 3150A, 63kA for 1 second, SF6 gas-insulated metal enclosed GT bay module. Each set shall be complete & shall comprising of a) ONE set of 3x1-phase, SF6 insulated circuit breaker, complete with operating mechanism and controlled switching device b) ONE set of 3x1-phase, 3-core, multi ratio, current transformers as per single line diagram. (Core details shall be finalised at detail engg. stage) c) ONE set of 3x1-phase, 2-core, multi ratio, current transformers as per single line diagram. (Core details shall be finalised at detail engg. stage) d) THREE sets of 3x1-phase, group operated Disconnector switches, complete with manual and motor driven operating mechanisms. e) Four sets of 3x1-phase, group operated maintenance earthing switches, complete with manual and motor driven operating mechanisms. f) Gas monitoring System, pressure switches etc as required. g) Barriers and other items as required.	Set	3

Project : 400kV GIS at 3 X 800MW Patratu STPS (Stage-I)

Technical Specification for 400 kV Gas Insulated Switchgear

SL	Description	Remarks_Long_Description	Unit	Quantity
A2	Fully equipped 400kV, 63kA for 1 second, SF6 GIS STATION TRANSFORMER bay Module	400kV, 3150A, 63kA for 1 second, SF6 gas-insulated metal enclosed Station Transformer bay module. Each set shall be complete & shall comprising of a) ONE set of 3x1-phase, SF6 insulated circuit breaker, complete with operating mechanism and controlled switching device b) ONE set of 3x1-phase, 3-core, multi ratio, current transformers as per single line diagram. (Core details shall be finalised at detail engg. stage) c) ONE set of 3x1-phase, 2-core, multi ratio, current transformers as per single line diagram. (Core details shall be finalised at detail engg. stage) d) THREE sets of 3x1-phase, group operated Disconnector switches, complete with manual and motor driven operating mechanisms. e) FOUR sets of 3x1-phase, group operated maintenance earthing switches, complete with manual and motor driven operating mechanisms. f) Gas monitoring System, pressure switches etc as required. g) Barriers and other items as required.	Set	3
A3	Fully equipped 400kV, 63kA for 1 second, SF6 GIS LINE bay Module	400kV, 3150A, 63kA for 1 second, SF6 gas-insulated metal enclosed LINE bay module. Each set shall be complete & shall comprising of a) ONE set of 3x1-phase, SF6 insulated circuit breaker, complete with operating mechanism (suitable for 1&3 phase auto reclose) b) ONE set of 3x1-phase, 3-core, multi ratio, current transformers as per single line diagram. (Core details shall be finalised at detail engg. stage) c) ONE set of 3x1-phase, 2-core, multi ratio, current transformers as per single line diagram. (Core details shall be finalised at detail engg. stage) d) ONE set of 3x1-phase, 3-core, multi ratio, current transformers as per single line diagram. (Core details shall be finalised at detail engg. stage) e) THREE sets of 3x1-phase group operated Disconnector switches, complete with manual and motor driven operating mechanisms. f) TWO sets of 3x1-phase, group operated maintenance earthing switches, complete with manual and motor driven operating mechanisms. g) TWO set of 3x1-phase, group operated high speed earthing switches, complete with manual and motor driven operating mechanisms. h) Gas monitoring System, pressure switches etc as required. i) Barriers and other items as required.	Set	6

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Project : 400kV GIS at 3 X 800MW Patratu STPS (Stage-I)
Technical Specification for 400 kV Gas Insulated Switchgear

SL	Description	Remarks_Long_Description	Unit	Quantity
A4	Fully equipped 400kV, 63kA for 1 second, SF6 GIS BUS REACTOR bay Module	400kV, 3150A, 63kA for 1 second, SF6 gas-insulated metal enclosed BUS REACTOR bay module. Each set shall be complete & shall comprising of a) ONE set of 3x1-phase, SF6 insulated circuit breaker, complete with operating mechanism and controlled switching device b) ONE set of 3x1-phase, 3-core, multi ratio, current transformers as per single line diagram. (Core details shall be finalised at detail engg. stage) c) ONE set of 3x1-phase, 2-core, multi ratio, current transformers as per single line diagram. (Core details shall be finalised at detail engg. stage) d) THREE sets of 3x1-phase group operated Disconnector switches, complete with manual and motor driven operating mechanisms. e) FOUR sets of 3x1-phase, group operated maintenance earthing switches, complete with manual and motor driven operating mechanisms. g) Gas monitoring System, pressure switches etc as required. h) Barriers and other items as required.	Set	2
A5	Fully equipped 400kV, 63kA for 1 second, SF6 GIS TIE bay Module - With CSD	400kV, 3150A, 63kA for 1 second, SF6 gas-insulated metal enclosed TIE bay module. Each set shall be complete & shall comprising of a) ONE set of 3x1-phase, SF6 insulated circuit breaker, complete with operating mechanism with controlled switching device b) TWO set of 3x1-phase, 3-core, multi ratio, current transformers as per single line diagram. (Core details shall be finalised at detail engg. stage) d) TWO sets of 3x1-phase, group operated Disconnector switches, complete with manual and motor driven operating mechanisms. e) TWO sets of 3x1-phase, group operated maintenance earthing switches, complete with manual and motor driven operating mechanisms. f) Gas monitoring System, pressure switches etc as required. g) Barriers and other items as required.	Set	4
A6	Fully equipped 400kV, 63kA for 1 second, SF6 GIS TIE bay Module	400kV, 3150A, 63kA for 1 second, SF6 gas-insulated metal enclosed TIE bay module. Each set shall be complete & shall comprising of a) ONE set of 3x1-phase, SF6 insulated circuit breaker, complete with operating mechanism (suitable for 1&3 phase auto reclose) b) TWO set of 3x1-phase, 3-core, multi ratio, current transformers as per single line diagram. (Core details shall be finalised at detail engg. stage) d) TWO sets of 3x1-phase, group operated Disconnector switches, complete with manual and motor driven operating mechanisms. e) TWO sets of 3x1-phase, group operated maintenance earthing switches, complete with manual and motor driven operating mechanisms. f) Gas monitoring System, pressure switches etc as required. g) Barriers and other items as required.	Set	3

SL	Description	Remarks_Long_Description	Unit	Quantity
A7	Bus VT Modules for Main Buses	400kV, 4000A, 63kA for 1 sec, SF6 gas insulated Bus VT bay module, Disconnector module with Earth switches connected to Main Bus Bars, each comprising of: a) ONE set of 3x1-phase, 4000A, 63kA group operated Disconnector switches, complete with manual and motor driven operating mechanisms. b) THREE nos. single phase Voltage transformers c) TWO set of 3x1-phase, group operated maintenance earthing switches, complete with manual and motor driven operating mechanisms. d) Gas monitoring devices, barriers, pressure switches, etc. as required.	Set	2
A8	LA/ Surge arrester Module	THREE nos. single phase LA/Surge Arrester. (Note : Number of LA/ Surge arrester and their rating shall be decided based on insulation co-ordination / transient analysis studies for the GIS system. Insulation Coordination study is in bidder scope. However the LA indicated in SLD are the minimum numbers of LA to be provided by bidder).	Set	2
A9	BusBar Modules	One set of three single phase(isolated), 4000A, 63kA for 1 sec, SF6 gas-insulated metal enclosed bus bars, each comprising of : a) Three individual 4000A bus bars enclosures running across the length of the switchgear to inter connect each of the circuit breaker bay modules in one and half breaker bus system. b) Gas monitoring systems, pressure switches, telescopic enclosure etc. as required. c) Barriers Length of bus bar to be indicated by bidder.	Set	2
A10	Single Phase Isolated, 400kV, 63kA for 1 second, SF6 Gas-Insulated Metal enclosed Bus Bars for Tie Bay Interconnection	Isolated phase, 400kV, 3150A, 63kA for 1 second, SF6 gas-insulated metal enclosed bus bars, each set comprising of : (a) Three (3) nos. single phase(isolated) bus bars to inter connect the Tie Bay circuit breaker bay modules with Circuit breaker bay Modules of Line/GT/ST/Bus Reactor bays in one and half breaker bus system. (b) Gas monitoring System, barriers, pressure switches, etc. as required.	Set	14
A11	400kV, 3150A GIS duct from GIS GT/Outgoing Lines/ Station transformer/Bus reactor to SF6 to Air bushing	400kV, 3150A 63kA for 1 sec, SF6 gas insulated GIS duct shall be complete & comprising of:- a) Single phase (isolated) SF6 ducts along with all accessories to connect 400kV GIS with 400kV side GT/Outgoing Lines/ST/Reactor. b) Gas monitoring devices, barriers, pressure switches, etc. as required. Length of GIS duct to be indicated by the bidder.	Lot	1
A12	400kV,3150A SF6 to Air Bushing	400kV, 3150A, 63 kA for 1 sec, 25mm/kV creepage, SF6 gas insulated, SF6 to Air Bushing for Over head connection of Line/GT/ST/REACTOR with GIS.	Nos.	42

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Bharat Heavy Electricals Limited
 Project : 400kV GIS at 3 X 800MW Patratu STPS (Stage-I)
 Technical Specification for 400 kV Gas Insulated Switchgear

SL	Description	Remarks_Long_Description	Unit	Quantity
A13	Local Control Cubicles	Bay Control Cabinet for GT/BUS REACTOR/LINES/ STATION TRANSFORMER/ TIE BAYS/ BUS VT including cable between GIS & LCC.	No.	23
A14	First Filling of SF6 gas including extra for Compensating Losses for 10 % of total Gas Quantity. Additionally, 20% of total quantity of SF6 gas shall also be supplied in non returnable cylinders. (Bidder to indicate quantity)	First filling of SF6 gas for the equipment supplied plus an additional quantity sufficient for conducting all tests on equipment at site before placing it into successful operation. Additionally, 20% of total quantity of SF6 gas shall also be supplied in non returnable cylinders as spare requirement. Bidder to indicate quantity with break up.	Lot	1
A15	Supply of structure work for Installation of GIS including support structure for GIS ducts, SF6 to air bushings, supports, platforms, ladders, foundation bolts, embedded parts in floors etc., which are required for installation of GIS as per the specification. (The civil works will be done based on supplier design & drawings).	Bidder to indicate estimated weight in the bid (in MT) alongwith support documents & unit prices per MT in their offer. Bidder to quote in units as MT. Addition/deletion shall be on unit rate basis but only if there is any change in input.	Lot	1
A16	Supply of Earthing material for GIS including High frequency earthing material, if required. The quantity shall be estimated & provided by bidder.	Bidder shall define clearly what constitutes the main grounding bus of the GIS. Bidder must supply, commission the entire grounding work of GIS viz conductor, clamps, joints, bimetallic strips (for connection between different type of earthing materials), operating and safety platforms etc. Bidder shall provide suitable measure to mitigate transient enclosure voltage caused by high frequency currents caused by lightning strikes, operation of surge arrester, phase/earth fault and discharg between contracts during switching operation.	Lot	1

Project : 400kV GIS at 3 X 800MW Patratu STPS (Stage-I)
Technical Specification for 400 kV Gas Insulated Switchgear

SL	Description	Remarks_Long_Description	Unit	Quantity
A17	Consumables required for GIS (Bidder to quote item wise with detailed BOQ for these consumables)	Consumables including grouting material as per manufacturer requirement having limited shelf life required during erection, testing and commissioning. It shall be supplied just before erection after confirmation from BHEL.(1 lot is for complete package).	Lot	1
A18	Type Tests (If Required)	Bidder to refer clause 1.8 and 1.9 of TS TB-397-316-003 Rev 00 and provide the list of tests for which type tests are required to be conducted.	Lot	1
A19	Controlled Switching Device for ONE set of 3150A, 3x1-phase, SF6 insulated circuit breaker without PIR, complete with operating mechanism (suitable for 1&3 phase auto reclose)	Optional Item.	Nos	1
B	Supply Item - Mandatory Spares (B1 to B5)	These prices will also be used for addition/deletion/replacement (shall be considered as initial spares)		
B1	400 KV GIS (as applicable)			
B1.1	SF6 gas pressure Relief Devices, 3 nos of each type		Sets	2
B1.2	SF6 pressure gauge with coupling device cum switch or density monitors and pressure gauge, as applicable (1 no. of each type)		Set	1
B1.3	Rubber gaskets, "o" Rings and seals for SF6 gas, including Circuit Breaker, Disconnecter and other GIS equipments (6 no. of each type)		Set	1

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Project : 400kV GIS at 3 X 800MW Patratu STPS (Stage-I)
Technical Specification for 400 kV Gas Insulated Switchgear

SL	Description	Remarks_Long_Description	Unit	Quantity
B1.4	Molecular filter for SF6 gas with filter bags - 20 % of total supply		Lot	1
B1.5	SF6 gas - 20 % of total gas - included in A14.		Lot	0
B1.6	Covers with all accessories necessary to close a compartment in case of dismantling of any part of the Enclosure to ensure the sealing of the compartment			
B1.6.1	For 1 phase enclosures (3 nos. of each type)		Set	1
B1.6.2	Locking device to keep Dis-connectors and Earthing switches in close or open position in case of removal of the driving mechanism (if applicable)		Nos.	3
B1.6.3	Bus support insulator of each type for single phase enclosure (6 nos. of each type)		Set	1
B1.6.4	SF6 to air bushing for 1 phase enclosure		Nos.	2
B1.6.5	Spares for Local control cabinet including MCB, fuses, timers, Aux. Relay of each type & rating, terminals of each type (set)		Nos.	1
B1.6.6	All types of Corona shield (3 Nos. of each type)		Set	1
B1.6.7	Windowscope/ Observing window, 3 Nos. of each type (if applicable)		Set	1
B2	Circuit Breaker			
B2.1	Complete Circuit Breaker 1 phase pole of each type & rating complete with interrupter, main circuit and enclosure with operating mechanism		Sets	3
B2.2	Fixed, moving and arcing contacts (3 nos. of each type)		Set	1
B2.3	Trip Coil assembly with resistor as applicable. 3 nos. of each type		Sets	2
B2.4	Closing Coil assembly with resistor as applicable. 3 nos. of each type		Sets	2

Project : 400kV GIS at 3 X 800MW Patratu STPS (Stage-I)
Technical Specification for 400 kV Gas Insulated Switchgear

SL	Description	Remarks_Long_Description	Unit	Quantity
B2.5	Relays, Power contactors, push buttons, timers & MCBs etc of each type & rating		Set	1
B2.6	Closing assembly/ valve, 3 nos. of each type (if applicable)		Sets	2
B2.7	Trip assembly/ valve, 3 nos. of each type (if applicable)		Sets	2
B2.8	Aux. switch assembly, 3 Nos. of each type		Set	1
B2.9	Operation counter, 3 nos. of each type		Set	1
B2.10	Rupture disc, 3 Nos. of each type (if applicable)		Set	1
B2.11	Set of spares for pneumatic/spring/ hydraulic operated mechanism - 1 set for each type of Circuit breaker		Set	1
	Spare for pneumatic operated mechanism			
	a. Motor of compressor - one no			
	b. Pressure switch and valve - one no. of each type			
	Spare for spring operated mechanism			
	a. Motor - one no			
	b. Limit switch - one no. of each type			
	Spare for hydraulic operated mechanism			
	a. Motor - one no			
	b. Limit switch - one no. of each type			
B2.12	Insulating nozzle (6 nos. each) - 1 set for each type of Circuit breaker		Set	1
B3	Disconnecter			
B3.1	Complete set of 3 nos. of single phase disconnecter including main circuit, enclosure and driving mechanism		Set	1

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Project : 400kV GIS at 3 X 800MW Patratu STPS (Stage-I)
Technical Specification for 400 kV Gas Insulated Switchgear

SL	Description	Remarks_Long_Description	Unit	Quantity
B3.2	High speed/ fast acting fault making grounding switch, 3 nos. of single phase of each rating, including main circuit, enclosure and driving mechanism		Set	1
B3.3	3 nos. of single phase Earthing switch including main circuit, and driving mechanism		Set	1
B3.4	Copper contact fingers for disconnecter male & female contact- for one complete (3 phase) disconnecter of each type & rating		Set	1
B3.5	Copper contact fingers for earthing switch male & female contact- for one complete (3 phase) disconnecter of each type & rating		Set	1
B3.6	Open/close contactor assembly, timers ,key interlock for one complete (3 phase) disconnecter and earthing switch of each type & rating		Set	1
B3.7	Push button switch - each type		Set	1
B3.8	Limit switches and Aux. switches for complete 3-phase equipment			
B3.8.1	a. For Disconnector		Sets	3
B3.8.2	b. for Earth switch		Set	1
B3.8.3	c. For high speed earth switch		Set	1
B3.9	Rotor housing assembly for complete 3 - phase equipment			
B3.9.1	a. For Disconnector		Sets	2
B3.9.2	b. For Earth Switch		Set	1
B3.9.3	c. For high speed earth switch		Set	1
B3.10	Motor with gear assembly for complete 3-phase equipment			

Project : 400kV GIS at 3 X 800MW Patratu STPS (Stage-I)
Technical Specification for 400 kV Gas Insulated Switchgear

SL	Description	Remarks_Long_Description	Unit	Quantity
B3.10.1	a. For Disconnecter		Sets	3
B3.10.2	b. For Earth Switch		Set	1
B3.10.3	c. For high speed earth switch		Set	1
B3.11	Bearing for complete 3-phase equipment			
B3.11.1	a. For Disconnecter		Sets	5
B3.11.2	b. For Earth Switch		Set	1
B3.11.3	c. For high speed earth switch		Set	1
B3.12	Interlocking coil with resistors, timers, key interlock for complete 3 phase equipment, as applicable (each type & rating)		Set	1
B3.13	Relay, Power contactors, resistors, fuses,push buttons, timers & MCBs (Complete for one 3 phase equipment)			
B3.13.1	a. For Disconnecter		Sets	3
B3.13.2	b. For Earth Switch		Set	1
B3.13.3	c. For high speed earth switch		Set	1
B4	Current Transformer			
B4.1	Complete CT , as applicable, with enclosure, as applicable, 1 no. of each type & rating		Set	1
B5	Voltage Transformer			
B5.1	Gas Insulated complete VT with enclosure		Set	1

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SL	Description	Remarks_Long_Description	Unit	Quantity
C	Supply Item - Mandatory Maintenance Equipment (C1 to C5)		lot	1
C1	SF6 Gas filling and evacuating plant (portable)		Nos.	1
C2	SF6 Gas Filtering, Drying, Storage, Recycling Plant		Nos.	1
C3	SF6 gas analyzer		Nos.	1
C4	SF6 Gas leak detector		Nos.	1
C5	Operational analyser with DCRM kit		Nos.	1
D	Supply Item - Mandatory Monitoring Equipments (D1 to D2)		lot	1
D1	Dew Point Meter		Nos.	1
D2	Portable PD Monitoring System for Gas Insulated Switchgear		Nos.	1
E	Supply Item - Tools & tackle & Testing Equipment	Only special tools shall be in bidder's scope. Bidder to submit list of tools, tackle, slings, spanners, gauges, slings and other lifting devices, drills, instruments and appliances necessary for the complete assembly and erection at site of the GIS, required for installation, gas filling, maintenance, site testing of the GIS which shall be arranged by BHEL. EOT cranes shall be provided by BHEL, capacity of EOT crane to be recommended by bidder. Bidder to furnish detailed BOQ for returnable and non-returnable Tools and Tackles along with unit prices.	lot	1
F	Services: Supervision of Erection, commissioning & site testing including earthing and training (F1 to F9)	GT bays, Station transformer bay, Line bays, Bus reactor bays, Bus VT bays, LA/Surge arrester bays, Tie bay etc.etc. will be commissioned seperately at different stages.	Lot	1
F1	Insulation co-ordination studies	In scope of GIS supplier.	Lot	1
F2	Site visit for supervision of unloading, storage & verification of material at site		Lot	1
F3	Supervision of Erection of GIS	Complete GIS including busbar, GT bays, Station transformer bay, Line bays, Bus reactor bays, Bus bays, LA/Surge Arrester bay, tie bay, etc.	Set	1

SL	Description	Remarks_Long_Description	Unit	Quantity
F4	Supervision of Erection of GIS Duct - GIS to SF6 to Air Bushings	Complete GIS ducts of all rating	Lot	1
F5	Supervision of Erection of complete SF6 to Air Bushing	SF6 to Air Bushing complete in all respect.	Set	42
F6	Testing & Commissioning of GIS	Complete GIS including busbar, GT bays, Station transformer bay, Line bays, Bus reactor bays, Bus VT bays. LA/Surge Arrester bay, tie bay, etc.	Set	1
F7	Final successful Testing of GIS including HV test and its accessories	Bus VT bays, Bus reactor bays, Bus VT bays, tie bay, etc. may be commissioned separately.) Final testing as per IEC for complete GIS including busbar,GT bays, Station transformer bay, Line bays,Bus reactor bays, Bus VT bays, tie bay etc., Ducts, SF6 to Air Bushing etc.	Lot	1
F8	Training for GIS to PVUNL Engineers	Training for GIS shall cover following parts and mandates: a) GIS equipments including system description, basic Design and engineering, Quality Assurance concepts, Erection and operational aspects for the offered equipments , Training duration= 5 days, place of training =Manufacturers works, No of Trainees = 8 b) Operation,Maintenance, Site Testing and Trouble shooting for GIS,Training duration= 5 days, place of training =Site, No of Trainees = 6 The cost of Boarding and lodging expenses of the PVUNL training participant have to be borne by the Supplier. This includes training in India and foreign countries as applicable.	Lot	1
F9	Training for GIS to BHEL Engineers	Training for GIS shall cover following parts and mandates: a) GIS equipments including system description, basic Design and engineering, Quality Assurance concepts, Erection and operational aspects for the offered equipments , Training duration= 5 days, place of training =Manufacturers works, No of Trainees = 5 b) Operation,Maintenance, Site Testing and Trouble shooting for GIS,Training duration= 5 days, place of training =Site, No of Trainees = 5 Lodging and Boarding of Training Participants shall be in BHEL scope.	Lot	1
G	Any other item required for completion of project (G1 to G2)			

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Project : 400kV GIS at 3 X 800MW Patratu STPS (Stage-I)
Technical Specification for 400 kV Gas Insulated Switchgear

SL	Description	Remarks_Long_Description	Unit	Quantity
G1	Supply - Any other item required for completion of project and not covered in A to E- Complete List to be provided by bidder along with unit prices.		Lot	1
G2	Services - Any other item required for completion of project and not covered in F - Complete List to be provided by bidder along with unit prices.		Lot	1
H	Supply - Unit Prices of Individual Item/Equipment (H1 to H31)	Unit Prices of Individual Equipment included here or in mandatory spares are required for any Addition/Deletion of Equipment and replacement of damaged items. Vendor to ensure that the unit prices have a logical relationship with prices of assemblies in main items (Bay, Busbar etc). Quoting for unit prices is mandatory and shall be considered for evaluation.		
H1	400kV, 3150A Circuit breaker (1 pole complete without enclosure without operating mechanism)		No	1
H2	400kV, 3150A Circuit breaker with PIR (1 pole complete without enclosure without operating mechanism)		No	1
H3	400kV, 4000A Isolator (1 pole) without operating mechanism		No	1
H4	400kV, 3150A Isolator (1 pole) without operating mechanism		No	1
H5	400 kV Maintenance Earthing switch without operating mechanism		No	1

SL	Description	Remarks_Long_Description	Unit	Quantity
H6	400kV High speed earth switch without operating mechanism		No	1
H7	400kV Current transformer (1 of each type) (Individual prices to be furnished).		No	1
H8	400kV Voltage transformer (1 of each type) (Individual prices to be furnished).		No	1
H9	Operating Mechanism box for 400kV, 3150 A Circuit Breaker		No	1
H10	Operating Mechanism box for 400kV, 4000 A Isolator		No	1
H11	Operating Mechanism box for 400kV, 3150 A Isolator		No	1
H12	Operating mechanism for 400kV, Maintenance Earthing Switch		No	1
H13	Operating Mechanism for 400kV, High Speed Earthing Switch		No	1
H14	Single Phase Bus bar (Any type)	Complete single phase 400kV,4000A, 63 kA for 1s bus bar including Gas monitoring systems, barriers, pressure switches	m	1
H15	Conductor for Single phase Bus bar/ bus duct (any type)	Conductor for bus bar, bus duct, GiB, Interconnecting conductors of any type with interconnecting parts as required.	m	1

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Project : 400kV GIS at 3 X 800MW Patratu STPS (Stage-I)
Technical Specification for 400 kV Gas Insulated Switchgear

SL	Description	Remarks_Long_Description	Unit	Quantity
H16	GIS metallic enclosure (any type)	Enclosure for bus bar, bus duct, GIB, straight cast enclosure etc with fixing hardware as required.	m	1
H17	Epoxy resin insulators for bus support with holes for gas flow (of each type and rating)	Bidder to inform details at tender stage	set	1
H18	Gas barrier insulators (of each type and rating)	Bidder to inform details at tender stage	set	1
H19	Density switch		no.	1
H20	Gas monitoring system devices	1 set = 1 no of each type	lot	1
H21	PD sensor		No.	1
H22	Optical indicator for CB, Isolator		No.	1
H23	Elbow / Angle / T-bends		No.	1
H24	Telescopic enclosure		No.	1
H25	Sleeve enclosure		No.	1

SL	Description	Remarks_Long_Description	Unit	Quantity
H26	Expansion joints for bellows		set	1
H27	Cross Tank		No.	1
H28	Supervision Services of manpower for erection per day (excl. travel time)		days	1
H29	Services of manpower for Testing & commissioning per day (excl. travel time)		days	1
H30	Hiring charges of HV test kit	Additional HV test kit charges including charges of manpower, HV test kit, accessories & tools required for completion of HV test (Dielectric Test after installation of GIS). HV test kit charges include one or more bay at site.	lot	1
H31	Training for GIS to PVUNL Engineers at manufacture's work.	Visit to Manufacturer's works have been considered. Lodging and Boarding of Training Participants shall be in bidder's scope.	Manday	1

Notes:

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

Item no. A19 & F are optional items and BHEL reserves right at its sole discretion to order these items or not.

BHEL reserves the right for quantity variation due to any reason upto $\pm 30\%$ of total value at same unit rate and terms during execution of contract. The quantity of individual items may however vary upto any extent.

(* One set corresponds to actual quantity of components and devices as installed for the equipment at Site)

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Sub : Sub-Qualifying Requirements for 400KV GIS Switchyard

CI.No. 5.16.1

- A) We Bidder/Sub vendor..... have designed, manufactured, erected/ supervised erection, tested/ supervised testing and commissioned/ supervised commissioning of one (1) Gas Insulated Switchgear (GIS) equipment(s) installation having at least six (6) bays of 400kV or above voltage class with short circuit current of not less than 40 kA for 1 second, which have been in successful operation for minimum two (2) years as per stipulated requirements mentioned under Clause no. 5.16.1 of Sub-Section-IA, Part-A, Section-VI of Bidding documents. The details of above are given below:

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

Signature of authorized signatory.....

Sl. No.	Item Description	Installation(s)
8	Short Circuit current rating (in kA for 1 Sec.)	
9	Date of Commissioning	
10	Date of commencement of successful operation	
11	No. of years in successful operation	
12	Certificate(s) from the client(s) & copy of LOA/P.O. are enclosed along with the bid at Annexure-... to this Attachment-3K	Yes*/ No*

NOTE :

1. For the purpose of qualifying requirements, one no of bay shall be considered as a comprising of at least one circuit breaker, two disconnectors and single phase current transformers.
2. Bidder may give details of more than one installation for Employer's reference, if he so desires.

* Bidder to strike-off whichever is not applicable.

Signature of authorized signatory.....

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Cl.No. 5.16.2(a)

- A) We Bidder/Sub vendor..... confirm that we are meeting the requirements specified in clause no. 5.16.2 (a) of Sub-Section-IA, Part-A, Section-I of Bidding Documents, and in support of same we give the following details:

We the Bidder / Sub vendor have designed, constructed/erected, tested and commissioned one (1) Air Insulated Substation/ Switchyard of 400 kV or above voltage class having at least six (6) bays which should have been in successful operation for a minimum period of two(2) years as per stipulated requirements mentioned under Clause no. 5.16.2(a) of Sub-Section-IA, Part-A, Section-VI of Bidding documents. The details of above are as under:

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

Signature of authorized signatory.....

b) No. of bays

c) Whether Air Insulated Substation/
Switchyard or not

Yes*/ No*

Sl. No.	Item Description	Installation(s)
8	Date of Commissioning	
9	Date of commencement of successful operation	
10	No. of years in successful operation	
11	Certificate(s) from the client(s) & copy of LOA/P.O. are enclosed along with the bid at Annexure-... to this Attachment-3K	Yes*/ No*

NOTE :

- For the purpose of qualifying requirements, one no of bay shall be considered as a comprising of at least one circuit breaker, two disconnectors and single phase current transformers.
- Bidder may give details of more than one installation for Employer's reference, if he so desires.

* Bidder to strike-off whichever is not applicable.

Signature of authorized signatory.....

Cl.No. 5.16.2 (b)

- B) Further, We/our-Sub-vendor have associated with the GIS manufacturer M/s (Name of the associate) we confirm that we are meeting the requirements specified in clause no. 5.16.2 (b) and in support of same we give the following details:**

We the Bidder/Sub vendor have associated with a GIS manufacturer for sourcing of GIS equipment who meets the requirement indicated at Cl.No. 5.16.1 of Sub-Section-IA, Part-A, Section-VI of Bidding Documents. The associate will also be fully responsible for the performance of the GIS portion of the contract. Further we (Bidder/Sub-vendor) shall arrange a Deed of Joint Undertaking jointly executed by Bidder/Sub vendor and its Associate prior to placement of order on approved vendor as per clause 5.16.2(b) of Sub-Section-IA, Part-A, Section-VI of Bidding Documents. The details of above Associate are given below:

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

Signature of authorized signatory.....

Sl. No.	Item Description	Installation(s)
8	Short Circuit current rating (in kA for 1 Sec.)	
9	Date of Commissioning	
10	Date of commencement of successful operation	
11	No. of years in successful operation	
12	Certificate(s) from the client(s) & copy of LOA/P.O. are enclosed along with the bid at Annexure-... to this Attachment-3K	Yes*/ No*

Note :

- For the purpose of qualifying requirements, one no of bay shall be considered as a comprising of at least one circuit breaker, two disconnectors and single phase current transformers.
- Bidder may give details of more than one installation for Employer's reference, if he so desires.

*** Bidder to strike-off whichever is not applicable.**

Signature of authorized signatory.....

Cl.No. 5.16.3(a)

A) We Bidder/Sub vendor..... confirm that we are meeting the requirements specified in clause no. 5.16.3 (a) and in support of same we give the following details:

We the Bidder / Sub vendor have designed, constructed/erected, tested and commissioned one (1) Air Insulated Substation/ Switchyard of 400 kV or above voltage class having at least six (6) bays which should have been in successful operation for a minimum period of two(2) years as per stipulated requirements mentioned under Clause no. 5.16.3(a) of Sub-Section-IA, Part-A, Section-VI of Bidding documents. The details of above are as under:

Sl. No.	Item Description	Installation(s)
1	Client name and its address	
2	Name & Location of the Substation/ Switchyard	
3	Name and designation of the Contact person(s) of client Organization with Address, Telephone, Fax and email etc.	
4	Name of Contract	
5	Order ref. & Date	
6	Scope of work executed by us for aforesaid Contract includes :	
	i) Design	Yes*/ No*
	ii) Construction/ Erection	Yes*/ No*
	iii) Testing	Yes*/ No*
	iv) Commissioning	Yes*/ No*
7	Details of 400kV or above Bays	
	a) Voltage level (in kV)	
	b) No. of bays	
	c) Whether Air Insulated Substation/ Switchyard or not	Yes*/ No*

Signature of authorized signatory.....

Sl. No.	Item Description	Installation(s)
8	Date of Commissioning	
9	Date of commencement of successful operation	
10	No. of years in successful operation	
11	Certificate(s) from the client(s) & copy of LOA/P.O. are enclosed along with the bid at Annexure-..... to this Attachment-3K	Yes*/ No*

Note :

1. For the purpose of qualifying requirements, one no of bay shall be considered as a comprising of at least one circuit breaker, two disconnectors and single phase current transformers.
2. Bidder may give details of more than one installation for Employer's reference, if he so desires.

*** Bidder to strike-off whichever is not applicable.**

Signature of authorized signatory.....

Cl.No. 5.16.3 (b)

- B) Further, We have established manufactuirn facilities for GIS Equipment in India based on technological support of an associate M/s who meet the requirements specified in clause no. 5.16.1 of Sub-Section-IA, Part-A, Section-VI of Bidding Documents and in support of same we give the following details :**

We the Bidder / Sub-vendor have established manufacturing facilities for GIS Equipment in India based on technological support of an Associate (who meets the requirement at 5.16.1 of Sub-Section-IA, Part-A, Section-VI) and we have designed, manufactured, erected/ supervised erection, tested/ supervised testing and commissioned/ supervised commissioning of at least one (1) Gas Insulated Switchgear (GIS) equipment(s) installation having at least six (6) bays of 400kV or above voltage class with short circuit current of not less than 40 kA for 1 second. The associate will be fully responsible for the performance of the GIS portion of the contract. Further, we (Bidder/Sub-vendor) shall arrange a Deed of Joint Undertaking jointly executed by Bidder/Sub vendor and its Associate prior to the placement of order on approved vendor as per Cl.No. 5.16.3(b) of Sub-Section-IA, Part-A, Section-VI of Bidding Documents. The details of the above are given below:

- I) For Bidder/sub-vendor's having GIS Manufacturing facility in India**

Sl. No.	Item Description	Installation(s)
1	Name & Location of the GIS manufacturing facilities	
2	Name and address of the associate providing technological support with Telephone, Fax and email etc.	
3	Whether manufacturing facility for GIS available in India based on technological support of Associate	Yes*/ No*
4	Client name and its address	
5	Name & Location of the GIS equipment installation.	
6	Name and designation of the Contact person(s) of client Organization with Address, Telephone, Fax and email etc.	
7	Name of Contract	
8	Order ref. & Date	

Signature of authorized signatory.....

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Sl. No.	Item Description	Installation(s)
9	Scope of work executed by our/our sub-vendor's Associate (GIS manufacturer) for aforesaid Contract includes :	
	i) Design	Yes*/ No*
	ii) Manufacturing	Yes*/ No*
	iii) Erection/ supervised erection	Yes*/ No*
	iv) Testing/ supervised testing	Yes*/ No*
	v) Commissioning/ supervised commissioning	Yes*/ No*
10	Details of 400kV or above Bays	
	a) Voltage level (in kV)	
	b) No. of bays	
11	Short Circuit current rating (in kA for 1 Sec.)	
12	Date of Commissioning	
13	Certificate(s) from the client(s) & copy of LOA/P.O. are enclosed along with the bid at Annexure-..... to this Attachment-3K	Yes*/ No*

Signature of authorized signatory.....

II) For the Associate, providing technological support, to GIS manufacturer having manufacturing facility in India

Sl. No.	Item Description	Installation(s)
1	Client name and its address	
2	Name & Location of the Switchgear (GIS) equipment installation	
3	Name and designation of the Contact person(s) of client Organization with Address, Telephone, Fax and email etc.	
4	Name of Contract	
5	Order ref. & Date	
6	Scope of work executed by Associate of GIS manufacturer for aforesaid Contract includes :	
	i) Design	Yes*/ No*
	ii) Manufacturing	Yes*/ No*
	iii) Erection / supervised erection	Yes*/ No*
	iv) Testing/ supervised testing	Yes*/ No*
	v) Commissioning/ supervised commissioning	Yes*/ No*
7	Details of 400kV or above Bays	
	a) Voltage level (in kV)	
	b) No. of bays	
8	Short Circuit current rating (in kA for 1 Sec.)	
9	Date of Commissioning	
10	Date of commencement of successful operation	
11	No. of years in successful operation	

Signature of authorized signatory.....

Sl. No.	Item Description	Installation(s)
12	Certificate(s) from the client(s) & copy of LOA / P.O. are enclosed along with the bid at Annexure-.... to this Attachment-3K	Yes*/ No*

Note :

1. For the purpose of qualifying requirements, one no of bay shall be considered as a comprising of at least one circuit breaker, two disconnectors and single phase current transformers.
2. Bidder may give details of more than one installation for Employer's reference, if he so desires.

*** Bidder to strike-off whichever is not applicable.**

Signature of authorized signatory.....

Cl.No. 5.16.4

Further, We have established manufactuirn facilities for GIS in India based on technological support of parent company M/s who meet the requirements specified in clause no. 5.16.1 of Sub-Section-IA, Part-A, Section-VI of Bidding Documents and in support of same we give the following details :

We the Bidder / Sub-vendor have established manufacturing facilities for GIS in India based on technological support of parent company (who meets the requirement at 5.16.1 of Sub-Section-IA, Part-A, Section-VI). The parent company will be fully responsible for the performance of the GIS portion of the contract. Further, we (Bidder/Sub-vendor) shall arrange a Deed of Joint Undertaking jointly executed by Bidder/Sub vendor and its parent company prior to the placement of order on approved vendor as per Cl.No. 5.16.4 of Sub-Section-IA, Part-A, Section-VI of Bidding Documents. The details of the above are given below:

I) For Bidder/sub-vendor's having GIS Manufacturing facility in India

Sl. No.	Item Description	Installation(s)
1	Name & Location of the GIS manufacturing facilities	
2	Name and address of the associate providing technological support with Telephone, Fax and email etc.	
3	Whether manufacturing facility for GIS available in India based on technological support of parent company	Yes*/ No*

Signature of authorized signatory.....

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II) For the Parent company, providing technological support, to GIS manufacturer having manufacturing facility in India

Sl. No.	Item Description	Installation(s)
1	Client name and its address	
2	Name & Location of the Switchgear (GIS) equipment installation	
3	Name and designation of the Contact person(s) of client Organization with Address, Telephone, Fax and email etc.	
4	Name of Contract	
5	Order ref. & Date	
6	Scope of work executed by Associate of GIS manufacturer for aforesaid Contract includes :	
	i) Design	Yes*/ No*
	ii) Manufacturing	Yes*/ No*
	iii) Erection / supervised erection	Yes*/ No*
	iv) Testing/ supervised testing	Yes*/ No*
	v) Commissioning/ supervised commissioning	Yes*/ No*
7	Details of 400kV or above Bays	
	a) Voltage level (in kV)	
	b) No. of bays	
8	Short Circuit current rating (in kA for 1 Sec.)	
9	Date of Commissioning	
10	Date of commencement of successful operation	
11	No. of years in successful operation	

Signature of authorized signatory.....

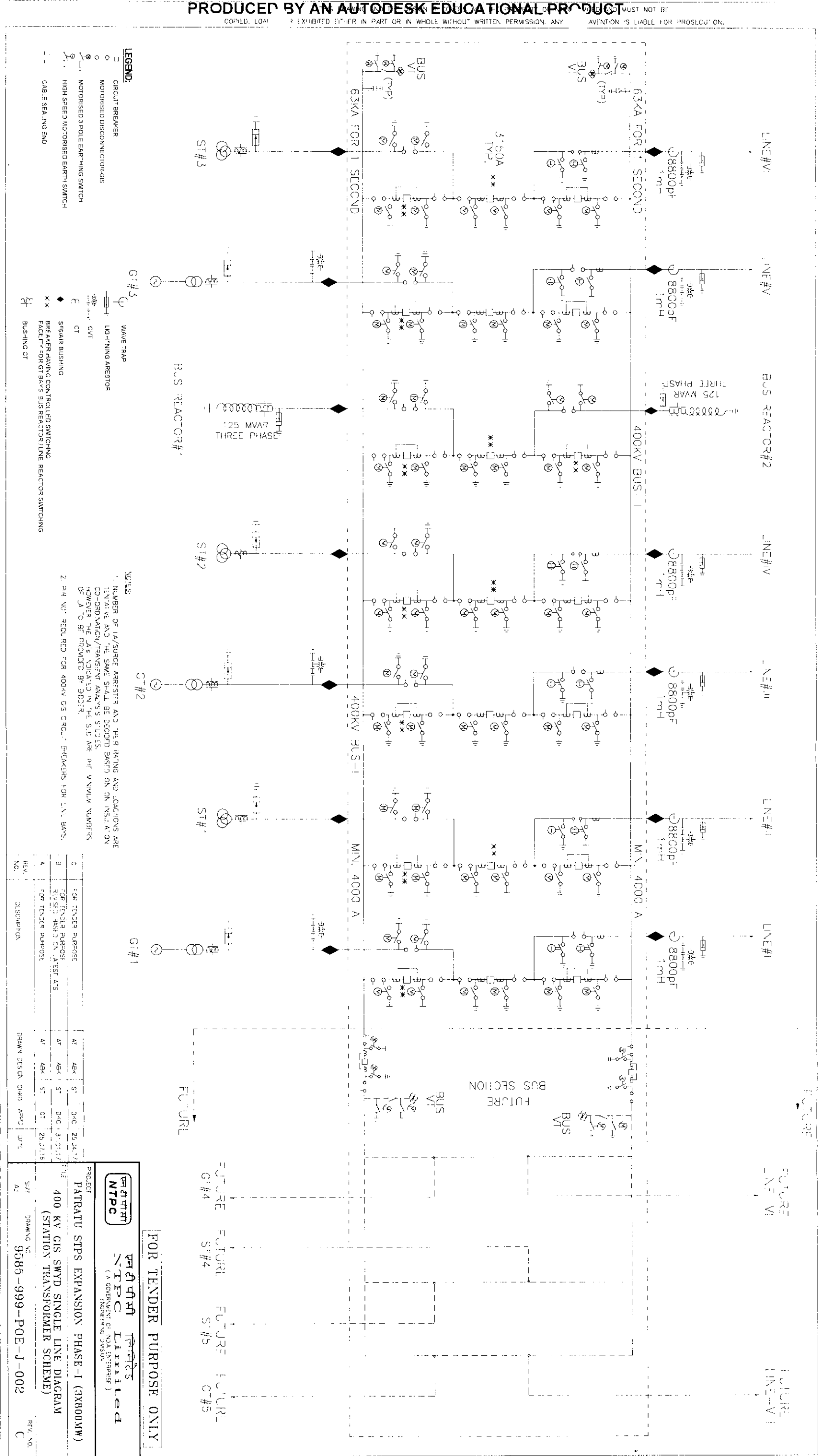
Sl. No.	Item Description	Installation(s)
12	Certificate(s) from the client(s) & copy of LOA / P.O. are enclosed along with the bid at Annexure-.... to this Attachment-3K	Yes*/ No*

Note :

1. For the purpose of qualifying requirements, one no of bay shall be considered as a comprising of at least one circuit breaker, two disconnectors and single phase current transformers.
2. Bidder may give details of more than one installation for Employer's reference, if he so desires.

*** Bidder to strike-off whichever is not applicable.**

Signature of authorized signatory.....



DESCRIPTION

SHEET

DESCRIPTION

SHEET

AC YARD OVERVIEW

2

400kV INDOOR GIS

4

GIS HALL

ω

400KV C I DETAILS

5

400kV OUTDOOR EQUIPMENT

4

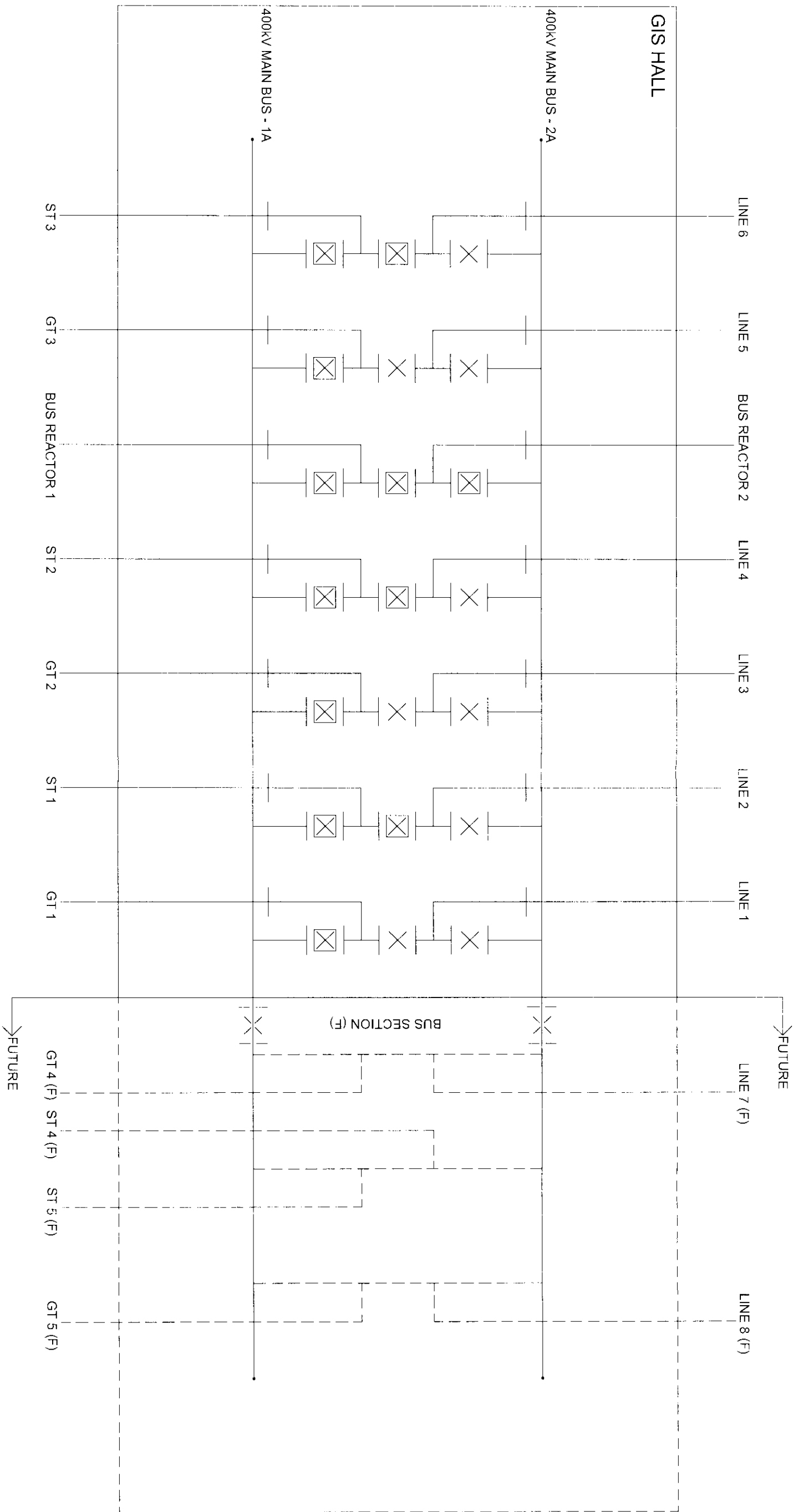
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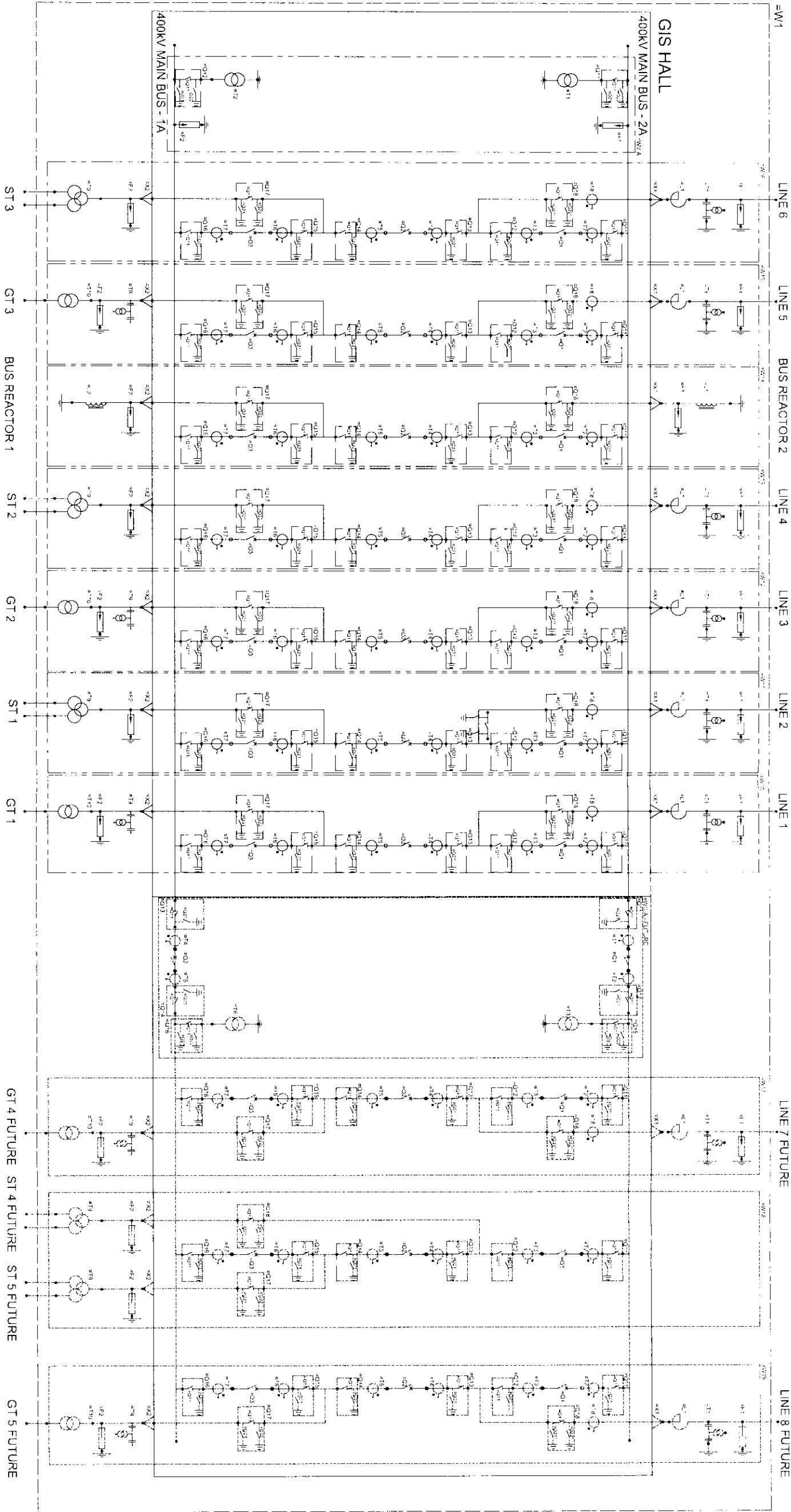
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NOTES:
EARTHING SWITCHES WITH * ARE HIGH SPEED EARTHING SWITCHES.

PROJECT NO.		SIGN. & DATE		REF. DRG. No.	
A		B		C	
REV		DATE		REV	
12		11		10	
11		10		9	
10		9		8	
9		8		7	
8		7		6	
7		6		5	
6		5		4	
5		4		3	
4		3		2	
3		2		1	
2		1			
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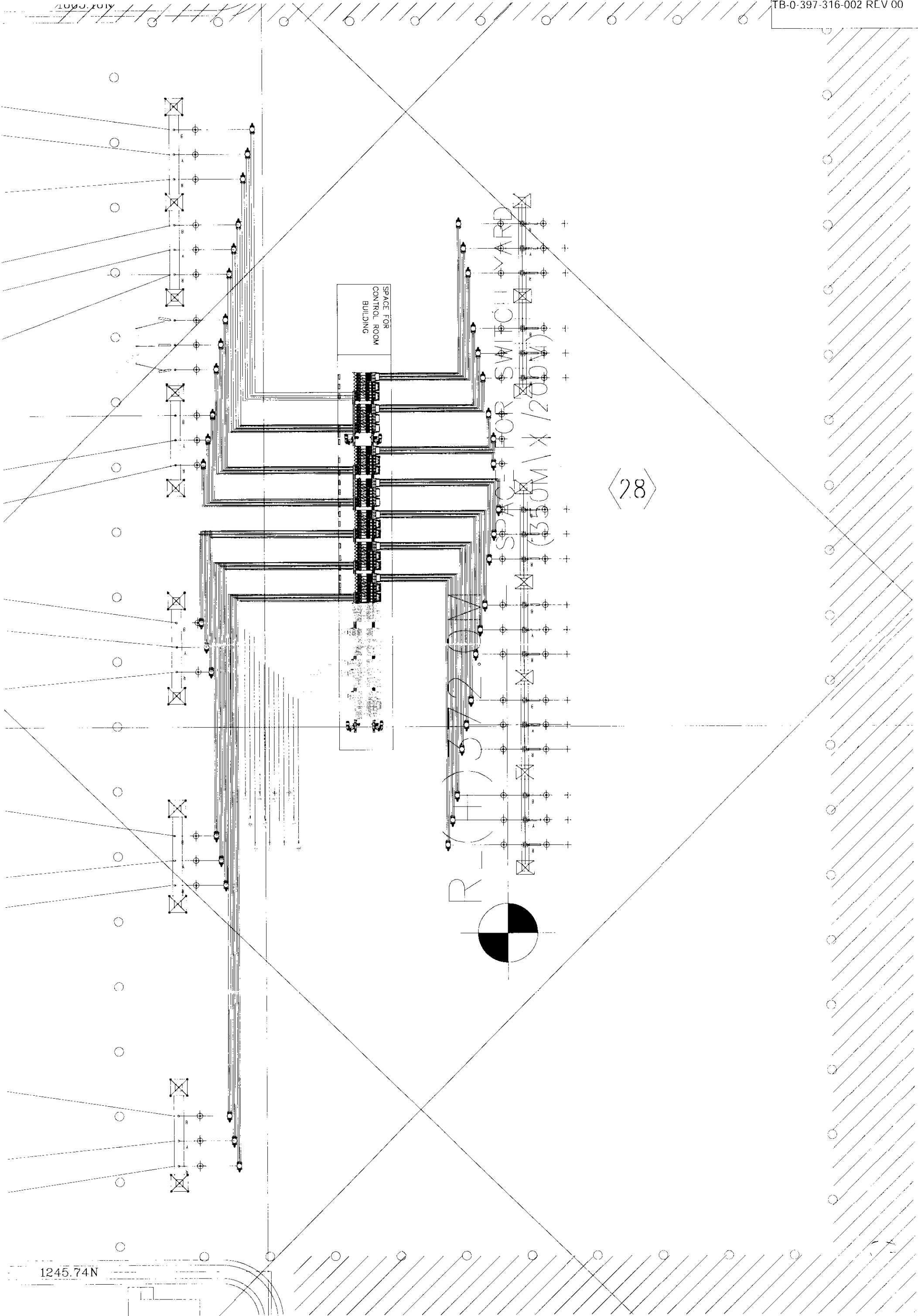
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COMPUTER DRG. PATH NAME

1. NOMENCLATURE MAY CHANGE AFTER FINALIZATION OF VENDOR.

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R = (F) 372 (350M) X 1200V

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