



BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION BUSINESS HVDC ENGINEERING & SYSTEMS

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	NOA NO.	-									
	Station	Talcher , Odisha									
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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 Talcher Thermal Power Project Stage – III (2X600 MW)
b)	Customer	NTPC Limited



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

- a) Two (2) fully equipped Generator Transformer Bays having controlled switching facility.
- b) Two (2) fully equipped Station Transformer Bays having controlled switching facility.
- c) Five (5) fully equipped Line Bays.
- d) One (1) fully equipped Bus Reactor Bay having controlled switching facility.
- e) Five (5) fully equipped Tie Bays having controlled switching facility.
- f) Two (2) fully equipped Bus Voltage Transformer Bays with Bus Isolator and Grounding Switches.
- g) 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.



1.2 SPECIFIC TECHNICAL REQUIREMENTS

S.No.	Technical Parameter	Unit	Value
1	Type of GIS	Indoor Type	
2	Location	Place: Talcher District: Angul State: Odisha	
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	3150
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



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 Talcher is located in Angul District of Odisha 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 given 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.



- 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 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-linear 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.

c) Details of earthing system:

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

- d) For Step and Touch Potential the following parameters shall be considered
- i) Current distribution factor – 1 (one)
 - ii) Duration of fault current – 0.5 sec
 - iii) Human body weight – 50kg
- e) Grid resistance shall be less than 1(one) ohm.



1.7 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, 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.

1.8 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 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 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.
- Testx. 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.
- 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
- vii. Repetitive charge transfer test
- viii. Heat dissipation behavior Test

The type test to be done as given above and also as listed in IEC 60099-4.

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

1.9 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



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

1.10 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)	

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



1.12 DRAWINGS ENCLOSED FOR REFERENCE

Sl. No.	Ref. Drawing No.	Drawing Title	Rev
1.	4540-999-POE-J-002A, REV-A	Single Line Diagram for 400kV GIS under Switchyard & BOP Electrical Pkg.	A
2.	4540-999-POE-F-001, REV-A	General Layout Plan	A

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.

Bidder to suggest tentative GIS building layout along with bus duct routing. BHEL will position 400 kV tower based on GIS bidder recommendation. Bidder to furnish GIS bus duct quantities considered in bid.

1.13 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.



- 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.



- 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.



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.



- 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.



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

- 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 2.18.00 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 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 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):
 - h) 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.



(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.



Annexure-C

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.



Annexure-C

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.

Annexure-D

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.

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 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 |
| 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.

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



ANNEXURE-I

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 IEC60255-26

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 disconnector 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 disconnector shall not take place unless the movable contacts have reached such a position that the clearance between the



contacts is at least 80 percent of the rated isolating distance.

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

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.



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 disconnecter 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.



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).



iii. Rated switching impulse	i) ± 1050 kVp between live terminals and earth.
Withstand voltage	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)



- 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.



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.



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.				



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. Values and calculations shall be furnished with offer.

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 |



(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	650 kVp



voltage at 500A

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 arrestor housing 630 kV (rms)

k) Impulse withstand voltage of arrestor 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.



n) The surge arrestors are provided to protect the following equipment whose insulation levels are indicated in the table I given below. The contractor shall carry out the insulation coordination studies for deciding the location of the surge arrestors.

TABLE – I		
S.NO.	EQUIPMENT TO BE PROTECTED	INSULATION LEVEL
	LIGHTNING IMPULSE (kVp) FOR 400 KV SYSTEM	SWITCHING SURGE 250/2500 (kVp) FOR 400 KV SYSTEM
1.	Power Transformer	± 1425 ± 1175
2.	Instrument Transformer	± 1425 ± 1050
3.	Reactor	± 1300 ± 1050
	CB/Isolator	
-	Phase to ground	± 1425 ± 1050
-	Across open contacts	± 1425 (± 240) ± 900 (± 340)

o) Surge arrestors shall be capable of discharge on severe re-energisation switching surges on a 400 kV line upto 450 km. length with surge impedance of 300 ohms and capacitance of 11.986 nF/km and over voltage factor of 2.3 p.u.

Surge arrestor shall be capable of discharging energy equipment to class 4 of IEC for a 420 kV system on two successive operations followed immediately by 50 Hz energisation with a sequential voltage profile as specified below:

650 kVp for 3 peaks
575 kVp for 0.1 second
550 kVp for 1 second
475 kVp for 10 seconds

p) 400 kV line circuit breakers are equipped with closing resistor of 400 ohms with pre insertion time switching over voltage to 2.3 p.u.



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 order/ 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.
- 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.
- j) Insulation resistance of control circuits, motor etc.
- k) 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.

PROJECT: TALCHER THERMAL POWER PROJECT STAGE-III (2 X 660MW)	
CUSTOMER: NTPC Limited	
Technical Specification	TB-Talcher-316-001 Rev 00
Section-3: Project Details and General Specification	

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	NTPC Ltd.
b)	Engineer/Consultant/ Inspector	NTPC Ltd.
c)	Project Title	Talcher Thermal Power Project Stage – III (2X 660MW) – 400kV GIS Switchyard
d)	Project Location	Place: Talcher District: Angul State: Odisha
e)	Nearest Railway Station	Talcher - on Talcher-Cuttack section of North Eastern Railway at about 4 Kms.
f)	Distance of project location from the Railway station	4 km (approx.)
g)	Nearest Major Town	Talcher
h)	Distance of the town from the project site	The site is approachable from Banarpal–Talcher section of National Highway No. 23 at a distance of about 1 km from Anand Bazar.
i)	Nearest commercial airport	Bhubaneswar
j)	Distance of airport from the project site	About 90 km by road.
<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
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.	50 m/ sec
g)	Category of terrain	Cat –2
h)	Risk Coefficient “K1”	1.08

3.1.1 SYSTEM PARAMETERS:

PROJECT: TALCHER THERMAL POWER PROJECT STAGE-III (2 X 660MW)	
CUSTOMER: NTPC Limited	
Technical Specification	TB-Talcher-316-001 Rev 00
Section-3: Project Details and General Specification	

Sl.No.	Parameters	400 kV
1	Highest system voltage	420 kV rms
2	Lightning Impulse voltage	$\pm 1425 \text{ kVp}$
3	Switching impulse voltage	$\pm 1050 \text{ kVp}$
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	$\pm 10\%$	50 (+3% -5%)	3Phase , 4 Wire	Solidly Earthed
2	240V	$\pm 10\%$	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%.

CHAPTER-B

ELECTRICAL

SUB-SECTION-DB-E0-7 & 10

SWITCHYARD

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)	

CLAUSE NO	GAS INSULATED SWITCHGEAR .	
	Bidder's Name:	
	14. Rated one minute power frequency withstand voltage	kV (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)

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	

CLAUSE NO	GAS INSULATED SWITCHGEAR	
	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	

CLAUSE NO	GAS INSULATED SWITCHGEAR (GIS) 
	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 along with 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 27⁰C 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

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)

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	

CLAUSE NO	GAS INSULATED SWITCHGEAR . एन टी पी सी NTPC
	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

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.) A - Closing(3 poles) current at rated supply voltage (220 VDC) A - Tripping voltage range (percent) - Closing voltage range (percent) 11. Heaters - Continuously current rating .....A - Thermostat power rating .....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	

CLAUSE NO	GAS INSULATED SWITCHGEAR	
	Bidder's Name: contacts & Aux. contacts. - Material of main contacts/arcing 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 Kilimetric 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	

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 (GIS)	
	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	

CLAUSE NO	GAS INSULATED SWITCHGEAR I. 
	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

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	

CLAUSE NO	GAS INSULATED SWITCHGEAR .	
	Bidder's Name: - Contacts, .....Deg. C - Hottest part .....Deg. 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	

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 (cm²) iii) Material of contacts iv) Contact pressure (Kg/cm²) v) Maximum current density under normal current carrying capacity (Amp/cm²) vi) Thickness of silver plating c) Auxiliary contacts on Disconnecting switch i) Total number i) 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 Un / $\sqrt{3}$	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	

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	.....

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	.....

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	.....

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	

CLAUSE NO	GAS INSULATED SWITCHGEAR						एनटीपीसी NTPC
	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							

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	.....

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			.....

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)	.....

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 Support Barrier (Details for each type of insulator used to be indicated separately) 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	

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

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	.....

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)	.....

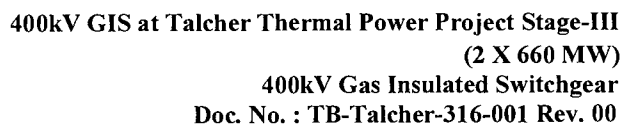
CLAUSE NO.	BIDDER'S NAME	
11.	1.2/50 micro sec. impulse withstand voltage (kVp) of insulator with corona ring	.....
	i) Dry (kV rms)	.....
	ii) Wet (kV rms)	.....
12.	Min. Corona Extinction Voltage (kV)	.....
13.	Radio Interference Voltage at $1.1 U_m/\sqrt{3}$ (micro volts) for frequency between 0.5 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	.....

CLAUSE NO.	BIDDER'S NAME
	a) Ball & Socket/other b) Normal/antifog 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)

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

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)	

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	..... ..... ..... .....



SCHEDULE OF DEVIATIONS

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

Company:



**400kV GIS at Talcher Thermal Power Project Stage-III
(2 X 660 MW)**

**400kV Gas Insulated Switchgear
Doc. No. : TB-Talcher-316-001 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 boxes, SF6 gas filling, and interconnecting power and control	Confirmed	Yes/No



400kV GIS at Talcher Thermal Power Project Stage-III

(2 X 660 MW)

400kV Gas Insulated Switchgear

Doc. No. : TB-Talcher-316-001 Rev. 00

Sl.	Particulars	Reply by bidder	
	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 Talcher, design and construction of GIS should be suitable for the climate/ Meteorological Condition as mentioned in Section-1 and in section-3.</i> <i>Bidder to inform what measures shall be taken to ensure the same at bid stage.</i>	Writeup attached with bid.	Yes/No
3.2	Details regarding the design features of equipment which are intended to prevent burn through when an internal arc occurs.	Enclosed with bid	Yes/No
3.3	Material of enclosure – Non Magnetic	Confirmed	Yes/No
3.4	Material of bus bar - Non Magnetic	Confirmed	Yes/No
3.5	Requirement of AC and DC auxiliary loads	Enclosed with bid	Yes/No
3.6	Catalogues of GIS	Enclosed with bid	Yes/No
3.7	Catalogues of all Maintenance equipment. Bidder to confirm that offered equipment meets the requirements of specification.	Enclosed with bid	Yes/No
3.8	Approved makes – Bidder to confirm that the offered Maintenance equipment are of approved make	Confirmed	Yes/No
4	Calculations		
4.1	All calculations including Thermal calculations based on the climatic conditions indicated in Section 3 shall be submitted during detailed engineering stage.	Confirmed	Yes/No



400kV GIS at Talcher Thermal Power Project Stage-III

(2 X 660 MW)

400kV Gas Insulated Switchgear

Doc. No. : TB-Talcher-316-001 Rev. 00

Sl.	Particulars	Reply by bidder	
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
8	TYPE TESTS REQUIREMENTS		



**400kV GIS at Talcher Thermal Power Project Stage-III
(2 X 660 MW)
400kV Gas Insulated Switchgear
Doc. No. : TB-Talcher-316-001 Rev. 00**

Sl.	Particulars	Reply by bidder	
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.

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-A17	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) Two (2) fully equipped Generator Transformer Bays having controlled switching facility. b) Two (2) fully equipped Station Transformer Bays having controlled switching facility. c) Five (5) fully equipped Line Bays. d) One (1) fully equipped Bus Reactor Bay having controlled switching facility. e) Five (5) fully equipped Tie Bays having controlled switching facility. f) Two (2) fully equipped Bus Voltage Transformer Bays with Bus Isolator and Grounding Switches. g) 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) THREE 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	2

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) THREE 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	2
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 183 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) ONE 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	5

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) THREE 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	1
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) 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	5
A6	Bus VT Modules for Main Buses	400kV, 3150A, 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, 3150A, 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

SL	Description	Remarks_Long_Description	Unit	Quantity
A7	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
A8	BusBar Modules	One set of three single phase(isolated), 3150A, 63kA for 1 sec, SF6 gas-insulated metal enclosed bus bars, each comprising of : a) Three individual 3150 A 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
A9	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	10
A10	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
A11	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.	30
A12	Local Control Cubicles	Bay Control Cabinet for GT/BUS REACTOR/LINES/ STATION TRANSFORMER/ TIE BAYS/ BUS VT including cable between GIS & LCC.	No.	17

SL	Description	Remarks_Long_Description	Unit	Quantity
A13	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
A14	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
A15	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
A16	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
A17	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

SL	Description	Remarks_Long_Description	Unit	Quantity
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
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 A13.		Lot	1
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

SL	Description	Remarks_Long_Description	Unit	Quantity
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
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			

SL	Description	Remarks_Long_Description	Unit	Quantity
	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
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

SL	Description	Remarks_Long_Description	Unit	Quantity
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 Disconnecter		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 Disconnecter		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			
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	Interlockingcoil with resistors, timers,key interlock for complete 3 phase equipment , as applicable (each type & rating)		Set	1

SL	Description	Remarks_Long_Description	Unit	Quantity
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 Insuted complete VT with enclosure		Set	1
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

SL	Description	Remarks_Long_Description	Unit	Quantity
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 bays 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 bays, Line bays, Bus reactor bays, Bus VT bays, LA/Surge Arrester bay, tie bays, etc.	Set	1
F4	Supervision of Erection of GIS Duct - GIS to SF6 to Air Bushings	Complete GIS ducts of all rating	Lot	1

SL	Description	Remarks_Long_Description	Unit	Quantity
F5	Supervision of Erection of complete SF6 to Air Bushing	SF6 to Air Bushing complete in all respect.	Set	30
F6	Testing & Commissioning of GIS	Complete GIS including busbar, GT bays, Station transformer bays, Line bays, Bus reactor bays, Bus VT bays, LA/Surge Arrester bays, tie bays, etc.	Set	1
F7	Final successful Testing of GIS including HV test and its accessories	HV Test kit shall be arranged by the bidder on returnable basis. (GT bays, Station transformer bays, Line bays, Bus reactor bays, Bus VT bays, Tie bays, etc. may be commissioned separately.) Final testing as per IEC for complete GIS including busbar, GT bays, Station transformer bays, Line bays, Bus reactor bays, Bus VT bays, Tie bays etc., Ducts, SF6 to Air Bushing etc.	Lot	1
F8	Training for GIS to NTPC 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 Trainess = 8 b) Operation,Maintenance, Site Testing and Trouble shooting for GIS,Training duration= 5 days, place of training =Site, No of Trainess = 6 The cost of Boarding and lodging expenses of the NTPC training participants 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 Trainess = 5 b) Operation,Maintenance, Site Testing and Trouble shooting for GIS,Training duration= 5 days, place of training =Site, No of Trainess = 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)			
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.		

Project : 400kV GIS at 2 X 660MW Talcher TTPS (Stage-III)
 Technical Specification for 400 kV Gas Insulated Switchgear

SL	Description	Remarks_Long_Description	Unit	Quantity
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, 3150A Isolator (1 pole) without operating mechanism		No	1
H4	400 kV Maintenance Earthing switch without operating mechanism		No	1
H5	400kV High speed earth switch without operating mechanism		No	1
H6	400kV Current transformer (1 of each type) (Individual prices to be furnished).		No	1
H7	400kV Voltage transformer (1 of each type) (Individual prices to be furnished).		No	1
H8	Operating Mechanism box for 400kV, 3150 A Circuit Breaker		No	1
H9	Operating Mechanism box for 400kV, 3150 A Isolator		No	1
H10	Operating mechanism for 400kV, Maintenance Earthing Switch		No	1
H11	Operating Mechanism for 400kV, High Speed Earthing Switch		No	1
H12	Single Phase Bus bar (Any type)	Complete single phase 400kV,3150A, 63 kA for 1s bus bar including Gas monitoring systems, barriers, pressure switches	m	1

SL	Description	Remarks_Long_Description	Unit	Quantity
H13	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
H14	GIS metallic enclosure (any type)	Enclosure for bus bar, bus duct, GIB, straight cast enclosure etc with fixing hardware as required.	m	1
H15	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
H16	Gas barrier insulators (of each type and rating)	Bidder to inform details at tender stage	set	1
H17	Density switch		no.	1
H18	Gas monitoring system devices	1 set = 1 no of each type	lot	1
H19	PD sensor		No.	1
H20	Optical indicator for CB, Isolator		No.	1
H21	Elbow / Angle / T-bends		No.	1
H22	Telescopic enclosure		No.	1
H23	Sleeve enclosure		No.	1
H24	Expansion joints for bellows		set	1
H25	Cross Tank		No.	1
H26	Supervision Services of manpower for erection per day (excl. travel time)		days	1
H27	Services of manpower for Testing & commissioning per day (excl. travel time)		days	1
H28	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
H29	Training for GIS to NTPC Engineers at manufacturer's work.	Visit to Manufacturer's works have been considered. Lodging and Boarding of Training Participants shall be in bidder's scope.	Manday	1

SL	Description	Remarks_Long_Description	Unit	Quantity
I	Type Tests - Please refer Technical Specification Clause-1.7 , page- 8 of 64.	Quoting for type tests is mandatory and shall be considered for evaluation.		
I1	The following type tests (as applicable) are proposed to be conducted on a complete single pole assembly of one typical GIS switchgear bay module as per IEC 62371-203. 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.			
I2	Lightning impulse voltage dry tests.		No. of Type / Rating	1
I3	Switching impulse voltage dry tests.		No. of Type / Rating	1
I4	Power frequency voltage dry tests.		No. of Type / Rating	1
I5	Partial discharge tests.		No. of Type / Rating	1
I6	Radio Interference Voltage test (as applicable)		No. of Type / Rating	1
I7	Test to prove the temperature rise of any part of the equipment and measurement of the resistance of the main circuit.		No. of Type / Rating	1
I8	Test to prove the ability of the main circuit and earthing circuit to carry the rated peak and the rated short time withstand current.		No. of Type / Rating	1
I9	Test to verify the making and breaking capacity of the included switching devices.		No. of Type / Rating	1
I10	Test for satisfactory operation of the included switching devices.		No. of Type / Rating	1
I11	Test to prove the strength of enclosures.		No. of Type / Rating	1

SL	Description	Remarks_Long_Description	Unit	Quantity
I12	Gas tightness test		No. of Type / Rating	1
I13	Electromagnetic capability test (if applicable)		No. of Type / Rating	1
I14	Test on partitions		No. of Type / Rating	1
I15	Mechanical operation tests.		No. of Type / Rating	1
I16	Test to prove the satisfactory operation at limit temperature.		No. of Type / Rating	1
I17	Verification of degree of protection of auxiliary and control circuits.		No. of Type / Rating	1
I18	Test to prove performance under thermal cycling and gas tightness test on gas barrier insulators		No. of Type / Rating	1
I19	Capacitive Current switching test		No. of Type / Rating	1
I20	Shunt reactor current switching test		No. of Type / Rating	1
I21	For surge arrester and Bus VT following type tests are proposed to be conducted as per relevant IEC.		No. of Type / Rating	
I22	Surge Arrester (As per IEC 60000-4)			
I23	Insulation withstand test on housing		No. of Type / Rating	1
I24	Residual voltage test		No. of Type / Rating	1
I25	Long duration current impulse withstand test		No. of Type / Rating	1
I26	Pressure relief test (if applicable)		No. of Type / Rating	1

SL	Description	Remarks_Long_Description	Unit	Quantity
I27	Operating duty test		No. of Type / Rating	1
I28	Partial Discharge Test		No. of Type / Rating	1
I29	Leakage Test		No. of Type / Rating	1
I30	Repetitive charge transfer test		No. of Type / Rating	1
I31	Heat dissipation behavior Test		No. of Type / Rating	1
I32	Bus VT (As per IEC 60044-2)			
I33	Temperature rise test		No. of Type / Rating	1
I34	Lighting Impulse test		No. of Type / Rating	1
I35	Switching Impulse		No. of Type / Rating	1

SL	Description	Remarks_Long_Description	Unit	Quantity
I36	Determination of errors		No. of Type / Rating	1
I37	Short circuit withstand capability		No. of Type / Rating	1
I38	Chopped lighting impulse test		No. of Type / Rating	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.

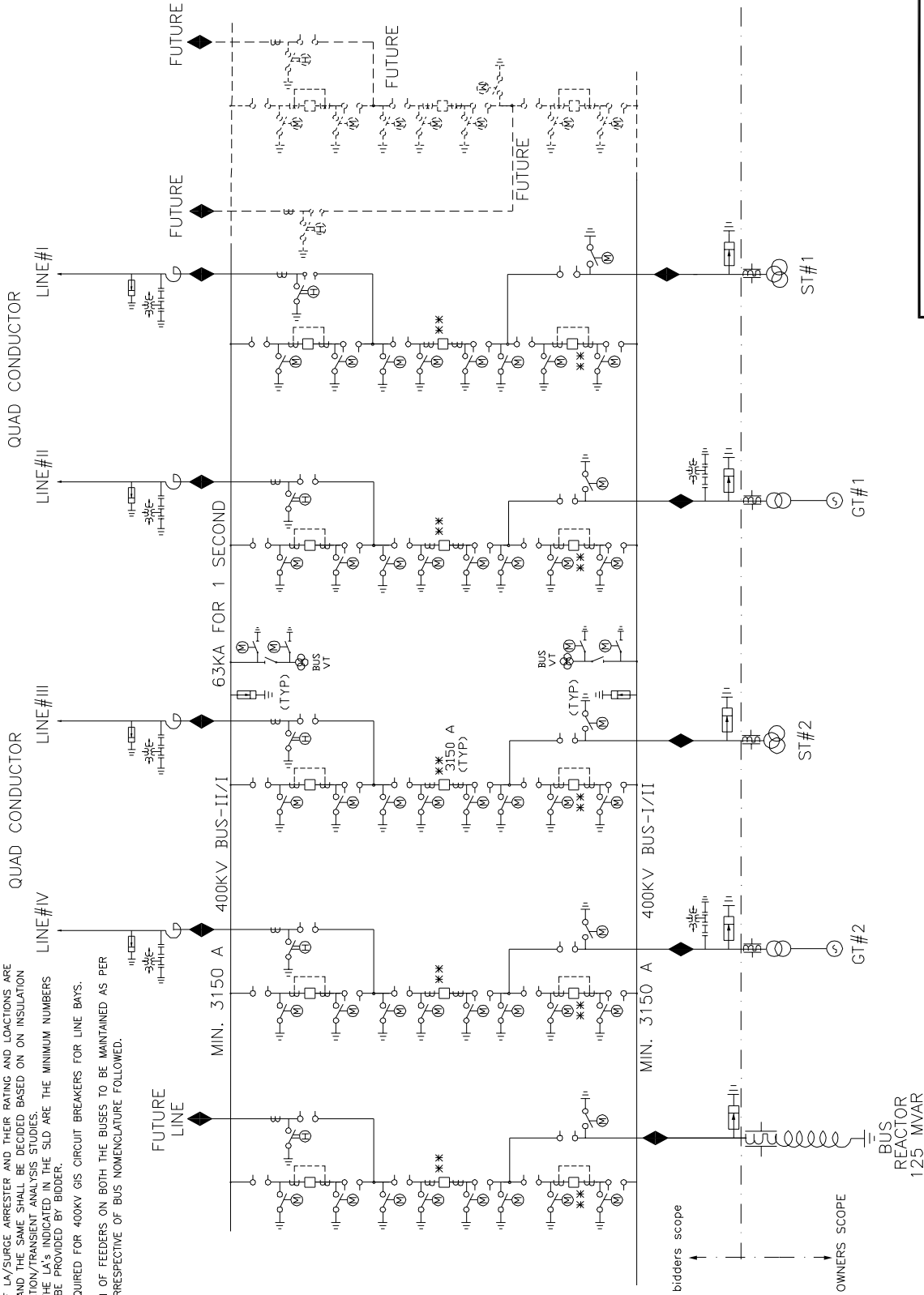
Item no. A17 & F are optional items and BHEL reserves right at its sole discretion to order these items or not.

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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- NOTES:
1. NUMBER OF LA/SURGE ARRESTER AND THEIR RATING AND LOCATIONS ARE TENTATIVE AND THE SAME SHALL BE DECIDED BASED ON ON INSULATION CO-ORDINATION/TRANSIENT ANALYSIS STUDIES. HOWEVER THE LA'S INDICATED IN THE SLD ARE THE MINIMUM NUMBERS OF LA TO BE PROVIDED BY BIDDER.
 2. PIR NOT REQUIRED FOR 400KV GIS CIRCUIT BREAKERS FOR LINE BAYS.
 3. DISTRIBUTION OF FEEDERS ON BOTH THE BUSES TO BE MAINTAINED AS PER THIS SLD IRRESPECTIVE OF BUS NOMENCLATURE FOLLOWED.



FOR TENDER PURPOSE

A	RELEASED FOR TENDER PURPOSE	DRAWN	CHKD		DATE	
			SCH	GH	APPD	
REV. NO.	DESCRIPTION					

- LEGEND:
- CIRCUIT BREAKER
 - MOTORIZED DISCONNECTOR-GIS
 - MOTORIZED 3 POLE EARTHING SWITCH
 - HIGH SPEED MOTORIZED EARTH SWITCH
 - BUSHING CT
 - WAVE TRAP
 - LIGHTNING ARRESTOR
 - CVT
 - CT
 - SF6AIR BUSHING
 - BREAKER HAVING CONTROLLED SWITCHING



एन टी सी लिमिटेड
NTPC Limited
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT TALCHER TPP STAGE-III (2X660 MW)

TITLE SINGLE LINE DIAGRAM FOR 400KV GIS UNDER SWITCHYARD & BOP ELECTRICAL PKG

REV. NO. A
DRAWING NO. 4540-999-POE-J-002A
SIZE

