



BHARAT HEAVY ELECTRICALS LIMITED

TRANSMISSION PROJECTS ENGINEERING MANAGEMENT

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				DATE	27-09-2017		29/12/17
				GROUP	TBEM	W.O. No	84002
CUSTOMER	Uttarakand Jal Vidyut Nigam Ltd. (UJVNL)						
PROJECTS	2X60MW VYASI HYDRO ELECTRIC PROJECT (HEP)						

CONTENTS

Section	Description	No. of Sheets
1.	Scope, Specific Technical Requirements & BOQ Section-1	08
	Technical Requirement of PQR	01
	SLD and others related drawings	09
2.	Equipment Specification Section 2	59+1
3.	Project Details And General Technical Requirement Section 3	16
4.	GTP	44
5.	Technical Check List	05
	Compliance Certificate	01

Rev No.	Date	Altered	Checked	Approved	REVISION DETAILS			
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Technical Requirement

Name of Project : 2X60MW Vyasi HEP

Name Of Item : - 220kV GIS

Sr. No	Technical Requirement	Supporting documents	Reference of attached documents
1.	The manufacturer must have Experience of designed, manufactured, Type tested & supplied 132kV or higher voltage GIS in India for a period of at least 3 years as on date of award of contract date i.e.08.05.2017.	PO Copy, Performance certificate /Letter /MOM etc. issued by end customer for Satisfactory operation, Inspection report, and LR details CA certificate etc.	
2.	The manufacturer should have functional service facility with all tools and tackles, trained manpower required for installation, commissioning and repair of GIS.	Declaration by bidder and supporting documents etc.	
3.	Bidder have to submit declaration and assure that no Chinese National/company having close link with china is envisaged to work in GIS.	Declaration by bidder etc.	

Signed with Seal of Bidder

Date

SECTION – 1

1.1 SCOPE

This Specification covers Design, Manufacture, Inspection at manufacturer's works, Testing and Delivery at site, Supervision of unloading and storage at site, installation and commissioning including site testing along with necessary equipment, training of BHEL and UJVNL personnel for 220 kV Gas Insulated Substation (GIS) as per the specification complete with all auxiliaries, accessories and spare parts complete in all respect in line with specification.

This section covers the scope and quantities of 220 kV GIS. The Specific Technical Requirements for the above item as specified by the customer/UJVNL 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:

Section 1 Scope, project specific technical requirement & BOQ
Section 2 Specific Technical Requirement
Section 3 Project details and general technical requirements
Section 4 Technical Check List

In case of any discrepancies between the requirements mentioned under Section-1/Section-2 and those specified in the Section-3, the specifications given under Section-1/Section-2 shall prevail and shall be treated as binding requirements.

Bidder to submit filled up **Annexure-A** attached with Section-1 confirming that there are no deviations and the offer is in full compliance with the specification.

The equipment is required for the following project:

Name of the Project : **2X60 MW VYASI HEP**
Name of the Customer : **UJVN LIMITED**
Main Contractor : **BHEL**

The 220kV Gas Insulated Switchgear (GIS) in double bus bar configuration in GIS Floor plan at EL 544m shall include in present six bays i.e. two generator transformer bays , one Station Auxiliary transformer bay ,two line bay and one bus coupler bay as shown in single line diagram (SLD).

- Two Line bays: LAKWAR and DEHRADUN
- Two GT(Generator Transformer) bays: GT 1 & GT 2
- One bay for Start Auxiliary transformer
- One bay for Bus Coupler
- 220kV Bus VT = 2 Set

1.2 BILL OF QUANTITIES:

As per Annexure-1

1.3 SPECIFIC TECHNICAL REQUIREMENT

As per section 2,

1.4 Training:

The bidder shall provide comprehensive training for Customer (UJVNL/BHEL's) engineering, operating & maintenance staff covering all aspects of GIS equipment, systems, operation & maintenance.

The bidder shall train, instruct and supervise the Customer (UJVNL/ BHEL) staff to an adequate standard of knowledge and capability for good trouble shooting, repair and of the GIS equipment as well as to an adequate standard for safe and efficient commercial operation of GIS.

The training shall at least include:

- Training at manufacturer's works during the assembly of the major items.
- Classroom and hands on training.
- On the job training during erection, commissioning and reliability test run
- Simulator training

The bidder shall submit the training plan for the classroom, on the job and simulator training including schedule, place, contents of lectures etc. for the Customer approval no less than six (6) months in advance to the cold commissioning.

Post training assessment shall be carried out and documented in case the results of the training are below the expectations, which have been agreed upon by both bidder and customer before training, the respective training modules shall be repeated in an improved way and the related cost for the repeated training shall be borne by the Contractor.

1.6 It may be noted that:

- For system details and transport details refer Project Information in section 3.
- Manufacturer to mark Indoor storage requirement on the material to be stored in covered storage. The rest of the material shall be stored outdoor.
- 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.
- Defect liability period shall be 24 months from the date of operational acceptance. In case of repair / replacement further defect liability period shall be of 24 months. However aggregate defect liability period shall be 36 months.
- Confirm that the consumables (list to be enclosed by bidder during contract stage) with shelf life of fewer than two years shall be supplied before erection after clearance from BHEL.
- Supplier will submit detailed bar chart indicating all the milestones from Engineering till manufacturing/ testing, dispatch to site and commissioning.
- Bay spacing if required to be changed as per building column and beam requirement. Same shall be adjusted without any cost implicating to BHEL at contract stage.

PROJECT: 2X60 MW VYASI HEP

CUSTOMER: UJVN LIMITED

Technical Specification of 220kV Gas Insulated Substation

Section-1: Scope, Specific Technical Requirements & Quantities

TB-398-316-001

REV.00

1.7 Earthing of GIS

Supply of Earthing Material and Erection of all Earthing connection for GIS to GIS, GIS to Earth Mesh, GIB to structure, Bushing to structure and structure to Main Earth mate on Floor shall be in bidder's scope.

The quantity shall be estimated by the bidder, based on their design philosophy. Supply of Earthing Material and Erection of Earth mesh on floor/ switchyard shall be done by BHEL in supervision of manufacturer as per manufacturer's design. Design philosophy shall be submitted along with the bid of section 2 to be followed for earthing.

Only supply of following items shall be done by BHEL:

- 1. 40mm dia MS Rod**
- 2. 75X12 GI Flat**
- 3. 50X6 GI Flat**

Any other earthing material if required shall be in bidder's scope of supply and erection.

1.8 Drawings Enclosed

1.9

Sl. No.	UJVNL/BHEL Drg. No.	Drawing Title
1.	Drg. No. TB-VYASI-220kV GIS-01, Rev01	Single Line Diagram of 220kV Pothead yard and GIS.
2.	Drg. No. TB-VYASI-220kV GIS-02	GIS Floor plan at EL 544m.
3.	Drg. No. TB-VYASI-220kV GIS-03, Rev01	Connection of GIS with GT/ST
4.	Drg. No. TB-VYASI-220kV PH-01, Rev01	Typical arrangement of 220kV Pothead yard and its connection.

220kV GIS shall be placed in power house at EL 544m above transformer hall/yard and 220kV pothead yard shall be at EL 535m. 220kV GIS shall be connected to 220kV pothead with 220kV SF6 Bus duct.

220kV GIS Bus Duct shall also be used for connecting the GIS at EL 544m to Generator Transformer at EL 535m.

5MVA, 220/11kV Station Transformer shall also be placed at EL 535m adjacent to Generator Transformer and it is connected to GIS through bus duct.

Size of 220kV GIS Hall shall be 44mx15m at EL 544m.

Size of 220kV Pothead yard shall be 50mx26m at EL 535m.

PROJECT: 2X60 MW VYASI HEP	
CUSTOMER: UJVN LIMITED	
Technical Specification of 220kV Gas Insulated Substation Section-1: Scope, Specific Technical Requirements & Quantities	TB-398-316-001 REV.00

1.10 Type Testing

Type test certificates will be accepted for the equipment used in the similar applications if the proposed equipment does not deviate in the relevant technical characteristics and if the type tests are made in an internationally recognized test laboratory and if the reports are not older than 10 years as on **08.05.2017**.

In case the contractor is not able to submit valid Report of Type Test(s) or in case Type tests Reports are not found to be meeting the specification requirements, or not including all specified tests, the contractor shall conduct all such tests under this contract. The costs of such test shall be deemed to be included in the price. The UJVNL/BHEL shall have right to witness the Type Tests. Waiver of Type Tests will not be entertained in normal circumstances.

All acceptance, routine and sites tests as per the specification (Refer Section-2) and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.

The bidder shall submit the following type test reports for the tests conducted on the GIS package. However any other Type test reports not mentioned but required as per relevant standards shall also be submitted.

For Applicable Type test list as per Section-2.

The average Intensity of electromagnetic field shall not be more than 500 micro Tesla. The Contractor shall furnished all documents in support of above during detailed Engineering.

Tests Witness

Tests shall be performed in presence of Owner's representative if so desired by the Owner. The bidder shall give at least ten (10) days' advance notice of the date when the tests are to be carried out.

1.11 INSPECTION & TESTING

All acceptance, routine and sites tests as per the specification (Refer Section-2) and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.

Prior to dispatch, the routine & acceptance tests shall be carried out on equipment and accessories in accordance with Section-2 and applicable IEC and the material shall be offered for final inspection by BHEL and UJVNL in accordance with quality assurance plan.

During manufacture and on completion, all equipment shall be subjected to the Routine tests as laid down in latest editions of IEC 62271-203 & IEC 62271-1. Test shall include but not limited to the following:

As per Section-2

PROJECT: 2X60 MW VYASI HEP	
CUSTOMER: UJVN LIMITED	
Technical Specification of 220kV Gas Insulated Substation	TB-398-316-001
Section-1: Scope, Specific Technical Requirements & Quantities	REV.00

1.12 Tests after installation on Site

Field acceptance tests after installation of the complete switchgears shall be made according to IEC 62271-203 and shall be subject to agreement between manufacturer and Employer/Employer's Representative before purchase order award. The Tenderers shall state in their offers the type of tests to be conducted on site. The dielectric tests shall comprise at least a power frequency voltage withstand test and partial discharge test according to IEC 62271-203 Procedure A for 170 kV and below and Procedure B for 220 kV and above, where partial discharge test shall include UHF method. Voltage transformers shall also be tested, erected and assembled to GIS.

Other tests

The following checks and test measurements shall be made during erection and commissioning in accordance with agreed standards, but not limited to as per Section-2.

All defects detected as a result of routine or on site testing shall be repaired by the manufacturer and tests repeated at his own expense.

Acceptance of any equipment by Employer's representatives shall not relieve the manufacturer from any of his performance guarantees, or from any of his other obligations resulting from this Contract.

Where no tests are detailed for items of equipment, a full program of tests shall be agreed with the Employer/Employer's Representative. The Employer/Employer's Representative reserves the right to call for such extra tests as may be necessary to prove compliance with the specification.

1.13 Packing, Packing & Shipping Instructions:

Refer Section-2&3.

1.14 QUALITY PLAN

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

For Manufacturing Quality Assurance Plan (MQP) and Field Quality Plan refer Section-3.

1.15 INFORMATION TO BE FURNISHED BY THE CONTRACTOR/ SUB CONTRACTOR

Information/ documents to be furnished at the TENDER STAGE shall be as per section 2 & 3.

1.16 DRAWINGS / DOCUMENTS

The drawings / documents submitted shall be project and product specific and shall incorporate all project details and title block and numbering scheme of the customer as detailed in Section 2 & 3.

ANNEXURE-A BOQ					
Sl.No.	Description	Items	Detailed Description	Unit	Quantity
A	Supply Item - 220kV GIS as per enclosed SLD with double bus bar scheme comprising of Items	A- GIS 220 kV	The 220 KV SF6 gas insulated switch gear shall have Double Bus Bar arrangement. The SF6 gas insulated switch gear (50 HZ) shall be of the indoor metal- enclosed type, comprising of following modules:- a) Two Line bays:LAKWAR HEP Line-1 and DEHRADUN Line-2 b) Two GT(Generator Transformer) bays: GT 1 & GT 2 c) One bay for Station transformer d) One bay for Bus Coupler e) Two Bus VTs The Switchgear shall be complete with all necessary terminal boxes, inspection window, SF6 gas filling required interconnecting wiring/cabling , 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,instrumentation and control cables between GIS to LCC and between LCC to LCC including cable tray, glands, lugs, ferrules,walkway/catwalk for maintenance,consumables ,grounding material etc.	lot	1
A1	BusBar Modules	A1 - BusBar Modules	One set of three single phase(isolated) or three phase encapsulated, 1600A, 50kA for 1sec, SF6 gas-insulated metal enclosed bus bars, each comprising of : a) Three single phase(isolated) or three phase encapsulated individual 1600A bus bars enclosures running across the length of the switchgear to inter connect each of the circuit breaker bay modules in double bus bar configuration. b) Gas monitoring systems, pressure switches, telescopic enclosure etc. as required. c) Barriers (communicating , non-communicating types)	Set	2
A2	Bus VT for Main Buses	A2 - Bus VT for Main Buses	220kV, 1600A, 50kA for 1sec , SF6 gas insulated Bus VT bay module, Disconnector module with Earth switches (Maintenance & High speed) and LA module connected to Main Bus Bars, each comprising of: a) ONE set of 3x1-phase, 1600A, 50kA group operated Disconnector switches, complete with manual and motor driven operating mechanisms. b) THREE nos. single phase Voltage transformers c) ONE set of 3x1-phase, group operated safety grounding switches, complete with manual and motor driven operating mechanisms. (Suitable for Bus Bar Earthing Duty) d) ONE set of 3x1-phase, group operated high speed earthing switches, complete with manual and motor driven operating mechanisms. e) Gas monitoring devices, barriers, pressure switches, etc. as required.	Set	2
A3	Fully equipped 220kV, 50kA for 1second, SF6 GIS GT bay module	A3 - Fully equipped 220kV, 50kA for 1second, SF6 GIS GT bay module	220kV, 1600A, 50kA 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 b) ONE set of 3x1-phase, 4-core, multi ratio, current transformers (CT A) as per single line diagram. (Core details shall be finalised at detail engg. stage) c)ONE set of 3x1-phase, 3-core, multi ratio, current transformers (CT B) 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) Two sets of 3x1-phase, group operated maintenance earthing switches , complete with manual and motor driven operating mechanisms. f) One sets of 3x1-phase, group operated high speed earthing switches , complete with manual and motor driven operating mechanisms. g)ONE set of 3x1-phase, Voltage transformers h)ONE set of 3x1-phase, Surge Arrester i)ONE set of 3x1-phase, GIS to GT transformer interconnecting Module j) Gas monitoring System, pressure switches etc as required. k) Barriers cones,machanis box and other items as required.	Set	2
A4	Fully equipped 220kV, 50kA for 1second, SF6 GIS BUS COUPLER bay Module	A4 - Fully equipped 220kV, 50kA for 1second, SF6 GIS BUS COUPLER bay Module	230kV, 1600A, 50kA for 1 second , SF6 gas-insulated metal enclosed BUS Coupler bay module. Each set shall be complete & shall comprising of a) ONE set of 3x1-phase, SF6 insulated circuit breaker , complete with operating mechanism b) ONE set of 3x1-phase, 3-core, multi ratio, current transformers (CT A) as per single line diagram. (Core details shall be finalised at detail engg. stage) c) ONE set of 3x1-phase, 3-core, multi ratio, current transformers (CT B) as per single line diagram. (Core details shall be finalised at detail engg. stage) d) TWO sets of 3x1-phase group operated Disconnector switches, complete with manual and motor driven operating mechanisms. e) TWO sets of 3x1-phase, group operated maintenance earthing switches , complete with manual and motor driven operating mechanisms. (If required, high speed fault make grounding switch to be provided) f) Gas monitoring System, pressure switches etc as required. g) Barriers cones,machanis box and other items as required.	Set	1
A5	Fully equipped 220kV, 50kA for 1 second, SF6 GIS LINE bay Module	A5 - Fully equipped 220kV, 50kA for 1 second, SF6 GIS LINE bay Module	230kV, 1600A, 50kA for 1second , SF6 gas-insulated metal enclosed LINE bay module. Each set shall be complete & shall comprising of: a) ONE set of 3x1-phase, SF6 insulated circuit breaker , complete with operating mechanism (suitable for 1&3 phase auto reclose) b) ONE set of 3x1-phase, 3-core, multi ratio, current transformer (CT A) as per single line diagram. (Core details shall be finalised at detail engg. stage) c)ONE set of 3x1-phase, 3-core, multi ratio, current transformer (CT B) 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) TWO sets of 3x1-phase, group operated maintenance earthing switches , complete with manual and motor driven operating mechanisms. (If required, high speed fault make grounding switch to be provided) f) ONE set of 3x1-phase, group operated high speed earthing switches , complete with manual and motor driven operating mechanisms. g) Gas monitoring System, pressure switches etc as required. h) Barriers cones,machanis box and other items as required.	Set	2
A6	Fully equipped 220kV, 50kA for 1second, SF6 GIS ST bay module	A6 - Fully equipped 220kV, 50kA for 1second, SF6 GIS ST bay module	220kV, 1600A, 50kA for 1 second , SF6 gas-insulated metal enclosed ST bay module. Each set shall be complete & shall comprising of a) ONE set of 3x1-phase, SF6 insulated circuit breaker , complete with operating mechanism b) ONE set of 3x1-phase, 4-core, multi ratio, current transformers (CT A) as per single line diagram. (Core details shall be finalised at detail engg. stage) c)ONE set of 3x1-phase, 3-core, multi ratio, current transformers (CT B) 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) Two sets of 3x1-phase, group operated maintenance earthing switches , complete with manual and motor driven operating mechanisms. f) One sets of 3x1-phase, group operated high speed earthing switches , complete with manual and motor driven operating mechanisms. g)ONE set of 3x1-phase, Voltage transformers h)ONE set of 3x1-phase, Surge Arrester i)ONE set of 3x1-phase, GIS to ST transformer interconnecting Module j) Gas monitoring System, pressure switches etc as required. k) Barriers cones,machanis box and other items as required.	Set	1
A7	220kV, 1600A GIS duct from SF6 to Oil bushing for GT & ST Connection and GIS Duct from SF6 to Air bushing for Outgoing Lines	A7 - 220kV, 1600A GIS duct from SF6 to Oil bushing for GT & ST Connection and GIS Duct from SF6 to Air bushing for Outgoing Lines	220kV, 1600A 50kA for 1sec , SF6 gas insulated GIS duct shall be complete & comprising of:- a) Three Nos. single phase (isolated) GIS duct from SF6 to Oil bushing for GT & ST Connection and GIS Duct from SF6 to Air bushing for Outgoing Lines b) Gas monitoring devices, barriers, pressure switches, etc. as required. (Total GIS Bus duct length is equal to sum of single phase lengths of all GIS ducts,Which is approximate 600Mtrs +/- 10%).	lot	1
A8	220kV, 1600A SF6 to Air Bushing (Polymer/composite/ porcelain)	A8 - 220kV, 1600A SF6 to Air Bushing (Polymer/composite/ porcelain)	230kV, 1600A, 50 kA for 1sec , 25mm/kV creepage, SF6 gas insulated, SF6 to Air Bushing for Over head connection of Line with GIS.	Nos.	6
A9	230kV, 1600A SF6 to Oil Bushing	A9 - 230kV, 1600A SF6 to Oil Bushing	230kV, 1600A, 50 kA for 3sec , 25mm/kV creepage, SF6 gas insulated, SF6 to Oil Bhushing for connection of GT/ST with GIS.	Nos.	9
A10	Local Control Cubicles	A10 - Local Control Cubicles	Bay Control Cabinet for LINES/ GT/ ST BAYS/Bus Coupler/ VT	Lot	1
A11	Supply of First filling of SF6 gas plus extra for conducting all tests, compensating losses for 10%of total gas. Additionally 10 % of total quatnity of SF6 gas shall also be supplied in non returnable cylinders.	A11 - Supply of First filling of SF6 gas plus extra for conducting all tests, compensating losses for 10%of total gas. Additionally 10 % of total quatnity of SF6 gas shall also be supplied in non returnable cylinders.	First filling of SF6 gas, and hydraulic fluid, if required for the equipment supplied plus an additional quantity sufficient for conducting all tests on equipment at site before placing it into successful operation for compensating losses for 10% of total gas quantity. Additionally, 10 % of total quantity of SF6 gas shall also be supplied in non returnable cylinders. Bidder to note that GIS duct considered is 600Mtrs +/-10% for estimation.	Lot	1
A12	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).	A12 - 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. Bidder to note that GIS duct considered is 600Mtrs +/-10% for estimation.	Lot	1
A13	Supply of Earthing material for GIS including High frequency earthing material. The quantity shall be estimated provided by bidder for above floor earthing connection.	A13 - Supply of Earthing material for GIS including High frequency earthing material. The quantity shall be estimated provided by bidder for above floor earthing connection.	Supply of Earthing Material and Supervision of Erection of all Earthing connection for GIS to GIS and GIS to Earth Mesh on Floor shall be in bidder's scope. The quantity shall be estimated by the bidder, based on their design philosophy. Design philosophy shall be submitted alongwith the bid in line with Technical Specification. Supply of Earthing Material and Erection of Earth mesh on floor shall be done by BHEL in supervision of manufacturer as per manufacturer's design limited to following: 2.75X12 GI Flat 3. 50X6 GI Flat shall be in BHEL's scope. Any other earthing material if required shall be in bidder's scope of supply. Bidder to note that GIS duct considered is 600Mtrs +/-10% for estimation.	Lot	1

Sl.No.	Description	Items	Detailed Description	Unit	Quantity
	A14 Supply of Consumables (with limited shelf life) required for GIS	A14 - Supply of Consumables (with limited shelf life) required for GIS	Consumables including grouting material 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
B	Supply Items - Mandatory spares	B - Supply Items - Mandatory spares	These prices will be used for addition/deletion/replacement (shall be considered as initial spares)	Lot	1
	220kV GAS INSULATED SWITCHGEAR				
B1	Disconnecting switch complete with Operating mechanism and all necessary apparatus etc	B1 - Disconnecting switch complete with Operating mechanism and all necessary apparatus etc		No.	1
B2	Safety Earth switch complete with Operating mechanism and all necessary connecting apparatus	B2 - Safety Earth switch complete with Operating mechanism and all necessary connecting apparatus.		No.	1
B3	Spare auxiliary contacts for disconnecting and safety grounding switches	B3 - Spare auxiliary contacts for disconnecting and safety grounding switches		No.	1
B4	MCB (as applicable) of each type and rating	B4 - MCB (as applicable) of each type and rating		No.	1
B5	Current Transformers complete in all respect including terminal connectors etc.(Secondary winding)	B5 - Current Transformers complete in all respect including terminal connectors etc.(Secondary winding)		No.	1
B6	220 kV Bus PT complete in all respect including terminal connectors etc.	B6 - 220 kV Bus PT complete in all respect including terminal connectors etc.		Set	1
B7	Circuit breakers complete with operating mechanism and all necessities apparatus	B7 - Circuit breakers complete with operating mechanism and all necessities apparatus		No.	1
B8	Single phase SF6 gas insulated zinc oxide surge arrester	B8 - Single phase SF6 gas insulated zinc oxide surge arrester		No.	1
B9	Trip coils for circuit breaker	B9 - Trip coils for circuit breaker		Nos.	3
B10	Closing coils for circuit breaker	B10 - Closing coils for circuit breaker		Nos.	3
B11	SF6 gas cylinder with 40 kgs of SF6 gas	B11 - SF6 gas cylinder with 40 kgs of SF6 gas		No	1
B12	SF6 to air Bushing(1ph) (Polymer/composite/Porcelain)	B12 - SF6 to air Bushing(1ph) (Polymer/composite/Porcelain)		No.	1
C	Supply Item - Tools & tackle & Testing Equipment	C - Supply Item - Tools & tackle & Testing Equipment	In addition to mentioned special tools & tackles/ equipment, any other special tools & Tackles/ equipment shall be in bidder's scope and hence bidder to furnish detailed BOQ for special Tools & Tackles/ equipment along with unit prices to be handed over to ultimate customer. Further to this, Bidder to submit list of tools & tackles, slings, spanners, gauges, slings and other lifting devices, drills, instruments and appliances, special in nature and shall be necessary for the complete assembly and erection at site of the GIS, required for installation, gas filling, maintenance, site testing of the GIS and this shall be arranged by bidder on returnable basis only. Bidder shall also submit list of general list of tools & tackles to be arranged by BHEL/its sub contractor. EOT cranes shall be provided by BHEL, capacity of EOT crane to be recommended by bidder.	Lot	1
C1	SF6 gas filling & evacuating equipment portable	C1 - SF6 gas filling & evacuating equipment portable	Make DILO/ Any equivalent makesubject to customer approval. It shall be in line with As per clause No. 1.01.00 a)& 1.02.00 of ANNEXURE-I of Section-2.	No.	1
C2	SF6 gas filtering, drying, storage & recycling plant	C2 - SF6 gas filtering, drying, storage & recycling plant	Make DILO/ Any equivalent/reputed makesubject to customer approval. It shall be in line with As per clause No. 1.01.00 b)& 1.02.00 of ANNEXURE-I of Section-2.	No.	1
C3	SF6 gas leak detector	C3 - SF6 gas leak detector	Any reputed make, subject to customer approval. It shall be in line with clause No. 1.04.00 of ANNEXURE-I of Section-2	Nos.	2
D	Services: Supervision of Erection, commissioning & site testing including earthing	D - Services: Supervision of Erection, commissioning & site testing including earthing	Supervision of Erection, commissioning & site testing of ST BAY, BUS COUPLER BAY, LINE BAYS,GT BAYS, BUS VT BAY,Bus duct,SF6 to Air Bhushing,SF6 to Oil Bhushing Modules etc.	Lot	1
D1	Insulation co-ordination studies	D1 - Insulation co-ordination studies		Lot	1
D2	Site visit for supervision of unloading, storage & verification of material at store	D2 - Site visit for supervision of unloading, storage & verification of material at store	Store shall be provided by BHEL	Lot	1
D3	Supervision of Erection of GIS	D3 - Supervision of Erection of GIS	Complete GIS including busbar, ST BAY, BUS COUPLER BAY, LINE BAYS, GT BAYS, BUS VT BAY,Bus Duct including SF6 to Air Bushing, SF6 to Oil Bhushing and associated modules etc to complete the work in all respect	Set	1
D4	Testing & Commissioning of GIS	D4 - Testing & Commissioning of GIS	Complete GIS including busbar, ST BAY, BUS COUPLER BAY, LINE BAYS, GT BAYS, BUS VT BAY,Bus Duct including SF6 to Air Bushing, SF6 to Oil Bhushing and associated modules etc.to complete the work in all respect.	Set	1
D5	Final successful Testing of GIS including arrangement of HV test kit along with Testing personnel	D5 - Final successful Testing of GIS including arrangement of HV test kit along with Testing personnel	HV Test kit shall be arranged by the bidder on returnable basis along with testing personnel for conducting test. Final testing as per IEC for complete GIS including busbar, ST BAY, BUS COUPLER BAY, LINE BAYS, GT BAYS, BUS VT BAY, Ducts, SF6 to Air Bushing, SF6 to Oil Bhushing and associated modules etc.	Lot	1
E	Services: Training	- Services: Training			
E1	Training for GIS to UJVN/BHEL engineers - Visit to manufacturer's works = 30 mandays	E1 - Training for GIS to UJVN/BHEL engineers -Visit to manufacturer's works = 30 mandays	Training module shall include concepts and familiarisation oprational aspects of GIS.	Lot	1
E2	Lodging and boarding of Training participants for GIS to UJVN/BHEL engineers -at manufacturer's works = 30 mandays	E2 - Lodging and boarding of Training participants for GIS to UJVN/BHEL engineers -at manufacturer's works = 30 mandays	Lodging and boarding of Training participants shall be in bidder's scope.	Lot	1
E3	To and Fro charges Training participants for GIS training to UJVN/BHEL engineers -at manufacturer's works	E3 - To and Fro charges Training participants for GIS training to UJVN/BHEL engineers -at manufacturer's works	To and fro charges of Training participants from vendor works to delhi	Lot	1
E4	Training for GIS to UJVN/BHEL engineers - ETC, Operation and maintenance of Plant (GIS) at site = 30 mandays	E4 - Training for GIS to UJVN/BHEL engineers -ETC, Operation and maintenance of Plant (GIS) at site = 30 mandays	Training for site operation, maintenance and troubleshooting of the GIS .	Lot	1
E5	Lodging and boarding of Training participants for GIS to UJVN/BHEL engineers -at Site = 30 mandays	E5 - Lodging and boarding of Training participants for GIS to UJVN/BHEL engineers -at Site = 30 mandays	Lodging and boarding of Training participants shall be in bidder's scope.	Lot	1
F	Any other item required for completion of project	- Any other item required for completion of project			
F1	Supply - Any other item required for completion of project and not covered in Supply portion - Complete List to be provided by bidder along with unit prices.	F1 - Supply - Any other item required for completion of project and not covered in Supply portion - Complete List to be provided by bidder along with unit prices.		Lot	1
F2	Services - Any other item required for completion of project and not covered in service portion - Complete List to be provided by bidder along with unit prices.	F2 - Services - Any other item required for completion of project and not covered in service portion - Complete List to be provided by bidder along with unit prices.		Lot	1
G	Supply - Unit Prices of Individual Item/Equipment	G - Supply - Unit Prices of Individual Item/Equipment	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.		
G1	220kV, 1600A Circuit breaker (1 pole complete with enclosure without operating mechanism)	G1 - 220kV, 1600A Circuit breaker (1 pole complete with enclosure without operating mechanism)		Set	1
G2	220kV, 1600A Circuit breaker with PIR (1 pole complete without enclosure without operating mechanism)	G2 - 220kV, 1600A Circuit breaker with PIR (1 pole complete without enclosure without operating mechanism)		Set	1
G3	220kV, 1600A Isolator (1 pole) without operating mechanism	G3 - 220kV, 1600A Isolator (1 pole) without operating mechanism		Set	1
G4	220 kV Maintenance Earthing switch without operating mechanism (3 pole complete with enclosure and without operating mechanism)	G4 - 220 kV Maintenance Earthing switch without operating mechanism (3 pole complete with enclosure and without operating mechanism)		Set	1
G5	220 kV High speed earth switch without operating mechanism (3 pole complete with enclosure and without operating mechanism)	G5 - 220 kV High speed earth switch without operating mechanism (3 pole complete with enclosure and without operating mechanism)		Set	1
G6	220 kV Current transformer (1no. of each type) (Individual prices to be furnished).	G6 - 220 kV Current transformer (1no. of each type) (Individual prices to be furnished).		Set	1
G7	Operating Mechanism box for 220kV, 1600 A Circuit Breaker	G7 - Operating Mechanism box for 220kV, 1600 A Circuit Breaker		Set	1
G8	Operating Mechanism box for 220kV, 1600 A Isolator	G8 - Operating Mechanism box for 220kV, 1600 A Isolator		Set	1
G9	Operating mechanism for 220kV, Maintenance Earthing Switch	G9 - Operating mechanism for 220kV, Maintenance Earthing Switch		Set	1
G10	Operating Mechanism for 220kV, High Speed Earthing Switch	G10 - Operating Mechanism for 220kV, High Speed Earthing Switch		Set	1
G11	Single Phase Bus bar/bus duct (any type)	G11 - Single Phase Bus bar/bus duct (any type)	Complete single phase 220kV,1600A, 50 kA for 1s bus bar including Gas monitoring systems, barriers, pressure switches	Mtr	1
G12	Conductor for Single phase Bus bar/ bus duct (any type)	G12 - 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.	Mtr	1
G13	GIS metallic enclosure (any type)	G13 - GIS metallic enclosure (any type)	Enclosure for bus bar, bus duct, GIB, straight cast enclosure etc with fixing hardware as required.	Mtr	1
G14	Epoxy resin insulators for bus support with holes for gas flow (of each type and rating)	G14 - 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

Sl.No.	Description	Items	Detailed Description	Unit	Quantity
	G15 Gas barrier insulators (of each type and rating)	G15 - Gas barrier insulators (of each type and rating)	Bidder to inform details at tender stage	set	1
	G16 Density switch	G16 - Density switch		set	1
	G17 Gas monitoring system devices	G17 - Gas monitoring system devices	1 set = 1 no of each type	set	1
	G18 SF6 to Oil Bhushing for GT/ST	G18 - SF6 to Oil Bhushing for GT/ST		No.	1
	G19 PD sensor	G19 - PD sensor	1 set = 1 no of each type	Set	1
	G20 Optical Indicator for CB, Isolator	G20 - Optical Indicator for CB, Isolator		Set	1
	G21 Elbow /Angle / T-bends	G21 - Elbow /Angle / T-bends		Set	1
	G22 Telescopic enclosure	G22 - Telescopic enclosure		Set	1
	G23 Sleeve enclosure	G23 - Sleeve enclosure		Set	1
	G24 Expansion joints for bellows	G24 - Expansion joints for bellows		Set	1
	G25 cross tank	G25 - cross tank		Set	1
	G26 Controlled Switching Device for ONE set of 1600A, 3x1-phase, SF6 insulated circuit breaker without PIR, complete with operating mechanism (suitable for 1&3 phase auto reclose)	G26 - Controlled Switching Device for ONE set of 1600A, 3x1-phase, SF6 insulated circuit breaker without PIR, complete with operating mechanism (suitable for 1&3 phase auto reclose)		No.	1
H	Services: Supervision of Erection, commissioning & site testing including earthing	- Services: Supervision of Erection, commissioning & site testing including earthing	Prices of Supervision erection and Testing & Commissioning included here are required for any Addition/Deletion for days. Quoting for unit prices is mandatory and shall be considered for evaluation.		
	H1 Supervision of Services of manpower for erection per day (excl. travel time)	H1 - Supervision of Services of manpower for erection per day (excl. travel time)		day	1
	H2 Supervision of Services of manpower for Testing & commissioning per day (excl. travel time)	H2 - Supervision of Services of manpower for Testing & commissioning per day (excl. travel time)		day	1
	H3 Hiring charges of HV test kit with Testing personnel	H3 - Hiring charges of HV test kit with Testing personnel	Additional HV test kit charges including charges of manpower, HV test kit, accessories & tools and Testing personnel 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
Note 1	CT & VT details given in single line diagram are tentative and may change at contract stage. Changes to be incorporated by bidder without any cost and delivery implication to BHEL.				
Note 2	Item no. G1 to G26 and H1 to H3 are optional items and BHEL reserves right at its sole discretion to order these items or not.				



SUB-SUPPLIER/VENDOR		DESIGNED BY BOY THOMAS	UNTOLD.DWG. GR.	ANGLE 	SCALE NTS	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM NO.	NO. OF ITEM
		DEPT. CIRCU. SIS	TITLE SINGLE LINE DIAGRAM OF 220kV POTHEADYARD & GIS			DRAWING NO. TB-VYASI-220kV GIS-01			REV. 01
						SHEET NO. 01		NO. OF SHEET 03	

REV.	DATE	ALTERED		REV.	DATE	ALTERED		REV.	DATE	ALTERED		REV.	DATE	ALTERED	
		CHECKED	APPROVED			CHECKED	APPROVED			CHECKED	APPROVED			CHECKED	APPROVED
ZONE				ZONE				ZONE				ZONE			
12		11		10		9		8		7		6		5	

S.N.	EQUIPMENT	SYMBOL	EQUIPMENT DESIGNATION	QTY.
1.	220 KV, 1600 A, 3X1-PH , GROUP OPERATED MOTORISED DISCONNECTOR		201-89A, 201-89B, 201-89C, 202-89A, 202-89B, 202-89C, 203-89A, 203-89B, 203-89C, 204-89A, 204-89B, 205-89A, 205-89B, 205-89C, 206-89A, 206-89B, 206-89C, 207-89B, 208-89A	19
2.	220 KV MOTORISED 3X1-PH, GROUP OPERATED EARTHING SWITCH (MAINTENANCE)		201-89AE, 202-89BE, 203-89AE, 204-89BE, 204-89AE, 205-89BE, 206-89BE, 207-89BE2, 208-89BE2, 201-89AE1, 202-89CE2, 203-89CE2, 205-89AE1, 206-89AE1,	14
3.	220 KV HIGH SPEED 3X1-PH, GROUP OPERATED EARTHING SWITCH (HIGH SPEED)		202-89CE1, 203-89CE1, 201-89AE2, 205-89AE2, 206-89AE2, 208-89BE1, 207-89BE1,	07
4.	220 KV, 3 CORE 1-PH CURRENT TRANSFORMER		201-CTB, 202-CTA, 202-CTB, 203-CTA, 203-CTB, 204-CTA, 204-CTB, 205-CTB, 206-CTB	27
5.	220 KV, 4 CORE 1-PH CURRENT TRANSFORMER		201-CTA, 205-CTA, 206-CTA	09
5.	220 KV, 1600A, 3X1-PH, METAL ENCLOSED SF6 CIRCUIT BREAKER WITH OPERATING SPRING MECHANISM		201-52, 201-52, 202-52, 202-52, 203-52, 203-52, 204-52, 204-52, 205-52, 205-52, 206-52, 206-52	06
6.	220 KV, 1-PH BUS VOLTAGE TRANSFORMER		201-VT, 205-VT, 206-VT, 207-VT, 208-VT	15
7.	216 KV, 1-PH SURGE ARRESTER		201-SA, 205-SA, 206-SA	09

S.N.	EQUIPMENT	SYMBOL	QTY.	EQUIPMENT DESIGNATION
1.	220 KV, 1600 A, 3X1-PH , HDB ISOLATOR WITH ONE EARTH SWITCH		02	202-89L, 203-89L 202-89BE, 203-89BE
2.	4400PF, 220KV, 220KV / $\frac{110V}{\sqrt{3}}$ / $\frac{110V}{\sqrt{3}}$ / $\frac{110V}{\sqrt{3}}$, SINGLE PHASE CVT		06	202-CVT, 203-CVT
3.	216 KV, 1-PH SURGE ARRESTER (OUTDOOR), 1 M.H.		06	202-SA 203-SA
4.	220KV, 1mH. 1600A, 40KA/SSEC. SUSPENSION TYPE WAVE TRAP (OUTDOOR)		04	202-WT 203-WT
5.	220 KV SF6 to AIR TERMINATION (OUTDOOR)		06	-----
6.	220 KV OIL TO SF6 BUSHING (GT, ST Bay)	-----	09	-----

NOMINAL VOLTAGE	220 kV
HIGHEST SYSTEM VOLTAGE	245 kV
NO. OF PHASES	3
BASIC INSULATION LEVEL	1050 kV _P
1 MIN POWER FREQUENCY W/S VOLTAGE	460 kVrms
CREEPAGE DISTANCE	25mm/kV
SHORT CIRCUIT CAPABILITY	50 kA/1s
FREQUENCY	50 Hz
SYSTEM EARTHING	SOLIDLY EARTHED

- 1). THE CT/CVT DETAILED PARAMETERS SHALL BE MENTIONED SEPARATELY IN KEY PROTECTION DIAGRAM. ✓
- 2). WAVE TRAPS WOULD BE IN TWO PHASES ONLY. *of line Bay.*

REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED						
		CHECKED			CHECKED			CHECKED			CHECKED									
		APPROVED			APPROVED			APPROVED			APPROVED									
ZONE			ZONE			ZONE			ZONE			ZONE								
12		11			10			9			8			7			6			5

ADDITIONAL INFORMATION				PROJECT		2X60MW VYASI HYDRO ELECTRIC PROJECT							
STATUS OF DRAWING				CUSTOMER		UJVNL LTD.							
DISTRIBUTION OF PRINTS													
DRN		NAME	SIGN	DATE	NO. OF VAR		BHARAT HEAVY ELECTRICALS LTD. TRANSMISSION BUSINESS GROUP						
		PK											
CHK		VPM/LAK	23/12/17										
APPD		DKM/RS											
SUB-SUPPLIER/VENDOR						DRAWN BY UNTOLOMS. GR.		ANGLE 	SCALE NTS	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM NO.	NO. OF ITEM
 23/12						SEPT. 216							
						TITLE							
						SINGLE LINE DIAGRAM OF 220kV POTHEADYARD & GIS							
						DRAWING NO. TB-VYASI-220kV GIS-01				REV. 01			
						INC. NO. 02		NO. OF INC. 03					

DRAWING No. TB-VYASI-220kV-GIS-01

PARTICULARS OF CVTs

VT NO.	VOLTAGE RATIO IN (kV)	BURDEN (VA)	ACCURACY CLASS	PURPOSE
BUS-1 VT	$\frac{220000}{\sqrt{3}} / \frac{110}{\sqrt{3}} / \frac{110}{\sqrt{3}} / \frac{110}{\sqrt{3}}$	50,50,50	3P,3P,0.2	PROTECTION, PROTECTION, METERING
BUS-2 VT	$\frac{220000}{\sqrt{3}} / \frac{110}{\sqrt{3}} / \frac{110}{\sqrt{3}} / \frac{110}{\sqrt{3}}$	50,50,50	3P,3P,0.2	PROTECTION, PROTECTION, METERING
201-VT 202-VT 206-VT	$\frac{220000}{\sqrt{3}} / \frac{110}{\sqrt{3}} / \frac{110}{\sqrt{3}} / \frac{110}{\sqrt{3}}$	50,50,50	3P,3P,0.2	PROTECTION, PROTECTION, METERING
204-CVT 203-CVT	$\frac{220000}{\sqrt{3}} / \frac{110}{\sqrt{3}} / \frac{110}{\sqrt{3}} / \frac{110}{\sqrt{3}}$	50,50,50	3P,3P,0.2	PROTECTION, PROTECTION, METERING

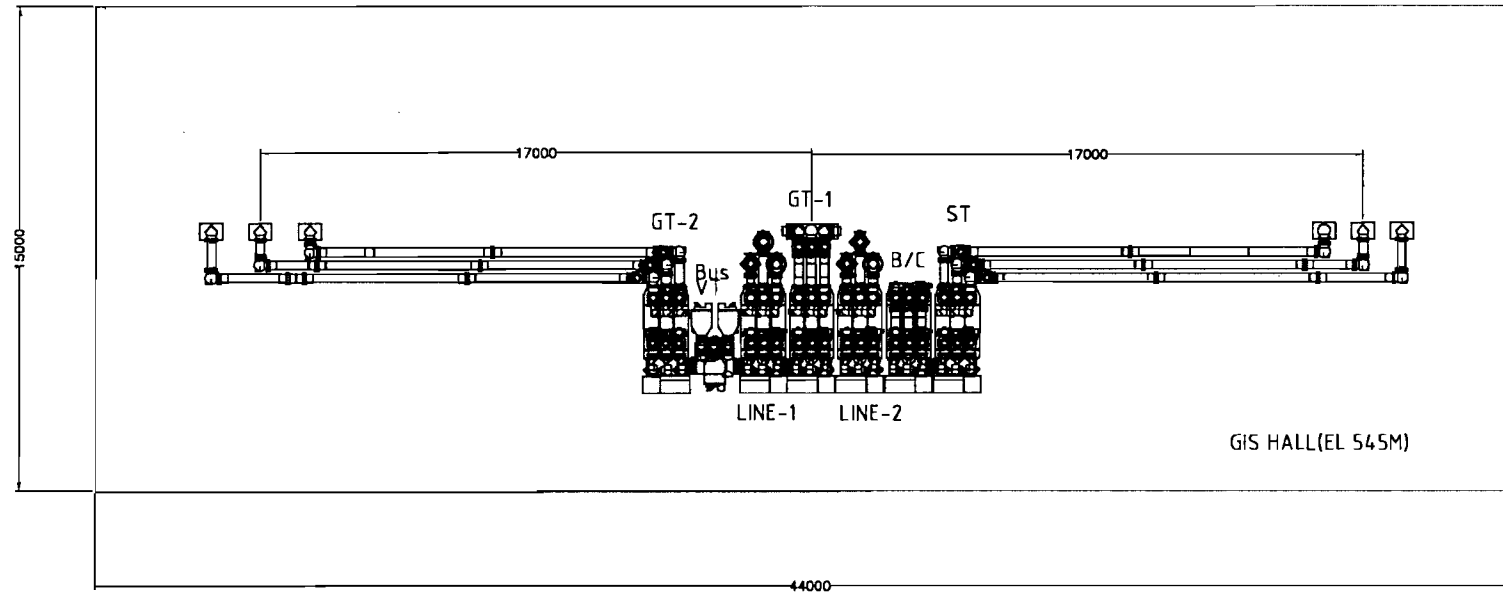
PARTICULARS OF CURRENT TRANSFORMER

CT REF.		CORE No.	RATIO	BURDEN (VA)	ACCURACY CLASS	MIN. KNEE POINT VOLTAGE (Vk)	MAX.EXCITING CURRENT AT Vk (mA)	MAX Rct	PURPOSE
203-CT	CTA	1	1600-800-400/1A	NA	PS	1600-800-400V	30-60-120mA	8-4-2 Ohms	MAIN-1 PROTECTION
		2	1600-800-400/1A	NA	PS	1600-800-400V	30-60-120mA	8-4-2 Ohms	MAIN-2 PROTECTION
		3	1600-800-400/1A	25	0.2S	NA	NA	-	(SPARE)
204-CT	CTB	3	1600-800-400/1A	25	0.2S	NA	NA	-	METERING ISF ≤ 5
		2	1600-800-400/1A	NA	PS	1600-800-400V	30-60-120mA	8-4-2 Ohms	BUSBAR PROTECTION
		1	1600-800-400/1A	NA	PS	1600-800-400V	30-60-120mA	8-4-2 Ohms	BUSBAR PROTECTION
202-CT	CTA	1	500-250/1A	NA	PS	500-250V	30-60mA	2.5-1.25 Ohms	87GT1 PROTECTION
		2	500-250/1A	NA	PS	500-250V	30-60mA	2.5-1.25 Ohms	87GT2 PROTECTION
		3	500-250/1A	NA	PS	500-250V	30-60mA	2.5-1.25 Ohms	REF PROTECTION
		4	500-250/1A	NA	PS	500-250V	30-60mA	2.5-1.25 Ohms	B/U O/C PROTECTION
201-CT	CTB	3	500-250/1A	25	0.2S	NA	NA	-	METERING ISF ≤ 5
		2	1600-800/1A	NA	PS	1600-800V	30-60mA	8-4 Ohms	BUSBAR PROTECTION
		1	1600-800/1A	NA	PS	1600-800V	30-60mA	8-4 Ohms	BUSBAR PROTECTION
		1	1600-800/1A	NA	PS	1600-800V	30-60mA	8-4 Ohms	BUSBAR PROTECTION
205-CT	CTA	1	1600-800-400/1A	NA	PS	1600-800-400V	30-60-120mA	8-4-2 Ohms	BUSBAR PROTECTION
		2	1600-800-400/1A	NA	PS	1600-800-400V	30-60-120mA	8-4-2 Ohms	BUSBAR PROTECTION
		3	1600-800-400/1A	25	0.2S	NA	NA	-	METERING < 5(ISF)
	CTB	3	1600-800-400/1A	25	0.2S	NA	NA	-	SPARE
		2	1600-800-400/1A	NA	PS	1600-800-400V	30-60-120mA	8-4-2 Ohms	SPARE
		1	1600-800-400/1A	NA	PS	1600-800-400V	30-60-120mA	8-4-2 Ohms	SPARE
206-CTA	CTA	1	60-30/1A	NA	PS	60-30V	60-120mA	1.5-0.75 Ohms	87T1 PROTECTION
		2	60-30/1A	NA	PS	60-30V	60-120mA	1.5-0.75 Ohms	87T2 PROTECTION
		3	60-30/1A	NA	PS	60-30V	60-120mA	1.5-0.75 Ohms	REF PROTECTION
		4	60-30/1A	NA	PS	60-30V	60-120mA	1.5-0.75 Ohms	B/U O/C PROTECTION
	CTB	3	60-30/1A	15-7.5	0.5-1.0	NA	NA	-	METERING ISF ≤ 5
		2	1600-800/1A	NA	PS	1600-800V	30-60mA	8-4 Ohms	PROTECTION
		1	1600-800/1A	NA	PS	1600-800V	30-60mA	8-4 Ohms	PROTECTION

NOTE : THE CT DETAILED PARAMETERS ARE SUBJECT TO CONFIRMATION FROM THE MANUFACTURER AND MAY VARY AS PER PROTECTION & METERING REQUIREMENT.

ADDITIONAL INFORMATION		PROJECT	2X60MW VYASI HYDRO ELECTRIC PROJECT	
STATUS OF DRAWING		CUSTOMER	UJVNL LTD.	
DISTRIBUTION OF PRINTS				
DRN	NAME	SIGN	DATE	NO. OF VAR
	PK			
CKD	VPM/LK		23/12/27	
APPR	DGM/RS			
SUB-SUPPLIER/VENDOR				
CONTRACTOR		BHARAT HEAVY ELECTRICALS LTD. TRANSMISSION BUSINESS GROUP		
DESIGNED BY	UNTOLOWS. GR.	ANGLE	SCALE	WEIGHT (KG)
CHKD. DATE	NTS			
TITLE		SINGLE LINE DIAGRAM OF 220kV POTHEADYARD & GIS		
DRAWING NO.		TB-VYASI-220kV GIS-01		
REV.		01		
SHEET NO.		03		
NO. OF SHEET		03		

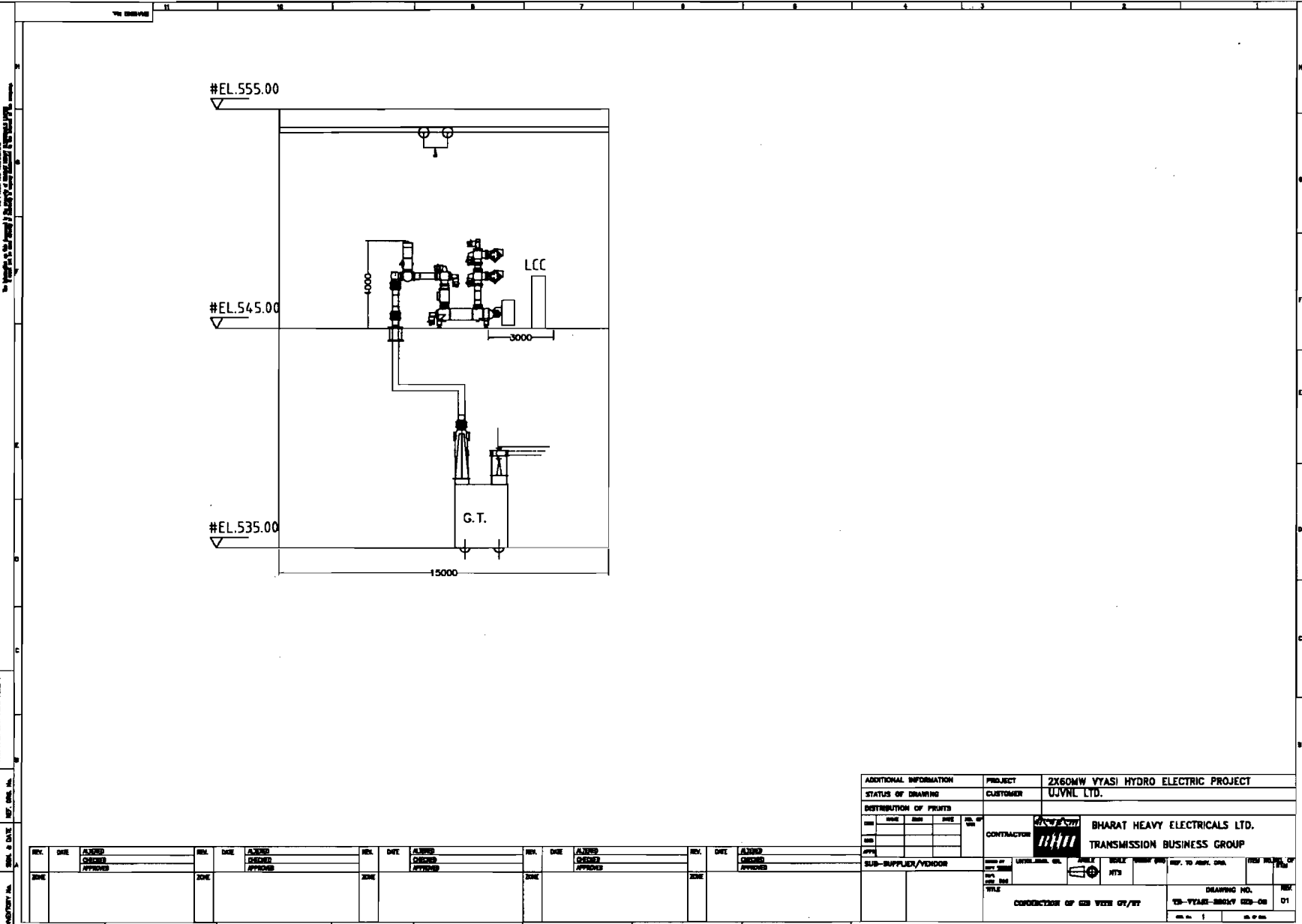
FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM)



TYPICAL ARRANGEMENT OF GIS FLOOR PLAN AT EL 545m

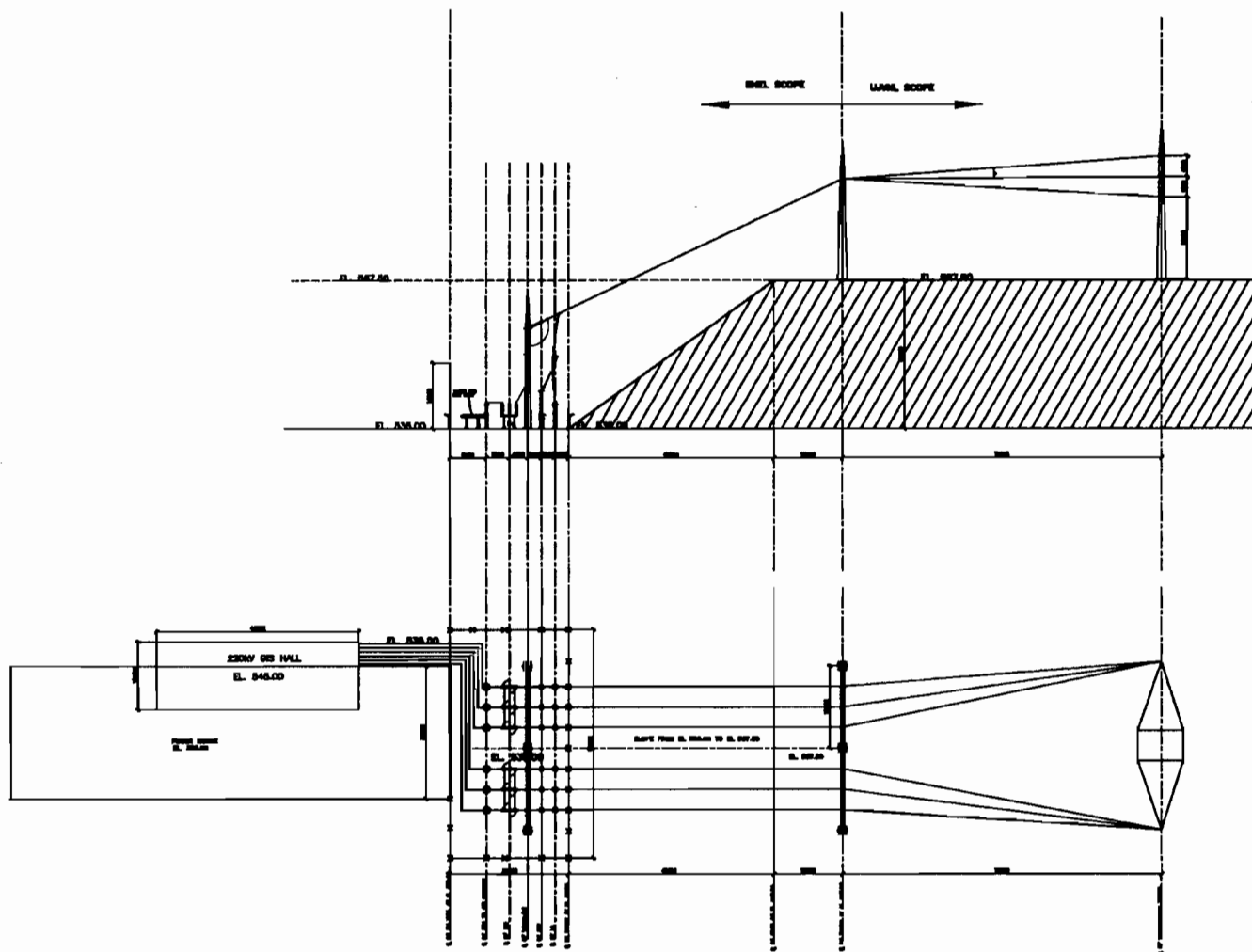
ADDITIONAL INFORMATION		PROJECT		2X60MW VYASI HYDRO ELECTRIC PROJECT	
STATUS OF DRAWING		CUSTOMER		UJVNL LTD.	
DISTRIBUTION OF PRINTS		CONTRACTOR		BHARAT HEAVY ELECTRICALS LTD. TRANSMISSION BUSINESS GROUP	
SUB-SUPPLIER/VENDOR		DESIGNED BY		UNIVERSAL ENL	
		CHECKED BY		SCALE	
		DATE		NTS	
		NO. OF		REF. TO ARCH. DWG.	
		SHEET		ITEM NO. OF	
		TITLE		DRAWING NO.	
		GIS FLOOR PLAN AT EL 545m		YS-VYAS-22019 03B-08	
				REV. 02	

11	10	0	7	0	0	4	3	2	1
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ADDITIONAL INFORMATION				PROJECT		2X60MW VTASI HYDRO ELECTRIC PROJECT			
STATUS OF DRAWING				CUSTOMER		UYNL LTD.			
DISTRIBUTION OF PRINTS				CONTRACTOR		BHARAT HEAVY ELECTRICALS LTD. TRANSMISSION BUSINESS GROUP			
ISS	REVISED	DATE	BY						
APPROV									
SUB-SUPPLIER/VENDOR				DESIGN BY	UNIT/SCALE	DATE	PROJECT NO.	REF. TO ARCH. DWA.	ITEM NUMBER OF SET
					MTS				
TITLE				DRAWING NO.				REV	
				2X-60MW-BEHV-002-00				01	
				COORDINATION OF CDS WITH DT/ST				DATE: \$ / \$ / \$	

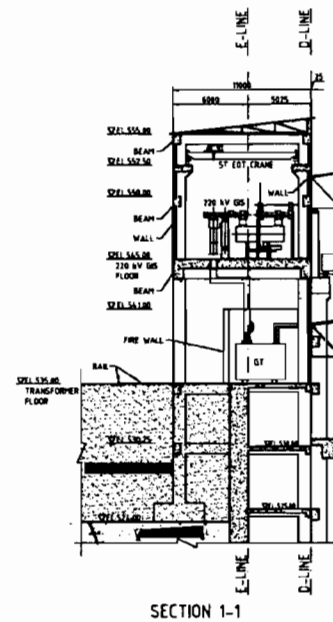
FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM)



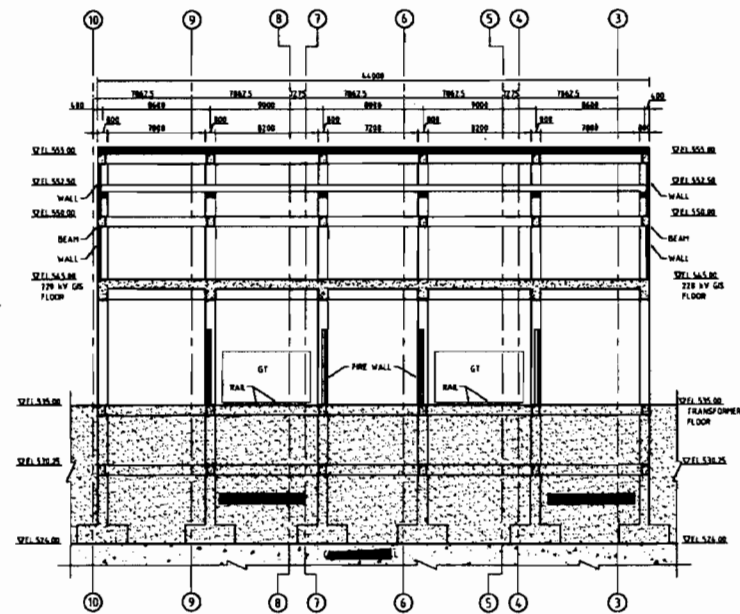
NOTE:-
1. SHOW POWER TOW WALL AT LEVEL AT EL. 845.
2. WALL TO CHECK THE LOCATION OF TRANSMISSION TOWER.
3. WALL, SHOWN TO POWER TOW AT EL. 845.

ADDITIONAL INFORMATION					PROJECT		2X80MW VYASI HYDRO ELECTRIC PROJECT					
STATUS OF DRAWING					CUSTOMER		UJVNL LTD.					
DISTRIBUTION OF PRINTS												
NO.	DATE	NO.	DATE	NO. OF SETS		BHARAT HEAVY ELECTRICALS LTD. TRANSMISSION BUSINESS GROUP						
1		2		3								
4		5		6								
7		8		9								
SUB-SUPPLIER/VENDOR					DESIGN OF		INTENDED FOR	SCALE	REVISION	NO.	DATE	
					REV. NO.			MTS		REF. TO ASSY. DATA	REV. NO.	DATE
					REV. DATE							
					TITLE							
TYPICAL ARRANGEMENT OF 80KV POTHEAD YARD AND ITS CONNECTION								DRAWING NO.			REV.	
								TD-VYASI-220KV PE-01			01	
								REV. NO. 1			REV. DATE	

REV.	DATE	APPROVED	REV.	DATE	APPROVED	REV.	DATE	APPROVED	REV.	DATE	APPROVED	REV.	DATE	APPROVED	REV.	DATE	APPROVED
1			2			3			4			5			6		



SECTION 1-1



SECTION 2-2

CLAUSE NO.	SECTION-2 220 KV GAS INSULATED SWITCHGEAR
1.00.00	CODES & STANDARDS
1.01.00	The switchgear specified herein shall operate satisfactorily in the climatic conditions as specified. The performance, testing and rating of the switchgear shall conform to the latest edition of the following IEC / IS publications: IEC -62271-100 : High Voltage Alternating Current circuit breaker IEC- 60376 : Specification of technical grade sulphur hexafluoride (SF6) for use in electrical equipment IEC- 68 Part III : Environmental Testing IEC -71 : Insulation coordination. IEC-60099-1/4 : Non linear resistor type arresters for AC systems. IEC -62271-102 : AC dis-connectors and earthing switches IEC- 60137 : Insulated Bushing for alternating voltages above 1000 V. IEC –60044-1 : Current transformers IEC –60044-2 : Voltage transformers IEC –267 : Guide to testing of circuit breakers IEC –60270 : High voltage test techniques-Partial discharge measurements. IECIEC- 60480 : Guidelines for the treatment and checking of SF6 taken from electrical equipments and specifications for its reuse. IEC- 506 : Switching impulse test on HV insulators. IEC-62271-203 : Gas Insulated metal enclosed switchgear for rated voltage above 52 KV IEC-60694 /62271-1 : Common specification for HV switchgear and control gear standards. IEC- 60859 : Cable connections for gas insulated metal enclosed switchgear. IEC –61128 : Alternating current dis-connectors. Bus transfer current switching by dis-connector IEC -61129 : AC earthing switches: Induced current switching. IEC-1259 : Requirement for switching of bus charging current by dis-connectors.

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR
	IS –2705 : Current transformers IS- 3156 : Voltage transformers IEC- 60439 : Factory built assembly of New Voltage Switchgear and Control Gear IEEE-80 (2000) : IEEE- Guide for safety in AC substation grounding CIGRE-44 : Earthing of GIS –an application guide (Electra no: 151, Dec'93) IEC-62271-306 : Direct connection between power transformer & gas insulated metal enclosed switchgear for rated voltage above 72.5 KV IEC-62271-305 : Cable connection for gas insulated metal enclosed switchgear for rated voltage above 72.5 KV
1.02.00	The proposed switchgear may conform to the standards of the country of manufacture, provided these standards are based on, or equivalent or better to the above referred standards. The contractor proposing any other standards than the above referred standards must specifically indicate the standards to which the switchgear conforms. The deviations, if any, from the above codes & standards that affect performance and rating are required to be clearly indicated by the contractor along with the offer. The contractor is required to furnish the English version copy of all the standards along with the bid.
1.03.00	Compliance with the provisions of the specifications does not absolve the switchgear contractor from the responsibility of furnishing switchgear and accessories of proper design, electrically and mechanically suited to meet the operating guarantees at the specified service conditions.
1.04.00	If there are, in the opinion of the contractor, any contradictions between the above standards and these specifications, such contradictions shall be brought to the attention of the Employer.
2.00.00	RATINGS
2.01.00	The ratings and general characteristics of the GIS shall be as follows: (The ratings applicable to specific items of equipment are indicated in the applicable sections dealing with the equipment). a) Type of Switchgear enclosed, SF6 gas insulated switchgear 245 KV Single phase, metal b) Location Indoor c) Frequency 50 + 3% -5% Hz d) Rated voltage class, KV rms 220

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR		
	e)	Highest System voltage, KV rms	245
	f)	Number of phases	Three
	g)	Rated lightning impulse withstand voltage (KV peak)	
	i)	Phase to earth	1050
	ii)	Across open contacts	1200
	h)	Rated one minute power frequency with stand voltage (KV rms)	
	i)	Phase to earth	460
	ii)	Across open contacts	530
	i)	System earthing	Effectively grounded
	j)	Rated normal current (Amps.)	
	i)	Generator transformer feeder circuits	1600 A
	ii)	Out going feeder circuits	1600 A
	iii)	Bus coupler circuits	1600 A
	k)	Rated short circuit withstand current at rated maximum voltage for one sec.	Not less than 50 KA rms (symmetrical)
	l)	Rated breaking capacity of circuit breaker	50 KA rms
	m)	Rated making capacity	100 KA peak
	n)	Prospective transient recovery Voltage appearing across the Circuit breaker terminals	As per IEC62271-100
	o)	Radio interference voltage at for frequency between 0.5 MHZ and 2 MHZ at 156 KV (rms)	Less then 1000 micro volts
	p)	Partial discharge level at $1.1 U_n/\sqrt{3}$	5 pico coulombs or less
	q)	Material of enclosure	Aluminium alloy
	r)	Material of bus bar	Aluminium alloy

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR
	s) Insulation medium SF6 gas
2.02.00	All current carrying components of the equipment specified shall be capable of continuous operation at the specified rated current without exceeding the maximum temperature rise specified in the relevant IEC standards.
2.03.00	Thermal calculations shall be based on the climatic conditions indicated in Project synopsis. These calculations shall be submitted for review of the Employer.
3.00.00	GENERAL DESIGN AND SAFETY REQUIREMENT
3.01.00	The GIS assembly shall be of double bus bar arrangement and shall consist of separate modular compartments e.g. Circuit Breaker compartment, Bus bar compartment filled SF ₆ 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-energising the adjacent feeders. These compartments shall be designed to minimize the risk of damage to adjacent sections and protection of personnel in the event of a failure occurring within the compartments. Stainless steel carbon impregnated or nickel plate rupture diaphragms with suitable deflectors shall be provided to prevent uncontrolled bursting pressures developing within the enclosures under worst operating conditions. The compartments of GIS assemblies shall be supplied filled with SF ₆ gas at a positive pressure and hermetically sealed to protect the dielectric system during transportation.
3.02.00	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.
3.03.00	The switchgear, which shall be of modular design, shall have complete phase isolation. The conductors and the live parts shall be mounted on high graded epoxy resin insulators. These insulators shall be designed to have high structural strength and electrical dielectric properties and shall be shaped so as to provide uniform field distribution and to minimize the effects of particle deposition either from migration of foreign particles within the enclosures or from the by-products of SF ₆ breakdown under arcing conditions.
3.04.00	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.
3.05.00	Gas barrier insulators shall be provided so as to divide the GIS into separate compartments. They shall be suitably located in order to minimize disturbance in case of leakage or dismantling. They shall be designed to withstand 1.5 times full rated pressure on one side while vacuum is exerted on the other side. They shall be designed to withstand any internal fault thereby keeping an internal arc inside the faulty compartment. Due to safety requirement for working on the pressurised equipment, whenever the pressure of the adjacent gas compartment is reduced, it should be ensured by the contractor that adjacent compartment would remain in service with reduced pressure. The gas tight barriers shall be clearly marked on the outside of the enclosures.

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR
3.06.00	The material and thickness of the enclosures shall be such as to withstand an internal flash over without burn through for a period of 500ms till the backup relay protection clears the fault. The material shall be such that it has no effect of environment as well as from the by-products of SF ₆ breakdown under arcing condition.
3.07.00	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.
3.08.00	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 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.
3.09.00	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 .
3.10.00	The contractor shall guarantee that the pressure loss within each individual gas-filled compartment shall not be more than 0.1% per year.
3.11.00	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 SF ₆ during interruption. Each gas compartment shall be fitted with separate non-return valve connectors for evacuating & filling the gas and checking the gas pressure etc.
3.12.00	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. Routine maintenance to any of its external components including the protective relays and instrument transformers shall not be required in less than five years intervals. The internal components shall be maintenance free for at least 10 years. Routine replacement of insulating gas shall not be required in intervals of less than ten years.
3.13.00	Bracings shall be provided for all mechanical components against the effects of short circuit currents. The arc faults shall be positively confined to the originating compartment and shall not spread to the other parts of switchgear.

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR
3.14.00	The thermal rating of all current carrying parts shall be minimum for one sec. for the rated symmetrical short-circuits current.
3.15.00	The Switchgear shall be of the free standing, self-supporting with easy accessibility to all the parts during installation & maintenance, dead front design with all high-voltage equipment installed inside gas-insulated metallic and earthed enclosures, suitably sub-divided into individual arc and gas-proof compartments at least for: a) Bus bars b) Intermediate compartment c) Circuit breakers d) Bus / Line disconnections e) Gas insulated bus duct section between Generator-Transformer and GIS. f) Current Transformers g) Voltage Transformers h) Surge Arrestors i) Gas Insulated bus duct section GIS shall be of isolated phase type and each phase/pole shall be housed in a separate enclosure or three phase encapsulated. The bus enclosure should be sectionalized in a manner that maintenance work on any bus disconnector (when bus and bus disconnector are enclosed in a single enclosure) can be carried out by isolating and evacuating the small effected section and not entire bus.
3.16.00	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.
3.17.00	It is required that the three phases of each switchgear bay be arranged side by side. Segregated phase blocks of equipment in which one phase of each switchgear bay is mounted in a separate block are not acceptable. The arrangement of the equipment offered must provide adequate access for operation, testing and maintenance.
3.18.00	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 bay 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 bay.
3.19.00	The bay control unit shall be placed in the relay room in the GIS Hall 44mX15m as GIS Layout Plan at 544M"
3.20.00	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 neighboring bays.

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR
3.21.00	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.
3.22.00	All interlocks that prevent potentially dangerous mal-operations, shall be constructed such that they can not be operated easily, i.e. the operator must use tools or brute force to over-ride them.
3.23.00	The actual position of circuit breakers, disconnections and grounding switches must be positively displayed by mechanical indicators visible from the operating position.
3.24.00	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 corona. No corona shall be visible in complete darkness when the equipment is subjected to specified test voltage. There shall be no radio interference from the energized switchgear at rated voltage.
3.25.00	The enclosure shall be of continuous design and shall meet the requirement as specified in clause no: 10 (special consideration for GIS) of IEEE -80 year 2000. The enclosure shall be sized for carrying induced current equal to the rated current of the bus. The conductor and the enclosure shall form the concentric pair with effective shielding of the field internal to the enclosure.
3.26.00	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.
3.27.00	The breaker enclosure shall have provision for easy withdrawal of the interrupter assemblies. The removed interrupter assembly must be easily and safely accessible for inspection and possible repairs.
3.28.00	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.
3.29.00	The enclosure shall be designed to practically eliminate the external electromagnetic field and thereby electrodynamic stresses even under short circuit conditions.
3.30.00	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.
3.31.00	The Contractor shall furnish the following information regarding the loosely distributed metallic particles within the GIS encapsulation. a) Calculations of critical field strength for specific particles of defined mass and geometry.

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR
	b) The methodology and the equipments required for electrical partial discharge (PD) detection and/or UHF detection method. 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 contractor shall furnish the details & drawings for ground mat requirement for GIS.
3.32.00	The ladders and walkways shall be provided wherever necessary for access to the equipment. The suitability of using a portable ladder with adjustable height may be examined by the contractor and if found suitable, shall be offered.
3.33.00	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. The possibility of using heaters without thermostats in order to achieve the higher reliability may be examined by the contractor and accordingly included in the offer but it shall be ensured by the contractor that the temperature rise of different enclosures where heating is provided should be within safe limits as per relevant standards. Detail calculation with a copy of the relevant extract of standard to which the above arrangement conforms to, shall also be furnished along with the offer. The heaters shall be so arranged and protected as to create no hazard to adjacent equipment from the heat produced.
3.34.00	Arrangement shall be provided to visually observe the contact position of disconnecting switches and earth switches.
3.35.00	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.
3.36.00	The sealing provided between flanges of two modules / enclosures shall be such that long term tightness is achieved.
3.37.00	Alarm circuit shall not respond to faults for momentary conditions. The following indications including those required elsewhere in the specifications shall be generally provided in the alarm & indication circuits.
3.37.01	Gas Insulating System a) Loss of gas density b) Loss of heater power (if required) c) Moisture in gas d) Low gas pressure e) Any other alarm necessary to indicate deterioration of the gas insulating system
3.37.02	Operating System a) Low operating pressure. b) Loss of Heater Power. c) Loss of operating power.

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR
	d) Loss of control e) Pole-disordance
3.38.00	The common point of the two bus bars along with the Earth switch shall be designed and their compartmentalisation shall be done in a way to avoid complete shutdown of the system.
3.39.00	Adequate number of gas leak detectors shall be installed at various location at the base of the GIS structure to detect presence of gas which may be harmful for human. The detector shall send alarm signal locally as well as at remote stations.
3.40.00	-----NA-----
3.41.00	The equipment shall be suitable for operation under the ambient conditions prevailing at project site specified else where in the specification. The prevailing conditions shall be taken into account by the Contractor in the design of the equipment.
4.00.00	MANDATORY MAINTENANCE EQUIPMENTS The maintenance equipment as per necessary for the operation and maintenance of GIS shall be supplied along with GIS. A list of such equipments is enclosed as Annexure-I.
5.00.00	BELLOWS OR COMPENSATING UNITS Adequate provision shall be made to allow for the thermal expansion of the conductors and of differential thermal expansion between the conductors and the enclosures. The metallic bellows (preferably of stainless steel) of following types or other suitable equivalent arrangement shall be provided wherever necessary. i) Lateral / vertical mounting units: These shall be inserted, as required, between sections of bus bars, on transformer. Provision of these shall enable sections of the switchgear to be removed and reinserted without interfering with adjacent parts. Lateral mounting shall be made possible by a sliding section of enclosure and tubular conductors. ii) Axial compensators: These shall be provided to accommodate changes in length of bus bars due to temperature variations. iii) Parallel compensators: These shall be provided to accommodate large linear expansions and angle tolerances. iv) Tolerance compensators: These shall be provided for taking up manufacturing, site assembly & foundation tolerances. v) Vibration compensators: These bellow compensators shall be provided for absorbing vibrations caused by the transformers when connected to SF₆ switchgear by oil / SF₆ bushings.

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR						
6.00.00	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.						
7.00.00	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 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. Contractor shall submit to the Employer the detailed criteria design regarding location of pressure relief devices/rupture diaphragms.						
8.00.00	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.) Each enclosure has to be tested as a routine test at 1.5 times the design pressure for one minute. The bursting strength of Aluminum castings 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 enclosures.						
9.00.00	EQUIPMENT DETAILS						
9.01.00	Circuit Breakers						
9.01.01	Type & Rating I) The power from Generating Units is proposed to be stepped up to 220 KV by Generator Transformers. The Generator Transformers shall be connected to the proposed 220 KV GIS which shall be connected to pothead yard through Gas Insulated Bus duct section (GIB). The circuit breakers offered shall be suitable for operation with Generating Units, Generator Transformers, and Transmission Lines. II) SF₆ gas-insulated circuit breaker shall conform to IEC-62271-100 and have the following performance characteristics and ratings: <table><tr><td>i)</td><td>Type of breaker</td><td>220 KV Single phase, metal enclosed, SF₆ gas insulated.</td></tr><tr><td>ii)</td><td>Rated frequency</td><td>50 Hz</td></tr></table>	i)	Type of breaker	220 KV Single phase, metal enclosed, SF ₆ gas insulated.	ii)	Rated frequency	50 Hz
i)	Type of breaker	220 KV Single phase, metal enclosed, SF ₆ gas insulated.					
ii)	Rated frequency	50 Hz					

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR
	iii) Rated normal current:- - Bus coupler breaker 1600 A - Generator transformer feeder breaker 1600A - Out going line breaker 1600A iv) Number of poles 3 v) Installation Indoor vi) Temperature rise As per IEC 60694 vii) Rated short time withstand current KA (rms value of ac component) 50 KA for 1 second viii) Rated short circuit making current, KA(peak) 100 KA ix) Rated out of phase breaking current (rms) 10KA x) Rated short circuit breaking current - Rated short circuit current 50 KA (rms) - Rated duration of short circuit 1 sec - Percentage of D.C. component >70% a) System Earthing Effectively earthed. b) First-pole-to clear factor 1.3 c) Closing time < 100 ms d) Rated duration of short circuit 1 Sec xi) Rated transient recovery voltage for terminal faults As per IEC xii) Rated characteristics for short line faults -do- xiii) Standard values of rated line characteristics for short line faults -do

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR
	xiv) Rated One minute Power insulation level i) Phase to Earth 460 KV (rms) ii) Open contact 530 KV (rms) xv) Rated lightning impulse withstand voltage (KV peak) i) Phase to earth 1050 KV ii Across open contacts 1200 KV xvii) Rated operating duty cycle - Breakers 0-0.3 s-CO-3 min-CO - Auto re-closing (line breakers) Single-phase and 3-phase only - Rated insulation level As specified - Rated line charging with voltage factor of 1.4pu 125A with maximum breaking current permissible switching Over voltage of 2.0 pu - Rated inductive current All the circuit breakers shall be capable of interrupting 100 Amperes inductive current, xviii) Control of switching Switching surge over voltages while surges (Line Breakers) re-energising to be limited to 2.0 p.u. xix) Operating mechanism Spring Charged xx) Radio interference voltage Not exceeding 1000 micro-volts for freq. between 0.5MHz and 2.0MHz at 156 kV (rms) a) Partial discharge level, (pico coulombs) at $1.1 U_n/\sqrt{3}$ 5 or less b) Rated supply voltage of closing and opening devices and auxiliary circuit 220 V dc, 240 V ac, 50Hz / 415 V ac, 50 Hz, 3-phase.

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR		
	c)	Number of auxiliary Contacts	12 NO and 12 NC on each pole wired to terminal blocks in control Cabinet
	-	Number of trip coils	2 per pole
	-	Number of closing coils	1 per pole
	d)	SF ₆ gas characteristics for SF ₆ circuit breaker	As per IEC-60376
	xxi)	Rated break time	
	i)	60 ms under test duties 2,3 & 4 at rated values	
	a)	65 ms under test duties 1-5 and short line fault test duties and combined variation trip coil voltage, opening pressure and quenching media pressure.	
	xxi)	Maximum difference in the instant of closing/opening of contacts	a) 2.5 millisecc within a pole i) 3.3 millisecc between poles (opening) ii) 5.0 milli sec between poles (closing)
	xxii)	Noise level	: 140dB at 50m distance from the base of circuit breaker
	III)	The governing data for the selection of circuit breakers shall not be limited to the above mentioned parameters but shall also take into account various provisions contained in these specifications and relevant standards. The circuit breakers to be supplied must be suitable for the intended services i.e. for no load, full load and fault service conditions.	
9.02.00	Duty Requirement		
9.02.01	Circuit breakers shall be C ₂ -M ₁ class as per IEC 62271-100. the circuit breaker shall be totally 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 for any type of fault or fault location also for line charging and dropping when used on 220 KV effectively grounded system with transmission lines of adequate length and characteristic specified elsewhere in the specification and perform make and break operation as per the stipulated duty cycles satisfactorily.		
9.02.02	The circuit breaker shall be capable for breaking the steady and transient magnetizing current corresponding to 220 KV transformer of 75 MVA rating. It shall be capable of breaking line charging current as per IEC 62271-100 with a voltage factor of 1.4		
9.02.03	The circuit breaker shall be reasonably quiet in operation. Noise level in excess of 140dB measured at the base of the breaker would be unacceptable. Contractor shall indicate the noise level of breaker at a distance of 50 to 150m from base of the breaker.		

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR
9.02.04	The total break time of the breaker shall not be exceeded under any duty conditions as specified such as with the combined variation of trip coil voltage (70-110%), pneumatic/hydraulic pressure and SF6 pressure etc. while furnishing the proof of the total break time of complete circuit breaker. The contractor may specifically bring out the effect of non-simultaneity between poles and show how it is covered in the guaranteed total break time.
9.02.05	The DC components of the circuit breaker, as per IEC-62271-100 shall correspond to the guaranteed minimum opening time under any condition of operation.
9.02.06	The critical current which gives the longest arc duration at lock out pressure of SF6 and the duration shall be indicated.
9.02.07	All the duty requirements specified above shall be provided with the support of adequate test reports to be furnished with the bid.
9.03.00	Construction & Design a) SF₆ gas insulated metal enclosed circuit breakers shall comply with the latest revision of IEC-62271-100 & other relevant IEC except to the extent explicitly modified in the specification. Circuit breakers shall be of single pressure (puffer type). They shall be designed for installation in SF₆ gas insulated metal clad switchgear and shall use SF₆ gas for both insulation & arc quenching. Suitable means shall be provided to ensure that all interrupters & secondary auxiliary switches open and close without loss of synchronism & are of adequate dielectric strength under all operating conditions including an open-close-open operation with zero external dead time delay. The interrupting duty shall be distributed uniformly between interrupters. There shall be two trip and one closing coils per pole for each breaker. b) The circuit breakers shall be provided with independent and reliable spring charged mechanism or electro-hydraulic/pneumatic operating mechanism for each pole. Provision shall be made for simultaneous opening and closing of all the three poles of the circuit breakers. The full details of the spring charged mechanism/hydraulic operating mechanism/pneumatic mechanism and constructional & operational features must be described in the bid. The detailed drawings to illustrate the operational features shall be supplied by the contractor. c) Each circuit breaker shall be capable of withstanding without requiring change of any parts, atleast maximum no. of interruptions at rated short circuit current with associated rate of rise of recovery voltage. The contractor shall state this data and the equivalent number of interruptions at rated continuous current or the cumulative electrical endurance which could be safely withstood by the breaker and also submit proof of short circuit rating with transient voltage severity along with the offer. d) Out-of-Phase Switching The circuit breaker shall be capable of interrupting symmetrical short circuit current under out-of-phase switching conditions.

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR									
	Short line Faults: Circuit breaker supplied shall be capable of interrupting line faults on overhead transmission line. e) The circuit breakers shall be designed to withstand the high stresses imposed on them during fault clearing, load rejection, out of phase switching, re-energization of lines with trapped charges and perform make & break operations as per the stipulated duty cycles satisfactorily. The breakers shall also be required to break small inductive currents without causing excessive over-voltages, line charging currents without re-strikes, handle evolving faults and meet the requirements regarding partial discharge, radio interference and corona. However, all the breakers shall be capable of breaking inductive current. f) The circuit breakers shall be suitable for in-rush and magnetizing current. The circuit breakers offered shall be suitable for single phase generator transformers, bus coupler and out going lines without re-striking and without causing excessive switching surges. Occasionally, a power transformer operating under ferro-resonant conditions and having non-sinusoidal current and voltage wave-forms with higher than normal peak values may have to be switched. The Contractor shall provide proof test data and comments on breaker for such applications. g) Insulation Co-ordination The insulation strength across the open contacts of the circuit breaker for lightning impulse, switching surges and power frequency withstand voltages shall be as per IEC60694/62271-100. i) The circuit breaker and bus insulation shall be coordinated so that due to lightning impulse, switching surge and power frequency voltage no flashover shall take place. In case flashover takes place, the same shall be confined in the bus rather than in the circuit breakers in either open or closed position. ii) The circuit breakers shall be vertical / horizontal mounted depending on contractor's preferred layout for the double bus system considering the space limitations indicated in the layout and taking into account the worst service conditions / forces imposed by the earthquake. iii) Each circuit breaker pole shall be equipped with enclosed type mechanical position indicator clearly visible from the breaker front. The remote position indicator on the bay module control cabinet and in the power house control room shall be provided. The details of the inscription and coloring of the mechanical indicator are given as under: <table><tr><td></td><td>Sign</td><td>Background colour</td></tr><tr><td>Open position</td><td>Open</td><td>Green</td></tr><tr><td>Closed position</td><td>Close</td><td>Red</td></tr></table>		Sign	Background colour	Open position	Open	Green	Closed position	Close	Red
	Sign	Background colour								
Open position	Open	Green								
Closed position	Close	Red								

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR
	Each pole of the breaker shall be provided with operating counter to record the number of operations performed during service. h) The breakers shall be provided with pressure gauges and pressure relays for the operating mechanism. i) The circuit breakers shall be supplied with thermostatically controlled tank heaters wherever required. Where the heater current rating exceeds one ampere, thermostatically controlled contactors shall be used. j) The circuit breakers shall be provided with a rating plate as per the requirements of IEC. The voltage required to operate the tripping coil shall also be indicated. k) Circuit breakers except line circuit breakers shall be designed for 3-phase tripping and closing. Only line circuit breakers shall have single-phase and 3-phase auto-reclosing capabilities. The line breakers shall be capable of independent pole operation. Each phase shall be completely isolated from the other two phases. l) All necessary interposing & interlocking control relays for circuit breaker tripping and closing shall be located in the control cabinets supplied by the Contractor. m) The disconnectors shall be interlocked electrically with the associated circuit breakers such that the disconnector cannot be operated unless the associated circuit breaker is opened. The interlocking shall prevent any incorrect switching sequence and enable the breakers to be operated without risks, either from the Bay Module Control Cabinet, Bay Control Unit or from the power house control room. The actuation of the manual operating device shall also be disabled to energize the electrical control circuits. Necessary interlocks shall be provided to prevent from hunting and other dangerous or undesirable operations of the circuit breaker. n) The circuit breaker control system shall prevent closing of the circuit breaker when there is insufficient stored energy in the operating mechanism storage system and insufficient SF₆ gas density / dielectric strength. It shall lockout the breaker when the SF₆ gas density drops below a minimum permissible level. The state of the breaker arc-quenching and insulating gas shall be monitored by a temperature-compensated pressure switch or density switch with two alarm levels. The first stage alarm shall be set well before any dangerous condition is reached; the second stage shall initiate breaker lockout. In addition, the actual gas pressure shall be shown on a local control cubicle. o) The circuit breaker shall be able to operate locally or from a remote point. Local operation shall be by means of an open/close control switch located in the bay module control cabinet. Remote control via a remote/local control transfer switch will be from the switchyard control room & power house central control room or from remote control centre. The protection devices will remain operational in either remote or local control mode. When in the maintenance mode, all remote trip or close control signals will be blocked.

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR
	The breaker controls shall operate from the two independent 220 V DC systems with both the trip coils connected. Mechanical indicators coupled to the movable contact system shall be provided to show the true position of the main breaker contacts. Operation counters shall be provided for each breaker pole or otherwise for each breaker. p) Control scheme for the circuit breakers shall be submitted by the Contractor giving full details of operating mechanism and their advantages along with relevant drawings. q) The circuit breaker shall be provided with duplicate electrical tripping facilities. This shall include but not be limited to the following:- a) Two electrically separate identical trip coils. b) Two electrically independent and identical sets of wiring, terminals and protective equipment for connection to two independent control and/or tripping power sources. r) The above noted requirement refers only to duplicate electrical tripping facilities and should not be interpreted as requiring the provision of any mechanical or hydraulic components in duplicate form. Duplicate opening control valve would be considered as an advantage over two solenoids on the same valve. s) The circuit breaker as well as local control cubicle shall be provided with red and green local indicating lamps which shall be connected through one normally open and one normally closed contact of auxiliary switch for each pole. The circuit breaker shall further be provided with amber lamp to indicate healthy trip conditions. i.e trip circuit supervision t) All DC coils (trip, close, auxiliary etc.) shall be equipped with surge suppression devices such as diodes across the coils to provide a discharge path for transient voltage. The provision of such devices shall neither extend the drop out time of coil nor shall interfere with normal operation of the circuit breaker. a) On failure of auxiliary supply, the operating mechanism shall be capable of performing a complete O—0.3S—CO—3 Min—CO sequence for all breakers & corresponding sequence for other breakers. b) Only line circuit breakers shall be designed for automatic re-closing duty cycles from remote devices as per duty envisaged in these specifications. c) Auxiliary Switches for the Circuit Breakers. Apart from any auxiliary switches normally required in the circuit breakers for control or auxiliary functions as detailed herein, each pole of circuit breaker shall be provided with auxiliary switches having twelve(12) normally open 'NO' and twelve(12) normally closed 'NC' contacts, all electrically independent and readily convertible from

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR
	normally open to normally closed operation or vice-versa. If non-adjustable and non-convertible types of auxiliary switches are offered, the contractor is required to furnish the technical details of such switches along with their advantages over the adjustable and convertible switches to be derived by the Employer. Six 'NO' and six 'NC' contacts shall be adjustable for early make or early break operation. An early make 'NO' contact connected in series with an early break 'NC' contact shall provide a pulse during circuit breaker closing and tripping. The above twenty four contacts of each pole shall be connected by the Contractor to terminal blocks in the bay module control cabinet. The contacts shall be capable of interrupting as per IEC 694. d) Breakers shall have separate operating mechanism for each pole and shall be equipped with an electrical phase disagreement circuit, complete with a time delay relay with adjustable setting. The relay shall provide automatic 3-phase tripping of the circuit breaker or single pole tripping in case of line breaker, and shall have a normally open contact wired to the bay control cabinet terminal block. e) The Contractor shall supply all relays, switches and accessories to provide for fail- safe operation of the circuit breaker under conditions of low stored energy. The circuit breaker shall have local storage sufficient for a duty cycle following the loss of supply to the main energy storage system. The recharging time following the restoration of the supply shall be less than 30 minutes. Low stored energy in any pole shall initiate at:- i) Level 1: Low stored energy (pressure) alarm. ii) Level 2 Initiate blocking of breaker closing when stored energy is insufficient to perform a close-open duty cycle. iii) Level 3 Initiate automatic lockout of circuit breaker tripping and isolation at a point where sufficient stored energy is still available to perform the operation. f) The Contractor shall explain the features incorporated in the circuit breaker control mechanism to properly supervise the operation of opening of each pole of the breaker. A pole discordance alarm shall be provided for annunciation. g) The means shall be provided to mechanically block the operating mechanism so that adjustments may be made safely. h) All auxiliary devices, such as heaters, receptacles, etc. shall be suitable for connection to the following power sources. The details of these sources are given as under: a) 240 V A.C. Single phase- 50Hz

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR
9.04.00	b) 415 V A.C. 3-phase, 4-wire, 50Hz c) 220 V DC from station battery banks for control circuits. Operating Mechanism General requirements: a) Circuit breaker shall be operated by pneumatic mechanism or electric spring charged mechanism or electro-hydraulic mechanism or a combination of these. The mechanism shall be housed in a dust proof cabinet and shall have IP: 42 degree of protection. b) The operating mechanism shall be anti-pumping and trip free (as per IEC definition) electrically and either mechanically or pneumatically under every method of closing. The mechanism of the breaker shall be such that the position of the breaker is maintained even after the leakage of operating media and/or gas c) The operating mechanism shall be strong, rigid, not subject to rebound or to critical adjustments at site and shall be readily accessible for maintenance. d) The operating mechanism shall be suitable for high speed re-closing and other duties specified. During re-closing the breaker contacts shall close fully and then open. The mechanism shall be anti-pumping and trip free (as per IEC definition) under every method of closing. e) The mechanism shall be such that the failure of any auxiliary spring will not prevent tripping and will not cause trip or closing operating of the power operating devise. f) A mechanical indicator shall be provided to show open and close position of the breaker. It shall be located in a position where it will be visible to a man standing on the ground level with the mechanism housing closed. An operating counter shall also be provided in the central control cabinet. g) Working parts of the mechanism shall be of corrosion resisting material. Bearings which require grease shall be equipped with pressure type grease fittings. Bearing pin, bolts, nuts and other parts shall be adequately pinned or locked to prevent loosening or changing adjustment with repeated operation of the breaker. h) The contractor shall furnish detailed operation and maintenance manual of the mechanism along with the operation manual for the circuit breaker. i) The close and trip circuits shall be designed to permit use of momentary-contact switches and push buttons. j) Each breaker pole shall be provided with two (2) independent tripping circuits, valves, pressure switches, and coils each connected to a different set of protective relays.

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR
9.05.00	k) The breaker shall normally be operated by remote electrical control. Electrical tripping shall be performed by shunt trip coils. However, provisions shall be made for local electrical control. For this purpose a local/remote selector switch and close and trip control switch/push buttons shall be provided in the breaker central control cabinet. l) The trip coil shall be suitable for trip circuit supervision during both open and close position of breaker. m) Closing coil and associated circuits shall operate correctly at all values of voltage between 85% and 110% of the rated voltage. Shunt trip and associated circuits shall operate correctly under all operating conditions of the circuit breaker up to the rated breaking capacity of the circuit breaker and at all values of supply voltage between 70% and 110% of rated voltage. If additional elements are introduced in the trip coil circuit their successful operation and reliability for similar applications on circuit breakers shall be clearly brought out in the additional information schedules. n) Densimeter contacts and pressure switch contacts shall be suitable for direct use as permissive in closing and tripping circuits. Separate contacts have to be used for each of tripping and closing circuits. If contacts are not suitably rated and multiplying relays are used then fail safe logic/schemes are to be employed. DC supplies for all auxiliary circuit shall be monitored and for remote annunciations and operation lockout in case of dc failures. o) The auxiliary switch of the breaker shall be positively driven by the breaker operating rod. Spring operated Mechanism a) 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. b) As long as power is available to the motor, a continuous sequence of the 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. c) Breaker operation shall be independent of the motor which shall be used solely for compressing the closing spring. Facility for manual charging of the closing spring shall also be provided. The motor rating shall be such that it required preferably not more than 30 seconds for full charging of the closing spring. d) Closing action of circuit breaker shall compress the opening spring ready for tripping. e) When closing springs are discharged after closing a breaker, closing springs shall automatically be charged for the next operation and an indication of this shall be provided in the local and remote control cabinet.

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR
9.06.00	f) Provisions shall be made to prevent a closing operation of the breaker when the spring is in the partial charged condition. g) The spring operating mechanism shall have adequate energy stored in the operating spring to close and latch the circuit breaker against the rated making current and also to provide the required energy for the tripping mechanism in case the tripping energy is derived from the operating mechanism. Hydraulically Operated Mechanism: a) Hydraulically operated mechanism shall comprise of operating unit with power cylinder, control valves, high and low pressure reservoir, motor etc. b) The hydraulic oil used shall be fully compatible for the temperature range to be encountered during operation. e) The oil pressure switch controlling the oil pump and pressure in the high pressure reservoir shall have adequate no. of spare contacts for continuous monitoring of low pressure, high pressure etc. at switchyard control room. d) The mechanism shall be suitable for at least two close open operations after failure of AC supply to the motor starting at pressure equal to the lowest pressure of auto re-close duty plus pressure drop for one close open operation. e) The mechanism shall be capable of operating the circuit breaker correctly and performing the duty cycle specified under all conditions with the pressure of hydraulic operated fluid in the operating mechanism at the lowest permissible pressure before make up. The operating time at the lowest pressure for a particular operation shall not exceed the guaranteed operating time within any value of trip coil supply voltage as specified f) Trip lockout shall be provided to prevent operations of the circuit breaker below the minimum specified hydraulic pressure. Alarm contacts for lost of Nitrogen shall also be provided. g) 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. h) Hydraulic controls are to be provided and such controls shall be interlocked to prevent the circuit breakers from being tripped under conditions which will not allow a complete and safe trip operation. A close operation shall also be blocked unless a complete close open or trip free operation can be safely carried out. i) For hydraulic operated mechanism, auxiliary switches must be provided with a separate operating device working on the same mechanism. The operation of both the mechanisms should be simultaneous.

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR								
9.07.00	Pneumatically-operated mechanism								
9.07.01	Contractor shall offer unit compressor with each circuit breaker. The unit compressors are to be located outdoor near the breaker(s).								
9.07.02	The breaker local air receivers shall comply with the requirement specified, and shall have sufficient capacity for two 'CO' operations of the breaker at the lowest pressure for re-close duty without refilling.								
9.07.03	Independently adjustable pressure switches with potential free ungrounded contacts to actuate lockout device shall be provided. This lock out device with provision for remote alarm indication shall be incorporated in the circuit breaker to prevent operation whenever the pressure of the operating medium is below that required for satisfactory operation at the specified rating. The scheme should permit operation of all block and alarm relays as soon as the pressure transient present during the rapid pressure drop has been damped and a reliable pressure measurement can be made. Such facilities shall be provided for following conditions: <table data-bbox="383 824 925 1048"> <tr> <td>Trip lockout pressure</td><td>—2 nos</td></tr> <tr> <td>Close lockout pressure</td><td>—1 no.</td></tr> <tr> <td>Extreme low pressure</td><td>—1 no.</td></tr> <tr> <td>Auto re-close lock out pressure</td><td>—1 no.</td></tr> </table>	Trip lockout pressure	—2 nos	Close lockout pressure	—1 no.	Extreme low pressure	—1 no.	Auto re-close lock out pressure	—1 no.
Trip lockout pressure	—2 nos								
Close lockout pressure	—1 no.								
Extreme low pressure	—1 no.								
Auto re-close lock out pressure	—1 no.								
9.07.04	The compressed air mechanism shall be capable of operating the circuit breaker under all duty conditions with the air pressure immediately before operation between 85% and 110% of the rated supply pressures. The make/break time at this supply pressure shall not exceed the specified make/ break time within any value of trip coil supply voltage as specified.								
9.07.05	Following additional fittings shall be required for pneumatic Circuit Breaker a. Unit compressed air system b. Breaker Local air receiver c. Pressure gauge, spring loaded safety valve and pressure switch with adjustable contacts. d. Pressure switch to initiate an alarm if the pressure in auxiliary reservoir falls below a preset level for longer than it is normally necessary to refill the reservoir. e. Stop, non return and other control valves, piping and all accessories up to breaker mechanism housing.								
10.00.00	DISCONNECTORS								
10.01.00	Type & Rating a) Disconnectors shall be of the single phase, single-pole, group operated type, installed in the switchgear at the locations as shown in the single-line								

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR		
	diagram to provide electrical isolation of the circuit breakers from the generator transformers, double bus and transmission lines. The disconnectors shall conform to IEC-62271-102 and shall have the following ratings and performance characteristics in addition to those specified:		
	i)	Rated Voltage (rms)	220 KV
	ii)	Rated Frequency	50Hz
	iii)	System Earthing	Effectively earthed
	iv)	Type	SF6 Insulated
	v)	Rated insulation level	Open contact Phase to Earth
	a)	One minute Power frequency withstand voltage across open gap	530 KV (rms) 460 KV (rms)
	b)	Lightning Impulse withstand Voltage across isolating distance	1200KVp 1050KVp
	vi)	Rated normal current	
		• Generator transformer module	1600 Amps
		• Line Module	1600 Amps.
		• Bus coupler module	1600 Amps
	vii)	Rated Short time withstand current for Disconenctor and earth switch	50KA (rms) for 1 sec
	viii)	Rated dynamic short circuit withstand current of Disconnector and Earth switch	100KAp
	xi)	Temperature rise over ambient temp.	As per IEC
	x)	Rated Mechanical terminal Load	As per IEC
	xi)	Rated supply voltages of closing and opening devices & auxiliary circuits phase & 415 V, 50Hz, three phase AC.	220 V DC ungrounded 240 V, 50Hz, single
	xii)	Total operating time of dis-connec-tor along with its operating mechanism	Not to exceed 12 seconds
	xiii)	Rated capacitive current make and break capacity	0.5 Amps.
	xiv)	Interruption of loop current	1600/20 A/V

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR
	xv) Partial discharge level at 1.1 Un/√3 5 pico coulombs xvi) Radio interference voltage 1000 micro-volts from frequency between 0.5 MHz and 2.0 MHz at 156 KV (rms) b) The Contractor shall offer only those dis-connectors which are guarded against the effect of VFTs (Very Fast Transients)
10.02.00	Duty Requirement Disconnecter and Earth switch shall be capable of withstanding the dynamic and thermal effects of the maximum possible short circuit of the system in their closed position. They shall be constructed such that they do not open under influence of short circuit current. The earth switches wherever provided shall be constructional interlocked so that the earth switches can be operated only when the disconnecter is open and vice versa.
10.02.01	The earthing switches shall be capable of discharging trapped charges of the associated lines
10.02.02	Disconnecter and earth switches shall be able to bear on the terminals the total forces including electro dynamic forces on the attached conductor without impairing reliability or current carrying capacity.
10.02.03	The disconnecter shall be capable of making/breaking normal currents when no significant change in voltage occurs across the terminals of each pole of the isolator on account of making /breaking operation.
10.03.00	Construction & Design a) The three pole group operated disconnectors shall be operated by electric motor suitable for use on AC/220 V DC ungrounded system and shall be equipped with a manual operating mechanism for emergency use. The motor shall be protected against over current & short circuit. 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 re-strikes 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.

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR
	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 switchyard control 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 six normally open and six normally closed contacts for use by others over and above those required for switchgear interlocking purposes. The auxiliary switch contacts are to be continuously adjustable such that, when required, they can be adjusted to make contact before the main switch contacts. 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 isolator 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 isolator and high-speed grounding switches from the bay module control panel should be achieved from the individual control switches with the remote/local transfer switch set to local. 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

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR									
10.04.00	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:									
	<table><tr><td></td><td>Sign</td><td>Back ground colour</td></tr><tr><td>Open position</td><td>Open</td><td>Green</td></tr><tr><td>Closed position</td><td>Closed</td><td>Red</td></tr></table>		Sign	Back ground colour	Open position	Open	Green	Closed position	Closed	Red
		Sign	Back ground colour							
	Open position	Open	Green							
	Closed position	Closed	Red							
	r) All the disconnecting switches shall have endoscopic arrangement allowing easy visual inspection of the travel of the switch contacts in both open and close positions, from the outside of the enclosure.									
	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.									
	Safety Grounding Switches									
	a) Three-pole, group operated, safety grounding switches shall be operated by electric motor for use on AC/ 220V DC ungrounded system and shall be equipped with a manual operating mechanism for emergency use. The motor shall be protected against over current and short circuit.									
b) In order to provide test facilities for CTs, transformers, cables etc., certain ground switches may require to be electrically insulated from the enclosures and have easily removable ground connections.										
c) Each safety grounding switch shall be electrically interlocked with its associated disconnecter and circuit breaker such that it can only be closed if both the circuit breaker and disconnecter are in open position. Safety grounding switch shall however be mechanically key interlocked with its associated disconnecter.										
d) Each safety grounding switch shall have clearly identifiable local positive driven mechanical indicator together with position indicator on the bay module control cabinet and provision for taking the signal to Power House Control Room.										
e) The details of the inscription and colouring for the indicator are given as under:										
	<table><tr><td></td><td>Sign</td><td>Background colour</td></tr><tr><td>Open position</td><td>Open</td><td>Green</td></tr><tr><td>Closed position</td><td>Closed</td><td>Red</td></tr></table>		Sign	Background colour	Open position	Open	Green	Closed position	Closed	Red
	Sign	Background colour								
Open position	Open	Green								
Closed position	Closed	Red								

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR
10.05.00	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 four normally open and four 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 and remotely at each bay module control cabinet & in the power house control room.
	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 operating mechanism for each phase suitable for operation from a AC/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 100 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.

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR									
	f) The details of the inscription & colouring for the indicator shall be as under: <table><thead><tr><th></th><th>Sign</th><th>Background colour</th></tr></thead><tbody><tr><td>Open position</td><td>Open</td><td>Green</td></tr><tr><td>Closed position</td><td>Closed</td><td>Red</td></tr></tbody></table> g) High-speed ground switch operation should be possible locally from the bay module control cabinet, or remotely from the Switchyard control 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 can not 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 four normally open(NO) and four 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.		Sign	Background colour	Open position	Open	Green	Closed position	Closed	Red
	Sign	Background colour								
Open position	Open	Green								
Closed position	Closed	Red								
11.00.00	CURRENT TRANSFORMERS									
11.01.00	General									
11.01.01	The current transformers and accessories shall conform to IEC-60044-1 and other relevant standards except to the extent explicitly mentioned in the specification.									
11.01.02	The particulars of the various cores may change within reasonable limits as per the requirements of protection relays. The contractor is required to have these values confirmed from the Employer before proceeding with design of the cores. The other characteristics of CTs shall be as given below:									

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR		
11.01.03	Type & Rating		
	a)	i)	Rated short time thermal current for 1sec., kA(rms) 50
		ii)	Rated dynamic current kA (peak) 100
		ii)	Rated insulation levels
			- 1 Min.power frequency withstand voltage 460kV
			- 1.2/50micr.sec. lightning impulse withstand voltage 1050kV
		iv)	Power frequency over voltage with-stand requirements for secondary windings As specified
		v)	Limits of temperature rise As per IEC 185
		vi)	Maximum radio interference Not exceeding 1000 micro voltage at 156 KV (rms)
		vii)	Partial discharge level, pC at 1.1 Un / √3 5 or less
11.01.04	viii)	Nos. of Core As per specify in detailed Engineering stage/SLD	
	ix)	Accuracy class of Measuring Current Transformer 0.2	
	Construction Details		
	a)	The current transformers incorporated into the GIS will be used for protective relaying and metering and shall be of metal-enclosed type. The secondary windings shall be air insulated and mounted inside the metal enclosure or shall be housed in gas compartment and terminals are brought out to a separate box for facilitating connection to external cables. 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 pannels 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		

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR																							
	arrangement of the current transformer cores with respect to the primary terminals (P1 & P2) 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. d) Current transformers guaranteed burdens and accuracy class are to be intended as simultaneous for all cores. e) The current transformers shall be suitable for high speed auto re-closing. f) Electro magnetic shields to be provided against high frequency transients typically 1-30 MHz. g) Provision shall be made for primary current injection testing of current transformers.																							
12.00.00	BUS VOLTAGE TRANSFORMERS																							
12.01.00	General																							
12.01.01	The voltage transformers and accessories shall conform to IEC 60044-2 and other relevant standards except to the extent explicitly mentioned in the specification.																							
12.01.02	Voltage transformers shall be of the electro magnetic type with SF ₆ gas insulation. The earth end of high voltage winding and the ends of secondary winding shall be brought out in the terminal box.																							
12.01.03	The rating and diagram plate shall be provided complying with the requirement of IEC specification incorporating the year of manufacture and including turns ratio, voltage ratio, burden, connection diagram etc.																							
12.01.04	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.																							
12.01.05	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.																							
12.01.06	The transformer shall be able to sustain full line voltage without saturation of transformer.																							
12.01.07	<table><tr><td colspan="2">Type and Rating</td><td></td><td></td><td></td></tr><tr><td></td><td>Parameter</td><td>Winding-I</td><td>Winding-II</td><td>Winding-III</td></tr><tr><td>a)</td><td>Rated secondary voltage, V</td><td>110/√3</td><td>110/√3</td><td>110/√3</td></tr><tr><td>b)</td><td>Rated secondary burden, VA</td><td>50</td><td>50</td><td>50</td></tr></table>				Type and Rating						Parameter	Winding-I	Winding-II	Winding-III	a)	Rated secondary voltage, V	110/√3	110/√3	110/√3	b)	Rated secondary burden, VA	50	50	50
Type and Rating																								
	Parameter	Winding-I	Winding-II	Winding-III																				
a)	Rated secondary voltage, V	110/√3	110/√3	110/√3																				
b)	Rated secondary burden, VA	50	50	50																				

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR					
12.01.08	c)	Accuracy class	0.2	3P	3P	
	d)	Utilisation	Metering	Spare	Protection	
	e)	Transformation ratio for all windings		220 / $\sqrt{3}$ KV	110/ $\sqrt{3}$ V	
	f)	Temperature rise		As per IEC		
	g)	Voltage factor		1.5 for 30 sec.		
	h)	Rated insulation level				
		- 1 Min.power frequency withstand voltage		460kV		
		- 1.2/50micr.sec. lightning impulse withstand voltage		1050kV		
	i)	One minute power frequency with-stand voltage for secondary winding		3KV (rms)		
	j)	Radio interference voltage at 1.1Un/ $\sqrt{3}$ and frequency range 0.5 to 2 MHz at 156 KV (rms)		1000 micro volts		
	k)	Partial discharge level		5 pico coulombs or less		
	Constructional 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, nonresistant and shall be contained in their own- SF ₆ 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.					
c)	The voltage transformer secondary shall be wired to their associated secondary circuit breakers in the bay control cabinets.					
13.00.00	SF6 BUSHING CONNECTION					
13.01.00	SF6 GIS to XLPE Cable Termination		Not Applicable			
	a)	The 220 KV overhead lines emanating from surface pothead yard are to be connected to 220 KV GIS by the interfacing of XLPE cable sealing end to SF₆ gas filled bushing compartment. The SF₆ gas filled cable termination housing suitable for making connection to 500 mm² XLPE Copper Cable is under the scope of Contractor. The ducts and the casing shall be suitable for				

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR						
	the requirements for which it is designed. The Cable termination kit alongwith its insulators and structure shall be within the Contractor's scope. The Contractor shall have to supply all the details for proper co-ordination with the XLPE cable. This interface section shall be designed in a manner which will allow ease of operation and maintenance. b) The inter connecting bus duct shall employ capacitive grading and shall be divided into independent gas compartments by a barrier insulator with grading electrodes. The inter connecting GIS compartment shall be filled with SF₆ gas. The gas space on the switchgear side of the barrier insulator shall have the same SF₆ gas pressure as that of switchgear. e) The SF₆ GIS to XLPE cable termination shall conform to IEC 62271-305 (latest edition) and shall have the following ratings: <table><tr><td>(a)</td><td>Rated lightning impulse with stand voltage</td><td>1050 KV (peak)</td></tr><tr><td>(b)</td><td>One minute power frequency withstand voltage</td><td>460 KV (rms)</td></tr></table> The copies of the type test certificates shall be supplied by the contractor along with the offer. d) The provision shall be made for a removable link. The gap created when the link is removed should have sufficient electric strength to withstand the switchgear high voltage site tests. The Contractor may suggest alternative arrangements to meet these requirements. The corona rings/stress shields for control of electrical field in the vicinity of the isolation gap shall be provided by the GIS supplier. e) All supporting structures for the SF₆ bus duct connections between the XLPE cable sealing ends and the GIS shall be supplied by the GIS supplier. f) All contact surfaces of external terminals shall be silver plated using pure silver. g) Sufficient interconnecting bus shall be supplied to connect together the various items of equipment. Bus stubs with appropriate caps shall be provided. The provision for return current conductor shall be made at the interface by the contractor. h) The openings for access shall be provided in each phase terminal enclosures as necessary to permit removal of connectors to isolate the XLPE cables to allow carrying out of insulation tests. The typical arrangement drawing of interconnecting bus duct from GIS bay module to XLPE cable termination end shall be submitted along with offer.	(a)	Rated lightning impulse with stand voltage	1050 KV (peak)	(b)	One minute power frequency withstand voltage	460 KV (rms)
(a)	Rated lightning impulse with stand voltage	1050 KV (peak)					
(b)	One minute power frequency withstand voltage	460 KV (rms)					
13.02.00	Interface Between SF6 GIS to Transformer Oil Bushings a) The enclosure of the SF₆ gas -to-oil bushings of the generator transformers shall be supplied by the GIS supplier and shall provide the transition section between the enclosure of SF₆ equipment and the SF₆ gas to-oil bushing of the transformer . The region adjacent to the interface point shall						

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR
	meet the minimum requirement as per IEC-62271-306. The ducts and the casing shall be suitable for the requirements for which it is designed. The Contractor shall specify the forces which shall be transmitted to the SF₆ bushing of the transformer. GIS equipment offered by the contractor should also with-stand the forces from transformer to GIS, as intimated by the transformer supplier. The Contractor shall have to supply all details for proper co-ordination with the transformer alongwith the offer. This interface section shall be designed in a manner which will allow ease of operation and maintenance generator transformer bushing. This interfacing portion shall be suitably sectionalized along with SA. b) Provision shall be made for a removable link. The gap created when the link is removed should have sufficient di-electric strength to withstand the switchgear high voltage site tests. The corona rings/stress shields for control of electrical field in the vicinity of the isolation gap shall be provided by the GIS supplier. c) The SF₆ gas pressure within the termination compartment at the junction of the transformer bushing and the SF₆ duct shall be 5.3 bar at 200° C to ensure correct environment for the SF₆ bushing termination. d) Supporting structures for the SF₆ duct connections between the transformer and the GIS shall be supplied by the Contractor. The requirements of any of the interface drawing for civil construction works of the foundation and installation of the equipments shall also be included in the offer. e) Effective forces generated during the operation of transformer and those generated in the enclosure and the conductors of the SF₆ equipment shall not exceed the allowable limits specified in the relevant IEC standard. f) Precise positional alignment of the enclosures is of crucial importance. The location and tolerances for the connection between the transformer and the equipment shall be specified by the Contractor. The Contractor is required to make provision for alignment and positional adjustment within the equipment. g) Sufficient interconnecting bus shall be supplied to connect together the various items of equipment. Bus stubs with appropriate caps shall be provided. h) The connection at transformer shall allow atleast 25mm of movement in any direction. The openings for access shall be provided in each phase terminal enclosures as necessary to permit removal of connectors to isolate the step-up transformer to carry out insulation tests. The typical arrangement drawing of interconnecting bus-duct from GIS bay module to step up transformer bushing housing shall be submitted along with offer. The interface equipment shall incorporate following features. i) Housing to cover the transformer HV side oil to SF₆ bushing. This housing shall be filled with SF₆ gas after assembly.

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR
	ii) Porcelain bushing with oil and SF₆ gas separating barrier insulator and flexible connections between transformer HV terminal & SF₆ bus duct conductor is to be housed inside the enclosure. iii) The lateral mounting unit shall be suitable to allow axial assembly tolerances and to allow the transformers to be easily connected to or disconnected from the switchgear. iv) Compensators shall be provided to avoid transfer of the transformer vibrations to the switchgear. i) SF₆ gas enclosure at the SF₆ to oil bushing shall conform to the relevant IEC and meet all the technical requirements as specified.
14.00.00	SURGE ARRESTORS
14.01.00	Each arrester shall conform to IEC-60099-4 for Gapless Arrester wherever applicable and shall have the following technical performance characteristics and ratings.
15.00.00	DUTY REQUIREMENTS
15.01.00	The surge arrester shall be of heavy duty station class and gapless (metal oxide) type without any series or shunt gaps.
15.02.00	The Surge Arresters (SAs) shall be capable of discharging over-voltages occurring due to switching of unloaded transformers and long lines.
15.03.00	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.
15.04.00	The SAs shall be fully stabilised thermally to give a life expectancy of one hundred (100) years under site conditions.
15.05.00	The SAs shall be suitable for circuit breaker duty cycle in the given system.
15.06.00	The SAs shall protect power transformers, circuit breakers, disconnecting switches, instrument transformers, etc with insulation levels specified in this specification.
15.07.00	The SAs shall be capable of withstanding meteorological and short circuit forces under site conditions.
15.08.00	The surge arrestors are provided to protect the following equipment whose insulation levels are indicated in the table A given below. The contractor shall carry out the insulation coordination studies for deciding the location of the surge arrestors.

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR		
	TABLE – A		
	SNO.	EQUIPMENT TO BE PROTECTED	INSULATION LEVEL LIGHTNING IMPULSE (KVp) FOR 220 KV SYSTEM
	1.	Power Transformer	950
	2.	Instrument Transformer	1050
	3.	CB/Isolator	
		- Phase to ground	1050
		- Across opencontacts	1200
15.09.00	220 kV class arrestors shall be capable of discharging energy equivalent to class 3 of IEC for 220 kV system on two successive operations.		
15.10.00	Type & Rating		
	i)	Rated system Voltage	220KV
	ii)	System neutral earthing	Effectively earthed
	iii)	Rated voltage of arrestor KV (rms)	198
	iv)	Rated frequency	50Hz
	iv)	Class of arrestor	Station type, heavy duty, SF ₆ gas-insulated, non linear zinc oxide gap less
	v)	Maximum continuous operating voltage capability, (L-N), KV rms	168 kV
	vi)	Nominal discharge current	10 KA of 8/20 micro-sec. wave
	viii)	Long duration discharge class	3
	ix)	Low current long duration test value (2000 micro sec.)	1000 A
	x)	Pressure relief class	Class A of Table VII of IS: 3070 or equivalent IEC.
	xi)	Partial discharge at 1.05 MCOV (Continuous operating voltage)	Not more than 50 p.C.

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR (E17)
	xii) Maximum residual voltage at i) 10KA nominal discharge current 600 KVp ii) 5 KA nominal discharge current 560 KVp xiii) Steep fronted wave residual voltage at 10KA 650 KVp xiv) Current for pressure relief test 50 KA (rms) xv) Prospective symmetrical fault current 50 KA for 1 Sec. xvi) High current short duration test Value (4/10 micro second work) 100KAp xvii) One minute dry/wet power frequency withstand voltage of arrestor housing 460 KV (rms) xviii) Lightning impulse withstand voltage of equipment to be protected: - Transformers, KV (peak) 950 - GIS component, KV (peak) 1050 xix) Radio interference voltage at 156 KV(rms) Not exceeding 1000 micro-volts xx) Partial discharge level at 1.1 Un /√3 5 or less Pico coulombs xxi) Energy level 5 KJ/KV (minimum) xxii) Connection to system Phase to earth
15.10.01	The contractor may select the technical parameters and characteristics of the surge arrestor so as to obtain a security ratio of atleast 1.30 under all conditions of over voltages and the basic insulation provided for the transformer winding. The contractor shall furnish a report containing the technical justification & calculations in support of the selection of the location and other technical parameters of the surge arrestor along with his bid.
15.10.02	This study report should highlight the technical comments on the proposed rated voltage, the line discharge class and the energy handling capacity. The basis for selecting the line discharge class as indicated in the offer may also be furnished along with the offer.
15.10.03	The contractor shall perform an insulation co-ordination study after award of contract to verify that protection of switchgear, main transformers against over voltages is adequate. The final surge arrestor characteristics, their numbers and exact locations of surge arrestors shall be decided after this study.

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR
15.11.00	Construction Details
15.11.01	One SF6 gas insulated, metal enclosed surge arrestor of the gapless non linear zinc oxide, heavy duty, station type shall be located on H.V. side of each generator transformer and one outdoor Lightning Arrestor on each outgoing feeder bay (Line side). Bidder to consider the number of LAs as indicated in the Single line Diagram in drawing no: TB-VYASI-220kVGIS-01 as minimum quantity. However additional Lightning Arrestors if required based on the insulation coordination/transient analysis studies for switchyard systems to be carried out by the Contractor during detail engineering, is also in the scope of the Contractor
15.11.02	The arrestor enclosure shall be vertically or horizontally mounted to suit the layout of the switchgear as suggested by the contractor and shall be fitted with a discharge counter located in an easily accessible position.
15.11.03	The main grounding connection from the surge arrestor to the earth shall be provided by the Contractor. The size of the connecting conductor shall be such that all the energy is dissipated to the ground without getting overheated.
16.00.00	BUSBARS
16.01.00	The conductors of the bus bars shall be fabricated from aluminum tubular sections of cross- sectional area suitable to meet the current rating requirements. The bus bars shall be housed in One/3 phase enclosure. The tubular bus section shall be housed in corrosion resistant aluminum enclosures, filled with pressurized SF ₆ gas. The conductors shall be supported from the enclosures by homogeneous epoxy resin insulators shaped to ensure uniform electrical field distribution and zero corona at rated voltage. Adequate provisions shall be made for absorption of the thermal expansions between the conductors and the enclosures. The metal bellow type compensators for adjusting tension shall be provided where 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.
16.02.00	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.
16.03.00	Main bus bars shall be designed to have future extension bay as indicated in the single line diagram. The bus conductor end connectors and enclosure flanges shall be designed accordingly.
16.04.00	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 Contractor.
16.05.00	The interior of all the enclosures except cast flanges of aluminium / aluminum alloy shall not be painted.
16.06.00	The SF ₆ GIS bus-bars shall have continuous current rating of 1600 Amps.

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR
16.07.00	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.
16.08.00	Where the interconnecting GIS bus passes through building walls, flooring or other enclosures, the Contractor shall supply the wall plates, flanges and their fixtures.
16.09.00	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 contractor must submit details of the means deployed along with the offer.
16.10.00	The "Interface" requirements between the equipments shall be in the scope of Contractor.
16.11.00	Each gas compartment barrier shall be easily identifiable from the outside of the switchgear. The means of identification used shall be a black band, approx. 10mm wide, permanently affixed to the barrier insulator on the outer surface of the enclosure at the location of the barrier insulator. In case of leakage of the gas from any compartment, indication of respective compartments should be provided on the annunciator.
17.00.00	CONTROL EQUIPMENT
17.01.00	Circuit Breaker Accessories/Auxiliary Equipment
17.01.01	The accessories and auxiliary equipment to be supplied with the circuit breaker and other components of the same bay module shall include all parts necessary for proper functioning of the circuit breaker as well as the following items to be installed in the breaker control cabinet: a) Operation counter, electrically operated. b) One set of adequately rated thermostatically controlled, anti-condensation heater with provision for monitoring of heater failure, wired to terminal blocks. c) Pair of copper grounding terminals to be located near the control cable entrance. d) Operating mechanism, pressurizing unit, gauges and switches. e) All motors shall have individual thermal over-current protection. f) Circuit breaker SF₆ gas pressure monitoring Unit g) One vermin-proof sheet steel cabinet of class IP-42 and adequate size shall be provided for housing the operating mechanism, control and auxiliary equipment and for terminating all control, alarm and auxiliary circuits in suitable terminal blocks. The control cabinet shall be provided with hinged doors with provision for locking and removable cable gland plates for bottom cable entry. The viewing windows shall be provided for observation of the instruments without opening the cabinet. Suitably

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR
	engraved name plates shall be provided to identify all the equipment in the control cabinet.
17.01.02	All control wiring and terminations from the circuit breaker cubicle to the switchgear bay module control cabinet shall be provided by Contractor.
17.01.03	All control cables shall be PVC insulated, shielded, Fire Retardant, Low Smoke (FRLS) with stranded copper conductors. Cable shields shall be grounded at both ends. Grounding connections shall be as short & direct as possible and shall terminate at the point of entry to cabinets or terminal boxes.
17.01.04	Coaxial type cable glands suitable for use with shielded cables shall be used at each termination.
17.01.05	All control cables termination shall be plug-in type and shall be installed in such a manner as to limit the effects of transient electromagnetic voltage on the control cables to an acceptable level.
18.00.00	BAY MODULE CONTROL CABINETS
18.00.01	Each switchgear bay module shall be suitable for local control and remote control (Switchyard control room in GIS hall and from power house control room as well as Remote control centre). Main control cabinet for GIS equipment shall be of the floor standing type. The cabinet shall have double, full height, hinged, gasketed, lockable doors. One door shall have a safety glass window through which the various switchgear controls can be viewed without opening the doors.
18.00.02	The cabinet will be utilized for the switchgear bay local control module and as the terminating center for all power supply, control annunciation and supervisory wiring interfacing.
18.00.03	The following equipments shall be mounted on the cabinet door: - Remote/local control transfer switch for the circuit breakers and disconnecter switches. - Normal operation/maintenance control transfer switch for dis-connector of remote electrical controls. - Mimic diagram of the switchgear bay complete with semaphore indicators for the switchgear component position indication and local control switches for open / close or close-trip control of the circuit breaker, isolators and grounding switches. The following equipments shall be mounted internally in the cabinet: - All bay switchgear interlocking wiring and auxiliary relays. - AC and DC power supply circuit breakers. - All necessary incoming and outgoing terminal blocks. - Space heaters

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR
	- All instruments and devices required for supervision & control of GIS
18.00.04	The bus voltage transformer secondary terminal circuit breaker will be mounted with in the bus VT bay module control cabinet.
18.00.05	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.
18.00.06	Each annunciator module shall have electrically separate changeover contacts for remote alarm indication. Each remote alarm contact shall be wired to terminal blocks. The annunciator panel shall be complete with an audible warning horn, acknowledge/reset for horn silence and lamp test push buttons. The horn shall automatically silence if the acknowledge reset button is not operated within 1 minute of the alarm initiation. However, the illuminated window of the fault point shall continue to flash until the acknowledge signal is given.
18.00.07	The control cabinets shall be suitable for bottom entry of cables.
19.00.00	SUPPORTING STRUCTURES
19.01.00	The Contractor 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 Employer.
19.02.00	The floor of the switchgear building will be designed to support all the loads imposed by the equipment supporting framework. The Contractor 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 Contractor shall supply the details of static and dynamic loads to be supported by the slab along with the offer.
19.03.00	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.
19.04.00	All steel structure members shall be hot dip galvanised.
19.05.00	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.
20.00.00	SF₆ GAS PROCESSING UNIT
20.01.00	SF₆ gas processing unit suitable for evacuating, liquefying, evaporating, filling, drying, storing and purifying SF₆ gas during the initial installation, subsequent maintenance and future extension of GIS, shall be provided. The cart shall be equipped with rubber wheels and shall be easily maneuverable by two workers on the GIS floor. The unit shall be provided with gas testing kit to measure the moisture contents of the gas and with pressure monitoring system. The instrument for the measurement of acidity shall also be provided along with nozzle etc.

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR
20.02.00	The unit shall be self-contained (except for additional gas storage bottles) and fully equipped with at least an electric vacuum pump, gas compressor, gas drier, gas filter, refrigeration unit, evaporator, gas storage tank, full instrumentation for measuring vacuum on vacuum pump, compressor inlet temperature, tank pressure and temperature, valves and piping to perform the following operations as a minimum requirement: i. Evacuation from a gas filled compartment using the vacuum pump. ii. Transfer of SF₆ gas from a system at some positive or negative pressure to the storage tank via the gas drier and filter. iii. Recirculation of SF₆ gas in the storage tank through the drier. iv. Recirculation of SF₆ gas in any switchgear or bus duct compartment through the drier and filter. v. Evaporating and filling SF₆ gas. vi. Drawing off and liquefying SF₆ gas. vii. A combination operation of filling SF₆ gas into gas system and evacuating a second gas system using the vacuum pump. viii. Pressure monitoring. ix. Measurement of moisture content & acidity measurement. Separate portable instruments should be included in the offer
21.00.00	MONITORING
21.01.00	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 each circuit breaker 3-pole tripping plus isolation of the circuit breaker through automatic opening of the associated disconnecting switches. All wiring shall be in the scope of the Contractor. For wiring between the GIS compartment gas density switches and the terminals in the circuit breaker control cabinet continuous shielded cable shall be used.

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR
21.02.00 21.03.00 21.04.00 21.05.00	Additional Monitoring equipments as per Annexure-II shall also be in the scope of the contractor. 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. Each gas section shall be fitted with a suitable valve for routine gas sampling. The Contractor shall satisfy the Employer regarding accuracy limits of gas monitoring devices. 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 Condition: 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.

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR
22.00.00	TECHNICAL REQUIREMENTS
22.01.00	Common Requirements All the SF6 gas insulated circuit breakers, dis-connectors, grounding switches and bus bars shall be of single isolated phase type.
22.02.00	Protective Finish 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 Contractor.
22.03.00	Fire Retardancy a) All components shall be fire retardant and shall be tested in accordance with IEC 695. Gas emissivity when the material is heated shall be minimal. PVC material shall not be used. b) Control cables in a grouped environment shall not catch fire, flame or continue to burn when tested as per IEC 695. The method of test and criteria for success or failure shall be in accordance with the above IEC.
23.00.00	GROUNDING
23.01.00	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.
23.02.00	The contractor shall define clearly what constitutes the main grounding bus of the GIS. The contractor must supply the entire material for grounding bus of GIS viz conductor, clamps, joints, bimetallic strips (for connection between different type of earthing materials), operating and safety platforms etc. The contractor is also required to supply all the earthing conductors and associated hardware material for the following: i) Connecting all GIS equipment, bus ducts, enclosures, control cabinets, supporting structure etc. to the ground bus of GIS. ii) Connecting grounding bus of GIS to the ground mat riser in transformer cavern to be provided by the Employer.
23.03.00	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.

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR
23.04.00	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.
23.05.00	The grounding connector shall be of sufficient mechanical strength to withstand electromagnetic forces as well as capable of carrying the anticipated maximum fault current without overheating. At least two grounding paths shall be provided to connect each point to the main grounding bus. Necessary precautions should be undertaken to prevent excessive currents from being induced into adjacent frames, structures of reinforcing steel and to avoid establishment of current loops via other station equipment. Care should be taken to prevent discontinuities in enclosure grounding path at the transformer connections to GIS to prevent circulating currents in the circuit breaker and transformer tank made of steel.
23.06.00	All flexible bonding leads shall be of tinned copper. All connectors, for attaching flexible bonding leads to grounding conductors and grounding conductors to support structures shall be tinned bronze with stainless steel or tinned bronze hardware.
23.07.00	The contractor 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 contacts during switching operation. The grounding system shall ensure safe touch & step voltages in all the enclosures. The contractor shall provide suitable barrier of non-liner resistor/counter discontinued SF6/Transformer and SF6/ HV cable bushing etc. to mitigate transient enclosure voltage.
24.00.00	HIGH VOLTAGE TRANSIENTS High voltage transients from switching operations and internal faults are coupled to the external enclosure of the GIS. Since the effects of these transients on people are not known, the operating personnel are required to avoid contact with the enclosure during switching operations. Such a restriction is considered undesirable. The Contractor is therefore required to furnish the details of the devices and techniques to be deployed by him for reducing transients to an acceptable level along with his offer.
25.00.00	BURN THROUGH PREVENTION
25.01.00	The Contractor shall furnish the details regarding the design features of their equipment which are intended to prevent burn through when an internal arc occurs. Internal arcing test reports for aluminum enclosures of a similar configuration and wall thickness of the equipment should be included in the offer. The worst case of fault with an arc adjacent to a spacer should be considered and discussed in the offer. The effect of pressure rise and time to burn through should also be discussed for an internal arc. The latest and most efficient technique of burn through shall be incorporated by the Contractor and the details of the same shall be furnished by the Contractor along with the offer.
25.02.00	The Contractor is required to furnish the details regarding techniques to be used by him to reduce or eliminate the probability of burn through.

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR
26.00.00	BOLTING REQUIREMENTS
26.01.00	The details of bolt sizes and threading shall be shown on the appropriate drawings.
26.02.00	Where self locking type of nuts are used, they shall be of the reusable type. The pressed type of nuts are not acceptable.
26.03.00	The GIS supplier shall arrange all the foundation bolts, embedment and insertions as required well in advance in order to enable the contractor to make provision for these embedment in the slab as required.
27.00.00	HEATERS
27.01.00	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.
27.02.00	All the thermostats and the temperature indicating devices shall be calibrated in metric units.
28.00.00	SERVICE LIFE
28.01.00	SF ₆ 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. In order to minimize maintenance and component replacement, the Contractor shall submit proof that all offered SF ₆ GIS equipments has withstood a life of 2000 mechanical operations. The maintenance free period for any of its external components shall not be less than 5 years intervals & internal components including refilling of gas shall not be less than 10 years. The Contractor shall propose the recommended period for scheduled maintenance.
29.00.00	WELDING
29.01.00	Pressure Vessel and Pressure Pipe Welding
29.02.00	The pressure vessel and pressure piping shall be designed and built according to the requirements of International standards for construction & inspection of boilers and pressure vessels.
29.03.00	All welding and brazing must satisfy the requirements of the relevant Indian/International standards.
29.04.00	In addition to the requirements of the specifications, the following requirements shall also be fulfilled: a) All welding procedures to be used in the fabrication of pressure vessels and piping shall be submitted to Employer for approval. These procedures must be in consistence with the International Standards. b) All butt welds shall be full penetration welds

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR
	c) All the welding works shall be performed by the qualified welders and the test certificates of welder qualification duly approved by reputed test house shall be submitted to the Employer.
29.05.00	Non-Destructive Examination Procedure (NDE) NDE procedures to be adopted by the fabricator shall be submitted to the Customer for approval. As a minimum requirement, butt welds on pressure vessels and pressure piping shall be subjected to radiography inspection.
30.00.00	INSPECTION AND TESTING
30.01.00	General
30.01.01	All the equipment, apparatus, materials and supplies provided by the contractor under this contract shall be subjected to tests in the shop and at the field in the presence of Employer for conformity with the requirements of the specifications. The method and procedure of the tests shall be as specified for the particular item or shall be in conformity with the applicable recognized standards for performing such test. The details of the test procedures and test equipment to be used should be intimated to the Employer well in advance i.e. not less than 30 days before these tests are conducted. Unless otherwise specified, the contractor shall perform all shop and field tests.
30.01.02	The Contractor shall submit a detailed quality assurance plan within 30 days after the commencement date intimating the testing program to the Employer for approval. The testing of the related equipment shall be coordinated so that testing may proceed with minimum delay. The performance tests shall start, proceed, stop and be resumed in accordance with the approved schedule.
30.01.03	The Contractor 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 will be subjected to such retesting as may be necessary until the equipment is proved to be in satisfactory operation.
30.01.04	Within 30 days of completion of each and every specified test, including commissioning tests, the Contractor shall submit six signed copies of the test reports to the Employer.
30.01.05	The test reports shall indicate the tests performed, the results obtained, instruments used, names of personnel carrying out the tests and provisions for signatures of witnesses. They shall also show the number and date. The format of these reports shall be submitted along with testing procedure for the Employer's approval well in advance.
30.01.06	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.

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR
	- Data in tabulated form - The comparison of the test results with the guaranteed requirements of the specification and explanation of deviations, if any.
30.02.00	Shop Tests
30.02.01	All major parts of the equipment, especially those necessitating sub-division of parts for transport and subsequent reassembly at site, shall be match assembled in the factory and carefully match marked before dismantling. The dowel holes shall be provided with dowels to assist in reassembly. The accuracy of fitting has to be assured at site at all stages of assembly.
30.02.02	Each transport section of switchgear shall be shop tested.
30.02.03	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 switch gear. However, for electronic modules, equipment and individual components temperature & voltage stress tests shall also be performed. Routine tests shall be conducted by automatic processes, wherever practicable particularly during testing of wiring. An example of the other tests referred to above would be as follows: a) Verification of terminal markings and accuracy & composite error tests for current and potential transformers. b) Routine and standard acceptance tests for surge arrestors specified in IEC 60099-4 relevant to metal oxide type arrestors without gaps. c) Routine tests (on transport section): i) Dry Power frequency voltage with-stand 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

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR
30.03.00	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 60694/ 62271-1. In addition, corrosion protection tests at random on all equipment shall be performed. Mechanical Tests Mechanical tests shall be carried out as per respective IEC and also include the following. (a) Mechanical operation of Circuit Breaker - 25 open and close operations at rated voltage & rated pressure. - 5 open and close operations at minimum voltage & minimum pressure. - 5 open and close operations at maximum voltage & maximum pressure. - 5 close - open cycles at rated voltage and rated pressure. - 5 open-close-open cycles at rated voltage and rated pressure. - 5 close open operating cycles with the tripping mechanism energized by the closing of the main contacts. - 5 open-close sequences 0-0.3 sec-CO-3 min-CO for breakers. (b) The operating times are to be recorded as follows: - Opening time measured at rated supply voltage for each pole. - Closing time measured at rated supply voltage for each pole. - Recording of time travel diagram. - Measure hydraulic mechanism recharging time after one opening and closing. (c) Mechanical operation of Disconnecter and Ground Switches - 5 open/close cycles at rated voltage. - 5 open/close cycles at minimum voltage. - 5 open/close cycles at maximum voltage.

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR
30.04.00 30.04.01	- Ensure operation of interlocks in proper sequence. (d) Gas tightness leak test on single pole assembly of switchgear module. (e) Design and visual checks as per respective IEC. Electrical Tests/Routine Tests The electrical tests to be performed on the specified factory assemblies shall be as per respective IEC and shall include the following: - Main circuit resistance measurement for each pole. - Measurement of resistance of circuit breaker close and trip coils. - Measurement of power consumption of motor operated mechanism at rated supply voltage. - Ensure operation of electrical interlocks in proper sequence. (a) Control cubicle - Operation or functional checks of all circuits at rated supply voltage. - Dielectric test of auxiliary circuits at 2000 V at 50 Hz for one minute. - Operation test of all pressure density monitoring switches. - Dielectric tests (in the following order): - Power frequency withstand test - Partial discharge test (b) Current transformers (As Per IS-2705 / IEC 60044-1) i) Verification of terminal marking & polarity. ii) Power frequency dry withstand tests on primary windings iii) Power frequency dry withstand tests on secondary windings iv) Over voltage inter-turn test v) Determination of errors or other characteristics. vi) Partial Discharge tests (as per IS: 11322) For the protective current transformers the following additional tests shall be performed: i) Knee point voltage test

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR
	ii) Exciting current test iii) Secondary winding resistance tests iv) Turns ratio test v) For the protective current transformers (other than class PS type the following additional tests should be performed: vi) Current error & phase displacement vii) Composite error test (c) Surge arrestors (As per IEC-60099-4). i) Measurement of reference voltage. ii) Residual voltage test. iii) Satisfactory absence from partial discharges & contact noise to be checked on each unit by any sensitive method adopted by contractor. iv) A leakage check may be made on each unit by any sensitive method adopted by contractor in case of arrester unit with sealed housing. v) Current distribution test for multi-column arrester. (d) Dis-connectors & grounding switches (As per IEC-62271-102) i) Power frequency voltage with-stand dry tests of the main circuit and auxiliary circuits. ii) Voltage with-stand tests on auxiliary and control circuits. iii) Measurement of the resistance of the main circuit. iv) Mechanical operating tests v) Tests to prove as per IS: 9921 (e) Voltage transformers (As per IEC 60044-2/IS: 3156) i) Verification of terminal marking and polarity ii) Power frequency dry withstand tests on primary and secondary windings. iii) Determination of errors or other characteristics iv) Partial discharge measurement as per IS: 11322

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR																																																																																																									
	(f) Routine tests for circuit-breakers (as per IEC 62271-100): i) Power frequency voltage withstand of dry tests on the main circuit ii) Voltage withstand tests on control and auxiliary circuits iii) Measurement of the resistance of the main circuit iv) Mechanical operating tests v) Design and visual checks																																																																																																									
30.05.00	Any assembly which fails to meet the requirements of these tests shall not be shipped, without the specific approval of the Employer.																																																																																																									
30.06.00	In addition to the above tests, all the enclosures shall be pressure tested after manufacture in accordance with the latest requirements of IEC 62271-203.																																																																																																									
30.07.00	The routine tests for bus bars shall be as per the relevant IEC standard and shall include the tests as specified.																																																																																																									
	PERCENTAGE CHECKS TO BE APPLIED FOR VARIOUS TESTS <table><tr><th>Sl. No</th><th>Name of the Test</th><th>Support Insulator</th><th>Gas Barrier</th><th>Enclosure</th><th>Conductor</th><th>Accessories</th></tr><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td></tr><tr><td>i)</td><td>Dimension</td><td>100%</td><td>100%</td><td>100%</td><td>100%</td><td>100%</td></tr><tr><td>ii)</td><td>Gas Tightness</td><td>-</td><td>100%</td><td>100%</td><td>-</td><td>100%</td></tr><tr><td>iii)</td><td>Pressure Test</td><td>-</td><td>100%</td><td>20%</td><td>-</td><td>-</td></tr><tr><td>iv)</td><td>Welding (X-ray)</td><td>-</td><td>-</td><td>10%</td><td>-</td><td>-</td></tr><tr><td>v)</td><td>Electric resistance</td><td>-</td><td>-</td><td>-</td><td>100%</td><td>-</td></tr><tr><td>vi)</td><td>50Hz voltage with-stand</td><td>100%</td><td>100%</td><td>-</td><td>-</td><td>-</td></tr><tr><td>vii)</td><td>Partial discharges</td><td>100%**</td><td>100%</td><td>100%</td><td>-</td><td>-</td></tr><tr><td>viii)</td><td>Section shall be RIV free at 2 times rms line to ground</td><td>100%</td><td>100%</td><td>100%</td><td>100%</td><td>-</td></tr><tr><td>ix)</td><td>Weld shall be leak tested with SF6 leak detector</td><td>-</td><td>-</td><td>100%</td><td>-</td><td>-</td></tr><tr><td>x)</td><td>Contact resistance measurement at plug in contact</td><td>-</td><td>-</td><td>-</td><td>100%</td><td>-</td></tr><tr><td>xi)</td><td>Cleanliness aspect</td><td>100%</td><td>100%</td><td>100%</td><td>100%</td><td>100%</td></tr><tr><td>xii)</td><td>Silvering</td><td>-</td><td>-</td><td>-</td><td>*</td><td>-</td></tr><tr><td>xiii)</td><td>Packing</td><td>*</td><td>*</td><td>*</td><td>*</td><td>*</td></tr></table>	Sl. No	Name of the Test	Support Insulator	Gas Barrier	Enclosure	Conductor	Accessories	1	2	3	4	5	6	7	i)	Dimension	100%	100%	100%	100%	100%	ii)	Gas Tightness	-	100%	100%	-	100%	iii)	Pressure Test	-	100%	20%	-	-	iv)	Welding (X-ray)	-	-	10%	-	-	v)	Electric resistance	-	-	-	100%	-	vi)	50Hz voltage with-stand	100%	100%	-	-	-	vii)	Partial discharges	100%**	100%	100%	-	-	viii)	Section shall be RIV free at 2 times rms line to ground	100%	100%	100%	100%	-	ix)	Weld shall be leak tested with SF6 leak detector	-	-	100%	-	-	x)	Contact resistance measurement at plug in contact	-	-	-	100%	-	xi)	Cleanliness aspect	100%	100%	100%	100%	100%	xii)	Silvering	-	-	-	*	-	xiii)	Packing	*	*	*	*	*
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CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR
30.08.00 30.08.01	* : Sample tests or control - : Not required ** : Sample tests on insulators alone and 100% for insulators in sub-assemblies Type Tests The following type tests shall be conducted on a complete single pole assembly of one typical switchgear bay module as per IEC 62271-203 . 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. i) Lightning impulse voltage dry tests. ii) Power frequency voltage dry tests. iii) Partial discharge tests. iv) Radio interference voltage tests. v) Test to prove the temperature rise of any part of the equipment and measurement of the resistance of the main circuit. vi) Test to prove the ability of the main circuit and earthing circuit to carry the rated peak and the rated short time withstand current. vii) Test to verify the making and breaking capacity of the included switching devices. viii) Tests to prove satisfactory operation of the included switching devices. ix) Test to prove the strength of enclosures. x) Gas tightness test xi) Electromagnetic compatibility test xii) Test on partitions xiii) Internal arc tests. xiv) Mechanical operation tests. xv) Test to prove the satisfactory operation at limit temperature. xvi) Verification of degree of protection of auxiliary and control circuits. xvii) Test to prove performance under thermal cycling and gas tightness test on insulators

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR
30.09.00 30.10.00	xviii) Earthquake withstand test. In case the contractor has not type tested a similar module for earthquake withstand test he shall supply supporting design calculations of simulated parameters of this test. Following type tests on one piece each of related component parts of a single pole assembly of one typical switchgear bay module shall be conducted. a) Circuit breakers (In accordance with IEC 62271-100) i) Dielectric test. ii) Radio Interference Voltage tests. iii) Temperature rise-tests. iv) Measurement of Resistance of Main Circuit. v) Short time with-stand current & peak withstand current tests. vi) Mechanical operation test at ambient temperature vii) Miscellaneous Provisions for making & breaking test viii) Short circuit current making & breaking tests ix) Verification of degree of protection x) EMC test xii) Critical current tests. xiii) Single Phase short circuit tests. xiv) Short line fault tests. xv) Out of phase making & breaking tests i. Capacitive current switching tests. ii. Tightness test b) Surge arrestors (In accordance with IEC60099-4) i) Insulation with-stand tests. ii) Residual voltage tests. iii) Long duration current impulse withstand test iv) Operating duty tests v) Pressure relief test.

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR
	vi) Tests of arrestor disconnectors vii) Artificial pollution test. viii) Partial discharge test. ix) Seal leakage test. x) Current distribution test for multi column arrestor. c) Disconnectors & Earth switches (In accordance with IEC 62271-102) i) Dielectric tests ii) Radio interference voltage (r.i.v.) tests iii) Temperature – rise tests iv) Measurement of the resistance of the main circuit (for isolators) v) Short-time and peak withstand current test vi) Tests to prove the short-circuit making performance of earthing switches vii) Operating & mechanical endurance tests viii) Operation at the temperature limits d) CTs (As per IEC 60044-1) i) Short time current tests. ii) Temperature rise test. iii) Lightning impulse test for current transformers for service in electrically exposed installation v) Determination of errors or other characteristics Special tests i) Chopped lightning impulse test e) Potential transformers (as per IEC 60044-2) I. Temperature rise tests - II radio interference voltage (r.i.v) III. Lightning Impulse test. IV. Determination of errors. V. Short circuit withstand capability test. Special tests i) Chopped lightning impulse test as a type test

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR
30.11.00	Pressure vessel test Test according to used pressure vessel code shall be performed on the enclosures.
30.12.00	Shop Test Reports The Contractor shall furnish to the Employer six bound certified copies of a report describing the complete shop tests. This 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 calculations, wherever necessary or desirable, to show the test values employed in the equations. - Curves showing relation of tested quantities. - Data in tabulated form - Comparison of the test results with the guaranteed requirements of the specifications and justification of deviations, if any.
30.13.00	Performance Tests Performance tests will be required to prove that equipment meets the requirements of the specifications and the guarantees. All the tests conducted by the contractor shall be subjected to Employer's approval. The contractor 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 contractor 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 contractor and incorporated in the final test report. The performance tests shall comprise of: a) Field stage tests, to be carried out during erection, to demonstrate that the equipment or any component or subassembly has been properly erected and functions correctly. b) Commissioning tests, precedent to the acceptance of work, in respect of the equipment or any section of the equipment, to demonstrate proper operation. c) Final acceptance tests, precedent to issue of a Final Acceptance Certificate, to prove compliance with performance guarantees.
30.14.00	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 Employer. The contractor 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:

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR
30.15.00	(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 contractor, prior to acceptance tests. Written evidence shall be produced on these tests. Random checks shall be made in the presence of the Project Manager (PM). (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 contractor shall submit a detailed programme to Employer's for approval. Detailed records, including all the details of tests performed and the results obtained shall be prepared by the contractor and furnished to the Employer. Commissioning Tests On completion of the erection and installation, the contractor shall give the Employer a written certificate stating that the equipment has been erected and installed in accordance with the specifications and approved drawings, thus giving notice of readiness to be carried out before the equipment is placed into regular service. The contractor shall demonstrate that all specification have been met and in addition, that the entire equipment, including all auxiliary equipments & accessories, are properly erected, installed and correctly adjusted. The following commissioning tests shall be performed as 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 is also acceptable as alternative. The Contractor 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 contractor should be indicated in the offer. (b) Partial discharge measurement tests. (c) Voltage tests for the main circuits

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR
30.16.00	(d) Voltage tests for the auxiliary and control circuits. (e) Tests to verify the resistance of the main circuits. (f) Operation tests for various components. (g) Gas leakage tests. (h) Calibration of SF6 gas pressure/density switches. 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 Employer may direct Contractor to rectify the defects or repair, reconstruct or replace faulty work and Contractor shall without delay, carry out the instructions of the Employer in this respect. Except as otherwise provided hereunder, responsibility for apparatus & test equipment and the control thereof shall be exercised by contractor subject to the over riding control of the Employer. Commissioning tests shall be as per the IEC standard and shall not be restricted to the tests stated above. The Contractor shall also recommend any additional commissioning tests. Final Acceptance Tests After commissioning tests have been satisfactorily completed, the contractor, in cooperation with and under the supervision of Employer shall conduct the final acceptance tests listed below to determine whether all the requirements of these specifications have been fulfilled: a) SF₆ GIS complete with all appurtenances, shall be operated at continuous rating and at such part loading as may be directed by the Employer, continuously for 30 calendar days. b) All shop tests included in the test report as specified shall be deemed to be a part of the final acceptance tests. Routine tests may be repeated at the site, if, in the opinion of the Employer, these are necessary to establish the conformity of the equipment with the specifications. c) A record of all performance tests shall be embodied in a test report. Successful completion of the final acceptance tests shall be a condition precedent to a final acceptance certificate for the equipment.
30.17.00	Test Reports The contractor 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 Employer and reproduced at the expense of the contractor in six copies for submission to the Employer.

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR
	<u>ANNEXURE-I</u> 1.00.00 MANDATORY MAINTENANCE EQUIPMENT 1.01.00 SF₆ Gas Handling Plants:- a) SF₆ gas filling and evacuating equipment (Portable)- 1 No.: The capacity of this plant shall be such that it shall not take appreciable time for filling or evacuating of a GIS bay including all equipments 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- 1 No.: - This shall include all the necessary devices for measurement of purity, moisture content, decomposition products etc. of SF₆ gas mixing with air/oil/moisture during above process should be proved to be Nil during testing. - 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 300 kg of SF₆ gas. 1.02.00 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. 1.03.00 SF₆ gas analyzing equipment and instruments should have capacity for performing the following functions: a) The moisture content measurement or alternatively dew point measurement. b) The SF₆ gas content measurement. c) Sensitivity should not be affected by dust, humidity, heat & wind etc.

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR
1.04.00	d) Acidic product detection NOTE: The equipments should have in-built calibration facility. The calibration/sensitivity check shall be demonstrated at contractor's supplier's works. SF₆ Gas leak detector - 2 nos.: 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.
1.05.00	Operational analyzer and Signature analysis equipment - 1no.: The operational analyzer shall meet the following requirements: a) Operational analyzer 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 re-closing 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 analyzer shall have provisions for recording at least 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. 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 along with each analyser and peripheral system. g) Demonstration at manufacturer's premises for functional/operational check and compatibility with breaker. 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.

GIS Termination Arrangement(SF6 to Air Bushings) :-

- a) Outdoor SF6 bushings, for the connection between the GIS and overhead lines or conventional air insulated equipment shall be furnished where specified.
- b) Bushing shall comply with the relevant IEC standards. The bushing can be with composite insulators (Silicon rubber) or with porcelain insulators with all surfaces free from imperfection. The internal and external electrical field of the bushings can be controlled by a capacitive grading body or by grading shields.
- c) For SF6/Air bushings, the GIS manufacturer shall provide detailed drawings and information.

220kV High Voltage Outdoor Bushing (Polymer/Composite/Porcelain)

Sl No.	Item	Unit	Required
1	Applicable Standards	IEC	60137,61463
2	Operating Voltage (U0/U)	kV	220
3	Rated Voltage	kV	245
4	Rated short circuit withstand Current	kA	50kA for 1s
5	Rated Peak withstand Current	kA	100
6	Insulation Medium		SF6
7	Material Enclosers		Polymer/Composite/Porcelain
8	Lightning impulse withstand voltage (peak) (phase to phase and phase to earth) at minimum operating gas pressure	kV	1050
9	Power frequency withstand Voltage (1Min.) (phase to phase and phase to earth) at minimum operating gas pressure	kV	460
10	Rated Current at 50 degree	A	1600
11	Creepage distance at rated voltage	Mm/kV	25

SECTION-3

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, equipments and services covered under other respective sections and are not exclusive. However in case of conflict between the requirements specified in this section and requirements specified under other sections, the requirements specified under respective sections shall hold good.

3.1 PROJECT INFORMATION AND SYSTEM PARAMETERS

a)	Customer/ Purchaser/ Owner	Uttarakhand Jal Vidhyut Nigam Limited
b)	Project Title	220kV switchyard for 2 X 60MW Vyasi HEP
c)	Location	Village Vyasi, 5.0 Km.d/s of Lakhwar, Dehradun
d)	Elevation above MSL	535 mtr.
e)	Transport Facilities	Airport ,Railways at Dehradun, accessible by Road from National Highway NH-123 at Barawala (3 km from Dakpathar).
f)	Postal Address	To follow
SITE CONDITIONS		
a)	Max. temp.	42.8°C
b)	Min. temp.	0.3°C
c)	Design ambient temp.	50°C
d)	Latitude/Longitude	30° 31' 00" N/ 77° 53' 00" E
e)	Maximum Relative humidity	100 %
f)	Minimum Relative humidity	8%
g)	Pollution Severity	Less Polluted
h)	Seismic acceleration	0.18g
i)	Seismic zone	Zone-IV
l)	Wind Velocity & Zone	47 m/s Zone IV

SYSTEM PARAMETERS

Nominal system voltage	220 kV
Highest system voltage	245 kV
Rated Normal Current at Nominal System Voltage	1250A
Basic Impulse level	1050kVP
Power frequency withstand voltage	460kVrms
Switching Impulse voltage	850kV
Maximum Permissible Switching Over Voltage to Earth (kV)	487kV
Frequency	50 Hz $\pm$ 5%
Rated short time current	50 kA for 1 sec
Creepage distance	25mm/kV
System Earthing	Solidly Grounded

Note:-**Seismicity**:-The project is situated in a seismic zone and falls within Zone IV of the seismic zoning Map of India. Value of peak ground acceleration has been recommended as 0.36g for maximum Credible Earthquake (MCE) and 0.18g for Design basis Earthquake (DBE).

Wind Load:- The basic wind load as per IS875 (part-3) shall be applied on the vertical projected area, multiplied with the applicable factor for different type of structures.

AUXILIARY POWER SUPPLY

3 phase A.C power supply	415V, 50 Hz, 3-phase 4 wire, solidly earthed with variation in frequency of $\pm$ 5% and variation in voltage $\pm$ 10%.
1 phase A.C power supply	240V, 50 Hz, 1-phase, AC supply with variation in frequency of $\pm$ 5% and variation in voltage $\pm$ 10%.
D.C. power supply	220V(variation under worst condition from 198V to 242V) , 2-wire ungrounded, 50V, 2 wire system (+) earthed , 48V $\pm$ 20%

Transportation Limitations:- For shipments, the Manufacturer shall pack the items to meet size and weight restrictions of the Indian railways and road systems. Shipments from Manufacturer's work (in case of foreign manufacturer) shall travel to the Port of entry in India, from where these will be transported, after necessary port clearances etc., by the Contractor to Dehradun , which shall be the nearest rail head for the Project, and further transported to site. However, in certain cases the Contractor may be required to transport the materials from Port of entry to Dehradun and further to Vyasi HE Project site directly by road transport. However, Indian contractors shall be responsible in all respects for transportation of all materials and equipment up to the project site.

Manufacturers shall consult with the concerned authorities of railways and highways to ensure that their packaging will be such as to permit them to transport the plant and equipment within such imposed limits. Manufacturers shall arrange to deliver the maximum size subassemblies consistent with safe and convenient transport. All materials and equipment etc. arrived at Dehradun will be unloaded from rail wagons and reloaded on to road transport for shipment to project site by the Contractor. The roads and bridges enroute shall be made suitable for 70R loading capacity.

3.2 GENERAL TECHNICAL REQUIREMENT

3.2.1 QUALIFYING REQUIREMENT

As per section-1 of item Specific QR

3.2.2 TYPE TESTS

For all the items of equipment's, bidder shall furnish copies of Type Tests Certificates for the equipment's of the type and ratings similar to those specified. Type Tests Certificates furnished shall be as per the provisions of relevant standards for such equipment's. In case the contractor is not in position to furnish, such type tests certificates or the type tests certificate furnished by him are not as per the relevant standard for such equipment and, therefore, not acceptable to the Employer, Type Test for such items and equipment's will have to be got conducted by the contractor at his cost.

All the switchyard equipment's shall be type and routine tested as per relevant IS / IEC- Publication or Type tests certificate shall be furnished to prove that the equipment fulfils all characteristics defined in Specifications. The contractor is required to carry out all type tests on one apparatus of each type and routine tests on all apparatus and submit the reports to the Employer. If approved by the Employer, type test certificates can be accepted in place of type tests in case of the same have been carried out on same type & similar capacity. All equipment/systems to be supplied shall conform to type tests as per relevant standards and proven type.

The Bidder / Contractor shall furnish the reports of all the type tests carried out in within last **ten years from the date of bid opening (i.e. 08.05.2017)** as listed in relevant clauses in respective electrical specification and relevant standards for all components / equipment / systems. These reports should be for the tests conducted on identical/similar components/equipment/systems to those offered/proposed to be supplied under this contract.

Type tests done in an independent government laboratory or in the presence of representative of State Electricity Board or other reputed public undertakings, the type test reports of the same shall be submitted for scrutiny /approval. If these are found suitable and technically acceptable, conducting of type tests shall be waived off.

In case Contractor is not able to submit report of type test(s) conducted in last ten years, or in case type test report(s) are not found to be meeting the specification/relevant standard requirements, then all such tests shall be conducted under this contract by the Bidder free of cost to Employer/Purchaser, and reports shall be submitted for approval. No charges shall be paid under this contract. All acceptance and routine

tests as per relevant standards and specification shall be deemed to be included in the bid price.

3.2.3 CODES AND STANDARDS

All materials and equipment shall generally comply in all respect with the latest edition of relevant international electro-technical commission (IEC) or any other internationally accepted standard which ensure equal or better quality or relevant Indian standard(IS) mentioned against each equipment and this specification.

3.3 MATERIAL/WORKMANSHIP

3.3.1 General Requirement

Where the specification does not contain characteristics with reference to workmanship, equipment, materials and components of the covered Equipment it is understood that the same must be new, of highest grade of the best quality of their kind conforming to best engineering practice and suitable for the purpose for which they are intended. All design calculations, materials, works, manufacturing and testing shall conform to the latest applicable standards.

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

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

All materials and equipment shall be installed in strict accordance with the manufacturer's recommendation(s). Only first-class work in accordance with the best modern practices will be accepted. Installation shall be constructed as being the erection of equipment at its permanent location. This, unless otherwise specified, shall include unpacking, cleaning and lifting into position, grouting, leveling, aligning, coupling of or bolting down to previously installed equipment bases/foundations, performing the alignment check and final adjustment prior to initial operation, testing and commissioning in accordance with the manufacturer's tolerances and instructions and the Specification. All factory assembled rotating machinery shall be checked for alignment and adjustments made as necessary to re-establish the manufacture's limits suitable guards shall be provided for the protection of personal on all exposed rotating and / or moving machine parts and shall be designed for easy installation and removal for maintenance purpose. The spare equipment(s) shall be installed at designated locations and tested for

healthiness.

The Contractor shall apply oil and grease of the proper specification to suit the machinery, as is necessary for the installation of the equipment. Lubricants used for installation purposes shall be drained out and the system flushed through where necessary for applying the lubricant required for operation. The Contractor shall apply all operational lubricants to the equipment installed by him.

All oil, grease and other consumables used in the Works/ Equipment shall be purchased in India unless the Contractor has any special requirement for the specific application of a type of oil or grease not available in India. In such is the case he shall declare in the proposal, where such oil or grease is available. He shall help purchaser in establishing equivalent Indian make and Indian Contractor. The same shall be applicable to other consumables too.

3.3.2 Provisions For Exposure to Hot and Humid climate

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

3.4 COLOUR SCHEME AND CODES FOR PIPE SERVICE

The contractor shall propose a color scheme for those equipment/Items for which the colour scheme has not been specified in the specification for the approval of purchaser. The decision of purchaser shall be final. The scheme shall include:

Finishing colour of Indoor equipment

Finishing colour of Outdoor equipment.

Finish colour of all cubicles.

Finishing colour of various auxiliary system equipment including piping

Finishing colour of various building items.

All steel structures, plates etc shall be painted with non-corrosive paint on a suitable primer. It may be noted that normally all electrical equipment in switchyard are painted with shade RAL 7032. All The indoor cubicles shall be of same colour scheme and for other miscellaneous items, colour scheme will be approved by the purchaser.

3.5 PROTECTION

All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protecting device. All ends of all valves, pipings and conduit equipment connections shall be properly

sealed with suitable devices to protect them from damage.

All equipment accessories and wiring shall have fungus protection, involving special treatment of insulation and metal against fungus, insects and corrosion. The parts which are likely to get rusted, due to exposure to weather should also be properly treated and protected in a suitable manner. Screens of corrosion resistant material shall be furnished on all ventilating louvers to prevent entry of insects.

3.6 FUNGISTATIC VARNISH

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

3.7 SURFACE FINISH

All surfaces that are so indicated on the drawings or those that require machining for their intended function, or those that are usually machined according to good workshop practice shall be machined. Surface finish qualities shall be adequate for the intended use and shall be indicated on the Contractor's Drawings. Suitable measuring device such as scatter meter or other acceptable measuring device will be used to determine compliance with specified surface finish.

All interiors and exteriors of tanks, control cubicles and other metal parts shall be thoroughly cleaned to remove all rust, scales, corrosion, greases or other adhering foreign matter. All steel surfaces in contact with insulating oil as far as accessible, shall be painted with not less than two coats of heat resistant, oil insoluble, insulating paints.

All metal surfaces exposed to atmosphere shall be given two primer coats of zinc chromate and two coats of epoxy paint with epoxy base thinner. All metal parts not accessible for painting shall be made of corrosion resisting material. All machine finished or bright surfaces shall be coated with a suitable preventive compound and suitably wrapped or otherwise protected. All paints shall be carefully selected to withstand tropical heat and extremes of weather within the limit specified. The paint shall not scale off or wrinkle or be removed by abrasion due to normal handling. All external painting shall be as per RAL 7032.

Before delivery, all exposed, unfinished metal surfaces shall be cleaned and shop painted. Cleaning and Preparation of steel surfaces shall be in accordance with relevant standards and they shall be given at least one prime coat the same day. Paint shall be in accordance with applicable portions of relevant Indian and International standards. The colours of the paint will be selected at the Employer's option. All interior surfaces of the crane those are accessible for maintenance inspections shall also be completely painted. All other interior surfaces shall be painted with only the 1 coat of primer. The inside of all gear housings shall be painted with 2 coats of oil resisting enamel as recommended by the gearhousing manufacturer. A

quantity and type of paint equal to 15% of the paint used for the second and third coats shall be provided for field touchup work. Monorail hoists shall be painted with the manufacturer's standard finish. The colour of the paint will be subject to approval of the Employer/Customer.

3.8 GALVANIZING

All structural steel including ladders, platforms, hand rails and the like and all exterior and interior steel surfaces of outdoor Works, as well as bolts and nuts associated with galvanised parts shall be hot-dip galvanised, electrolytic galvanised or serialised, as may be appropriate to the particular case. Galvanising shall be performed in accordance with VDE Standard 0210 (Verband Deutscher Elektrotechniker) or IS 4795:1996. For galvanizing, only original blast furnace raw zinc shall be applied, which shall have a purity of 98.5%. The thickness of the zinc coat shall be for bolts and nuts, approx. 60 micrometer.

Conforming to latest version of IS:2629 or any other equivalent authoritative standard. However, hardware less than M12 size shall be electro-galvanized. Minimum weight of zinc coating shall be **610 gms. per square meter** and minimum thickness of coating shall be 85microns for all items thicker than 6mm. For items lower than 6 mm thickness, requirement of coating shall be as per relevant ASTM.

3.9 PACKING

The following details are to be clearly indicated in the material forwarding documents:

- a) Name and address of the consignee.
- b) Purchase order number.
- c) Name of supplier/s.
- d) Description of equipment / material.
- e) Net weight.
- f) Gross weight.

All the equipment's shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. On request of the purchaser, the Contractor shall also submit packing details/associated drawing for any equipment material under his scope of supply, to facilitate the purchaser to repack any equipment/ material at a later date, in case the need arises. Any material found short inside the packing cases shall be supplied by the supplier without any extra cost.

The cases containing easily damageable material shall be very carefully packed and marked with appropriate caution symbol i.e. fragile, handle with care, use no Hooks etc. All electrical parts shall be carefully protected from damage by sand, moisture, heat or humid atmospheric conditions by packing them in high-pressure polyethylene foil.

All the cable shall be supplied on nonreturnable wooden drums with adequate barrel diameter so as to avoid any damage to the cables and to withstand rough handling during transportation and storage. A layer of waterproof paper shall be applied to the surface of the drums and over the outer cable layer.

A circular space of at least 40mm shall be left between the cable and the lagging. Each drum shall carry the name of the manufacturer, the name of the Employer, his address, order number, item number, type, size length of cable, net and gross weight duly stencilled thereon.

3.10 HANDLING, STORING AND INSTALLATION

Contractor may engage manufacturer's Engineers to supervise if required for unloading, transportation to site, storing, testing and commissioning of the various equipment being procured by them separately. In case of any doubt/misunderstanding as to the correct interpretation of manufacturer's drawings or instructions, necessary clarifications shall be obtained from the purchaser. Contractor shall be held responsible for any damage to the equipment consequent to not following manufacturer's drawings/instructions correctly.

Where assemblies are supplied in more than one section, contractor shall make all necessary mechanical and electrical connections between sections including the connection between buses. Contractor shall also do necessary adjustments/alignments necessary for proper operation of circuit breakers, isolators and their operating mechanisms. All components shall be protected against damage during unloading, transportation, storage, installation, testing and commissioning.

Contractor shall be responsible for examining all the shipment immediately of any damage, shortage, discrepancy etc. for the purpose of Purchaser's information only. Any demurrage, pilferage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor. The Contractor shall be fully responsible, for the equipment/material until the same is handed over to the purchaser in an operating condition after commissioning.

The minimum phase to earth, phase to phase and section clearance along-with other technical parameters for the various switchyard voltage levels to be maintained shall be strictly as per the approved drawings.

The design and workmanship shall be in accordance with the best engineering practices to ensure satisfactory performance throughout the service life. If at any stage during the execution of the Contract, it is observed that the erected equipment(s) do not meet the above minimum clearances, the Contractor shall immediately proceed to correct the discrepancy at his risks and costs.

3.11 DEGREE OF PROTECTION

The supplier shall propose following Degree of protection for those equipment/Items for which the degree of protection has not been specified in the specification for the approval of BHEL/UJVNL. The decision of BHEL/UJVNL shall be final. The enclosures of the Control Cabinet, Junction boxes and Marshalling boxes panels etc. to be installed shall be provided with degree of protection as detailed here under:

- a) Installed outdoor: IP-55
- b) Installed indoor in air conditioned area: IP-42
- c) Installed in covered area IP:52
- d) For LT switchgear (AC & DC distribution Boards): IP-54

The degree of protection shall be in accordance with IS:13947, (Part-1)/IEC-947(Part-1). Type test report/or degree of protection test on each type of the box shall be submitted for approval. If necessary the cubicles shall be equipped with automatically controlled heating elements for protection against internal condensation and moisture. All panels/cubicles shall have approximately 20% space for mounting of future devices. Door operated interior illuminating lamps, power socket for 240V 5 /15A and communication socket shall be provided in all panels.

3.12 RATING PLATES, NAME PLATES AND LABELS

The switchyard equipment shall have a rating plate with the information required by relevant IEC i.e. at least the following:

- Manufacturer's name
- Type number
- Serial number
- Rated Voltage
- Rated impulse withstand voltage
- Rated power frequency withstand voltage
- Rated frequency
- Rated current
- Rated short circuit breaking current
- Rated short time current (r.m.s), & duration Each instrument transformer must have its own rating plate with the information as required in IEC 600441 and IEC 60186.

3.13 EARTHING

The operating mechanism housing, control cabinets, support structure etc. shall be provided with two separate earthing terminals suitable for bolted connection to 50x6mm mild steel flat to be provided for connection to station earth mat.

Circuit breakers, LA, Isolator, CVT, CT, BPI shall be provided with two grounding pads suitable for

connection to galvanized steel flat of Size 75X12 mm. Control panels, Relay panel, outdoor marshalling boxes, Junction boxes, Lighting panels and distribution board shall be provided with two grounding pads, for connection to galvanized steel flat. The two pads shall be provided, one each at the middle of the two opposite sides of the bottom frame of the equipment. Earthing of hinged door shall be done by using a separate earth wire.

The Contractor shall connect all equipment included in the scope of delivery to the grounding system. In addition to the grounding through cable screens, all equipment such as cubicles, motors, etc. shall be connected directly to the grounding system using copper wire of area not less than 50 mm sq. at two different points. In general, all iron parts such as supports, covers, railing, etc. shall be connected to the grounding system. Each conductor shall have its own separate connection point. Pressed on closed shoes shall be used for connections to bars.

3.14 TERMINAL BLOCKS AND WIRING

Wiring within cubicles and equipment enclosures shall conform to requirements of this section unless otherwise specified. Control wiring shall be stranded copper and shall be not smaller than 1.5 mm sq. except as otherwise agreed by the Engineer.

Larger size wiring shall be used where needed for the current carrying capacity requirements. Cables shall have at least 1000 V grade PVC insulation except for 110V DC and telemetering or communication system equipment for which 650V and 300 V ratings respectively may be acceptable.

For current and potential transformer secondary circuits the minimum cross section of the conductors shall not be less than 2.5mm sq. Wiring shall terminate at terminal blocks at one side only. Where tap connections are required, they shall be made on terminal blocks. Wiring shall be neatly arranged and laid in plastic conduits accessible from the front door. The conduits shall not be filled more than 70 %.

Each cubicle shall be provided with an earthing bar (PE) of sufficient cross section carrying any possible fault current without undue heating. All metallic parts of the cubicle not forming part of the live circuits, all instrument transformer terminals to be earthed and other earthing terminals as well as all cable screens and PE-wires shall be connected to the earthing bar.

The terminal blocks shall be located to allow a neat and easy connection work and shall be safely accessible while the equipment is in service. Control circuits and power circuits shall be completely separated by use of divided or separate terminal blocks. Power terminal blocks shall be rated in accordance with applicable standards and shall be provided with covers. Control wiring terminal shall be equipped with facilities for opening the circuit. It shall be possible to interchange a single terminal block for a new one without dismantling a whole row. Current transformer terminal blocks shall have provisions for short-circuiting and disconnecting. Not more than two wires shall be connected to any one terminal. Terminal blocks using screws acting directly on the wire will not be accepted. At least **20%** spare terminals shall be provided. Terminals shall be marked with printed labels.

Terminal blocks shall be 1100 V grade and have continuous rating to carry the maximum expected current on the terminals. Those shall be of moulded piece complete with insulated barriers stud type terminals, washers nuts and lock nuts. Screw clamp, overall insulated, insertion type, rail mounted terminals can be used in place of stud type terminals. But preferably the terminal blocks shall be non-disconnecting stud type equivalent to Elmex type CATM4, Phoenix cage clamp type of Wedge or equivalent. The Insulating material of terminal block shall be nylon 6.6 which shall be free of halogens, fluorocarbons etc.

Terminal block for current transformer and voltage transformer secondary leads shall be provided with test links and isolating facilities. The current transformer secondary leads shall also be provided with short circuiting and earthing facilities.

The terminal shall be that maximum contact area is achieved when a cable is terminated. The terminal shall have a locking characteristic to prevent cable from escaping from the terminal clamp unless it is done intentionally. The conducting part in contact with cable shall preferably be tinned or silver plated however Nickel plated copper or zinc plated steel shall also be acceptable. The terminal blocks shall be of extensible design. The terminal blocks shall have locking arrangement to prevent its escape from the mounting rails.

The terminal blocks shall be fully enclosed with removable covers of transparent, non deteriorating type plastic material. Insulating barriers shall be provided between the terminal blocks. These barriers shall not hinder the operator from carrying out the wiring without removing the barriers.

The arrangements shall be in such a manner so that it is possible to safely connect or disconnect terminals on live circuits and replace fuse links when the cabinet is live. At least 20 % spare terminals shall be provided on each panel/cubicle/box and these spare terminals shall be uniformly distributed on all terminals rows.

There shall be a minimum clearance of 250mm between the first bottom row of terminal block and the associated cable gland plate. Also the clearance between two rows of terminal blocks shall be a minimum of 150 mm. The Supplier shall furnish all wire, conduits and terminals for the necessary inter-phase electrical connection (where applicable) as well as between phases and common terminal boxes or control cabinets.

All input and output terminals of each control cubicle shall be tested for surge withstand capability in accordance with the relevant IEC Publications, in both longitudinal and transverse modes. The supplier shall also provide all necessary filtering, surge protection, interface relays and any other measures necessary to achieve an impulse withstand level at the cable interfaces of the equipment.

3.15 CONTROL CABINETS, JUNCTION BOXES, TERMINALS BOXES AND MARSHALLING BOXES FOR OUTDOOR EQUIPMENTS

All types of boxes, cabinets etc. shall generally conform to and be tested in accordance with IS-5039, IS-8623 or IEC-439, as applicable and the clause given below.

Control cabinet, Junction boxes, Marshalling boxes & Terminal boxes shall be made of sheet steel or

aluminium and shall be dust, water and vermin proof. Sheet used shall be least 2.0 mm cold rolled or 2.5mm hot rolled. The box shall be properly braced to prevent wobbling. There shall be sufficient reinforcement to provide level surfaces, resistance to vibrations and rigidity during transportation and installation. In case of aluminium enclosed box the thickness of aluminium shall be such that it provides adequate rigidity and long life as comparable with sheet of specified thickness. Cabinet/boxes shall be free standing floor mounting type, wall mounting type or pedestal mounting type as per requirements.

Removable plates with gaskets shall be fitted at the top and bottom of the box to provide the entry for conduit or cable. The door shall be provided with suitable gasket and fitted with a lock type handle. The door shall be hung on hinges having brass bodies and stainless steel pins. Each cable junction box shall be provided with terminals of adequate rating on the terminal strip of suitable thickness. Disconnecting (sliding) type terminal blocks shall be provided, to facilitate testing & maintenance without disconnecting the cables.

Multi block terminal board of 15 A, 500 V rating shall be provided to form in assembly of number of terminal block. Assembly may be secured with only two screws on the surface. There shall be provision on the strips to add more terminal in case of further requirement.

Cabinet /boxes shall be provided with double hinged doors with padlocking arrangements. The distance between two hinges shall be adequate to ensure uniform sealing pressure against atmosphere. The quality of gaskets shall be such that it does not get damaged/cracked during the operation of the equipment.

All door, removable covers and plates shall be gasketed all around with suitably profiled EPDM gaskets. The gasket shall be tested in accordance with approved quality plan. The quality of gasket shall be such that it does not get damaged /cracked during the years of the equipment or its major overhaul whichever is earlier. All gasketed surfaces shall be smooth, straight and reinforced if necessary to minimize distortion and to make a tight seal. Ventilating Louvers, if provided, shall have screen and filters. The screen shall be fine wire mesh made of brass.

All boxes/cabinets shall be designed for the entry of cables from bottom by means of weather proof and dust-proof connections. Boxes and cabinets shall be designed with generous clearances to avoid interference between the wiring entering from below and any terminal blocks or accessories mounted within the box or cabinet. Suitable cable gland plate projecting atleast 150 mm above from the base of the Marshalling Kiosk/box shall be provided for this purpose along with the proper blanking plates. Necessary number of cable glands shall be supplied and fitted on this gland. The gland shall project at least 25mm above gland plate to prevent entry of moisture in cable crutch. Gland plate shall have provision for some future glands to be provided later, if required

3.16 SPACE HEATERS

The space heaters shall be suitable for single phase 50 Hz AC supply from an independent source, which should automatically switch off before starting of unit. However, once the dehumidification unit is switched ON, it shall be controlled automatically with a thermostat. The dehumidification unit shall be designed to avoid hot spot. The heater shall be suitable for continuous operation at 240 V AC supply voltage and shall be provided with on – off switch and fuse shall be provided for heater.

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

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

3.17 QUALITY

BHEL quality plan to be followed subject to TBEM / customer's approval.

3.18 GUARANTEE:

The supplier shall guarantee that the goods under the Contract are new, unused of the most recent or current models and incorporated all recent improvements in design and materials unless provided otherwise in the Contract. The supplier shall further guarantee that the goods supplied under this Contract shall have no defects arising from design, materials or workmanship, installation and erection, if that may develop under normal use of the supplied goods. The supplier shall also guarantee the performance of the works executed by him including the performance of all the materials/goods supplied by him.

BHEL shall promptly notify supplier in writing of any claims arising under guarantee in respect of goods. Upon receipt of such notice, the supplier shall, with all reasonable speed, repair or replace the defective works or parts thereof, free of cost at site. All the expenses towards transportation of defective parts to supplier's works and of repaired/replaced parts to site shall be borne by the Supplier.

If the Supplier, having been notified, fails to remedy the defects within 14 days, the BHEL will proceed to take such remedial action as may be necessary, at the supplier's risk and expenses. All expenses in this regard will be recovered from Supplier.

3.19 DOCUMENTATION

3.19.1 LIST OF DOCUMENTS

The bidder shall submit a detailed list of drawings / documents along with the bid proposal which he intends to submit to the Employer after award of the contract.

The supplier shall necessarily submit all the drawings / documents unless anything is waived.

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

3.19.2 DRAWINGS

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

Each drawing submitted by the Contractor shall be clearly marked with the name of the Employer, name of consultant, the unit designation, contract no., and the name of the Project. If standard catalogue pages are submitted, the applicable items shall be indicated therein. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.

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

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

3.19.3 APPROVAL PROCEDURE

The scheduled dates for the submission of these as well as for, any data/information to be furnished by the Employer would be discussed and finalized at the time of award. The supplier shall also submit required no. of copies as mentioned in this specification of all drawings/design documents/test reports for approval by the Employer. The following schedule shall be followed generally for approval.

i.	Approval/comments/by employer on	Within 2 weeks of receipt
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	Initial submission	
ii.	Resubmission	Within 2 (two) weeks (whenever from date of comments required) Including both ways postal time.
iii.	Approval or comments	Within 2 weeks of receipt of resubmission
iv.	Furnishing of distribution copies	2 weeks from the date of last approval.

Note: The contractor may please note that all resubmissions must incorporate, all comments given in the submission by the Employer failing which the submission of documents is likely to be returned. Every revision shall be a revision number, date and subject, in a revision block provided in the drawing, clearly marking the changes incorporated.

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

Title Block

Customer	M/s Uttarakand Jal Vidyut Nigam Ltd.
Project:	2X60 MW Vyasi HEP
Contractor	BHEL

3.19.3 DOCUMENTS TO BE SUBMITTED ALONGWITH OFFER

- 1) Drawings
- 2) Guaranteed Technical Particulars
- 3) Type Test Reports
- 4) Manufacturing Quality Plan

3.20 DOCUMENTATION SCHEDULE

S. No.	DESCRIPTION	TENDER STAGE	CONTRACT STAGE FOR APPROVAL	FINAL DOCUMENTATION	
				Prints	CDs
1	Drawings and Data Sheets	1	10	13	-
2	Drawings "As Built"	-	-	13	05
3	Type Test Reports	1	05	13	-
4	Erection Manuals	-	11	13	-
5	Operation and Maintenance Manuals	-	11	13	-
6	Manufacturing Quality Plan	1	11	13	-
7	Field Quality Plan	1	11	13	-
8	Inspection Test Reports	-	-	13	-

Drawings will also be submitted in mini cartridges in AUTOCAD Release -14 package or any other CAD package along with conversion files for all major items.

Final Documentation shall be submitted in bound volumes with Customer & Project etc. written on top .

GTP

**220 KV GAS INSULATED
SWITCHGEAR**

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR (E17)	
I.	Bidder's Name: TECHNICAL PARTICULARS GIS MODULE The bidder shall submit with his bid the following technical particulars for the 220KV 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 - Generator Transformer feeder circuit Amp. i) Line feeder circuit Amp. ii) Bus coupler circuit Amp. iii) 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)	

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR (E17)
	Bidder's Name: 13. Rated Switching impulse withstand voltage .....kV (peak) 14. Rated one minute power frequency withstand voltage .....kV (peak) 15. Maximum temperature rise over ambient deg. C. 16. Thermal rating of current carrying parts at 220 KV for the rated symmetrical short circuit current Sec 17. Altitude upto which the switchgear shall operate satisfactorily (m) 18. Ambient conditions of the operation of the GIS (°C) 19. Earthing details of enclosure 20. - Features adopted for preventing burn through in the various enclosures of SF6 GIS - Time in m sec to withstand an internal flashover without burn through 21. Guaranteed number of loaded/unloaded operations of various equipments of SF6 GIS a) circuit breakers, b) disconnectors, c) grounding switches etc 22. Design pressure of the enclosures for a) Circuit breakers b) Disconnectors c) Surge arresters etc. d) GIS duct

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR (E17)
	Bidder's Name: e) VT f) CT 23. Type test pressure of the enclosures a) Circuit breakers b) Disconnectors c) Surge arresters etc d) GIS duct e) VT f) CT 24. Routine test pressure of enclosure a) Circuit breakers b) Disconnectors c) Surge arresters etc d) GIS duct e) VT f) CT 25. Operating pressure of pressure relief valve a) Circuit breakers b) Disconnectors c) Surge arresters etc 26. Maximum permissible gas dew point 27. No of gas compartments a) Each line bay b) Each Generator bay c) Bus coupler bay

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR (E17)
	Bidder's Name: 33. Details of the control wiring used in the equipment 34. The extent of field welding required for site assembly, if any alongwith the procedure to be adopted by the firm at site 35. Details of the documents, drawings & photographs enclosed showing the basic operating principles of the major components of the equipment, presenting a clear picture of the fundamental principle, general arrangements and operating mechanism Yes/No 36. Details of the flow diagram/ drgs. enclosed showing all valves and pressures involved, for the hydraulic and gas system, or both Yes/No 37. Details of the test data enclosed including test data of the parts indicating the ability of the equipment (including high speed grounding switches) Yes/No 38. The values of resistors inserted in the line circuit breaker during closing operations, if any, alongwith the length of time the resistors are left in the circuit. ....ohms/pole 39. Values of maximum switching surges generated 40. Methods adopted to limit switching surges for breaker and disconnectors 41. Heat generated in K.W. when the complete switchgear is operating at its rated capacity 42. a) Seismic level for which GIS is designed b) Noise level in (dB) at distance of (m)

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR (E17)
	Bidder's Name: i) 0 ii) 50 iii) 100 iv) 150 43. Type and Material of a) Breaker main contact. b) Disconnecting switch contact c) Grounding switch contact d) Busbars e) Internal bus contact. f) Enclosure. g) Terminal pads. 44. Details of provisions made for movement of maintenance personnel on the equipment 45. Capacitance per metre of the enclosed bus .....pF/ metre 46. Inductance .....H/m 47. Surge impedance in ohms of the enclosed bus (The bidder should furnish the method used for the calculations of surge impedance and capacitance of insulated bus). ohm 48. a) Electric resistance at 75 deg C in ohms/metre. - Bus enclosure - Internal bus b) Data used for calculation of electric resistance in (a)

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR (E17)												
	Bidder's Name: - Cross sectional area of bus conductor - Cross sectional area of bus enclosure. - Conductivity of material of bus conductor - Conductivity of material of bus enclosure. - Current density in bus conductor. 49. Maximum power losses in the bus bar per single phase meter at rated voltage and current at 20°C in <table style="width: 100%;"> <tr> <td style="width: 50%;">a) Enclosure</td><td style="width: 50%; text-align: right;">W</td></tr> <tr> <td>b) Conductor</td><td style="text-align: right;">W</td></tr> </table> 50. Dimensions <table style="width: 100%;"> <tr> <td style="width: 50%;">a) Bus enclosure outside diameter</td><td style="width: 50%; text-align: right;">(mm)</td></tr> <tr> <td>b) Bus enclosure wall thickness</td><td style="text-align: right;">(mm)</td></tr> <tr> <td>c) Internal bus, outside diameter</td><td style="text-align: right;">(mm)</td></tr> <tr> <td>d) Internal bus thickness</td><td style="text-align: right;">(mm)</td></tr> </table> 51. Capacity & filling ratio of containers in which SF6 gas would be shipped (m³) and the corresponding pressure (Kg/cm²) 52. Whether GIS are despatched filled with SF6 or required to be filled at site 53. Type and make of SF6 pipe coupling used	a) Enclosure	W	b) Conductor	W	a) Bus enclosure outside diameter	(mm)	b) Bus enclosure wall thickness	(mm)	c) Internal bus, outside diameter	(mm)	d) Internal bus thickness	(mm)
a) Enclosure	W												
b) Conductor	W												
a) Bus enclosure outside diameter	(mm)												
b) Bus enclosure wall thickness	(mm)												
c) Internal bus, outside diameter	(mm)												
d) Internal bus thickness	(mm)												

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR (E17)	
	Bidder's Name:	
54	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 analyser	
	iv) SF6 gas leak detector	
	v) Gas analyzing equipments	
55.	Type and material of gaskets used to ensure gas tight joints	
56.	a) Type and make of	
	i) Densimeter	
	ii) Pressure gauge	
	b) Densimeter settings	
	i) Lockout	
	ii) Alarm	
57.	Whether the following are enclosed	
	a) Type test reports	Yes/No
	b) Operation manual for equipments	Yes/No
	c) Details of SF6 gas filling, evacuating, filtering, drying storage & recycling plant	Yes/No
	d) Details of SF6 gas leak detector	Yes/No
	e) Details of operations Analyser	Yes/No
	f) SF6 gas analyzing equipment	Yes/No

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR (E17)
	Bidder's Name: g) Leaflets & literature bringing out salient features of equipment offered Yes/No 58. Details of equipments and procedure for conducting site test (including power frequency test) of the bay module as per IEC 59. Length of longest section for transportation mm 60. Weight of the heaviest piece of equipment to be handled during installation on site. Kg 61. The weight of each assembled bay to be indicated separately (Kg) 62. SF6 GAS 1. Name of manufacturer & address 2. standard applicable 3. Electrical properties (please give details) 4. Compatibility with material used in switchgear 5. Impurities in percentage (please mention details of impurities) 6. Condensation temperature 7. Physical properties (please give details) 8. Certification that gas meets the requirement of all the properties 9. Tests to be conducted by the manufacturer at works 10. Tests proposed to be conducted at site to detect and limit the moisture content in gas compartments

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR (E17)
	Bidder's Name: 11. Gas Monitoring Devices "Details of the sketches enclosed showing the type and location of gas density, gas pressure, gas moisture content and other fault monitoring devices to be supplied. Yes/No 63. Whether the common point of bus disconnectors alongwith Earth Switch has been brought out in a separate compartment Yes/No 64. Whether details of recommended arrangement for Cable/SF6 gas termination gas enclosed Yes/No 65. Whether details of recommended arrangement for oil/SF6 gas termination enclosed Yes/No 66. Whether provision exists for extensive of busbars on both ends Yes/No 67. Whether arrangement provided for easy dismanting of cable/SF6 & oil/SF6 terminations in case of maintenance Yes/No 68. Details of arrangement provided to account for thermal expansion for busbars enclosed Yes/No 69. Details of earthing arrangement adopted for the GIS enclosed Yes/No 70. Whether layout plan sections of each bay/equipment of GIS/AIS indicating the complete arrangement enclosed Yes/No

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR (E17)
	Bidder's Name: - 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 40°C ambient temp. A - Rated interrupting current for 1s, kA - Rated symmetrical interrupting current kA - Rated asymmetrical interrupting current kA - Rated short circuit making current kA (peak) 4. Rated Insulation level a) One minute dry power frequency withstand voltage i) Between live terminal and ground (kV rms)

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR (E17)
	Bidder's Name: 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 g) Closing time

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR (E17)
	Bidder's Name: 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 a) 10% rated breaking current b) 30% — do— ms

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR (E17)																																																						
	Bidder's Name: <table><tr><td>c)</td><td>60% — do—</td><td>ms</td></tr><tr><td>d)</td><td>100% — do—</td><td>ms</td></tr><tr><td>e)</td><td>Arc duration from separation of arc at contact to instant of arc extinction for full rated interrupting capacity.</td><td>ms</td></tr><tr><td>-</td><td>Length of arc at</td><td></td></tr><tr><td>a)</td><td>10% rated breaking current</td><td>mm</td></tr><tr><td>b)</td><td>30% — do—</td><td>mm</td></tr><tr><td>c)</td><td>60% — do—</td><td>mm</td></tr><tr><td>d)</td><td>100% — do—</td><td>mm</td></tr><tr><td>e)</td><td>Max. length of arc at lowest fault current</td><td>mm</td></tr><tr><td>-</td><td>Longest time to interrupt current less than 25% of rated symmetrical short circuit current from energizing trip circuit</td><td>ms</td></tr><tr><td>-</td><td>Minimum time from arc extinction to contact remake for auto reclosing.</td><td>ms</td></tr><tr><td>-</td><td>Minimum dead time for</td><td></td></tr><tr><td>a)</td><td>3 phase reclosing</td><td>ms</td></tr><tr><td>b)</td><td>1 phase reclosing</td><td>ms</td></tr><tr><td>-</td><td>Maximum difference of time at opening of series contacts within one pole</td><td>ms</td></tr><tr><td>-</td><td>Maximum difference of time at opening between phases</td><td>ms</td></tr><tr><td>-</td><td>Maximum difference of time at closing between phases</td><td>ms</td></tr><tr><td>-</td><td>Details of the curve enclosed for maximum opening time vs. 3 phase fault current</td><td></td></tr></table>	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	-	Length of arc at		a)	10% rated breaking current	mm	b)	30% — do—	mm	c)	60% — do—	mm	d)	100% — do—	mm	e)	Max. length of arc at lowest fault current	mm	-	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	
c)	60% — do—	ms																																																					
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CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR (E17)
	Bidder's Name: - Number of interruptions before scheduled maintenance is required - Number of mechanical operations before scheduled maintenance is required - 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

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR (E17)
	Bidder's Name: 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 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

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR (E17)
	Bidder's Name: c) Air Consumption at rated pressure for i) Closing (m^3) 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

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR (E17)
	Bidder's Name: l) Inner & outer dia of piping (mm) m) Whether time totaliser for the compressor provided 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

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR (E17)
	Bidder's Name: g) Time required to make up pressure upto loss of nitrogen pressure after i) C-operation 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

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR (E17)
	Bidder's Name: - Weight of gas per breaker Kg - Lockout pressure bar - Alarm pressure - 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

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR (E17)
	Bidder's Name:
	iv) 150
13.	Interrupters
-	Type of main contacts, arcing contacts & Aux. contacts.
-	Material of main contacts/arcing contacts, silver coated or not
-	Contact pressure Kg/sq mm
-	Number of interrupters per pole
-	Breaker length of an interrupter mm
-	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 small 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

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR (E17)
	Bidder's Name: 23. Maximum breaking Capacity under Kilimetric faults and rated TRV characteristic (kA peak) 24. Maximum period between closing 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)

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR (E17)	
	Bidder's Name:	
	30. Partial discharge level at $1.1 U_n/\sqrt{3}$ Pico-coulombs	
	31. Radio interference level at 156 kV (rms) microvolt	
	32. Maximum impact loading on foundation during breaker operations under fault conditions. Kg	
	i) Closed conditions	
	ii) Open conditions	
	33. Seismic withstand value	
	i) Vertical	
	ii) Horizontal	
	34. Tests to be conducted by the supplier at works (All details to be given)	
	a) Type tests	
	b) Routine tests	
	35. Tests to be conducted at site	
	36. Overall dimensions (LxBxH), m	
	37. Weight of breaker complete with operating mechanism, bushing, frame work, Kg	
	a) with SF6 gas	
	b) without SF6 gas	
	38. Descriptive bulletins and drawings of the circuit breakers giving general details of construction.	
	39. Out of phase switching capability of the circuit breaker	
	40. Comments regarding the suitability of the circuit breaker for restrike free operation of power transformer carrying full load current.	

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR (E17)
	Bidder's Name:
41.	Guaranteed time difference between the first pole and last pole operation timing. ms
42.	Data on operating Coils
	(a) No. of trig coils/pole (No.)
	(b) No. of dose coils/pole (No.)
43.	Details of the standard accessories to be supplied alongwith the breaker
44.	No. of the enclosed drg. showing the control scheme of circuit breaker
45.	Details of the provision to be made on GIS to reduce H.V. transients to acceptable values.
46.	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).
47.	(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	Disconnecter Switches
1.	Manufacturer's name & address
2.	Type & designation
3.	Standard applicable
4.	Rated Frequency

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR (E17)
	Bidder's Name:
5.	Whether all the 3 poles are gang operated
6.	Rated voltage
	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

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR (E17)	
	Bidder's Name:	
	- Bus coupler module	A
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 40 ⁰ 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.	220 KV GAS INSULATED SWITCHGEAR (E17)	
	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)	.....

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR (E17)	
	Bidder's Name:	
	20. Controls	.....
	a) Rated D. C. control voltage (Volts)	.....
	b) Limits of voltage	.....
	c) Power consumption of control coils (W)	.....
	21 Constructional Features	
	a) Whether position of earth switch can be interchanged at site to either side of pole	Yes/No
	b) Main contacts	.....
	i) Type of contacts	.....
	ii) Contact area (cm ²)	.....
	iii) Material of contacts	.....
	iv) Contact pressure (Kg/cm ²)	.....
	v) Maximum current density under normal current carrying capacity (Amp/cm ²)	.....
	vi) Thickness of silver plating	.....
	c) Auxiliary contacts on Disconnecting switch	.....
	i) Total number	.....
	i) NO	.....
	iii) NC	.....
	iv) Adjustable	.....
	v) Make before break	.....

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR (E17)
	Bidder's Name: vi) Rated voltage (volts) 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.

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR (E17)		
	Bidder's Name: - Overtravel distance after making of contacts mm - Distance between the contacts in the fully open position mm - Current density at the minimum cross section of switch blade A/mm² - Speed of break m/s 23. Partial discharge level at $1.1 U_n / \sqrt{3}$ pico-coulombs 24. a) Total operating time of disconnector along with its operating mechanism secs. b) Total operating time of disconnector 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 disconnector. 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		

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR (E17)	
	Bidder's Name:	
	34. Rated mechanical terminal load.	Kg
	35. Rated supply voltage of operating devices and auxiliary circuits.	V
	36. Rated pressure of SF6 gas	bar
	37. Minimum distance 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

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR (E17)		
	Bidder's Name: 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 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 156 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		

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR (E17)	
	Bidder's Name:	
	i) NO	.....
	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.	220 KV GAS INSULATED SWITCHGEAR (E17)	
	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 156 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.	220 KV GAS INSULATED SWITCHGEAR (E17)	
	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. Rated voltage	.....
	6. Rated frequency	.....
	i) Rated continuous normal current (A)	.....
	7. Short time current withstand for 1 sec. (kA)	.....
	8. Dynamic current withstand (kA peak)	.....

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR (E17)						
	Bidder's Name:						
	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						
	V						

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR (E17)		
	Bidder's Name:		
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 156 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 40 ⁰ 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	.....	
		Wdg - I	Wdg - II Wdg - III
4.	Rated primary voltage	kV	
5.	Rated secondary voltage	V	

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR (E17)		
	Bidder's Name: 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. Error angle 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 ii) Routine tests 22. Tests to be conducted at site For Breaker For Bus Bar		

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR (E17)
	Bidder's Name:
	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)
	b) Impulse withstand test voltage of arrester housing with 1.2/50 micro sec wave, (kVp)

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR (E17)	
	Bidder's Name:	
	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 156 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
18.	Protective level provided by surge arrestor	.....
19.	Energy level	kJ/kV

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR (E17)	
	Bidder's Name:	
	20. Details of the type test reports enclosed and the standards as per these tests have been carried out	.....
	G) SUPPORT & BARRIER INSULATORS (Details for each type of insulator used to be indicated separately)	Support Barrier
	1. Manufacturer & address	.....
	2. Type of insulators used	.....
	3. One-minute power frequency dry withstand test voltage	kV
	4. Dry flashover value	kV(rms)
	5. Wet flashover value	kV(rms)
	6. 1.2/50 microsecond lightning impulse withstand test voltage	kV(peak)
	7. Creepage distance	mm
	8. Puncture value of insulator in SF6 gas	kV
	9. Weight of insulators in the SF6 GIS enclosure.	Kg
	H) GROUNDING CONNECTION	
	a. Type of conductor	.....
	b. Arrangement for connecting conductor to ground	.....
	c. Type of painting, if any required to be carried out at end points of ground riser	.....
	I) DESIGN CLEARANCE	
	Minimum insulating clearances at nominal rated SF6 gas pressure and rated voltage/BIL voltage for the following :	
	a) Main bus to ground	.....

CLAUSE NO.	220 KV GAS INSULATED SWITCHGEAR (E17)
	Bidder's Name: 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

TECHNICAL CHECK LIST
FOR 220KV GIS

Sl.	Particulars	Reply by bidder.	
1	TECHNICAL QUALIFYING REQUIREMENT		
1.1	The manufacturer must have Experience of designed, manufactured, Type tested & supplied 132kV or higher voltage GIS in India for a period of at least 3 years as on date of award of contract date i.e.08.05.2017.	Confirmed	Yes/No
1.2	The manufacturer should have functional service facility with all tools and tackles, trained manpower required for installation, commissioning and repair of GIS.	Confirmed	Yes/No
1.3	Bidder have to submit declaration and assure that no Chinese National/company having close link with china is envisaged to work in GIS.	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 Civil contractor based on the input (configuration, loads etc) provided by bidder. The supply of embedded plate on which GIS will rest and foundation bolt for GIB shall be in BHEL scope. However consumables like grouting material for Structure of GIS and GIB shall be in scope of bidder. The erection of structure shall be done by BHEL.	Confirmed	Yes/No
2.4	SF6 GIS to Transformer Oil Bushings- As per as per clause 13.02.00 of section-2.	Confirmed, submitted alongwith offer.	Yes/No
2.5	SF6-GIS to Transformer Oil bushing - Interface for connecting GT bushing with bus duct shall be complete with structures etc shall be provided by the bidder as per clause 13.02 of section-2. Limit of supply as per technical specification and as per IEC 61639.	Confirmed	Yes/No
2.6	SF6 to Air Bushing to supplied as per section-2 for outgoing lines	Confirmed	Yes/No
2.7	Confirm that the consumables (list to be enclosed by bidder during contract stage) with shelf life of fewer than two years shall be supplied before erection after clearance from BHEL.	Confirmed	Yes/No
2.8	Detailed list of Commissioning spares for testing & commissioning of GIS till handing over	Attached	Yes/No
2.9	Detailed list of Tools & tackle & Testing Equipment	Attached	Yes/No
2.10	The Switchgear shall be complete with all necessary terminal boxes, SF6 gas filling, interconnecting power and control wiring, grounding connections, gas monitoring equipment and piping, support structures.	Confirmed	Yes/No
2.11	The scope of supply shall also include all erection and mounting hardware and interconnecting cables within GIS.	Confirmed	Yes/No
2.12	Design philosophy of earthing submitted with the bid	Confirmed	Yes/No
2.13	Earthing of GIS shall be in bidder scope. The items and accessories required for completeness of earthing except 75X12 GI flat , 40mm dia MS Rod and 50X6 GI Flat	Confirmed	Yes/No

Sl.	Particulars	Reply by bidder.	
	shall be in bidder's scope.		
3	Technical		
3.1	Altitude : The GIS will be placed an altitude of 544M above MSL, the equipment including pressure relief devices and pressure and density monitoring devices shall be suitable for operation under prescribed conditions as per Technical specification. <i>Bidder to inform what measures shall be taken to ensure the same at bid stage.</i>	Writeup attached with bid.	Yes/No
3.3	Details regarding the design features of equipment which are intended to prevent burn through when an internal arc occurs.	Enclosed with bid	Yes/No
3.4	Material of enclosure - Al. alloy	Confirmed	Yes/No
3.5	Material of bus bar - Al. alloy	Confirmed	Yes/No
3.6	Requirement of AC and DC auxiliary loads	Enclosed with bid	Yes/No
3.7	Catalogues of GIS	Enclosed with bid	Yes/No
3.8	Catalogues of all Maintenance equipment. Bidder to confirm that offered equipment meets the requirements of specification. However it shall be subject to customer approval.	Enclosed with bid	Yes/No
3.9	Approved makes – Bidder to confirm that the offered Maintenance equipment are of approved make. However it shall be subject to customer approval.	Confirmed	Yes/No
4	Calculations		
4.1	All calculations including Thermal calculations based on the climatic conditions indicated as per technical specification shall be submitted during detailed engineering stage.	Confirmed	Yes/No
4.2	Devices or techniques deployed for reducing transients to an acceptable level along with 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 number & location of surge arresters shall be decided. The number and location of surge arresters shall be indicated with the bid. <i>Any increase in quantity at the time of detailed engineering shall be on bidder's account.</i>	Confirmed	Yes/No
4.5	Measures to limit external over voltages (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 along with Technical Specification .	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	Tool & tackles and Site Test		

Sl.	Particulars	Reply by bidder.	
7.1	Special tools & Tackles/ equipment shall be in bidder's scope and hence bidder to furnish detailed BOQ for special Tools & Tackles/ equipment along with unit prices to be handed over to ultimate customer. Bidder shall also submit list of general list of tools & tackles to be arranged by BHEL/its sub contractor. EOT cranes shall be provided by BHEL, capacity of EOT crane to be recommended by bidder.	Confirmed	Yes/No
7.2	Bidder to submit list of tools & tackles, slings, spanners, gauges, slings and other lifting devices, drills, instruments and appliances, special in nature and shall be necessary for the complete assembly and erection at site of the GIS, required for installation, gas filling, maintenance, site testing of the GIS and this shall be arranged by bidder on returnable basis only.	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.	Confirmed	Yes/No
8	TYPE TESTS REQUIREMENTS		
8.1	The 220kV GIS should have been type tested (as per relevant IEC). The GIS and equipment/components shall be of same make and type as that used in type test.	Confirmed	Yes/No
8.2	Type test report for 220 kV GIS shall be submitted along with the bid not older than 5 years as on 08.05.2017. Differences, if any, in the items offered and those which have been type tested shall be clearly brought out along with explanation for suitability.	Confirmed and enclosed with bid	Yes/No
8.3	In case the test reports are not found technically valid during contract stage by BHEL/UJVNL, the bidder shall repeat these test(s) <u>at no extra cost to the purchaser and no delivery implication</u> . Technical valid - Any error or incompleteness (any/all additional type tests not carried out) or discrepancy in the test reports vis-à-vis offered equipment due to any design / manufacturing changes (including substitution of components) or non-compliance with the requirement stipulated in the Technical Specification.	Confirmed	Yes/No
8.4	Earthquake - In case the bidder has not type tested a similar module for earthquake withstand test, they shall supply supporting design calculations of simulated parameters of the test.	Confirmed	Yes/No
8.5	The type tests conducted earlier should have either been conducted in an accredited independent laboratory (accredited base on ISO / IEC Guide 25 / 17025 or EN 45001 by the national accreditation body of the country where laboratory is located). The short circuit test should have been conducted in a laboratory which should be a member of STL (Short-Circuit Testing Liaison - www.stl-liaison.org). If the laboratory is not a national laboratory and member of STL, relevant papers of accreditation shall be submitted in English. If the laboratory is in-house, the tests should have been witnessed by a client.	Confirmed. Details provided with bid.	Yes/No
8.6	The type test report shall be complete including list the test objects, photographs, oscillographs, test arrangement, drawing of tested objects (GIS, equipment etc), test connections. The type test report shall be in English. If it is in any other language, it should include an English version (Translation shall be attested by the Bidder). The English version should be complete with measured values and conclusion.	Confirmed	Yes/No

2. TYPE TESTS

Sl. No.	Type test	LAB	Report No. & Date
A	Type Tests on a complete single pole assembly of one typical switchgear bay module		
1.	Lightning impulse voltage dry tests.		
2.	Switching impulse voltage dry tests.		
3.	Power frequency voltage dry tests.		
4.	Partial discharge tests.		
5.	Radio interference voltage tests.		
6.	Test to prove the temperature rise of any part of the equipment and measurement of the resistance of the main circuit		
7.	Test to prove the ability of the main circuit and earthing circuit to carry the rated peak and the rated short time withstand current		
8.	Test to verify the making and breaking capacity of the included switching devices.		
9.	Tests to prove satisfactory operation of the included switching devices.		
10.	Test to prove the strength of enclosures.		
11.	Gas tightness test		
12.	Electromagnetic compatibility test		
13.	Test on partitions		
14.	Internal arc tests.		
15.	Mechanical operation tests.		
16.	Test to prove the satisfactory operation at limit temperature.		
17.	Verification of degree of protection of auxiliary and control circuits.		
18.	Test to prove performance under thermal cycling and gas tightness test on insulators		
19.	Earthquake withstand test		
B	Type Tests on a component parts - Circuit breakers (In accordance with IEC 62271-100)		
20.	Dielectric test.		
21.	Radio Interference Voltage tests.		
22.	Temperature rise-tests.		
23.	Measurement of Resistance of Main Circuit.		
24.	Short time with-stand current & peak withstand current tests		
25.	Mechanical operation test at ambient temperature		
26.	Miscellaneous Provisions for making & breaking test		
27.	Short circuit current making & breaking tests		
28.	Verification of degree of protection		
29.	EMC test		
30.	Critical current tests.		
31.	Single Phase short circuit tests.		
32.	Short line fault tests.		
33.	Out of phase making & breaking tests - i. Capacitive current switching tests.		
34.	Out of phase making & breaking tests -ii. Tightness test		

C	Type Tests on a component parts - Surge arrestors (In accordance with IEC60099-4)		
35.	Insulation with-stand tests.		
36.	Residual voltage tests.		
37.	Long duration current impulse withstand test		
38.	Operating duty tests		
39.	Pressure relief test.		
40.	Tests of arrestor disconnectors		
41.	Artificial pollution test.		
42.	Partial discharge test.		
43.	Seal leakage test.		
44.	Current distribution test for multi column arrestor.		
D	Type Tests on a component parts - Disconnectors & Earth switches (In accordance with IEC 62271-102)		
45.	Dielectric tests		
46.	Radio interference voltage (RIV) tests		
47.	Temperature – rise tests		
48.	Measurement of the resistance of the main circuit (for isolators)		
49.	Short-time and peak withstand current test		
50.	Tests to prove the short-circuit making performance of earthing switches		
51.	Operating & mechanical endurance tests		
52.	Operation at the temperature limits		
E	Type Tests on a component parts - CTs (As per IEC 60044-1)		
53.	Short time current tests.		
54.	Temperature rise test.		
55.	Lightning impulse test for current transformers for service in electrically exposed installation		
56.	Determination of errors or other characteristics		
57.	Special tests - i. Chopped lightning impulse test		
F	Type Tests on a component parts - Potential transformers (as per IEC 60044-2)		
58.	Temperature rise tests		
59.	Radio Interference Voltage (R.I.V)		
60.	Lightning Impulse test.		
61.	Switching Impulse test.		
62.	Determination of errors.		
63.	Short circuit withstand capability test.		
64.	Special tests - i. Chopped lightning impulse test as a type test.		

Note : The above list of Type test are only indicative . The bidder shall submit/conduct type test if required by customer in addition to above list.

Bidder signature with stamp

COMPLIANCE CERTIFICATE

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

1. The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusion/ deviation with regard to same.
2. There are no deviation(s) with respect to specification other than those furnished in the 'schedule of deviations'.
3. Only those technical submittals which are specifically asked for in NIT to be submitted at tender stage shall be considered as part of offer. Any other submission, even if made, shall not be considered as part of offer.
4. Any comments/ clarifications on technical/ inspection requirements furnished as part of bidder's covering letter shall not be considered by BHEL, and bidder's offer shall be construed to be in conformance with the specification.
5. Any changes made by the bidder in the price schedule with respect to the description/ quantities from those given in 'BOQ' of the specification shall not be considered (i.e., technical description & quantities as per the specification shall prevail).

Date:

Bidder's Stamp & Signature