



BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION BUSINESS ENGINEERING MANAGEMENT
NOIDA

DOCUMENT NO.	TB-405-316-001	Rev 00	Prepared	Checked	Approved
TYPE OF DOC.	TECHNICAL SPECIFICATION	NAME	Vyom	SKS	AG
<u>TITLE</u> 420kV GAS INSULATED SWITCHGEAR (GIS)		SIGN	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>
		DATE	03/10/2020	03/10/20	3/10/20
		GROUP	TBEM		
		WO No.	84008A		
CUSTOMER	SJVN Arun-3 Power Development Company (P) Ltd. (SAPDC)				
Consultant	SJVN Ltd				
PROJECT	4x225MW Arun-3 (HEP),Nepal				

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Remarks: Bidder to note that data and details of Guaranteed Technical Particulars shall not be reviewed during Technical Evaluation/ Review, hence compliance of Guaranteed Technical Particulars in line with Technical Specification has to be ensured by the bidder.

Enclosure-

- (1) Drawing no. TB-3-405-510-001, Rev -06 - Single line diagram of 420kV GIS and Pothead
- (2) Drawing no. TB-405-316-001, Rev -03 - Layout Plan & Elevation of Switchyard
- (3) Drawing no. 34520001107, Outline General. Arrangement-Transformer Cavern

Rev.No.	Date	Altered	Checked	Approved	
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				Copies	

Section 1: Scope, Technical Requirements and Quantities

1) SCOPE:

This technical specification covers the requirements of design, manufacture, inspection and testing at manufacturer's works, proper packing and delivery to project site and supervision of installation and commissioning including site testing along with necessary equipment , training of BHEL and SAPDC/SJVN personnel for **420kV Gas Insulated Switchgear** as per the specification complete in all respect for efficient & trouble free operation mentioned under this specification with all auxiliaries, accessories and spare parts.

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

This section covers the specific technical requirements of 420kV Gas Insulated Switchgear. This constitutes minimum technical parameters for the above item as specified by the SAPDC/SJVN. The offered **420kV Gas Insulated Switchgear (GIS)** shall also comply with the Section-3 (Project Details and General technical requirements for all equipment under the Project) of this specification.

The specification comprises of following sections,

Section-1	:	Scope, Project specific technical requirements & Bill of Quantities (Annexure BOQ) ,MQP/FQP Format and Annexure TQR
Section-2	:	Specific technical requirements for the equipment under scope of supplies.
Section-3	:	Project Details and General technical requirements for all equipment under the Project.
Section-4	:	
Annexures		Annexure-A (SCHEDULE OF TECHNICAL DEVIATIONS) Annexure-B (Compliance Certificate) Annexure-C (Guaranteed Technical Particulars) Annexure-D (Technical Checklist) Annexure-E (Quality Formats)

The following order of priority shall be followed. In case of conflict between requirements specified in various documents, the more stringent one shall be followed.

2) Statutory Regulations:

In particular, the latest version of the following statutory regulations, as applicable, shall be followed for system,

1. Indian Electricity Act
2. CEA regulations
3. The Factory Act
4. Section-1
5. Section-2(SJVN specification)
6. Section-3
7. Codes & standards

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

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

The equipment is required for the following project:

Name of the Customer	: SJVN Arun-3 Power Development Company (P) Ltd. (SAPDC)
Consultant	: SJVN Ltd
Name of Main Contractor	: Bharat Heavy Electricals Limited
Name of the Project	: 4x225MW Arun-3 (HEP),Nepal

420kV switchyard shall be of two main bus configuration with following bays:

- 420kV Line Feeder = 2 Nos.
- 400kV Line Reactor Bay = 2 Nos.
- 400kV Bus Reactor Bay = 1 Nos
- 420kV GT = 4 Nos.
- 420kV Bus Coupler = 1 Nos.
- 420kV Bus VT = 2 Nos.

The scope of supplies shall be as per the Bill of Quantities (Annexure BOQ) enclosed with the Technical Specification.

3) STANDARD AND CODES:

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

IEC 62271-203	Gas Insulated metal-enclosed switchgear for rated voltages above 52KV
IEC 62271-207	Seismic qualification for gas-insulated switchgear assemblies for rated voltages above 52kV
IEC 60376	New sulphur hexafluoride
IEC 62271-100	High voltage alternating current Circuit breakers
IEC 62271-1	Common clauses for high voltage Switchgear and control-gear standards
IEC 62271-102	Alternating current disconnections (isolators) and earthing switches
IEC 60044-1	Current transformers
IEC 60044-2	Voltage transformers
IEC 60137	Bushings for alternating voltages above 1000 V
IEC 62271-209	Cable connections for gas-insulated switchgear
IEC 60480	Guide to checking of sulphur hexafluoride taken from electrical equipment
IEC 60099-1/4	Non-linear resistor type arresters for AC systems
IEC 60439	Factory-built assemblies of low-voltage switchgear and control Gear.
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 61639	Direct connection between Power Transformers and gas insulated metal enclosed switchgear for rated voltage 72.5kV and above

4) Technical Qualifying Requirements:

Please refer Annexure_TQR

5) Type tests:

The contractor shall submit the certificates from Govt. approved labs/ accredited laboratories of the type tests listed under Clause 16.A.7.3 of Section-2 for the **400 KV GIS & 400 KV SF6 CGI Bus Ducts** which should have been carried out within last five (5) years from the date of bid opening (**09.02.2018**). These type test reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract

and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. In case the contractor is not able to submit report of the type test(s) conducted within last five years from the date of bid opening, or in case the type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct the type tests without any commercial implication to BHEL/SAPDC/SJVN.

6) Functional Guarantee:

The bidder has to consider the functional guaranteed value for the GIS equipment as per following :-

- a) **Min Accepted Guarantee** for the Total GIS Losses (Conductor Loss + Enclosure Loss) in kW per meter shall be as follows:-

Maximum power losses per single phase meter at rated voltage and current in : (at 40 deg.C ambient) - As per IEEE (37.23-989)			
a)	-Enclosure	kW	0.09625
b)	-conductor	kW	0.17233
	Total	kW	0.26858

b) Evaluation, Penalty and Rejection Criteria

- Penalty on Guarantee (INR) :** 2,50,000/- per kW@@
- Rejection :** >10% of guaranteed losses as mentioned above

Location to demonstrate Guarantee: At Works

Rectification to Meet Guarantee: At Works**

Liquidated Damages shall be levied for short fall @ Rs.2,50,000/- per KW.

@@ Penalty shall be imposed on Total losses which shall be calculated as Total measured length of GIS Bus duct multiplied by per kW loss per meter length.

**The Contractor shall have to make goods and meet the guarantees in case of shortfall in test values vis-à-vis guaranteed values. Two months will be given to the Contractor for the same for rectification and re-demonstration.

The bidder has to refer Cl. No. 16A.3.4 of section-2 for details.

7) Manual:

The following manuals are required to be supplied by the bidder:

Sr.No	Manual Description
1	Storage and preservation manual
2	Safety manual
3	Erection Manual
4	Testing and commissioning manual
5	Operation manual
6	Maintenance manual
7	Repair process / procedure manual for equipment / system

8) Drawings / Documents required for providing Manufacturing Clearance:

a) Drawings / Documents required for Engineering Manufacturing Clearance

The drawings/ documents, as follows shall be submitted for providing technical clearance for manufacturing of GIS and furthermore, it shall be used for delay analysis, if any, from bidder. The first drawing submission will be counted from the date of submitting reasonably correct drawings.

The last date on which the following documents/drawings are approved will be considered as the date of manufacturing clearance:

Sno	Approval of Drawings Required for issuing Manufacturing Clearance
1	Gas SLD
2	GTP
3	OGA / equipment layout drawing including plan & section for complete GIS
4	Feeder wise Plan & Section (Generator, Line, Bus Coupler, Reactor, Bus PT, SA etc.)
5	Isometric layout arrangement of complete GIS
6	Arrangement / Installation/ Sub Assembly Drawings for each Bays including equipment Schedule
7	Surface Preparation / Surface requirement document/Painting Specification
8	Sub-Vendor List
9	MQP
10	GIS Interlocking Scheme (Electrical & Mechanical)
11	GIS Inter Bay Bus wiring
12	Grounding Study, if any for HF/ Normal frequency
13	Earthing arrangement etc.
14	Volume calculation for SF6 Gas
15	Civil Work Guide including Foundation, Surface Finish, referencing details etc.
16	Loading on foundation (Dead Load, Normal Operation Force & Short Circuit Force)
17	Grouting procedure document for foundation frame
18	Support Structures sizing selection
19	Drawings for Wall & Floor Openings
20	Support Structure Drawing of complete GIS (Bay wise)
21	Drawings for Walkways, Ladders etc.
22	Drawings for Partial Discharge Network, Density Switches, Gas Monitoring, CB Analyzers etc.
23	Drawings and GTP for the Special Tools as per Technical Spec and BOQ

The Manufacturing clearance shall be provided Lot wise, however lot item can be clubbed together subject to approval of drawing/ documents. MFC date will be counted from the date of approval of drawings in Cat I/ Cat II , for each lot , as per the following table.

Please refer to Sl. No. of items in the Annexure BOQ also,

Lot description covering BOQ items	Sl. No. of approved Drawing required in Cat I/ Cat II for MFC.
Lot-1 (BOQ Item A.1 – A.9) Lot-2 (BOQ Item A.10 – A.14)	Sl. No. 1-9
Lot-3 (BOQ Item A.15 – A.23)	Sl. No. 10-22
Lot-4 (Item B , C , D , E and F)	Sl. No. 23

The above drawings / documents submitted shall be project and product specific and shall incorporate all project details and title block and numbering scheme of the BHEL/SAPDC/SJVN as detailed in Clause 3.18 of Section 3.

- b) Additionally, the successful bidder is required to submit drawings and documents that shall cover but not limited to the following:

<u>Sno</u>	<u>Drawing Description</u>
1	Insulation coordination Study including selection and siting of SA
2	Short Circuit Withstand Capability & mitigation measures
3	Heat Loss Calculation (Enclosure & Conductor)
4	Burn Through capability of enclosure calculation
5	Energy Storage Duty calculation of CB Spring
6	Sizing & selection of expansion bellows, compensators, bypass
7	Arrangement / Installation/ Assembly for XLPE to SF6 Bushing for each EHV cable. All Electrical & Control Drawings such as Electrical Panels OGA, Cable Block & Termination Diagram, Schematic Diagram, JB/MB/Kiosk Diagram etc. in respect of GIS.
8	Component wise weight schedule, lifting arrangement & safety arrangement.
9	Gas Handling Procedure document covering extraction, filling etc.
10	Selection of Gas Barrier compartments.
11	Erection Procedure documents along with all the drawings pertaining to this section.
12	HV Testing Procedure Document and calculation for adequacy of HV Testing Kit.
13	Technical Datasheet & Catalogue of every component used under this chapter.
14	3D Isometric layout arrangement of complete GIS
15	Type Test Reports

9) Deleted

10) Earthing of GIS:

Supply of all earthing material and supervision of Erection for all Earthing connection as per the technical specification Clause 16.A.5.7 of Section 2, shall be in bidder's scope. The quantity shall be estimated by the bidder, based on technical specification Clause 16.A.5.7 of Section 2, bidder's design philosophy, IS/IEC/IEEE requirement as applicable.

Bidder to submit detailed calculations and layout drawings for earthing system during detailed engineering stage. Bidder to provide the bill of quantity of entire items required for the earthing of the GIS. However, supply of 40mm MS ROD, 75X12/50x6mm GI Flat shall be done by BHEL. Any other earthing material like Copper / Al / etc including High frequency earthing (except 40mm MS Rod, 75x12/50x6mm GI Flat) , if required shall be in bidder's scope of supply only. Erection of earth mat shall be done by BHEL under the supervision of bidder/manufacturer as per manufacturer's design philosophy.

Design philosophy shall be submitted along with the bid in line with Clause 16.A.5.7 of section 2 to be followed for earthing.

11) Drawings Enclosed:

Sl. No.	BHEL Drg. No.	Drawing Title
1.	TB-405-510-001	Single line diagram of 420kV GIS and Pothead
2.	TB-405-316-001	Layout Plan & Elevation of Switchyard
3.	34520001107	Outline General Arrangement-Transformer Cavern

Note: Refer attached layout drawing for GIS Building Size. GIS to be supplied should be accommodated in area as per cl. No. 16A.4.7 of Section-2. Bay sequence of GIS may change during detailed engineering.

12) BILL OF QUANTITIES: As per Annexure-1:

Note – Overall Contract Value may vary by +/- 20% of the contract value.

13) DEFECT LIABILITY AND LATENT DEFECT:

Defect Liability

- "Defect Liability Period" means the period of validity of the warranties given by the Contractor commencing at Completion of the Facilities or a part thereof, during which the Contractor is responsible for defects with respect to the Facilities (or the relevant part thereof) as provided here.
- The Contractor warrants that all the facilities or any part thereof are new, unused, and of the most recent or current models, and that they incorporate all recent improvements in design and materials, unless provided otherwise in the Contract.
- The Contractor further warrants that the Plant and equipment shall be free from defects arising from any act or omission of the Contractor or arising from design, materials, and workmanship, under normal use in the conditions prevailing in the country of final destination.

- d) The defect liability period shall be Twenty Four months (24) months from the date of completion of the facilities (or any part thereof) or eighteen (18) months from the date of operational acceptance/taking over of the facilities (or any part thereof), of respective unit/ common auxiliary whichever period concludes earlier.
- e) If during the Defect Liability Period any defect should be found in the design, engineering, materials and workmanship of the Plant and equipment supplied or part thereof, the Contractor shall promptly, in consultation and agreement with the Employer regarding appropriate remedying of the defects, and at its cost, repair, replace or otherwise make good (as the Contractor shall, at its discretion, determine) such defect as well as any damage to the Facilities caused by such defect. The Contractor shall not be responsible for the repair, replacement or making good of any defect or of any damage to the Facilities arising out of or resulting from any of the following causes:
 - (a) improper operation or maintenance of the Plant and equipment by the Employer
 - (b) operation of the Facilities outside specifications provided in the Contract
 - (c) normal wear and tear
- f) The Employer shall give notice to the Contractor stating the nature of any such defects together with all available evidence thereof, promptly following the discovery thereof. The Employer shall afford all reasonable opportunity for the Contractor to inspect such defects.

Upon receipt of notice the contractor shall within one week start the repair work, expeditiously repair or replace the defective Plant and equipment or parts thereof, at no cost to the Employer.

If the Contractor fails to commence the work necessary to remedy such defect or any damage to the Facilities caused by such defect within a reasonable time (which shall in no event be considered to be less than fifteen (15) days), the Employer may, following notice to the Contractor, proceed to do such work, and the reasonable costs incurred by the Employer in connection therewith shall be paid to the Employer by the Contractor or may be deducted by the Employer from any monies due the Contractor or claimed under the Performance Security.
- g) If the repair, replacement or making good is of such a character that it may affect the efficiency of the Plant and equipment or any part thereof, the Employer may give to the Contractor a notice requiring that tests of the defective part of the Facilities shall be made by the Contractor immediately upon completion of such remedial work, whereupon the Contractor shall carry out such tests.

If such part fails the tests, the Contractor shall carry out further repair, replacement or making good (as the case may be) until that part of the Facilities passes such tests. The tests in Character shall in any case be not less than what has already been agreed by the Employer and the Contractor for the original equipment / part of the Facilities.
- h) If the Plant and equipment or any part thereof cannot be used by reason of such defect and/or making good of such defect, the Defect Liability Period of the Facilities or such part, as the case may be, shall be extended by a period equal to the period during

which the Facilities or such part cannot be used by the Employer because of any of the aforesaid reasons.

Upon correction of the defects in the Facilities or any part thereof by repair/replacement, such repair/replacement shall have the Defect Liability Period extended by a period of twelve (12) months from the time such replacement/repair of the facilities or any part thereof subject to maximum time period of thirty six (36) months from the date of putting plant and equipment into use.

- i) The Contractor's obligations under this Clause shall not apply to:
 - a) Any materials that are supplied by the Employer are normally consumed in operation, or have a normal life shorter than the Defect Liability Period stated herein
 - b) Any designs, specifications or other data designed, supplied or specified by or on behalf of the Employer or any matters for which the Contractor has disclaimed responsibility herein.
 - c) Any other materials supplied or any other work executed by or on behalf of the Employer, except for the work executed by the Employer for remedy of defects in the work executed by the contractor as per provisions mentioned below.
- j) The Employer shall afford the Contractor all necessary access to the Facilities and the Site to enable the Contractor to perform its obligations under this Clause .The Contractor may, with the consent of the Employer, remove from the Site any Plant and Equipment or any part of the Facilities that are defective if the nature of the defect, and/or any damage to the Facilities caused by the defect, is such that repairs cannot be expeditiously carried out at the Site.
- k) Except as provided in (Defect Liability), the Contractor shall be under no liability whatsoever and howsoever arising, and whether under the Contract or at law, in respect of defects in the Facilities or any part thereof, the Plant and Equipment, design or engineering or work executed that appear after Operational acceptance or any part thereof, except where such defects are the result of the gross negligence, fraud, criminal or wilful action of the Contractor.
- l) The contractor shall provide an extended warranty for a period of 36 months from the date of taking over of Facilities for the part repaired (as envisaged in POINT NO. (h)).

14) INSPECTION & TESTING:

Materials used for construction of major & important sub-assemblies shall be thoroughly shop tested and inspected by the bidder at his own expense prior to dispatch. Shop test shall comprise of routine test & any other tests (if applicable) as per the of Section-2 & Section-3.

- a) GIS and its associated materials shall be subject to inspection by BHEL/SJVN/SAPDC or authorized representative at manufacturers' works. Hence, Bidder shall furnish all necessary information concerning the supply to BHEL/SJVN/SAPDC.
- b) During fabrication assembly, the equipment shall be subject to inspection by BHEL/SJVN/SAPDC or by an agency authorized by the owner to assess the progress of work as well as to ascertain that only quality raw material is used.

Routine and acceptance tests as listed in relevant standard and equipment specifications of Section-2 & Section-3 shall be conducted.

- c) Bidder shall also furnish factory acceptance testing procedures from manufacturers for BHEL/SJVN/SAPDC approval.

Note : Inspection and testing shall be done as per section-2 & section-3 of technical specification. However, any other test not mentioned but required as per relevant IEC/IS shall also be performed.

15) FIELD TESTING, COMMISSIONING and PERFORMANCE TESTING:

- (i) Bidder shall submit site acceptance testing (SAT) procedures and get them approved from BHEL/SJVN/SAPDC before carrying out the site testing at site.
- (ii) Bidder shall interface with manufacturers of other equipment wherever required and shall freely and readily supply all technical information for this purpose as and when called for.
- (iii) Bidder shall coordinate with manufacturers of other equipment wherever required and shall freely and readily supply all technical information for this purpose as and when called for.
- (iv) Further appropriate testing and commissioning reports and as-built documentation as necessary be submitted.

Note - Testing equipment shall be provided by the OEM in addition to testing personnel. Site commissioning test shall be done as per section-2 & section-3 of technical specification.

Bidder to submit list of general tools, tackle, slings, spanners, gauges, slings and other lifting devices, drills, instruments and appliances necessary for the complete assembly and erection at site of the GIS, required for installation, gas filling, maintenance, site testing of the GIS, and same shall be arranged by BHEL /BHEL ETC contractor. However, any other special tools & tackle and testing and commissioning tools/ kit shall be brought at site by Bidder on returnable basis.

16) PACKING AND DISPATCH:

The packing, marking and documentation within and outside the packages shall comply strictly with such special requirements as shall be expressly provided for in the Contract and, subject to any subsequent instruction ordered by the Employer consistent with the requirements of the Contract AS PER Specification. Reference Export-worthy packing details is attached “Annexure - Export Worthy Packing”.

17) QUALITY PLAN:

The Bidder shall follow Quality Assurance Programme to ensure that the equipment and services under the scope of contract whether manufactured or performed at the Bidder's works or at his sub-vendor's premises or at the SAPDC's site or at any other place of work are in accordance with the technical specifications. Such programme shall be outlined by the Bidder and be submitted along with the bid. The QA programme shall be generally in line with IS/ISO- 9001, Section-2 & Section-3.

18) IP requirement

IP requirement shall be based on applicable National/ international standards and the same shall be finalized during detail engineering. However the minimum requirement shall be as under or as specified in the particular technical specifications of various components:

- For outside installation and area which are humid, corrosive, and prone to dripping and/ or spray of water, the protection class of cubicles shall be IP 65.
- Cubicles housing electronic cards/modules such as of unit control boards/local control boards, digital governors, LCC Panels & Mechanism Box for GIS, static excitation equipment shall be of protection class of IP 52.
- Other cubicles and enclosures shall be of protection class IP 42 or higher according to their location.

19) OTHER GENERAL INFORMATION:

Other general information for **Vendor** shall be as follows.

- a) **Storage shall be provided by BHEL.** However, bidder shall provide their tentative space requirement for covered and/ or open store area during tender stage only. In addition to this, bidder shall submit their standard storage instruction manual also.
- b) Bidder shall submit list of consumables with shelf life of fewer than two years and same shall be dispatched just before the erection and only after specific clearance from BHEL.
- c) In addition to this, packing of GIS & its accessories shall be suitably robust for long term storage of **minimum 2 years**.
- d) Bidder shall offer their latest type tested compact model so that offered GIS and associated system gets accommodated in the space allocated in technical specification. No additional space will be provided. Bidder to note that if bidder fails to meet above requirement, his technical offer is **liable for rejection**.

- e) Bidder shall conduct insulation co-ordination studies for successfully establishing suitability of surge arrester rating, and any other requirement for successful operation of GIS.
- f) Bidder shall be required to submit 3D/Isometric OGA Drawing for complete GIS and bus duct.
- g) Bidder shall check and ensure adequacy of system protection for successful operation of GIS. After checking of system by bidder, GIS shall be installed and if any failure, malfunction of any part occurs after/ during commissioning, same shall be replaced immediately without any extra cost.
- h) EOT crane (10T) shall be provided by BHEL.**
- i) CT/ VT parameters mentioned in SLD is indicative only. Bidder has to ensure correctness of CT/VT sizing as per relays selected for GIS during contract stage / detailed Engineering stage.
- j) Any change in bay pitch (distance between bays) as per civil requirement for foundation layout during detailed engineering stage shall be incorporated by bidder without any cost and delivery implication to BHEL.
- k) Bidder shall include painting and marking of all buses, individual incomers, all outgoing feeders etc. with details such as tag no., feeder rating, sending end source reference etc.
- l) Bidder will submit detailed bar chart indicating all the milestones from Engineering till manufacturing/ testing, dispatch to site and commissioning.
- m) All supporting structures including foundation /fixing bolts /embedded plate and hardware required for fixing and erection of SF6 bus duct shall be in Bidder scope.
- n) All hardware and structure required for fixing and erection of GIB duct in Pothead yard and GT Cavern including foundation /fixing bolts /embedded plate shall be in bidder scope of supply.
- o) All hardware and structure required for fixing and erection of GIS on GIS floor including foundation /fixing bolts /embedded plate shall be in bidder scope of supply.
- p) All supporting structures including foundation /fixing bolts /embedded plate and hardware for the SF6 duct connections between the generator transformers oil to SF6 bushing and the GIS duct shall be in Bidder scope.

- q) Main bus bars of GIS shall be designed for convenient future extension of the switchgear as per SLD and related technical details shall be provided by bidder to meet the requirements of other make /GIS supplier.
- r) Gas Insulated Bus duct length inside and upto centreline of GIS Building Wall shall be considered as included in the GIS Bays by Bidders. GIB Length shall be measured from the centreline of the GIS building wall to SF6 Air bushing and SF6 to Oil Termination Modules on Line/Bus Reactor.
- s) 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.
- t) The word 'TYPE' means the Make, Model no., Type, Range, Size/ Length, Rating, Material as applicable.
- u) The terminology used under 'Part Description' is the commonly used name of the part and may vary from manufacturer to manufacturer. The manufacturer/bidder shall clearly bring out the terminology used by them in the bid.
- v) The instruments to be supplied for the maintenance and operation needs to be successfully demonstrated at site. MICC will be issued only after the successful demonstration of respective equipment at site.
- w) 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.

Annexure: FQP and MQP Format

	PROJECT NAME (MW)		MANUFACTURING / FIELD QUALITY ASSURANCE PLAN					CONTRACTOR NAME, ADDRESS & LOGO					
	ITEM DESCRIPTION		SUB-ITEM		QAP NO.		REV. NO	ISSUE DATE	SUB-CONTRACTOR NAME, ADDRESS & LOGO				
SR. NO.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
					M/C	S				M	C	S	
1	2	3	4	5	6		7	8	9	10			11
LEGENDS													
M	MANUFACTURER		C	CONTRACTOR				S	SJVN LTD.				
P	PERFORM		V	VERIFICATION OF RECORDS				W	WITNESS / CHP				
IR	INSPECTION REPORT		DRG	DRAWING				CHP	CUSTOMER HOLD POINT				
MA	MAJOR		MN	MINOR				CR	CRITICAL				
ME	MEASUREMENT		NDT	NON DESTRUCTIVE TESTING				HT	HEAT TREATMENT				
TR1	CERTIFICATE OF COMPLIANCE TO TS/STANDARD REQUIREMENT WITHOUT ANY CHECK LIST OF TESTS CARRIED OUT.		TR2	CERTIFICATE OF COMPLIANCE TO TS/STANDARD REQUIREMENT WITH CHECK LIST OF TESTS CARRIED OUT.				TR3	TEST REPORT/TEST CERTIFICATE WITH TEST RESULTS BASED ON SPECIFIC INSPECTION & TESTING AT MANUFACTURER FACILITY/NABL APPROVED LAB.				
NOTE: QAP SHALL BE READ IN CONJUNCTION WITH QUALITY ASSURANCE REQUIREMENT GIVEN AS PART OF TECHNICAL SPECIFICATION.													
MANUFACTURER / SUB-CONTRACTOR:			CONTRACTOR:		FOR SJVN USE:			REFERENCE DOC NO. OF SJVN:					
PREPARED BY:		REVIEWED BY		REVIEWED & RECOMMENDED By		REVIEWED BY		RECOMMENDED BY		APPROVED BY			
NAME, DESIGNATION & SIGNATURE		NAME, DESIGNATION & SIGNATURE		NAME, DESIGNATION & SIGNATURE		NAME & SIGNATURE		NAME & SIGNATURE		SIGNATURE & SEAL			

Annexure_TQR

Technical Qualifying Requirements:

Selection of Sub-Vendor

The Bidder shall have designed, manufactured, type tested at least the minimum specified quantity of all equipment as below covered under the scope of this contract of at least the rating as specified herein under or higher:

Minimum rating required for the 400 KV GIS & 400 KV SF6 CGI Bus Ducts

420 kV Class GIS & 420 kV CGI Bus Ducts and auxiliary equipment of 400 kV (minimum) 50 Hz, 50% of rated current of 2500A (**i.e. 1250 A**), 40 kA/1sec (min.) short circuit rating, SF6 gas insulated switchgear for indoor/outdoor installation for minimum of **6 nos of bays**.

These equipments should have been supplied in last 20 years & should be in successful operation for at least 2 years in last 7 years as on the **date of Bid opening (09.02.2018)** in Power Plant or Sub-stations or Industrial Complex etc.

Sl. No of Purchase Indent	Line Items	Description	Detailed Description	Unit	Qty
	A	Supply Item : 400kV, 2500A , 50kA for 1 second GIS double bus scheme as per attached single line diagram drawing no. TB -405-510-001. Comprising of Items (A.1-A.24)	The 400kV SF6 Gas Insulated Switchgear shall have three single phase construction, Double Main Bus Scheme. 400kV, 2500A, 50kA for 1 sec Double Bus bar GIS comprising of but not limited to the following modules/bays :- a. 4 nos. Fully Equipped GT Incomer Bays including Interfacing GIS Module in GT Cavern (Fully Equipped Bay) b. 2 nos.Fully Equipped Outgoing line Bays c. 2 nos. Fully Equipped Line Reactor Bays d. 1 no. Fully Equipped Bus Reactor Bay e. 1 no. Fully Equipped Bus Coupler Bay f. 2 no. Bus PT bays, Bus Extension Module complete with local control cabinet (LCC), cable etc. Typical Bay includes Busbar, Circuit Breaker, Disconnecter , Maintenance Earthing Switch, High Speed Earthing Switch, Current Transformer, Voltage Transformer, Surge Arrestor, SF6 to EHV Cable termination Module,SF6/Air termination module,SF6 to Oil Termination Module , Gas Monitoring Devices,Online PD Monitoring System, Pressure Switches etc. Each end of the main bus bars shall be designed for convenient future extension of the switchgear. Bus conductor and connectors and enclosure flanges shall be designed accordingly. Bus Busbar system should be suitably provided with end caps/ end seals to insulate the live bus bar. Continuous on-line monitoring and diagnostic systems in all individual bays (including LCD display) to monitor partial discharge, internal arcing, gas density, gas pressure, leakage, moisture etc., operating parameters such as current, voltage, temperature etc. complete with sensors, control / processor units, wiring/cabling in all respects. Refer attached Single Line Diagram drawing no. TB -405-510-001 for details of equipments and bays. The Switchgear shall be complete with all necessary terminal boxes, inspection windows, SF6 gas filling valve , static filters, density switches , safety diaphragm, interconnecting cabling & wirings, grounding connections, gas monitoring systems and pipings, trays, support structures , walkways,Bellows and Compensators like Lateral mounting units, Axial compensators, Parallel compensators,Tolerance Compensators, Vibration compensators, etc. The scope of supply shall also include all erection and mounting hardware and interconnecting cables between GIS to LCC and between LCC to LCC including Cable Trays, Tags, Glands, ferrules, Lugs etc. Refer Section 2 and Single Line Diagram for details.		
1	A.1	SUPPLY- GIS : 400KV, 50KA FOR 1S, 2500A, DOUBLE MAIN BUS SCHEME - GENERATOR TRANSFORMER GIS BAY	400kV,2500A ,50 kA for 1 second, SF6 gas insulated GT Feeder Bay Module each set comprising of following but not limited to:- a) One set of 2500A, One nos. of 3-phase SF6 insulated circuit breaker without preinsertion resistor but with CSD, complete with operating mechanism suitable for 3 phase operation. b) Three nos. Single-phase,multi ratio, current transformers as per single line diagram.(CT disposition shall be as per SLD) c) Three nos. Single phase , SF6 to OIL Termination Module on GT. (to be quoted separately-refer note) d) Six nos. Single Phase ,SF6 to EHV Cable Module (to be quoted separately-refer note) e) Three nos. Single Phase ,Interfacing Modules . (to be quoted separately-refer note) f) Two nos. of 3-phase, 2500A, group operated Disconnecter switches, complete with manual and motor driven operating mechanisms. g) One nos. of 3-phase, group operated safety grounding switches, complete with manual and motor driven operating mechanisms. h) One no. of 3-phase, high speed make proof grounding switch, complete with group operated manual and motor driven operating mechanisms for each phase. i) Gas monitoring system, pressure relief device, busbar, insulator, expansion joint/ flexible connection etc. as required. j) Barrier cones, mechanism box and other items as required. k) Any other item required to complete the system in all respects but not limited to above. Refer Section-2 and Single Line Diagram for Details. Note : 1.The Bidder shall quote for CSD of Circuit Breaker separately at Line Item No - A.16 in the BOQ 2.The Bidder shall quote for the SF6 to OIL Termination Module on GT separately at Line Item No. A.12 in the BOQ. 3.The Bidder shall quote for the SF6 to EHV Cable Termination Module separately at Line Item No. A.11 in the BOQ. 4.The Bidder shall quote for the Interfacing GIS Module separately at Line Item No. A.10 in the BOQ.	Set	4
2	A.2	SUPPLY- GIS : 400KV, 50KA FOR 1S, 2500A, DOUBLE MAIN BUS SCHEME - LINE GIS BAY	400kV,2500A, 50KA for 1 second, SF6 gas insulated metal enclosed Line Feeder Bay Module each set comprising of following but not limited to :- a) One set of 2500A, One nos. of 3-phase SF6 insulated circuit breaker without preinsertion resistor but with CSD ,complete with operating mechanism (suitable for 1 & 3 phase auto reclose). b) Three nos. single phase,multi ratio,current transformers as per single line diagram.(CT disposition shall be as per SLD). c) Three nos. Single phase SF6 to Air Termination Bushing. (to be quoted separately-refer note) d) Three nos. of 3-phase, 2500A, group operated Disconnecter switches, complete with manual and motor driven operating mechanisms. e) One nos. of 3-phase, group operated safety grounding switches,complete with manual and motor driven operating mechanisms. Two f) One no. of 3-phase, high speed make proof grounding switch, complete with group operated manual and motor driven operating mechanisms for each phase. g) Gas monitoring system, pressure relief device, busbar, insulator, expansion joint/ flexible connection etc. as required. h) Barrier cones, mechanism box and other items as required. i) GIS Duct inside the GIS building from Switchgear upto centerline of the Building wall through which the GIS duct passes. j)Any other item required to complete the system in all respects but not limited to above. Refer Section-2 and SLD for Details. Note : 1. The Bidder shall quote for CSD of Circuit Breaker separately at Line Item No - A.16 in the BOQ 2. The Bidder shall quote for SF6 to Air Termination Module separately at Line Item No - A.14 in the BOQ.	Set	2
3	A.3	SUPPLY- GIS : 400KV, 50KA FOR 1S, 2500A, DOUBLE MAIN BUS SCHEME - LINE REACTOR GIS BAY	400kV,2500A,50KA for 1 second, SF6 gas-insulated metal enclosed Line Reactor bay module each set comprising of following but not limited to :- a) One set of 2500A,One nos. of 3-phase SF6 insulated circuit breaker without preinsertion resistor but with CSD , complete with operating mechanism. b) Three nos. Single-phase,multi ratio, current transformers as per single line diagram.(CT disposition shall be as per SLD) c) Three no. Single Phase ,SF6 to Oil Termination Module on the Line Reactor. (to be quoted separately-refer note) d) One nos. of 3-phase, 2500A, group operated Disconnecter switches, complete with manual and motor driven operating mechanisms. e) One nos. of 3-phase, group operated safety grounding switches, complete with manual and motor driven operating mechanisms. f) One no. of 3-phase, high speed make proof grounding switch, complete with group operated manual and motor driven operating mechanisms for each phase. g) Three Nos. of single phase 336kV, 20kA , SF6 gas insulated metal enclosed zinc oxide surge arrestors . h) Gas monitoring system, pressure relief device, busbar, insulator, expansion joint/ flexible connection etc. as required. i) Barrier cones, mechanism box and other items as required. j) GIS Duct inside the GIS building upto centerline of the Building wall through which the GIS duct passes. k) Any other item required to complete the system in all respects but not limited to above. Refer Section-2 and SLD for Details. Note : 1.The Bidder shall quote for CSD of Circuit Breaker separately at Line Item No - A.16 in the BOQ 2.The Bidder shall quote for the SF6 to Oil Termination Module on Line/Bus Reactor separately at Line Item No. A.13 in the BOQ.	Set	2
4	A.4	SUPPLY- GIS : 400KV, 50KA FOR 1S, 2500A, DOUBLE MAIN BUS SCHEME - BUS REACTOR GIS BAY	400kV, 50KA for 1 second, SF6 gas-insulated metal enclosed Bus Reactor Bay module each set comprising of following but not limited to :- a) One set of 2500A, One nos. of 3-phase SF6 insulated circuit breaker without preinsertion resistor but with CSD , complete with operating mechanism b) Three nos. Single-phase,multi ratio, current transformers as per single line diagram.(CT disposition on either side of breaker/bus or elsewhere shall be as per SLD) c) Three nos. single phase SF6 to Oil Termination Module on the Bus Reactor . (to be quoted separately-refer note) d) Two nos. of 3-phase, 2500A, group operated Disconnecter switches, complete with manual and motor driven operating mechanisms. e) One nos. of 3-phase, group operated safety grounding switches, complete with manual and motor driven operating mechanisms. f) One no. of 3-phase, high speed make proof grounding switch, complete with group operated manual and motor driven operating mechanisms for each phase. g) Three Nos. of single phase 336kV, 20kA , SF6 gas insulated metal enclosed zinc oxide surge arrestors . h) Gas monitoring system, pressure relief device, busbar, insulator, expansion joint/ flexible connection etc. as required. i) Barrier cones, mechanism box and other items as required. j) GIS Duct inside the GIS building upto centerline of the Building wall through which the GIS duct passes. k) Any other item required to complete the system in all respects but not limited to above. Refer Section-2 and SLD for Details. Note : 1.The Bidder shall quote for CSD of Circuit Breaker separately at Line Item No - A.16 in the BOQ 2.The Bidder shall quote for the SF6 to Oil Termination Module on Bus Reactor separately at Line Item No. A.13 in the BOQ.	Set	1
5	A.5	SUPPLY- GIS : 400KV, 50KA FOR 1S, 2500A, DOUBLE MAIN BUS SCHEME - BUS COUPLER GIS BAY	400kV, 50KA for 1 second, SF6 gas-insulated metal enclosed Bus-Coupler bay module comprising of following but not limited to :- a) One set of 2500A,One nos. of 3-phase SF6 insulated circuit breaker without preinsertion resistor but with CSD , complete with operating mechanism suitable for 3 phase operation. b) Three nos. single -phase,Single-phase,multi ratio, current transformers as per single line diagram. (CT disposition on either side of breaker/bus or elsewhere shall be as per SLD) c) Two nos. of 3-phase, 2500A, group operated Disconnecter switches, complete with manual and motor driven operating mechanisms. d) Two nos. of 3-phase, group operated safety grounding switches, complete with manual and motor driven operating mechanisms. e) Gas monitoring system, pressure relief device, busbar, insulator, expansion joint/ flexible connection etc. as required. f) Barrier cones, mechanism box and other items as required. g) GIS duct inside the GIS Building. h) Any other item required to complete the system in all respects but not limited to above. Refer Section-2 and SLD for Details. Note : 1.The Bidder shall quote for CSD of Circuit Breaker separately at Line Item No - A.16 in the BOQ	Set	1
6	A.6	SUPPLY- GIS : 400KV, 50KA FOR 1S, 2500A, BUSBAR MODULE	These shall be inserted, as required, between sections of bus bars, CGI bus duct connections, and shall be used to create electrical connectivity of BUS BARS considering the thermal expansion, accomodating of GIS Modules due to shifting of GIS Bays arising due to civil and archetectural requirements or expansion joint in the building that houses GIS. Bidder shall consider the bus bars/modules compatible with the Bellows/Compensators like Lateral mounting units, Axial compensators,Parallel compensators,Tolerance Compensators,Vibration compensators etc. Refer Section-2 and SLD for Details.	set	2
7	A.7	SUPPLY- GIS : 400KV, 50KA FOR 1S, DOUBLE MAIN BUS SCHEME - BUS MEASUREMENT GIS BAY/ VOLTAGE TRANSFORMER BAY	400kV, 50 kA for 1 sec, SF6 gas insulated Bus VT bay module connected to Main Bus Bars. Each set shall be complete in all respects and comprising of following but not limited to, a) Three nos. single phase Voltage transformers . b) One no. of 3-phase,group operated Disconnecter switches, complete with manual and motor driven operating mechanisms. c) One no. of 3-phase, group operated safety grounding switches, complete with manual and motor driven operating mechanisms for each phase. d) Gas monitoring system, pressure relief device, busbar, insulator, expansion joint/ flexible connection etc. as required. e) Any other item required to complete in all respects but not limited to above. Refer Section-2 and SLD for Details.	Set	2
8	A.8	SUPPLY- GIS : 50KA FOR 1S, RATING (AS PER TS), SURGE ARRESTOR INCLUDING SURGE COUNTER FOR GIS BUS	Three nos of single plase 336kV,20kA, SF6 gas insulated, metal enclosed surge arrestors of the gapless metal oxide, heavy-duty type. Refer Section 2 and SLD for details.	Set	2

Sl. No of Purchase Indent	Line Items	Description	Detailed Description	Unit	Qty
9	A.9	SUPPLY- GIS : 400KV, 50KA FOR 1S, 2500A, DOUBLE MAIN BUS SCHEME - BUS EXTENSION MODULE	400kV,2500A, 50 kA for 1 sec, SF6 gas-insulated metal enclosed bus extension module. Each set shall be complete in all respects and comprising of following but not limited to, a) One no. of 3-phase, 2500A, group operated Disconnector switches, complete with manual and motor driven operating mechanisms. b) Two no. of 3-phase, high speed make proof grounding switch, complete with group operated manual and motor driven operating mechanisms for each phase. c) Gas monitoring system, pressure relief device, busbar, insulator, expansion joint/ flexible connection etc. as required. d) Any other item required to complete in all respects but not limited to above. Refer Section-2 and SLD for Details.	Set	2
10	A.10	SUPPLY- GIS : 400KV, 50KA FOR 1S, 2500A, INTERFACING GIS MODULE	400kV,2500A,50kA for 1 sec , 3 x 1 phase SF6 gas-insulated metal enclosed Interfacing GIS Module near GT in GT Cavern Area . Each shall be complete in all respects and comprising of following but not limited to, a) Three nos. Single-phase,multi ratio, current transformers as per single line diagram. (CT disposition on bus or elsewhere shall be as per SLD) b) Three Nos. of single phase 336kV, 20kA , SF6 gas insulated metal enclosed zinc oxide surge arrestors . c) One no. of 3-phase, high speed make proof grounding switch, complete with group operated manual and motor driven operating mechanisms for each phase. d) Gas monitoring system, pressure relief device, busbar, insulator, expansion joint/ flexible connection etc. as required. e) Barrier cones, mechanism box and other items as required. f) Any other item required to complete the system in all respects but not limited to above. Refer Section-2 and SLD for Details.	Set	4
11	A.11	SUPPLY- GIS : 400KV, 50KA FOR 1S, 2500A, SF6 TO EHV CABLE CONNECTION MODULE	SF6 gas-insulated metal enclosed module shall be Single Phase and shall be used in GT bay Modules. Each shall be complete in all respects and comprising of following but not limited to, (a) 400kV XLPE Cable to SF6 Bushing Module shall be of the plug-in type with dry-type or fluid-filled terminations. The interfaces conform to IEC standards. A removable link, which disconnects and isolates the GIS from the cable during high-voltage test for convenience and ease of operations shall also be provided (if applicable) . (b) Gas monitoring system, pressure relief device, busbar, insulator, expansion joint/ flexible connection etc. as required. (c) All the Cable connection module shall be suitable for connection of 400 kV XLPE cable (d) Any other item required to complete in all respects but not limited to above. The bidder shall have to make provision in termination module for fixing the cable / termination kit (male/ female) in line with IEC62271-209 for scope division, which shall be supplied by BHEL/Its vendor. Bidder has to supply GIS with cable termination modules for all GT Bays (In GIS building and in GT Cavern area) Refer Section-2 and SLD for Details.	Nos	24
12	A.12	SUPPLY- GIS : 400KV, 50KA FOR 1S, SF6 TO OIL CONNECTION MODULE (TYPE-A)	a. Single phase ,400kV , 2500A , termination module for connecting <u>Oil Bushing on Generator Transformer</u> to GIS SF6 bus duct. b. Scope of supply and split of scope division of GIS Bidder shall be as per IEC 62271-211. c. Gas monitoring system, pressure relief device, busbar, insulator, expansion joint/ flexible connection etc. as required. d. Barrier cones, mechanism box and other items as required. e. Any other item required to complete the system in all respects but not limited to above. Refer Section-2 and SLD for Details.	Nos.	12
13	A.13	SUPPLY- GIS : 400KV, 50KA FOR 1S, SF6 TO OIL CONNECTION MODULE (TYPE-B)	a.Single phase ,400kV , 2500A , termination module for connecting <u>Oil Bushing on Line/Bus Reactor</u> to GIS SF6 bus duct. b.Scope of supply and split of scope division of GIS Bidder shall be as per IEC 62271-211. c.Gas monitoring system, pressure relief device, busbar, insulator, expansion joint/ flexible connection etc. as required. d. Barrier cones, mechanism box and other items as required. e. Any other item required to complete the system in all respects but not limited to above. Refer Section-2 and SLD for Details.	Nos.	9
14	A.14	SUPPLY- GIS : 400KV, 50KA FOR 1S, 2500A, SF6 TO AIR BUSHING	Single phase 400 kV , 2500A ,SF6 to Air Bushing shall be supplied for the air termination of the GIS shall be as per IEC. a.Single phase ,400kV , 2500A , termination module for terminating GIS SF6 bus duct in Potheadyard. b.Scope of supply shall be as per latest version of IEC c.Gas monitoring system, pressure relief device, busbar, insulator, expansion joint/ flexible connection etc. as required. d. Barrier cones, mechanism box and other items as required. e. Any other item required to complete the system in all respects but not limited to above. Refer Section-2 and SLD for Details.	Nos.	6
15	A.15	SUPPLY- GIS : 400KV, DOUBLE MAIN BUS SCHEME - LOCAL CONTROL CUBICLES (LCC)-TYPE A	Local Control Cabinet (LCC) to be housed in the GIS Building in the Potheadyard for each bay shall be supplied. LCCs shall be separate freestanding floor mounted type and cover the requirement for the following but not limited to - (1) 4 nos of fully equipped GT Bay Modules (2) 2 nos of fully equipped Line Bay Modules (3) 2 nos of fully equipped Line Reactor Bays Module (4) 1 nos of fully equipped Bus Reactor Bay Module (5) 1 nos of fully equipped Bus Coupler (6) 2 Sets of Bus VT Bay Module (7) 2 Sets of Bus Surge Arrester Bay Module (8) 2 Sets of Bus Extension Module Refer Section-2 and SLD for Details. Note : 1. Bidder shall meet the requirement of LCC for the complete GIS System in the Potheadyard . 2. The Quantity of the LCC shall be finalised at the time of detailed engineering. 3. Bidder to quote for above requirement as per the requirement of their offered GIS. 4. This is the minimum requirement. Any increase in the number of LCC at detailed engineering shall be without any cost and delievery implication.	Nos	10
16	A.16	SUPPLY- GIS : 400KV, DOUBLE MAIN BUS SCHEME - LOCAL CONTROL CUBICLES (LCC)-TYEP B	Local Control Cabinet (LCC) to be housed in the GT Cavern Area in the Powerhouse Building for Interfacing GIS Modules at A.10. LCCs shall be separate freestanding floor mounted type and cover the requirement for the following but not limited to - (a) 4 Sets of Interfacing GIS Module Refer Section-2 and SLD for Details. Note : 1. Bidder shall meet the requirement of LCC for the complete GIS System in the GT Cavern Area in the Powerhouse Building. 2. The Quantity of the LCC shall be finalised at the time of detailed engineering. 3. Bidder to quote for above requirement as per the requirement of their offered GIS. 4. This is the minimum requirement. Any increase in the number of LCC at detailed engineering shall be without any cost and delievery implication.	Nos	4
17	A.17	SUPPLY- GIS : 400KV, CONTROLLED SWITCHING DEVICE (CSD) FOR GIS CB	Controlled Switching Device for ALL of the 400kV, 2500A, One nos. of 3-phase, SF6 insulated circuit breaker of the offered GIS. CSD shall be deployed for optimization of switching behavior of bidder supplied GIS Breaker. Refer Section-2 for Details.	Nos	10
18	A.18	SUPPLY- GIS : 400KV, 50KA FOR 1S, 2500A, SINGLE PHASE GAS INSULATED BUS DUCT	400kV, 2500A 50kA for 1 sec, SF6 gas insulated GIS Bus duct (GIB) shall be complete & comprising of following but not limited to :- a) Single phase (isolated) SF6 ducts along with all accessories to connect 400kV GIS with Oil to SF6 bushing of all Line Reactor . b) Single phase (isolated) SF6 ducts along with all accessories to connect 400kV GIS with Oil to SF6 bushing of Bus Reactor. c) Single phase (isolated) SF6 ducts along with all accessories to connect 400kV GIS with outdoor SF6 to 400kV Air Bushings of all line bays. d) Gas monitoring devices, barriers, pressure switches, etc. as required . The total tentative length shall be sum of single phase (isolated) SF6 bus duct (GIB) lengths to all Line Reactor, Bus Reactor and 400 kV SF6 to Air Bushing. However ,exact length shall be calculated and finalised during detailed engineering stage. Note : The measurement of the length of the GIS duct shall be done from the centreline of the GIS Building Wall to the outdoor pothead yard equipment listed in a), b) and c) above. Refer SLD and Section 2 for details.	m	300
19	A.19	SUPPLY- GIS : 400KV, DOUBLE MAIN BUS SCHEME - SF6 GAS REQUIRED FOR PLACING GIS INTO SUCCESSFUL OPERATION	First filling of SF6 gas for the equipment supplied plus an additional quantity sufficient for conducting all the tests on equipment at site before placing it into successful operation. In addition 20% of the total quantity of SF6 gas shall also be supplied. SF6 gas shall be supplied in non-returnable cylinders . Refer Section 2 and SLD for details.	MT	11
20	A.20	SUPPLY- GIS : DOUBLE MAIN BUS SCHEME - STRUCTURE MATERIAL INCLUDING FOUNDATION BOLTS, EMBEDDED ITEMS, RAILS AND/ OR OTHER MATERIALS ETC.	Supply of structure work for Installation of GIS including support structure for GIS bus ducts, SF6 to Oil bushing of GT / Recator, SF6 to 400kV XLPE cable termination, SF6 to Air Bushing for Lines. Supports, platforms, foundation bolts, embedded parts in floors etc., which are required for installation of GIS components as per the specification that comprises of but not limited to the following : a) Base Plate / Channel / Metallic / Structural Member for seating of GIS system b) Lattice / Pipe structure required for installation of GIS, GIB, SF6 to Air Bushing of Line/ SF6 to Oil bushing of GT & Recator / SF6 to 400kV XLPE cable termination c) Foundation bolt / Anchor Fastening bolts for GIS system. d) Equipment fixing hardware. e) Cable tray arrangement (mounted on structures of) GIS / GIB / SF6 to Air Bushing of Line/ SF6 to Oil bushing of GT & Recator / SF6 to 400kV XLPE cable termination. Supply of structure material/base frames, required for complete installation of GIS including support structure (foundation bolts/chemical or mechanical anchors) in floor, platform & railing etc. shall be in bidder's scope. The civil works shall be done based on bidder's design & drawings. Refer Section 2 and SLD for details.	MT	45

Sl. No of Purchase Indent	Line Items	Description	Detailed Description	Unit	Qty
21	A.21	SUPPLY- GIS : 400KV, LADDER, WALKWAY, MOBILE PLATFORM ETC	Bidder to quote for the following 1. Ladder 2. Walkways 3. Mobile Platform Any reputed make , which shall be subject to approval by customer during detailed engineering as per of Section-2 of technical specification.	MT	5
22	A.22	SUPPLY- GIS : 400KV, DOUBLE MAIN BUS SCHEME - EARTHING MATERIALS INCLUDING HIGH FREQUENCY EARTHING(IF APPLICABLE)	Supply of Earthing Material (Except 40mm MS ROD ,75x12mm / 50x6 GI Flat) and Supervision of erection of all Earthing connection for 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. Supply of only 40mm MS ROD & 75x12mm / 50x6 GI Flat and Erection of Earth mesh on floor shall be done by BHEL. Design philosophy shall be submitted along with the bid in line with section-2 of technical specification. If any special earthing like high frequency earthing are required then supply and supervision of erection of the same shall be in bidder's scope. Refer Section-2 and SLD for details.	Lot	1
23	A.23	SUPPLY- GIS : 400KV, DOUBLE MAIN BUS SCHEME - CONSUMABLES FOR GIS	Supply of All consumables including grouting material and chemicals for the chemical anchors bolts if applicable for the complete installation, testing, commissioning and placing into successful operation of the GIS equipment. Consumables required during erection, testing and commissioning for complete package. It shall be supplied after confirmation from BHEL. Refer Section-2 and SLD for details.	Lot	1
24	A.24	SUPPLY- GIS : 400KV, CONTINUOUS ONLINE MONITORING AND DIAGNOSTIC SYSTEM INCLUDING REMOTE MONITORING AND SUPERVISION STATION	Continuous Online Monitoring system shall be complete in all respects and comprising of following but not limited to, Continuous on-line monitoring and diagnostic systems in all individual bays (including LCD display) to monitor partial discharge, internal arcing, gas density, gas pressure, leakage, moisture etc., operating parameters such as current, voltage, temperature etc. complete with sensors, control / processor units, wiring/cabling in all respects , also comprising of following but not limited to Gas Monitoring System as follows, (a) All gas compartments shall have their own independent gas supervision and alarm systems. There shall not be any interconnection between different gas compartments for the purpose of gas monitoring. (b) Individual temperature compensated gas pressure gauge(s)/ density device(s) shall be provided in each of the gas compartments which will monitor and indicate the state of gas density. The system shall be such that it can be installed separately/ integrated with SAS/SCADA (As applicable). Remote monitoring and supervision station shall be complete in all respects but not limited to following : Remote monitoring and supervision station having time synchronization facility for CSD , SF6 Gas Monitoring & Conitnuous Online Monitoring System to be placed in control room for system operator. Continuous Online Monitoring and Alarm System shall be as per section -2 of technical specification.	Set	1
	B	Supply Item: Maintenance Supply Items . Refer Technical Spec for details			
25	B.1	SUPPLY- GIS : SF6 GAS PROCESSING UNIT	Gas processing units suitable for evacuating, liquefying, filling, drying, vacuuming and purifying SF6 gas during initial installation, subsequent maintenance and future extension of the GIS. Processing unit shall have facility of handling all said functions for at least 3 different compartments simultaneously. Both processing units complete with all valves, couplings, fittings etc. shall include the following: a. 20 no. hose pipe - 20m b. 10no. hose pipe - 10m c. 5no. hose pipe - 5m Four way coupling / manifold - 10 sets Straight coupling - 12 sets Required fittings and accessories for above. SF6 Gas Processing Unit shall be as per section -2 of technical specification.	Nos	2
26	B.2	SUPPLY- GIS : VACUUMING MACHINE	Vacuuming machines suitable for vacuuming GIS compartments with latest technical requirements. Processing unit shall have facility of handling all said functions for at least 3 different compartments simultaneously. SF6 Gas Vacuuming machine shall be as per section -2 of technical specification.	Nos	2
	C	Supply Item: Mandatory SPARES . Technical Spec to be referred for details.			
27	C.1	SPARES- GIS : 400KV, 50KA FOR 1S, 2500A, SF6 TO AIR BUSHING	SF6 / Air outdoor bushings, complete with gaskets and connectors.	Nos	2
28	C.2	SPARES- GIS : 400KV, 50KA FOR 1S, 2500A, CIRCUIT BREAKER - COMPLETE CIRCUIT BREAKER POLE OF EACH TYPE & RATING	Single phase 400 kV 2500A circuit breaker complete with all necessary apparatus.	Nos	3
29	C.3	SPARES- GIS : 400KV, 50KA FOR 1S, 2500A, CIRCUIT BREAKER - CIRCUIT BREAKER INTERRUPTING HEADS	400 kV 2500A circuit breaker interrupting heads, complete with all necessary apparatus.	Nos	1
30	C.4	SPARES- GIS : 400KV, 50KA FOR 1S, 2500A, CIRCUIT BREAKER - CIRCUIT BREAKER OPERATING MECHANISM	400 kV, 2500 A circuit breaker operating mechanisms, complete with motor & all necessary connecting apparatus.	Nos	1
31	C.5	SPARES- GIS : 400KV, 50KA FOR 1S, 2500A, DISCONNECTOR SWITCH (3 PHASE)	3 phase 400 kV, 2500A isolator switch.	Nos	1
32	C.6	SPARES- GIS : 400KV, 50KA FOR 1S, 2500A, DISCONNECTOR SWITCH (3 PHASE)-OPERATING MECHANISM	3 phase 400 kV, 2500A isolator switch operating mechanism complete with necessary apparatus.	Nos	1
33	C.7	SPARES- GIS : 400KV, 50KA FOR 1S, 2500A, DISCONNECTOR SWITCH - INTERNAL PARTS	400 kV, 2500A isolator switch internal parts, complete with all necessary gaskets, mounting hardware etc.	Set	1
34	C.8	SPARES- GIS : 400KV, 50KA FOR 1S, SAFETY GROUNDING SWITCH (3 PHASE)	3 phase 400 kV, 2500A safety grounding switch complete with all necessary gaskets, mounting hardware etc.	Set	1
35	C.9	SPARES- GIS : 400KV, 50KA FOR 1S, HIGH SPEED GROUNDING SWITCH (3 PHASE)	3 phase 400 kV, 2500/500/200 A high speed grounding switch complete with all necessary gaskets, mounting hardware etc.	Set	1
36	C.10	SPARES- GIS : 400KV, 50KA FOR 1S, VT CORE	400 kV /√3 / 110 V / √3 / 110 V /√3 /110/ √3 V VT core,	Nos	1
37	C.11	SPARES- GIS : 400KV, 50KA FOR 1S, CT CORE	400 kV current transformer cores, set to comprise one core of each ratio, burden and accuracy used in the equipment.	Set	1
38	C.12	SPARES- GIS : 400KV, 50KA FOR 1S, SURGE ARRESTOR INCLUDING SURGE COUNTER FOR GIS BUS	336 kV, single phase, station class gas insulated gapless surge arrestors.	Nos	2
39	C.13	SPARES- GIS : GAS MONITORING DEVICE	Gas monitoring devices complete with all necessary fittings,gaskets & switches.	Nos	3
40	C.14	SPARES- GIS : CONTROL SWITCHES	Control switches/control relays comprising one switch / relay of each type and rating used in the control cubicles.	Set	1
41	C.15	SPARES- GIS : LOW VOLTAGE CIRCUIT BREAKERS	Low voltage circuit breakers, comprising one circuit breaker of each type and rating used in the control equipment.	Set	1
42	C.16	SPARES- GIS : FUSES	Control circuit fuses, each set to comprise one of each type and rating of control circuit fuse used on the equipment.	Sets	10
43	C.17	SPARES- GIS : LED	LEDs, each set to comprise one of each type and rating used on the equipment.	Sets	10
44	C.18	SPARES- GIS : INSPECTION WINDOWS	Inspection windows.	Sets	3
45	C.19	SPARES- GIS : SHEER PINS	Sheer pins.	Nos	100
46	C.20	SPARES- GIS : 400KV, 50KA FOR 1S, 2500A, CIRCUIT BREAKER - CLOSING COILS	400 kV circuit breaker closing coils.	Sets	100

Sl. No of Purchase Indent	Line Items	Description	Detailed Description	Unit	Qty
47	C.21	SPARES- GIS : 400KV, 50KA FOR 1S, 2500A, CIRCUIT BREAKER - TRIP COILS	400 kv circuit breaker trip coils.	Nos	200
48	C.22	SPARES- GIS : SPARE PARTS FOR SF6 GAS PROCESSING UNIT	Spare parts for SF6 gas processing unit.	Set	1
49	C.23	SPARES- GIS : 400KV, LCC - SPARE CARDS,CONTACTORS AND AUXILLARY RELAY	Cards, contactors and auxiliary relays of each type in local control cubicles. 20% of the installed capacity	Lot	1
50	C.24	SPARES- GIS : 400KV, SPARE AUXILIARY CONTACTS FOR DISCONNECTING SWITCHES AND GROUNDING SWITCHES.	Spare auxiliary contacts for isolator switches and grounding switches.	Set	1
51	C.25	SPARES- GIS : 400KV, 50KA FOR 1S, HIGH SPEED GROUNDING SWITCH - INTERNAL PARTS COMPLETE WITH ALL NECESSARY GASKETS, MOUNTING HARDWARE ETC.	400 kv high speed fault making switch internal parts complete with all necessary gaskets, mounting hardware etc.	Set	1
52	C.26	SPARES- GIS : 400KV, 50KA FOR 1S, HIGH SPEED GROUNDING SWITCH INTERNAL OPERATING MECHANISM COMPLETE WITH ALL NECESSARY CONNECTING EQUIPMENT.	400 kv high speed fault making grounding switch internal operating mechanism complete with all necessary connecting equipment.	Set	1
	D	Supply Item: General Purpose Tools and Tackles (Schedule V(D)). Refer Technical Spec for details			
	D.A	Specific tools for operating the GIS. Refer Technical Spec for details			
53	D.1	SUPPLY- GIS : SPRING CHARGING HAND CRANK FOR CB MECHANISM	Spring charging hand crank for CB mechanism	No	1
54	D.2	SUPPLY- GIS : HAND CRANK OF SUITABLE LENGTH	Hand crank of suitable length	No	1
55	D.3	SUPPLY- GIS : HAND CRANK FOR MECHANISM OF DISCONNECTOR ,EARTH SWITCH, HIGH SPEED EARTH SWITCH	Hand crank for mechanism of Isolator, earth switch, high speed earth switch	No	1
56	D.4	SUPPLY- GIS : DIGITAL MANOMETER	Digital manometer Make DILO or equivalent	No	1
57	D.5	SUPPLY- GIS : TEMPERATURE METERING SET	Temperature metering set of make Manutan or equivalent	No	1
58	D.6	SUPPLY- GIS : RELIEF VALVE MANOMETER	Relief valve manometer with coupling elements	No	1
59	D.7	SUPPLY- GIS : FILLING HANDLE FOR SF6 GAS PROCESSING MACHINE	Filling handle , DILO or equivalent	No	1
60	D.8	SUPPLY- GIS : GAS SERVICE CART	Gas service cart of make DILO or equivalent	No	1
61	D.9	SUPPLY- GIS : TOOLS FOR SERVICE MODULE TIGHETNING	Tools for service module tightetning	Set	1
	D.B	Measuring and analysing tools for GIS erection and commissioning			
62	D.10	SUPPLY- GIS : SF6 GAS LEAKAGE DETECTOR	SF6 gas leakage detector of Make Dilo or equivalent	No	1
63	D.11	SUPPLY- GIS : MULTIMETER DIGITAL	Multimeter digital of make FLUKE or equivalent	No	1
64	D.12	SUPPLY- GIS : SF6 GAS VOLUME PERCENTAGE MEASURING DEVICE	Sf6 gas volume percentage measuring device of make DILO or equivalent	No	1
65	D.13	SUPPLY- GIS : SF6 GAS DECOMPOSITION PRODUCT	SF6 Gas decomposition product of make DILO or equivalent	No	1
66	D.14	SUPPLY- GIS : INSULATION TESTER DEVICE	Insulation tester device of Make Meggar or equivalent	No	1
67	D.15	SUPPLY- GIS : AMMETER	Ammeter of Make Fluke or equivalent	No	1
	E	Supply Item: Tools & Instruments for Testing & Commissioning (Schedule V(A)). Refer Section-2 for Details.			
68	E.1	SUPPLY- GIS : DEW POINT METER	Dew point measuring device with all necessary auxiliaries, accessories and consumables, Dilo/equivalent make.	No	1
69	E.2	SUPPLY- GIS : CONTACT RESISTANCE METERING DEVICE	contact resistance metering device with all necessary auxiliaries, accessories and consumables, Scope / equivalent make.	No	1
70	E.3	SUPPLY- GIS : CB TIMING MEASURING DEVICE	CB time measuring device with all necessary auxiliaries, accessories and consumables, Scope / equivalent make.	No	1
71	E.4	SUPPLY- GIS : OSCILLOSCOPE	Oscilloscope of make with all necessary auxiliaries, accessories and consumables, Fluke / equivalent make.	No	1
72	E.5	SUPPLY- GIS : ENDOSCOPE	Endoscope with all necessary auxiliaries, accessories and consumables, S.T. Com / Equivalent make.	No	1
73	E.6	SUPPLY- GIS : CIRCUIT BREAKER ANALYSER KIT	Circuit Breaker analyser suitable upto 400kv rating including HT,LT as well as 15.75kv with all necessary auxiliaries, accessories and consumables, SCOPE T&M / ISA /Megger /Programma or equivalent.	No	1
74	E.7	SUPPLY- GIS : HEAVY INDUSTRIAL VACUUM CLEANER	Heavy industrial vacuum cleaner with all necessary auxiliaries, accessories and consumables. Eureka Forbes or equivalent make	No	1

Sl. No of Purchase Indent	Line Items	Description	Detailed Description	Unit	Qty
75	F	SUPPLY- GIS : TOOLS FOR ANNUAL MAINTENANCE OF GIS	Tools for Annual Maintenance (Operation, Maintenance & Handling) of GIS shall be supplied by the contractor. Details of tools to be finalized during detailed engineering in consultation with the supplier.	Set	2
	G	Services: Supervision of Erection of Testing & Commissioning			
76	G.1	SERVICES- GIS : 400KV, SITE VISIT FOR SUPERVISION OF UNLOADING & VERIFICATION OF MATERIALS FOR PROPER STORAGE & UP-KEEPING AT SITE	This includes following activities but not limited to, (a) Supervision of safe unloading of GIS & its accessories at site. (b) Reconciliation, storage & upkeeping of materials, with due instructions/ training to site persons for long storage.	Lot	1
77	G.2	SERVICES- GIS : 400KV, SUPERVISION OF ERECTION OF GIS INCLUDING EARTHING	Supervision of Erection & Earthing of Complete GIS as supplied under including busbar(including bus bar bellows /compensators) , GT bays,Line Reactor Bays,Bus Reactor Bay, Line bays, bus coupler bay, bus PT bay , Bus Surge Arrester Bay, Bus Extension, etc.	Lot	1
78	G.3	SERVICES- GIS : 400KV, SUPERVISION OF ERECTION OF GIS- FOR GAS INSULATED BUS DUCT	Total tentative length is sum of single phase (isolated) SF6 duct lengths of all 12 nos. GT ,2 nos line reactors and 1 no bus reactor . Exact length shall be calculated by the bidder during detailed engineering stage.	m	300
79	G.4	SERVICES- GIS : 400KV, SUPERVISION OF ERECTION OF GIS- SF6 TO OIL TERMINATION MODULE (TYPE A)	Supervision of Erection of SF6 to Oil bushing on Generator transformer (Oil /SF6) . 1 Lot is supervision work for 1 nos single phase SF6 to Oil bushing on Generator transformer (Oil /SF6) module.	Lot	12
80	G.5	SERVICES- GIS : 400KV, SUPERVISION OF ERECTION OF GIS- SF6 TO OIL TERMINATION MODULE (TYPE B)	Supervision of Erection of SF6 to Oil bushing on Line/Bus Reactors (Oil /SF6) . 1 Lot is supervision work for 1 nos single phase SF6 to Oil bushing on Line/Bus Reactor (Oil /SF6) module.	Lot	9
81	G.6	SERVICES- GIS : 400KV, SUPERVISION OF ERECTION OF GIS- SF6 TO EHV CABLE TERMINATION MODULE	Supervision of Erection of SF6 to 400kV EHV Cable Termination Module . 1 Lot is supervision work for 1 nos single phase SF6 to 400kV EHV Cable Termination Module	Lot	24
82	G.7	SERVICES- GIS : 400KV, SUPERVISION OF ERECTION OF GIS- FOR SF6 TO AIR BUSHING	Supervision of Erection of SF6 to Air Bushing in Potheadyard. 1 Lot is supervision work for 1 nos single phase SF6 to Air bushing in Potheadyard.	Lot	6
83	G.8	SERVICES- GIS : 400KV, SUPERVISION OF ERECTION OF GIS- INTERFACING GIS MODULE	Supervision of Erection of Interfacing GIS Module between the SF6 to 400kV XLPE Termination and SF6 to Oil Termination Module on GT in GT Cavern Area 1 Lot is supervision work for 3 nos single phase Interfacing GIS Module.	Lot	4
84	G.9	SERVICES- GIS : 400KV, TESTING & COMMISSIONING OF GIS	TESTING & COMMISSIONING of Complete GIS as supplied including busbar(including bus bar compensators),BUS DUCT , GT bays,Line Reactor Bays,Bus Reactor Bay, Line bays, bus coupler bay, bus PT bay , Bus Surge Arrester Bay, Bus Extension etc. at site acceptance testing for GIS as per customer approved SAT procedure shall be in bidder's scope.	Lot	1
85	G.10	SERVICES- GIS : 400KV, TESTING & COMMISSIONING OF GIS- FOR SF6 TO EHV CABLE TERMINATION MODULE	TESTING & COMMISSIONING OF GIS- FOR SF6 TO 400kV EHV CABLE TERMINATION MODULE . 1 Lot is testing and commissioning work for 1 nos single phase SF6 to 400kV EHV Cable Termination Module	Lot	24
86	G.11	SERVICES- GIS : TESTING AND COMMISSIONING OF GIS- SF6 TO OIL BUSHING/TERMINATION MODULE (TYPE A)	TESTING AND COMMISSIONING OF GIS- SF6 TO OIL BUSHING/TERMINATION MODULE ON GT (Oil /SF6) . 1 Lot is testing and commissioning work for 1 nos single phase SF6 to Oil bushing on Generator transformer (Oil /SF6) module.	Lot	12
87	G.12	SERVICES- GIS : TESTING AND COMMISSIONING OF GIS- SF6 TO OIL BUSHING/TERMINATION MODULE (TYPE B)	TESTING AND COMMISSIONING OF GIS- SF6 TO OIL BUSHING/TERMINATION MODULE ON Line/Bus Reactor (Oil/SF6) 1 Lot is testing and commissioning work for 1 nos single phase SF6 to Oil bushing on Line/Bus Reactor (Oil /SF6) module.	Lot	9
88	G.13	SERVICES- GIS : TESTING & COMMISSIONING OF GIS- FOR SF6 TO AIR BUSHING	TESTING & COMMISSIONING OF GIS- FOR SF6 TO AIR BUSHING in Potheadyard. 1 Lot is testing and commissioning work for 1 nos single phase SF6 to Air bushing in Potheadyard.	Lot	6
89	G.14	SERVICES- GIS : TESTING AND COMMISSIONING OF GIS- INTERFACING GIS MODULE	TESTING AND COMMISSIONING OF GIS- INTERFACING GIS MODULE 1 Lot is testing and commissioning work for 3 nos single phase Interfacing Module in GT Cavern Area	Lot	4
90	G.15	SERVICES- GIS : 400KV, FINAL SUCCESSFUL HV/ POWER FREQUENCY TESTING OF GIS INCLUDING ARRANGING OF HV TEST KIT ALONG WITH OPERATOR	HV Test kit along with operator shall be arranged by the bidder on returnable basis. (GTs, Reactors, bus coupler & Line bays may be commissioned separately). Final testing as per IEC for complete GIS shall be done by the bidder.	Lot	1
91	G.17	SERVICES- GIS : 400KV, INSULATION CO-ORDINATION STUDIES FOR GIS SYSTEM	As per section -2 of Tech. Specification.	Lot	1
92	G.18	SERVICES- GIS : 400KV, FINAL DOCUMENTATION	This includes As-Built Drawings, Schematics, Relay Parameters etc. These documents shall be submitted by the bidder.	Lot	1
	H	Services: Training			
93	G.1	SERVICES- GIS : 400KV, TRAINING FOR GIS AT MANUFACTURER'S WORKS	Training of Engineers nominated by the BHEL/SAPDC/SJVN (6 Nos. SAPDC/SJVN & 2 Nos of BHEL Engineers)during erection, testing and commissioning, and for operation and maintenance. To and fro travelling charges , lodging and boarding charges of Trainees shall be in BHEL/SAPDC/SJVN scope. (1 LOT = 8 Persons * 4Week) Lodging / Boarding, To & FroTravelling Charges of the Trainer, Training Material & Any other charges shall be borne by the bidder.	Lot	1
94	G.2	SERVICES- GIS : 400KV, TRAINING FOR GIS AT SITE	Training of Engineers nominated by the BHEL/SAPDC/SJVN (6 Nos. SAPDC/SJVN & 2 Nos of BHEL Engineers)during erection, testing and commissioning, and for operation and maintenance. To and fro travelling charges , lodging and boarding charges of engineers shall be in BHEL/SAPDC/SJVN scope. (1 LOT = 8 Persons * 1 Week) Lodging / Boarding, To & FroTravelling Charges of the Trainer, Training Material & Any other charges shall be borne by the bidder.	Lot	1
	I	Supply: Reference unit prices of Individual Item/ Equipment for any addition or deletion			
95	I.1	400kV , 2500A Disconnecter	1 Set= 1 No of each rating and type with all three poles with enclosure & without operating mechanism	Set	1
96	I.2	400kV , 2500A Safety Earthing Switch	1 Set= 1 No of each rating and type with all three poles with enclosure & without operating mechanism	Set	1
97	I.3	400kV , 2500A High Speed make proof Earthing Switch	1 Set= 1 No of each rating and type with all three poles with enclosure & without operating mechanism	Set	1
98	I.4	Surge Arrestor including Surge Counter (Rated arrester voltage – 336 kV)	1 Set= 1 No of each rating and type with enclosure. Rated voltage may be changed after insulation coordination study.	Set	1
99	I.5	400kV Current Transformer	1 Set= 1 No of each rating and type with enclosure	Set	1
100	I.6	400kV Voltage Transformer	1 Set= 1 No of each rating and type with enclosure	Set	1
101	I.7	Operating Mechanism for Circuit Breaker	1 Set= 1 No of each rating and type	Set	1
102	I.8	Operating Mechanism box for Disconnecter	1 Set= 1 No of each rating and type	Set	1

Sl. No of Purchase Indent	Line Items	Description	Detailed Description	Unit	Qty
103	I.9	Operating Mechanism for Safety Earthing Switch	1 Set= 1 No of each rating and type	Set	1
104	I.10	Operating Mechanism for High Speed make proof Earthing Switch	1 Set= 1 No of each rating and type	Set	1
105	I.11	Single Phase 400kV Bus Bar	Single Phase 400kV Bus Bar	mtr	1
106	I.12	GIS Mettalic Enclosure (Any Type)	400kV GIS Mettalic Enclosure (Any Type)	mtr	1
107	I.13	Conductor for Single phase Bus bar/ bus duct (any type)	Conductor for Single phase Bus bar/ bus duct (any type)	mtr	1
108	I.14	Gas Permeable/ Communication type Insulator	Gas Permeable/ Communication type Insulator	set	1
109	I.15	Gas non -Permeable/non - Communication type Insulator	Gas non -Permeable/non - Communication type Insulator	set	1
110	I.16	Supply of Gas monitoring system devices	1 set =1 no of each type	set	1
111	I.17	PD sensor(UHF type)	Supply of PD sensor(UHF type)	No.	1
112	I.18	Optical indicator for CB, Isolator, if applicable	Supply of Optical indicator for CB, Isolator, if applicable	No.	1
113	I.19	Telescopic enclosure , if applicable	Supply of Telescopic enclosure , if applicable	No.	1
114	I.20	Sleeve enclosure , if applicable	Supply of Sleeve enclosure , if applicable	No.	1
115	I.21	Cross tank , if applicable	Supply of Cross tank , if applicable	No.	1
116	I.22	Density Monitor Switch	Supply of Density Monitor Switch	No	1
117	I.23	Elbows	Supply of Elbows	No	1
118	I.24	Expansion joints/ Flexible connections/bellows	Supply of Expansion joints/ Flexible connections/bellows	No	1
119	I.25	400kV Bus Bar Modules : Lateral mounting units	Lateral mounting units: These shall be inserted, as required, between sections of bus bars, CGI bus duct connections, on transformer and CGI ducts termination. Refer Section-2 for Details.	Set	2
120	I.26	400kV Bus bar Modules : Axial compensators	Axial compensators: These shall be provided to accommodate changes in length of bus bars due to temperature variations. Refer Section-2 for Details.	Set	1
121	I.27	400kV Bus bar Modules: Parallel compensators	Parallel compensators: These shall be provided to accommodate large linear expansions and angle tolerances. Refer Section-2 for Details.	Set	1
122	I.28	400kV Bus bar Modules: Tolerance Compensators	Tolerance Compensators: These shall be provided for taking up manufacturing and assembly tolerances. Refer Section-2 for Details.	Set	1
123	I.29	400kV Bus bar Modules: Vibration compensators	Vibration compensators: These bellow compensators shall be provided for absorbing vibrations caused by transformers when connected to SF6 switchgear by Oil/SF6 bushings. Refer Section-2 for Details.	Set	1
	J	Service: Reference unit prices of Individual Item/ Equipment for any addition or deletion due to change in SLD, damage or replacement etc.	Unit Prices of Individual items included here are required for any Addition/Deletion of Services. Vendor to ensure that the unit prices have a logical relationship with prices of main items. Quoting for unit prices is mandatory and shall be considered for evaluation.		
124	J.1	Services of supervision for Erection of GIS	Services of supervision for Erection of GIS	Manday	1
125	J.2	Services of Testing & Commissioning of GIS	Services of Testing & Commissioning of GIS	Manday	1
126	J.3	Hiring charges of HV test kit with operator	Additional HV test kit charges including charges of operator, HV test kit, accessories & tools required for completion of HV test (Dielectric Test after installation of GIS). HV test kit charges include one or more bay at site.	Lot	1
	Note :				
(1) Gas Insulated Bus duct length inside and upto centreline of GIS Building Wall shall be considered as included in the GIS Bays by Bidders.GIB Length shall be measured from the centreline of the GIS building wall to SF6 Air bushing and SF6 to Oil Termination Modules on Line/Bus Reactor. (2) 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. (3) The word 'TYPE' means the Make, Model no., Type, Range, Size/ Length, Rating, Material as applicable. (4)The terminology used under 'Part Description' is the commonly used name of the part and may vary from manufacturer to manufacturer. The manufacturer/bidder shall clearly bring out the terminology used by them in the bid. (5) The supply of the intruments used for the maintenance and operation shall also include their demonstration.					

Section - 2



GAS INSULATED SUBSTATION

Scope of work under this section covers the provision of labour, tools, plants, materials and performance of work necessary for the design, engineering, manufacture, quality assurance, quality control, shop assembly, shop testing, packaging & delivery at site including insurance, unloading, site storage and preservation, in plant transportation at site, erection / installation, testing supervision, pre commissioning, successful commissioning, performance and acceptance testing, handing over to Employer and warrantee for two years of GIS as per the specifications hereunder, complete with all auxiliaries, accessories, spare parts and warranting a trouble free safe operation of the installation. The scope of work covered under this section shall be read in conjunction with Section-1

The scope of work shall be a comprehensive functional system complete in every respect including but not be limited to following:

- a) **Double bus bar** comprising of:-
1. 2 no. - 3 phase, SF6 gas insulated, metal-enclosed 2500A bus bars enclosed in three individual bus bar enclosures running along the length of the switchgear to interconnect each of the circuit breaker bay modules.
 2. 2 no. - three phase, 2500A group operated isolator switches, complete with manual & motor driven operating mechanisms, for Bus Sectionalizer.
 3. 4 no. - three phase, high speed fault making grounding switches, complete with motor driven operating mechanism, for Bus Sectionalizer.
- b) **VT-bay** comprising of:-
1. 6 no. – Single phase voltage transformers with three secondary windings alongwith one three phase group operated Disconnector& Earth switch, complete with motor driven operating mechanism.
- c) **Surge Arrestor-bay** comprising of:-

1. 6 no. -Single phase 336 kV (r.m.s.) SF6 Surge Arrestors.

Note:- The manufacturer shall perform an insulation co-ordination study to verify protection of switchgear and main transformers against over voltages is adequate. The final surge arrester characteristic, their number and exact locations of surge arrestors shall be decided after this study.

d) Bus coupler bay

One, 420 kV, bus coupler circuit breaker bay module comprising:-

- i) 1 no. - One 2500A, 3 phase, SF6 gas insulated circuit breaker complete with common and reliable operating mechanism for all three phases.
- ii) 3 no. -Two core, 2500-1250-625/1A single phase current transformers.
- iii) 3 no. -Three core, 2500-1250-625/1A single phase current transformers.
- iv) 2 no. - Three phase, 2500A group operated isolator switches, complete with manual & motor driven operating mechanisms.
- v) 2no. - Three phase, group-operated safety grounding switches, complete with motor driven operating mechanism.

e) Generator Transformer bays:

4 no. - 420 kV, 500A generator transformer feeder circuit breaker bay modules each comprising:-

- i) One – 500 A, three phase, SF6 gas insulated circuit breaker, complete with common and reliable operating mechanism for all three phases.
- ii) Three- 3 core, 500/1 A single phase current transformers.
- iii) Three- 2 core, 500/1 A single phase current transformers.
- iv) Three– 2 core, 2500-1250-625/1A single phase current transformers.
- v) Two-three phase, group operated bus bar disconnector, each complete with manual and motor driven operating mechanisms.
- vi) One-three phase, group operated, safety grounding switch, each complete with manual and motor driven operating mechanism.
- vii) One-three phase high speed fault making grounding switch, complete with group operated manual and motor driven operating mechanisms.
- viii) Three-336 kV single phase, SF6 insulated, metal enclosed zinc oxide surge arrestors.
- ix) GIS Adapter Section: - Three-Single phase gas insulated Adapter section for Oil-SF6 and SF6 to XLPE cable bushing connection, comprising of:-
 - a) Three- 4 core, 500/1 A single phase current transformers.
 - b) 3-Single phase 336 kV (r.m.s.) SF6 Surge Arrestors.

- c) 1-Three phase group operated safety grounding switch complete with manual and motor driven operating mechanism.

f) Line feeder bays

Two-420 kV, 2500A transmission line feeder circuit breaker bay modules, each comprising:-

- i) One –2500A, 3 phase, SF6 gas insulated circuit breaker [REDACTED] [REDACTED] complete with separate and reliable operating mechanisms for each phase.
- ii) Three – 3 core single phase current transformers (2500-1250-625/1A).
- iii) Three – 2 core, single phase current transformers (2500-1250-625/1A).
- iv) Two – 3 phase, 2500A, group operated bus bar disconnector, each complete with manual and motor driven operating mechanisms.
- v) One-three phase, 2500A group operated feeder disconnector, complete with manual and motor driven operating mechanisms.
- vi) Two-3 phase group-operated safety grounding switches, each complete with manual and motor driven operating mechanisms.
- vii) One-3 pole, high speed fault making grounding switch, complete with group-operated manual and motor driven operating mechanism.
- viii) Three-single phase, SF6 gas insulated metal enclosed bus ducts to outdoor SF6/ Air bushings complete with support structures and other accessories.
- ix) Three - single phase, SF6/ air outdoor bushings complete with mounting structures, a/w terminal connector suitable for quad moose conductor and other accessories.

g) Line Reactor bays

Two - 420 kV, 200A Reactor feeder circuit breaker bay modules, each comprising:-

- i) One –200A, 3 phase, SF6 gas insulated circuit breaker [REDACTED] [REDACTED] complete with separate and reliable operating mechanisms for each phase.
- ii) Three – 6 core single phase current transformers (200/1A).
- iii) One-three phase, 200A group operated feeder disconnector, complete with manual and motor driven operating mechanisms.

- iv) One-3 phase group-operated safety grounding switches each complete with manual and motor driven operating mechanisms.
- v) One-3 pole, high speed fault making grounding switch, complete with group-operated manual and motor driven operating mechanism.
- vi) Three-single phase, SF6 gas insulated metal enclosed bus ducts to outdoor Oil/SF6 bushings, (as per the layout drawing no. SJVN/ED/Arun-III/EM-2017-04) complete with support structures and other accessories.
- vii) Three-336 kV single phase, SF6 insulated, metal enclosed zinc oxide lightning arrestors.

h) Bus reactor bays:

One – 420 kV generator transformer feeder circuit breaker bay modules each comprising:-

- i) One – 2500 A, three phase, SF6 gas insulated circuit breaker, complete with common and reliable operating mechanism for all three phases.
- ii) Three- 4 core, 200/1 A single phase current transformers.
- iii) Three- 2 core, 2500-1250-625/1A single phase current transformers.
- iv) Two-three phase, group operated bus bar disconnectors, each complete with manual and motor driven operating mechanisms.
- v) One-three phase, group operated, safety grounding switch, each complete with manual and motor driven operating mechanism.
- vi) One-three phase high speed fault making grounding switch, complete with group operated manual and motor driven operating mechanisms.
- vii) Three-336 kV single phase, SF6 insulated, metal enclosed zinc oxide surge arrestors.
- viii) Three-single phase, SF6 gas insulated metal enclosed bus ducts to outdoor Oil/SF6 bushings, (as per the layout drawing no. SJVN/ED/Arun-III/EM-2017-04) complete with support structures and other accessories.

16A.1.2 Miscellaneous components and auxiliary system

- i) Local control panels for each of the above bays.
- ii) Control switching devices (point on wave controller) for all circuit breaker bays.
- iii) SF6 gas monitoring for all individual bays.
- iv) Continuous on-line monitoring and diagnostic systems in all individual bays (including LCD display) to monitor partial discharge, internal arcing, gas density, gas pressure, leakage, moisture etc., operating parameters such as

- current, voltage, temperature etc. complete with sensors, control / processor units, wiring/cabling in all respect.
- v) 1 no. - Remote monitoring and supervision station having time synchronization facility for (ii), (iii) & (iv) above, to be placed in control room for system operator.
 - vi) Each module shall be complete with all necessary terminal boxes, control cabinet, interconnecting power and control wiring, grounding, gas monitoring equipment and piping, support structures and platforms etc.
 - vii) Control Cables for connection between local control panels and various equipment in the switchgear bay – in lot.
 - viii) Control cables required for electrical inter-locking etc. – in lot.
 - ix) Power cables for connection between local control panels and various equipments (like motor etc.) in the switchgear bay – in lot.
 - x) Galvanized steel structures for mounting the switchgear including all fittings, nuts, bolts, anchors, chemicals, leveling equipments etc. – in lot.
 - xi) Complete material fitting etc. required for the grounding of GIS – in lot.
 - xii) First filling of SF6 gas for the equipment supplied plus an additional quantity sufficient for conducting all tests on equipment at site before placing it into successful operation. Additionally, 20 percent of total quantity of SF6 gas shall also be supplied in non-returnable cylinders.
 - xiii) Two no. gas processing units suitable for evacuating, liquefying, filling, drying, vacuuming and purifying SF6 gas during initial installation, subsequent maintenance. Processing unit shall have facility of handling all said functions for at least 3 different compartments simultaneously. Both processing units complete with all valves, couplings, fittings etc. shall include the following:
 - a. 20 no. hose pipe – 20m
 - b. 10no. hose pipe – 10m
 - c. 5no. hose pipe – 5mFour way coupling / manifold – 10 sets
Straight coupling – 12 sets
Required fittings and accessories for above -
 - xiv) Two no. Vacuuming machines suitable for vacuuming GIS compartments with latest technical requirements. Processing unit shall have facility of handling all said functions for at least 3 different compartments simultaneously.
 - xv) One set of switchgear handling equipment and any special tool required for handling and dismantling of the switchgear and auxiliary equipment.
 - xvi) All equipment, instruments and devices necessary for maintenance of the switchgear and auxiliary equipment.

16A.1.3 Common supplies and services

- i. Drawings, documents and design calculations as per clause 16A.6.
- ii. Shop, assembly, inspection & tests as per clause no. 16A.7.
- iii. Packaging, handling and site storage as per clause no. 16A.8.
- iv. Delivery, installation and commissioning as per clause no. 16A.9.
- v. Tools and instruments as per clause no. 16A.10.
- vi. Spare parts as per clause no. 16A.11
- vii. Field/touch-up painting including all painting materials.

16A.1.4 Completeness of System

Any other item (s) not mentioned specifically but necessary for the satisfactory completion of scope of work defined above, as per accepted standard (s)/best international practice.

16A.2 STANDARDS & REGULATIONS

The design, manufacture and testing of the various equipment covered under this specification shall comply with the requirements of the latest edition of the relevant IEC/IS/IEEE/ISO standards only. Preference for latest IEC standards for particular equipment / system shall be governed over IEEE/ IS/ ISO standards. Further rules, guide lines and standard laid down by international/ national agency shall be applicable in this specification.

The relevant abstract (in soft / hard copy) of all referred standards shall be provided free of cost during engineering stage for facilitating review/ approval of submitted drawing/documents.

16A.3 PARAMETERS & GUARANTEES**16A.3.1 Ratings**

The ratings and electrical characteristics of the complete GIS shall be as follows:-

(The ratings applicable to specific items of equipment are included in the applicable sections dealing with the equipment).

a)	Type of Switchgear	Three phase, metal enclosed SF6 gas insulated switchgear
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b)	Location	Indoor
c)	Frequency	50 ± 3%
d)	Nominal voltage class kV	400
e)	Highest System voltage kV	420
f)	BIL (kV Peak)	
	i) to earth	1425
	ii) Across open switching device	1665
g)	Switching Surge (kV Peak)	1050
h)	One minute power frequency withstand voltage (kV rms)	
	i) to earth	650
	ii) Across open switching device	815
i)	System	Effectively grounded
j)	Continuous current (Amp)	
	i) In generating bays	500
	ii) In bus bars	2500
	iii) Bus coupler bay	2500
	iv) Feeder bays	2500
	v) Bus Reactor bay	2500
	vi) Line Reactor bay	200
k)	Rated short circuit current at rated maximum voltage, for 1 second not less than kA rms (Symmetrical)	50
l)	Rated making capacity (kA)	125 peak
m)	Prospective transient recovery voltage	As per IEC 56 appearing across the circuit breaker terminals (kV)

n)	Radio interference voltage at 320 kV (rms)	Less then 500 micro volts
o)	Partial discharge level	10 or less pico-coulombs at $1.5 U_n/\sqrt{3}$
p)	Control voltage DC	220V +10%/-20%
q)	Auxiliary AC supply, 3 phase	415 V $\pm$ 10%
r)	Maximum Gas leakage rate (%) of the respective volume, per year	0.5%
s)	Material of enclosure	Aluminium / Aluminium Alloy
t)	Material of bus bar	Aluminium / Aluminium Alloy
u)	Insulation medium	SF6 Gas
v)	Minimum burn through =	500msec
w)	SF6 gas leakage rate shall be less than	< 1% per year

16A.3.2 All current carrying components of the equipment specified shall be capable of continuous operation at the specified rated current without exceeding the maximum temperature rise specified in the relevant IEC standards.

16A.3.3 Thermal calculations shall be based on the climatic conditions described in GTS of TS considering the approximate length of GIS as 100 m.

16A.3.4 Guarantees & Penalties

- i) The bidder shall indicate guaranteed maximum values of total losses(conductor loss & enclosure loss) & further indicate whether losses are firm or subject to tolerance. In case losses are subject to tolerance, ceiling shall be indicated for tolerance. Bidder to refer Clause 6 of Section 1of the Technical Specification.
- ii) On testing at shop if it is found that actual losses are more than the values quoted, including maximum tolerance specified, if any, the penalty will be imposed on the supplier @ Rs.2,50,000 for each K.W. in excess to losses & recovered.

- iii) The purchaser reserves the right to reject the GIS if the total losses exceed the declared losses beyond 10%. In case temperature rise of bus bars and enclosures exceeds the guaranteed values, quoted by the supplier, the purchaser also reserve the right to reject the GIS.
- iv) TESTS TO MEASURE LOSSES IN BUS CONDUCTOR AND ENCLOSURE OF THE GIS

Tests at factory shall be carried out by the supplier to prove that actual measured during testing are within guaranteed values quoted in the tender. Tenderer shall furnish methodology of carrying out loss measurement in his tender. If after deduction of tolerance as specified by the tenderer, the actual losses during testing exceed the guaranteed value of losses up to a maximum limit of 10%. The supplier shall pay to the purchaser as penalties @ Rs. 2,50,000 per K.W. as specified in previous clauses.

16A.4 DESIGN AND CONSTRUCTION

- 16A.4.1 The GIS assembly shall consist of completely separate pressurized sections in order to de-pressurize one gas compartment for inspection, maintenance or, if necessary, repair while keeping the adjacent compartments in service.

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 equipment. Stainless steel partition diaphragms with suitable deflectors shall be provided to prevent uncontrolled bursting pressures developing within the enclosures.

The switchgear, which shall be of modular design, shall have complete phase segregation. Each section shall be complete with high grade Epoxy resin, gastight seal-off 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 byproducts of SF6 breakdown under arcing conditions.

- 16A.4.2 The material and thickness of the enclosures shall be such as to withstand an internal flashover without a burn through for a period long enough (500 ms) to enable the backup relay protection to clear the fault.

Sufficient access openings shall be provided at the switchgear to ensure that each switchgear component can be inspected during installation or for future maintenance. Each section shall have easily removable connection pieces to allow for easy replacement of any component with the minimum of disturbance to the remainder of the equipment.

- 16A.4.3 Materials used in the manufacture of 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 aluminium or aluminium alloy 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 fitted with silver plated finger contacts or tulip contacts. The contacts shall allow the tubular conductors to expand or contract axially due to temperature variation without imposing any mechanical stress on supporting insulators.

- 16A.4.4 Each pressure filled enclosure shall be designed and fabricated to comply with the requirements of the applicable pressure vessel codes of the country of origin (Copies of the relevant codes shall be supplied to the purchaser free of cost).

Manufacturer shall guarantee that the pressure loss within each individual gas-filled compartment will not be more than 1 percent per year.

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 byproducts of SF₆ during interruption. Each gas compartment shall be fitted with separate non-return valve connectors for evacuating and filling the gas and checking the gas pressure etc. Arc faults caused by external reasons shall be positively confined to the originating compartment and shall not spread to other parts of the switchgear. Routine replacement of insulating gas shall not be required in intervals of less than ten years.

- 16A.4.5 Temperature rise of current carrying parts shall be limited to the values stipulated in latest edition of IEC 60694, under rated current and the climatic conditions as specified in specification. (Latest IEC to be followed).

Thermal rating for all current carrying parts shall be a minimum of 1 sec. at 420 kV for the rated symmetrical short-circuit current. If the maximum short-circuit time is to be extended, the I^2t value shall remain constant.

415V, 3 phase/240 V, Single phase, 50 Hz, A.C. & 220V D.C. auxiliary voltage supply for control alarm, operating mechanism and space heaters shall be available.

16A.4.6 The switchgear shall be of freestanding, self-supporting, 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 compartments
- c) Circuit breakers
- d) Isolators
- e) Gas insulated bus duct section between GT, Reactor and GIS.
- f) Surge Arrestors.
- g) Current Transformers
- h) Voltage Transformers.

“Each phase/pole of GIS shall be housed in the separate enclosures”.

16A.4.7 Arrangement of the individual switchgear bays shall be such as to achieve optimum space saving, neat and logical arrangement, and adequate accessibility to all external components.

GIS hall shall have tentative dimensions as under:-

- | | | | |
|----|--------------------------|---|----------|
| a) | Length | - | 105 mts. |
| b) | Width | - | 16 mts. |
| c) | Height (Upto crane beam) | - | 9 mts. |

While finalizing the layout plans of GIS, care should be taken to minimize the size of halls. The layout shall generally be shown on the drawings. Adjustment in layout shall be possible with purchaser's approval.

16A.4.8 Switchgear shall be suitable for future extension through Bus sectionalizer as shown in SLD and layout drawings.

For routine inspections and possible repairs, all elements shall be accessible without removing support structures. The removal of individual enclosure parts, or entire equipment in any bay, shall be possible without disturbing the enclosures of adjoining bays.

- 16A.4.9 All interlocks that prevent potentially dangerous mal-operations, shall be constructed such that they cannot be defeated easily, i.e. the operator must use tools or brute force to over-ride them.

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

Visible corona – In general the contours of energized metal parts of the GIS and any other accessory shall be such as to eliminate areas or points of high electrostatic flux concentrations. Surfaces shall be smooth with no projection or irregularities which may cause visible corona. No corona shall be visible in complete darkness when the equipment is subjected to test voltage specified.

- 16A.4.10 The enclosure assembly shall consist of completely separate pressurized sections designed to minimize the risk of damage to adjacent sections and protection of personnel in the event of failure occurring within the equipment. The switchgear shall be designed so that induced voltage and temperature shall not exceed permissible limits. Stainless steel carbon impregnated or nickel plate rupture diaphragms with suitable deflectors shall be provided to prevent uncontrolled bursting pressure developing within the enclosures under worst operating conditions.

Workmanship shall be of the highest quality and shall conform to the best modern practices. Metal enclosures shall be fabricated from Aluminium/Aluminium alloy, all joint surfaces shall be machined and all castings shall be spot faced for all bolts heads or nuts and washers. All screws, bolts, studs and nuts shall conform to metric system. The colour shade of paint applied on outer surface of the enclosures shall be as recommended by the Purchaser.

- 16A.4.11 The breaker enclosure shall have provision for easy withdrawal of the interrupter assemblies. The procedure may not involve the removal or dislocation of enclosure parts of neighboring bay. The removed interrupter assembly must be easily and safely accessible for inspection and possible repairs.

The enclosures of the same phase shall be electrically interconnected. 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. The enclosure shall be designed to practically eliminate the external electromagnetic field and thereby electro-dynamic stresses even under short circuit conditions.

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

- 16A.4.12 Each gas compartment shall be fitted with separate non-return valve connectors for evacuating & filling the gas, checking gas pressure etc.

The switchgear shall have provision for connection to the purchaser's grounding risers. The provision shall consist of grounding pads of unpainted steel, of suitable size. The tenderer shall furnish the details & drawings for ground mat requirement for GIS.

- 16A.4.13 Ladders and walkways shall be provided wherever necessary for access to the equipment.

Wherever required, heaters shall be provided for equipment to ensure proper functioning of the switchgear at ambient temperatures, specified. The heaters shall be rated 240 V with thermostat, control switches and fuses, connected as a balanced 3-phases, 4-wire load. The heaters shall be so arranged and protected as to create no hazard to adjacent equipment from the heat produced.

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

shall have holes for gas communication on both sides. Gas tight barriers shall be clearly marked on the outside of the enclosures.

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 also be designed to withstand any internal fault thereby keeping on internal arc inside the faulty compartment”.

Alarm circuit shall not respond to faults for momentary conditions. Following alarm circuits including those required elsewhere in the specification shall be generally provided for indication of:-

In the Gas Insulating System:

- a) Loss of gas density.
- b) Loss of heater power (failure of a.c. supply)
- c) Any other alarm necessary to indicate deterioration of the gas insulating system.

In the Operating System:

- a) Loss of heater power. (failure of ac supply)
- b) Loss of operating power (failure of ac/dc supply)
- c) Loss of control.
- d) Pole-discrepancy

16A.4.14 The equipment will be operated under the following ambient conditions. In the design of the equipment, these conditions shall be taken into account by the supplier as required.

- a. The ambient temperature at the project site and Average daily temperature inside the power house given in Section-3.
- b. The humidity will be up to 100 percent (indoors).
- c. For design purposes, the barometric pressure shall be calculated for elevation of GIS floor.

- 16A.4.15 The completely assembled and installed equipment shall be able to withstand safely the dynamic forces induced in any part of the equipment by an “Equipment Design earthquake”. The earthquake forces shall be 0.16g in vertical direction and 0.24g in other two horizontal directions.

To prove the capability of the equipment to withstand the “Equipment design earthquake” the supplier shall model the equipment, mathematically as series of discrete mass points connected by members in such a manner that it will represent the equipment completely installed and ready for service. The resulting system shall be dynamically analyzed using “Model Analysis”. The calculations shall be supplied to the purchaser. Alternatively, the supplier may use other means, if agreed to in advance by the purchaser and shall supply all details of these tests alongwith the offer.

16A.4.16 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.

In addition to this, provision of bellows in vertical & horizontal direction inside and outside GIS building are to be kept for minor adjustment in XYZ plane upto $\pm 20\text{mm}$. A bellow near interface section (transformers and reactors) is also to be provided for adjustment upto $\pm 20\text{mm}$. Suitable margin in rollers provided at the wall opening at GIS are also to be kept in XYZ for adjustment. Metal bellows (preferably of stainless steel) of following types or suitable equivalent arrangement shall be provided wherever necessary:-

- i) Lateral mounting units: These shall be inserted, as required, between sections of bus bars, CGI bus duct connections, on transformer and CGI ducts termination. Provision of these shall enable sections of the switchgear to be removed and reinserted without interfering with adjacent parts. Lateral mounting shall be made possible by a sliding section of enclosure and tubular conductors.
- 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 and assembly tolerances.
- v) Vibration compensators: These bellow compensators shall be provided for absorbing vibrations caused by transformers when connected to SF6 switchgear by Oil/SF6 bushings.

16A.4.17 Circuit breakers

16A.4.17.1 The three phase circuit breakers in each bay module shall be of the 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 and arc quenching. Means shall be provided to ensure that all interrupters and secondary auxiliary switches open and close without loss of synchronism or of 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. The circuit breakers shall be provided with independent and reliable operating mechanism for each pole. Full details regarding electro spring operating mechanism and constructional & operational feature must be described in the bid. The detailed drawings to illustrate the operational features must be supplied.

The operating mechanism employed shall be of proven design and shall be in service for a period of at least 5 years without failure/ mal-operation at a number of installations supplied by the bidder.

Each circuit breaker shall be capable of withstanding without requiring change of any parts, at least **10 nos** interruptions at rated short circuit current with associated rate of rise of recovery voltage. The bidder shall design the circuit breaker in accordance with the recommendation of IEC 62271-100. The service life of circuit breaker shall be at least **10,000** switching operation, at rated current/as per relevant IEC/ IEEE standard. The supplier will also submit proof of short circuit rating with transient voltage severity.

Suitable margin in circuit breaker compartments/foundations are to be kept for adjustment in XYZ plane upto 10mm.

16a.4.17.2 Out-of-Phase Switching

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

Short line Faults: Circuit breaker supplied shall be capable of interrupting short line faults on overhead transmission line at amplitude factor of 1.5.

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 and break operations as per its IEC. They shall also be required to break small inductive currents without causing excessive over-voltages, line charging currents without restrikes, handle evolving faults and meet the requirements; regarding partial discharge, radio interference and corona.

In rush and magnetizing current associated with large power transformers of single phase 92 MVA, 80MVAR Bus and Line Reactor will have to be switched by the circuit breakers without restriking and without causing excessive switching surges. Occasionally, a power transformer operating under ferro-resonant conditions and having non-sinusoidal current and voltage wave-forms with higher than normal peak values will have to be switched. The supplier shall provide proof test data and comment on breaker for such applications.

16A.4.17.3 Insulation Co-ordination

The bidder shall carry out the insulation coordination study for the complete Power station covering the equipments from Generator to Pothead Yard (including Bus duct, GT, XLPE Cable, GIS etc) and switching and lightning impulse voltages of electrical equipments in the power station subjected to approval by employer. Number, location and characteristics of Lightning arrester, shown in SLD are for tender purpose only. Bidder shall finalize the same in consultation with the employer on the basis of above study.

The insulation strength across the open contacts of the circuit breaker in respect of lightning impulse, switching surges and power frequency withstand voltages shall be as per IEC 60694 latest version. (Latest IEC to be followed).

The circuit breaker and bus insulation shall be coordinated so that for impulse, switching surge and 50 Hz voltage high enough to cause flashover, shall take place in the bus rather than in the circuit breaker in either the open or closed position. The circuit breaker shall have the required capabilities as defined in IEC relevant latest version.

16A.4.17.4 **Mechanical requirements:**

The circuit breakers shall be horizontal mounted depending on manufacturer's preferred layout for the double bus system and taking into account the worst service condition forces imposed by the earthquake withstand requirements stated in this Specification.

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

	Sign	Background Colour
Open position	Open	Green
Closed position	Close	Red

Each pole of the breaker shall be provided with operating counter to record the number of operations performed during service.

The circuit breakers shall be provided with pressure gauges and pressure relays for the operating mechanism. The circuit breaker shall be supplied with thermostatically controlled tank heaters as required. Where the heater current rating exceeds one ampere, thermostatically controlled contactors shall be used.

16A.4.17.5 The circuit breaker shall be provided with a rating plate which, in addition to the requirement of IEC, contains the voltage required to operate the tripping coil.

All circuit breakers except line circuit breakers shall be designed for 3-phase tripping and closing. Only line circuit breakers shall have single-phase and 3-phase auto-reclosing capabilities. The line breakers shall be capable of independent pole operation. Each phase shall be completely isolated from the other two phases. The circuit breakers shall be trip-free and have anti-

pumping and phase discrepancy protection. There shall be two trip coils per pole of the breakers.

- 16A.4.17.6 All necessary interposing, interlocking control relays for circuit breaker tripping and closing shall be located in the control cabinets supplied by the supplier.

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

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. It shall trip the breaker when the SF6 gas density drops below a minimum permissible level. The state of the breaker arc-quenching and insulating gas shall be monitored by a temperature-compensated pressure switch or density switch with two alarm levels. The first stage alarm shall be set well before any dangerous conditions is reached, the second stage shall initiate breaker operation. In addition, the actual gas pressure shall be shown on a local pressure indicator.

The circuit breaker shall be able to operate locally or from a remote point. Local operation shall be by means of an open/close control switch located in the bay module control cabinet. Remote control via a Remote/local control transfer switch will be from the power house control room. Protection trips will remain operational in either remote or local control mode. When in the maintenance mode, all remote trip or close control signals will be blocked. The breaker controls shall operate from the two independent 220 V DC systems with both the trip coils connected. A manually operated tripping device shall also be provided with each breaker which can be operated in an emergency or during maintenance. Mechanical indicators coupled to the movable contact system shall be provided to show the true position of the main breaker contacts. Operating counters shall be provided for each breaker pole or otherwise for each breaker.

16A.4.17.7 The circuit breaker shall be provided with duplicate electrical tripping facilities. Thus shall include but not be limited to the following:-

- a) Two electrically and magnetically separate identical trip coils. Simultaneous energizing of both coils shall not affect the breaker opening time. Non-polarised coils shall be preferred.
- b) Two electrically independent and identical sets of wiring, terminals and protective equipment for connection to two independent control and/or tripping power sources.

16A.4.17.8 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.

The circuit breaker shall be provided with red and green local LED type indicating lamps which shall be connected through one normally open and one normally closed circuit auxiliary switch of each pole. The circuit breaker shall further be provided with amber lamp to indicate healthy trip conditions.

All necessary relays, switches and devices shall be provided to allow for local operation. A two-pole single throw switch shall be connected to isolate the closing devices and primary tripping coils from their potential supply and a further two-pole single throw switch shall be similarly connected to isolate the standby tripping coils. The control supply shall have provision of HRC fuses of appropriate capacities for overload protection.

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

- | | | |
|----|--------------------------|--------------------------------|
| a) | Breaker closing control | 85% to 110% of 220 V DC |
| b) | Breaker tripping control | 70% to 110% of 220 V DC |
| c) | A.C. Control devices | 85% to 110% of 230 V, 50 Hz AC |

16A.4.17.9 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. Circuit breaker closing coil operated by minimum pressure interlocks must be continuously rated to prevent burn-out when power is applied to an open circuit breaker which has no gas or air pressure. Circuit breaker trip coils operated by minimum pressure interlocks must be continuously rated to prevent burn out when power is applied to a closed circuit breaker which has no gas pressure.

Alternatively, where continuously rated coils are not provided, the supplier shall provide suitable interlocks to protect the coils.

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

16A.4.17.10 Auxiliary switches for the circuit breaker:

Apart from any auxiliary switches normally required in the circuit breakers for control or auxiliary functions as detailed herein, each pole of each circuit breaker shall be provided with eighteen normally open ‘a’ and eighteen normally closed ‘b’ switches, all electrically independent and readily convertible from normally open to normally closed operation or vice-versa. Six ‘a’ and six ‘b’ switches shall be adjustable for early make or early break operation. An early make ‘a’ contact connected in series with an early break ‘b’ contact shall provide a pulse during circuit breaker closing and tripping. The above thirty six switches of each pole shall be cabled by the supplier to terminal blocks in the control cabinet. The contacts shall be capable of interrupting 5A, 220V DC (resistive).

Breakers shall have separate operating devices for each pole and shall be equipped with an electrical phase dis-agreement 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 if desired and shall have a normally open contact wired to the control cabinet terminal block.

The supplier shall supply all relays, switches and accessories to provide for fail-safe operation of the circuit breaker under conditions of low stored energy where stored energy (oil) is used for operation. 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:-

- a) Level 1 Low stored energy (pressure) alarm.
- b) Level 2 Initiate blocking of breaker closing when stored energy is insufficient to perform a close-open duty cycle.
- c) Level 3 Initiate automatic circuit breaker tripping and isolation at a point where sufficient stored energy is still available to perform the operation.

16A.4.17.12 The SF6 gas insulated circuit breaker shall have the following performance characteristic and ratings, in addition to those stated in above clauses.

- a) Type of breaker 420 kV rated voltage three phase metal enclosed, double interrupter, horizontal mount, SF6 gas insulated spring operated. / Hybrid mechanism.
- b) Rated normal current (A)
 - i) Generator, Transformer 500
 - ii) Line breakers 2500
 - iii) Bus coupler 2500
 - iv) Line reactor 200
 - v) Bus reactor 2500
- c) Number of poles 3

d)	Installation	Indoor
e)	Temperature rise	As per IEC 60694 (Latest IEC to be followed).
f)	Rated short circuit current, KA (rms value of ac component). (for 1 sec)	50
g)	Rated short circuit making current, KA (peak)	125
h)	System Neutral Earthing	Effectively earthed
i)	First-pole-to-clear factor	1.3
j)	Rated duration of S.C.	1 Second
k)	Total break time for any current Upto the rated breaking current.	Not exceeding 50ms.
l)	Closing time	Not exceeding 100 ms
m)	Difference in the instants of closing/opening of contacts:	
	i) Within a pole	Not exceeding 5 ms.
	ii) Between poles	Not exceeding 10 ms.
n)	Rated transient recovery voltage for terminal faults.	As per IEC 62271-100
o)	Rated characteristics for short line faults.	As per IEC 62271-100
p)	Standard values of rated line characteristics for short line faults.	As per IEC 62271-100
q)	Rated operating duty cycle	

i)	Line breakers/ bus coupler breaker	As per latest relevant IEC
ii)	GT / Reactor breakers	
r)	Auto reclosing (Line breakers only)	Single-phase and 3-phase.
s)	Operating mechanism	spring
t)	i) Number of trip coils ii) Number of closing coils	2 per pole 1 per pole
u)	SF6 gas characteristics for SF6 circuit breaker.	As per relevant IEC
v)	Rated line charging breaking capacity Small inductive breaking current Control of switching surge	As per relevant IEC As per relevant IEC As per relevant IEC
w)	Radio interference voltage at 320 kV (r.m.s.)	≤ 500 micro volts.
x)	Corona extinction voltage kV (r.m.s.)	320
y)	Partial discharge level pico coulombs.	10 or less
z)	No. of auxiliary contacts	18 NO and 18 NC in each pole wired to terminal block-control cabinet.
	Main contact material	Cu-silver.

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

16A.4.18 **Isolator switches**

- 16A.4.18.1 Isolator switches shall be of the 3-phase, single-pole, group-operated type, installed in the switchgear in locations as shown on the single line diagram to provide electrical isolation of the circuit breakers from the transformer, double bus, bus reactors, line reactors and transmission lines. The isolators shall be electric motor operated suitable for use on 220 V DC ungrounded system and shall be equipped with a manual operating mechanism for emergency use. The motors shall be protected by circuit breaker.

The disconnecting switches shall be arranged such that the three phases operate simultaneously. Closed and open status of all three phases shall be achieved in fail safe manner through individual limit switch in all phases or suitable alternative. All parts of the operating mechanism shall be able to withstand without damage the full starting torque of the motor mechanism until the motor overload protection operates.

It shall be possible to operate the disconnecting switches manually by cranks or hand wheels. In the manual position the power operator shall be both mechanically and electrically disconnected.

Every dis-connector located in the generator and line bay shall be designed to break the capacitive charging currents when opening. Contact shielding shall be designed to prevent high local stresses caused by the transient recovery voltages when these currents are interrupted. The bidder should describe the contact shielding in detail. The switch operating mechanisms shall be complete with all necessary linkages, clamps, couplings, operating rods, support brackets and grounding devices. All bearings shall be permanently lubricated or shall be such that no lubrication or maintenance is required.

- 16A.4.18.2 Opening and closing of the isolators shall be either by local or remote control. Local operation shall be by means of a two-position control switch located in the bay module control cabinet. Remote control through the Remote/local transfer switch will be from the power house control room.

The isolator operations shall be interlocked electrically with the associated circuit breakers such that the isolator control is inoperative if the circuit breaker is closed. Actuation of the emergency manual operating device shall

also disable the electrical control circuits, and shall be key interlocked with the associated circuit breakers.

Each isolator switch shall be supplied with 18 (eighteen) normally open and 18 (eighteen) normally closed auxiliary switches for other use over and above those required for switchgear interlocking purposes. Also, it shall be possible to change normally open contact into normally closed contact and vice-versa.

Signaling of the isolator closed position 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 with-stand current can be carried safely. Signaling of the dis-connector open position shall not take place unless the main contacts are fully separated.

- 16A.4.18.3 The auxiliary switches and auxiliary circuits shall be capable of carrying a current of at least 10A DC continuously. Auxiliary switches shall be capable of breaking at least 2A in a 220 V DC circuit with a time constant of not less than 20 milliseconds. Auxiliary switches shall be positively driven in both directions.

Isolator provided with safety grounding switches shall have mechanical key and electrical interlocks to prevent closure of the grounding switches when the isolator switches are in the closed position and to prevent closure of the isolator switch when the grounding switch is in the closed position.

Isolator provided with high-speed fault make grounding switches will be interlocked such that the fault make switches close first to discharge the radial cable or line charging currents before the respective isolators may be opened.

When the lines, GTs, Reactors and XLPE Cable are taken out of service for maintenance, etc., the isolators and high-speed grounding switches of the Gas Insulated Switchgear are required to operate as follows:

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

mechanism will be energized to open the isolator. Operation of the isolator control switch to close will close the isolator, which when proved closed, will signal the high-speed grounding switch to open.

Local control of the isolators and high-speed grounding switches from the bay module control panel will be from individual control switches with the Remote/ Local transfer switch set to local. All electrical sequence interlocks will apply in both remote and local control modes but in local mode the time delay relay will be blocked.

Each isolator switch shall have a clearly identifiable local, positively driven mechanical position indicator, together with remote position indicator on the bay module control cabinet and remotely in the power house control room. The indicator shall have the following wording and coloring:-

	<u>Sign</u>	<u>Background Colour</u>
Open position	Open	Green
Closed position	Close	Red

- 16A.4.18.5 All the disconnecting switches shall have endoscopic arrangement allowing easy visual confirmation from outside the enclosure of full travel of the switch contacts to both of the open and close positions.

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

The control and power cables will terminate, at one point for each 3-phase disconnecting switch. It will be the supplier's duty to supply all equipment needed to extend from this point to the individual phases. All mechanism cabinets shall have heaters rated 240 V A.C.

- 16A.4.18.6 The isolators shall conform to latest relevant IEC 62271-102 and shall have the following ratings:

a)	Rated insulation level	As per relevant IEC
b)	Power frequency withstand voltage across Open gap, for 1 min.	As per relevant IEC
c)	Impulse withstand voltage across Open gap	As per relevant IEC
d)	Switching Impulse withstand voltage	As per relevant IEC
e)	Rated normal current (A),	
	i) In generating bays	500
	ii) In bus bars	2500
	iii) Bus coupler bay	2500
	iv) Feeder bays	2500
	v) Bus Reactor bay	2500
	vi) Line Reactor bay	200
f)	Rated supply voltages of closing devices and auxiliary circuits	220 V DC un- grounded; 240 V, 50 Hz, single-phase AC 415 V, 50 Hz, three-phase AC.
g)	Total operating time of isolator alongwith its operating mechanism.	Not to exceed 12 s
h)	Rated magnetizing/capacitive current make and break capacity.	As per relevant IEC.
i)	Partial discharge level	=<10 pico coulombs
j)	Corona extinction voltage	320 kV (r.m.s.)

- k) Radio interference voltage at **320 kV(r.m.s.)** = < **500**
microvolts

The Supplier shall offer only the dis-connectors which are proved against the effect of VFT (dis-connector switching and very fast transients).

16A.4.19 **Safety grounding switches**

- 16A.4.19.1 Three phase, single pole, group operated work in progress safety grounding switches shall be provided as shown in the single line diagram. Each grounding switch group shall have a single electric motor suitable for operation from a 220 V DC ungrounded supply. Means of emergency manual operation shall also be provided.

The safety grounding switches shall be arranged such that the three phases operate simultaneously. Closed and open status of all three phases shall be achieved in fail safe manner through individual limit switch in all phases or suitable alternative. All parts of the operating mechanism shall be able to withstand without damage the full starting torque of the motor mechanism until the motor overload protection operates.

In order to provide test facilities, certain ground switches may be required to be insulated from the enclosures and have easily removable ground connections. Each safety grounding switch shall be electrically and mechanically key interlocked with its associated isolator switch and circuit breaker such that it can only be closed if both the circuit breaker and isolator switch are open.

Safety ground switch operation shall be achieved locally from the bay module control cabinet only; remote control is not required. Positive mechanical position indication shall be provided locally at each switch and remotely at each bay module control cabinet, and in the power house control room.

The indicator shall have the following wording and colouring:-

	Sign	Background Colour
Open position	Open	Green
Closed position	Close	Red

- 16A.4.19.2 Interlocks shall be provided such that manual operation of the switches or insertion of the manual operating device will disable the electrical control circuits.

Each ground switch shall be fitted with six normally open and six normally closed auxiliary switches for other use over and above those required for local interlocking and position indication purposes. Provision shall be made for padlocking the ground switches in either the open or closed positions. All portions of the grounding switch and operating mechanism requiring grounding shall be properly grounded.

The main grounding connection on each grounding switch shall be rated to carry the full short circuit rating of the switch for 1 second and shall be equipped with a silver-plated terminal connector suitable for connection to the switchyard grounding grid. The safety grounding switches shall conform to the requirements of IEC 62271-102.

16A.4.20 High speed, make proof grounding switches

- 16A.4.20.1 Grounding switches located at the entrances of the transmission lines, transformer feeder, bus bars and reactor feeder circuits shall be of the high-speed, make proof type and will be used to discharge the respective charging currents, in addition to their safety grounding function. These grounding switches shall also be capable to interrupt the inductive and capacitive currents and to withstand the associated TRV.

The high speed make proof grounding switches shall be arranged such that the three phases operate simultaneously. Closed and open status of all three phases shall be achieved in fail safe manner through individual limit switch in all phases or suitable alternative. All parts of the operating mechanism shall be able to withstand without damage the full starting torque of the motor mechanism until the motor overload protection operates.

These Three phase switches shall be group operated from a single electric motor operator suitable for operation from a 220 V DC ungrounded supply. The switches shall be fitted with a stored energy closing system to provide fault making capability.

- 16A.4.20.2 The short circuit making current rating of each ground switch shall be equal to its withstand current rating of 50 KA. Each switch shall have a positive local mechanical position indicator, a remote indicator at the bay module control cabinet and remote indication in the power house control room.

The indicator wording and coloring shall be as follows:-

Sign	Background Colour	
Open position	Open	Green
Closed position	Close	Red

High speed ground switch operation shall be obtained locally from the bay module control cabinet, or remotely from the power house control room in conjunction with opening of the associated isolator switch.

The high speed grounding switches shall be electrically and mechanically key interlocked with their associated circuit breakers such that the grounding switches cannot be closed if the circuit breakers are closed. The grounding switches will be required to close before the isolator switches are open in order to dissipate the trapped charges, when the lines are taken out of service for maintenance, etc.

- 16A.4.20.3 Interlocks shall be provided such that insertion of the manual operating devices will disable the electrical control circuits.

Each high speed ground switch operator shall be fitted with six normally open and six normally closed auxiliary switches 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.

All portions of the grounding switches and operating mechanism requiring connection to ground shall be properly grounded, by using flexible copper conductor having minimum cross section area of 50mm².

The main grounding connection on each grounding switch shall be rated to carry the withstand short circuit current rating of the switch for 1 s and shall

be equipped with a silver plated terminal connector suitable for connection to the switch yard grounding grid.

The high speed make proof grounding switches shall conform to the requirements of IEC 62271-102 latest edition.

16A.4.21 **Current transformers**

The current transformers incorporated into the GIS will be used for protective relaying and metering and shall be metal enclosed type. The secondary leads shall be brought out through a gastight bushing plate into the secondary terminal box. All current transformers shall have effective electromagnetic shields to protect against high frequency transients.

A current transformer marshalling terminal box shall be provided and located in an accessible position for connections of each phase. The marshalling box shall be used for the star/delta configuration and be equipped with terminals with short circuiting facility for the secondary circuits. The wiring between each current transformer core to marshalling terminal box to protection panels and to other required places are required to be done as per scheme.

The tentative detail of current transformer parameters is mentioned in tender SLD and will be finalized during detail engineering. The approval on the same has to be taken by the contractor before manufacturing.

The particulars of the various cores are likely to change within reasonable limits. Manufacturer is required to have these values confirmed by purchaser before proceeding with design of the cores. Provision shall be made either with in the current transformers or outside for primary current injection testing. Other characteristics of CTs shall be as given below:-

- | | | |
|----|---|---------------------------|
| a) | Rated short time thermal current
for 1 s, kA (rms) | 50 |
| b) | Rated insulation levels | As per latest IEC 60044-1 |
| c) | Power frequency overvoltage
withstand requirements for | As per latest IEC 60044-1 |

secondary windings

- | | | |
|----|--|---------------------------|
| d) | Limits of temperature rise | As per latest IEC 60044-1 |
| e) | Maximum Radio Interference voltage at 320 kV (r.m.s) | =< 500 Microvolt |
| f) | Corona extinction voltage kV (r.m.s.) | 320 |
| g) | Partial discharge level | <10 pico-coloumbs |

16A.4.22 Voltage transformers

Single phase voltage transformer shall be located on the 420 kV bus-A & bus-B in SF6 switchgear

The voltage transformer shall be effectively shielded against high frequency electromagnetic transients.

The voltage transformer secondaries shall be wired by manufacturer to their associated secondary circuit breakers in the bay module control cabinets to the line protection panels and to other required panels as per the scheme.

The voltage transformers shall conform to latest edition of relevant IEC 60044-2. The tentative detail of current transformer parameters is mentioned in tender SLD and will be finalized during detail engineering. The approval on the same has to be taken by the contractor before manufacturing.

16A.4.23 SF6-To-Air Bushings (Polymer / Porcelain type)

- 16A.4.23.1 The 400 kV overhead lines are to be connected to SF6 GIS by Air to SF6 gas filled bushings through 400 kV Bus Ducts. The air terminations shall consists of a polymer which encloses the conductor & an appropriate ground sleeve. The shell shall be sealed to aluminium flanges by elastomer seals. The conductor shall be provided with a plug in contact to accommodate thermal expansion and facilitate replacement of the bushing shell without disturbing welded line sections.

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

The Air/SF6 bushing shall conform to IEC-60137 and shall have the following rating:

- a) Lighting impulse withstand voltage - 1425 kV (Peak)
- b) Switching surge withstand voltage - 1175 kV(Peak)
- c) One minute power frequency - 630 kV (RMS)

16A.4.23.2 The SF6-to-Air bushing shall be SF6 gas-insulated type and shall be suitable for the indoor ambient conditions stated in **Section 3** of these specifications. If the bushings of condenser type with grading elements are offered, these shall be fitted with capacitance taps for the measurement of tan delta and partial discharge. The test sockets shall be brought but to an accessible location on the mounting base.

All bushings shall be so designed that there will be no stressing of any parts due to temperature changes and adequate means shall be provided within the support structures to accommodate bus-duct enclosure and conductor expansion.

All contact surfaces of external terminals shall be silver-plated using pure silver. The bushing shall be hermetically sealed and be impervious to impurities and moisture during shipment and storage. Suitable supporting structures of galvanized steel for the bushings and bimetallic terminal connectors connecting overhead conductors shall be provided by manufacturer.

The SF6-to-air bushings which shall be complete with suitable corona rings, shall conform to latest edition of IEC-60137.

Rated current	2,500 Amps.
Rated short time current (rms)	50 kA for 1 sec.
Rated frequency	50 Hz $\pm 3\%$
Rated insulation level	As per clause 16A.4
Temperature rise	As per IEC-60137
Minimum creepage distance	6720 mm
Corona extinction voltage	320 kV (rms)
Radio interference level at 320 kV (rms)	Less than 500 Microvolts
Partial discharge level	Less than 10 pico-coulomb

16A.4.25 Surge arrestors

- 16A.4.25.1 SF6 gas insulated, metal enclosed surge arrestors of the gapless metal oxide, heavy-duty, station type shall be located on H.V. side of generator transformers, GIS near XLPE interface, Bus & Line Reactor and Busbar.

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

Alignment of discs is of vital importance and necessary precautions while transporting the same has to be taken care. Methodology to ensure the trouble free transportation of surge arrester shall be supplied.

- 16A.4.25.2 Each arrestor shall conform to latest edition of IEC-60099-1 & 5 and shall have the following technical performance characteristics:-

a)	Rated voltage of arrestor	336 kV (rms)
b)	Class of diverter	Station type, heavy duty SF6 gas insulated, metal oxide, gapless.
c)	Maximum continuous voltage capability, (L-N),	273 kV (rms.)
d)	Maximum discharge current (8/20 microsecond wave)	20kA
e)	Maximum switching surge protective level	As per latest IEC
f)	Maximum residual voltage (discharge voltage) at 10 KA (8/20 microsecond current Wave)	As per latest IEC
g)	Maximum equivalent front-of wave protective level, (10 KA with voltage wave cresting in 0.5 microsecond).	As per latest IEC
h)	Impulse withstand voltage of equipment to be protected:	
i)	Transformers	As per latest IEC
ii)	GIS component	As per latest IEC
iii)	Reactors	As per latest IEC
i)	Switching surge withstand voltage of equipment to be protected.	As per latest IEC
j)	Radio interference voltage at 320 kV (RMS)	Not exceeding 500 micro-volts.
k)	Partial discharge level	20 or less pico coulombs

- | | | |
|----|---------------------------|--------------|
| l) | Corona extinction voltage | 320 kV (rms) |
| m) | Energy level | 10 kJ/ kV |

Arrestor Duty

- | | | |
|-----|-----------------------------------|---|
| i) | Connection to system: | Phase to earth |
| ii) | Type of equipment being protected | a) Generator step up transformer.
b) GIS near XLPE interface
c) Busbar
d) Bus and Line Reactor |

Additional equipment and fitting:

- | | | |
|------|--|------------------------------------|
| i) | Whether metal enclosed arrestor is required | - Yes |
| ii) | Type of mounting (pedestal, bracket, hanging) Bidder should study the layout and offer most suitable type of mounting. The reason for selecting particular type of mounting shall be explained in the bid. | |
| iii) | Mounting orientation, if other than vertical:- | Bidder to decide best orientation. |

Remark: Bidder has to submit the values for above parameters as per relevant latest IEC during detail engineering

- 16A.4.25.3 The bidder shall select the technical parameters and characteristics of the surge arrestor from the insulation coordination study so as to obtain a security ratio of at least 1.30 under all conditions of over voltages and the basic insulation provided for the transformer winding. The bidder shall furnish alongwith his bid report containing the technical justification and calculations in support of the selection of the location and other technical parameters of the surge arrestor.

This study report should highlight the technical comments on the proposed rated voltage, the long duration class and the energy handling capacity.

16A.4.26 Bus bars and bus ducts

The conductors of the bus bars and bus ducts shall be fabricated of aluminium of cross-sectional area suitable to meet the current rating requirements. The tubular bus sections shall be housed in aluminium enclosures, filled with pressurized SF6 gas. The conductors shall be supported from the enclosures by homogenous epoxy resin insulators shaped to ensure uniform electrical field distribution and zero corona at rated voltage. Adequate provision shall be made for absorption of the thermal expansion of the conductors and of differential thermal expansion between the conductors and the enclosures. Metal bellow type compensators with adjustable tensioners shall be provided where required. The enclosures shall be designed to eliminate as much as possible all external effects of the flux created by normal and fault currents. The power losses in the system shall be kept to minimum and induced voltages on the enclosures shall not be allowed to exceed reasonable limits of safety for operating personnel.

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

Each end of the main bus bars shall be designed for convenient future extension of the switchgear. Bus conductor and connectors and enclosure flanges shall be designed accordingly. All necessary indoor and outdoor galvanized steel supporting structures for the proper erection, leveling and alignment of the bus bars and bus ducts shall be provided by Manufacturer. Provisions shall also exist for the connection to the SF6 bushings of the transformer. The actual length of the bus duct would be finalized after layout is frozen. For any change in length for bus duct shall have no financial implication on the purchaser.

The buses shall have continuous current rating of 2500 Amps for 400 kV.

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 electro-magnetic forces caused by short circuit currents.

Where the bus passes through building, walls, flooring or other enclosures, the supplier shall supply the wall plates, flanges and all bolts. The SF6 Bus duct will be naturally ventilated and no forced ventilation/ cooling is envisaged. Wherever necessary, to absorb expansion, contraction, relative movement between the various items of equipment and also the earth quake forces, bellows or other means shall be provided. Supplier must submit details alongwith the offer. The bus shall be provided with all necessary supporting steel structure. The “Interface” arrangements between the equipment shall be in the scope of GIS supplier.

Each gas compartment barrier shall be easily identifiable from the outside of the switchgear. In no case, max length of GIB between two close barriers shall be 3 m. The means of identification used shall be a black band, approx. 10mm wide, permanently affixed to the barrier insulator on outer surface of the bus duct at the location of the barrier insulation. In case of leakage of gas from any compartment, indication should be made on the annunciators installed in each Local Control Panel.

16A.5 **AUXILIARY SYSTEM AND MISCELLANEOUS COMPONENTS**

16A.5.1 Circuit breaker accessories / auxiliary equipment

The accessories and auxiliary equipment to be supplied with the circuit breaker shall include all parts necessary for correct functioning of the circuit breaker such as:-

- a) Operation counter, electrically operated.
- b) One set of adequately rated, thermostatically controlled, anti-condensation heaters with provision for monitoring of heater failure, wired to terminal blocks.
- c) Two copper ground bus bar to be located near the control cable entrance.
- d) Operating mechanism, pressuring unit, gauges and switches.
- e) All motor driven auxiliaries shall have individual phase or pole thermal over-current protection.
- f) Circuit breaker SF6 gas pressure monitoring unit.
- g) One vermin proof, sheet steel cabinet of adequate size shall be provided for housing the operating mechanism, relays, control and auxiliary equipment and for terminating all control, alarm and auxiliary circuits on 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. Viewing windows shall be provided for observation of the instruments without opening the cabinet. Suitably engraved name plates shall be provided to identify all equipment in the control cabinet.

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

All control cables shall be provided with double metallic shield. The external shields shall be grounded at both ends and the internal at one end only. Grounding connections shall be as short and direct as possible and shall terminate at the point of entry to cabinets or terminal boxes. Coaxial type cable glands suitable for use with shielded cable shall be used at each termination. All control shall be installed and terminated in such a manner as to limit the effects of transient electromagnetic voltages on the control conductors to an acceptable level.

16A.5.2 Bay module control cabinets

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

The panel will be utilized as both the switchgear bay local control and as the terminating center for all power supply, control annunciation and supervisory wiring interfacing with other systems. The A.C. and D.C. power supply for auxiliary and control equipment will be available and is covered under

Section 3 of technical specifications. Further distribution of A.C. and D.C. power supply shall be arranged by supplier. Two feeders of A.C. and D.C. supply each will be made available as main and stand by feeder for supplying power to one local control panel.

16A.5.2.1 a) Mounted on the cabinet door shall be:-

- i) Remote/ local control transfer switch for the circuit breakers and isolator switches.
 - ii) Normal operation/ maintenance transfer switch for the isolation of remote electrical control.
 - iii) 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.
- b) Mounted internally in the Cabinet shall be:
- i) All bay switchgear interlinking wiring and auxiliary relays.
 - ii) AC and DC power supply circuit breakers.
 - iii) All necessary incoming and outgoing terminal blocks.
 - iv) Space heaters.
 - v) All instruments and devices required for supervision control of GIS.

16A.5.2.2 The bus voltage transformer secondary terminal circuit breaker will be mounted within the bus VT bay module control cabinet. Mounted on the solid cabinet door shall be an annunciator panel having sufficient modules and lighted windows to annunciate all gas pressure/density and circuit breaker operating mechanism alarms and trips.

16A.5.2.3 Each annunciator module shall have electrically separate changeover contacts for remote alarm indication. Each remote alarm contact shall be wired to terminal blocks. The annunciator panel shall be complete with an audible warning horn and acknowledge/reset, horn silence and lamp test push buttons. Horn shall automatically silence if the acknowledge button is not operated within 1 minute of the alarm initiating. The lighted window of the fault point shall continue to flash until the acknowledge signal is given. The annunciator panel shall have sufficient modules and lighted windows to annunciate low/high gas pressure/density and all other abnormal conditions also.

The control cabinet shall be suitable for bottom entry of cables. All the indicating lamps shall be of LED type.

16A.5.3 **Supporting structure**

16A.5.3.1 The supplier shall design, fabricate and supply the equipment supporting framework including all rails, transverse and longitudinal beams and supporting members with all necessary hardware and all embedded parts. General structural designs and structural details shall be submitted for information to purchaser.

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

16A.5.3.2 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.

All steel structure members shall be hot dip galvanized.

10T EOT Crane has been envisaged [REDACTED] Accordingly, design of Structure and components of GIS shall be done.

16A.5.4 **SF6 Gas processing unit**

16A.5.4.1 An SF6 gas processing unit suitable for evacuating, liquifying, evaporating, filling, drying and purifying SF6 gas during the initial installation, subsequent maintenance and future extension of GIS shall be provided. The cart shall be equipped with rubber wheels and shall be easily maneuverable by two workers within the switchyard building. “The unit shall be provided with gas testing kit to measure the moisture contents of the gas and with pressure monitoring system. Acidity measurement instrument with nozzle etc. shall also be provided”.

The unit shall be self-contained (except for additional gas storage, bottles and external power supply at 415 V AC, 3-phase, 50 Hz) and fully equipped with at least an electric vacuum pump, gas compressor, gas drier, gas filter, refrigeration unit, evaporator, gas storage tank, full instrumentation for measuring vacuum on vacuum

pump, compressor inlet temperature, tank pressure and temperature, valves and piping to perform the following operations as a minimum requirement:-

- a) Evacuation from a gas filled compartment using the vacuum pump.
- b) Transfer of SF₆ gas from a system at some positive or negative pressure to the storage tank via the gas drier and filter.
- c) Recirculation of SF₆ gas in the storage tank through the drier.
- d) Recirculation of SF₆ gas in any switchgear or bus duct compartment through the drier and filter.
- e) Evaporating and filling SF₆ gas.
- f) Drawing off and liquefying SF₆ gas.
- g) A combination operation of filling SF₆ gas into a gas system and evacuating a second gas system using the vacuum pump.
- h) Pressure monitoring.
- i) Measurement of moisture content & acidity measurement.

16A.5.5 **On-Line monitoring**

Continuous on line monitoring system shall be provided to monitor conditions such as partial discharge, internal arcing, gas density, gas pressure, gas leakage, moisture etc. and operating parameters such as current, voltage, temperature etc. of GIS for smooth operation and detection of any changes in insulation at an early stage during normal operation to take appropriate remedial action.

Each system shall be complete with sensors, input/ output module, control/processor unit, relays, junction boxes, cabling and associated accessories for measuring, monitoring and data acquisition of intended parameters to be monitored.

16A.15.5 .1 **Gas monitoring system**

Each gas-filled compartment shall have its own SF₆ gas density / pressure monitoring system, each comprising of a temperature compensated SF₆ gas density monitoring unit and pressure gauge having alarm / trip contacts.

Gas pressure and density shall be continuously monitored and displayed by a suitable temperature compensated instrument, which will provide an alarm signal in case of pressure drop before the allowable minimum pressure is reached.

16A.5.5.2 **Partial discharge monitoring system**

The continuous on line partial discharge monitoring system for permanent supervision of switchgear dielectric condition shall be based on latest technology.

The system shall have the provision to continuously monitor, record, analyze, diagnose, indicate and trip etc. The system shall be of an international repute having proven performance and acceptability in the field. The details and scope of the system shall be approved during detail engineering.

16A.5.5.3 **Circuit breaker monitoring system**

Circuit breaker monitoring system for internal arcing, electrical wear, travel curves shall be provided for information on circuit breaker condition to predict maintenance/servicing.

Remark:

1. Continuous on-line monitoring and diagnostic systems in all individual bays (including LCD display) shall be provided in their respective Local Control Panels.
2. A remote station for system operator to control and supervise all the above 3 systems in the control room is to be provided and the same should be time synchronize with plant control system.

16A.5.6 **Common requirements**

All the SF6 Insulated Circuit breaker, disconnecter, earthing switches and bus duct shall be of single phase segregated type.

16A.5.6.1 **Protective finish**

The entire exterior surface shall be cleaned and painted, before leaving the factory with one coat of approved primer and two coats (water resistant) of approved finishes. The under-side of all painted surfaces bearing upon the concrete foundation

shall be given two coats of approved primer. Extra paint for re-touching shall be made available by the supplier.

16A.5.6.2 Fire retardancy

All components shall be fire retardant and shall be tested in accordance with IEC 60695. Gas emissivity when the material is heated shall be minimal. PVC material shall not be used.

Control wire in a grouped environment shall not convey flame, continue to burn when tested as per IEC 60695. The method of test and criteria for success or failure shall be in accordance with the above IEC.

16A.5.7 **Grounding**

16A.5.7.1 The GIS Supplier shall define clearly what constitutes the main ground bus of the GIS & bus ducts. The GIS supplier must supply the entire material for ground bus of GIS viz conductor, clamps, joints, operating and safety platforms etc, to be laid/embedded in GIS floors. The GIS supplier is also required to supply and erect all earthing connectors and associated hardware material for:

- i) Connecting all GIS equipment, bus ducts, enclosures, control cabinets, supporting structure etc. to the ground bus of GIS and;
- ii) Connecting ground bus of GIS to the groundmat in power house complex provided by the Purchaser at several points as per equipment.

16A.5.7.2 The enclosure of the GIS shall be grounded at several points so that there shall be grounded cage around all live parts. The ground continuity between each enclosure shall be affected over flanges, with links or straps to bridge and flanges. Subassembly-to-subassembly bonding shall be provided to assume safe voltage gradients between all intentionally grounded parts of the GIS assembly and between those parts and the main ground bus of the GIS.

A minimum of two nos. of Grounding connections should be provided for each of circuit breaker, transformer, cable terminals, surge arrestors, earth switches and at each end of the bus bars.

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.

- 16A.5.7.3 The grounding connector shall be of sufficient mechanical strength to withstand electromagnetic forces as well as capable of carrying the anticipated maximum faults current without overheating atleast for two paths to ground from the main ground bus. 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 steel.

The individual gas insulated Bus duct phase enclosures shall be directly bonded to each other by flexible bonding leads. These bonding leads shall also be the point of attachment for the ground lead. Sufficient bonding and grounding points shall be provided to limit potential rise due to a fault to acceptable values for personnel protection.

All flexible bonding lead shall be 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.

The purchaser will exchange the information regarding the earthing system proposed to be provided. The Supplier shall examine the same and shall advise suitably in the matter.

The enclosure shall represent the main grounding inter connection between the several areas. In parallel at least two grounding conductors sized for maximum earth fault current shall be placed. The supplier shall present a detailed proposal for the whole grounding system in respect of GIS for approval.

16A.5.8 High voltage transients

High voltage transients from switching operations and internal faults are coupled to the external sheath of the GIS. Because the effects of these transients on people are not known, operating personnel are required to avoid contact with the sheath during switching operations. Such a restriction is considered undesirable and the suppliers are requested to comment on devices and techniques which may reduce such hazard or new techniques to reduce transients to an acceptable level.

16A.5.9 Bolting requirements

Details of bolts sizes and threading shall be shown on the appropriate drawings.

Where self-locking type of nuts are used they shall be of the reusable type. Pressed type nuts are not acceptable. The supplier will be responsible for supplying suitable foundation bolts and clamps as required. He shall also be responsible for grouting the foundation bolts.

16A.5.10 **Heaters**

All heaters shall be suitable for connection to a 415 V AC, 3-phase, 4 wire, 50 Hz supply. The heater in the mechanism housing shall be connected inside the housing to this supply and shall be thermostatically controlled. Leads to tank heaters shall be enclosed in conduit. All thermostat and temperature indicating devices shall be calibrated in metric unit.

16A.5.11 **Service life**

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

16A.5.12 **Welding**

Pressure vessel and pressure pipe welding: The pressure vessel and pressure piping shall be designed and built to the requirement of International Standards for the construction and inspection of Boilers and pressure vessels.

All welding and brazing must satisfy the requirements of the relevant Indian/internationally accepted Standards.

In addition to the specification, the supplier shall be governed by the following requirements:-

- a) All welding procedures to be used in the fabrication of pressure vessels and pipings shall be submitted to purchaser for review. These procedures must be in consistence with the International Standard.

- b) All butt welds shall be full penetration welds.

This clause may be read in conjunction with welding clause mentioned in Contract document.

16A.5.13 Workplace Requirement for GIS Erection

The Contractor shall provide or submit the workplace requirement such as flooring, illumination, ventilation well in advance to the Employer for necessary coordination at Employer's end for implementation. The requirement shall be worked out during detailed engineering.

16A.6 DRAWING, DOCUMENTS AND DESIGN CALCULATIONS

After award of contract, the contractor shall furnish all drawings, documents, design calculations, data, manuals & other necessary literature, pertaining to equipment offered by them & so specified under various clauses, in accordance with requirements stipulated in Section 1.

A comprehensive list of all such drawings/documents planned to be submitted for reference/approval shall be provided beforehand for approval of the purchaser as already explained in clause no. 8 of Section 1. The list of drawings & documents to be furnished for approval / reference shall not be limited to the following:-

- i) Drawings, documents, design calculations literatures, manuals etc. in Section 1.
- ii) Drawings, documents, design calculations, literatures, manuals as listed in Clause 8 of Section 1.
- iii) Detailed quality assurance plan, giving complete specifications of the materials and specifications relating to inspection and testing of materials and finished components.
- iv) All drawings having bearing on civil foundations, equipments foundation details and loads
- v) Arrangement, installation, foundation, plan, section, detailing of main equipment and sub-assemblies including control & instrumentation system.

- vi) All Electrical, Hydraulic & Control Drawings such as Electrical Panels OGA, Cable Block & Termination Diagram, Schematic Diagram, JB/MB/Kiosk Diagram etc. in respect of this section.
- vii) All manufacturing drawings not specifically covered under approval/reference category shall be submitted for record and facilitate inspection of the component in the shop and assembly at site.
- viii) Drawings including outline drawing (isometric view) and photographs to show the general construction and overall dimensions of the equipment proposed. The drawings shall also show the location and general arrangement of all auxiliary devices and H.V. terminal arrangement. All dimensions shall be in mm.
- ix) Description of untanking procedure for circuit breakers and disassembly of other switchgear components, including extent of repairs which will be possible within the switchyard building.
- x) Detailed procedures for dismantling of bus bars and other equipment.
- xi) Any other drawings, documents, design calculations, literatures, manuals etc. not covered anywhere in the specification, but required to be furnished for approval / reference of employer for suitability of design to fulfill the scope of work.

16A.7 **SHOP ASSEMBLY, INSPECTION AND TESTS**

16A.7.1 The details of the test procedures and test equipment to be used shall be intimated to the purchaser well in advance.

Manufacturer shall submit a schedule of the specified testing programme to the purchaser for its approval. Testing of related equipment shall be coordinated so that testing may proceed with a minimum of delay.

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

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

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

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

The switchgear shall be completely assembled in the factory in sub assemblies of max. size and then each sub assembly shall be shop tested. Additionally 3-phase transmission line switchgear bay module shall be completely assembled including a representative section of outdoor SF6 gas insulated bus duct and one outdoor SF6/air bushing. All control and terminal boxes shall be temporarily connected with all power supply, control, interlocking and alarm wiring and piping such that the complete switchgear module may be tested in the shop before shipment as specified below.

16A.7.2 **Routine tests:**

All routine tests as per relevant latest IEC standard for switchgear Component forming part of G.I.S. namely circuit breaker, disconnecter, grounding switches, Current Transformers, Potential Transformers, Relays, surge arrestors and all types of SF6 bushing are to be conducted. However, for electronic modules, equipment and individual components burn-in tests, temperature and voltage stress tests shall also be performed. Routine testing shall be conducted by automatic processes, wherever practical, in particular wiring testing.

When switchgear and controlgear are not completely assembled before transport, separate tests shall be made on all transport units. In this event, the manufacturer shall demonstrate the validity of his test (example: leakage rate, test voltage, resistance of part of the main circuit).

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

16A.7.2.1 **Mechanical Tests**

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

- a) Mechanical Operation – Circuit Breaker:
 - i) 25 open and close at rated voltage and rated pressure.
 - ii) 5 open and close at minimum voltage and minimum pressure.
 - iii) 5 open and close at maximum voltage and maximum pressure.
 - iv) 5 close/open cycles at rated voltage and rated pressure.
 - v) 5 open/close/open cycles at rated voltage and rated pressure.
 - vi) 5 open-close sequences 0-0.3 sec-CO-3 min-CO for line breakers.
 - vii) 5 open-close sequences 0-0.3 sec-CO-3 min-CO for generator Transformers and bus coupler breakers.
- b) The Operating times are to be recorded as follows:
 - i) Opening time measured at rated supply voltage for each pole.
 - ii) Measured mechanical mechanism reset time or hydraulic mechanism recharging time after one opening and one closing.
- c) Mechanical Operation – Isolators and Ground Switches.
 - i) 5 open/close cycles at rated voltage.
 - ii) 5 open/close cycles at minimum voltage.
 - iii) 5 open/close cycles at maximum voltage.
 - iv) Ensure operation of interlocks.
- d) Gas Tightness Leak Test, On Complete Assembly.
- e) Design & visual checks as per respective IEC.

16A.7.2.2 **Electrical Tests:**

Electrical tests shall be as per respective IEC's & shall include the following:

The Electrical tests to be performed on the specified factory assemblies shall be as follows:-

- a) Main circuit resistance measurement, each pole.
- b) Measure resistance of circuit breaker close and trip coils.

- c) Measure power consumption of motor operated mechanisms at rated supply voltage.
- d) Ensure operation of electrical interlocks is performed in proper sequence.
- e) **Control Cubicle**
 - i) Operation or functional check of all circuits at rated supply voltage.
 - ii) Dielectric test, of auxiliary circuits at 2000 V 50 Hz for 1 minute.
 - iii) Operation test of all pressure density monitoring switches.
 - iv) Power frequency withstand test.
- f) **Current transformers (As per IEC 60044-1)**
 - i) Verification of terminal marking.
 - ii) Power frequency tests between sections of Primary and secondary windings.
 - iii) Test of inter turn insulation.
 - iv) Test for composite error.
 - v) Test for accuracy.
 - vi) Partial discharge tests.

Following tests shall be carried out for current transformers used for protection purpose.

 - i) Knee point voltage test.
 - ii) Exciting current test.
 - iii) Secondary winding resistance tests.
 - iv) Turns ratio test.
- g) **Surge arrester (As per IEC 60099-1 &5)**
 - i) Measurement of reference voltage.
 - ii) Residual voltage test.
 - iii) Satisfactory absence from partial discharges & contact noise to be checked on each unit by any sensitive method adopted by manufacturer.
 - iv) A leakage check may be made on each unit by any sensitive method adopted by manufacturer in case of arrester unit with sealed housing.
 - v) Current distribution test for multi-column arrester.
- h) **Circuit breaker**

Following tests as per IEC-62271-100:

- i) Dielectric test on the main circuit.
- ii) Test on auxiliary and main circuit.
- iii) Measurement of resistance on main circuit.
- iv) Tightness test.
- v) Design and visual checks.

i) **Disconnecter & grounding switch (As per IEC)**

Following tests as per IEC-62271-102:

- i) Power frequency voltage withstand dry tests of main circuit and auxiliary circuits.
- ii) Voltage withstand tests on auxiliary and control circuits.
- iii) Measurement of the resistance of the main circuit.
- iv) Mechanical operating tests.
- v) Measure power consumption of motor operated mechanism at rated supply voltage.

j) **Voltage transformers (As per IEC 60044-2)**

- i) Verification of terminal marking.
- ii) Power frequency withstand test between sections, primary and secondary windings.
- iii) Test for Accuracy
- iv) Partial discharge test.

16A.7.2.3 In addition to the above tests, all enclosures shall be pressure tested after manufacture in accordance with the latest requirements of IEC 517, Section 31.

16A.7.2.4 For bus bars & bus ducts the routine testing shall be as per the relevant IEC standard & shall also include the following:-

BUS BARS

S.No. Name of the PERCENTAGE CHECK TO BE APPLIED FOR VARIOUS TESTS

Test	Support	Gas	Enclosure	Conductor	Accessories
------	---------	-----	-----------	-----------	-------------

1.	2.	Insulator	barrier	5.	6.	16A.
i) Dimension		100%	100%	100%	100%	100%
ii) Gas Tightness		-	100%	100%	-	100%
iii) Pressure Test		-	100%	20%	-	-
iv) Welding (X-ray)		-	-	5%	-	-
v) Electric resistance		-	-	-	100%	-
vi) 50 Hz voltage						
withstand		100%	100%	-	-	-
vii) Partial discharges		100%	100%	-	-	-
viii) Section shall be RIV		100%	100%	100%	100%	-
free at 2 times rms						
line to ground.						
ix) Weld shall be leak		-	-	100%	-	-
tested with SF6						
leak detector.						
x) Contact resistance		-	-	-	100%	-
at plug in contact.						
xi) Cleanliness aspect		100%	100%	100%	100%	100%
xii) Silvering		-	-	-	-	-
xiii) Packing		-	-	-	-	-

16A.7.3 TYPE TESTS

The type test shall fall under Clause 5 of Section 1.

The type test report of the following equipments shall be submitted by bidder:

- i. Circuit Breaker
- ii. Surge Arrestor
- iii. Current Transformer
- iv. Potential Transformer
- v. SF6 to Air Bushing
- vi. Isolator and earth Switches

And the type test report of the following tests in respect of the above shall be submitted by bidder:

- a) Tests to prove the ability of the main and earthing circuit to carry the rated peak and the rated short time withstand current.
- b) Tests to prove strength of enclosures.
- c) Tests to verify the protection of persons against contact with live and moving parts.
- d) Lightning impulse voltage dry tests.
- e) Switching impulse voltage dry tests.
- f) Power frequency voltage dry tests
- g) Partial discharge tests.
- h) Temperature rise tests.
- i) Tests to verify the resistance of the main circuits.
- j) Short-time current tests on main circuits.
- k) Short-time current tests on grounding circuits.
- l) Internal arc tests.
- m) Operation tests at limit temperatures.
- n) Verification of degree of protection of auxiliary and control circuits.
- o) Pressure Vessel Tests**
- p) The Supplier shall offer only the dis-connectors which are proved against the effect of VFT (dis-connector switching and very fast transients).

16A.7.4

Field Tests

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

- a) Continuous testing of the properties of SF6 gas through the entire filling period.
- b) Testing of all current carrying and ground connections to all conductors and terminal pad, to determine that full clamping pressure is applied to all contact surfaces and all bolted connections are tightly secured with lock washers; testing of all flexible connections to ensure that sufficient slack is available for expansion.
- c) Individual inspection of pressure relief devices, density/pressure gauges and all other auxiliary devices to determine their conditions.
- d) Check of cabling between apparatus by the Contractor, prior to acceptance tests. Random checks shall be made in the presence of the Engineer.
- e) Measurement of the insulation resistance to earth of the various measuring and control circuits. Including cables, instruments and apparatus wherever practical and feasible.
- f) Check of all relay settings shall be in accordance with the calculated values and afterwards primary inspection tests by introducing fault artificially wherever feasible, otherwise testing with testing apparatus (simulated method). Primary checking of all tripping circuits.
- g) Operating checks of all control, signaling, measurement, 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. Detailed records, including all details of tests performed and results obtained shall be prepared by the Contractor.

16A.7.5 **Commissioning Tests**

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

- 2 The following commissioning tests shall be performed as agreed between Manufacturer and purchaser as per relevant IEC.
 - a) “High voltage tests for the main circuit and GI bus ducts for one minute power frequency withstand voltage”. If any special arrangement is required for performance of this test, the manufacturer shall make such suitable arrangements accordingly.
 - b) Voltage tests for the auxiliary and control circuits.
 - c) Tests to verify the resistance of the main circuits.
 - d) Operation tests for various components.
 - e) Gas leakage tests.
 - f) Calibration of SF6 gas pressure/density switches.
 - g) Measurement of moisture.
 - h) Evacuation & vacuum risk leak test of all flange connections for GI bus ducts.
 - i) Partial discharge measurement test.
- 3 After erection, a test shall be made to prove the absence of dangerous voltages in the enclosure and other metal parts such as pipes and framework
- 4 Except as otherwise provided hereunder, responsibility for apparatus and test equipment and the control thereof shall be exercised by Manufacturer subject to the overriding control of the purchaser.

16A.7.6 PERFORMANCE TESTING

If nothing unusual has been observed in load run and load rejection tests, the test service period of 72 hours shall follow. During this test service period, the unit must operate continuously at rated condition without any interruption except of those beyond the control of the Contractor. However, such interrupted period shall not be counted for in the test service period. There should be one month reliability run of the concerned unit bay along with other associated bays for evacuation of power reckoned from the date of taking over by employer. During reliability run, machine shall be operated by employer and any problem observed during this run shall be attended by the contractor including replacement of components and providing requisite manpower.

16A.8 PACKAGING, HANDLING & SITE STORAGE

The Contractor shall follow the general requirement of Packaging, Handling and

Storage elaborated here .

The Contractor shall pack all the consignment in sea worthy packaging strong enough to withstand rough handling during transit. Machine surface shall be suitably protected against scratches, corrosion, shocks, impact etc. Packages shall be suitably and distinctly identified for type of handling and kind of storage. The sealed packing units shall be suitable for a combined shipping and storage time of up to 24 months.

Considering the transport limitation and the erection methodology, the various components shall be assembled in the factory so as to obtain the largest possible unit for transport. These transport units after mechanical and electrical test in the factory shall be filled with SF6 or dry nitrogen, the gas pressure being slightly above atmospheric, to protect internal parts against influences of moisture and other deterioration while in transit or storage.

The Bus bar and other components inside the enclosure shall be rigidly supported by providing additional supports / braces to prevent movement / shock during transit / handling. Lock nuts shall be provided wherever jacking screws have been used to provide support to prevent loosening during transit. Sensitive components of GIS shall be vacuum packed/ sealed and tilt indicators and moisture indicators shall be mounted on the boxes / packages.

The Contractor shall transport and store the switchgear in accordance with instruction given by the manufacturer. The instruction for the transport and storage shall be submitted well in advance before delivery to Employer. The Contractor shall submit storage plan for approval and update periodically about storage status if storage period at site becomes more than three (3) months.

The Contractor shall submit the packaging drawing for major components for approval. This drawing shall specify the type of protective coating, packaging material and preservation materials etc. for major and sensitive components. The Contractor shall supply all the required tools and handling equipments like mobile crane, fork lifts, trailers, trucks for loading, handling in transit areas, unloading and storage of cases and packages.

16A.9

SITE INSTALLATION AND COMMISSIONING

The Contractor shall follow the requirements of installation procedure given below in conjunction with Clause 17 of the Section 1.

The Contractor has to do all the work related to assembly, erection, testing and commissioning complete in all respects. All necessary tools, plants, labour, materials including consumables for performing installation, testing and pre-commissioning

shall be provided by the Contractor. The Contractor shall submit the necessary data/information, layout and foundation/support drawings well in advance.

The Contractor shall provide and install the concrete inserts/ embedment, support steels and/or components for foundation/supports purpose as per approved erection drawings and coordinate the activities with civil contractors to keep his activities in synchronism with civil work. All installation for foundation shall be verified and accepted by the Engineer. The Contractor shall use anchor fasteners for installation of fixtures, mountings, conduits, cabling, panels etc. Chipping of concrete and/or taking support from reinforcement bars shall not be allowed.

Installation procedure

The Contractor shall submit detailed programs and the procedures to be adopted for erection / installation, testing and commissioning, before start of erection activities/ installation, for information of the Employer.

The installation procedure shall also have a section “site quality assurance plan” containing erection data sheets for various components. These sheets should specify site measurements/ inspections required to be made for ensuring proper installation.

16A.10 TOOLS AND INSTRUMENTS

16A.10.1 Tools for erection and Installation.

The Contractor shall bring his own tools, devices, testing instruments / equipments to site in order to erect and install the complete equipment delivered under this section. These shall remain the property of the Contractor unless otherwise agreed to take over any / all of these at mutually agreed conditions.

The Contractor shall also arrange for special tools for drilling (Hilti) along with sufficient drill bits, chemical grouts, and total station (including operator for same)

16A.10.2 Instruments for testing & commissioning

The list of instruments to be supplied shall be as per Schedule V(A). General requirement of these tools are as below:-

1. The contractor shall provide the highest model of the mentioned make or equivalent.
2. The timeframe to be reckoned the highest model of the mentioned make / equivalent shall be six months prior to the submission of drawings / documents for review / approval of equipment. .

3. The contractor shall submit the duly signed certificate by OEM / dealer certifying that the selected model is the highest model meeting the above timeframe criteria.
4. Supplied equipment's authorized service center shall preferably in India / Nepal.
5. Data sheet needs to be approved during detailed engineering of the finalized model selected from the list of makes. If the contractor proposes to supply the model / make equivalent to the specified list, then data sheet of the equivalent make along with the data sheet of one of the makes in the list shall be submitted during detailed engineering.
6. The instruments shall be supplied/handed over at site before the COD of 1st unit.
7. Defect liability of tools / instruments shall commence from the date of handing over & acceptance by the employer.
8. The other instruments (if any) shall also be handed over before COD of the 1st unit along with validity of Calibration certificate (as applicable) for at least one year. The defect liability period will commence from the date of handing over.
9. In case of repetition of tools / instruments in other chapters in addition to the mentioned list, those shall also be part of the scope of supply of contractor.
10. Contractor shall submit product catalogue, brochures, and routine / acceptance tests (if any), guarantee certificate, calibration certificate, instruction manual, O&M manual etc. of each and every instrument.
11. Instruments covered under this schedule shall also be governed by the vendor selection Clause 4 of Section 1.

16A.10.3 General purpose instruments for GIS

The list of General purpose tools to be supplied for GIS shall be as per BOQ



16A.10.4 Specific Tools for Operation, Maintenance & Handling of GIS

Two (2) sets of tools for Annual Maintenance (Operation, Maintenance & Handling) of GIS shall be supplied by the contractor. Details of tools to be finalized during detailed engineering in consultation with the suppliers.

16A.11 SPARE PARTS

The spare parts mentioned here under are meant for use by the Employer during operation and maintenance stage and shall not be used as erection spares required during installation.



The Contractor shall supply the mandatory spare parts as per BOQ

The Contractor shall supply the mandatory spare parts as per BOQ



SECTION- 3

PROJECT DETAILS AND GENERAL SPECIFICATIONS

3.0 GENERAL

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

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

3.1 PROJECT DETAILS

Name of the Project:	4x225MW , Arun-3 HEP ,Nepal
Name of the Customer:	SAPDC
Name of Consultant :	SJVN

SJVN Arun-3 Power Development Company (P) Ltd. (SAPDC), a company promoted by SJVN Ltd., as a single shareholder company in Nepal having its registered office at Lokanthali, Kathmandu, Nepal has signed Project Development Agreement with Government of Nepal to plan, promote, organize & execute Arun-3 Hydroelectric Project (900 MW) in Sankhuwasabha District. of Nepal.

The bid prepared by the Bidder and all correspondence and documents related to the bid exchanged by the Bidder and the consultant/owner shall be written in the English, provided that any printed literature furnished by the Bidder may be written in another language, as long as such literature is accompanied by a translation in English, in which case, for purposes of interpretation of the bid, the translation shall govern.

3.2 Location & Land Availability:

The proposed project site is located at a distance of 50 km from Khandbari, the headquarters of Sankhuwa sabha District of Nepal. It is at about 240 km from Biratnagar and about 740 km from Kathmandu. The location details of the proposed project site are as indicated below:

- Latitude 27°30'N – 27°-35'N
- Longitude 87° -12'E – 88°-20'E
- Distance from Tumlingtar (domestic airport) town is.....About 68 km
- Distance of Kathmandu (international airport) from Tumlingtar.....About 660.km

3.3 Climatic Condition

Average max temp : 30° C
Average Minimum Temp : 20° C
Maximum river water temperature : 25°C
Minimum river water temperature : 10°C
Ambient Temperature for the Equipment : 40° C

3.4 Seismic Zone

The equipment shall be designed for operation in seismic zone IV for earthquake resistance. The equipment and each part of it shall be strong enough and sufficiently well connected to resist total operating stresses resulting from forces in normal operation, abnormal condition and forces superimposed due to occurrence of earthquakes of intensity which cause a ground acceleration of 0.16 g in vertical direction and 0.24 g in the other horizontal directions.

3.5 Transportation

Unless otherwise specified in the **Specification**, responsibility for arranging transportation of plant and equipment lies with the Contractor. The Contractor shall at its own risk and expense transport all plant and equipment to a destination specified in bid document. The contractor shall transport the contracted plant and equipment/ supplies through registered common carriers only.

The nearest major airport is at Kathmandu which is at a distance of 740km from Project Site. Biratnagar is connected to Kathmandu by Road.

The major nearest seaport for the trans-shipment of heavy equipment to Nepal is Kolkata. Other sea ports for imported equipment would be Mumbai or Chennai as convenient. The two sea ports Mumbai & Chennai are connected to Kolkata and Jogbani by rail as well as roads.

Railway transport is available from Kolkata and other locations of Indian Cities to the Nepal-India border only. The broad gauge line from Kolkata ends at Jogbani, Bihar. All rail freight for Nepal has to be unloaded there. The distance of Kolkata by rail route is about 800 km. From Jogbani, the road distance to the projects sites via Biratnagar is about 300km.

Road access to Arun-3 project from Kolkata to Jogbani is 600km; from Biratnagar to Project Area via Hile is 300km. Total distance to project area from Kolkata is 900km. Alternative route could be from Kolkata to Raxaul which is 800km, further from Birganj to Dhalkebar to Hile to Project Area which is 450km. Total distance Kolkata to Project Area is 1250km.

Local transportation, insurance and other services incidental to the delivery of facilities to be supplied from Employer's country (Schedule- 2 Items) shall be quoted separately.

3.6 Transport Limitation

The transport limitation by road from Jogbani to the project site is the governing factor for determining permissible package size and weight.

The existing roads allow the transport of the packages of the following size and weight.

Size (in mm) (l x b x h) - 9700 x 6000 x 6000*

Weight (Tonnes) - 70R

Heaviest package to be transported with suitable number of axle for safe transportation of consignment for 70R bridge capacity.

* Height from the ground.

3.7 Salient features of Project

The salient features of Arun-3 HEP are as follows:

A. POWER HOUSE COMPLEX

i. Power House Cavern	Underground on Left bank
ii. Installed capacity	900 MW
iii. No. of units	4
iv. Unit Capacity	225 MW
v. Size of Power House Cavern	179.50m (L) x 22.5m (W) x 49.5m(H)

B. UNDERGROUND TRANSFORMER CAVERN

i. Size	146.14m (L) x 16 m(W)x 23m(H)
ii. Transformer Type	Single Phase
iii. Number and rating	13 nos. (including 1 spare), 15.75/420/v3kV, 50Hz, 92MVA
iv. Transformer Hall level	El. 552 m

C. Switchyard & Transmission

i. Type of Switching	Gas Insulated Substation and Pothead Yard
ii. Size	207m (L) x 106m (W)
iii. Switchyard level	El. 557 m
iv. Transmission System	400kV Arun III HEP – Muzzafarpur via Dhalkebar D/c Quad Moose Lines with LILO of both circuits at Dhalkebar 400/220kV substation

3.7.1 SYSTEM PARAMETERS

1	Continuous current carrying capacity (rms) at 40° C ambient temperature.	2000A (min)
2	Short time current carrying Capacity	50kA for 1sec
3	Voltage	400KV/420kV (rms) (Nom/Max)
4	Frequency	50Hz
5	System neutral earthing	Effectively earthed
6	Insulation Level	
a	One minute Dry Power frequency Withstand Voltage (kV rms)	630
b	One minute Wet power frequency Withstand Voltage (rms)	630
7	Switching Impulse withstand(250/2500 microsec.) voltage (kV peak)	1050
8	Impulse Withstand Voltage of arrester housing with 1.2/50 micro sec wave.	1425 kVp
9	Creepage distance	25 (mm/kV)
10	Radio Interference voltage at 320kV	As per CEA guidelines

3.7.2 AUXILIARY POWER SUPPLY

3.7.2.1 AC power

Three-phase system with grounded neutral for feeding three-phase and one-phase consumers (connected between phase and neutral), 415/240V $\pm$ 10% and 50Hz , -5% to +3 %. All motors and other electrical apparatus should be designed to work continuously under, -5% to +3 % frequency variation and $\pm$ 10% voltage variation.

3.7.2.2 DC power

DC Systems, ungrounded, with earth fault detection 220V plus (+) 10% and minus (-) 20% for the supply of main control circuits for high and medium voltage switchgear, protection circuits and to other larger essentials loads. Other voltage systems eventually needed, shall be generated from the above systems by means of dc/dc converters, inverters etc.

3.7.2.3 Deleted

3.7.2.4 Cabling & wiring

Wiring within cubicles and equipment enclosures shall conform to requirements of this section unless otherwise specified. Control wiring shall be single / stranded copper subjected to prior approval by purchaser during detailed engineering and shall not be smaller than 2.5 Sq. mm, except as otherwise agreed by the purchaser.

All Distribution Boards, Control & Protection panels, Motor Control control panels etc. shall be supplied completely wired internally up to the terminal blocks ready to receive purchaser control cable.

All inter cubicle and inter panel wiring and connections between panels of same Distribution Board, Control & Protection panels, Motor Control panels including all bus wiring for AC and DC supplies shall be provided by the tenderer. Larger size wiring shall be used where needed for the current carrying capacity requirements.

Cables shall have at least 1000 V PVC insulation except for 220V DC and telemetering or communication system equipment for which 650V and 300 V ratings respectively are acceptable.

For current and potential transformer secondary circuits the minimum cross section of the conductors shall not be less than 4.0 Sq. mm.

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 wire ways accessible from the front door.

Engraved core identification ferrules marked to correspond with panel wiring diagram shall be fitted at both ends of each wire.

Each cubical 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.

3.7.2.5 Power outlets

Power outlet for utilities such as electric drills, welding equipment etc., shall be provided in all floors of the powerhouse to enable repair and maintenance works to be done locally/ in-situ.

3.7.2.6 Terminal blocks

The terminal blocks shall be located to allow a neat and easy connection work and shall be safely accessible while the equipment is in service. Control circuits and power circuits shall be completely separated by use of divided or separate terminal blocks. Power terminal blocks shall be rated in accordance with applicable standards, and shall be provided with covers. Terminal blocks shall be 1100V grade and have continuous rating to carry the maximum expected current on the terminals.

Terminal blocks 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 such 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.

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.

Unless otherwise specified terminal blocks shall be suitable for connecting the following conductors on each side.

All circuits except CT/ PT flexible circuits	Minimum of two of 2.5 sq. mm copper
All CT/ PT Circuits flexible	Minimum of 2 nos. of 6 sq. mm copper

The arrangements shall be made 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.

Wherever duplication of a terminal block is necessary it shall be achieved by solid bonding links.

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 minimum clearance of 250 mm 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.

3.7.2.7 Protection requirement

For short circuit and overload protection of power and control circuits, air circuit breakers, moulded case circuit breakers or MCBs shall be used. Outlets from AC (and DC) distribution panels are protected in their respective panels.

3.7.2.8 Switches, Lamps & Instruments

General

Control switches, indicating lamps and instruments shall be arranged so that all parts are readily accessible for servicing without the necessity to remove other devices, terminal blocks or excessive amount of wiring.

All control switches and indicating devices mounted in cabinets and enclosures shall be visible with the doors closed.

Identification nameplates shall be provided for all control switches, indicating instruments and lamps, in accordance with clause "Nameplates".

Instruments and controls shall be located so that their dials, indicators and nameplates are clearly readable. Data for all instruments to be provided, including type, size, scale range, electrical ratings, nameplate and name of manufacturer, shall be furnished. Steel panels shall be provided for group mounting of the instruments.

All instruments shall be of an approved type and shall match, insofar as practicable, the other instruments with which they are associated; their dial type, scaled markings and units, type of connection and mounting, shall be co-coordinated. All piping and tubing required for instruments shall be furnished and installed. All instruments and control switches shall be furnished with necessary auxiliaries, i.e. resistors, shunts etc.

3.7.2.9 Control and Selector switches

The switches and push buttons shall be provided with ample contact ratings, suitable cam or block arrangements necessary for the control functions on 230 V AC or 220V DC circuits. The control switches used in mimic diagrams shall be of discrepancy type with built in lamp indication.

Control and Selector switches shall be rotary type with escutcheon plates clearly marked to show the function and positions. The switches shall be of sturdy construction suitable for mounting on panel front.

Switches with shrouding of live parts and sealing of contacts against dust ingress shall be provided.

Circuit breaker control switches shall have three positions and shall be spring return to "NEUTRAL" from "CLOSE" and "TRIP" positions and shall have pistol grip handles. They shall have at least two (2) contacts closing in close position, and two (2) contacts closing in trip position unless specified otherwise.

Ammeter and voltmeter selector switches shall have four stay out position with adequate number of contacts for three phase 4 wire system. These shall have oval handles. Ammeter selector switches shall have make before break type contacts to prevent open circuiting of CT secondaries. Contacts of the switches shall be spring assisted and shall be of suitable material to give a long trouble free service.

3.7.2.10 Push buttons

Push-buttons shall be of spring return, push to actuate type. Their contacts shall be rated to make, continuously carry and break 10A at 230V AC and 0.5A at 220V DC.

All push buttons shall have one normally open and one normally closed contact, unless specified otherwise. The contact faces shall be of silver or silver alloy.

All push buttons shall be provided with integral escutcheon plates marked with its function. The colour of the button shall be as follows:

Green : Breaker Close
Red : Breaker Open
Black : For overload reset

3.7.2.11 Indicating and signaling lamps

Each indicating and signaling lamp shall have a removable cap, which can be inscribed with wording and shall not be affected with the heat of the lamp.

Indicating lamps are preferably of LED type & low watt consumption and shall be replaceable from the front of the panel. The indicating and signaling lamps shall be of the same size and type.

Lamps shall be provided with series resistors, preferably built-in the lamps assembly. The lamps shall have escutcheon plates marked with its function, wherever necessary.

Lamps shall have translucent lamp-covers of the following colours, as warranted by the application.

Red : ACB's/MCCB's close
Green : ACB's/MCCB's open
White : Auto trip
Amber : For all healthy conditions e.g. control supply
Voilet : Circuit breaker spring charged
Blue : For all alarm conditions (e.g. overload) Also for "SERVICE" & "TEST" positions indicators

Indication lamps should be located just above the associated push buttons/control switches. All indicating lamps shall be suitable for continuous operation at 90% to 110% of their rated voltage.

3.7.2.12 HRC Fuses

HRC-Fuses shall have visible operation indicators.

HRC-Fuses shall be mounted on fuses carriers, which are mounted on fuse bases. Wherever it is not possible to mount fuses on carriers, fuses shall be directly mounted on plug-in type of bases. In such cases one set of insulated fuse pulling handles shall be supplied with each switchgear.

HRC-Fuse rating shall be chosen by the tenderer depending upon the circuit requirements.

3.7.2.13 Indicating instruments and Meters

Instruments mounted on panels, shall be of the semi flush type back connected, matching pattern, shape, and of approved finish to present neat and fitting appearance consistent with functional requirements. Mechanical quantity measuring instruments which are directly mounted on equipment shall have circular dials and shall be properly supported and guarded against accidental injury/breakage. These shall be placed in convenient locations.

The instruments shall accurately measure and indicate the quantity under all conditions of operation with minimum instrument errors. Changes in ambient temperature within the range prevailing at site shall not affect the accuracy. Contact making instruments shall have contacts suitable for 240 V AC or 220 V DC circuits.

The reading scales on the dials shall be in metric units only and range shall be such that the normal operating values of the quantities are indicated in the middle 3rd of the scale. The dials pointer etc. shall be designed to facilitate accurate reading by minimizing parallax and glare from instrument window and by providing clear bold dial markings. The size of dial and length of the scales of the indicating instruments shall be large enough to suit the requirements. The scale plates of panel mounted indicating instruments shall have a permanent white mat finish with black graduations and the pointer shall also be of the black colour. Instruments mounted on panels shall be of flush type and shall be back connected. All instruments on a switchgear panel shall be of matching pattern, shape and finish so as to present a pleasing appearance consistent with the functional requirements.

All instruments shall conform to relevant International or national applicable standards. These shall be subjected to tests prior to dispatch. The instruments shall be shock, vibration and moisture proof. The electrical instruments shall withstand dielectric test of 2000 V RMS to ground for one (1) minute as per standards.

The coils of electrical instruments shall be designed for continuous operation at 110% of the full load current at instrument potential. The coil rating of the measuring instruments shall be coordinated with those of the associated instrument transformers (i.e. CTs, PTs, etc.) by the supplier. The VA burden of the instruments shall be as low as possible. The meters shall be of the first grade in respect of accuracy classification.

Energy meter shall be suitable for 3-phase, 4-wire unbalanced system and shall comply generally with the relevant standard. All instruments shall be tested in accordance with the requirements of relevant standards.

3.7.2.14 Integrating instruments

The Wh and VARh meters shall be of the semi-flush-mounted type. Each meter shall be connected to terminal blocks suitable for opening and short-circuiting for testing purposes. The meter cases shall be dust-tight and with removable covers. The meters shall be three-phase, three element, equipped with an impulse contact mechanism, potential free for remote metering purposes, and shall be suitable for continuous operation from secondary of potential transformers and from secondary of current transformers, with transformer ratios and connections indicated on the contract drawings.

The meters shall be provided with primary-rated, direct reading registers, with five or more digits and a suitable multiplier. The meters for the outgoing lines shall be of the two-way type and all meters shall have mechanism to prevent negative registration.

The meters shall have built in over-voltage protection and isolation according to IEC Publication 60521. The tolerance ambient temperature range of the meters shall be 0 to 45 degrees C.

The protection class of the Wh meters shall be 0.2 and the VARh meters 0.2 according to IEC Publication 60687.

3.7.2.15 Measuring converters

The converters shall be suitable for direct connection to the secondary circuits of the potential and current transformers used, or other sensors, each as they apply. The converters shall be static type, having all accessories to provide an output signal of 4-20 mA, filtered DC.

For the measuring converters the following minimum requirements shall be fulfilled:

Current transducers shall be single-phase, of accuracy class 0.5 or better. Voltage transducers shall be single-phase of accuracy class 0.5 or better. W and VAR transducers shall be two elements, three-phase. Accuracy class of the transducers shall be 0.5 or better.

3.7.2.16 Measuring transformers

All current and voltage transformers shall be completely encapsulated cast resin insulated type suitable for continuous operation at the temperature prevailing inside the switchgear enclosure, when the distribution board is operating at its rated condition and the outside ambient temperature is 40 deg.C.

All instrument transformers shall be able to withstand the thermal and mechanical stresses resulting from the maximum short circuit and momentary current ratings of the associated switchgear.

All instrument transformer shall have clear indelible polarity markings. All secondary terminals shall be wired to a separate terminal on an accessible terminal block where star-point formation and earthing shall be done.

All VTs shall have readily accessible HRC current limiting fuses on both primary and secondary sides. The class of insulation should be E or better.

The parameter & rating of CTs & PTs are minimum requirement & tentative only. Contactor shall submit the calculations for selection of CT/PT for approval to purchaser. Potential transformer secondary windings shall be rated 110 / $\sqrt{3}$ V Current transformer secondary windings shall have a rated current of 1A / 5A.

3.7.2.17 Nameplates and Labels

Each major and auxiliary item of equipment shall have a nameplate permanently affixed thereto, or as directed, showing in a legible and durable manner the serial number, name and address of the manufacture, rated capacity, speed, electrical characteristics, and other significant information, as applicable.

The module identification plate shall clearly give the feeder number and feeder designation wherever applicable. For single front switchboards, similar panel and board identification labels shall be provided at the rear also.

All name plates shall be of non rusting metal or 3-ply lamicoid with white engraved lettering on black back-ground, inscriptions and lettering sizes shall be as per their standard practice. Suitable plastic sticker labels shall be provided for easy identification of all equipment, located

inside the panel/module. These labels shall be positioned so as to be clearly visible and shall give the device number, as mentioned in the module wiring drawings.

3.7.2.18 Motors

All electric motors for driving various equipment shall conform to relevant standards viz. IEC, BS or IS as applicable. The motor rating, torque characteristics, speed etc. shall be selected to suit the duty requirements.

Type of starter for motors shall be duly approved by the purchaser during detailed engineering. The detailed design calculation for selection of type of starters is to be submitted for approval. The priority for type of starters shall be in the following order:

1. Variable frequency drive
2. Soft starter
3. Star delta/ auto –transformer
4. Direct on-line starter

The enclosure of each motor shall be of the type best suited for the service conditions of the motor. The motor insulation shall be resistant to moisture, oil or oil vapour and the motors in general shall be so designed as to suit the tropical climate. Varnished cambric or glass insulation class F shall be used for connection from the windings to the terminals.

The terminal box shall be closed conduit box type conveniently located, and shall have means for terminating the external wiring for outdoor use. The motor terminals shall be of the stud type totally enclosed. Eye bolts or lugs shall be provided for lifting.

Space heaters to avoid condensation shall also be provided. Special type of motors, not adequately covered by these specifications, shall be offered for any special application, but these shall be subject to the approval of purchaser.

3.7.2.19 Space heaters

Space heater shall be provided in the Distribution Boards, Control & Protection panels, Motor Control panels etc. The space heaters shall be suitable for continuous operation on 240V AC, 50 HZ single phase supply, and shall be automatically controlled by thermostats. Necessary isolating switches and fuses shall also be provided.

3.7.2.20 Auxiliary relay, contacts and devices

All relays and timers in protective circuits shall be flush mounted on panel front with connections from the inside. They shall have transparent dust tight covers removable from the front. All protective relays shall have a draw out construction for easy replacement from the front. They shall either have built-in test facilities, or shall be provided with necessary test blocks and test switches located immediately below each relay. The auxiliary relays and timers may be furnished in non-draw out cases.

All AC auxiliary relays shall be suitable for operation with VTs and CTs secondaries.

DC auxiliary relays shall be designed for 220V DC unless otherwise specified and shall operate satisfactorily between 80% and 110% of the rated voltage. Relays shall have adequate thermal capacity for continuous operation in circuits in which they are used.

All protective relays and timers shall have at least two potentially free output contacts. Relays shall have contacts as required for protection schemes. Contacts of relays and timers shall be silver faced and shall have a spring action. Adequate number of terminals shall be available on the relay cases for applicable relaying schemes.

Suitable number of auxiliary contacts or auxiliary relays shall be provided with each VCB's / ACB's for indication, remote indication, annunciation and automatic changeover and interlocking scheme.

All protective relays, auxiliary relays and timers shall be provided with hand reset operation indicators (flag) for analysing the cause of operation.

3.7.2.21 Welding & NDT

Preparation of base material

Members to be joined by welding may be cut to shape and size by mechanical means such as shearing, machining, grinding, or by gas or arc cutting, to suit the conditions. Edges shall be shaped according to ASME requirements. Design of welded joints and selection of weld filler metal shall be in accordance with approved standards and shall allow thorough penetration and good fusion of the weld with the base metal. The edges of surfaces to be welded shall be sound metal free of visible defects such as laminations or defects caused by cutting operation at least 30 mm back from the edge of the weld, and free from rust, oil, grease, and other foreign matter.

The establishment of welding procedures, welder's qualifications shall conform to the requirements of the ASME Boiler and Pressure Vessel Code Section VIII and IX. The approved copy of the WPS & WPQR in accordance with the ASME requirements shall be submitted to the purchaser for review and record.

3.7.2.22 Field welding

Filler material required for field-welded joints shall be furnished by the Contractor. The Contractor shall perform all welding work at site in accordance with the applicable WPS. Only qualified welders shall be used for undertaking welding as per the applicable WPS. NDT shall be performed as per the approved drawings.

Preparation for field welding

All cutting, chamfering, and other shaping of metals necessary for the field connection shall be done as far as possible in the shop. Adequate temporary bolted field connections shall be provided to hold the assemblies rigidly and in proper alignment during shop and field assembly.

To ensure proper alignment during field erection, a minimum of two dowels shall be provided for each field connection between subassemblies. The holes shall be drilled and the dowels fitted at shop assembly after the subassemblies have been satisfactorily aligned. All stipulations for welding, structural work and other, shall be applied to fieldwork as well as to shop work, except where otherwise stated.

3.7.2.23 Painting

All the equipment furnished and installed by the Contractor shall be completely painted for final use, with the exception of those parts or surfaces that are expressly designated as unpainted. Surfaces to be painted shall receive the preparatory treatment and required number of coats. The Contractor shall perform all painting work in the shop, before shipment, followed by a final coat of paint at site after installation as per the standard procedure.

All materials, supplies, and articles furnished shall be the standard products of recognized reputable manufacturers. Colour schedule of equipment supplied shall be finalized during detailed design stage.

3.7.2.24 Galvanization

All materials to be galvanized shall be of the full dimensions shown or specified and all punching, cutting, drilling, screw tapping and the removal of burrs shall be completed before the galvanizing process commences. All galvanizing shall be done by the hot dip process with smelter, not less than ninety eight percent (98%) of which must be pure zinc. No alternative process shall be used without the approval of the purchaser. No components shall be galvanized which are likely to come into subsequent contact with oil. Bolts shall be completely galvanized including the threads, but the threads shall be left uncoated in the case of nuts.

The zinc coating shall be uniform, clean, smooth and as free from spangle as possible. In the case of component parts the zinc coating shall weigh not less than 0.6 kg/m² over the area covered and be not less than 0.09mm in thickness. All galvanizing shall comply with the requirements of the relevant ASTM standards/Indian Standards. All galvanized parts shall be protected from injury to the zinc coating due to differential aeration and abrasion during the period of transit, storage and erection. Damaged areas of the coating shall be touched up with an approved zinc dust paint or other approved flake metallic compound.

3.7.2.25 Pumps

All pumps forming part of the generating units and other plant and equipment shall be of high performance requisite type (viz. centrifugal, rotary etc.) and rating, of reputed make, and shall be directly coupled to their driving motors. The pumps shall be of self-priming type and with proper sealing systems and protection.

The materials of construction of pumps in general shall suit the service conditions. The materials of construction of the pumps handling water, such as drainage & dewatering pumps, turbine top cover drainage pumps etc. shall be resistant to abrasive effects of silt in such water. The pumps shall operate quietly without undue noise and vibration in their full operating range of head and flow. They shall be easy to maintain.

3.7.2.26 Embedded parts, Anchor Bolts and Fasteners

All embedded anchor bolts, rods, pipes, welding plates and support plates shall be provided by contractor. Anchor bolts shall consist of a threaded steel rod installed inside a pipe sleeve to provide lateral adjustment after the sleeve is embedded. The threaded end of the rod shall be provided with two steel nuts and two steel washers to permit leveling and anchoring the equipment prior to grouting.

Approved types of expansion or chemical anchors shall be used where practicable for small equipment.

3.7.2.27 Rust Prevention and Protection during Transit:-

Bright steel parts including all machined surfaces shall be given a thick coat of tar or tallow or any other approved rust resisting paint in plain colour to prevent rusting during shipment and transport.

3.7.2.28 Civil Works

Civil foundations for equipment of the generating units and other plant and equipment will be prepared by the Purchaser in accordance with the basic design data to be supplied by the Contractor.

The Contractor shall provide design for foundations and install the concrete inserts/embedment; support steels and/or components for foundation /supports purpose, shall do any chipping / levelling works, denting / painting etc.

3.7.3 Erection, Testing, Commissioning and performance of Guarantee Tests

3.7.3.1 Testing and inspection

Materials used for construction of major & important sub-assemblies shall be thoroughly shop tested and inspected by the Contractor at his own expense prior to dispatch. Shop test shall comprise of routine test & type tests.

The shop tests and inspections shall be as spelt out in individual equipment specifications as dealt in succeeding sections but shall not be limited to the same. Any other tests and inspection not specifically listed but are otherwise considered essential and advisable shall also be conducted.

The Bidders shall furnish schedule of the shop tests and inspections on materials and equipment. Important tests/inspections shall be subject to witness by the purchaser for which the Contractor shall give sufficient advance notice. In case purchaser is unable to witness shop tests/inspections, the Contractor shall be so intimated and the tests/inspections may then be carried out in the absence of the Purchaser.

Equipment on which tests and inspections have been duly witnessed and approved by the Purchaser may be dispatched by the Contractor. Equipment on which tests and inspections have not been witnessed by the purchaser shall be dispatched only after the shop tests and inspection Certificates have been approved by the Purchaser.

3.7.3.2 Dimensional Checks and Visual Inspection

Dimensional checks shall be performed on all major parts, components and partial assemblies, especially when close tolerances and fits are involved (tolerance of shafts, between stationary and moving parts, connecting dimensions for the assembly with other supplies, etc.). If the dimensional checks show discrepancies in measurement, which may affect the fit, assembly or dismantling of the respective part or component, the same have to be corrected correspondingly. Such correction or modification shall, however, in no way lead to sacrifices with respect to reliability of operation or inter-changeability, and shall be performed only after the agreement of the Owner has been obtained. If the correction or modification cannot be carried out in accordance with the terms mentioned above, the part or component concerned may be subject to rejection. Faulty machine parts or equipment shall by no means be delivered.

3.7.3.3 Functional Tests

Functional tests on partial assemblies and/or complete assemblies shall be carried out as much as possible already in the manufacturer's workshops. Such tests shall be performed as far as possible under operation-like conditions.

When requested by the Owner, the functional tests shall be repeated until full proof has been obtained that the functioning of the assemblies will comply with the requirements of the Contract Documents.

3.7.3.4 Erection, commissioning & field tests

The Contractor has to do all the work related to assembly, erection, testing and commissioning complete in all respects. All necessary tools, plants, labour, materials including consumables for performing installation, testing and pre-commissioning shall be provided by the Contractor.

The Contractor shall submit the necessary data/information, layout and foundation/support drawings well in advance. The Contractor shall provide and install the concrete inserts/embedment, support steels and/or components for foundation/supports purpose as per approved erection drawings and coordinate the activities with civil contractors to keep his activities in synchronism with civil work. All installation for foundation shall be verified and accepted by the Engineer.

The Contractor shall use anchor fasteners for installation of piping, fixtures, mountings, conduits, cabling, panels etc. Minor Chipping of concrete is permitted. However, taking support from reinforcement bars shall not be allowed.

3.7.3.5 Installation procedure

The Contractor shall submit six copies of all detailed programs and the procedures to be adopted for erection / installation, testing and commissioning well in advance, before start of erection activities/ installation.

The installation procedure shall also have a section "site quality assurance plan" containing erection data sheets / site protocols for various components. These sheets should specify site measurements/ inspections required to be made for ensuring proper installation.

3.7.3.6 Cable laying

Wiring between equipment enclosures shall be made with cables, laid in trenches and/or cable trays and in cable conduits. The Contractor shall submit for review to the Engineer a cable route layout-showing location of trenches, conduits and trays. All material for cable laying such as cable trays supports and fastening material shall be furnished and placed by the Contractor. Cables shall be properly fastened and marked where they enter enclosures by either cable clamps or nipples.

Cables in horizontal cable trays shall be fastened properly with clamps or plastic strips. Power and control cables shall be placed in separate trays or conduits. Cables shall be clearly marked at each terminal point and appropriate intermediate locations as per Standard.

Conduits shall be of heavy gauge rigid steel, hot-dip galvanized, cut square reamed, threaded and screwed tight at all joints.

Conduit entrances to pull boxes and switches shall have double lock nuts & insulating bushings. No running thread shall be used.

Flexible metallic conduit shall be used for connection to equipment, which are subject to vibration, and also for connection to level/limit/pressure switches.

3.7.3.7 Field inspection

The Contractor shall permit Engineer to perform inspections of the assembly which will include a complete verification of the assembly of all parts as to their levels, clearances, pertinent fits, alignments and quality of workmanship. The field supervisor of the Contractor shall provide Engineer with three (3) copies of all the clearances, tolerances and data of all pertinent fits, alignments and levels, so that the latter may repeat the Contractor's measurement, if desired.

Unless otherwise specified, any rejection based on the inspection will be reported to Contractor within fifteen (15) days.

3.7.3.8 Field tests

All field tests including tests during installation, pre-commissioning, commissioning, performance and field acceptance tests shall be conducted by the Contractor, in the presence of representative of the Employer. Procedure to be adopted for conducting these tests shall be submitted well in advance, before start of relevant testing, for approval of the Employer.

The equipment / system shall be deemed to be commissioned and ready for trial run only after successful operation for a test service period specified in sub clause "Performance Testing". In the event of any failure this period shall be repeated for any number of times till the successful operation as described above is achieved.

All test equipment and instruments shall be furnished by the Contractor and will remain the Contractor's property after the fulfillment of all field tests.

Any defects or leaks disclosed in the tests shall be duly mended/ repaired to meet the desired function and retested. All necessary materials and labour for performing all the above tests shall be provided by the Contractor.

The Contractor shall prepare written test certificates in a form agreed upon by the Contractor and Employer of all tests results and hand them over to the Employer in due time.

The design, location and approval tests of anchoring rings for the fixing of lifting apparatus necessary for assembly and dismantling of equipment and plant accessories shall be the responsibility of the Contractor.

3.7.3.9 Taking over of facilities

Taking over" means that the Facilities (or a specific part thereof where specified) have been completed operationally and structurally and put in a tight and clean condition, and that all work in respect of pre-commissioning of the Facilities or such specific part thereof has been completed and commissioning has been attained as per Technical Specifications. The contractor shall make formal request for taking over the facility to the EIC.

3.7.3.10 Operation acceptance

The operational acceptance by the Employer of the Facilities (or any part of the Facilities where the Contract provides for acceptance of the Facilities in parts), which certifies the Contractor's fulfillment of the Contract in respect of Functional Guarantees of the Facilities (or the relevant part thereof) in accordance with the provisions of Specification.

3.7.3.11 Consumables, oils and Lubricant

The Contractor shall deliver to the Owner all equipment complete with initial fill of fluids, grease or lubricants, transformer oil, Nitrogen, SF6 gas and other used gases in non returnable drums / containers and replace any quantity used up or lost during installation and testing.

The oil used for the lubrication and oil pressure systems for the turbine, governor, shutoff valve and generator shall be preferably of the same type.

Supply

The Contractor shall furnish the following:

- (i) All oil for initial filling of all equipment supplied, plus additional oil equivalent to the first filling requirement of one unit.
- (ii) Grease if required for initial filling of all of the equipment, plus 10% additional.
- (iii) Gases for initial filling of all equipment supplied, plus 10 % additional quantity.
- (iv) Flushing fluids to flush and clean all systems.

3.7.3.12 Deleted:

3.7.3.13 Submission of Drawings, Documents, Manual, software, Calculations, Safety Margin Details etc.

All drawings and documents shall be submitted to purchaser in hard form as well as in editable soft form. Bidder shall submit Ten (10) number hard copies of the documents & drawings to purchaser for reference / review / approval. A comprehensive list of all such drawings/documents planned to be submitted for reference/approval shall be provided beforehand to the purchaser.

Loading drawings

For all larger pieces of Works which, due to their dimensions and/or weight and transport limitations, will require special means for their transportation, the Contractor shall submit binding loading drawings indicating dimensions, weights, etc., of the respective pieces of Works and the necessary trailer for its transportation to the site.

Foundation drawings

If a piece of works requires its own foundation or needs a special area for installation, the contractor shall submit drawings indicating all pertinent dimensions, static and dynamic loads, etc. They shall include all essential details required for proper design and construction of the foundations and/or buildings.

In addition, they shall include openings, sleeves, slopes and the arrangement of any supporting structure, i.e. base-frames or other steel constructions for permanent fixing or erection purposes.

If conduits are to be installed in the foundations, the relevant information such as diameter, length, and purpose shall be indicated on the drawings.

Arrangement drawings

All arrangement drawings shall be drawn to scale. The General Arrangement Drawings shall show the physical arrangement of Works (constructions, machines, complete switchgears, control panels, instrument cubicles, etc.), civil constructions (buildings, rooms, foundations, ducts, etc.) and reserved areas (for pipes, cables, lines, etc.) in relation to each other and to

agreed co-ordinates and boundaries. Such drawings shall be prepared for the whole plot, for separate plots and for each building (building, hall, room, ducts and trenches, etc.).

Outline drawings

The Outline Drawing shall show all elements and the main dimensions of individual components where necessary in plan view, cross-section, side and top views. If reasonably possible such dimensions can be shown on Arrangement Drawings.

Design drawings

The Design Drawings shall include the shop drawings, assembly drawings, erection drawings, piping diagrams and piping arrangement drawings, etc., showing the dimensions, design and data of all constructions, apparatus and Works to be furnished under this Contract. The drawings shall - where applicable - substantially conform to the Contract Drawings and shall show:

- 3-D Assembly drawings for major components in hard and soft form.
- Details of manufacturing and treatment of major single work pieces specially manufactured for this Contract
- Assembly of the Works in plan and elevation with main dimensions Sub-assembly of the principal components of the Works with overall dimensions, adjustment and clearance tolerances, numbers of corresponding detail drawings
- Sub-assemblies in which the Contractor proposes to ship the Works
- All necessary details of the parts connecting to the Works supplied by others
- Location and sizes of auxiliary connections for oil, grease, water, air, electrical power etc.
- Location and size of the instruments and accessories provided
- Methods of lubrication and sealing
- Instructions for heat treatment, pressure tests, surface preparation and anticorrosive protection
- Full details of parts for which adjustment is provided or which are subject to wear
- Method and sequence of installation, field joints, erection and lifting devices, jacks, grout plugs, anchoring details, etc., if not shown on foundation drawings.

Installation drawings

The construction, mechanical, electrical and I & C Installation Drawings shall provide detailed information on the disposition of the various items of a system (e.g. lighting fixtures, socket outlets, connection boxes, transmitters, actuators, loudspeakers, telephones, pipes, valves, pumps, compressors, etc.) and of the piping and wiring respectively included in the installation or assembly. They shall be based on dimension drawings of cubicles, rooms, buildings or areas containing the Works.

Diagrams

Single-line diagrams

This is a simplified diagram of the essential electrical Works and their interconnections. Each circuit shall be represented by a single line only. It shall contain all required technical information of the Works represented, e.g. voltage, current, capacity, short circuit level,

ratios, voltage variations, positive and zero sequence impedances, measuring transformer and protection relay indices, interlocking, kind of switch drive, code designation, etc. as applicable.

Circuit diagrams

The Circuit Diagrams shall show the power circuits in all the phases with the main apparatus as well as the pilot circuits (measuring and control circuits). It shall show in full the functioning of part or all installations, Works or circuits with all required technical details.

Block diagrams

The Block Diagrams shall be used to show in a simplified manner the main inter - relationships between the elements of a system by means of symbols, block symbols and pictures without necessarily showing all the connections. The symbols used for the individual kinds of components, e.g. servomotors, computing modules, etc., shall clearly be explained on the diagram or on an attached legend.

Logic diagrams

The Logic or Functional Diagrams shall be used for representation of logic and sequence controls and interlocking by showing only binary logic elements and their effect on the various process equipment disregarding their electrical realisation. Logic function elements (AND, OR, NOR, NAND, STORAGE, etc.) shall be used for processing and combining binary signals.

Terminal diagrams

Such diagrams shall be prepared for any type of terminal box, marshalling rack, control cubicle, switchboard, etc., and shall show the terminals (properly numbered) and the internal and/or external conductors (wires or cables) connected to them.

The terminal diagram of each individual switchboard, terminal box, panel, etc., shall contain, but not be limited to the following information:

Protection co-ordination diagrams

These diagrams shall show in a graphical manner separately for each power supply circuit:

- A simplified single-line diagram of the circuit with technical data of all instrument transformers and relays
- Co-ordinated tripping curves of related protection devices
- Setting of the protection devices.

Emergency shutdown diagram

This diagram shall show the sequential steps and interdependencies during emergency closure.

Flow Charts

Flow charts shall be used for representing sequence of events for start / stop / shut down of the machine including associated equipment and auxiliaries.

Manuals

The following manuals covering all equipment of EM works shall be supplied as per the time schedule in both editable soft and hard form:-

Sr.No.	Manual Description
1.	Storage and preservation manual
2.	Safety manual
3.	Erection Manual
4.	Testing and commissioning manual
5.	Operation manual
6.	Maintenance manual
7.	Long term storage manual for Generator Transformer
8.	Long term storage manual for boxed up component / equipment.
9.	Repair process / procedure manual for equipment / system

As built drawing to be provided incorporating changes made during erection, testing and commissioning.

Drawing & Document Submission Schedule

Drawings & documents submission schedule of the EM package with the categorization (i.e. Approval / reference) & tentative submission date shall be submitted to purchaser.

Preliminary list of drawings under various categories have been prepared and appended at Section 1 of the Technical Specification.

3.8 DRAWINGS & DOCUMENTS TO BE SUBMITTED BY THE SUCCESSFUL BIDDER AFTER AWARD OF CONTRACT

One set of soft copies of all the approved drawings, documents including as built drawings shall be furnished by the Bidder to the Owner / Consultant in compact discs.

White prints or other non-reproducible drawings can be mailed folded. Blue prints shall generally not be used.

All drawings, prepared by the Bidder shall be as per IS: 696. Supplier's standard drawings are exempted from the above size limitation, unless his "standard" includes drawings of very large size or length. There shall be sufficient reference notes on the drawings to permit identification of all the drawings which are required for a proper understanding.

Bills of material and drawings shall be cross-referenced for easy identification.

All drawings shall be dimensioned in the metric system. Where drawings are usually made in the British (or other) system, they shall also have metric system dimensions in parentheses or below dimension line. Titles and written notations shall be in English. If the original is in another language it shall carry English translation. The translations will appear immediately on the drawings. Attached lists of translated words shall not be accepted.

Drawings and bills of material shall be identified by a numbering system to be mutually agreed later on. Any additional identification numbers or symbols that the Bidder selects to use for his own purposes are permissible so long as Owner's number is the prime means of identification.

The scale of the drawing shall be shown clearly in the title block of the drawing. Wherever possible, scales of drawings shall be:-

1:1	1 : 2.5	1 : 5	1 : 10	1 : 20	1 : 25
1:50	1 : 100	1 : 200	1 : 300	1 : 500	
1: 1000	1 : 2000	1 : 5000			

All reproducible must be made from original drawings.

All revised drawing shall clearly indicate the number, date and subject to each revision. All the revisions carried out in the drawings shall be clearly identified and marked.

Drawing list shall be kept up-to-date, incorporating all new additions, cancellations and changes, and will be reissued periodically with Progress Report.

General arrangement drawings shall be submitted for approval to the Owner/ Consultant prior to the commencement of detail engineering by the Bidder. These drawings shall show to scale all major equipment including electrical equipment and building outlines and overall dimensions as well as tie-in dimensions and clearances shall be clearly indicated. Approved arrangement drawings shall be used as basis for design and preparation of detail drawing to be prepared by the Bidder. The Bidder shall furnish all the necessary drawings, data etc., of the plant/equipment with appropriate "Status" stamp in adequate no. of copies as indicated below:

S. No.	DESCRIPTION	TENDER STAGE	CONTRACT STAGE FOR APPROVAL	FINAL DOCUMENTATION	
			Prints	Prints	CDs
1	Drawings and Data Sheets	1	6	10	-
2	Drawings "As Built "	-	-	10	-
3	Type Test Reports	1	6	10	02
4	Erection Manuals	-	6	10	-
5	Operation and Maintenance Manuals	-	6	10	-
6	Manufacturing Quality Plan	1	6	10	-
7	Field Quality Plan	1	6	10	-
8	Inspection Test Reports	-	-	10	-

All instruction manuals / O&M Manual/"as built drawing": 10 copies each

3.8.1.1 QUALITY ASSURANCE PROGRAMME

The Bidder shall follow Quality Assurance Programme to ensure that the equipment and services under the scope of contract whether manufactured or performed at the Bidder's works or at his sub-vendor's premises or at the SAPDC's site or at any other place of work are in accordance with the technical specifications. Such programme shall be outlined by the Bidder and be submitted along with the bid. The QA programme shall be generally in line with IS/ISO- 9001 and generally cover the following:

- ORGANISATION STRUCTURE FOR THE MANAGEMENT AND IMPLEMENTATION OF THE
- PROPOSED QUALITY ASSURANCE PROGRAMME
- QUALITY SYSTEM MANUAL
- DESIGN CONTROL SYSTEMS
- DOCUMENTATION AND DATA CONTROL SYSTEMS
- QUALIFICATION/EXPERIENCE OF BIDDER'S KEY PERSONNEL.
- PROCEDURE FOR PURCHASE OF MATERIAL, PARTS, COMPONENTS AND SELECTION OF SUB-VENDOR'S SERVICES INCLUDING VENDOR ANALYSIS, SOURCE INSPECTION, INCOMING RAW-MATERIAL INSPECTION, VERIFICATION OF MATERIALS PURCHASED, ETC.
- SYSTEM FOR SHOP MANUFACTURING AND SITE ERECTION CONTROLS INCLUDING PROCESS, FABRICATION AND ASSEMBLY.
- CONTROL OF NON-CONFORMING ITEMS AND SYSTEM FOR CORRECTIVE ACTIONS AND
- RESOLUTION OF DEVIATIONS.
- CONTROL OF CALIBRATION AND TESTING OF MEASURING / TESTING EQUIPMENT.
- SYSTEM FOR QUALITY AUDITS.
- SYSTEM FOR IDENTIFICATION AND APPRAISAL OF INSPECTION STATUS.
- SYSTEM FOR AUTHORISING RELEASE OF MANUFACTURED PRODUCT TO THE PURCHASER.
- SYSTEM FOR TRANSPORTATION /DELIVERY, HANDLING, STORAGE AND PRESERVATION.
- SYSTEM FOR MAINTENANCE OF RECORDS.

GENERAL REQUIREMENTS - QUALITY ASSURANCE

All materials, components and equipment covered under scope and its technical specifications shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme agreed mutually.

Minimum Quality Assurance Test Requirement (QATR) to be followed during Manufacturing and Field erection indicating requirement of various tests / inspections, on major equipment / items, to be carried out as stipulated in technical specification and standards mentioned therein, are attached hereto and are part of bidding documents.

Clarification, if any, on these quality assurance test requirement, raised by bidder shall be discussed and resolved during pre-bid meeting.

After the award of contract, the contractor shall submit the detailed Manufacturing & Field Quality Assurance Plans for complete equipment / material during detailed engineering in the format attached hereto (format of quality plan F-060-02 issue 2.0 rev. 01, Total 1 Page) for

approval and acceptance by SAPDC/Consultant in line with technical specification, Quality Assurance – General & Test Requirements and detailed engineering.

Manufacturing Quality Assurance Plans shall detail out for all the components and equipment & various tests/inspection, to be carried out in conformity with relevant latest IEC/IS/ISO etc, quality practices and procedures to be followed by Contractor's / Subvendor's Quality Control Organization, the relevant reference documents, standards and acceptance norms etc. during all stages of material procurement, manufacture, assembly and final testing / factory acceptance tests.

The Field Quality Assurance Plans shall detail out the various tests/inspection to be carried out in conformity with relevant latest IEC/IS/ISO, quality practices and procedures etc. to be followed by the contractor's / sub-contractor's site Quality Control Organisation during various stages of site activities from receipt of material/equipment at site till final commissioning/ acceptance/handover.

All major items/ equipment/ components to be manufactured in house as well as procured from sub-vendors (Bought out Items, BOI) to be listed in the bid. Bidder shall submit Quality Assurance Plan submission schedule in the bid for above listed items in attached Format (duly filled in the format F-060-05 Issue 2.0 Rev. 00, Total 1 Page) in line with L2 Schedule.

For components / equipment / Bought out Items procured by the contractor for the purpose of the contract, the Contractor's purchase specifications and inquiries shall call for quality plans to be submitted by the sub-vendors.

The quality plans called for from the sub-vendors shall detail out, during the various stages of manufacture and installation, the quality practices and procedures followed by the sub-vendor's quality control organisation, the relevant reference documents/standards used, acceptance level, inspection of documentation raised, etc.

Such quality plans of the successful sub-vendors shall be finalized with the SAPDC/Consultant in line with requirement mentioned above and such approved Quality Plans shall form a part of the purchase order/contract between the contractor and his sub-vendor.

Within three weeks of the release of the purchase orders /contracts for such bought out items /components, a copy of the same without price details but together with the detailed purchase specifications and other related documents such as data sheet, drawings, quality plans and delivery conditions shall be furnished to the SAPDC/Consultant by contractor along with a report of the Purchase Orders placed, on the monthly basis, so far for the contract.

The Quality Plans shall be submitted on electronic media e.g. CD or E-mail in addition to hard copy, for review and approval of SAPDC/Consultant. After approval, the same shall be submitted in compiled form on CD-ROM by contractor.

For all spares, replacement items and additional similar items, the quality requirements/Quality Plans as agreed for the main equipment supply shall be applicable.

All material of construction shall be as per technical specification / approved drawings / GTP.

Contractor's Plant internal standards must be traceable to acceptable International / National standards & salient points of difference (if any) shall be clearly stated with submission of plant standards. The contractor shall furnish copies of reference documents, plant standards, acceptance norms, test and inspection procedure etc. as referred in Quality Plans along with Quality Plan to SAPDC/Consultant. These Quality Plans and reference documents/standards etc. will be subject to approval of SAPDC without which manufacturer shall not proceed. These documents shall form a part of the contract.

Tests on components and sub-assemblies shall be carried out at various stages of manufacturing, till the product undergoes the final tests in conformity with the relevant standards.

The Customer Hold Points (CHPs), identified in approved quality plan, i.e. testing checks which shall be carried out in the presence of the SAPDC, beyond which the work will not proceed without written consent of SAPDC's authorized representative.

The contractor / sub-vendor shall carry out routine test on 100% items at his works. The quantum of check / test for routine and acceptance test by SAPDC/Consultant shall be generally as per criteria / sampling plan defined in referred standards. Wherever standards have not been mentioned, quantum of check / test for routine / acceptance test shall be as agreed during detailed engineering.

The quantum of check when specified in percentage (%) / sampling basis shall be treated as per lot per sub-vendor. When the quantum of check is indicated to in whole no., then same quantum of check shall be applicable to each sub-vendor supplying the same equipment.

For sub-vendors identified during pre-award stage for submission of vendor details/ credentials (category "DR"), contractor shall submit documents in format F-060-01 after placement of award in the manner as specified as under prior to any procurement and within a month after placement of award or a period as agreed at the time of pre-award discussions.

The proposed sub-vendors should be registered vendors of the bidder and must have proven experience for successful operation for similar equipment / items / processes as mentioned elsewhere in technical specification.

Before assigning any portion of work to the sub-vendor, other than one specified and duly accepted in the contract, the contractor will take prior approval of BHEL/SAPDC.

Normally no request for change of sub-vendors or inclusion shall be entertained by SAPDC. But in exceptional circumstances, if the request for change of sub-vendors or inclusion is found reasonable and justified, then the same shall be entertained and the decision of SAPDC in this respect shall be final and binding. The time consumed for the change / inclusion of sub-vendors shall not be excluded from the stipulated time of the completion of the contract. This change shall not relieve the contractor from the responsibility to complete the work within stipulated time in any manner.

The contractor's proposal shall include sub-vendor's facilities established at the respective works, the process capability, process stabilization, Q.C. system followed, experience list etc. along with his own technical evaluation of sub-vendor. (Format F- 060-01 issue 2.0 rev. 01, Supplier / Sub-vendor Assessment Sheet, Total 14 pages).

However, whenever felt necessary, sub-vendor assessment will also be carried out by SAPDC/Consultant in accordance with the above procedure and by factory visits; for existing/proposed vendors/sub-vendors. This approval shall not relieve the contractor from any obligation, duty or responsibility under the contract & SAPDC shall not be responsible for any complications arising between the contractor and his subcontractor(s) / sub-vendor (s) and / or any other liabilities.

SAPDC/Consultant reserves the right to carry out quality audit and quality surveillance of the system and procedures of the contractor / or their sub-vendor. The contractor shall provide all necessary assistance to enable SAPDC/Consultant to carry out such details & surveillance including Quality Manuals, if required by SAPDC/Consultant.

All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirement of ASME section-VIII/IX or other International equivalent standard acceptable to SAPDC/Consultant. All welding/brazing procedures shall be submitted to SAPDC/Consultant/BHEL for review / verification prior to carrying out the welding/brazing. However, wherever required by the SAPDC/Consultant, tests shall be conducted in presence of SAPDC's authorized representative.

All Brazers, Welders and welding operators employed on any part of the contract either in Contractor/his sub-vendor's works or at site or elsewhere shall be qualified as per ASME section-VIII/IX or other equivalent International Standards acceptable to SAPDC/Consultant.

Unless otherwise proven and specifically agreed with SAPDC/Consultant, welding of dissimilar material and high alloy materials shall be carried out at shop only.

All non-destructive examination shall be performed in accordance with written procedures as per International Standards. The NDT operator shall be qualified as per SNT-TC-IA (of the American or Indian Society of non-destructive examination). NDT shall be recorded in a report, which include detail of methods and equipment used, result/evaluation, job data and identification of personnel employed and details of correlation of the test report with the job.

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

Contractor shall submit Field Welding Schedule for field welding activities like field welding location, numbers, welding procedure to be used, requirements, codes and NDT requirement along with all supporting documents, like welding procedures, heat treatment procedures,

NDT procedures, etc. to SAPDC/Consultant for review at least ninety days before schedule start of erection work at site.

Any other statutory requirements as applicable for the equipment / systems shall also be complied with.

The inspection calls (duly filled in the format F-060-06 Issue 2.0 Rev. 00, total 1 Page) shall be placed at least 06 weeks in advance for overseas inspections excluding India and 15 days in advance for inspections within India and Nepal.

Before submitting the inspection call to SAPDC for witnessing the Customer Hold Points (CHP's) and/or requesting SAPDC for issuance of Material Dispatch Clearance Certificate (MDCC) based on Test Certificate (TC) review / Certificate of Conformance (COC), the contractor shall ensure that all Drawings / documents / GTP / technical data sheet, relevant to respective CHP / MDCC requirement, has been duly approved /accepted / noted by SAPDC.

Contractor shall ensure readiness of offered equipment by all means, before raising such call to SAPDC to attend CHP inspections. In case, SAPDC engineer (s) on reaching at a place of inspection found that material is not ready for inspection due to whatsoever reason, the complete inspection expenditure of SAPDC engineer(s) as per actual shall be chargeable to the contractor.

Only calibrated testing & measuring instruments shall be used while performing tests during manufacturing and erection, testing & commissioning at site by the contractor. Copy of the calibration certificates will be submitted to SAPDC/Consultant by the contractor during inspection as an evidence.

Non-conformities observed during manufacturing, shop testing, handling, packaging, transportation, storage, preservation, erection, testing & commissioning are required to be intimated by the contractor (Format for reporting, F-060-04 issue 2.0 rev 01, Total 5 pages). The acceptance/rejection of the non-conformities will be at the discretion of SAPDC.

Repair/rectification procedures to be adopted to make the job acceptable shall be subject to the acceptance of SAPDC. Action taken in accordance with decision of disposal of non-conformity for repair / rework / modification of the item / equipment and to prevent re-occurrence. The corrective and preventive action may involve modification of item / equipment, change in procedure and system etc. to achieve quality improvement at all stages and levels.

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

No material shall be dispatched from the manufacturer's works before the same is duly accepted, subsequent to pre dispatch/final inspection including verification of records of all

previous tests/inspection by SAPDC and duly authorised for Dispatch by issuance of Material Dispatch Clearance Certificate (MDCC).

The test reports of type tests conducted as per contract, in line with requirement stipulated in the technical specification / quality plan should be got accepted from SAPDC/Consultant before final inspection / issuance of MDCC.

All materials used or supplied shall be accompanied by valid and approved material certificates and tests and inspection reports. These certificates and reports shall indicate the heat numbers or other such acceptable identification numbers of the material. The material certified shall also have the identification details stamped on it to ensure physical correlation and traceability of material vis-a-vis test certificate. Such identification no. shall remain same and verifiable for all stages of manufacturing and installation.

3.8.1.2 QA DOCUMENTATION

The contractor shall be required to submit the QA Documentation in two hard copies and two CD ROMs, as identified in respective quality plan.

Each QA Documentation shall have a project specific Cover Sheet bearing name and identification number of equipment including index of its contents with page control on each document. The QA Documentation file shall be progressively completed by the Contractor/sub-vendor to allow regular reviews by all parties during the manufacturing.

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

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

The contractor shall be required to submit copies of the following quality assurance documents in original duly reviewed and accepted by contractor along with the request letter for issuance of MDCC (Material Dispatch Clearance Certificate):

- QUALITY PLAN CHECK LIST.
- MATERIAL MILL TEST REPORTS ON COMPONENTS AS SPECIFIED IN QUALITY PLAN.
- SKETCHES AND DRAWINGS USED FOR INDICATING THE METHOD OF TRACEABILITY OF THE
- RADIOGRAPHS TO THE LOCATION ON THE EQUIPMENT.
- NON-DESTRUCTIVE EXAMINATION RESULTS REPORTS INCLUDING INTERPRETATION REPORTS.
- CALIBRATION CERTIFICATE OF ALL METERS & MEASURING INSTRUMENTS PROPOSED TO
- BE SUPPLIED AS PART OF RELEVANT BILLING BREAKUP ITEM.
- ROUTINE TEST REPORTS FOR TESTING REQUIRED AS PER APPLICABLE CODES AND
- STANDARDS REFERRED IN THE SPECIFICATIONS.
- INSPECTION REPORTS DULY SIGNED BY AUTHORIZED REPRESENTATIVE OF SAPDC AND

- CONTRACTOR FOR THE AGREED CUSTOMER HOLD POINTS.
- ALL THE ACCEPTED DEVIATIONS SHALL BE INCLUDED WITH COMPLETE TECHNICAL DETAILS.
- LIST OF BALANCE POINTS IF ANY.
- CERTIFICATES IN RESPECT OF CALIBRATION, WELDERS & BRAZERS QUALIFICATION ETC.
- COPY OF ALL REFERENCE DRAWINGS AND REFERENCE TECHNICAL DOCUMENTS
- ACCEPTANCE OF TYPE TEST REPORTS BY SAPDC/CONSULTANT.

Similarly, the Contractor shall be required to submit two sets (two hard copies and two CD ROMs), containing QA Documentation pertaining to field activities as per Approved Field Quality Plans and other agreed manuals/procedures, within 2 weeks after commissioning of individual system.

On release of QA Documentation by Inspector, one set of quality document shall be forwarded to Consultant and other set to SAPDC. For the particular case of phased deliveries, the complete quality document to the SAPDC/Consultant shall be issued not later than 3 weeks after the date of the last delivery of equipment.

ASSOCIATED DOCUMENTS / FORMATS

- F-060-01 VENDOR / SUB-VENDOR ASSESSMENT SHEET
- F-060-02 QUALITY PLAN SUBMISSION BY CONTRACTOR.
- F-060-04 NON-CONFORMANCE REPORT (NCR)
- F-060-06 INSPECTION CALL REQUEST.

3.8.1.3 Safety

Safety of personnel

All equipment and services provided under this contract shall abide by international standards commonly accepted in the hydroelectric utility industry for safety of personnel whether involved with operation or maintenance.

Safety of operation

All equipment and services provided under this contract shall abide by commonly accepted standards for safety of operation.

The various system and sub-systems supplied under this contract shall be designed to follow and operate under a clear hierarchical structure:

- Plant control level,
- Unit control level,
- Functional control level, functional drive group level,
- Local drive level.

Each hierarchical control level shall perform its specific tasks and always depend on the subordinate lower control levels. In general, should a higher control level failure occur, the lower control level shall not be affected and shall be able to control the power plant with full safety.

The Contractor shall accordingly build into the "Electrical & Mechanical System" adequate levels of autonomy, independence, redundancy and functional distribution to insure that safety is maintained at all times.

3.8.1.4 Earthing

Earthing terminals for equipment of these specifications shall form part of equipment supplies. The contractor shall connect the earthing conductors to these terminals as required.

Risers from earthing bus shall be in the scope of purchaser. However, extension from these risers to the equipment shall be in the scope of supplier in the Power House, Transformer Hall, Switchyard and Butterfly Valve House.

However, overall earthing arrangement required for HT panel, LT panel, DG set, motor & motor control panels etc. at isolated location such as Dam Site, TRT Outfall area and Surge Shaft either by pit earthing or counter poise etc. shall be in the scope of supplier including civil works, design, material supply (for main earthing risers, interconnection, charcoal, salt, Bentonite etc.), erection, testing & commissioning etc.

A copper ground bus, sized to carry maximum short circuit current, shall run along the entire length of panel structure and shall have terminal connector at each end for connection to station ground grid (50 X 6 mm G.I. flat).

Tests

Each panel shall be completely assembled, wired, adjusted and tested at the factory prior to shipment. The test shall include wiring continuity tests, insulation tests and functional tests to ensure satisfactory operation and control of individual equipment.

Special Cables

Special cables for specific purpose, as required, shall be supplied and installed by the Bidder.

3.8.1.5 Completeness of the specification

Any fittings, accessories, equipment or any other things required for successful commissioning of Arun-III Hydro Electric Project, though may not have been specifically mentioned in the specification but are usually necessary for the completeness of the equipment shall be deemed to be included in the specification and shall be supplied by the contractor without any extra cost to the Employer.

3.8.1.6 Packaging and Shipment

The Contractor shall provide such packing of the Goods as it is required to prevent their damage or deterioration during transit to their final destination as indicated in the Contract. The packing shall be sufficient to withstand, without limitation, rough handling during transit and exposure to extreme temperatures, salt and precipitation during transit and open storage. Packing case size and weights shall take into consideration, where appropriate, the remoteness of the final destination of Goods and the absence of heavy handling facilities at all points in transit.

The packing, marking and documentation within and outside the packages shall comply strictly with such special requirements as shall be expressly provided for in the Contract and, subject to any subsequent instruction ordered by the Employer consistent with the requirements of the Contract.

After unpacking of Goods the packing material shall become the property of Employer

The contractor shall wrap, pack and crate all plant included in the work or part thereof, suitable for shipment to a tropical location, facilitating proper handling and protection from damage in rail, truck, ocean or air shipment as applicable. An approved drying agent, such as Silica Gel, shall be packed in containers or packages holding plant which may be adversely affected by moisture or excessive humidity.

All packing crates shall be clearly marked before shipping to indicate the contract number, shipping address, volume, weight, name, number and unit number of the contents, slinging and weight bearing points.

All plant parts shall be marked to facilitate erection. Each packing crate shall contain a packing list in a waterproof envelope. Parts shall be described and also identified by their numbered marking in the packing list.

Three copies of the packing list shall be forwarded to the purchaser prior to dispatch. The ownership of packaging materials shall be of Employer. All wooden packaging crates and steel support structures shall be dumped to the designated area within 5kms of the power house as per the direction of Engineer in charge.

The supplier shall be entirely responsible for the insurance, shipment, handling and transportation.

The equipment shall not be dispatched by the Bidder from the place of manufacture to the site until the dispatch instructions are issued by the Owner.

3.8.1.7 PACKAGING, HANDLING AND SITE STORAGE

The Contractor shall pack all the consignment in sea worthy packaging strong enough to withstand rough handling during transit. Machine surface shall be suitably protected against scratches, corrosion, shocks, impact etc. Packages shall be suitably and distinctly identified for type of handling and kind of storage.

Electronic equipment shall be packaged, shipped and stored in anti-static packing. All packages shall be stored indoor. Packages containing electronic equipment shall be stored in humidity controlled environment.

The Bidder shall indicate the number of packages of consignment together with the size (L x W x H) and weight for transporting the equipment in the Bidding Document.

3.9 SPECIAL INSTRUCTIONS TO BIDDERS

General

The Bidder shall base the equipment design on the information given in this specification. The equipment shall be complete in all respects. Any item which is not specifically mentioned herein but found essential for safe and efficient operation and maintenance and satisfactory performance of the system shall be deemed to have been included in the scope of the Bidder. It shall be presumed that the Bidder has studied the site, all the drawings, tender documents and is fully aware of the scope of work involved and the site conditions prevailing.

3.10 Codes and Standards

- a) All equipment, systems and works covered under this specification shall comply, in all respect, with requirements of applicable latest statutes and that of latest editions of codes and standards. Latest regulations and safety & environmental requirements as applicable in India / state of installation shall also be complied with.
- b) All codes and standards mentioned shall mean as relevant and applicable to a particular equipment / system.
- c) All other codes/standards not covered in Section 1 / Section 2 but required for the plant and system offered shall also be referred / followed by the Bidder. The Bidder, along with the bid, shall submit a comprehensive list of codes and standards to be followed for various equipment / system.
- d) In all cases where IBR does not govern, German, American, British, ISO or other international standards established to be equivalent or superior to the codes specified are also acceptable. In the event of any conflict between the requirements of equivalent codes and standards and the requirements of Indian standards / regulations, the latter will govern unless specified otherwise in the specifications.
- e) The Bidder shall be responsible to be in possession of all the specified Codes / Standards and ensure reference to the same before submitting the offer/ bid.
- f) Mandatory codes / local regulations to be followed for safety, design, fabrication and operation of the switchyard shall be, followed:
- g) If the equipment supplied does not conform to the codes and standards mentioned in this specification, but is manufactured to the Bidder's own standard, developed as a result of his experience, is also acceptable provided the same is found to be superior to the above mentioned codes and standards. The Bidder shall identify such equipment and shall also present sufficient data to the Owner / Consultant to support his design and to establish the superiority. The design may be accepted by Owner/ his Consultants only if the Purchase / his consultant is satisfied that sufficient experience exists with the design proposed.

- h) Design not meeting the stipulations of the codes and standards will not be acceptable.
- i) Apart from various codes and standards mentioned in Section 1/2, the Manufacturer shall comply with other requirements of codes and standards mentioned in this Specification for detailed design, manufacture, testing, erection, construction etc.

Control System	IEEE – 122 , 1992
Metering / Dosing pumps	API 675 – 1987 (Positive displacement pumps – controlled volume) API 676 – 1987 (Positive displacement pumps – Rotary).
Centrifugal pumps	API 610 – 1990, ASME PTC 8.2 – 1965
Gear Box	API 613 – 1993 & AGMA 420 & 421
Coupling	API 671 – 1993
Structural	IS 1893 – 1991, IS 875-1992 & IS 800 – 1991
Pressure Vessel	ASME Sec. VIII, Div. 1 – 1995
Piping	ANSI B 31.1-1995 / 31.3 – 1993, IBR
Valve	API
Instrument	ISA, API
Electrical	As per specification attached & relevant
	IS/IEC
Tanks	API 650- 1993
Electrodes	AWS, IS
Painting	IS Standards
Performances Tests	
Overload test of crane and hoists	IS 3177

3.11 Deviations and Assumptions

Bidders requested to carefully examine and understand the specifications and seek clarifications, if required, to ensure that they have understood the specifications. The Bidder's offer should not carry any sections like clarifications, interpretations and/or assumptions. In the event of conflict between the Technical Specifications and the condition of contract, the requirements as indicated in the technical specification shall govern, unless confirmed otherwise by the Owner in writing before the award of contract, based on written request from the bidder for such a clarification.

In the event of conflict between requirements of any two clauses of the specification documents, the more stringent requirements shall apply, unless otherwise confirmed by the Owner in writing before the award of this contract, based on a written request from the Bidder for such clarification.

The Bidders are advised that while making their Bid Proposals and quoting prices, all terms and conditions of bidding documents may appropriately be taken into consideration. Bidders are required to furnish a certificate indicating their full compliance to the terms and conditions of the bidding documents.

3.12 Limit of Contract

Equipment furnished shall be complete in all respect with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/ or needed for erection, completion and safe operation of the equipment as required by applicable codes though they may not have been specifically detailed in the respective specifications, unless included in the list of exclusions. All similar standard components/ parts of similar standard equipment provided shall be interchangeable with one another.

This review by the Owner's Engineer / Consultant may not indicate a thorough review of all dimensions, quantities and details of the equipment, materials, any devices or items indicative of the accuracy of the information submitted. This review and/ or approval by the Engineer shall not be construed by the Bidder, as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements specified under these specifications and documents.

3.13 Latent Defects

Notwithstanding the issue of the Take Over Certificate, the Contractor shall be responsible for making good with all possible speed any Latent Defect in any Works /equipment of the plant which appears at any time before the expiry of defect liability period. And shall remedy such defect at its own cost and expense. The latent defect liability period shall be a minimum of 5 years from the end of defect liability period. The defects to which this applies are defects in design, materials or workmanship or defects arising from any act or omission of the Contractor done or omitted prior to Take-over of the portion of the Plant affected by the defects or during the Warranty Period which a reasonable examination at the end of the Warranty Period would not have disclosed.

3.14 Defect Liability

The Contractor warrants that all the facilities or any part thereof are new, unused, and of the most recent or current models, and that they incorporate all recent improvements in design and materials, unless provided otherwise in the Contract.

The Contractor further warrants that the Plant and equipment shall be free from defects arising from any act or omission of the Contractor or arising from design, materials, and workmanship, under normal use in the conditions prevailing in the

If during the Defect Liability Period any defect should be found in the design, engineering, materials and workmanship of the Plant and equipment supplied or part thereof, the Contractor shall promptly, in consultation and agreement with the Employer regarding appropriate remedying of the defects, and at its cost, repair, replace or otherwise make good (as the Contractor shall, at its discretion, determine) such defect as well as any damage to the Facilities caused by such defect. The Contractor shall not be responsible for the repair,

replacement or making good of any defect or of any damage to the Facilities arising out of or resulting from any of the following causes:

- (a) Improper operation or maintenance of the Plant and equipment by the Employer
- (b) Operation of the Facilities outside specifications provided in the Contract
- (c) Normal wear and tear.

3.15 Completion Schedule

The Bidder shall submit Time Bar chart indicating completion date of major activities such as submission of design data / calculations and drawings for approval, manufacturing of components / units, supply, inspection etc. without which the Tender shall not be considered. Time Bar Chart furnished shall afterwards form part of the contract and cannot be altered arbitrarily except Force Majeure conditions as may be agreed with the Owner.

3.16 Drawings & Documents for Owner's use and Archives

The Bidder shall submit all final drawings, documents, manuals for Owner's use and for reference / record required during course of operation and maintenance of the plant. Numbers of copies and their form (hard copy, electronic form, reproducible) to be submitted and the details of the documents, drawings, manual etc. to be furnished by the Bidder are described elsewhere in the specification.

Drawings, documents, calculation, data & Information to be submitted by the Bidder along with the offer:

Technical Data to be submitted with the Tender

- 1) List of performance tests proposed by the Bidder to demonstrate the guaranteed parameters for generator and other electrical equipment.
- 2) Specific energy consumption.
- 3) Type test certificates for major categories of equipment, issued by independent testing authority.
- 4) Guaranteed Technical Parameters.
- 5) Technical catalogues.
- 6) Manufacturing Quality Plan

Operation & Maintenance Manuals

Instruction manuals, presenting the basic categories of information for the operating and/or maintenance personnel, as detailed herein below shall be furnished by Bidder. The instruction manuals shall present the following basic categories of information in particular complete and comprehensive manner and prepared for the use by operating and/or maintenance personnel.

- i. Instructions for initial commissioning, short duration and long duration shut down.
- ii. Instruction for operation, routine inspection and maintenance including preventive maintenance.

- iii. Recommendation for inspection points, method of inspection and period of inspection.
- iv. Information on detection, cause and rectification of troubles and faults.
- v. Instructions on normal repairs and overhaul.
- vi. Complete parts list with proper and complete identification (Tag nos./Serial nos. as shown in the respective approved drawings) and ordering information for all replaceable parts. The identification details of equivalent and alternative makes for these spare parts which are not manufacturer's own product shall also be listed.
- vii. List of all special tools and tackle & spares and instructions for use of such tools and tackle & spares.
- viii. One complete set of as built drawings of the entire systems.
- ix. The information shall be organized in a logical and orderly sequence. A general description of equipment including significant technical characteristics shall be included to familiarize operating and maintenance personnel with the equipment. Such description and technical characteristics shall not differ from the approved data.
- x. Necessary drawings, curves and other illustrations shall be included or copies of appropriate approved drawings shall be bound in the manuals. Tests, adjustment and calibration information, as appropriate, shall be included. Safety and other warning notices and installation, maintenance and operating cautions shall be emphasized.
- xi. Write-up, figures, part list etc., shall be clearly legible. The manuals shall be prepared on good quality paper securely bound in durable folders.
- xii. The instruction manuals shall be subject to Consultant's approval in the same fashion as that for drawings.
- xiii. Instruction manual shall give step by step procedure for Erection, testing and commissioning
- xiv. Operation, Maintenance and Repair Instruction manual shall also contain:
- xv. List of spare parts with ordering specifications and manufacturer's catalogues
- xvi. List of consumables, lubricants, chemicals with specifications, brand names and annual consumption figures.
- xvii. Drawings relevant for erection, operation, maintenance and repair of the equipment.
- xviii. Procedure for ordering spares.
- xix. Maintenance Manual shall also include:
- xx. Diagnostic trouble shooting / fault location charts
- xxi. Tests for checking of proper functioning.

Drawings / documents for approval

Quality Control & Quality Assurance plan.

G.A. and Cross Sectional drawings of all equipment indicating weights, material of construction, bill of material, dimension, specification etc.

Final design calculations and assumptions.

Actual performance data and characteristic curves based on the testing at site.

Technical specification of all equipment, motors, for all system and all other accessories.

Final list of drawings.

As built drawings.

Miscellaneous

- i. General arrangement and cross sectional drawings of all major components with bill of material.
- ii. Foundation drawings, load data & design calculation for all equipment.
- iii. Erection drawings for all equipment and structures showing complete erection details.
- iv. Engineering and design calculations of installations and units.
- v. QAPs
- vi. Detailed procedures of shop testing of all the items applicable shall be submitted to the Owner/ Consultant for approval before conducting tests.
- vii. Following shop test certificates/test curves/data, shall be furnished.
 - Materials and components test certificates.
 - Performance test results and characteristic curves of all fans, pumps, and electric drive motors etc.
 - Non-destructive test results as applicable.
 - Reports and test certificates of shop tests.
 - Type test & routine test certificates.
- viii. Detailed quality assurance program along with quality plan shall be submitted.

Following data shall be furnished:-

- a) Technical data of all the plant, equipment, drive motors, instruments, panels, etc. shall be furnished.
- b) Following lists/tables / write ups shall be furnished, complete with tag nos. and brief specification. Proper numbering system as approved by Consultant/Owner shall be adopted.
 - i) Instrument schedule (with service, range, make of instrument).
 - ii) Flow element schedule.
 - iii) Valve schedule.
 - iv) Pipe schedule.
 - v) Cable schedule (Power & Control).
 - vi) Schedule of actuators (electric/pneumatic)

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.

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.

3.17 Workmanship and Quality Control

All moving parts of equipment, which can conceivably cause injury to the operator and otherwise authorized personnel within the vicinity of working area shall be suitably guarded and warning displays shall be put at prominent places.

The Bidder shall clearly indicate and identify the plans and procedures, which shall be followed in the design, manufacture and installation of plant and equipment to control and assure to the Owner of the desired quality.

FUNGI STATIC VARNISH

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

3.17.1 Equipment Mounting

All instruments, switches etc. mounted on the front face of the panels shall be of flush type.

All equipment shall be so mounted that removal and replacement may be accomplished individually without interruption of service to others.

All equipment inside the panel shall be so located that their terminals and adjustments are readily accessible for inspection and maintenance. Adequate ventilation shall be provided in enclosed panel.

Each of the LV switchboards shall be designed for 1.1 times the required rating as a spare capacity. Further all LV Switchboard shall be provided with 20 % spare modules of each rating and type of module.

3.18 Title Block :

Project	4x225MW Arun-3 (HEP),Nepal			
Customer	SJVN Arun-3 Power Development Company (P) Ltd. (SAPDC)			
Consultant	 SJVN Ltd			
	BHARAT HEAVY ELECTRICALS LTD. TRANSMISSION BUSINESS GROUP NOIDA		Na me	Sign
		Drawn		
		Checked		
		Approved		
Title	Drawing Number :			Rev

-----XXXX-----

Section – 4

GTP Format

GAS INSULATED SWITCHGEAR

ANNEXURE-12A- (GIS)

SCHEDULE OF GTPs and OTHER TECHNICAL PARTICULARS

1. GENERAL

Sl.No.	Description	Unit
1.	Name of manufacturer	
2.	Place of manufacturer	
3.	Manufacturer's type designation/Model	
4.	Rated voltage	
5.	System frequency	
6.	Maximum (Continuous) service rated voltage	
7.	Normal Current Rating	
a)	Under normal condition	Amp.
b)	Under fault condition	Amp.
8.	Short Time Current Rating	
a)	1 sec. rms	KA
b)	3 sec. rms.	KA
1.	BIL of the SF6 switchgear (KV Peak)	
2.	Switching surge (kV Peak)	
3.	Maximum temperature rise over	°C ambient
4.	Altitude upto which the switchgear shall operate satisfactorily	
5.	Ambient conditions of the operation of the GIS	
6.	Earthing details of enclosure.	
7.	Density and pressure of gas in various compartments of the Enclosure.	

8. Please explain the features adopted for preventing burn through in the various enclosures of SF6 GIS
9. What is the guaranteed life time of the GIS?
10. Guaranteed number of loaded/unloaded operation of various equipment of SF6 GIS i.e. GIS Circuit Breaker, disconnects, earthing switches etc. (Please mention item wise)
11.
 - a) Is the equipment supplied leak proof? If no, the average leakage and percentage per year.
 - b) Quantity of SF6 gas required to completely charge the 3-pole equipment including any tank storage system(kg.)
 - c) Operating pressure, Kg/cm2
12. Detail the feature existing in the equipment to carry out P.D. measurements at works/site.
13. Please state the control wiring features alongwith details of all control wiring used in the equipment.
14. Methods adopted to limit switching surges for breaker and disconnectors.
15. Values of maximum switching surges generated?
16. Please specify the noise level.
17. Material Used In Fabricating (Copper, Aluminium, Silver, etc.)
 - a) Breaker main contact surface
 - b) Disconnecting switch contact surfaces.
 - c) Grounding switch contact surfaces.
 - d) Internal bus.
 - e) Internal bus contact surfaces.
 - f) Bus enclosure.
 - g) Terminal pads.
 - h) Terminal pad contact surface
18. **Operating System**
 - a) Breaker
 - b) Disconnecting switch
 - c) Quick acting grounding switch
 - d) Slow acting grounding switch

19. Time required to recharge the operating system to a fully charged condition after four successive operations. (without compressor or pump action), minutes:
20. Capacitance per metre of the enclosed bus in pico Farads/metre.
21. Surge impedance in ohms of the enclosed bus (Please describe the methods of calculations used to determine surge impedance and capacitance of insulated bus).
22. Electric Resistance At 30⁰/45⁰C in Ohms/Meter.
 - a) Bus enclosure.
 - b) Internal bus.
23. **Dimensions**
 - a) Bus enclosure outside diameter (mm)
 - b) Bus enclosure wall thickness (mm)
 - c) Internal bus, outside diameter (mm)
 - d) Internal bus thickness (mm)

II. TECHNICAL

Sl.No.	Description	Unit
--------	-------------	------

A)CIRCUIT BREAKER

1. Name plate data

- manufacturer
- type designation
- rated frequency
- rated voltage
- rated interrupting current
- number of poles
- class (Indoors)

Hz
kV
kA

Breaking Capacity

- i) KA
- ii) MVA (Symmetrical).

Making Capacity

Make time

2. Operating Voltages

- maximum operating voltage kV
- minimum operating voltage kV
- range factor

3. Current ratings

- rated continuous current A
- rated interrupting current for 1s, kA
- rated symmetrical interrupting current kA
- rated asymmetrical interrupting current kA
- percentage D.C. components
- rated making current, kA(peak)

4. Rated Insulation level

- a) Dry 1 minute power frequency withstand voltage:
- to earth kV (rms)
 - across open contacts kV (rms)
- b) 1.2/50 full wave microsecond lightning impulse with stand voltage.
- I) To ground
- II) Across the open contact
- c) 250/2, 500 microsecond switching impulse withstand voltage kV(peak)
- d) Line to ground power frequency withstand voltage at gas pressure equivalent to atmospheric pressure. KV
- e) Minimum external creepage distance phase to ground mm
- f) Minimum allowable moisture content in interrupting medium ppm
- g) Total Break time ms
- i) At 10% rated interrupting capacity ms
 - ii) At 60% rated interrupting capacity ms
 - iii) At rated interrupting capacity ms
5. Maximum temperature rise above ambient at rated load and voltage:
- Contacts °C
 - Hottest part °C

6. Operating data

- rated duty cycle
- reclosing duty cycle
- permissible tripping delay ms
- maximum arc duration at 10% rated breaking current ms
 - 30% -do- ms
 - 60% -do- ms
 - 100% -do- ms
- Closing time ms
- Total Break Time ms
- a) 10% rated breaking current ms
- b) 30% rated breaking current ms
- c) 60% rated breaking current ms
- d) 100% rated breaking current ms
- e) Arc duration from separation of arc contact to instant of arc extinction for full rated interrupting capacity ms
- Length of arc at
 - a) 10% rated breaking current mm
 - b) 30% rated breaking current mm
 - c) 60% rated breaking current mm
 - d) 100% rated breaking current mm
 - e) Max. length of arc lowest fault current mm
- Longest time to interrupt current less than 25 percent of rated symmetrical short circuit current from Energizing trip circuit. ms
- Minimum time from arc extinction to contact remake for auto-reclosing.
- minimum dead time for;
 - a) 3 phase reclosing
 - b) 1 phase reclosing
- 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
- 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 TRRV without changing any parts.

a) recovery voltage - rate of rise at ;

- rated symmetrical interrupting current kV/ms
- 60 percent of rated symmetrical interrupting current kV/ms
- 30 percent of rated symmetrical interrupting current kV/ms
- 10 percent of rated symmetrical interrupting current kV/ms

b) Amplitude factor

c) Phase factor

d) Natural frequency (Hz)

- Devices used for controlling RRRV
- Devices used for uniform voltage distribution
- Distribution of voltage across breaks.
- Switching resistors
- Preinsertion (on closing) ohm
- Preinsertion time ms
- Tripping ohm

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:

- tripping
- closing
- number of closing/opening coils to be used.

8. (a) Air supply for mechanical operation (applicable to breakers with operating mechanism). pneumatic

- Compressor motor hp, voltage/phase and quantity of motors
- Storage air receiver pressure, Kg./cm²
- Minimum air pressure required for successive interruption
- At breaker rating Kg/cm².
- number of stored close-open operations.
- Quantity of air required for one close-open operation.

(b) Hydraulic fluid supply for mechanical operation (applicable to breakers with hydraulic operating mechanism)

Bid Document for EM Works of AHEP (4x225) 900MW No. SJVN/ECD/SAPDC/AHEP/EM/17	Section-VII (Attachments)	Page 120 of 258
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- pump, motor, hp, voltage/phase and quantity of motors
- storage compartment pressure, Kg/cm²
- minimum oil pressure required for successful interruption
- breaker rating, Kg/cm²
- No. of stored close-open operation without pumps operation
- Quantity of oil required for one close open operation

9. SF6 gas system:

- normal operating pressure Kg/Sq.m
- normal operating density g/cc
- wt. Of gas per breaker kg
- lockout pressure kg/sq.m
- 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 or puffer
- quantity of compressed gas for puffer action
- total volume of SF6 gas required per circuit breaker
- at operating pressure.

10. Control Power Requirement:

- Tripping (3 poles) current at rated supply voltage (220 V D.C.) A
- Tripping (3-poles) current at 70% of supply voltage (220 V D.C.) A
- Closing (3-poles) current at rated supply Voltage (220 V.D.C.) A
- Closing (3-poles) current at 85% of supply voltage (220 V.D.C.) A
- tripping voltage, range, percent
- closing voltage, range, percent

11. Heaters

- connected continuously A
- connected by thermostat W

12. Noise performance (circuit breaker operation)

- measurement standard
- noise level db
- distance m

13. Interrupters

- type of main contact, arcing contact & aux. Contacts
- material of main contact/arcing contacts, silver

Bid Document for EM Works of AHEP (4x225) 900MW No. SJVN/ECD/SAPDC/AHEP/EM/17	Section-VII (Attachments)	Page 121 of 258
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- coated or not.
 - contact pressure kg/mm.
 - Number of interrupters per pole
 - Break length of an interrupter
 - Length of contact travel
 - Rate of contact travel at tripping
 - Rate of contact travel at closing
- mm
mm
m/sec
m/sec
14. First pole to clear factor
 15. Whether fixed trip or trip free
 16. Details of Anti pumping device.
 17. Rated line-charging breaking current. A
 18. Rated single capacitor bank breaking current. A
 19. rated small inductive breaking current A
 20. Rated characteristics for short line fault
 21. a) Rated transient recovery voltage for terminal faults.
b) Parameters as per IEC
 22. Rated value of phase making current kA(rms)
 23. Max. Interrupting capacity under phase opposition conditions
 24. Capacity for interrupting in-rush current of transformer
 25. Max. over voltage factor of the circuit breaker when switching off:
 - a) unloaded transformer
 - b) loaded transformer
 - c) open circuited lines
 - d) synchronous system
 26. Details of operating counter
 27. No. of auxiliary contacts their continuous rating and breaking capacities, including those used for circuit breaker operation and interlocking.
 - i) Those closed when breaker is closed
 - ii) those open when breaker is open
 - iii) those adjustable w.r.t. the position of main contacts
 28. Partial discharge level pico-coulombs
 29. Radio interference level microvolt

30. Corona extinction voltage kV(rms)
31. Maximum impact loading on foundation during breaker opening and closing operations under fault conditions kg.
32. Seismic withstand value (Horizontal and vertical)
33. Tests to be conducted by the supplier at work and site. (Please give all details).
- a) type tests
- b) Routine tests
34. Overall dimensions (LxBxH),m
35. Weight of breaker complete with operating mechanism, bushing, frame work: kg.
- c) with SF6 gas
- d) without SF6 gas
36. Descriptive bulletins and drawings of the circuit breakers giving general details of construction.
37. Out of phase switching capability of the circuit breaker.
38. Please specify the suitability of the circuit breaker for restrike free operation of shunt reactor and power transformer carrying full load current.
39. What provision exists on the circuit breaker for uprating the capacity at a later time? Please mention details alongwith uprated capacities.
40. What are the guaranteed time difference between the first pole and last pole operation timing in m/sec.
41. Please describe the standard accessories to be supplied alongwith the breaker.
42. Has a copy of control scheme of circuit breaker attached alongwith the offer?
43. Please explain in detail, provision existing on GIS to reduce H.V. transients to acceptable values.
44. What are the guaranteed degraded values of B.I.L. Switching surges and 50 Hz rated values during the Life of equipment? Please supply test data to support this guarantee.

B) GIB BUS DUCT

S.No.	Description	Unit
1.	Manufacturer/Designing Firm	
2.	Type designation	
3.	Location of Manufacturing Plant	
4.	Nominal Voltage Class	kV
5.	Rated maximum voltage	kV
6.	Rated frequency	Hz
7.	1 minute power frequency kV rms	
-	250/2, 500 sec. Switching	kV
-	1.2/50 micro sec.	kV
8.	Rated short circuit current (1 second)	kA
9.	Maximum permissible operating temperature of current carrying parts.	°C
10.	Temperature rise of current carrying parts above _____ °C ambient	°C
11.	Maximum safe continuous current that can be carried with ambient temperatures of:	
-	20°C in open air	A
-	30°C in open air	A
-	40°C in open air	A
12.	The consideration or component which limits the current rating:	
13.	SF6 pressure (absolute value)	
-	Normal at 20°C	Bar
-	"Refill" level	Bar
-	"Zone trip" level	Bar
14.	Maximum permissible moisture content of SF6 gas	
-	at the time of filling	ppm/vol
-	service limit	ppm/vol
15.	Guaranteed maximum SF6 gas leakage per year.	
-	complete bus duct	%
-	smallest compartment	%
16.	Temperature rise of enclosure at rated current (above _____ °C ambient)	

- Outdoor	°C
17. Capacitance per meter/phase	pf/m
18. Resistance	micro-ohm/m
19. Inductance	micro-henries/m
20. Surge Impedance	ohms
21. Grounding	
Maximum potential rise of enclosure at _____ KA sym:	V
22. Over pressure relief diaphragm	
- material	
- operating pressure	bar
23. Maximum power losses per single phase meter at rated voltage and current in: (at 40 deg.C ambient) As per IEEE (37.23-989)	
- enclosure	W
- conductor	W
- total	W
24. Total weight of SF6 gas in the largest compartment	Kg.
25. Average weight per single phase meter length (including SF6 gas)	Kg.
26. Maximum span between bus duct supports	m
27. Maximum unsupported conductor span	m
28. Allowable deviation in support height	mm
29. Insulator material	
30. Conductor material	
31. Conductor wall thickness	mm
32. Conductor outside diameter	mm
33. Enclosure material & its shape	
34. Enclosure thickness	mm
35. Enclosure inner diameter	mm

36. Elbow wall thickness mm
37. Elbow inner diameter mm
38. Maximum length of single phase gas compartment between two close barriers shall be 3m (yes/no)
39. Describe the sliding contact design.
- Material of contact
 - Is plating used? State material.
40. How is bonding between metallic parts of insulators, etc. performed?
- Where spring loaded electrical connections are
Employed to bond a floating internal metallic part,
The following information is required.
- Spring contact arrangement is shown in the attached
 - Drawing nos.
 - State materials used in sliding surfaces
 - The spring pressure
 - Number of mechanical tests carried out.
 - Extent of service experience.
41. Is the enclosure bolted or welded?
42. Describe method of particle control employed
43. Are double O-ring seals employed between the sections?
44. Are bus duct lengths shipped with conductor and insulators, factory assembled?
45. Description of technique used to control thermal expansion in:
- conductor
 - enclosure
46. Which type of bus duct (field weld type/flanged type) is being offered?
47. Shape and cross sectional area of conductor mm²
48. Current density A
49. Standard length of each unit m

50. Distance between phases center to center	mm
51. Details of flexible joints	
52. Details of termination at transformer end	
53. Silver coating at joint-thickness and length	
54. Enclosure burn through time at rated short circuit current	Sec.
55. Enclosure design pressure	kg/cm ²
56. Enclosure rupturing pressure	kg/cm ²
57. Barrier insulator rupturing pressure	kg/cm ²
58. Maximum movements due to expansion, and/or contraction	
59. Lateral	mm
60. Longitudinal	mm
61. Maximum forces at interface tensile, Compressive	kg. kg.
62. tolerance on positioning of flanges	mm
63. Maximum permissible differential settlements (vertical) due to settlement of foundations	
64. Arrangement of earthing	
65. Minimum creepage distance over insulator	
67. Conductor treatment (Ventilation, painting)	

C) SF6-TO-AIR BUSHING

Sl.No.	Description	unit
1.	Manufacturer	
2.	Location of Manufacturing Plant	
3.	Material	
4.	Rated voltage	kV
5.	Rated continuous current	A

- | | |
|---|----------|
| 6. Rated short-time current for 1 second | kA |
| 7. Rated insulation level | |
| - dry and wet power frequency with stand voltage | kV (rms) |
| - 1.2/50 microsecond lightning impulse withstand voltage | kV(peak) |
| - 250/2,500 microsecond switching impulse withstand voltage. | kV(peak) |
| 8. Corona extinction voltage | kV (rms) |
| 9. Rated BIL (Crest) | kV |
| 10. Rated power frequency withstand voltage | kV rms |
| 11. External Strike Distance: | |
| Phase-to-ground | mm |
| Phase-to-phase | mm |
| 12. External creep distance | mm |
| 13. Cantilever strength | Nm |
| 14. Acceptable terminal load | N |
| 15. Colour of porcelain/composite material | |
| 16. Weight | Kg |
| 17. Explain how the dielectric stress is controlled at the top and at the bottom: | |
| 18. Partial discharge level, pico-coulomb | |
| 19. Radio interference level, microvolt | |
| 20. Has equipment been type tested and to which standards? | |

D) DISCONNECTS/GROUNDING SWITCHES

C.I. Isolator Switches

Sr.No.	Description	Unit
1.	Manufacturer	
2.	Type & Designation	
3.	Rated voltage	(kV)
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4. 1.2/50 microsecond lightning impulse withstand voltage kV (peak)
- Between line terminals and ground
 - Between terminals with disconnecting switch in Open position.
- 250/2,500 microsecond switching impulse withstand voltage kV (peak)
- Between line terminals and ground
 - Between terminals with disconnecting switch in Open position.
5. Dry 1 minute Power Frequency withstand voltage kV (RMS)
- i) Between terminals and ground.
 - ii) Between terminals with disconnecting switch in open position
6. Rated frequency Hz
7. Rated normal current A
8. Rated peak short circuit current KA
9. Rated Short Time Current KA (Peak)
- i) 1 sec.
 - ii) 3 sec.
10. Rated peak withstand current KA (peak)
11. Rated inductive breaking current A
12. TRV caused by breaking/making inductive current KV
13. Rated capacitive breaking current A
14. TRV caused by breaking /making capacitive current KV
15. Rated insulation level
- 1-minute power frequency withstand voltage kV (rms)
 - 1.2/50 microsecond lightning impulse withstand voltage kV (peak)
 - 250/2,500 microsecond switching impulse withstand voltage kV(peak)
16. Maximum temperature rise above ambient at rated current
- contacts °C
 - hottest part °C

17. Motor operating mechanism

- closing current A
- opening current A
- closing time S
- opening time S
- operating voltage and range V

18. Design data

- type of contacts
- contact pressure
- surface treatment and thickness of surface coating/silver electrolytic plating.
- overtravel distance after contact made mm
- distance between fully open contact
- current density at the minimum cross section of switch blade.
- speed of break mm/s

19. Partial discharge level pico-coulombs

20. Corona extinction voltage kV(rms)

21. Radio interference level microvolt

22. Auxiliary switches

- No. of NO and NC contacts
- Rated voltage
- Rated current
- Test voltage

23. No. of operations which the switch can withstand without any need for inspection.

24. Type of mounting

25. No. of pole per phase

26. Safety Factor taken into account while designing the isolator

27. Whether arcing contacts provided? If so, give type and material used.

28. Wt. Of 3 pole isolating switch

- with earthing blades Kg.
- without earthing blades Kg.

29. Type of interlock between main isolator and earthing switch

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30. Has equipment been type tested and to which standards?
31. Fault making capability (for quick acting grounding switches)
32. Rated maximum time duration of short circuit.
33. Rated mechanical terminal load.
34. Rated supply voltage of operating devices and auxiliary circuits.
35. Rated pressure of SF6 gas.
36. Minimum distance between poles with regard to insulation and forces caused by short circuit currents.
37. Tests to be conducted by the Manufacturer at works and site:
 - i) Type tests
 - ii) Routine tests

E) Grounding Switches/High speed fault making grounding Switch

Sl.No.	Description	Unit
-	Manufacturer	
-	Type designation	
-	Maximum permissible operating voltage	kV
-	Maximum make and carry current for 1 sec	KA(Peak)
-	Rated inductive breaking current	A
-	TRV caused by breaking/making inductive current	kV
-	Rated capacitive current	A
-	TRV caused by breaking/making capacitive current	kV
-	Motor operating mechanism	
-	Closing current	A
-	Closing time	S
-	Opening current	A
-	Opening time	S
-	Design data	
-	Ground connection insulation	kV
-	Type of contacts	
-	Over travel distance	mm
-	Distance of fully open contacts	mm
-	Speed of make	mm/s
-	Partial discharge, level	pico-coulomb
-	Corona extinction voltage	kV(rms)
-	Radio interference level	microvolt

Has equipment been type tested and to which standards?

Dia of NO and NC contacts, its rated voltage and current

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F) CURRENT TRANSFORMERS

(particulars for different groups of CT's be given on separate sheet)

Sl.No.	Description	Unit
1.	Name of Manufacturer	
2.	Type	
3.	Manufacturer's type designation	
4.	Rated voltage	
5.	Normal continuous rating	
6.	Normal ratio of transformation	
7.	Rated primary current	
8.	Rated secondary current	
9.	Numbers of cores	

For Each Type of C.T.

Sr.No.	Description	Unit
10.		

C	Rated	Class of	Accuracy	Current	Phase	Composite
O	Output	accuracy	limit	error at	displacement	errors at
R	(VA)		factor	rated	at rated	rated acc-
E				primary	primary	uracy limit
				Current	current	primary
				%	(Minutes)	current

I
II
III
IV
V

11.

C	Knee	Secondary	Secondary	Exciting	Instrument
O	point	limiting	winding	current	security
R	voltagev	voltage	resistance		current
E					

I
II
III
IV
V

Sr.No.	Description	Unit
12.	One second over current factor time rated current.	
13.	Rated current dynamic (Peak value in amps)	
14.	Rated continuous thermal current temperature rise over ambient	°C
15.	One minute power frequency dry withstand test voltage	kV(rms)
16.	One minute power frequency wet withstand test voltage	kv(rms)
17.	1.2/50 microsecond impulse withstand test voltage	kv(peak)
18.	One minute power frequency withstand test voltage on secondaries	kV(rms)
19.	Total weight	kg.
20.	Magnetisation curves of CT cores	
21.	Mounting details	
22.	Overall dimensions	

G) VOLTAGE TRANSFORMER

Sr.No.	Description	Unit
1.	Name of Manufacture	
2.	Type	
3.	Rated primary voltage	
4.	Rated secondary voltage	
5.	Rated output per phase	
6.	Rated frequency	Hz
7.	standard values of rated voltage factor	
8.	Limits of temperature rise.	
9.	One-minute power frequency withstand voltage test	kV (rms)
10.	1.2/50 micro second. Impulse withstand voltage test	kV (peak)
11.	Total weight	(Kg.)
12.	Limits of voltage error and phase displacement in %.	
13.	Error angle	
14.	Voltage error	
15.	Accuracy class	

16. voltage factor and rated time
17. Tests to be conducted by the manufacturer at works /site:
 - i) Type tests
 - ii) Routine tests

H) SF6 GAS

Sr.No.	Description	Unit
1.	Name of manufacturer	
2.	Electrical properties (Please give details).	
3.	Compatibility with material used in switchgear.	
4.	Impurities in percentage (Please mention details of impurities)	
5.	Size of the Cylinder in which gas is proposed to be supplied	
6.	Condensation temperature.	
7.	Physical properties. (Please give details)	
8.	Certification that gas meets all the properties requirement.	
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.	
a)	- normal pressure	kg/cm ²
	- normal operating density	g/cc
	- maximum pressure to maintain dielectric insulation for 420-KV no load.	g/cc
	- maximum leakage rate per year at normal pressure	percent
	- maximum permissible moisture content by weight	ppm
	- permissible variation in ambient temperature	
	- Details of gas filters	
	- Effective life of filters	
	- Test pressure for gas system	kg/cm ²
	- Constituents of gas in percent of weight & volume of SF6	%
b)	Alarm Levels	
	- First alarm level, circuit breakers	kg/cm ²
	- Second alarm level, circuit breakers	kg/cm ²
	- First alarm level, all other components	kg/cm ²
	- Second alarm level, all other components	kg/cm ²

Gas Monitoring Devices

“Describe (with the aid of sketches) the type and location of gas density, gas pressure, gas moisture content and other fault monitoring devices which shall be supplied.

Pressure Relief Devices

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- | | | |
|-----|--|--------------------|
| (a) | Rupturing pressure | kg/cm ² |
| (b) | Time to rupture | seconds |
| (c) | Describe (with the aid of a sketch) location and quantity of pressure relief devices used in each gas section. | |

I) SURGE ARRESTORS

Sr.No.	Description	Unit
-	Manufacturer	
-	Type designation	
-	Class of arrestor	
-	Rated continuous operating voltage (MCCV),	kV
-	Maximum discharge current (8/20 microsecond wave)	kA
-	Maximum 0.5 microsec discharge voltage	kV
-	Impulse discharge voltage (residual voltage) at 10 kV (8/20 microsecond current wave).	kV(Peak)
-	maximum switching surge protective voltage	kV(Peak)
-	Partial discharge level	pico-coulomb
-	Corona extinction voltage	kV(rms)
-	Radio interference level, microvolt at 266	kV(rms)
-	High current short duration value	
-	Short circuit capability & class of pressure relief	
-	Long duration discharge class	
-	Has equipment been type tested and to which standards?	

J) INSULATORS FOR GI SWITCHGEAR

(Please Mention Details Separately for each type of insulator used)

Sr.No.	Description	Unit
1.	Manufacturer	
2.	Type of Insulators used.	
3.	1-minute power frequency dry withstand test voltage	kV
4.	Dry flashover value	kV(RMS)
5.	Wet flashover value	kV(RMS)
6.	1.2/50 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.

K) DESIGN CLEARANCE

Manufacturer shall state the following minimum insulating clearance, at nominal rated SF6 gas pressure and rated voltage/BIL voltage.

Sr.No.	Description	Unit
a)	Main bus to ground	
b)	Circuit breaker	
-	to ground	
-	across contact	
c)	Isolator switches	
-	to ground	
-	across contacts	
d)	Safety grounding switches	
-	to ground	
-	across contacts	
e)	High-speed make proof grounding switches	
-	to ground	
-	across contacts	
f)	SF6 –to-air bushings	

L) WEIGHTS AND DIMENSION

- | | | |
|-----|---|-----|
| (a) | Shipping weight of heaviest package | Kg. |
| (b) | Dimensions of largest package, | mm |
| (c) | Shipping weight of all special lifting devices, wrenches and tools etc. | |
| (d) | Shipping weight of SF6 gas treatment unit | |

(e) Weight of each type of switchgear bay module

- Transmission line kg.
- Generator line incoming feeder kg.
- bus coupler bay module kg.

M) OTHER MISCELLANEOUS EQUIPMENTS

a) Control Switching Device

- Make
- Model
- CT Input
- VT Input
- Aux. Input

b) Expansion Bellows (for adjustment in X-Y plane upto +/-20mm)

- Location
- i) (inside/outside wall opening)
- ii) Transformer & GIS interface section

c) Gas Monitoring

- Make
- Model
- Type

d) Partial Discharge Monitor

- Make
- Model
- Type

e) Internal Arcing Monitor

- Make
- Model
- Type

SECTION-5:
TECHNICAL CHECKLIST

Sl. No.	Particulars	Confirmation Bidder	by
1	Technical Qualifying Requirement		
1.1	The Bidder shall have designed, manufactured, type tested at least the minimum specified quantity of all equipment as below covered under the scope of this contract of at least the rating as specified herein under or higher: <u>Minimum rating required for the 400 KV GIS & 400 KV SF6 CGI Bus Ducts</u> 420 kV Class GIS & 420 kV CGI Bus Ducts and auxiliary equipment 400 kV (minimum) 50 Hz, 50% of rated current, 40 kA/1sec (min.) short circuit rating, SF6 gas insulated switchgear for indoor/outdoor installation for minimum of 6 nos of bays. These equipments should have been supplied in last 20 years & should be in successful operation for at least 2 years in last 7 years as on the date of Bid opening (09.02.2018) in Power Plant or Sub-stations or Industrial Complex etc.	Confirmed	Yes/No
1.2	All the documents shall be submitted in English. Translated pages should be attested by the ultimate customer, if attested only by the bidder it shall be notarized.	Confirmed	Yes/No
2	Un-priced BOQ		
2.1	Confirm that all items have been quoted separately. (If any item has not been quoted, the same shall be specifically brought out with technical reasons thereof)	Confirmed	Yes/No
2.2	Any other supply/ service required for the execution for the complete work of GIS & its accessories is deemed to be included in the offer, whether specifically mentioned in the specification or not. Bidder to submit list of items along with their respective quantities required for completeness of GIS & its accessories.	List of items required to be attached.	Yes/No
2.3	Building for GIS shall be constructed by Civil contractor based on the input (configuration, structure loads etc.) provided by bidder. The supply of all structural material to be embedded including foundation bolts, plates etc. as well as consumables like grouting material etc. shall be in bidder's scope. The erection of structure shall be done by BHEL under supervision of bidder.	Confirmed	Yes/No
2.4	EHV Cable termination module - Interface for connecting 400kV XLPE cable with GIS shall be in bidder scope. The typical arrangement drawing of interconnecting bus-duct from GIS bay module to 400kV XLPE cable indoor termination shall be submitted by the bidder during detailed engineering stage.	Confirmed	Yes/No
2.5	SF₆ to Air Termination Module – Interface for connecting LINE bus duct shall be complete with structures etc shall be provided by the bidder. Limit of supply as per technical specification and as per IEC.	Confirmed	Yes/No

2.6	Interfacing GIS Module A GIS Interface for connecting 400kV XLPE Cable and Oil to SF6 bushing of generator transformer in the GT Cavern shall be as per IEC /specification shall be in bidder scope . The typical arrangement drawing of interconnecting shall be submitted by the bidder during detailed engineering stage. Note - Supply of structure supports, platforms, foundation bolts, embedded parts in floors etc., for connection between GIS GT Bays and Oil to SF6 bushing of GT shall be in Bidder scope.	Confirmed	Yes/No
2.7	Confirm that the consumables (list to be enclosed by bidder during contract stage) with shelf life of two years shall be supplied after specific clearance by BHEL/SJVN/SAPDC.	Confirmed	Yes/No
2.8	Supply of All the testing instruments & devices required for successful testing and commissioning of the equipment at site till handing over shall be under bidder's scope.	Confirmed	Yes/No
2.9	Detailed list of Special Tools , tackles & slings as per Technical Specification to be supplied at site	Confirmed	Yes/No
2.10	Detailed list of Operation & Maintenance Spares of GIS as of technical specification to be supplied at site	Confirmed	Yes/No
2.11	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
2.12	The scope of supply shall also include all erection and mounting hardware and interconnecting cables within GIS.	Confirmed	Yes/No
2.13	Design philosophy of earthing submitted with the bid	Confirmed	Yes/No
2.14	Design of Earthing of GIS shall be in bidder scope. The items and accessories required for completeness of earthing shall be in bidder's scope. Mesh on floor shall be provided by BHEL as per bidder's design.	Confirmed	Yes/No
2.15	Any change in bay pitch (distance between bays) as per civil requirement for foundation layout during detailed stage shall be incorporated by bidder without any cost and delivery implication to BHEL.	Confirmed	Yes/No
3	Technical		
3.1	Operating mechanism of circuit breaker shall be as per specification.	Confirmed	Yes/No
3.2	Material of bus bar- Aluminum alloy	Confirmed	Yes/No
3.3	Requirement of AC and DC auxiliary loads	Enclosed with bid	Yes/No
3.4	Catalogues of GIS	Enclosed with bid	Yes/No
3.5	Catalogues of all Maintenance equipment. Bidder to confirm that offered equipment meets the requirements of specification.	Enclosed with bid	Yes/No
4	Calculations		
4.1	The design of the equipment shall be such that the agreed permitted movement of foundations and mechanical or thermal effects do not	Confirmed	Yes/No

	impair the assigned performance of the equipment.		
4.2	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.	Confirmed	Yes/No
4.3	Measures to limit external over voltages (e.g. surge arresters) should be considered and detailed out based on the site conditions etc.	Enclosed with bid	Yes/No
4.4	All calculations including Thermal calculations based on the climatic conditions indicated in Section 3 shall be submitted during detailed engineering stage.	Confirmed	Yes/No
5	Technical Deviations		
5.1	Confirm that the Complete systems have been offered as per the requirements of Technical Specification and Technical Deviation sheet has been submitted. <i>Deviations mentioned elsewhere in the bid will not be considered.</i>	Confirmed	Yes/No
6	Bar chart		
6.1	Bidder will submit detailed bar chart indicating all the milestones from Engineering till manufacturing/ testing, dispatch to site and installation commissioning based on the drawing & document schedule attached in section1.	Confirmed	Yes/No
7	Conditions		
7.1	<u>Store</u> 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
8	Site Test		
8.1	Bidder to submit list of general tools, tackle, slings, spanners, gauges, slings and other lifting devices, drills, instruments and appliances necessary for the complete assembly and erection at site of the GIS, required for installation, gas filling, maintenance, site testing of the GIS on returnable basis. HV Test kit shall be in scope of bidder.	Confirmed	Yes/No
8.2	Bidder to furnish detailed BOQ for non-returnable special Tools and Tackles. Slings along with unit prices to be handed over to ultimate customer as per technical specification.	Confirmed	Yes/No
8.3	All field tests including tests during installation, pre-commissioning, commissioning, field acceptance tests shall be conducted by the bidder, in presence of representative of the BHEL/SAPDC/SJVN. No separate site test will be conducted by BHEL/SAPDC/SJVN.	Confirmed	Yes/No
9	TYPE TESTS REQUIREMENTS		
9.1	The 420kV 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
9.2	Type test report for 420 kV GIS shall be submitted along with the bid. 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

9.3	In case the test reports are not found technically valid during contract stage by BHEL/SJVN/SAPDC, the bidder shall repeat these test(s) at no extra cost to the purchaser and no delivery implication. 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
9.4	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
9.5	The type test report shall be complete including the list of test objects, photographs, oscillographs, test arrangement, drawing of tested objects (GIS, equipment etc.) and 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
9.6	The contractor /bidder shall submit the type test reports for the tests conducted as per the relevant IEC/IS on the equipment similar to those to be supplied under this contract and the tests should have been conducted at a laboratory not earlier than five (5) years prior to 09.02.2018. 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 without commercial implication to BHEL. The costs of such test shall be deemed to be included in the price. The SAPDC/SJVN/BHEL shall have right to witness the Type Tests. Waiver of Type Tests will not be entertained in normal circumstances. All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.	Confirmed	Yes/No

10	FUNCTIONAL GUARANTEE		
10.1	The contractor /bidder shall meet the requirements of the FUNCTIONAL GUARANTEE as stipulated in Section-1. In case the bidder fails to meet the requirements of the Functional Guarantee, Liquidated Damages shall be levied as stipulated in Section-1 and Section-2. Penalty shall be imposed on Total losses which shall be calculated as Total measured length of GIS Bus duct multiplied by per kW loss per meter length.	Confirmed	Yes/No

Date:

Bidder's Stamp & Signature

ANNEXURE - A
SCHEDULE OF TECHNICAL DEVIATIONS

Bidder shall list out all technical potential deviation/ change request (s) along with clause with respect to technical specifications. (To be provided in editable format along with signed copy)

Sno	Page No	Clause No.	Extract from Specification	Bidders Comment/Clarification
Bill of Quantity (Annexure 1)				
Section 1				
Section 2				
Section 3				

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

Date:

Bidder's Stamp & Signature

ANNEXURE-B:
COMPLIANCE CERTIFICATE OF TECHNICAL SPECIFICATION

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

Annexure - C

	Manufacturing Quality Assurance Test Requirements			
	Project Name: Arun- III HEP (4 x 225 MW)		Doc. No.: QAI/A/M/EM/GIS/01	Rev. No.: 02
	Item Description: 420 KV Gas Insulated Switchgear		Issue Date: 30.05.17	Pages : 7
Sr. No.	Component, Operation & Characteristics	Applicable Standard		Remarks
1	2	3		4
1	Switchgear to be completely assembled in sub-assemblies of max. size for shop testing. 3- phase Transmission line switchgear bay module to be completely assembled including a representative section of outdoor SF6 to Air GIS Busduct and one outdoor SF6 to air bushing as per cl. no. 16A.7.1 of Technical Specification or otherwise when switchgear and controlgear are not completely assembled before transport, separate tests shall be made on all transport units. In this event, the manufacturer shall demonstrate the validity of his test (example: leakage rate, test voltage, resistance of part of the main circuit) as per cl. no. 16A.7.2	TS/REL STD		W
2	Gas tightness leakage test on complete assembly (As per above)	TS/REL STD		W
3	CIRCUIT BREAKER			
3.1	Casting/ Welded enclosures			
i	Review of WPS and PQR.	ASME Sec IX		V
ii	NDT.	-do-		V
iii	Physical & Chemical properties of incoming material.	Manufacturer Plant standard		V
iv	Visual Dimensional & Cleanliness check	Approved Drg./Tech. Spec/IEC 62271-203		V
v	Tightness test (Helium test)	Approved GTP/Tech. Spec/referred standard		V
3.2	Bought out items like Stress Shield, Breaking & Connecting Elements etc			
	i) Make, Model & Routine test	Approved datasheet/ Tech. Spec		V
3.3	Pressure test of enclosure	Approved GTP/Tech. Spec/ IEC 62271-203		V
3.4	Corrosion protection test of the enclosures	TS/ REL STD		V
3.5	Dielectric tests on auxiliary and control circuits	Approved GTP/Tech. Spec/ IEC 62271-203		W
3.6	Insulation resistance checking (LV wiring)	Tech. Spec/ IEC 60204-1		
3.7	Verification of LV wiring	Tech. Spec/ Approved drg./ IEC 62271-203		W
3.8	Mechanical operating tests including timing and speed tests			
3.8.1	25 Open& 25 Close operation at rated voltage & pressure	Approved GTP / Tech. Spec / IEC 62271-100		W
3.8.2	5 open & 5 close operations at minimum voltage & minimum pressure	-do-		W
3.8.3	5 open & 5 close operations at maximum voltage & maximum pressure	-do-		W
3.8.4	5 close-open cycles at rated voltage & rated pressure	-do-		W
3.8.5	5 CB operation sequences O-0.3 sec-CO-3 min-CO for line breakers	Approved GTP/Tech. Spec/IEC62271-100		W
3.8.6	5 CB operation sequences O-0.3 sec-CO-3 min-CO for Generator Transformer and bus coupler breakers	Approved GTP/Tech. Spec/IEC62271-100		W
3.8.7	Opening time & speed measured at rated supply voltage for each pole	Spec/Drgs./ IEC 62271-203		W
3.8.8	Closing time & speed measured at rated supply voltage for each pole	-do-		W
3.8.9	Recharging time after one opening & one closing operation	-do-		W
3.8.10	Measurement of resistance of Close and Trip coils	Approved GTP/Tech. Spec		W
3.8.11	Measurement of Current consumption of Motor operating mechanism at rated supply voltage.	Approved GTP/Tech. Spec		W
3.9	Dimension check- Major & Interface	Approved DRG/ GTP/TS		W
3.10.	Measurement of Resistance of main circuit	Approved GTP/Tech. Spec/IEC 62271-203		W
3.11	Gas tightness test	Approved GTP/Tech. Spec/IEC 62271-203		W
3.12	P.F. voltage tests of the main circuit at 650 kV, 50 Hz for 1 min	Approved GTP/Tech. Spec/App. Drg./IEC 62271-203		W
3.13	PD measurement	-do-		W
3.14	Checking of operation of interlock	-do-		W
3.15	Design and General details of construction	Applicable drawings		W
4	DISCONNECTORS, EARTHING SWITCHES& HIGH SPEED EARTHING SWITCHES			
4.1	Casting/Welded enclosures			
i	Review of WPS and PQR, if applicable	ASME sec. IX		V
ii	NDT , if applicable	-do-		V
iii	Physical & Chemical properties of incoming material.	Manufacturer Plant standard		V
iv	Visual Dimensional & Cleanliness check	Approved Drg./Tech. Spec/IEC 62271-203		V
v	Tightness test (Helium test)	Approved GTP/Tech. Spec/referred standard		V
4.2	Pressure test of the enclosures	Approved GTP/Tech. Spec/IEC 62271-203		V
4.3	Corrosion protection test of the enclosures	TS/ REL STD		V
4.4	Test on Driving mechanism without Disconnector & Earth switch			
4.4.1	Verification of LV wiring	Approved Drg./Tech. Spec/IEC 62271-203		V
4.4.2	Dielectric tests at 2 kV, 50 Hz for 1 min	Approved GTP/Tech. Spec/IEC 62271-203		V
4.4.3	Insulation resistance checking (LV wiring)	Tech. Spec/IEC 60204-1		V
4.4.4	5 O/C cycles at U norm, min & max voltage	Approved GTP./Tech. Spec/IEC 62271-102		V

Sr. No.	Component, Operation & Characteristics	Applicable Standard	Remarks
1	2	3	4
4.4.5	Measurement of current consumption of Motor operating mechanism at rated supply voltage.	Approved GTP/Tech. Spec	W
4.5	Test on Driving mechanism with Disconnecter & Earth switch		
4.5.1	Measurement of current consumption	Approved GTP./Tech. Spec/IEC 62271-102	V/W
4.5.2	Manual open close operation (5 O/C)	Approved GTP./Tech. Spec/IEC 62271-102	V/W
4.5.3	Measurement of Torque drive inlet	Approved GTP./Tech. Spec/IEC 62271-102	V/W
4.5.4	Electrical operation 5 CO at U norm, Umin & Umax voltage	Approved GTP./Tech. Spec/IEC 62271-102	V/W
4.6	Measurement of the resistance of the main circuit	Approved GTP/Tech. Spec/IEC 62271-203	W
4.7	Gas tightness test	Approved GTP/Tech. Spec/IEC 62271-203	W
4.8	P.F. voltage tests of the main circuit	Approved GTP/Tech. Spec/App. Drg./IEC 62271-203	W
4.9	P.D. measurement	-do-	W
4.10.	Checking of operation of interlock	-do-	W
4.11	Design and General details of construction	Applicable drawings	W
5	CURRENT TRANSFORMER		
5.1	Casting/Welded enclosures		
i	Review of WPS and PQR, if applicable	ASME Sec IX	V
ii	NDT, if applicable	-do-	V
iii	Physical & Chemical properties of incoming material.	Manufacturer Plant standard	V
iv	Visual Dimensional & Cleanliness check	Approved Drg./Tech. Spec/IEC	V
v	Tightness test (Helium test)	Approved GTP/Tech. Spec/referred STD	V
5.2	Verification of terminal markings	Approved Drgs./IEC 60044-1	W
5.3	Checking of polarity	Approved GTP/ App. Drgs./IEC 60044-1	W
5.4	Pressure test of enclosure	Approved GTP/ App. Drgs./IEC 60044-1	V
5.5	Corrosion protection test of the enclosures	TS/ REL STD	V
5.6	RCT measurement for PS class CT	-do-	W
5.7	Excitation characteristic , Knee Point Voltage test, Turn Ratio test for PS class CT	-do-	W
5.8	Inter turn over voltage test	Approved GTP/Tech. Spec/IEC 60044-1	W
5.9	Accuracy test (Ratio and Phase angle error)	Approved GTP/App. Drg./IEC 60044-1	W
5.10.	1 Min. Power Frequency with stand test Voltage on Secondaries	Approved GTP/App. Drg./IEC 60044-1	W
5.11	Composite error Accuracy	Approved GTP/IEC 60044-1	W
6	VOLTAGE TRANSFORMER		
6.1	Casting/Welded enclosures		
i	Review of WPS and PQR, if applicable	ASME Sec IX	V
ii	NDT, if applicable	-do-	V
iii	Physical & Chemical properties of incoming material.	Manufacturer Plant standard	V
iv	Visual Dimensional & Cleanliness check	Approved Drg./Tech. Spec/IEC	V
v	Tightness test (Helium test)	Approved GTP/Tech. Spec/referred STD	V
6.2	Verification of terminal marking	Approved Drgs./IEC 60044-2	V
6.3	Pressure test of enclosure	Approved GTP/ App. Drgs./IEC 60044-2	V
6.4	Corrosion protection test of the enclosures	TS/ REL STD	V
6.5	partial discharges measurement	Approved GTP/Tech. Spec/IEC 60044-2	W
6.6	Power frequency withstand tests between sections and on primary & secondary windings	Approved GTP/Tech. Spec/App. Drg./IEC 60044-2	W
6.7	Accuracy class designation	-do-	V
6.8	Limits of Voltage errors and Phase displacement	-do-	W
7	SURGE ARRESTOR		
7.1	Casting/Welded enclosures		
i	Review of WPS and PQR, if applicable	ASME Sec IX	V
ii	NDT, if applicable	-do-	V
iii	Physical & Chemical properties of incoming material.	Manufacturer Plant standard	V
iv	Visual Dimensional & Cleanliness check	Approved Drg./Tech. Spec/referred STD	V
v	Tightness test (Helium test)	Approved GTP/Tech. Spec/referred STD	V
7.2	Pressure test of the enclosures	Approved GTP/Tech.Spec/Drags./IEC 62271-203	V
7.3	Corrosion protection test of the enclosures	TS/ REL STD	V
7.4	Residual voltage test	Approved GTP/Tech.Spec/IEC 60099	W
7.5	Measurement of reference voltage and Recording of Leakage current in ma	Approved GTP/Tech.Spec/IEC 60099	W
7.6	PD test (PD test at 1.05 at 1.05 MCOV)	-do-	W
7.7	Satisfactory absence from partial discharges & contact noise to be checked on each unit by any sensitive method adopted by manufacturer	-do-	W
7.8	Current distribution test for multi- column arrestor	-do-	W
7.9.	Gas tightness test	Approved GTP/IEC 62271-203	W
8	OTHERS GIS COMPONENTS (Busbar Conductor, Busbar enclosure, Support Insulator, Gas Barrier (Cone), Accessories, etc.)		
8.1	Bus Enclosure		
i	Review of WPS and PQR, if applicable	ASME Sec IX	V
ii	NDT, if applicable.	-do-	V
iii	Physical & Chemical properties.	Manufacturer Plant standard	V
iv	Visual Dimensional & Cleanliness check	Approved Drg./Tech. Spec/referred STD	V
v	Tightness test (Helium test)	Approved GTP/Tech. Spec/referred STD	V
vi	Dimension	As approved per drawing	V

Sr. No.	Component, Operation & Characteristics	Applicable Standard	Remarks
1	2	3	4
vii	Leak testing of all the welds/flanges with SF6 leak detector. (Gas tightness test)	Approved GTP/Tech. Spec./referred STD	V
viii	Pressure test	Approved GTP/Tech. Spec./referred standard	V
ix	Welding X-ray	As per referred STD	V
x	DPT	As per referred STD	V
xi	Corrosion Protection test (One test sample piece for Aluminium)	App. GTP/TS/App. Drg/ Rel. STD	V
xii	RIV free	App. GTP/TS/App. Drg/ Rel. STD	V
xiii	Cleanliness & Packing	As per Manufacturer operating Instruction	V
8.2	Bus bar conductor		
i	Dimension,	As per drawing	V
ii	Mechanical & Chemical Properties	Manufacturer Plant standard	V
iii	Electrical Conductivity/ Resistivity/Resistance	Approved GTP/Tech. Spec./referred STD	V
iv	Silver plating Thickness	-do-	V
v	Cleanliness	Plant standard	V
vi	Contact resistance at Plug in contact	Plant standard	V
vii	Corrosion Protection test (One test sample piece for Aluminium)	App. GTP/TS/App. Drg/ Rel. STD	V
viii	RIV free	App. GTP/TS/App. Drg/ Rel. STD	V
ix	Packing	As per Manufr. packing Instruction	V
8.3	Support Insulator & Gas Barrier (Cone)		
i	Visual & Dimension	As per drawing	V
ii	Pressure Test (only for gas barrier)	Approved GTP/Tech. Spec.	V
iii	P.F. voltage tests of the main circuit	Approved GTP/Tech. Spec./App. Drg./IEC 62271-203	W
iv	Tightness test	Approved GTP/Tech. Spec./App. Drg./IEC 62271-203	W
v	P.D. measurement	-do-	W
vi	RIV free	App. GTP/TS/App. Drg/ Rel. STD	W
vii	Cleanliness & Packing	As per Manufacturer operating Instruction	W
8.4	Assembly of conductors and Enclosures including cones of each type and accessories.		
i	PF Voltage tests on main Circuit	App GTP/ App. Drg/ Tech. Spec /referred STD	W
ii	PD Measurement	-do-	W
iii	Design and general details of construction	Applicable drawings	W
8.5	Measurement of losses in bus conductor and enclosure	Approved GTP/Tech. Spec./ App Procedure	W
8.6	Bushings- SF6 to Air bushing		
8.6.1	Hollow insulator (Porcelain)		
	All Routine tests	Approved GTP/TS/IEC 62155	V
8.6.2	Assemble bushing		
	All Routine tests	Approved GTP/TS/IEC 60137	V
8.7	Bellows (Lateral, Axial, Parallel, tolerance and vibration)		
i	Review of WPS and PQR	ASME Sec IX	V
ii	NDT, if applicable	-do-	V
iii	Physical & Chemical properties.	Manufacturer Plant standard	V
iv	Visual Dimensional & Cleanliness check	Approved Drg/Tech. Spec./referred STD	V
v	Tightness test (Helium test)	Approved GTP/Tech. Spec./referred STD	V
vi	Corrosion Protection test	App. GTP/TS/App. Drg/ Rel. STD	V
8.8	Copper Strips		
i	Physical & Chemical Properties	Manufacturer Plant standard	V
ii	Visual & Dimensional Check.	Approved Drg/Tech. Spec./referred STD	V
8.9	Power, Control & Instrumentation cables		
i	Make & Type	Approved datasheet/Tech. Spec.	V
ii	Routine tests	Approved GTP/Tech. Spec./referred STD	V
8.10.	Pressure Gauges, Density Switches, Rupture Disc, Endoscope arrangement, Valves, Moisture absorbers, UHF Sensors, etc		V
i	Make & Type	Approved datasheet/Tech. Spec.	V
ii	Functional Tests	Approved GTP/Tech. Spec./referred STD	V
8.11	ACCESSORIES		
8.11.1	SF6 Gas		
	Make	DRG/Data sheet/TS	V
	Weight and pressure after filling of SF6 Gas (Weight of SF6 Gas)	DRG/Data sheet/TS	V
	Purity check (Composition)/ Impurities in Percentage	DRG/Data sheet/TS/IEC	V
	Acidity (SO2) measurement	IEC 60376/TS/ Relevant Standard	V
	Measurement of dew point & Moisture content/water content	DRG/Data sheet/TS	V
	Testing of electrical properties of SF6 Gas	DRG/Data sheet/TS	V
	Verification of manufacturer seal & label	DRG/Data sheet/TS	V
	Check of leakage before dispatch	DRG/Data sheet/TS	V
8.11.2	Density Monitoring Equipment		
	Make, Type, rating & Switching Point Pressure	Approved datasheet/ Tech. Spec	V
8.11.3	Tools & Tackles		
	Size, Make and condition of the tools in terms of aesthetics, etc.	As per approved datasheet/ Catalogue	V
8.11.4	PD Monitoring system (UHF Sensors)		
	i) Make, Type, rating	Approved GTP/Tech. Spec/Drg/referred STD	V
	ii) Continuity and Insulating Test on UHF Sensors	-do-	V
	iii) Operational & Functional test	-do-	V

Sr. No.	Component, Operation & Characteristics	Applicable Standard	Remarks
1	2	3	4
8.11.5	Gas Handling Unit		
i	Make & Model	As per approved datasheet/ Catalogue	V
ii	Operational & Functional test	Tech. Spec/Drq/referred STD	V
8.11.6	Vacuum Pump		
	i) Make & model	REL. STD/DRG/TS	V
	ii) Visual Inspection	REL. STD/DRG/TS	V
	iii) Verification of :		
	a) Free air displacement & revolution	REL. STD/DRG/TS	V
	b) Ultimate Vacuum	REL. STD/DRG/TS	V
8.11.7	Power & Control Cable and Cable Tray		
	Make, Type, Rating	REL. STD/DRG/TS	V
	Routine Tests	REL. STD/DRG/TS	V
8.12	Steel Structure		
8.12.1	Raw Material		
8.12.1.1	Hot-rolled Structural Steel Angle Sections, Bars & Plates		
	Chemical Composition, Tensile Test (TS, YS% Elongation), Bend Test, Visual Check for Surface Finish, Dimension 1) For angle-Leg length out of squareness, camber, weight ii) for bars-diameter, ovality iii) for plates- thickness weight, Y Groove Crackability Test	DRG/ IS 2062/ IS 8500/ IS 228/ IS 10842	V
8.12.1.2	Zinc		
	Chemical Composition	IS 209	V
8.12.2	In process Inspection		
8.12.2.1	Fabrication of steel structure		
	Straightening, Cropping (Cutting), Stamping, Marking Hole by punching/ drilling, Edge Security, Hole to Hole Distance, Overall length of member, Gauge Distance, Notching Flange cut, corner cut & level cut, Heel Grinding, Bending MS Section, Bending- MS Plate, Other Dimensions	IS 802 (P-II)/ DRG	V
8.12.2.2	Welding Fillet Weld		
	Suitability	IS 822/ ASME Sec IX	V
8.12.2.2.1	Welding Procedure Specification (WPS)		
	Qualification	IS 822/ ASME Sec IX	V
8.12.2.2.2	Procedure Qualification Record (PQR)		
	Qualification	IS 822/ ASME Sec IX	V
8.12.2.2.3	Welder Performance Qualification		
	Weld Size, Weld Quality	DRG/ ASME Sec VII	V
8.12.2.2.4	Inspection of Welds		
	DP Test	ASTM- 65	V
8.12.2.3	Inspection of Fabricated Parts (Black) before Galvanizing		
	Dimensions, Surface Finish	DRG/ IS 802 (P-II)	V
8.12.2.4	Proto Assembly		
	Dimensions, Fit up/ Fowling/ Notching	DRG	W
8.12.2.5	Revision of Drawings/ Shop Sketch on proto feedback		
	Revision of Drawing (For re-approval)	DRG	V
8.12.2.6	Galvanising		
8.12.2.6.1	Degreasing		
	Solution Strength, pH value	IS 2629	V
8.12.2.6.2	Rinsing		
	Cleanliness	IS 2629	V
8.12.2.6.3	Pickling		
	Acid Content, Iron Content	IS 2629	V
8.12.2.6.4	Rinsing		
	Cleanliness (Mill Scale Paint Marks etc)	IS 2629	V
8.12.2.6.5	Pre-Fixing		
	Dry fluxing, Iron Content, Specific Gravity, pH valve, Temperature	IS 2629	V
8.12.2.6.6	Pre-heating		
	Temperature	IS 2629	V
8.12.2.6.7	Hot Dip Galvanizing		
	Temperature, Immersion Time, Removal of excessive Zinc while lifting from Zinc Bath by bumping process	IS 2629	V
8.12.2.6.8	Quenching of Running Water		
	Cooling & Cleaning	IS 2629	V
8.12.2.7	Post Treatment or Dichromating		
	Solution Strength	IS 2629	V
8.12.2.8	Checks on members		
	Surface defects & finish, Thickness of zinc coating, Mass of zinc coating, Uniformity of zinc coating (Preece Test), Adhesion Test of zinc coating (Pivoted Hammer Test/ Knife Test)	IS 4759/ IS 6745	V
8.12.2.9	Stenciling of Mark/ Numbers		
	Marking	DRG	V
8.12.3	Final Inspection		
8.12.3.1	Fabricated Members after galvanizing		
	Surface finish, defects & dichromating, Dimensions	IS 2629/ IS 4759	V
8.12.3.2	Verification of Basic Material Quality		
	Chemical Composition, Tensile Strength, Bend Test	DRG/ IS 2062/ IS 8500/ IS 228/ IS 10842	V
8.12.3.3	Fillet Welding Quality		
	Weld Quality	IS 822	V
8.12.3.4	Galvanizing Test		
	Thickness of Zinc Coating, Mass of Zinc Coating, Uniformity of Zinc Coating (Preece Test), Adhesion Test of Zinc Coating (Pivoted Hammer Test/ Knife Test)	IS 2629/ IS 4759/ IS 6745/ IS 2633	W
8.12.4	Packing, Storing, Bundling and Handling	IS 2629	V
8.12.5	Corrosion Protection test (One test sample piece for steel structure)	App. GTP/TS/App. Drq/ Rel. STD	V
8.12.6	Dispatch		
	Verification, Sequential Supplies, Stenciling/ Part no., Quantity, Quality	DRG/ BOM/ LOA	V
8.12.7	Cadmium plated Bolts, Foundation Bolts, Step Bolts and Hexagonal Nuts		

Sr. No.	Component, Operation & Characteristics	Applicable Standard	Remarks
1	2	3	4
8.12.7.1	Mechanical test		
	Surface Integrity, Dimension, Hardness, Head soundness, Proof Load, Strength under wedge loading, Tensile Test, Shear Strength	TS/DRG/Rel. STD	V
8.12.7.2	Cadmium plating Test		
	Coating Thickness Weight, Stripping Test, Magnetic/ Electronic Measurement, Uniformity of Coating, Adhesion of Coating	TS/DRG/Rel. STD	V
8.12.8	Spring Washer		
	Surface Integrity, Dimensions, Hardness, Permanent Set Test, Permanent Load Test, Twist Test, Thickness of Coating, Adhesion Test	TS/DRG/Rel. STD	V
8.12.9	Packing of Hardware		
	Packing	TS/DRG	V
9	BAY MODULE CONTROL CUBICLE, ALL ASSOCIATED PANELS & ONLINE MONITORING SYSTEM PANELS FOR GIS		
9.A	Raw Material		
9.A.1	Insulating Material: FRP, SMC & DMC Sheet & components, Insulator		
	a) Visual	DRG & IS9431	V
	b) Dimensional & Creepage distance	-do-	V
	c) 1 Min Dry PF Test (as applicable)	-do-	V
	d) Cantilever Strength (as applicable)	-do-	V
9.A.2	Cards: Input & Output Cards, power supply cards, Communication/ Network Cards, Processors, Converters		
	Make, type & Functional test	DRG/ Rel STD/TS	V
	Burn-in test, temperature and voltage stress tests	DRG/ Rel STD/TS	V
9.A.3	HMI, SF6 gas & partial discharge monitoring equipment, control switching device equipment		
	Make, Model/ Type & Functional test, Datasheet compliance	DRG/ Rel STD/TS	V
9.A.4	Power & Control Cable and Instrumentation cable		
	Routine & Acceptance test	DRG/ Rel STD/TS	V
9.A.5	Bus Bar (Copper)		
	Material test	DRG/ Rel STD/TS	V
	Dimension check, Silver plating on contact surface	DRG/ Rel STD/TS	V
9.A.6	CT, PT & Control Transformer		
	Routine & Acceptance test	DRG/ Rel STD/TS	V
9.A.7	MCB, Relays, Contactors, Timer, Auxiliary & Selector Switches, Transducers (All Type), Sensors		
	Make, Type & Rating	DRG/TS/ REL. STD	V
	Routine & Acceptance test	DRG/TS/ REL. STD	V
	Measurement of Resistance	DRG/ Rel STD/TS	V
9.A.8	Meters (all type) , Indicating & Monitoring instruments		
	Make, Model & Type and Calibration certificate	DRG/ Rel STD/TS	V
	Accuracy test, HV test & routine test	DRG/ Rel STD/TS	V
9.A.9	Indicators, Push Button, Selector Switch		
	Make, Type & Operation check	DRG/ Rel STD/TS	V
9.A.10	Earthing flat (Galvanized steel)		
	Dimension & Material test, Galvanization Check	DRG/ Rel STD/TS	V
9.A.11	Gasket		
	Dimension check, Chemical & Physical properties, Surface finish	DRG/ Rel STD/TS	V
9.A.12	Sheet Steel for fabrication & Steel for structure		
	Dimension, Chemical & Mechanical properties, Bend test	DRG/ Rel STD/TS	V
9.B	Final Inspection		
9.B.1	Dimension check for height, width, depth & sheet thickness of panel	REL. STD/DRG/TS	W
	Dimension check for bus bar & check phase to phase, phase to earth clearance	REL. STD/DRG/TS	W
	Visual check as per OGA, DRG & verification of BOM	REL. STD/DRG/TS	W
	Visual check of alignment of Boards, Operation of Doors, Locks, Shutters, Base grouting & gland plates	REL. STD/DRG/TS	W
	Verification of correct wiring, Ferruling, dressing, routing,, bunching, continuity check, colour coding and earthing	REL. STD/DRG/TS	W
	Insulation resistance measurement before & after HV test	IEC 60204-1	W
	Dielectric test on Main, auxiliary & control circuit	IEC 62271-203 § 7.2	W
	Functional test on all AC & DC circuit including heating, Lighting, Fan & thermostat	REL. STD/DRG/TS	W
	Verification of Setting, Operational & scheme test of all relay	DRG/Data sheet/Plant Standard	W
	Operational & Functional Check, Protection & Interlock Check		
	a)Hardwire Healthiness Check, Checking of control & relay logics	DRG/ Rel STD/TS	W
	b) Functional checks as per approved schematics. Functional checks of electronic & Power Module	DRG/ Rel STD/TS	W
	c)Functional & Operation test of control switching devices & SF6 gas monitoring system, partial discharge monitoring system	DRG/ Rel STD/TS	W
	d)Parameterisation of software. Functional testing of continuous online monitoring & diagnostic system	DRG/ Rel STD/TS	W
	Verification of protection against electrical shock	TS/DRG/REL STD	W
	Verification of IP Class	Approved GTP/Tech. Spec./Drg	V
	Visual Inspection for Paint Shade, Surface Finish, Coating, Thickness & Adhesion.	Approved GTP/Tech. Spec./Drg	W
9.B.2	Packing & Marking	DRG/Data sheet/TS/Mfr. Std.	V
LEGENDS			
W: CUSTOMER HOLD POINT (CHP)		DRG: DRAWING	
TS: TECHNICAL SPECIFICATION		REL. STD: RELEVANT STANDARD	
V: VERIFICATION OF RECORDS / REPORTS / TCs			
NOTES:			
1	Any test at any stage not covered in Quality Assurance Test Requirement (QATR), but part of technical specification of contract, shall also be carried out by Contractor / firm.		
2	QATR shall be read in conjunction with General Quality Assurance Requirement given as part of Technical Specification.		
3	Dielectric Test voltage shall be corrected, if installed at an altitude higher than 1000m as per clause no. 4.2.2 of IEC 60071-2		



Field Quality Assurance Test Requirements

Project Name: Arun 3 HEP (4x225 MW)				Doc. No. QAI/A/F/EM/EP/05	Rev. No. 02
Item Description: Motor Starter Panel				Issue Date: 30.05.17	Page No. 2
Sr. No.	Component, Operation & Characteristics	Applicable Standard	Remarks		
1	2	3	4		
1	Material Receipt				
	External conditions of Equipment free from Damages etc	TS/Instruction Manual/ Reference standard	W*		
	Number of packages in each Equipment and physical condition of each package	TS/Instruction Manual/ Reference standard	W*		
2	Storage of Material				
	Proper Placement of equipment as per the Instruction Manual.	TS/Instruction Manual/ Reference standard	W*		
	Ensure that no damage or rusting takes place during storage	TS/Instruction Manual/ Reference standard	W*		
	Ensure that all delicate Equipment are stored in protected area.	TS/Instruction Manual/ Reference standard	W*		
3	Embedments				
3.1	Installation/fixing of embedments as per drawing				
	Leveling & alignment before and after concreting	TS/Instruction Manual/ REL.STD	W*		
3.2	Blockout				
	Check for visual, dimensions & Co-ordinates of blockout	TS/Instruction Manual/ REL.STD	W*		
3.3	Civil Work				
	Check for all Civil work as per instruction manual	TS/Instruction Manual/ REL.STD	W*		
4	Test During Installation				
	Check for correct nameplate details	DRG, TS & Relevant STD	W*		
	Ensure that the handling tools & tackles like strings, manila ropes, pulleys, etc. are free from damage.	DRG, TS & Relevant STD	W*		
	Ensure that proper tying, loading/packing on the vehicle/transport	DRG, TS & Relevant STD	W*		
	Ensure for proper unloading, positioning on an even Surface at erection site	DRG, TS & Relevant STD	W*		
	Ensure that panels are vertically upright during transport, loading, unloading and erection	DRG, TS & Relevant STD	W*		
	Check for foundation frame and its dimensions	DRG, TS & Relevant STD	W*		
	Check for layout of Panels	DRG, TS & Relevant STD	W*		
	Ensure correct sequence, orientation and alignment of panels	DRG, TS & Relevant STD	W*		
	Check for verticality of panels within ± 5 mm	DRG, TS & Relevant STD	W*		
	Check for clearances on all sides	DRG, TS & Relevant STD	W*		
	Check for proper tightness of base plate bolts, bolts joining panels	DRG, TS & Relevant STD	W*		
	Check for tightness of bus bar joints including earth bus bar, all terminals, CTs, PTs, meters and relays	DRG, TS & Relevant STD	W*		
	Covering of joints with Compounds (if specified)	DRG, TS & Relevant STD	W*		
	Ensure that all unused holes are plugged properly	DRG, TS & Relevant STD	W*		
	Ensure that all the unwanted bolts/nuts, wires, hands tools etc. inside the panels are removed	DRG, TS & Relevant STD	W*		
	Check tightness of covers, check for proper laying, dressing, crimping and terminal of all cables	DRG, TS & Relevant STD	W*		
	Ensure that proper earthing is carried out for the panels as per norms and Check for continuity of each bus	DRG, TS & Relevant STD	W*		
5	Pre- Commissioning Test				
1	General Test for Motor Switchgear				
	Check for Lubrication of all moving parts like doors etc.	DRG, TS & Relevant STD	W*		
	Dimension check of busbar and clearance between phase and phase to earth	DRG, TS & Relevant STD	W*		
	Check for alignment of Bus Bars with the Insulators	DRG, TS & Relevant STD	W*		
	Check for cleanliness/breakage/chipping of Insulators	DRG, TS & Relevant STD	W*		
	IR before & after HV test	DRG, TS & Relevant STD	W*		
	HV test on Bus Bars with CTs and breaker/contractor in position	DRG, TS & Relevant STD	W*		
	Verification of phase sequence for incoming supply	DRG, TS & Relevant STD	W*		
2	MCCB				
	Check for Proper alignment of Trucks for free movement and correct operation of shutters	DRG, TS & Relevant STD	W*		
	Check Control wiring for correctness of connections, continuity and IR values	DRG, TS & Relevant STD	W*		
	Contact resistance measurement of Circuit Breaker	DRG, TS & Relevant STD	W*		
	Check for manual operation of breakers completely assembled	DRG, TS & Relevant STD	W*		
	Check for proper closing and opening operations electrically at extreme conditions of control supply voltage and anti pumping operation	DRG, TS & Relevant STD	W*		
	Measurements of IR values, Resistance and minimum pickup voltage of Coils	DRG, TS & Relevant STD	W*		
	Checking of mechanical and electrical interlocks	DRG, TS & Relevant STD	W*		

Sr. No.	Component, Operation & Characteristics	Applicable Standard	Remarks
1	2	3	4
	Checking of spring charging motor and recharging time, correct operation of Limits switches	DRG, TS & Relevant STD	W*
	Calibration of release for MCCB	DRG, TS & Relevant STD	W*
3	Current Transformer		
	Insulation Resistance between windings and terminals to body	DRG, TS & Relevant STD	W*
	Measurements of secondary winding resistance	DRG, TS & Relevant STD	W*
	Shorting and earthing of spare CT cores	DRG, TS & Relevant STD	W*
4	Potential Transformer		
	IR Test	DRG, TS & Relevant STD	W*
	Ratio and Polarity Test	DRG, TS & Relevant STD	W*
	Checking of line connections as per connection diagram	DRG, TS & Relevant STD	W*
5	Heating & Lighting		
	Visual check- Make, Type & Rating	DRG, TS & Relevant STD	W*
	Dielectric test of main, auxiliary & control circuit	DRG, TS & Relevant STD	W*
	Functional Check	DRG, TS & Relevant STD	W*
6	Cable (Interpanel wiring)		
	Continuity Check	DRG, TS & Relevant STD	W*
	IR Test	DRG, TS & Relevant STD	W*
	HV Test	DRG, TS & Relevant STD	W*
7	Cubical Wiring for all cable		
	IR of all wires with respect to earth	DRG, TS & Relevant STD	W*
	Checking of wiring of control and selector switches and all interconnectors/terminals between panels and fields	DRG, TS & Relevant STD	W*
	Transducers/Instruments		
	Operational and functional checks	DRG, TS & Relevant STD	W*
	Verification of Glanding & Cable Tagging	DRG, TS & Relevant STD	W*
8	Relays		
	Checking of IR between all terminals and earth & between AC and DC Terminals	DRG, TS & Relevant STD	W*
	Checking of CT and PT Connection with particulars reference to their polarities as called in Drawing	DRG, TS & Relevant STD	W*
	Checking of operating characteristics by secondary current injection	DRG, TS & Relevant STD	W*
	Relay setting & Co-ordination vis-à-vis other protection relays/ release provided in the entire system including Motor-Starter/ LT & MV system	DRG, TS & Relevant STD	W*
9	Measuring, indication and indicating Instrument		
	IR between all terminal and earth	DRG, TS & Relevant STD	W*
	Checking of CT and PT connection with particular reference to their polarities as called in Drawing	DRG, TS & Relevant STD	W*
6	Commissioning Test		
	Function & Operation test including checking of protection and interlocking scheme	DRG, TS & Relevant STD	W*
	Verification of component temperature	DRG, TS & Relevant STD	W*
7	Performance Test as per Technical Specification	DRG, TS & Relevant STD	W*
LEGEND			
W: CUSTOMER HOLD POINT(CHP)		DRG: DRAWING	
TS: TECHNICAL SPECIFICATION		REL. STD: RELEVANT STANDARD	
V: VERIFICATION OF REPORT/TCs		W*: WITNESS BY SAPDC / MAIN CONTRACTOR	
NOTE:			
1. Any test at any stage not covered in Quality Assurance Test Requirement (QATR), but part of Technical Specification of contract, shall also be carried out by Contractor/ firm.			
2. QATR shall be read in conjunction with General Quality Assurance Requirement given as part of Technical Specification.			
3. Dielectric Test voltage shall be corrected, if installed at an altitude higher than 1000m as per clause no. 4.2.2 of IEC 60071-2.			
4. Responsibility for witnessing (W*) at site shall be finalized mutually at the time of finalization of FQAP as per the criticality of test.			

	MANUFACTURING &FIELD QUALITY ASSURANCE TEST REQUIREMENT		
	PROJECT NAME: ARUN III HEP (4X225 MW)	DOC.NO.QA/I/A/M/F/EM/S&S/01	REV. NO. 02
	ITEM DESCRIPTION: SECURITY & SURVEILLANCE SYSTEM	ISSUE DATE: 30.05.17	PAGES: 01
SR. NO.	CHARACTERISTICS	APPLICABLE STANDARD	REMARKS
1	2	3	4
1	Make , Model , Type , Rating and Serial No. Identification	DRG. / Rel. Std / TS/ Data Sheet	V
2	Shop Test		
2.1	A compliance/performance certificate for all equipments as specified in the technical specification shall be submitted by the contractor stating that the equipments are manufactured and tested in accordance with relevant IEC/IS standards and shall meet the performance guarantees to meet the provision of contract.	Rel. IEC/IS/TS	V
3	Receipt of Material		
3.1	External conditions of Equipment free from Damages etc	Packing list /Drawings /TS	W*
3.2	Number of packages in each Equipment and physical condition of each package	Packing list /Drawings /TS	W*
4.0.	Storage		
4.1	Proper Placement of equipment as per the Instruction Manual.	All parts fully covered	W*
4.2	Ensure that no damage or rusting takes place during storage	All parts fully covered	W*
4.3	Ensure that all delicate Equipment are stored in protected area.	All parts fully covered	W*
5.0.	Field Test		
5.1	All field test including tests during installation,Pre-commissioning, commissioning,performance & field acceptance tests shall be conducted by the contractor, in presence of representative of employer	DRG. / Rel. Std / TS/ Erection & Commissioning Protocol	W*
6	Installation & Pre- Commissioning Check		
6.1	Installation check as per drawing of all equipment	DRG. / Rel. Std / TS/ Erection & Commissioning Protocol	W*
6.2	Function test of subsystem	DRG. / Rel. Std / TS/ Erection & Commissioning Protocol	W*
6.3	System function & Operational check	DRG. / Rel. Std / TS/ Erection & Commissioning Protocol	W*
6.4	Software Test of function program	DRG. / Rel. Std / TS/ Erection & Commissioning Protocol	W*
7	Commissioning Test		
7.1	Complete functional testing of security system	DRG. / Rel. Std / TS/ Erection & Commissioning Protocol	W*
7.2	Complete functional testing of surveillance system	DRG. / Rel. Std / TS/ Erection & Commissioning Protocol	W*
8	Performance Test		
8.1	Performance Test as per Technical specification	DRG. / Rel. Std / TS/ Erection & Commissioning Protocol	W*
LEGENDS			
W: CUSTOMER HOLD POINT (CHP)		DRG: DRAWING	
TS: TECHNICAL SPECIFICATION		REL. STD: RELEVANT STANDARD	
V: VERIFICATION OF RECORDS / REPORTS / TC		W*: WITNESS BY SAPDC / MAIN CONTRACTOR	
NOTES:			
1	Any test at any stage not covered in Quality Assurance Test Requirement (QATR), but part of technical specification of contract, shall also be carried out by Contractor / firm.		
2	QATR shall be read in conjunction with General Quality Assurance Requirement given as part of Technical Specification.		
3	Responsibility for witnessing (W*) at site shall be decided mutually at the time of finalisation of FQAP as per the criticality of test.		

**ELECTRO MECHANICAL PACKAGE FOR
ARUN-3 HYDRO ELECTRIC PROJECT 900 (4X225) MW**

**(CHECK LIST FOR DOCUMENT SUBMISSION BY BIDDER WITH REGARD TO QUALITY
ASSURANCE PROGRAMME)**

Bidder's Name and Address:

To,

Addl. General Manager
Electrical Contract Department,
SJVN Limited, SJVN Complex,
2nd floor, Shanhan,
Shimla- 171 006 (HP)

Dear Sirs,

We hereby confirm that, we will follow the Quality Assurance Programme (containing overall Quality Management and procedures), as provided in the bid documents and all relevant details/documents required to be submitted alongwith the bid as per the QATR has been enclosed as per details given herein under:

Sr.no.	Document Description	Submitted(yes/No)
1.	Organization structure for the management and implementation of the proposed quality assurance programme.	
2.	Quality system manual.	
3.	Design control systems.	
4.	Documentation and Data control systems.	
5.	Qualification/experience of bidder's key personnel.	
6.	Procedure for purchase of material, parts, components and selection of sub-vendor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased, etc.	
7.	System for shop manufacturing and site erection controls including process, fabrication and assembly.	
8.	Control of non-conforming items and system for corrective actions and resolution of deviations.	
9.	Control of calibration and testing of measuring/testing equipment.	
10.	System for quality audit.	
11.	System for identification and appraisal of inspection status.	

Bid Document for EM Works of AHEP (4x225) 900MW No. SJVN/ECD/SAPDC/AHEP/EM/17	Section-VII (Attachments)	Page 254 of 258
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12.	System for authorizing release of manufactured product to the purchaser.	
13.	System for transportation /delivery, handling, storage and preservation.	
14.	System for maintenance of records.	

I hereby confirm that general Quality Assurance Requirements and Quality Assurance Test Requirements (QATRs) have been read in detail and same are *accepted/accepted with deviations mentioned in schedule for deviation.

Date: (Signature).....

Place : (Printed Name).....

(Designation)

(Common Seal).....

Note: Continuation sheets of like size and format may be used as per the Bidder's requirements and shall be annexed to this Schedule.

*strike whichever is not applicable

Bid Document for EM Works of AHEP (4x225) 900MW No. SJVN/ECD/SAPDC/AHEP/EM/17	Section-VII (Attachments)	Page 255 of 258
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Annexure –E

QA&I Formats

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	FORM	

VENDOR / SUB-VENDOR ASSESSMENT SHEET

TO BE FILLED-IN BY SUPPLIER / SUB-VENDOR

NAME OF SUPPLIER / SUB-VENDOR IN FULL					
		REGISTERED OFFICE		FACTORY / WORKS	
ADDRESS					
TELEPHONE NO.					
FAX NO.					
EMAIL ID					
PERSON(S) TO BE CONTACTED (NAME & DESIGNATION & MOBILE NO.)					
WEEKLY OFF					
SHIFT WORKING		Type of Company (Pl. Tick)		Type of Industry (Pl. Tick)	
OFFICE	WORKS	Pvt. Ltd	Public Ltd.	MSME	Large Scale
ONE	ONE	☐	☐	☐	☐
☐	☐	Proprietary	Partnership	Govt.	Contractor
TWO	TWO	☐	☐	☐	☐
☐	☐	Public Sector			
THREE	THREE	☐			
☐	☐				

	SJVN	FORM NO.: F-060-01 PAGE: 2 of 14 ISSUE: 2.0 REV. 01 DATE: 30/06/2016
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Sr. No.	Items / Services / Process for which Approval is desired for	Rating / Size & Type	Applicable Standards IS/DIN/BS/IEC Etc.

REGISTRATION DETAILS #			
PAN / TAN NO.	CENTRAL SALES TAX REG. NO.	STATE SALES TAX / TIN NO.	EXCISE DUTY REGISTRATION NO.
EXCISE CONTROL CODE NO.	SERVICE TAX REG. NO.	CATEGORY OF INDUSTRY	REGISTRATION NO. & VALIDITY DATE
		Micro ☐	
		Small ☐	
		Medium ☐	
		Large ☐	

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A. ORGANISATIONAL SOUNDNESS						
Sr. No.	DESCRIPTION		DETAILS TO BE FURNISHED			
1.	Nature of Business (Strike whichever is not applicable)		Manufacturing Unit / Engineering Consultant / Agents / Distributors / Stockists / Dealers / Traders / Indian Subsidiary / EPC contractor / Channel Partner (Attach authorization certificate of principal) / Erection contractor / Other			
2#	Year of commencement of Business / Factory Establishment					
3.	Year of Commencement of Manufacture / Services					
4.	Total Area/Covered Area in Sq. m.		Total Area	Covered Area		
5.	Electric Power-Connected Load					
6#	Electric Power Standby Load & System					
7.	Details of Directors					
Sr. No.	Name	Designation	Qualification	Experience		
8.	Details of Employees					
Please attach copy of Company's Organization Chart (For Unit)						
Division Status	Graduate		Diploma	Skilled	Un-Skilled	Remarks
	Technical	Non-Technical				
Production						
Engineering & Quality Control						
Administration & Other Supporting activities.						

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9. Brief Details of Product and Manufacturing Capability					
Sr. No.	Item & Material	Description (Type, Size Rating)	Annual Production for Last Three Years		
			I	II	III
10.#	Details of Foreign or Indigenous Collaborator				
Sr. No.	Product	Name & Address of Collaborator	Collaboration		
			Scope	Year	Valid up to
11#	Have your product been type tested by any external agency? If so, give details				
Sr. No.	Product	Test (Size / Type & class	Test Report No.	Next Due date	

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12.#	Have you been approved by any Statutory agency / third party agency like LLOYD, ASME, NTPC, PGCIL, EIL, Railways etc. ? If so, indicate details and enclose copies of approval letters				
Sr. No.	Item / Material / Service / Process	Description (Size, Type & Class)	Agency	Date of approval	Next Due date
13.#	Indicate Approval / Certification by National / International Standards / Agencies applicable for the subject product.				
Sr. No.	Product	Codes / Standards	License No. & Date		
14.#	Reference List (Experience in Particular Type of Equipment / Service / Process). Please indicate since how many years similar type of item / equipment / service / process provided (please furnish documentary evidence).				
Sr. No.	Item / Material / Service / Process	Type & Capacity / Rating	Customer (End User with Address)	Date of Supply / Service provided	Under Operation since year / Month
#Note: Please furnish the performance feedback certificate for proposed item / equipment / process / service form end user in line with requirement stipulated in Technical Specification.					

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	FORM	

15.#	Business Commenced with SAPDC/SJVN in past				
Sr. No.	Year	Name of Department / Project Dealt with	Item Supplied / Services Offered.		
16.A#	Machinery, Instrument & other Equipment Specific to Process & Product Facilities / service				
Sr. No.	Description of Machine	Capacity & Nos.	Location Shop	Make	Year of Manufg.
16.B#	Other General Facilities				
Sr. No.	Description of Machine	Capacity & Nos.	Location Shop	Make	Year of Manufg.
i	Material Handling Mobile Crane Fork Lift Over Head Cranes				
ii	Metal Cutting &				

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	Bending				
iii	Casting				
iv	Forging				
v	Fabrication				
vi	Welding				
vii	Machining				
viii	Heat Treatment				
ix	Sheet Metal				
x	Fettling & Cleaning, Sand Blasting, Shot Blasting & Pickling				
xi	Painting				
xii	Metal Coating				
xiii	Protection before packing				
xiv	Packing				
xv	Other				
17.#	If In-House Manufacturing Facilities not available, inform source of manufacturing details along with their facilities and experience				
Sr. No.	Process outsourced	Name of the company	Description of machine / Equipment	Remarks	
18. A#	Facilities for In-house Testing & Inspection				
Sr. No.	Description	Capacity & Nos.	Make & Year of Mfg.	Calibration Status	Approval Qualification

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18. B#	If In-house testing facilities are not available, indicate source of testing with relevant details.				
Sr. No.	Source of Testing	Description	Capacity & Nos.	Make & Year of Mfg.	Approval Qualification
Note: In case of outsourcing of major testing such as NDT, Electrical & Mechanical testing, no marks will be awarded. However, material composition testing by chemical method from NABL Lab shall not attract negative marking.					
18 C #	Details of any Government Laboratory facility available in area				
	Product related testing facility (type / Performance / Routine / Acceptance Test)				
19	Sources of Raw Material and Bought out Items				
Sr. No.	Description of Raw Material / Bought Out Items			Source	
20 #	Storage Area Availability				
	Storage for finished goods (Open / Close)				
	Raw Material storage and identification				

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21 #	Do you have in-house Design / R&D departments?	
22 #	Details of pending legal issues on contractual aspects with customers, if any.	
23 #	Please furnish details of Labour problems in the last three years, if any?	

B. FINANCIAL SOUNDNESS OF ORGANIZATION				
Financial Information for last Three Years (Please furnish copy of annual report)				
Sr. No.	Parameters	Year 20	Year 20	Year 20
1#	Please furnish annual turnover of the company. Growth in annual turnover w.r.t. previous years (%)			
2#	Please furnish Profit before tax (PBT) of the company. Growth in PBT w.r.t. previous years (%)			
3#	Please indicate the net worth (Net current assets – Net current liabilities) of the company?			
4#	Whether the vendor has been referred to BIFR / NCLT / any other similar Govt. agency.			
5#	Whether the supplier is a potentially sick company.			
6	Please mention current order book position, as on date in terms of Value and time			

C. QUALITY SYSTEM		
Sr. NO.	DESCRIPTION	Sub-vendor response (along with supporting document)
1*	Are you an ISO 9001 company? If yes, please furnish the certificate and what is your quality policy?	
2*	Is the company an ISO 14000 approved?	
3#	Is the company an OHSAS approved?	
4*	Have your company won any Quality award like Rajeev Gandhi National Quality Award, DMC Ramkrishna Bajaj National Quality Award, Golden Peacock National Quality Award etc? If yes provide documentary evidence.	
5*	Have you received appreciation letter from your customer. Please provide evidence.	
6	To whom your Q.C./Q.A. Chief reports to ? (Please furnish your organization structure)	
7*	If you have a written quality control manual/procedure, then please furnish the same.	

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7 (i) *	Incoming Material Control System (Furnish a copy of system and organization)	
7 (ii) *	Process Control: Are written procedure defining stage wise operations and functions on shop floor established and followed? (Furnish copy of work instruction and record of process control parameter)	
7 (iii) *	Manufacturing/Testing Procedure Qualification & Personnel Qualification (Procedure qualification specification & Record of personnel qualification (PQR) to be submitted).	
7 (IV) *	Are written Quality Control Instruction sheets prepared & properly used? (Please furnish evidence)	
7 (V) #	Are records generated during inspection maintained & available for review? (Please furnish evidence)	
7 (VI) *	Are quality control checks / procedure adequate to maintain desired quality level right from the incoming stage to final stage? Please furnish copy of such control checks / procedure.	
8.#	Documentation Control	
8 (i)	Does a system for clear and precise stipulation of responsibilities for documentation issue & change control exists?	
8 (ii)	Are changes made in writing?	
9*	Control of Inspection, measuring and testing equipment	
9 (i)	Are necessary gauges, testing and measuring equipment's, available and used?	
9 (ii)	Are testing and measuring equipment properly maintained?	
9 (iii)	Is recorded control on calibration of equipment available?	
10*	System of Identification & Traceability of materials, tools, jigs, fixtures & processed components, etc. (Copy of procedure to be submitted).	
11*	System of Storage / Preservation / Painting and Packing (copy of Procedure to be submitted)	
12*	Do you have written procedure for disposing off the non-conformities? If yes, please furnish the copy of the same also furnish three copies of NCR & CAPA.	
13*	Safety measures (Submit copy of safety system & record of accidents for last two years)	
14#	What type of Sampling Inspection Plan is used in your factory/company? Please furnish details.	
15	How good are you in keeping your dispatch commitments? Please give details of last ten deliveries stating details as below (Provide documentary evidence) Within delivery period:	

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	Delayed but accepted by user: Delayed but accepted with penalty:	
16 [#]	Have you ever been de-listed or put in under temporary suspension by any customer / contractor.	
D. AFTER SALES SERVICE		
Sr. NO.	DESCRIPTION	Sub-vendor response (along with supporting document)
1 [#]	For overcoming product deficiencies what are the analytical methods used at Customer's premises?	
2 [#]	What is the strength of your "after-sales service" team?	
3 [#]	What is the response time after receiving complaints from the customers? Provide evidence.	
4 [#]	Customer complaints handling system (Submit list of customer complaints & status for the last three years) Please furnish complete list of complaints attended to during last one year.	
5 [#]	How do you keep your "after-sales service" team updated?	
6 [#]	Provide certificate from 02 customers (end user) for satisfactory after sales services.	

Declaration by Director/ Partner/ Proprietor

I declare that the information furnished above and attached documents are correct to the best of my knowledge. I undertake to inform you at the earliest any change(s) in the details mentioned above.

Signature and Date

Name & Designation

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	FORM	

TO BE FILLED BY MAIN CONTRACTOR FOR SUB-VENDOR (MC)

Sr. No.	Parameters	Supplier response (along with supporting document)
1	Name and address of sub-vendor:	
2 (a)	Type of equipment / item / process / service for which approval is sought:	
2 (b)	Details of equipment / item / process / service for which approval is sought (i.e. Rating, capacity, type, size, weight, etc.):	
3	Experience of main contractor with sub-vendor:	
(a) [#]	Since how many years sub-vendor is registered with you for proposed type of equipment / item / process / services (furnish documentary evidence):	
4 [#]	Whether sub-vendor is meeting the qualification criteria indicated in the technical specification (furnish documentary evidence).	
5 [#]	Sub-vendor rating as per contractor's internal procedure in the scale 0-10 or 0-100% (furnish documentary evidence).	
6 [#]	Any dispute of main contractor with vendor during execution of last 05 contracts.	
7 [#]	Have you ever de-listed or put in temporary suspension the proposed sub-vendor? If yes, please provide the reason for same.	
8	Please indicate the reason for re-approving / re-listing the sub-vendor.	

I declare that the information furnished by Sub-vendor has been verified and found in order / minor changes which have been marked and initialed on this form itself / observed the following discrepancies.

(Signature & Designation)

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GUIDELINES TO SUPPLIERS FOR FILLING-UP VENDOR/SUPPLIER REGISTRATION FORM

- All columns are to be filled up properly in the space provided for. Wherever it is not applicable / not available, please mention "Not Applicable" / "Not Available". All pages of the form are to be signed along with seal by the authorized signatory.
- A separate sheet may be attached if the space provided is insufficient or additional information is to be given, Please put proper identification tag on the separately attached sheet.
- Any information / clarification required by SAPDC/ Consultant during evaluation must be given expeditiously.
- Please ensure that all required enclosures are attached with the filled up Vendor Registration Form.
- Marks shall be awarded on the basis of documentary evidences submitted by Vendor / sub-vendor wherever called in vendor / sub-vendor assessment form.
- Incomplete or incorrect forms will be rejected.
- Please fill up the check list given below and send along with the vendor registration forms to SAPDC/Consultant.
- In case any information found incorrect / false, the vendor shall be rejected / de-listed at any stage.
- Information with # marks is score able.
- Accepting or rejecting a vendor is sole discretion of SAPDC.
- Product catalogue / manual for the proposed item / equipment / process / service, if available, shall be submitted alongwith other documents.

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	FORM	

Furnish following information/Documents:-

Sr. No.	Description	Yes / No	Page No / Annexure
1	Latest audited annual account.		
2	Balance Sheet.		
3	Valid Income Tax Clearance Certificate.		
4	Details of Pending Arbitration cases.		
5	Details of pending disputes with Statutory Authorities.		
6	Organization chart		
7	Copy of Performance certificate (minimum 03)		
8	Copy of minimum three (03) completion certificates of similar work / service.		
9	Letter of approval from ASME / NTPC/ EIL / Railway / Lloyds / Power Grid etc. if any.		
10	ISO: 9001 certificate		
11	Quality Manual		
12	ISO: 14000 certificate		
13	OHSAS, ISO 18000 certificate		
14	Experience list		
15	Type test report & approval certificate		
16	Product Approval certificate from national / international agency.		
17	Quality award certificate		
18	Process and Personnel qualification certificates		
19	Copy of registration / enlistment with reputed / large organizations		
20	Detail of existing clients and details such as address, contact number and mail address.		
21	List of works / projects of similar nature executed with documentary evidences of works executed in last 02 years.		
22	Other documents mentioned elsewhere in vendor / sub-vendor assessment form.		

(Signature & Designation)

	SJVN	FORM NO.: F-080-02 PAGE: 1 of 1 ISSUE: 2.0 REV. 01 DATE: 30/06/2016
	FORM	

	PROJECT NAME (MW)			MANUFACTURING / FIELD QUALITY ASSURANCE PLAN				CONTRACTOR NAME, ADDRESS & LOGO			
	ITEM DESCRIPTION			SUB-ITEM	QAP NO.	REV. NO	ISSUE DATE	SUB-CONTRACTOR NAME, ADDRESS & LOGO			
SR. NO.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY	REMARKS
					M/C	S				M C S	
1	2	3	4	5	6	7	8	9	10	11	
LEGENDS											
M	MANUFACTURER		C	CONTRACTOR		S	SAPDC LTD.				
P	PERFORM		V	VERIFICATION OF RECORDS		W	WITNESS / CHP				
IR	INSPECTION REPORT		DRG	DRAWING		CHP	CUSTOMER HOLD POINT				
MA	MAJOR		MN	MINOR		CR	CRITICAL				
ME	MEASUREMENT		NDT	NON DESTRUCTIVE TESTING		HT	HEAT TREATMENT				
TR1	CERTIFICATE OF COMPLIANCE TO TS/STANDARD REQUIREMENT WITHOUT ANY CHECK LIST OF TESTS CARRIED OUT.		TR2	CERTIFICATE OF COMPLIANCE TO TS/STANDARD REQUIREMENT WITH CHECK LIST OF TESTS CARRIED OUT.		TR3	TEST REPORT/TEST CERTIFICATE WITH TEST RESULTS BASED ON SPECIFIC INSPECTION & TESTING AT MANUFACTURER FACILITY/NABL APPROVED LAB.				
NOTE: QAP SHALL BE READ IN CONJUNCTION WITH QUALITY ASSURANCE REQUIREMENT GIVEN AS PART OF TECHNICAL SPECIFICATION.											
MANUFACTURER / SUB-CONTRACTOR:			CONTRACTOR:		FOR SAPDC USE:		REFERENCE DOC NO. OF SJVN:				
PREPARED BY:		REVIEWED BY		REVIEWED & RECOMMENDED BY		REVIEWED BY		RECOMMENDED BY		APPROVED BY	
NAME, DESIGNATION & SIGNATURE		NAME, DESIGNATION & SIGNATURE		NAME, DESIGNATION & SIGNATURE		NAME & SIGNATURE		NAME & SIGNATURE		SIGNATURE & SEAL	

Prepared By:	Reviewed By:	Approved By:
		Process Owner

[illegible]

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	FORM	

NON-CONFORMITY REPORT FOR MANUFACTURING, TRANSPORTATION, STORAGE & ERECTION STAGES		FOR SAPDC USE ONLY
		NC NO.
		Date:
		PAGE 3 of 5
FOR SAPDC INTERNAL USE ONLY		
RECOMMENDATION of INCHARGE of RIO or FQA (In case of Major)/ CONCERNED SAPDC 's INSPECTION/ SITE ENGINEER (In case of Minor)		Disposition Code
DATE _____ NAME & DESIG. _____ SIGNATURE _____ RECOMMENDATION OF SAPDC CONCERNED ENGINEER		Disposition Code
DATE _____ NAME & DESIG. _____ SIGNATURE _____ GROUP HEAD		
DATE _____ NAME & DESIG. _____ SIGNATURE _____ RECOMMENDATION OF SAPDC (FOR MAJOR CATEGORY) (Comments of Engineering / Others deptt as applicable to be considered)		
DATE _____ NAME & DESIG. _____ SIGNATURE _____		

	SJVN	FORM NO.: F-060-04 PAGE: 4 of 5 ISSUE: 2.0 REV. 01 DATE: 28/06/2016
	FORM	

NON-CONFORMITY REPORT FOR MANUFACTURING, TRANSPORTATION, STORAGE & ERECTION STAGES		FOR SAPDC USE ONLY
		NC NO.
		Date:
		PAGE 4 of 5
PART B (Verification of Corrections of Non-Conformity)		
(Filled after Completion of corrections of Non-Conformity)		
ACTION TAKEN BY SUPPLIER/ CONTRACTOR (Attach Report of verification)		
DATE _____ NAME & DESIGN _____ SIG.OF SUPPLIER/ CONTRACTOR _____ SEAL _____ VERIFICATION BY SAPDC'S SITE ENGINEER/ INSPECTION ENGINEER		
DATE _____ NAME & DESIG. _____ SIGNATURE _____ IN-CHARGE of RIO/ FQA		
DATE _____ NAME & DESIG. _____ SIGNATURE _____ COMMENTS OF SAPDC ENGINEER		
DATE _____ NAME & DESIG. _____ SIGNATURE _____ GROUP HEAD		
DATE _____ NAME & DESIG. _____ SIGNATURE _____ HOD		
DATE _____ NAME & DESIG. _____ SIGNATURE _____		

	SJVN	FORM NO.: F-060-04
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NON-CONFORMITY REPORT FOR MANUFACTURING, TRANSPORTATION, STORAGE & ERECTION STAGES	FOR SAPDC USE ONLY
	NC NO.
	Date:
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INSTRUCTIONS 'MAJOR' NONCONFORMITY IS DEFINED AS DEPARTURE FROM SPECIFICATION WHICH AFFECTS PERFORMANCE RELIABILITY. SAFETY INTERCHANGEABILITY. ERECTION, COMMISSIONING OR WORKING LIFE ALL OTHER NON-CONFORMITIES SHALL BE TREATED AS CATEGORY 'MINOR'. - ACCEPTANCE OF DISPOSITIONED NON-CONFORMANCE IS WITHOUT PREJUDICE TO SAPDC RIGHT TO CLAIM COMMERCIAL REBATE AND DOES NOT ABSOLVE CONTRACTUAL OBLIGATIONS. - OBTAINING APPROVAL OF STATUTORY AUTHORITY IF ANY W.R.T. ABOVE NON CONFORMANCE IS THE RESPONSIBILITY OF SUPPLIER/ CONTRACTOR. - DISPOSITIONING OF THIS NON-CONFORMANCE IS FOR THIS SPECIFIC CASE ONLY AND NOT TO BE REGARDED AS PRECEDENCE. DISPOSITION CODE THE NON-CONFORMANCE SHALL BE DISPOSITIONED AS UNDER BY SAPDC AND SUPPLIER. (GIVE CODE AT APPROPRIATE BOXES):- (01) NC-REJECTED (02) NC- CONDITIONALLY ACCEPTED (SPECIFY CONDITION) (03) NC-ACCEPTED AS-IT-IS (04) NC-ACCEPTED WITH REPAIR. NC NUMBER - THIS NO. SHALL BE ALLOTTED BY SAPDC AND SHALL HAVE SAPDC PROJECT NAME, PACKAGE, FOLLOWED BY RUNNING SERIAL NO. & ENTER TO NC REPORT BY RIO/ FQA/ CQAL.

RESPONSIBILITIES OF CONTRACTOR - ASCERTAIN EXACT NATURE OF NON-CONFORMANCE AND ALONGWITH SUPPORTING DRAWING OF ITEMS/ EQUIPMENT ETC WITH WHICH NON-CONFORMANCE EXISTS. - IDENTIFY THE CAUSE OF NON CONFORMITY. - DECIDE ON CODE OF DISPOSING. - FINALISE THE CAUSE OF NON-CONFORMITY AND PROPOSE CORRECTIVE ACTION. - ENSURE AND CERTIFY THAT THE PRODUCT QUALITY PERFORMANCE, RELIABILITY AND WORKING LIFE IS NOT AFFECTED FOR MINOR NON-CONFORMITIES AND QUANTIFY THE EXTENT TO WHICH IT IS AFFECTED IN THE CASE OF CATEGORY 'MAJOR' NON-CONFORMITIES. - IMPLEMENT AGREED CORRECTIVE ACTION IN A TIME BOUND PROGRAMME AND PROVIDE FEEDBACK AS PER PART-B OF THE FORMAT

RESPONSIBILITIES OF RIO/ FQA - IDENTIFY THE PRODUCT APPROPRIATELY. - ANALYSE THE CAUSE OF NON-CONFORMITY AND PROPOSE RECOMMENDATION
--

	SJVN	FORM NO.: F-060-06
	FORM	PAGE: 1 of 1 ISSUE: 2.0 REV. 00 DATE: 30/06/2016

INSPECTION CALL REQUEST

Inspection Call No.		Date:				
Project:		Contract No. :				
Contractor/Supplier's Name & Address:		Sub-vendor/Sub-Supplier's Name & Address:				
Contact Person:		Contact Person:				
Telephone/Mobile No.:		Telephone/Mobile No.:				
Fax No.		Fax No.				
email ID:		email ID:				
Details of Equipment with Unit No.:						
Sr. No.	Equipment/Item Description and Sr. No.	Unit No.	BBU Ref.	QAP No. & Rev. No.	Relevant QAP Clause No.	Approved Drawing No. & Rev. No.
Status of Type Tests		Approved / Not Approved / Not Applicable		Place of Inspection:		
Proposed date of Inspection:				Anticipated Working Days Required		
Status of internal inspection by Vendor/sub-vendor		Completed		In-progress	Yet to be done	
Tentative date of completion of internal inspection in case inspection is in-progress/yet to be done:						
Note: Readiness status is to be submitted separately after completion of internal inspection by Manufacturer.						

Date:
Place:

Signature
Name
Designation
Department
Company

Annexure F - Export Worthy Packing

1.0 SCOPE:

For export jobs, sea worthy packing capable of performing all necessary functions like prevention of damage to the contents, sufficient to support frequent handling and lengthy periods of outdoor storage in adverse weather conditions are required. Workmanship and material used shall meet the technical requirements and be in accordance with best commercial export packing practices. Vendor shall be responsible for the packing, however, it shall meet the minimum requirements specified herein. Equivalent or better packing methods may be deployed subject to approval of the purchaser. Vendor shall submit the packing procedure for its equipment for purchaser's approval during detailed engineering.

2.0 TECHNICAL SPECIFICATION OF WOOD:

The wood shall be Fir, Chir, Silver Oak (Grevillea Robusta) or chemically treated mango with moisture content not exceeding 50 %. The wood shall have flexural & compressive strength, stiffness, shock absorption and nail retention properties. The wood shall be free from common defects such as warp, bone, twist, knot, cracks, splits, end splits, bend, visible sign of infection and any kind of decay caused by insects, fungus etc. Surface cracks with a maximum depth of 3 mm are permissible. A continuous crack of any depth all along the length is not allowed.

The wood shall be chemically treated to provide protection against deterioration due to fungi and attack by termites, borers, marine organism and any other kind of infection. It shall be treated only after final processing like cutting, planing, joint grooving etc.

3.0 TYPE, DESIGN & DIMENSION OF WOODEN PACKING CASES:

3.1.1 PACKING OF EQUIPMENTS:

Various mechanical, electrical and C&I equipment e.g. pumps, motors, equipment skids, heat exchangers, control panels, switch gears, transformers etc. shall be wrapped in weather proof packing and then secured in wooden packing cases. The construction of wooden packing cases shall be as per details given below and also in figures 1 to 11.

3.1.1 BOTTOM FRAME:

The construction of bottom frame shall be as per fig. 2. The number of slides/runners for bottom frames shall be selected depending upon the weight and overall dimension of the load to be carried. The equipment shall be secured by fixing their base frame/plate with the help of bolt & nuts etc to the bottom frame of the wooden packing cases. The equipment not provided with the base frame/plate like

cylindrical vessels etc. to be secured to the bottom frame of the wooden case with 'C' clamps fabricated from steel channels/angle irons.

3.1.2 TOP FRAME:

The construction of top frame shall be as per fig. 3.

3.1.3 END PANELS:

The dimensions of the end and lateral panels shall be calculated according to overall dimensions of the items to be packed.

Diagonal braces shall be used for packing cases having height exceeding 500 mm. Detail of bracing shall be as per figure 5 to 8.

3.1.4 SLING PLATE:

To facilitate lifting of cases, longitudinal under slide boards shall be fixed. To avoid damage to the box while lifting sling plates shall be provided. Refer fig. 11.

3.1.5 ANGLE IRON CLEATS :

Angle iron cleats shall be used for strengthening the joints as indicated in fig. 10.

3.1.6 OTHER REQUIREMENTS:

The thickness of planks for top, bottom, side and end panels shall be at least 25 mm. Planks used for this purpose shall be joined with each other by tongue & groove joint. The groove dimension shall be such that tongue fits tightly into groove to make good joint.

Runners/slides, traverse bars etc. shall be of single length i.e. without any joint. Planks for sheathing, diagonal bracing etc shall also be of single length upto 2400 mm. For sizes larger than 2400 mm, proper jointing is permitted for planks for sheathing and diagonal bracing.

Each equipment to be individually covered with double polyethylene petticoat. Sheet thickness of polyethylene sheet shall not be less than 0.175 mm (175 microns). The sealing shall be such so as not to allow moisture inside.

The inner surface of 4 sides of shooks shall be nailed with bituminised water proof kraft paper. Wherever 2 pieces of kraft paper are used, the joint shall have an overlap of minimum 20mm.

All the inner sides of the box shall be nailed with bitumen coated hessian polyethylene kraft paper. For top frame it shall project on all sides by 100mm and shall be nailed on sides. Wherever 2 pieces of kraft paper are used, the joint shall have an overlap of minimum 20mm.

For delicate equipment like control panels, switchgears etc suitable cushioning material like rubberized coir shall be provided on their bottom support. The thickness of coir shall be 50 mm (minimum) and width 100 mm (minimum).

For control panels and switchgears, the gap between the panel and casing shall be filled with rubberized coir with distance between consecutive supports less than 500 mm (ref fig 15). For other equipment suitable support from sides of the casing to be provided.

Switchgear cubicles, control panels and control desks shall be packed and shipped in separate convenient sections. The components e.g. circuit breakers relays and instruments etc. which are removed from panels for shipping purpose shall be separately packed and shipped as per packing instructions in clause 3.2.

Packing case for control panels & switchgear panels shall be finally covered with GI sheet of minimum thickness of 0.4 mm.

Packing cases shall be bound at edges by nailing MS clamps/brackets at sufficient intervals. Further, heavier boxes shall be strapped with 'C' clamps (ref fig 4) fabricated from steel channels/angles and lighter boxes shall be strapped with hoop iron strips.

3.1.7 ALTERNATIVE PACKING CASES FOR CONTROL PANELS AND SWITCHGEARS

If required, for control and switchgear panels, construction of wooden packing cases may be provided as per fig 14 & 15 and as detailed below:

Thickness of planks for all sides, binding and jointing battens shall be atleast 25 mm. Width of planks shall be at least 125mm and that of binding and jointing planks shall be at least 100 mm.

Top frame shall be suitable so that it does not collapse due to sandwiching between slings while lifting. Longitudnal and traverse bars for the bottom wooden pallet to be suitably selected.

Diagonal bracings shall be as per clause 3.1.3 and All other requirements shall be as per clauses 3.1.4 to 3.1.6.

3.2 PACKING OF LOOSE ITEMS:

Loose mechanical, electrical and C&I items eg valves, fittings, pressure/temperature gauges/switches, circuit breakers, relays etc shall be individually wrapped using polyethylene sheets/U foam/thermocole sheets/air bubbled sheets depending upon the item and then packed in wooden boxes. The left out spaces and top of the boxes shall be filled with rubberized coir to get proper cushioning effect. Special attention is to be paid to relays, instruments etc for arresting the movement of their operating mechanisms during transportation.

The construction of wooden packing case shall be as per clause 3.1 retaining its all features concerning strength of box. The construction of wooden packing case for loose electrical and C&I items shall be as per fig. 16.

Inner surface of 6 sides of the box shall be lined with Bitumen coated hessian polyethylene kraft paper. Rubberized coir of min. 25 mm thickness and 100 mm width shall be nailed to inner surfaces of bottom and 4 sides of the box.

Loose items such as Galvanised Steel Structure, Cable support racks, Cable Trays and GI Pipes etc. shall be individually wrapped using polyethylene sheets and further lots may be wrapped in Bitumen coated hessian cloth.

4.0 MOISTURE ABSORBER:

Silica gel is used for this purpose to protect contents over sufficiently long time from corrosion. Silica gel shall be of indicating type conforming to IS-304-1979 packed in cotton bags placed at different positions inside the packing for absorbing moisture and shall not come directly into contact with the equipment / material inside the package. The quantity of silica gel shall be enough for storage period of one (1) year, however, it shall not be less than 4 gms per litre volume of case subject to minimum of 400 gms per case.

5.0 INDICATION MARKS ON THE BOXES:

Markings shall be provided on the boxes indicating position of boxes for handling, storage and nature of consignment. For guidelines refer figure 12. The ink used for this purpose as well as for marking despatch instruction shall be indelible/nonwashable marking ink.

6.0 DESPATCH DETAILS:

External front and rear sides of the boxes to be planed for writing instructions.

Dispatch details such as consignor/consignee address, contract and case details, country of origin , port of delivery, stacking instructions shall be written on one of the side of boxes. An anodised aluminium plate shall be provided on one side of the boxes.

One copy of packing slip wrapped in polyethylene bag covered with aluminium packing slip holder to be nailed on the external surface of the box. One more copy of the packing slip wrapped in polyethylene bag to be kept inside the box at the prominent place.

7.0 INSPECTION:

There shall be a Customer Hold Point (CHP) for inspection of final assembly of packing. During above inspection, the records for Chemical Treatment shall be reviewed.

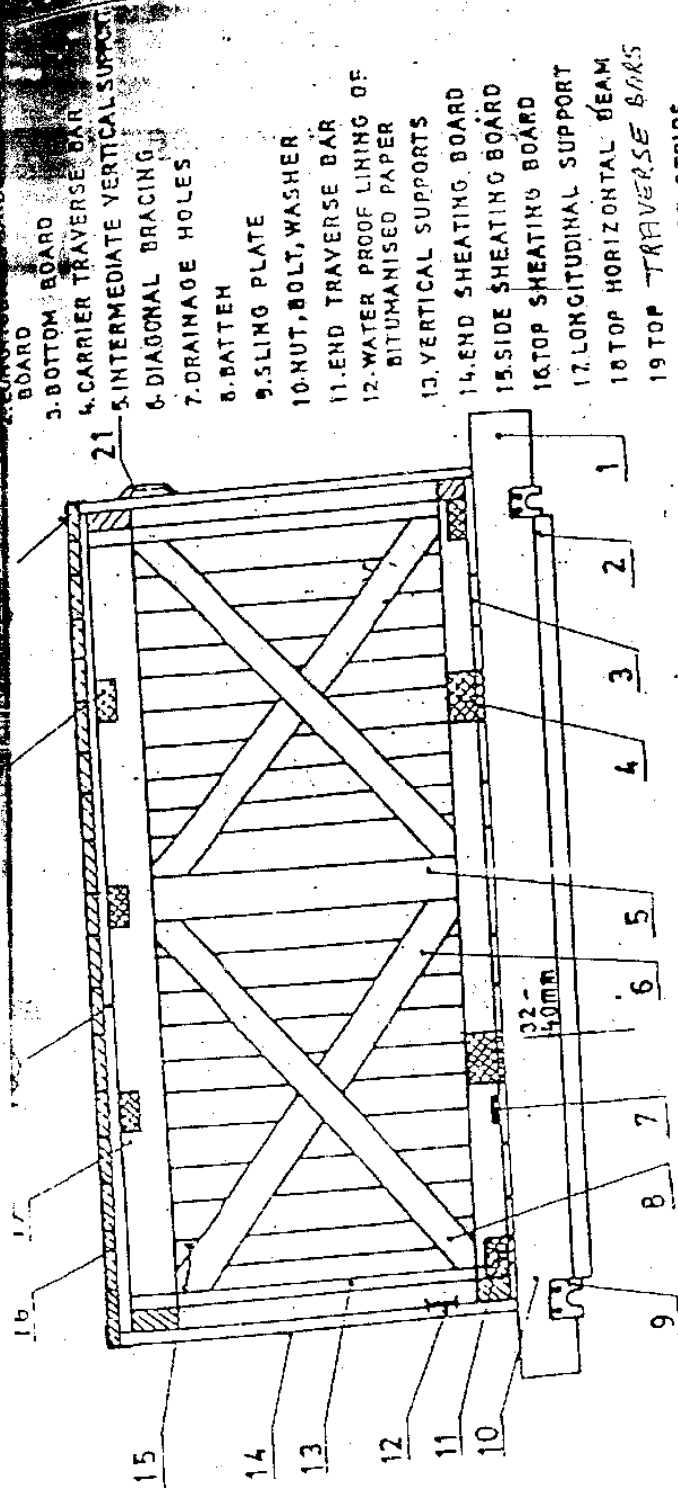


FIG. 1

NOMENCLATURE OF PARTS OF PACKING

CASIS

FIG. -1

BOTTOM FRAME ARRANGEMENTS

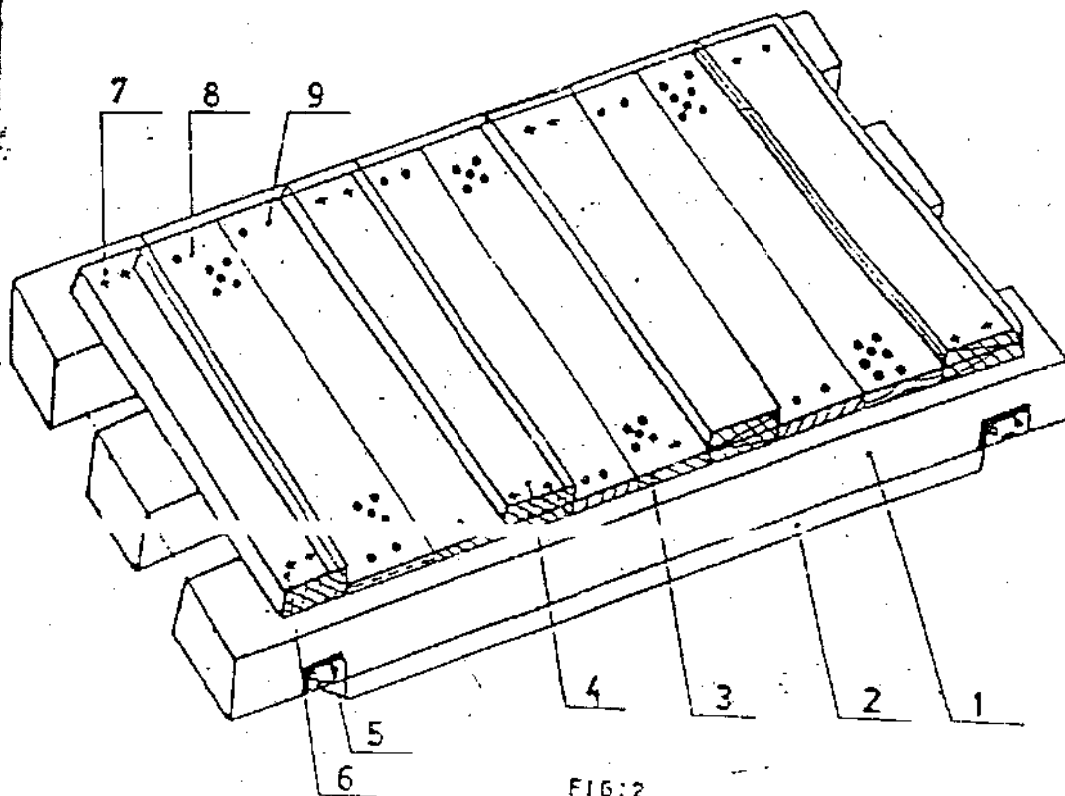


FIG:2

Nos. of slides : Minimum 2 Nos.

For length more than 1800 mm or
load more than 1000 kg, Nos. of
slides shall be minimum 3 Nos.

For dimensions of slides, refer Table 1

Cross section of end traverse bar; 100 X 100 mm.
(minimum)

1. SLIDE
2. UNDER SLIDE BOARD
3. BOTTOM BOARD
4. CARRIER TRAVERSE BAR
5. SLING PLATE
6. TRAVERSE BAR
7. BOLT, NUT & WASHER
8. DRAINAGE HOLES
9. NAILS

TOP FRAME ARRANGEMENT

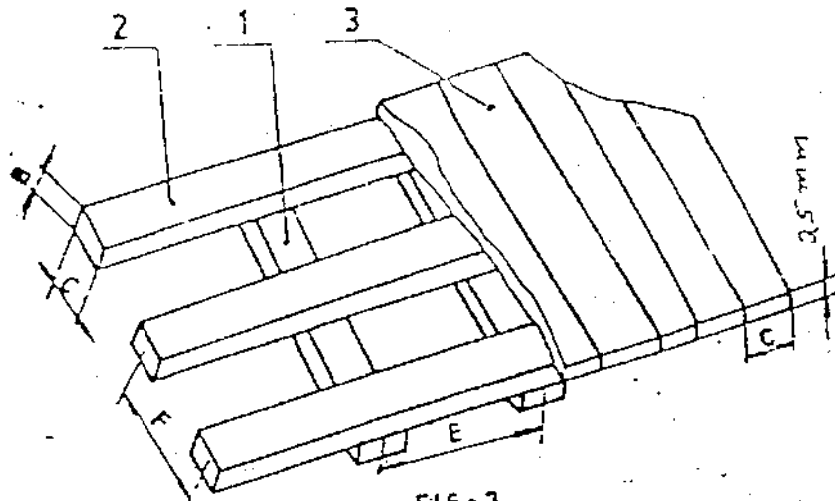


FIG-3

Dim F : 700 to 1000 mm
 Dim E : 500 to 900 mm
 B x C : 30 x 100 mm.

- 1 - Traverse Bars
- 2 - Horizontal Scans
- 3 - Top Board

ARRANGEMENT OF C-CLAMPS AROUND CASES

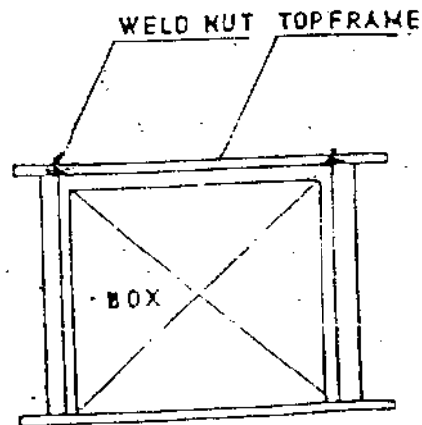
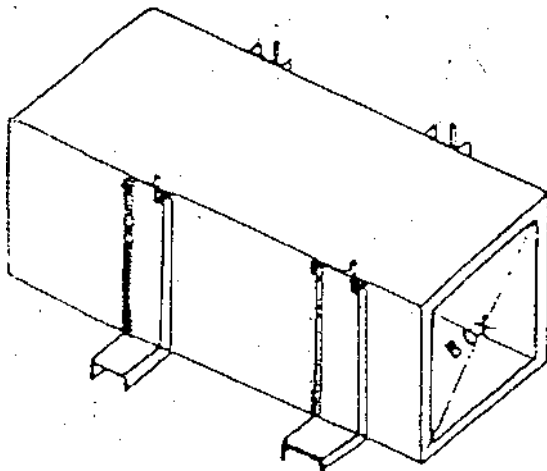


FIG:4

ARRANGEMENT OF DIAGONAL BRACING AND HORIZONTAL SUPPORT

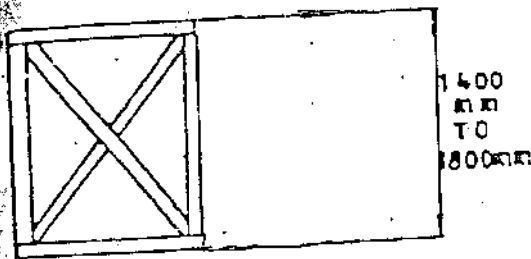


FIG: 6

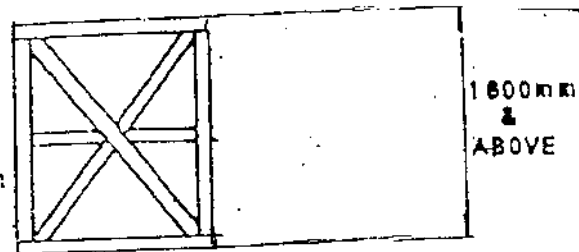


FIG: 8

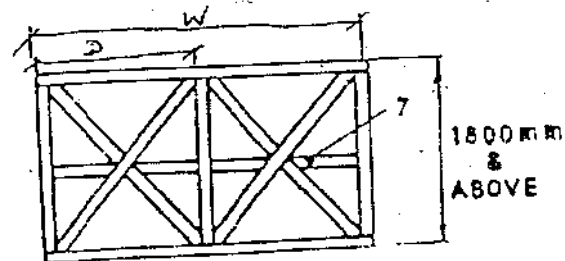


FIG: 9

7- Middle Horizontal Support

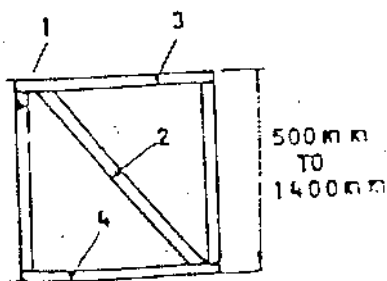


FIG: 5

- 1- Vertical Support
- 2- Diagonal Bracing
- 3- Upper Horizontal Support
- 4- Lower Horizontal Support

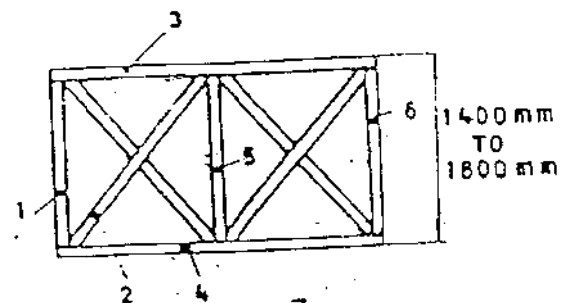
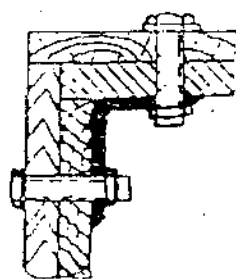
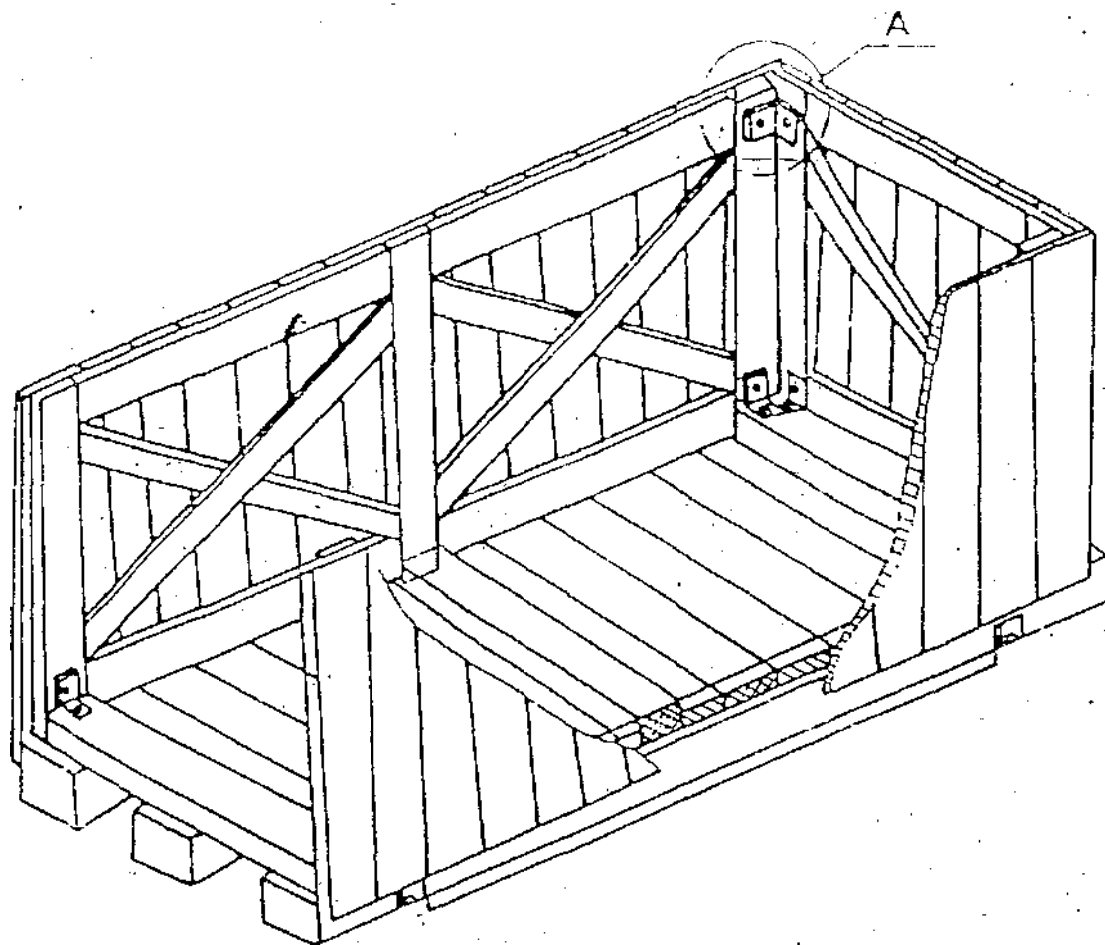


FIG: 7

- 1, 5, 6 - Vertical Support
- 2 - Diagonal Bracing
- 3 - Upper Horizontal Support
- 4 - Lower Horizontal Support

The dimensions of various items shall be as Table-2

ARRANGEMENT OF PACKING CASE



DETAIL-A

HOLE DIAMETER
MUST CONFORM
TO BOLT DIA

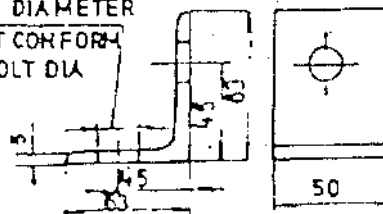


FIG:1D

ARRANGEMENT OF SLING - PLATE ON
CASES

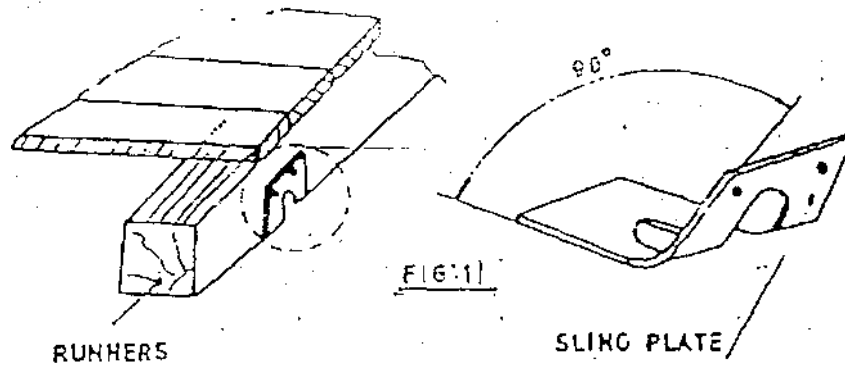


Table 1

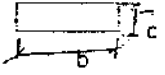
load	Length of Slides						
	600	800	1000	1200	1300	1500	2000
	Cross Section $b \times c$ 						
500	50 x 100	50 x 100	50 x 100	50 x 100	75 x 100	75 x 100	100 x 100
800	50 x 100	50 x 100	75 x 100	75 x 100	75 x 100	75 x 100	100 x 100
1000	75 x 100	75 x 100	75 x 100	100 x 100	100 x 100	100 x 110	100 x 150
1500	75 x 100	75 x 100	100 x 100	100 x 100	100 x 100	100 x 150	100 x 150
2000	75 x 100	100 x 100	100 x 100	100 x 150	100 x 150	100 x 150	150 x 150
2500	75 x 100	100 x 100	100 x 150	100 x 150	100 x 150	150 x 150	150 x 150
3000	100 x 100	100 x 150	150 x 150	150 x 150	150 x 150	150 x 150	

Table 2

End and side Panels	Width of the panel W	Distance between longitudinal support DIM 'D'						
		600	800	1000	1200	1400	1600	1800
		Cross Section (b : c)						
Fig 5 to Fig 9	600 to 1200	30 x 100	30 x 100	30 x 100	30 x 130	30 x 130	30 x 130	30 x 130
	1201 to 1600	30 x 130	30 x 130	30 x 130	30 x 130	30 x 130	30 x 130	30 x 130
	1601 to 2000	30 x 130	30 x 130	30 x 130	30 x 130	30 x 130	30 x 130	30 x 130
	2001 to 3000	30 x 130	30 x 130	30 x 130	30 x 130	30 x 130	30 x 130	40 x 150
	3001 to 4000	30 x 130	30 x 130	40 x 150	40 x 150	40 x 150	40 x 150	40 x 150

INDICATION MARKS ON CASES

SL. NO.	INDICATION MARK	MEANING
1		TOP SIDE
2		KEEP AWAY FROM HEAT
3		SLINGING POSITION
4		FRAGILE MATERIAL - HANDLE WITH CARE
5		CENTRE OF GRAVITY
6		KEEP DRY

BHEL-PEM-DELHI-INDIA					
CONSIGNEE					
MATERIAL			MO. NO.		
CUSTOMER REF.			CASE NO.		
DESPATCH ADVICE NOTE NO.			NET WT -KGS	GROSS WT -KGS	
DIMENSIONS(MM) LXBXH					
SPECIAL INSTRUCTIONS	HANDLE WITH CARE - KEEP DRY DO NOT DROP - DO NOT TILT				

FIG-13: MARKING PLATE.

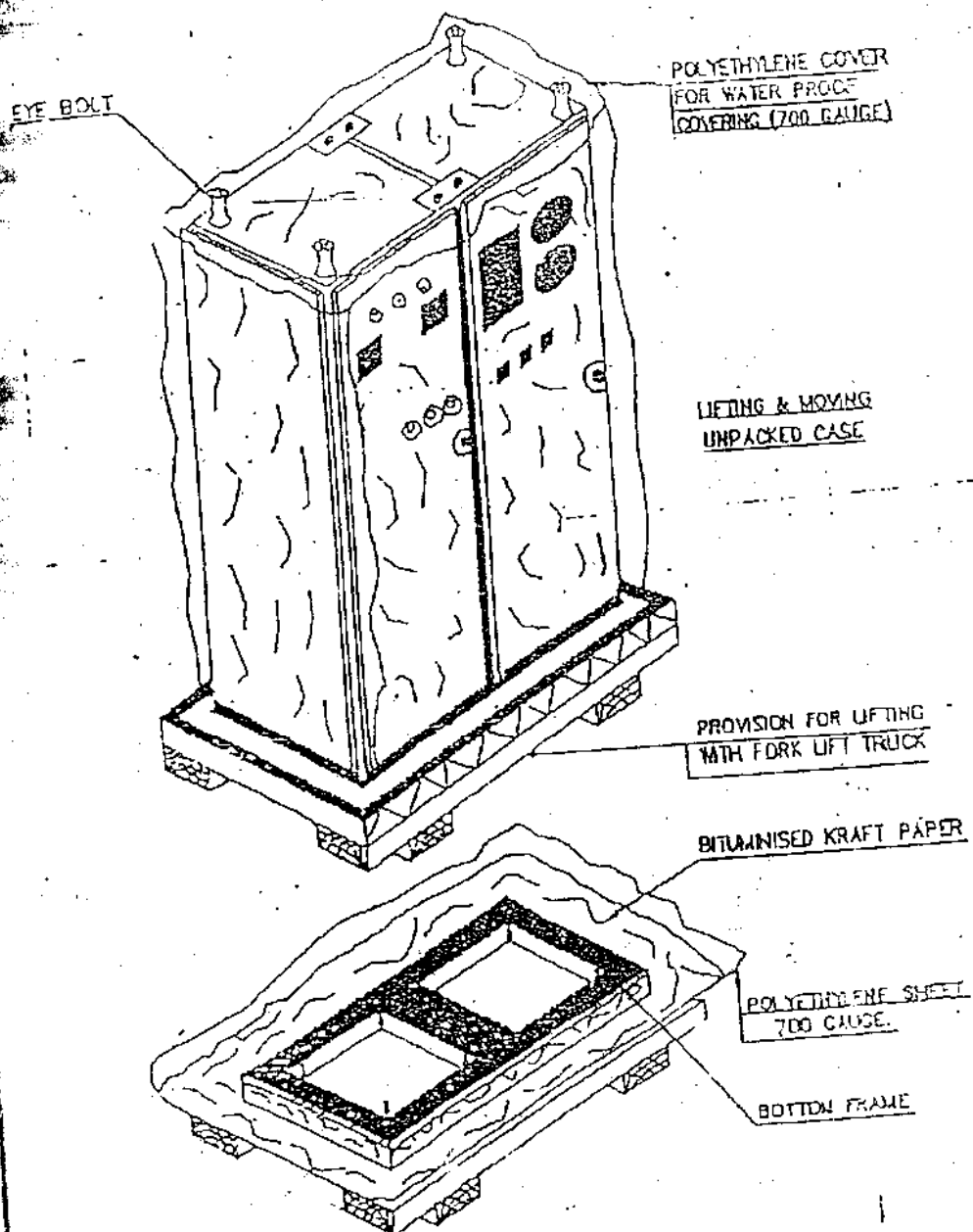


FIGURE-14

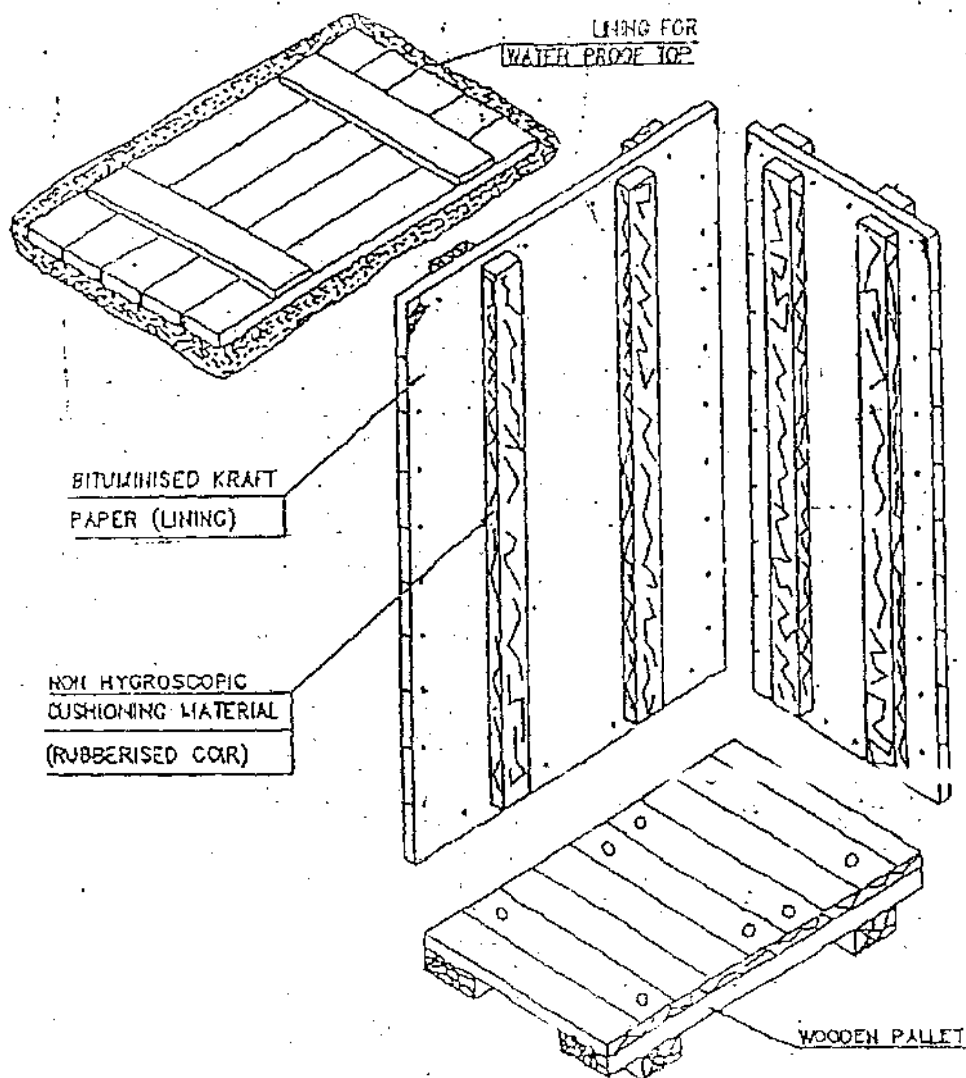


FIGURE-15

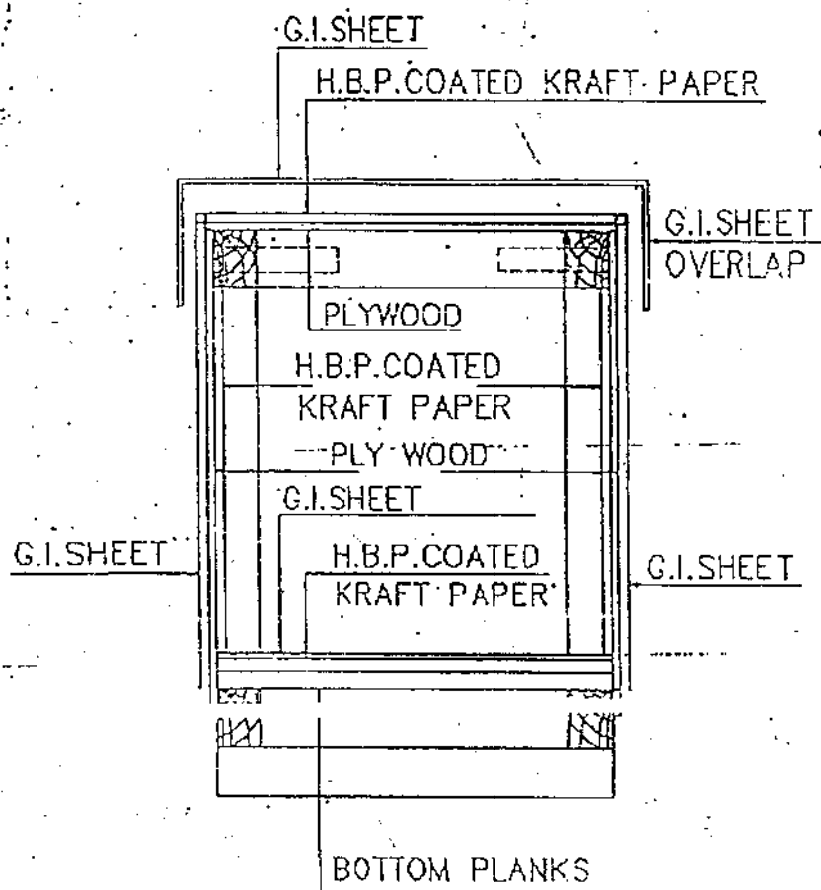
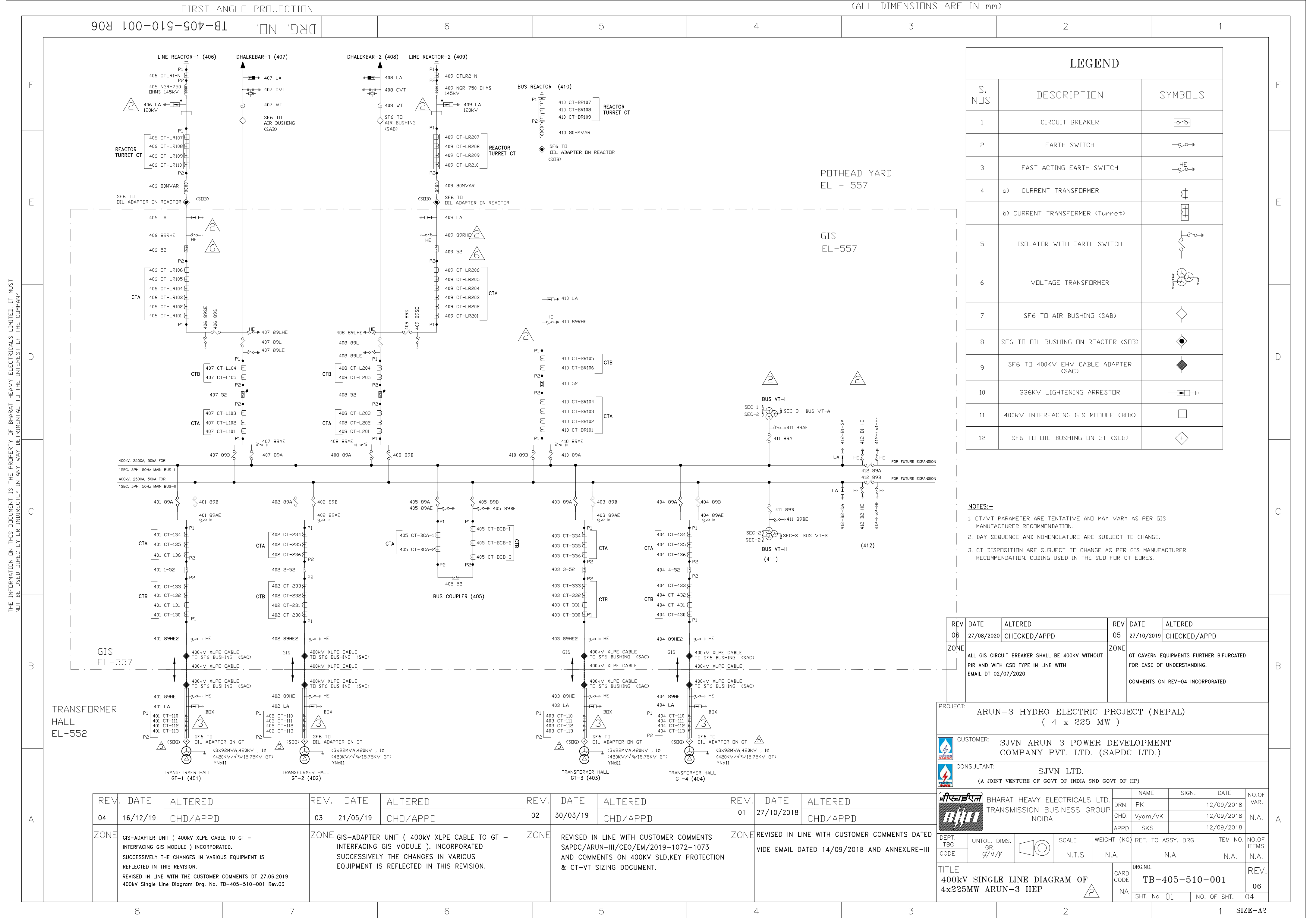


FIG-16 : CLOSED PACKING CASE WITH G.I.SHEET
SHOWING LAYERS OF PACKING MATERIALS.



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FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. TB-405-510-001 R06

6

5

4

3

2

1

PARTICULARS OF CURRENT TRANSFORMER (GIS):-

CT REF.	RATIO	BURDEN (VA)	ACCURACY CLASS	MIN. KNEE POINT VOLTAGE (V _k)	CT SEC. RESIS. (OHMS) AT 75deg.C	MAX. EXCTTING CURRENT (mA) @ V _k /2	LOCATION	PURPOSE
Y-(1,2) CT-LY01 CT-LY02 CT-LY03 CT-LY05 CT-LY04	2500-1250-625/1A 2500-1250-625/1A 2500-1250-625/1A 2500-1250-625/1A 2500-1250-625/1A	- - 20VA - -	PS PS 0.2S PS PS	2500-1250-625V 2500-1250-625V - 2500-1250-625V 2500-1250-625V	12.5-6.25-3.125 12.5-6.25-3.125 - 12.5-6.25-3.125 12.5-6.25-3.125	15/30/60 15/30/60 - 15/30/60 15/30/60	GIS	MAIN-I DISTANCE PROTECTION (21M) MAIN-II DISTANCE PROTECTION (21M2) METERING (1sf <=5) MAIN-I BUSBAR DIFF WITH INBUILT LBB MAIN-II BUSBAR DIFF WITH INBUILT LBB
U-(1,2,3,4) CT-U30 CT-U31 CT-U32 CT-U33 CT-U34 CT-U35 CT-U36	2500-1250-625/1A 2500-1250-625/1A 500/1A 500/1A 500/1A 500/1A 500/1A	- - - - - 15VA 15VA	PS PS PS PS PS 0.2S 5P20	2500-1250-625V 2500-1250-625V 500V 500V 500V 500V 500V	12.5-6.25-3.125 12.5-6.25-3.125 2.5Ω 2.5Ω 2.5Ω 2.5Ω -	15/30/60 15/30/60 50 50 50 50 -	GIS	MAIN-II BUSBAR DIFF WITH INBUILT LBB MAIN-I BUSBAR DIFF WITH INBUILT LBB MAIN-II CABLE DIFF.(87C2) MAIN-I CABLE DIFF.(87C1) OVERALL DIFFERENTIAL PROTECTION METERING (1sf <=5) GT OVERCURRENT PROTECTION
CT-BCA-1 CT-BCA-2 CT-BCB-1 CT-BCB-2 CT-BCB-3	2500-1250-625/1A 2500-1250-625/1A 2500-1250-625/1A 2500-1250-625/1A 2500-1250-625/1A	- - - - 20VA	PS PS PS PS 0.2S	2500-1250-625V 2500-1250-625V 2500-1250-625V 2500-1250-625V 2500-1250-625V	12.5-6.25-3.125 12.5-6.25-3.125 12.5-6.25-3.125 12.5-6.25-3.125 -	15/30/60 15/30/60 15/30/60 15/30/60 -	GIS GIS	BUSBAR DIFF - 2 WITH INBUILT LBB SPARE BUSBAR DIFF - 1 WITH INBUILT LBB SPARE METERING (1sf <=5)
X CT-BRX01 CT-BRX02 CT-BRX03 CT-BRX04 CT-BRX06 CT-BRX05	200/1A 200/1A 200/1A 200/1A 2500-1250-625/1A 2500-1250-625/1A	- - - 10VA - -	PS PS PS PS PS PS	200V 200V 200V - 2500-1250-625V 2500-1250-625V	1Ω 1Ω 1Ω - 12.5-6.25-3.125 12.5-6.25-3.125	80 80 80 - 15/30/60 15/30/60	GIS	REACTOR DIFFERENTIAL (87R) RESTRICTED EARTH FAULT (64R) BACK-UP IMP. PROT. (21R) METERING (1sf <=5) MAIN-I BUSBAR DIFF WITH INBUILT LBB MAIN-II BUSBAR DIFF WITH INBUILT LBB
CT-BRX07 CT-BRX08 CT-BRX09	200/1A 200/1A *	- - 10VA	PS PS 5.0	200V 200V -	1Ω 1Ω -	80 80 -	BUS REACTOR (STAR SIDE)	RESTRICTED EARTH FAULT (64R) REACTOR DIFFERENTIAL (87R) WTI (ONLY IN Y PH)
Z-(1,2) CT-LRZ01 CT-LRZ02 CT-LRZ03 CT-LRZ04 CT-LRZ05 CT-LRZ06	200/1A 200/1A 200/1A 200/1A 200/1A 200/1A	- - - - 10VA -	PS PS PS PS PS 1.0	200V 200V 200V 200V 200V -	1Ω 1Ω 1Ω 1Ω 1Ω -	80 80 80 80 80 -	GIS	REACTOR DIFFERENTIAL (87R) RESTRICTED EARTH FAULT (64R) SPARE SPARE LBB(50Z),BACKUP IMP. PROTN. (21R) METERING (1sf <=5)
CT-LRZ07 CT-LRZ08 CT-LRZ09 CT-LRZ10 CT-LRZ-N	200/1A 2500-1250-625/1A 2500-1250-625/1A * 200/1A	- - - 10VA -	PS PS PS 5.0 PS	200V 2500-1250-625V 2500-1250-625V - 200V	1Ω 12.5-6.25-3.125 12.5-6.25-3.125 - 1Ω	80 15/30/60 15/30/60 - 80	LINE REACTOR (STAR SIDE)	REACTOR DIFFERENTIAL (87R) MAIN-II DISTANCE PROTECTION (21M2) MAIN-I DISTANCE PROTECTION (21M1) WTI (ONLY IN Y PH) RESTRICTED EARTH FAULT (64R)
U-(1,2,3,4) CT-U10 CT-U11 CT-U12 CT-U13	500/1A 500/1A 500/1A 500/1A	- - - -	PS PS PS PS	500V 500V 500V 500V	2.5Ω 2.5Ω 2.5Ω 2.5Ω	30 30 50 50	400kV XLPE CABLE TO GT INTERFACING-GIS MODULE	GT DIFFERENTIAL PROT. GT DIFFERENTIAL REF PROT. MAIN-II CABLE DIFF.(87C2) MAIN-I CABLE DIFF.(87C1)

* TO BE INFORMED BY EQUIPMENT MANUFACTURER.

PARTICULARS OF VTs/CVTs

VT NO.	VOLTAGE RATION IN (V)	BURDEN (VA)	ACCURACY CLASS	PURPOSE	LOCATION
BUS VT-A	$\frac{400000}{\sqrt{3}} / \frac{110}{\sqrt{3}} / \frac{110}{\sqrt{3}}$	50,50,50	3P,0.2,0.2	PROTECTION SYNCHRONISING METERING	GIS
BUS VT-B	$\frac{400000}{\sqrt{3}} / \frac{110}{\sqrt{3}} / \frac{110}{\sqrt{3}}$	50,50,50	3P,0.2,0.2	PROTECTION SYNCHRONISING METERING	GIS
LINE CVT	$\frac{400000}{\sqrt{3}} / \frac{110}{\sqrt{3}} / \frac{110}{\sqrt{3}} / \frac{110}{\sqrt{3}}$	50,50,50,50	3P,3P,0.2,0.2	MAIN1/2 PROTECTION METERING AND SYNCHRONISING	ON LINE AT PDT HEAD YARD

A. 400kV OUT DOOR EQUIPMENT:-

SR.NO.	DESCRIPTION	SYMBOLS	LEGEND	BAY NO.	UNIT	QTY.
1.	336KV SURGE ARRESTER		SA	407, 408	NDS.	6
2.	120KV SURGE ARRESTER		SA	406, 409	NDS.	2
3.	400kV CVT		CVT	407, 408	NDS.	6
4.	400kV WAVE TRAP (2 PHASE ONLY)		WT	407, 408	NDS.	4

REV.	DATE	ALTERED
04	21/08/19	CHD/APPD

ZONE GIS-ADAPTER UNIT (400kV XLPE CABLE TO GT - INTERFACING GIS MODULE) INCORPORATED. SUCCESSVELLY THE CHANGES IN VARIOUS EQUIPMENT IS REFLECTED IN THIS REVISION.

REV.	DATE	ALTERED
03	21/05/19	CHD/APPD

ZONE GIS-ADAPTER UNIT (400kV XLPE CABLE TO GT - INTERFACING GIS MODULE) INCORPORATED. SUCCESSVELLY THE CHANGES IN VARIOUS EQUIPMENT IS REFLECTED IN THIS REVISION.

REV.	DATE	ALTERED
02	30/03/19	CHD/APPD

ZONE REVISED IN LINE WITH CUSTOMER COMMENTS SAPDC/ARUN-III/CEO/EM/2019-1072-1073 AND COMMENTS ON 400KV SLD,KEY PROTECTION & CT-VT SIZING DOCUMENT.

REV.	DATE	ALTERED
01	27/10/2018	CHD/APPD

ZONE REVISED IN LINE WITH CUSTOMER COMMENTS DATED VIDE EMAIL DATED 14/09/2018 AND ANNEXURE-III

A. INDOOR EQUIPMENT GIS:-

SR.NO.	DESCRIPTION	SYMBOLS	LEGEND	BAY NO.	UNIT	QTY.
1.	400kV,2500A , 3ph CIRCUIT BREAKER WITH CSD (GIS) WITHOUT PIR,SC-50KA/1sec		52	401, 402, 403, 404, 405, 410 406, 407, 408, 409	SETS	10
2.	400kV,2500A DISCONNECTOR SWITCH, 3X1 PH GROUP OPERATED, MOTORISED DISCONNECTOR SC RATING -50KA/1sec.		89A 89B 89R 89L 89S	401, 402, 403, 404, 405, 407, 408, 410, 411, 412 401, 402, 403, 404, 405, 407, 408, 410, 411, 412 -, -, -, - 407, 408 406, 409	SETS	24
3.	400 KV EARTH SWITCH, 3X1 PH. GROUP OPERATED, MAINTENANCE E/S		89AE 89BE 89RE 89SE 89LE	401, 402, 403, 404, 405, 407, 408, 410, 411 405, 411 -, -, -, - 406, 409 407, 408	SETS	15
4.	400kV HIGH SPEED EARTHING SWITCH, 3X1 PH. GROUP OPERATED, MAINTENANCE FAST E/S , SC RATING -50KA/1sec		89HE 89HE2 89RHE 89LHE	401, 402, 403, 404, 412-B1, 412-B2, 412-EX1, 412-EX2 401, 402, 403, 404 406, 409, 410 407, 408	SETS	17
5.	336KV , 1-PH SURGE ARRESTER , SC RATING - 50KA/1sec		SA	401, 402, 403, 404, 406, 409, 410, 412-B1 , 412-B2	NDS.	27
6.	400KV CURRENT TRANSFORMER (1PH)		CTA/CTB	401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411	NDS	66
7.	400kV,2500A, SC RATING 50KA/1sec - SF6 TO 400KV XLPE CABLE ADAPTER (GIS)		SAC	401, 402, 403, 404	NDS.	24
8.	400kV,2500A, SC RATING 50KA/1sec - SF6 TO AIR BUSHING		SAB	407, 408	NDS.	6
9.	400kV GIS, OIL TO SF6 ADAPTER DN 400kV SIDE OF REACTOR		SDB	406, 409, 410	NDS.	9
10.	400kV (1 PH.) VOLTAGE TRANSFORMER (GIS)		VT (GIS)	412	NDS.	6
11.	INTERFACING GIS MODULE (GIS MODULE IN GT CAVERN FOR INTERCONNECTING SF6 TO EHV CABLE AND SF6 TO OIL BUSHING MODULE DN GT)		BDX	401, 402, 403, 404	NDS.	12
12.	400kV GIS, OIL TO SF6 ADAPTER DN 400kV SIDE OF GT		SDG	401, 402, 403, 404	NDS.	12

NOTES:-

- CT/VT PARAMETER ARE TENTATIVE AND MAY VARY AS PER GIS MANUFACTURER RECOMMENDATION.
- BAY SEQUENCE AND NOMENCLATURE ARE SUBJECT TO CHANGE.
- CT DISPOSITION ARE SUBJECT TO CHANGE AS PER GIS MANUFACTURER RECOMMENDATION.

CODING USED IN THE SLD FOR CT CORES.

- LY-LINE SIDE Y=1 LINE 1 (BAY 407)
Y=2 LINE 2 (BAY 408)
- U = UNIT
U = 1 = UNIT 1 (BAY 401)
U = 2 = UNIT 2 (BAY 402)
U = 3 = UNIT 3 (BAY 403)
U = 4 = UNIT 4 (BAY 404)

- X =BUS REACTOR - (BAY 410)
- Z = LINE REACTOR
Z = 1 = LINE REACTOR 1 - (BAY 406)
Z = 2 = LINE REACTOR 2 - (BAY 409)

ELECTRICAL SYSTEM PARAMETERS -

- EQUIPMENT VOLTAGE 400KV
- MAX. SYSTEM VOLTAGE 420KV
- BASIC INSULATION LEVEL 1425KV
- SWITCHING IMPULSE 1050KV
- POWER FREQUENCY W/S VOLTAGE 650KV (RMS) FOR GIS
- FAULT LEVEL (1 sec) 50KA
- SYSTEM NEUTRAL GROUNDING SOLIDLY EARTHED

REFERENCE DRG.: - SJVN/ED/ARUN-III/EM-2017-01 TB-405-510-001 R01									
PROJECT: ARUN-3 HYDRO ELECTRIC PROJECT (NEPAL) (4 x 225 MW)									
CUSTOMER: SJVN ARUN-3 POWER DEVELOPMENT COMPANY PVT. LTD. (SAPDC LTD.)									
CONSULTANT: SJVN LTD. (A JOINT VENTURE OF GOVT OF INDIA SND GOVT OF HP)									
				BHARAT HEAVY ELECTRICALS LTD. TRANSMISSION BUSINESS GROUP NOIDA			NAME	SIGN.	DATE
							DRN. PK		12/09/2018
							CHD. Vyom/VK		12/09/2018
							APPD. SKS		12/09/2018
DEPT. TBG	UNTOL. DIMS. GR. g/M/f		SCALE N.T.S	WEIGHT (KG) N.A.	REF. TO ASSY. DRG. N.A.	ITEM NO. N.A.	NO.OF ITEMS N.A.		
TITLE 400kV SINGLE LINE DIAGRAM OF 4x225MW ARUN-3 HEP							DRG.NO. NA	TB-405-510-001	
							SHT. No	02	NO. OF SHT. 04
							REV. 06		

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SIZE-A2



TITLE	CARD CODE	DWG.NO.	REV
400kV SINGLE LINE DIAGRAM OF 4x225MW ARUN-3 HEP	NA	TB-405-510-001	06

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FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. TB-405-510-001 R06

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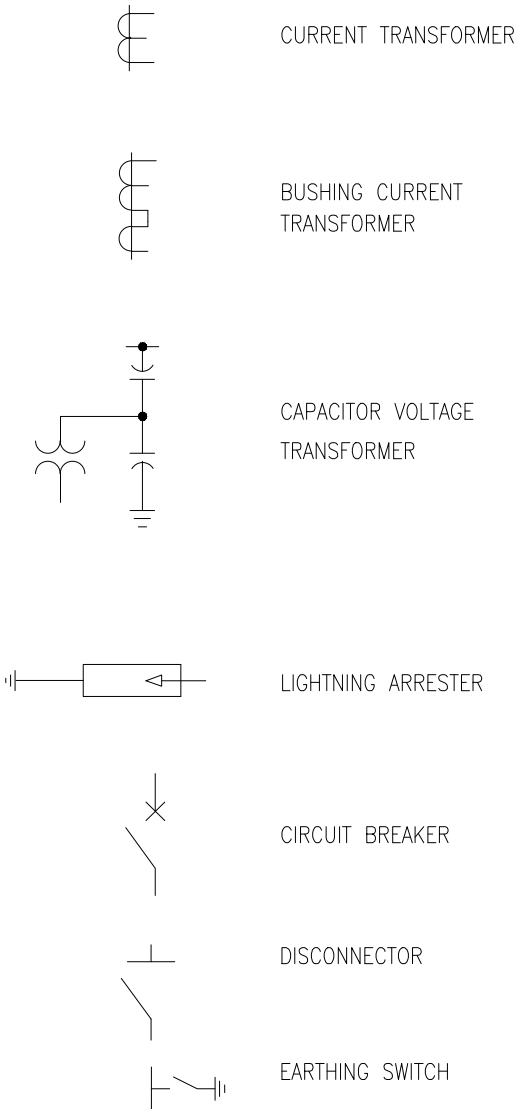
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LEGEND

DEVICE NO.	FUNCTION
21M1/M2	DIST. PROTECTION MAIN-I/II (BOTH OF SAME MAKE)
79	AUTO-RECLOSE FUNCTION (IN BUILT FUNCTION OF DISTANCE RELAY)
59	TWO STAGE OVER VOLTAGE PROTECTION
67/67N	DIRECTIONAL IDMT PHASE O/C / E/F PROTECTION WITH HIGH SET FUNCTION
WTI	WINDING TEMPERATURE INDICATOR
68	POWER SWING BLOCKING FUNCTION
46 BC	BROKEN CONDUCTOR PROTECTION
85	CARRIER-AIDED INER-TRIPPING FUNCTION
21R	BACKUP IMPEDANCE PROTECTION
78	OUT OF STEP PROTECTION
27	UNDER VOLTAGE PROTECTION
DR	DISTURBANCE RECORDER FUNCTION
63 AX/TX	BUCHHOLZ RELAY, ALARM/TRIP
PRD TX	PRESSURE RELIEF DEVICE, TRIP
490 AX/TX	OIL TEMPERATURE HIGH, ALARM/TRIP
49W AX/TX	WINDING TEMPERATURE HIGH, ALARM/TRIP
OLAX	OIL LEVEL LOW, ALARM
OTI	OIL TEMPERATURE INDICATOR
87R	REACTOR DIFFERENTIAL PROTECTION
64R	REACTOR RESTRICTED EARTH FAULT PROTECTION
99	OVER FLUXING PROTECTION
87BB1/BB2	BUSBAR DIFFERENTIAL PROTECTION MAIN-1/2 (BOTH OF SAME MAKE)
50Z	LOCAL BREAKER BACKUP PROTECTION
LCB	LOCAL CONTROL BOARD
EM	ENERGY METER (ABT)
870A	GT OVERALL DIFFERENTIAL PROTECTION (IN GRP)
51G	GT OVERCURRENT PROTECTION (IN GRP)
87C1/C2	CABLE DIFFERENTIAL PROTECTION OF 400KV XLPE MAIN-1/2 (IN GRP)
87T	TRANSFORMER DIFFERENTIAL (IN GRP)
64GT	RESTRICTED EARTH FAULT PROTECTION OF GT (IN GRP)

NOTE:

- 1) ALL PROTECTION FEATURES SHOWN IN THIS DRAWING SHALL BE PROVIDED IN THE OFFERED SYSTEM; HOWEVER, CLUBBING OF PROTECTION FUNCTIONS IN NUMERICAL RELAYS SHALL BE DECIDED AFTER FINALISATION OF RELAY SUPPLIER.
- 2) 50LBB PROTECTION SHALL BE BUILT-IN FUNCTION OF NUMERICAL RELAY



REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED
		CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD
ZONE			ZONE			ZONE			ZONE		

PROJECT: ARUN-3 HYDRO ELECTRIC PROJECT (NEPAL)
(4 x 225 MW)



CUSTOMER: SJVN ARUN-3 POWER DEVELOPMENT COMPANY PVT. LTD. (SAPDC LTD.)

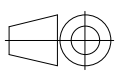


CONSULTANT: SJVN LTD.
(A JOINT VENTURE OF GOVT OF INDIA AND GOVT OF HP)



BHARAT HEAVY ELECTRICALS LTD.
TRANSMISSION BUSINESS GROUP
NOIDA

		NAME	SIGN.	DATE	NO.OF VAR.
DRN.	PK			12/09/2018	
CHD.	Vyom/VK			12/09/2018	N.A.
APPD.	SKS			12/09/2018	

DEPT. TBG CODE	UNTOL. DIMS. GR. g/M/f		SCALE N.T.S	WEIGHT (KG) N.A.	REF. TO ASSY. DRG. N.A.	ITEM NO. N.A.	NO.OF ITEMS N.A.
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TITLE
400kV SINGLE LINE DIAGRAM OF
4x225MW ARUN-3 HEP

CARD CODE
NA

DRG.NO.
TB-405-510-001

SHT. No 04

REV.
06

NO. OF SHT. 04

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1 SIZE-A2

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. TB-3-405-316-001

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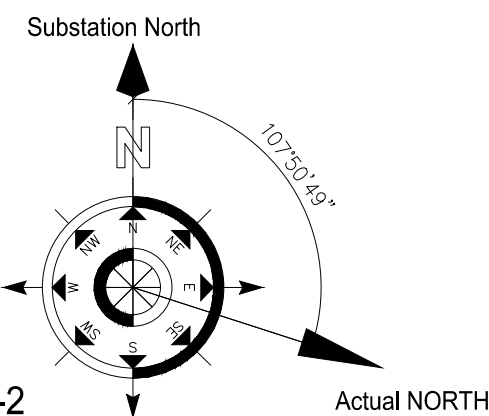
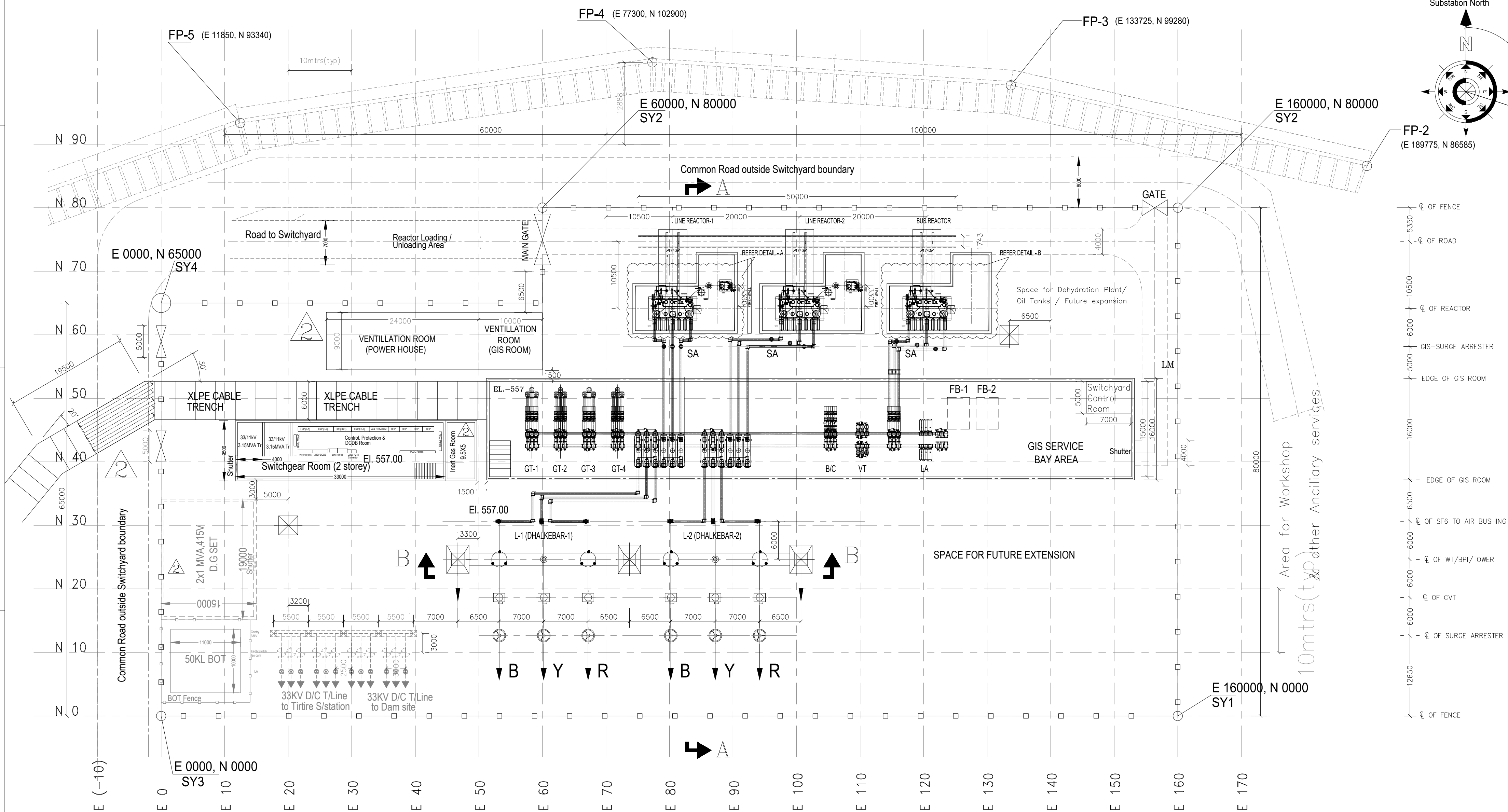
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MINIMUM CLEARANCE TABLE	400kV
PHASE TO PHASE (PP) (mm)	4000
PHASE TO EARTH (PE) (mm)	3500
SECTION CLEARANCE (SC) (mm)	6500
HEIGHT OF CONDUCTOR CENTRE LINE OF FIRST LEVEL (MIN.) MM. (FROM PLINTH LEVEL)	8000
GROUND CLEARANCE TO NEAREST PART NOT AT EARTH POTENTIAL OF AN INSULATOR SUPPORTING LIVE CONDUCTOR	2550
CREEPAGE DISTANCE (mm/kV)	25

LEGEND TABLE:-

	400kV TENSION INSULATOR NOT IN BHEL'S SCOPE
	QUAD MOOSE ACSR CONDUCTOR
	TWIN MOOSE ACSR
	SHIELD WIRE
	FENCE (NOT IN SCOPE OF BHEL)
	CONNECTION TO QUAD ACSR MOOSE CONDUCTOR
	PROPOSED SCOPE
	EXISTING/FUTURE SCOPE (NOT IN TBG SCOPE)
	GIB (GAS INSULATED BUS DUCT)
	TOWER WITH PEAK
	LM (LIGHTNING MAST)
	ENTRY GATE (NOT IN BHEL SCOPE)

CONDUCTOR SIZE DETAILS

EQUIPMENT INTERCONNECTION	400 KV	QUAD 'MOOSE' CONDUCTOR
CONNECTION DROPS	400 KV	QUAD 'MOOSE' CONDUCTOR TWIN 'MOOSE' CONDUCTOR ON CVT AND SURGE ARRESTER

CO-ORDINATES & ELEVATIONS OF IMPORTANT POINTS

S.No.	DESCRIPTION	POINTS	EASTINGS	NORTHINGS	ELEVATION
1.	SWITCH YARD	SY1	519427.546	3043730.041	557.00
		SY2	519332.186	3043683.753	557.00
		SY3	519517.939	3043543.820	557.00
		SY4	519422.580	3043497.532	557.00

The coordinates shown above are as per Drg No: PH-AR3-C001

2.	FLOOD PROTECTION WALL	FP2	519364.876	3043704.311	557.00
		FP3	519369.970	3043647.066	557.00
		FP4	519383.822	3043592.261	557.00
		FP5	519412.797	3043533.433	557.00

SYSTEM PARAMETERS

NOTES:-

- RATED VOLTAGE : 400kV
- HIGHEST SYSTEM VOLTAGE : 420kV
- SYSTEM VOLTAGE VARIATION : -5% to +5%
- RATED FREQUENCY : 50 Hz, ±3%
- INSULATION LEVELS FOR 400kV CIRCUIT BREAKERS AND DISCONNECTING SWITCHES
- 5A. RATED ONE MINUTE POWER FREQUENCY : 650 KV RMS (GIS)
WITHSTAND VOLTAGE BETWEEN LIVE TERMINAL AND EARTH: 630 KV RMS FOR POLEHEAD YARD EQUIPMENTS
- 5B. RATED LIGHTNING IMPULSE WITHSTAND VOLTAGE : A) ± 1425 KVP BETWEEN LIVE TERMINALS AND EARTH.
B) ± 1665 KVP IMPULSE ON ONE TERMINAL AND OTHER TERMINAL EARTHED (ACROSS ISOLATING DISTANCE).
- 5C. RATED SWITCHING IMPULSE WITHSTAND VOLTAGE : 1050 KVP (PHASE TO EARTH)
1425 KVP (PHASE TO PHASE)
- RATED SHORT TIME WITHSTAND CURRENT CAPACITY : 50 KA/SEC. RMS
- SYSTEM NEUTRAL EARTHING : EFFECTIVELY EARTHED
- AC AUX. SUPPLY : 415V, 3PH, 4 WIRE (+10% TO -10%)
240V, 1PH, 2 WIRE (+10% TO -10%)
- CONTROL VOLTAGE : 220V DC, 2 WIRE, +10% TO -20%
- GIS BUS CONFIGURATION : DOUBLE BUSBAR, 400 kV, 2500A, 50KA FOR 1S
- ALL EQUIPMENT SHALL BE RATED FOR 50 DEG CENTIGRADE AMBIENT AND OUTDOOR INSTALLATION.

400KV SWITCHYARD

BILL OF QUANTITY OUTDOOR EQUIPMENT:-

S.NO.	DESCRIPTION	SYMBOL	QUANTITY (NOS.)
1	420 kV INDOOR GIS		01
2	420 KV, 1-ph SF6 TO AIR BUSHING		06
3	420kV, 1-ph CVT		06
4	336kV, 1-ph SURGE ARRESTER		06
5	420kV, 8 KN, 1-ph, BUS POST INSULATOR		02
6	WAVE TRAP		04
7	400KV,80MVAR REACTOR (BHEL MAKE)		03
8	NGR (BHEL MAKE)		02
9	120kV, 1-ph SURGE ARRESTER FOR NGR		2

REV.	DATE	ALTERED
		CHD/APPD

REV.	DATE	ALTERED
		CHD/APPD

REV.	DATE	ALTERED
02	07/06/19	CHD/APPD

REV.	DATE	ALTERED
01	30/03/19	CHD/APPD

ZONE

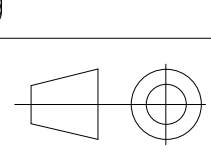
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- Building for Inert Gas System included.
- Common Ventilation Room for Power House and GIS Building included.
- Cable Trench shown for the CAT to Switchyard.
- The Layout of the Transformer Cavern shall be part of shown in "Cross Section and Plan of Transformer Cavern - 1 200 00 20558.
- Comments marked on Rev-01 incorporated.

Revised Switchyard Layout - Sketch - Drg No. SJVN/ED/Arun-III/EM-2017-04

PROJECT: ARUN-3 HYDRO ELECTRIC PROJECT (NEPAL)
(4 x 225 MW)CUSTOMER: SJVN ARUN-3 POWER DEVELOPMENT
COMPANY PVT. LTD. (SAPDC LTD.)CONSULTANT: SJVN LTD.
(A JOINT VENTURE OF GOVT OF INDIA AND GOVT OF HP)BHARAT HEAVY ELECTRICALS LTD.
TRANSMISSION BUSINESS GROUP
NOIDADEPT. TBG
CODESCALE
NTSCARD
CODETITLE
ELECTRICAL LAYOUT PLAN AND SECTION
OF 4x225MW OF ARUN-3 HEP

NAME	SIGN.	DATE
DRN. PK		30/10/2018
CHD. Vyorn/VK		30/10/2018
APPD. SKS		12/09/2018

DRG.NO.	REV.
TB-3-405-316-001	02
SHT. No 01	NO. OF SHT. 02

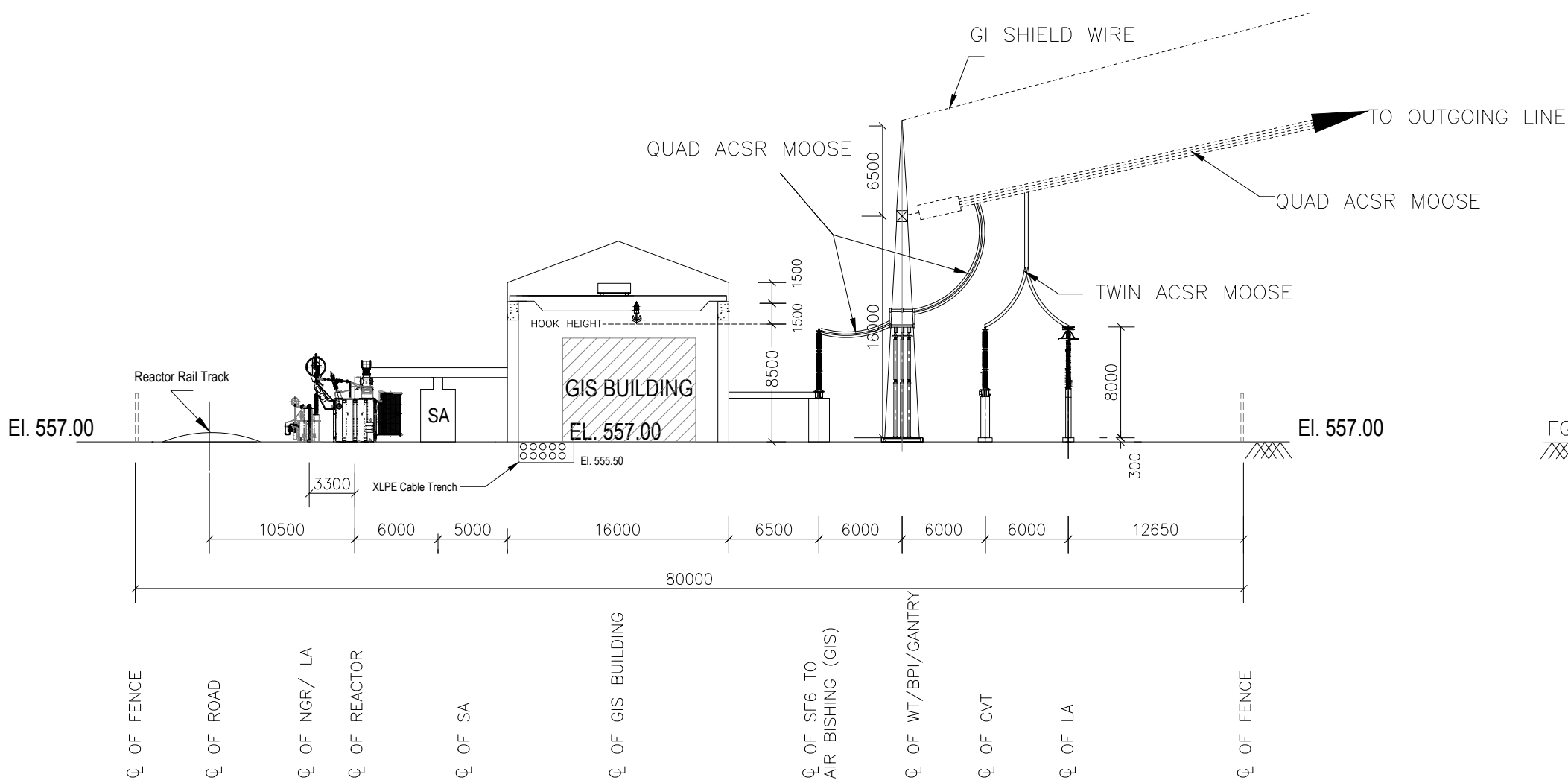
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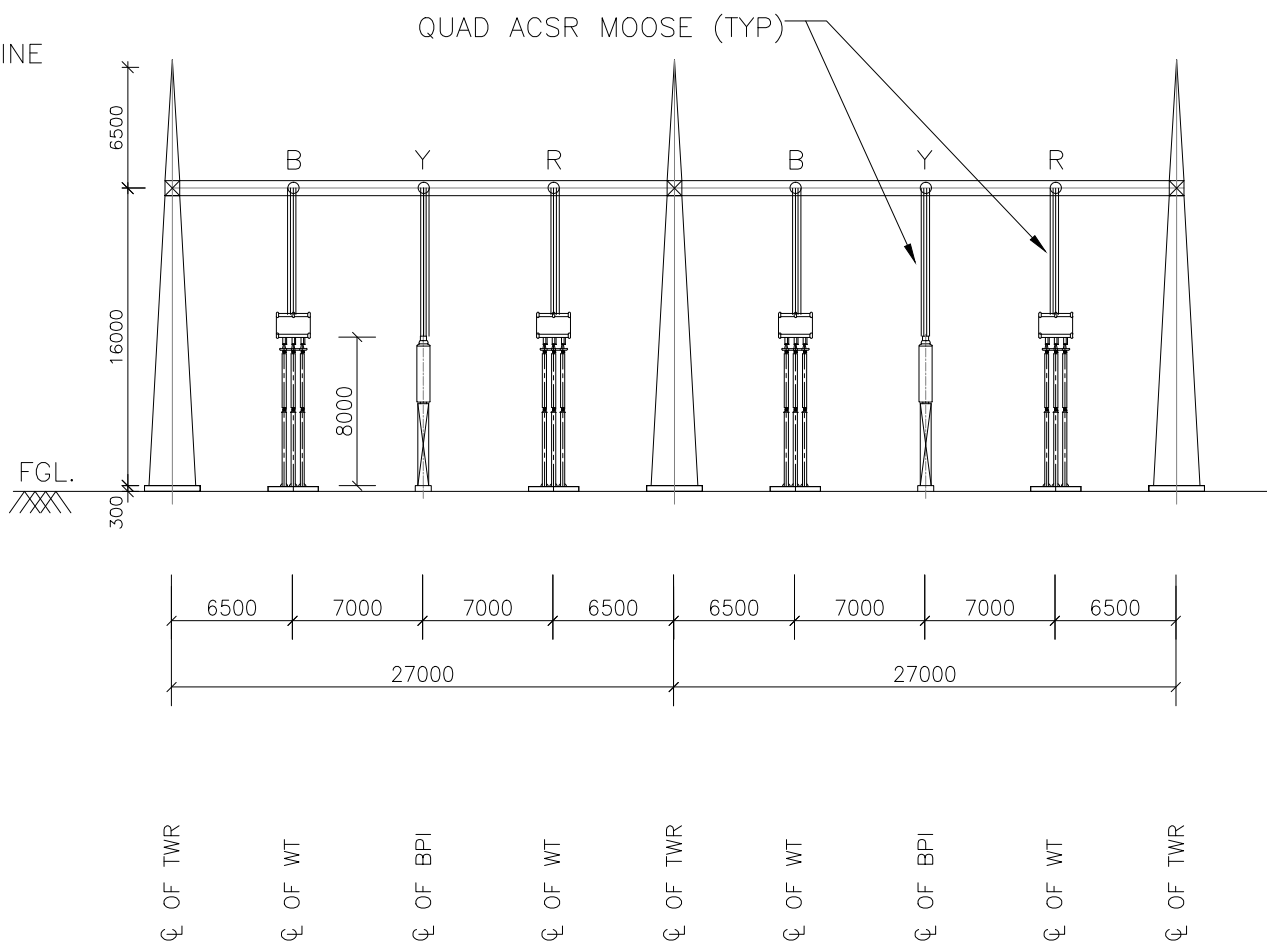
FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. TB-3-405-316-001



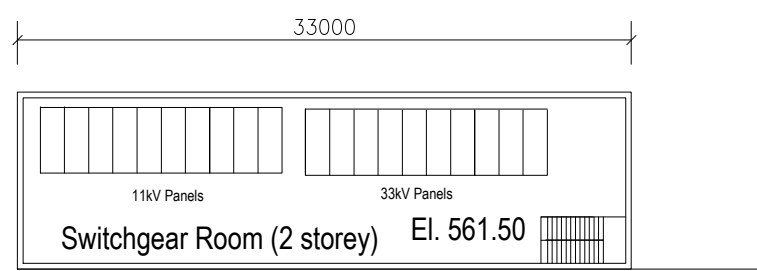
SECTION A-A



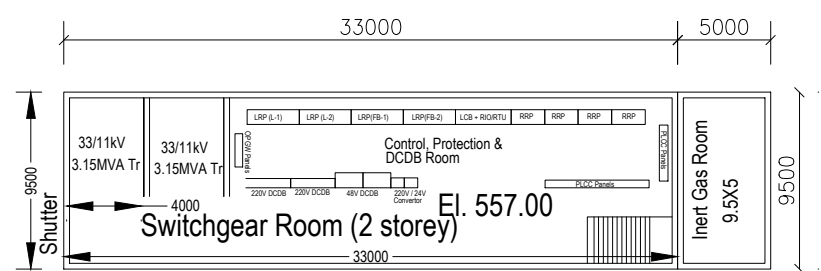
SECTION B-B

NOTES:-

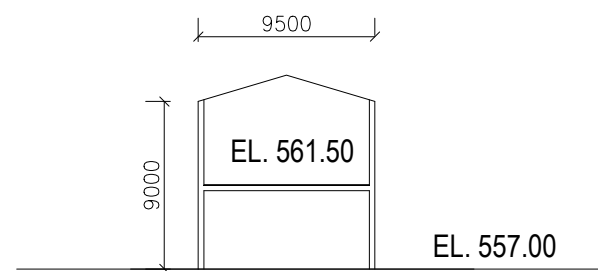
- ALL DIMENSIONS ARE IN MM. UNLESS OTHERWISE SPECIFIED.
- MINIMUM CLEARANCE TABLE
 - PHASE TO PHASE = 4000 MM.
 - PHASE TO EARTH = 3500 MM.
 - SECTIONAL CLEARANCE = 6500 MM
- LEVELS FOR SWITCHYARD ARE AS PER Revised Switchyard Layout - Sketch - Drg No. SJVN/ED/Arun-III/EM-2017-04
- ELEVATION OF SWITCHYARD AREA = 557.00 M.
- SYSTEM NOMINAL VOLTAGE = 400kV.
- SYSTEM HIGHEST VOLTAGE = 420kV.
- DOUBLE BUS-BAR SCHEME WITH BUS-COUPLER HAS BEEN ADOPTED IN GIS.
- CONDUCTOR FOR 400kV SYSTEM WILL BE QUAD/TWIN MOOSE.
- ALL STRUCTURE/CONDUCTOR HEIGHTS ARE ABOVE PLINTH LEVEL. PLINTH LEVEL - 300 MM ABOVE F.G.L.
- ALL FLEXIBLE CONNECTIONS ARE WITH QUAD MOOSE/TWIN ACSR MOOSE CONDUCTOR WITH 450 MM SPACING.
- LOCATION OF WAVE TRAPS ARE INDICATIVE ONLY AND THE EXACT LOCATION WILL BE BASED ON PLCC REQUIREMENT. THE FDN. DESIGN SHALL BE PROVIDED BY BHEL.
- GIS/BUS DUCT LAYOUT IS TENTATIVE AND SHALL BE FINALIZED AFTER VENDOR FINALIZATION OF GIS.
- SWITCHGEAR ROOM AND GIS BUILDING LAYOUT SHALL BE SUBMITTED SEPARATELY.
- THE SCOPE OF BHEL SHALL BE LIMITED TO POINT OF CONNECTION OF OUTGOING LINE AT THE DEAD END GANTRY.
- THE DETAIL OF THE CABLE TERMINATION ON GT AND CABLE SUPPORT SYSTEM SHALL BE ADDED IN SUCCESSIVE REVISIONS.
- ROADS , FENCE AND GATE IS NOT IN BHEL's SCOPE.
- OUTGOING STRINGING OF LINE CONDUCTOR & SHIELD WIRE ARE NOT IN BHEL SCOPE BUT CONNECTION OF EQUIPMENT TOWARDS LINE SIDE SHALL BE DONE BY BHEL..
- CONSTRUCTION OF FIRE RESISTANT WALL BETWEEN 400kV REACTOR UNITS ARE NOT IN BHEL SCOPE.
- PHASE SEQUENCE IS INDICATIVE & IT SHALL BE VERIFIED AT SITE DURING EXECUTION.
- THE DIMENSION OF THE XLPE CABLE TRENCH IS TENTATIVE AND SHALL BE FINALISED IN LINE WITH THE CABLE LAYING PHILOSOPHY OF THE EHV XLPE CABLE SUPPLIER.
- THE SWITCHGEAR BUILDING LAYOUT SHALL BE FURNISHED AS A SEPARATE DRAWING.
- DETAILS OF CABLE TRENCH - ROAD CROSSING ARRANGEMENT SHALL BE SHOWN IN CABLE TRENCH LAYOUT.
- FOUNDATION WORKS TO BE UNDERTAKEN BY EMPLOYER;HOWEVER,BHEL SHALL BE RESPONSIBLE FOR DESIGNING AND SUPPLYING DRAWINGS AND MATERIALS SUCH AS INSERT,EMBEDMENTS,BOLTS FOR FOUNDATION.
- REACTOR , UNLOADING AND HANDLING AT SITE SHALL BE ARRANGED BY BHEL.



PLAN AT EL 561.00



PLAN AT EL 557.00



SECTION

SWITCHGEAR ROOM

REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	PROJECT:	NAME	SIGN.	DATE
		CHD/APPD			CHD/APPD	02	07/06/19	CHD/APPD	01	30/03/19	CHD/APPD	CUSTOMER:	DRN.	PK	30/10/2018
ZONE			ZONE			ZONE			ZONE			CONSULTANT:	CHD.	Vyom/VK	30/10/2018
												APPD.	SKS		12/09/2018
												DEPT. TBG CODE	CARD CODE		
												TITLE	DRG.NO.		REV.
												ELECTRICAL LAYOUT PLAN AND SECTION OF 4x225MW OF ARUN-3 HEP	TB-3-405-316-001		02
												SHT. No 01	NO. OF SHT. 02		

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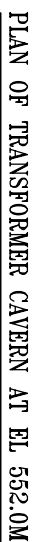
4

3

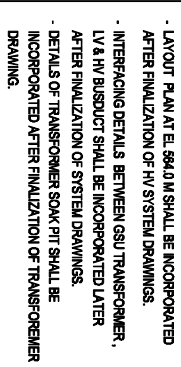
2

1

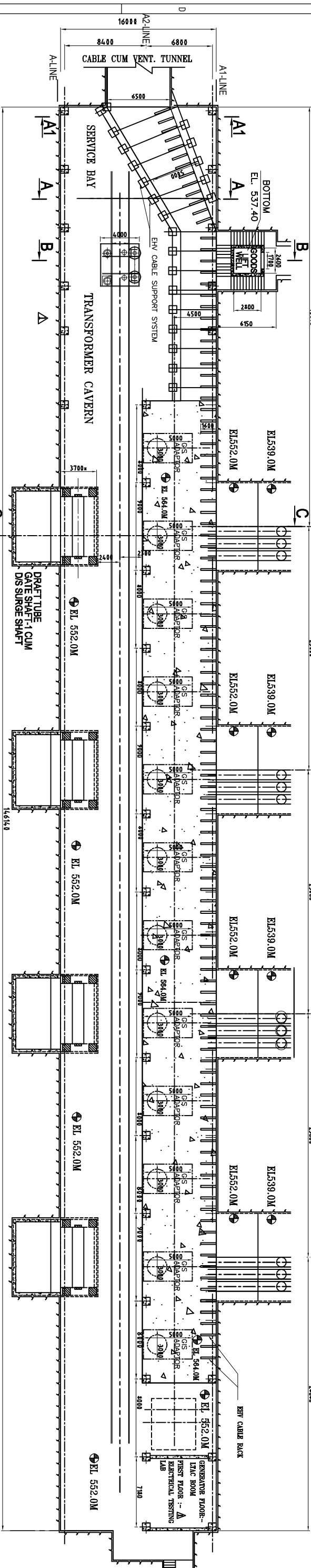
SIZE-A2



PLAN OF TRANSFORMER CAVERN AT EL 552.0M



- LAYOUT PLAN AT EL. 994.0 M SHALL BE INCORPORATED AFTER FINALIZATION OF HYDRO SYSTEM DRAWINGS.
- INTERFACING DETAILS BETWEEN GSU TRANSFORMER, LV & HV BUSDUCT SHALL BE INCORPORATED LATER AFTER FINALIZATION OF SYSTEM DRAWINGS.
- DETAILS OF TRANSFORMER SOAK PIT SHALL BE INCORPORATED AFTER FINALIZATION OF TRANSFORMER DRAWING.



PLAN OF TRANSFORMER CAVERN AT EL 552.0M/ EL 564.0 M

[illegible]