(105)

BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION PROJECTS ENGINEERING MANAGEMENT
NEW DELHI

DOCUMENT No.	TB-383-316-001	Rev 02	Prepared	Checked	Appd
TYPE OF DOC.	TECHNICAL SPECFICATION	NAME	MM	AS	RS
66 KV Gas Insulated Switchgear (GIS)		SIGN	Mum	Avtar S. Qadeer	4/5/15
		DATE	23.5.15	28/05/15	
		GROUP	TBEM		
		W.O. No			

CUSTOMER/ CONSULTANT	ONGC/ FITCHNER Consulting Engineers (India) Pvt Ltd.
PROJECT	Combined cycle captive power plant at ONGC Hazira (1x51 MW)

Contents:

SUITABLE FOR COASTAL AREA

Rev	Date	Altered	Checked	Approved				
Distribution				To				
				Copies				

	Bill of quantities for 66 kV GIS (Section 1)		
SL	**Description**	**Unit**	**Qty**
	[illegible] enclosed SLD with Two Main Bus scheme [illegible] controlling control cabinet (A1 to A21) [illegible] Current transformer [illegible] Earthing switches [illegible] bushing, Surge arrester, cable [illegible]	**lot**	**1**
A1	Generator transformer (GTG-3) bay	Set	1
A2	Generator transformer (GTG-4) bay	Set	1
A3	GEB Incomer bay	**Set**	**2**
A4	Station auxiliary transformer (SAT) bay	**Set**	**2**
A5	Generator transformer (STG-1) bay	Set	1
A6	Existing Grid transformer(GT) bay	**Set**	**2**
A7	Bus Coupler bay	Set	1
A8	Bus PT with associated isolator and earthswitch	Set	2
A9	Bus earth switch	No.	2
A10	Spare transformmer bay	**Set**	**1**
A11	GIS duct from GIS to SF6 to Air Bushing (3 phase)	m	150
A12	SF6 to Air HV bushing Termination (3 phase)	Set	3
A13	Provision of HV Cable termination (3 phase excluding cable termination)	Set	7
A14	Dummy panel (bus bar)	m	2
A15	66 kV Surge arresters including surge counters	Set	5
A16	First Filling of SF6 gas including extra for compensating losses for 10 % of total gas (Bidder to indicate quantity).	Lot	1
A17	Supply of structure work for Installation of GIS including support structure for GIS duct, SF6 to Air bushings, foundation bolts, embedded parts in floors etc., which are required for installation of GIS as per the specification. (The civil works will be done based on supplier design & drawings). Bidder to furnish in MT.	Lot	1
A18	Supply of grounding material for GIS . The quantity shall be estimated by bidder.	Lot	1
A19	Consumables required for GIS (Bidder to quote item wise with detailed BOQ for consumables)	Lot	1
A20	Insulation co-ordination studies	Lot	1
A21	Any other item required for completion of project and not covered above - Complete List to be provided by bidder along with unit prices.	Lot	1
	[illegible] (B1 to B5)	**lot**	**1**
B1	SF6 gas filling & evacuating plant	Nos	1
B2	SF6 gas filtering, drying, storage & recycling plant	Nos	1
B3	SF6 gas leak detector	Nos	2
B4	Breaker Operation analyzer with transducers	Nos	1
B5	Nitrogen filling (aplicable for hydraulic mechanisms only)	Nos	1
	[illegible]		**1**
C1	Operation & Maintenance spares ~~C1 to C4~~	Set	1
	[illegible] Commissioning & site testing	**Lot**	**1**
E1	Site visit for unloading & verification of material at store	Lot	1
E2	Supervision of Erection of GIS	Set	1
E3	Supervision of Erection of GIS - for Cable Termination	Set	7
E5	Supervision of Erection of GIS duct - GIS Duct to SF6 to Air bushing	Set	3
E4	Testing & Commissioning of GIS	Set	1
E5	Testing & Commissioning of GIS duct - GIS Duct to SF6 to Air bushing	Set	3
E6	Testing & Commissioning of GIS - for Cable Termination	Set	2
E7	Final successful testing of GIS including HV test kit	Lot	1

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	Bill of quantities for 66 kV GIS (Section 1)		
SL	**Description**	**Unit**	**Qty**
F	**Services: Training (F1)**	Lot	1
F1	Training for GIS at supplier's works for ONGC/BHEL engineers	mandays	24
G	**Supply – Unit Prices of Individual Item/Equipment (G1 to G30) for any addition or deletion, change in SLD, damage or replacement**	Lot	1
G1	66kV , 2000A Circuit breaker (1 pole complete without enclosure without operating mechanism)	No	1
G2	66kV , 630A Circuit breaker (1 pole complete without enclosure without operating mechanism)	No	1
G3	66kV , 2000A Isolators	No	1
G4	66kV , 630A Isolators	No	1
G5	Maintenance Earhing switch	No	1
G6	High speed earth switch	No	1
G7	Bus earth switch	No	1
G8	Current transformer (1 of each type)	Set	1
G9	Voltage transformer -Line/Bus	No	1
G10	Operating Mechanism for 66kV Circuit Breaker	No	1
G11	Operating Mechanism box for 66kV Isolator	No	1
G12	Operating mechanism for 66kV Maintenance Earthing Switch	No	1
G13	Operating Mechanism for 66kV High Speed Earthing Switch	No	1
G14	Conductor (all sizes)	kg	10
G15	Epoxy resin insulators for bus support with holes for gas flow	Nos.	1
G16	Gas barrier insulators	Nos.	1
G17	Density switch	Nos.	1
G18	Gas Monitoring Devices	Nos.	1
G19	PD sensor	Nos.	1
G20	Optical indicator for CB, Isolator	Nos.	1
G21	Communication cone	Nos.	1
G22	Elbows	Nos.	1
G23	Telescopic enclosure	Nos.	1
G24	Sleeve enclosure	Nos.	1
G25	Expansion joints or bellows	Nos.	1
G26	Straight cast enclosure	Nos.	1
G27	Cross tank	Nos.	1
G28	Services of manpower for erection per day (excl.travel)	Days	1
G29	Services of manpower for Testing & commissioning per day	Days	1
G30	Hiring charges of HV test kit	Lot	1
H	**Final Documentation**	Lot	1

SECTION – 1

1. SCOPE

The scope includes design, manufacture, testing at works, Packing, dispatch, supervision of erection, testing & commissioning, site test of 66 kV GIS.

This section covers the scope and quantities of 66 kV GIS. The Specific Technical Requirements for the above item as specified by the customer are given in Section-2. The offered equipment shall also comply with the General Technical Requirements for the project as detailed under section-3 of this specification.

In case of any discrepancies between the requirements mentioned under Section-1/Section-2 and those specified in the Section-3. The following shall be order of prevailing

a. Statutory Regulations
b. Section-1
c. Section – 2 ONGC Specification
d. International standards

The equipment is required for the following project:

Project name :	Combined cycle captive power plant at ONGC Hazira (1x51 MW)
Customer name :	ONGC
Consultant :	FITCHNER Consulting Engineers (India) Pvt Ltd.
Main Contractor :	BHEL

2. SPECIFIC TECHNICAL REQUIREMENT

Sl.No.	Technical Parameter	Unit	66 kV GIS
1	Type of GIS		3 phase encapsulated
2	Location		Indoor
3	Design ambient temperature		45 ^{0}C
5	Nominal voltage class, kV rms	kV	66
6	Maximum System voltage, kV	kV	72.5
7	Rated frequency,	Hz	50
8	Number of phases	Nos	3
9	Number of bus bars	Nos	2
10	Rated normal current of Bus at 50 Hz,A,rms	A	2000
11	Rated short circuit current at rated maximum voltage, not less than, kA, rms (symmetrical)	kA	40 for 3 sec
12	Duty Cycle of circuit breaker		O-0.3s-CO- 3 min-CO
13	Operating mechanism of circuit breaker		Electro-hydraulic/ spring charged

			mechanism or combination of these with anti-pumping and trip free features.
14	Auxiliary Supply		
a	AC, three phase	V	415 V ± 10 %
b	AC, single phase	V	240 V ± 10 %
c	DC	V	110 V ± 10 % isolated 2 wire system
15	Leakage rate of SF_6 per annum for each compartment		0.5% per year
16	Degree of Protection for gas compartments		IP 65
17	Degree of Protection for supporting frames, low voltage and other compartments		IP4X

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.

Thermal calculations shall be based on the climatic conditions described in section-3 of this document.

3. General Project details

1 Store will be provided by BHEL. Bidder to provide their requirement of space in open and closed store during tender stage.

2 Bidder to submit list of consumables with shelf life of fewer than two years. It shall be supplied before erection after clearance from BHEL.

3 Supplier will submit detailed bar chart indicating all the milestones from Engineering till manufacturing/ testing, dispatch to site and commissioning.

4 Project site Hazira is located in coastal area near Surat. Hence, design, material selection and construction of GIS should be suitable for the climate/ Metrological conditions as mentioned above and in section 3.

5 Also, packing of GIS shall be suitable for long term (minimum 1 year) storage in indoor or outdoor.

6 Bidder shall offer their compact model to minimise the building size.

7 Spare parts of offered GIS should be available for minimum 10 years from the date of commissioning.

8 Bidder shall conduct insulation co-ordination studies for establishing surge arrester rating, quantity and any other requirement for successful operation of GIS.

9 Successful Bidder shall submit 3D OGA Drawing for complete GIS and section drg of each equipment.

10 Bidder shall check and ensure adequacy of system protection for successful operation of GIS. After checking of system/site by bidder, GIS shall be installed and if any failure, malfunction of any part occurs after commissioning, bidder shall replace the part unconditionally within a month.

1. BILL OF QUANTITIES:

As per Annexure-I

2. Documents to be submitted for approval:

As per Annexure-II enclosed. Bidder to submit the documents for approval after PO placement as per schedule indicated. Bidder to confirm the list and schedule.

3. Earthing of GIS

Supply of Earthing material and erection of all Earthing connection for GIS to GIS and GIS to earth mesh on floor shall be in bidder's scope.
The quantity shall be estimated by the bidder, based on their design philosophy.
Supply of earthing material (only MS rod & GI flat) & erection of earthmat on floor shall be done by BHEL in supervision of manufacturer as per manufacturer's design. Design philosophy shall be submitted with bid in line with clause 7.37 of section 2 (ONGC specification).

Only supply of MS rod 40mm dia and GI flat of 75x12 mm or MS rod as recommended by bidder shall be in BHEL scope. Any other earthing material if required shall be in bidder's scope of supply and erection.

4. Type Testing

All the equipment shall have valid type test certificates as per relevant standards. The type test reports submitted shall be of tests conducted within last 5 years prior to the date of bid opening (date of bid opening is 17/12/2012).

For Offered GIS and components must be type tested as per IS/IEC from reputed testing laboratory such as CPRI or equivalent independent test laboratory.

In case any of above tests have not been conducted on the offered design of GIS or there has been a change in the design after the type tests the requisite tests shall be conducted by bidder on the offered design of GIS without any extra cost and delivery impact to BHEL.

5. Drg. Enclosed

Sl. No.	ONGC/BHEL Drg. No.	Drawing Title
1.	TB-0-383-510-001	66 kV system Single Line diagram
2.	0-381-01-01570	Plot Plan
3.	10-5111168-E-402	Equipment layout for 66kV GIS building area

6. INSPECTION & TESTING

Prior to dispatch, the routine & acceptance tests shall be carried out on equipment and accessories in accordance with the applicable IEC /IS and the material shall be offered for

final inspection by BHEL and ONGC in accordance with approved quality assurance plan.

7. QUALITY PLAN

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

Annexure-1

Notes:

1. Supply Item no A1 to A9 excludes cable termination module, surge arrester, GIS bus duct, SF6 to Air bushing.
2. Qty of items A10 to A14 may vary as per customer requirement. Unit rates shall be applicable for any addition/deletion in quantity (In SLD, GIS surge arrester is not shown, however it may be required at later stage) or replacement of any part.--
3. 66kV GIS is three phase encapsulated design. For items (A1 to A14, C1 to C4, G1 to G16) one set is for all the 3 phases
4. GIS shall be complete with gas monitoring devices, barriers, pressure switches etc as required.
5. Bidder to quote strictly as per BOQ. Rates shall not be combined. In case the charges are combined, BHEL reserves the right to reject the offer. Decision of BHEL shall be final.
6. Any other item of supply, services not listed in BOQ (A to H) but required for completion of Job/work/ project shall be deemed to be included in the above quoted prices and will have to supplied, executed free of cost. No extra price shall be payable in respect of extra item/service.
7. 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, 10 % of total quantity of SF6 gas shall also be supplied in non-returnable cylinders.
8. The total value of 66kV GIS (A1 to A16) is subjected to change by ± 10 % at order stage.
9. The bidder shall have to make provision in GIS for fixing the Cable Termination kit supplied by purchaser as per IEC. Supervision of Cable termination is included in scope.
10. The scope of supply shall also include following
    I. All mounting hardware.
    II. Bidder shall give dimensional GIS building layout and sectional elevation drawing along with bid showing all details as follows:
        a. Location of GIS
        b. Maintenance space required
        c. Location of local control cabinet
        d. All embedded parts drawing
        e. Trench layout drawing
        f. Routing of GIS Bus
        g. Location of air to SF6 termination.
        h. Earthing design & drawing (At contract stage)
        i. Foundation plan details with embedment's
11. Any change in bay pitch (distance between bays) as per civil requirement for foundation layout at during detailed stage shall be incorporated by bidder without any cost and delivery implication to BHEL.
12. It is bidder responsibility to arrange all necessary tools ,tackles, equipment and

Annexure-1

commissioning spares for testing & commissioning of GIS (items included in supply is not to be used by vendor).

13. Bidder to indicate estimated weight (in MT) along with1 support documents & unit prices per MT in their offer. Bidder to quote in unit as MT. Addition /deletion shall be on unit rate basis but only if there is any change in input.
14. For training, lodging & boarding shall not be in bidder's scope.
15. HV test kit shall be in scope of bidder.
    GT1,2,3, Lines , ST,SAT may be commissioned separately.
    Final testing for complete GIS including GT bays , ST bays, Line bays, bus PT, SAT bays, Ducts, SF6 to Air bushing etc.

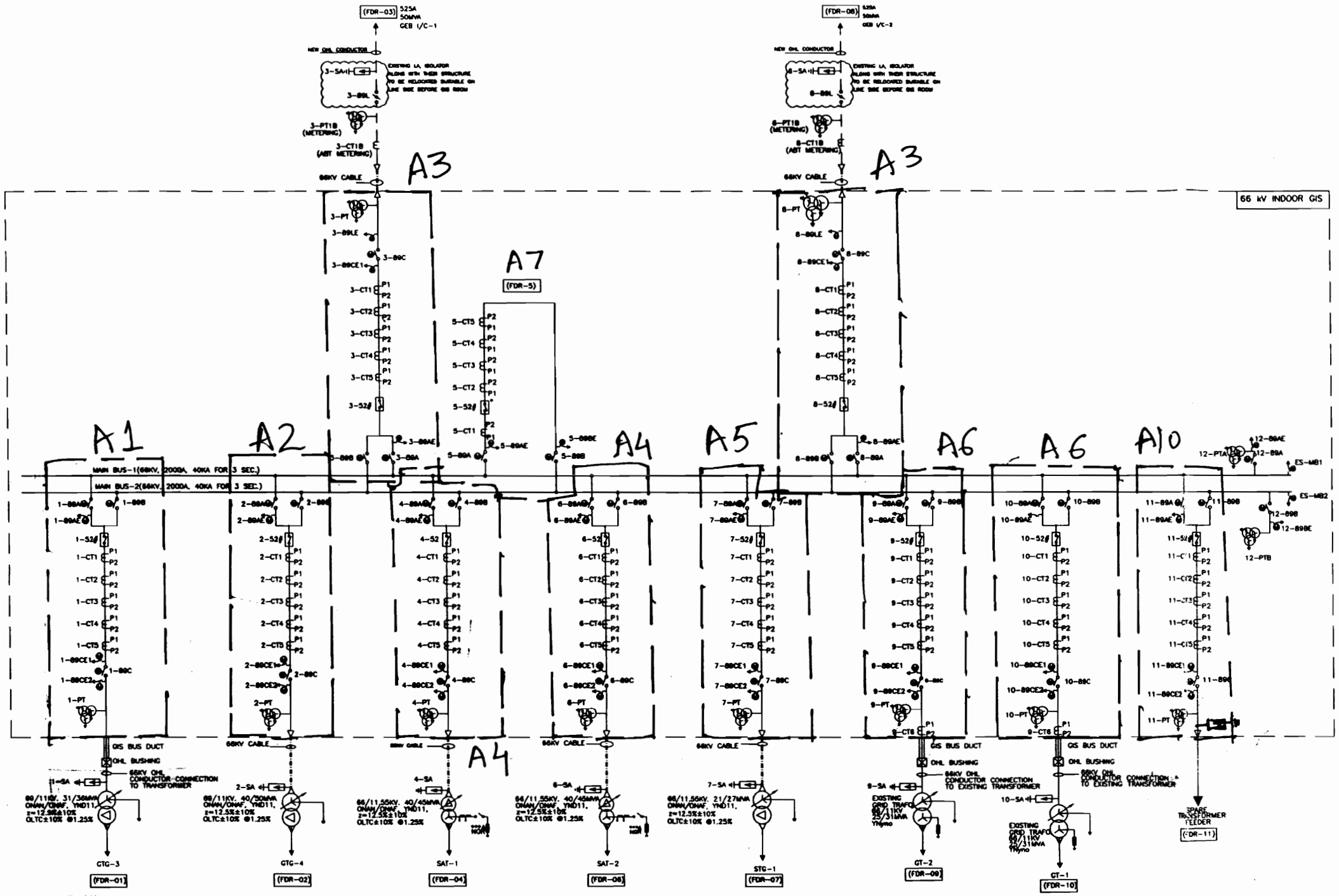
FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM)

DRG. NO. TB-0-383-510-001

COMPUTER DRG. PATH NAME :

SIGN & DATE

INVENTORY NO



REV.	DATE	ALTD.	CHD.	APPD.	REV.	DATE	ALTD.	CHD.	APPD.
SIGN.					SIGN.				

	NAME	SIGN.	DATE
DRAWN	DM		
CHECKED	MM/RK		
APPROVED	AS		

DISTRIBUTION OF PRINTS

DEPT.	CODE
TBEM	422

NAME OF PROJECT/CUSTOMER: ONGC LTD. COMBINED CYCLE CAPTIVE POWER PLANT AT HAZIRA UNIT, GUJARAT

NAME OF CONSULTANT: FITCHNER CONSULTING ENGINEERS INDIA PVT LTD

BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION BUSINESS GROUP

CARD CODE

TITLE: SLD FOR 66kV GIS

NEXT SHEET: 02

SHEET No.: 01

SCALE | W.O. No | DRG. No. TB-0-383-510-001 | REV. 00

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM)

DRG. NO. TB-0-383-510-001

1 | 2 | 3 | 4 | 5 | 6 | 7

COMPUTER DRG. PATH NAME :

SIGN & DATE

INVENTORY NO.

SL. NO.	FEEDER DISCRIPTION	FEEDER NO.	RATING	QTY.
1.	GTG-3	01	630A	01
2.	GTG-4	02	630A	01
3.	GEB I/C-1	03	630A	01
4.	SAT-1	04	630A	01
5.	BUS COUPLER	05	2000A	01
6.	SAT-2	06	630A	01
7.	STG-1	07	630A	01
8.	GT-2	08	630A	01
9.	GEB I/C-2	09	630A	01
10.	GT-1	10	630A	01
11.	SPARE TRFR FEEDER	11	630A	01
12.	BUS VT		–	02

BUS & LINE PT PARAMETERS (PT)

CORE NO.	RATIO	ACCURACY	BURDEN (VA)
CORE-1	$\frac{66KV}{\sqrt{3}}/\frac{110V}{\sqrt{3}}$	3P	100
CORE-2	$\frac{66KV}{\sqrt{3}}/\frac{110V}{\sqrt{3}}$	0.2	100

METERING PT PARAMETERS OF INCOMER#1,INCOMER#2 (PT1B)

CORE NO.	RATIO	ACCURACY	BURDEN (VA)
CORE-1	$\frac{66KV}{\sqrt{3}}/\frac{110V}{\sqrt{3}}$	0.2	30
CORE-2	$\frac{66KV}{\sqrt{3}}/\frac{110V}{\sqrt{3}}$	0.2	30

LEGEND

S.N.	EQUIPMENT DESCRIPTION	kV	SYMBOL	LEGEND
1.	CIRCUIT BREAKER (3-PH),	72.5		52
2.	CIRCUIT BREAKER (3-PH), WITH SYNCHRONISING FACILITY	72.5		52//
3.	ISOLATOR	72.5		89A, 89B, 89C
4.	HIGH SPEED EARTH SWITCH	72.5		89LE
5.	MAINTENANCE EARTH SWITCH	72.5		89AE, 89CE
6.	BUS EARTH SWITCH	72.5		ES
7.	CURRENT TRANSFORMER	72.5		CT
8.	POTENTIAL TRANSFORMER	72.5		PT
9.	SURGE ARRESTOR	60		SA
10.	66 KV XLPE CABLE TERMINATION	72.5		
11.	66 KV XLPE CABLE	72.5		
12.	66 KV SF6 TO AIR BUSHING	72.5		

CT PARAMETERS OF GTG#3, GTG#4, SAT#1, SAT#2 FEEDERS

	CT Ratio used	Min KPV	Imag	Min Burden	Acc Class	Rct at 75Deg	Purpose
CT1	500	700V	30mA at KPV/2	-	PS	5	87O
CT2	500	700V	30mA at KPV/2	-	PS	5	87T, 64REF, 50Z, 51, 51N, 25, 51NS
CT3	500	-	-	30VA	0.2s	-	Metering (Tariff), A (AS)
CT4	500	700V	30mA at KPV/2	-	PS		Spare
CT5	500	700V	30mA at KPV/2	-	PS		87B

CT PARAMETERS OF STG#1,SPARE

	CT Ratio used	Min KPV	Imag	Min Burden	Acc Class	Rct at 75Deg	Purpose
CT1	500	700V	30mA at KPV/2	-	PS	5	87O
CT2	500	700V	30mA at KPV/2	-	PS	5	87T, 64REF, 50Z, 51, 51N, 25, 51NS
CT3	300	-	-	30VA	0.2s	-	Metering (Tariff), A (AS)
CT4	500	700V	30mA at KPV/2	-	PS		Spare
CT5	500	700V	30mA at KPV/2	-	PS		87B

CT PARAMETERS OF GT#1(EXISTING),GT#2(EXISTING)

	CT Ratio used	Min KPV	Imag	Min Burden	Acc Class	Rct at 75Deg	Purpose
CT1	300	-	-	30VA	1	-	Metering (Existing)
CT2	300	-	-	50VA	5P10	-	51, 51N, 67, 67N (Existing)
CT3	300	700V*	30mA at KPV/2*	-	PS	3*	87GT (Existing)
CT4	500	700V	30mA at KPV/2	-	PS	5	Spare
CT5	500	700V	30mA at KPV/2	-	PS	5	87B
CT6	300	700V	30mA at KPV/2	-	PS	5	Differential protection

CT PARAMETERS OF INCOMER#1,INCOMER#2

	CT Ratio used	Min KPV	Imag	Min Burden	Acc Class	Rct at 75Deg	Purpose
CT1	500	700V	30mA at KPV/2	-	PS	5	87B
CT2	500	-	-	30VA	0.2s	-	Metering (Tariff)
CT3	500	-	-	15VA	5P20	-	51, 51N, 67, 67N, 37, 32, 46
CT4	500	700V	30mA at KPV/2	-	PS	5	21, DR, SER, FL, 27, 25, 79, VTS, 50Z, 59
CT5	500	-	-	30VA	0.2	-	MW, MVAR, A, V, PF, F, MWH (MFM), To SAS metering

METERING CT PARAMETERS OF INCOMER#1,INCOMER#2

	CT Ratio used	Min KPV	Imag	Min Burden	Acc Class	Rct at 75Deg	Purpose
CT1B	500	-	-	30VA	0.2s	-	Metering (Tariff)

CT PARAMETERS OF BUS COUPLER

	CT Ratio used	Min KPV	Imag	Min Burden	Acc Class	Rct at 75Deg	Purpose
CT1	2000	2000V	30mA at KPV/2	-	PS	20	87B2
CT2	2000	2000V	30mA at KPV/2	-	PS	20	87B1
CT3	3000	-	-	15VA	5P20	-	51, 51N, 50Z, 25
CT4	2000	-	-	30VA	0.2s	-	A (AS)
CT5	2000	2000V	30mA at KPV/2	-	PS	20	Spare

fSF <=5 FOR ALL METERING CORES

NOTES:-

1. THE DETAILS OF GIS MAY CHANGE AS PER VENDOR'S STANDARD PRACTICE (LOCATION OF BUS EARTHING SWITCH, PT)
2. 3-CT1B, 8-CT1B, 3-PT1B, 8-PT1B, RATIOS MAY CHANGE AS PER GETCO GUIDELINES.
3. METERING CT & PT SHALL BE OUTDOOR TYPE.

// – INDICATES CB WITH SYNCHRONISING FACILITY

REFERENCE DRAWING :-

1) KEY SINGLE LINE DIAGRAM BHEL PD DWG. NO. - 0-381-21-02259
1) 66KV SYSTEM SINGLE LINE DIAGRAM (TENDER DRG) DWG. NO. - 00-5111168-E-203

NAME OF PROJECT/CUSTOMER ONGC LTD.
COMBINED CYCLE CAPTIVE POWER PLANT AT HAZIRA UNIT, GUJARAT

NAME OF CONSULTANT FITCHNER CONSULTING ENGINEERS INDIA PVT LTD

REV.	DATE	ALTD.	CHD.	APPD.	REV.	DATE	ALTD.	CHD.	APPD.
SIGN.					SIGN.				

	NAME	SIGN.	DATE
DRAWN	DM		
CHECKED	MM/RK		
APPROVED	AS		

DISTRIBUTION OF PRINTS

DEPT.	CODE
TBEM	422

BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION BUSINESS GROUP

CARD CODE

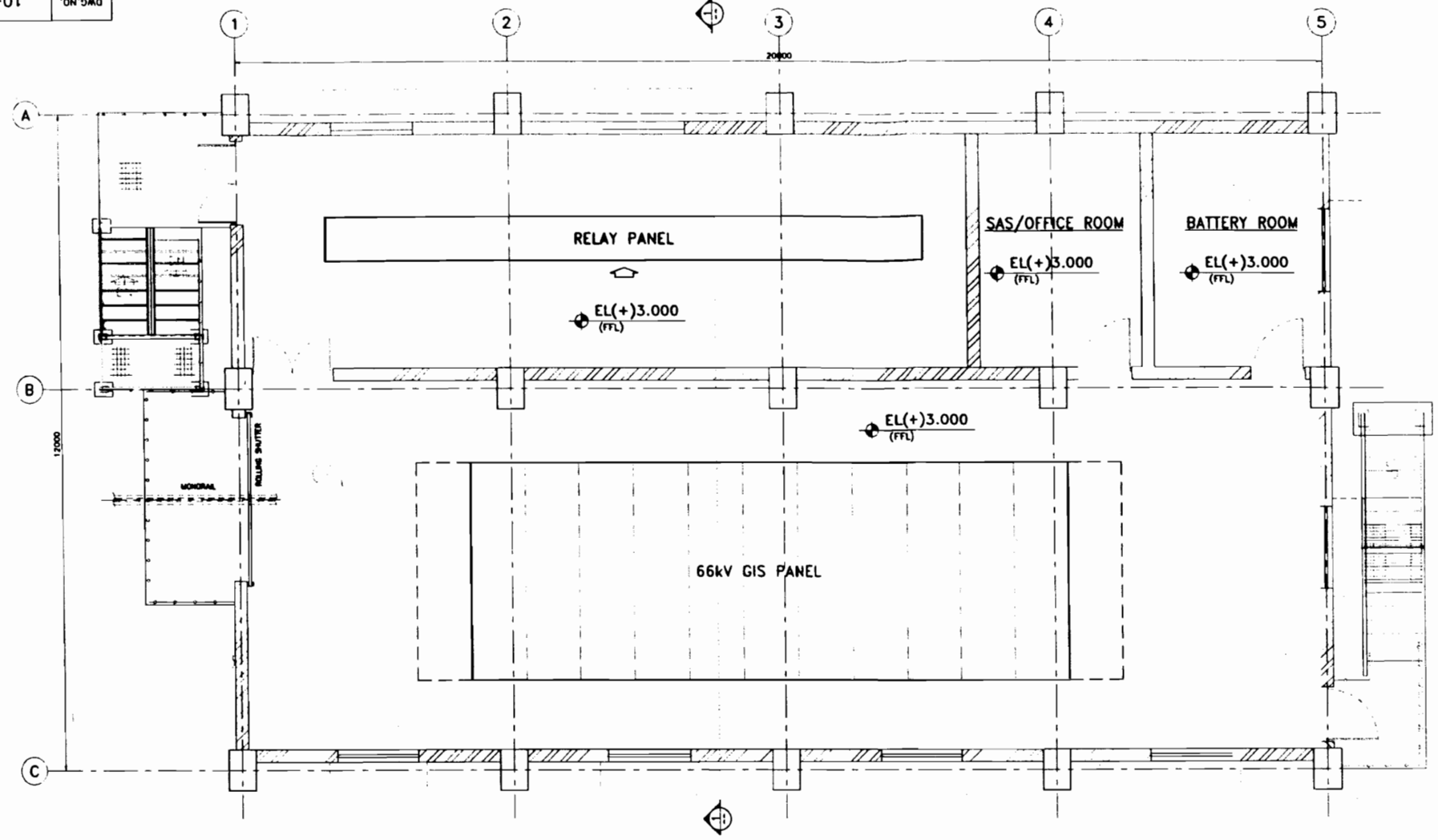
TITLE SINGLE LINE DIAGRAM FOR 66 kV GIS

NEXT SHEET -

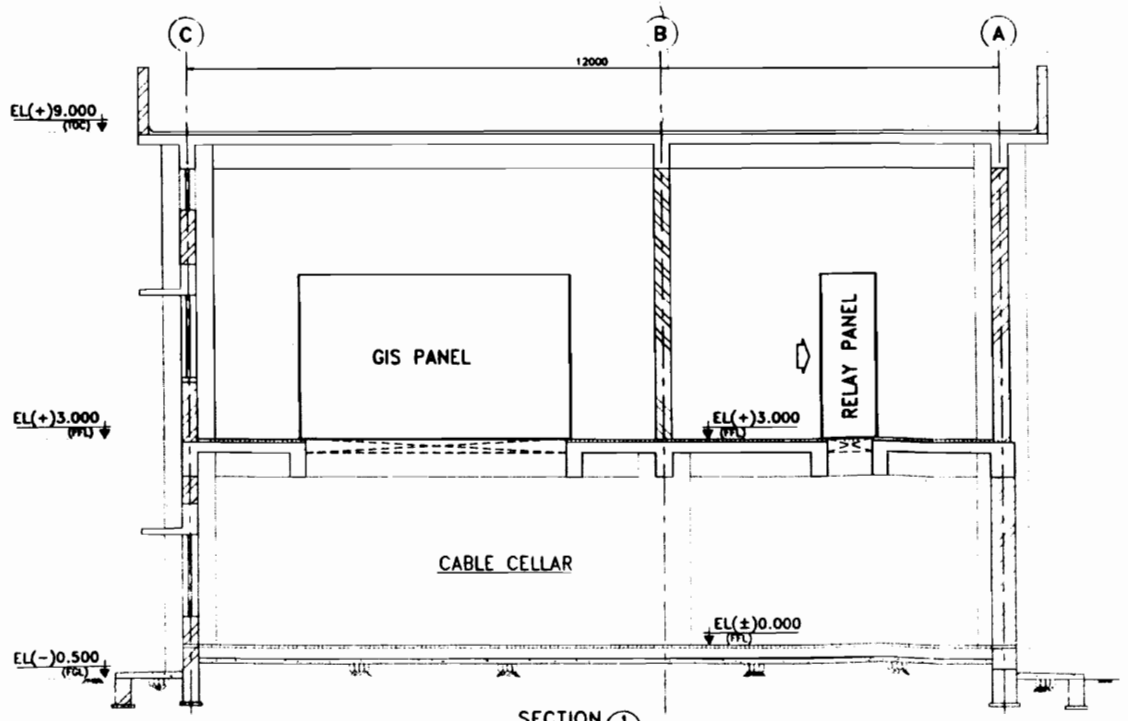
SHEET No. 02

SCALE | W.O. No | DRG. No. TB-0-383-510-001 | REV. 00

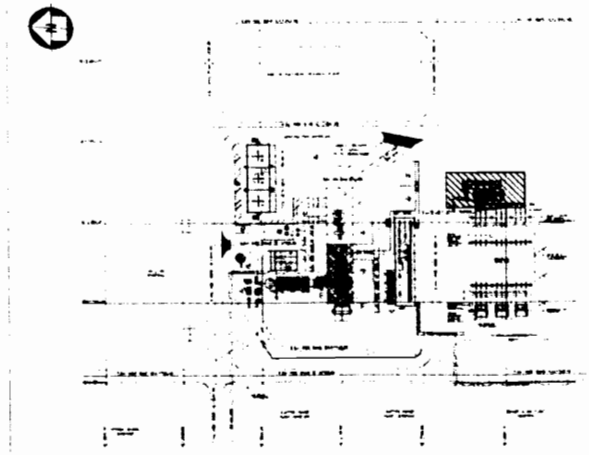
DWG.NO. 10-5111168-E-402 REV B



PLAN AT EL(+)3.000 M. LEVEL



SECTION 1 (SCALE 1:100)



KEY PLAN
(SCALE-N.T.S)

NOTES:-

1... ALL DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES.
2... EL(±)0.00 REFERS TO FINISHED FLOOR LEVEL OF PROPOSED STG BLDG.
3... BUILDING & PANEL DIMENSIONS INDICATED ARE TENTATIVE
4... CONTRACTOR TO SIZE THE BUILDING AS PER ACTUAL PANEL DIMENSIONS DURING DETAILING.

LEGEND:-

EL	ELEVATION
FFL	FINISH FLOOR LEVEL
FGL	FINISH GROUND LEVEL
TOP	TOP OF PAVING
TOC	TOP OF CONCRETE
◊	FRONT

REFERENCE DRAWING :-

1... PLOT PLAN. : 00-5111168-G-001

FOR TENDER PURPOSE ONLY

REV	DATE	DESCRIPTION	DRN.	STR.	MECH.	PROC.	ELEC.	INST.	APPD.
				CHECKED & CLEARED					
B	17.05.12	RELEASED FOR TENDER PURPOSE ONLY	DRP	--	--	--	APK	--	AVD
A	23.04.12	PRELIMINARY FOR REVIEW & COMMENTS	SDK	--	--	--	APK	--	AVD

FICHTNER Consulting Engineers (India) Private Limited Mumbai

CLIENT: OIL AND NATURAL GAS CORPORATION LTD.
COMBINED CYCLE CAPTIVE POWER PLANT
AT HAZIRA PLANT, GUJARAT.

	SIGNATURE		DATE
DRAWN	SAMEER	SDK	18.04.12
DESIGNED		APK	18.04.12
CHECKED		HN	18.04.12
APPROVED		AVD	18.04.12
PROJ. MGR.		SG	18.04.12

TITLE: EQUIPMENT LAYOUT FOR 66kV GIS BUILDING AREA

ISSUED (CLEARED FOR RFQ ONLY)		SIGNATURE		DATE
	STRUCTURAL	--	--	--
	MECHANICAL	--	--	--
	PROCESS	--	--	--
	ELECTRICAL	--	--	--
	INST.	--	--	--

PRELIMINARY		
TENDER	✓	
ENGINEERING		
CONSTRUCTION		

DEPT. ELECTRICAL | F. JOB NO.: CNT 5111168 | SCALE: 1 : 50 | REV.

DWG.NO. 10-5111168-E-402 | B

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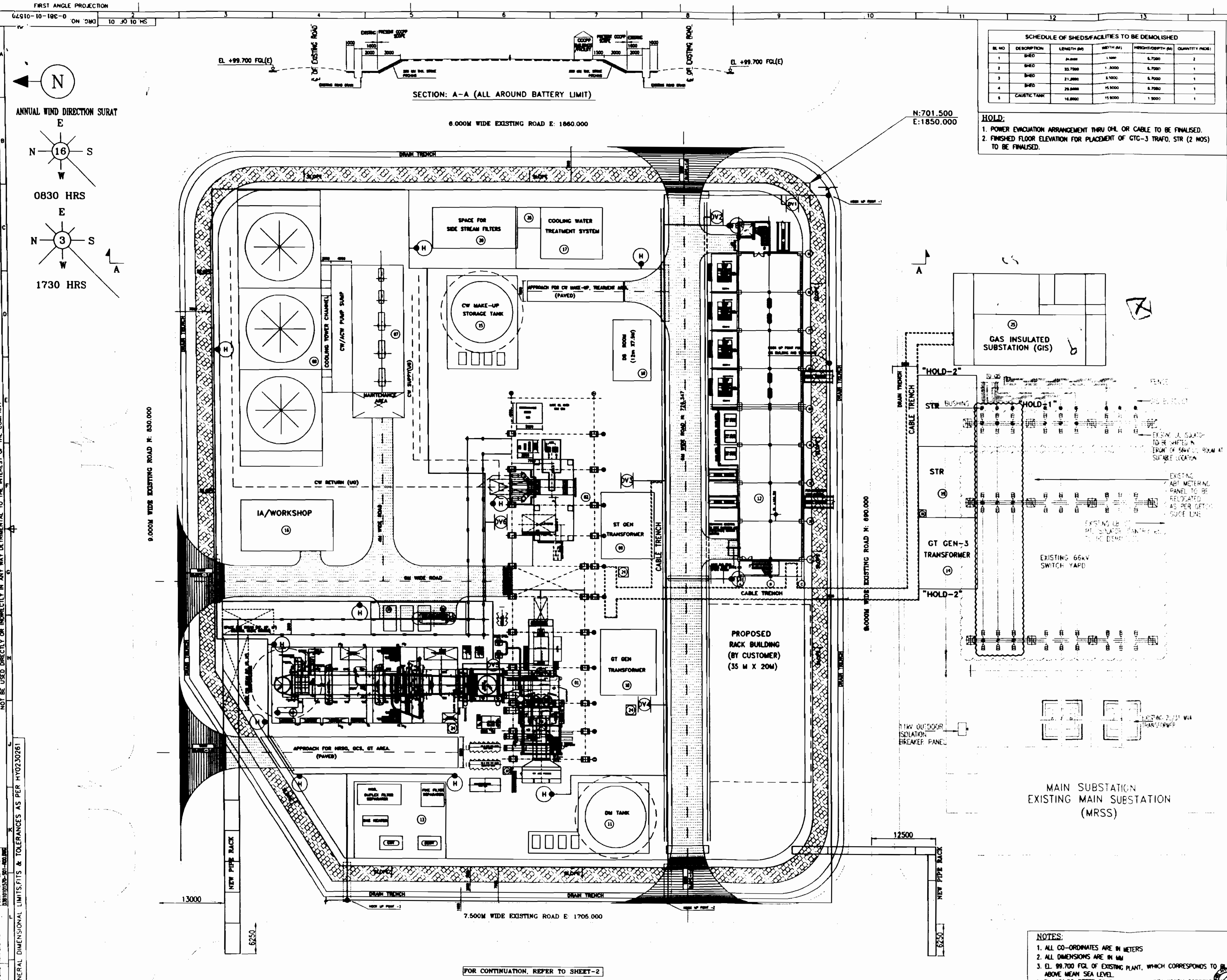
GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER HY0230261

FIRST ANGLE PROJECTION

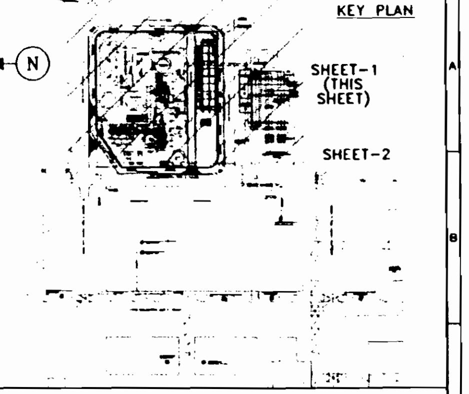


SCHEDULE OF SHEDS/FACILITIES TO BE DEMOLISHED					
SL NO	DESCRIPTION	LENGTH (M)	WIDTH (M)	HEIGHT/DEPTH (M)	QUANTITY (NOS)
1	SHED	[illegible]	[illegible]	6.7000	2
2	SHED	33.7000	[illegible]	6.7000	1
3	SHED	21.[illegible]	8.5000	6.7000	1
4	SHED	29.[illegible]	15.5000	6.7000	1
5	CAUSTIC TANK	16.8000	15.6000	1.5000	1

HOLD:

1. POWER EVACUATION ARRANGEMENT THRU OHL OR CABLE TO BE FINALISED.
2. FINISHED FLOOR ELEVATION FOR PLACEMENT OF GTG-3 TRAFO, STR (2 NOS) TO BE FINALISED.

KEY PLAN



LIST OF EQUIPMENTS/BUILDINGS (PRELIMINARY)			
S. NO.	DESCRIPTION	QTY.	SIZE (M X M)
1	GTG SHED	01	32 x 14
2	STG SHED	01	32 x 16
3	HRSG AREA	1	-
4	DEAERATOR AREA	1	-
5	HP BFP	3	2.5 X 5
6	LP BFP	2	0.6 X 1.5
7	CW, ACW PUMPS AREA	01	25 X 10
8	COOLING TOWER AREA	1	48 X 16
9	ST GENERATOR TRANSFORMER	01	9 X 11
10	GT GENERATOR TRANSFORMER	1	9 X 12
11	DM WATER TANK AREA	01	18.5 X 13
12	CABLE CELLAR /SWITCH GEAR/CONTROL ROOM	1	60 X 12(W) X 15(H)
13	FUEL GAS CONDITIONING AREA	01	15 X 18
14	NEW GEN. TRANSFORMER FOR EXISTING GTG-3	1	7.8 X 7.8
15	CW MAKE-UP STORAGE TANK	01	11.3 M DIA
16	IA/ WORKSHOP	01	18 X 10
17	COOLING WATER TREATMENT SYSTEM	01	12 X 10
18	DG ROOM	01	12 X 7.5
19	SAT	02	8.0 X 10
20	SIDE STREAM FILTERS AREA	01	16.5 X 8
21	GT LOCAL CONTROL ROOM	01	10 X 05
22	GT WATER WASH COLLECTION PIT	01	1.5 x 1.5
23	DRAIN PIT	01	04 X 04
24	DRAIN PIT	03	2.0 X 2.0
25	GAS INSULATED SUBSTATION (GIS) - INDOOR	01	20 X 12
26	BACK WASH PIT /CT DRAIN PIT	01	4.5 X 3.5

THE DIMENSIONS INDICATED ABOVE ARE PRELIMINARY, TO BE FINALISED AFTER RECEIPT OF PROJECT SPECIFIC EQUIPMENT DESIGN/DATA.

REFERENCE DRAWINGS.

A) CUSTOMER

A1. KEY PLAN SHOWING TERMINAL POINTS : 00-5111168-G-002 REV-C

REFERENCE LEVELS OF FLOORS/FOUNDATIONS

LEGEND:

FFL: Finished Floor Level
TOP: Top Of Paving
FGL(N): Finished Ground Level (NEW CCCPP AREA)
FGL(E): Finished Ground Level (FGL OF EXISTING PLANT)
MBL: Machine Base Level

- NEW PIPE RACK
- ROADS INSIDE CCCPP
- SLOPED AREA (WITH STONE PITCHING)

NOTES:

1. ALL CO-ORDINATES ARE IN METERS
2. ALL DIMENSIONS ARE IN MM
3. EL. 99.700 FGL OF EXISTING PLANT, WHICH CORRESPONDS TO RL 6.00 ABOVE MEAN SEA LEVEL.
4. EL. 101.20 REFER TO FGL OF CCPP AREA WHICH CORRESPONDS TO RL 7.50 ABOVE MEAN SEA LEVEL.

PROJECT: 1X51 MW COMBINED CYCLE COGENERATION CAPTIVE POWER PLANT

CLIENT: OIL AND NATURAL GAS CORPORATION LTD. AT HAZIRA PLANT, GUJARAT

CONSULTANT: FICHTNER Consulting Engineers (India) Private Limited, Bangalore.

EPC CONTRACTOR: BHARAT HEAVY ELECTRICALS LTD HYDERABAD

TITLE: PLOT PLAN (POWER BLOCK AREA)

DRAWING NO. 0-381-01-01570 REV. 01

SCALE 1:250

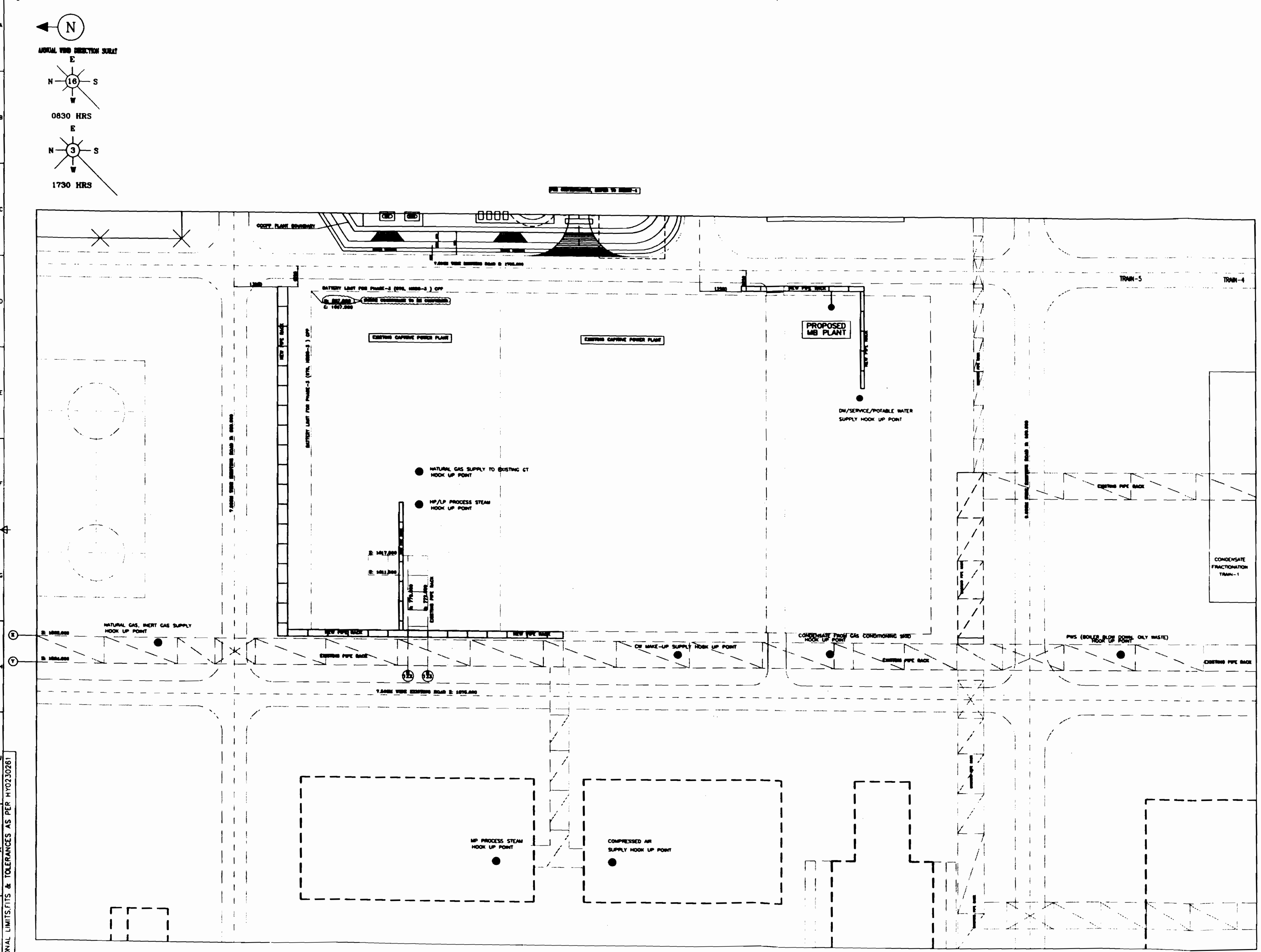
May Sat 30 15:30 2015

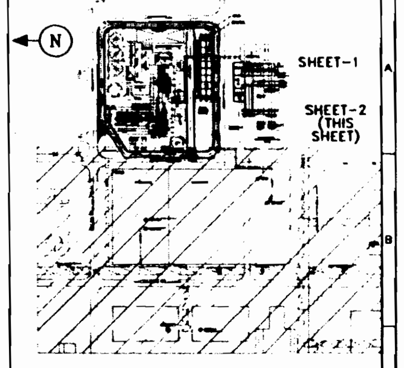
GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER HY0230261

FIRST ANGLE PROJECTION

DRG. NO. 0-381-01-01570

(ALL DIMENSIONS ARE IN mm)





KEY PLAN

LIST OF PIPING HOOK-UP POINTS WITH EXISTING PLANT/FACILITY

TP SL NO	LINE DESCRIPTION	TERMINAL POINT END CONNECTION DETAILS	MATERIAL	LOCATION ELEVATION	TERMINATION AT HOOK-UP POINT
1	NATURAL GAS TO CONDITIONING SKID	10	SA 106GR B	TBD	ANCHOR
2	INERT GAS SUPPLY	1	SA 106GR B	TBD	NOT APPLICABLE
3	NATURAL GAS TO EXISTING GT IN CPP	4	SA 106GR B	TBD	ANCHOR
4	HP PROCESS STEAM SUPPLY TO EXISTING CPP	6" (168.3X7.11) BW	SA 106GR B	TBD	ANCHOR
5	LP PROCESS STEAM SUPPLY TO EXISTING CPP	10" (273.0X9.27) BW	SA 106GR B	TBD	ANCHOR
6	MP PROCESS STEAM TO EXISTING CPP	8" (219.1X8.18) BW	SA 106GR B	TBD	ANCHOR
7	COMPRESSED AIR SUPPLY TO EXISTING PLANT	TBD	SA 106GR B	TBD	NOT APPLICABLE
8	CW MAKE-UP SUPPLY TO CCCPP	TBD	SA 106GR B	TBD	NOT APPLICABLE
9	GAS CONDENSATE FROM CCCPP	TBD	SA 106GR B	TBD	NOT APPLICABLE
10	PWS (BOILER BLOWDOWN, OIL WASTE) FROM CCCPP	TBD	SA 106GR B	TBD	NOT APPLICABLE
11	DM WATER SUPPLY TO CCCPP	TBD	SA 106GR B	TBD	NOT APPLICABLE
12	SERVICE WATER SUPPLY TO CCCPP	TBD	SA 106GR B	TBD	NOT APPLICABLE
13	POTABLE WATER SUPPLY TO CCCPP	TBD	SA 106GR B	TBD	NOT APPLICABLE

NOTES:

1. ALL CO-ORDINATES ARE IN METERS
2. ALL DIMENSIONS ARE IN MM
3. FOR REFERENCE DRAWINGS, LEGEND REFER TO SHEET-1 OF THIS DRAWING.

PROJECT: 1X51 MW COMBINED CYCLE COGENERATION CAPTIVE POWER PLANT

CLIENT: OIL AND NATURAL GAS CORPORATION LTD. AT HAZIRA PLANT, GUJARAT.

CONSULTANT: FICHTNER Consulting Engineers (India) Private Limited, Bangalore.

EPC CONTRACTOR: BHARAT HEAVY ELECTRICALS LTD HYDERABAD

BHARAT HEAVY ELECTRICALS LTD. HYDERABAD

	NAME	SIGN	DATE	NO. OF .AR
DRN.	SNN R		27.04.15	NA
CHD.	GS		27.04.15	
APPD.	WBS S		27.04.15	

DEPT. PED	UNTOL. DIMS. GR. /CAMR		SCALE 1:250	WEIGHT (KG) NA	REF. TO ASSY. DRG NA	ITEM NO NA	NO. OF ITEMS NA

TITLE: PLOT PLAN (DM PLANT AREA, PIPING HOOK-UP LOCATIONS)

CARD CODE: N.A.

DRAWING NO. 0-381-01-01570 REV. 01

SHT. No 02 NO OF SHT 02

SECTION – 2

1. Clarifications/ deviations to ONGC specification (3 pages)
2. ONGC Technical Specification for GIS (vol III/ sec 3, sub-sec 3.6.1, 3.6.2)

The enclosed specification is ONGC specification for which deviation/ clarification is submitted by BHEL. The specification shall be read in conjunction with deviation. For any differences, deviation shall supersede the ONGC technical specification.

Section 2

Project : ONGC Hazira CCCPP (1x51 MW)
Item : 66kV GIS

ANNEXURE-A

Sub section	clause no	Specification REQUIREMENT	BHEL Clarification	ONGC/FI Clarification
3.6.1	3.2.1	One no. 3 - Isolated phase, SF6 gas insulated metal enclosed busbars, ...	In 66kV , manufacturers have 3 phase encapsulated design	Noted
3.6.1	3.2.2, 3.2.3, 3.2.4, 3.2.5, 3.2.6 (b)	Single core single phase current transformers.	Current Transformers shall be of single core three phase encapsulated type	Noted .
3.6.1	3.2.2, 3.2.3, 3.2.4, 3.2.5, 3.2.6 (c)	3 phase, single pole group operated isolator switches, complete with manual and motor driven operating mechanism.	Isolators shall be 3 pahse common pole operated type	The Isolators shall be 3 phase single pole perated with a single drive mechanism & shall be complete with manual and motor driven operating mechanism
3.6.1	3.2.2, 3.2.3, 3.2.4, 3.2.5, 3.2.6 (d)	3 phase, single pole group operated safety ground switches, complete with manual and motor driven operating mechanism.	earthswitch shall be 3 pahse common pole operated type	The Earth Switches shall be 3 phase single pole operated with a single drive mechanism & shall be complete with manual and motor driven operating mechanism
3.6.1	3.2.4 (e)	3 phase single pole, high speed fault making ground switch, complete with manual and motor driven operating mechanism.	earthswitch shall be 3 pahse common pole operated type	The Earth Switches shall be 3 single pole gang operated with a single drive mechanism & shall be complete with manual and motor driven operating
3.6.2	A.4.1.1	Re-Closing Single and three phase high speed auto re-closing.	Three phase high speed auto re-closing	Noted for Three phase high speed auto re-closing
3.6.2	A.4.2.2	However even at 50% of rated supply voltage the breaker shall be able to operate.	As per IEC , the operating voltage between 70% to 110% of normal control voltage.	Kindly comply as per latest IEC Standards
3.6.2	A.7.3.0, A.7.22.0	Gas enclosures shall be designed to withstand high vacuum by provision of suitable reinforcement(s) at all the required locations. The gas filled enclosures shall conform to relevant pressure vessel code of	The GIS enclosure complies with CENELEC (European) standard.	Kindly proceed as per IS/IEC/IEEE standards
3.6.2	A.3.1.0 (g)	Circuit breaker Rated Break Time - a) Not more than 40 ms under test duties 2, 3 & 4 at rated values. b) Not more than 45 ms under test duties 1 to 5 and short line fault test duties and combined variation of trip coil voltage, operating pressure and quenching media pressure, etc.	IEC does not specify rated break time, it varies from manufacturer to manufacturer. Rated break time shall be less than 55 ms under test duties 2, 3 & 4 at rated values.	This can be as per OEM Recommendation. However Speed Curve Test shall be conducted at works and site (Please refer Vol III/Sec 3.6.2/Clause 6.0.0/Sheet 425)
3.6.2	A.7.4.0	Mandatory maintenance equipment (Nitrogen filling)	It is applicable only for GIS with hydraulic operating mechanisms	Noted as we understand BHEL provides spring operating Mecahnism for GIS

Project : ONGC Hazira CCCPP (1x51 MW)
Item : 66kV GIS

ANNEXURE-A

Sub section	clause no	Specification REQUIREMENT	BHEL Clarification	ONGC/FI Clarification
3.6.2	A.7.21.0, A.7.23.0	Corona The average intensity of electromagnetic field shall not be more than 50 micro tesla. The Bidder shall furnish all calculations and documents in support of	Calculation can not be provided. Supporting documents will be provided by the bidder.	Noted. Supporting Test Reports to be submitted
3.6.2	A.4.3.2	Operational requirements (66kV Circuit breaker) Operational requirement for The resistor shall have thermal rating to the following PIR successive closing operation	PIR not applicable for 66kV GIS	Noted
3.6.2	Cl no B.4.9.0	The auxiliary switch contacts are to be continuously adjustable...	The auxiliary contacts are adjustable at factory.	Noted. Kindly provide Spare Contacts As per Tender Specation & drawings
3.6.2	B.5.9.0	Disconnectors ...silver plated terminal connector	Earthing terminals shall be of copper	Noted
3.6.2	C.3.11.0	High speed earthing switches ...silver plated terminal connector	Earthing terminals shall be of copper	Noted
3.6.2	D.1.5.0	SF6 TO AIR TRANSITION BUSHINGS - .....porcelain parts by grinding and metal parts	SF6 to air bushing can be of composite type.	Noted. BHEL to provide Type Test Certificates for composite type
3.6.2	D.1.6.0	All current carrying contact surface shall be silver	All current carrying parts shall be of Aluminium	Noted
3.6.2	D.1.8.0	A test tap shall be provided for measurement of Capacitance & Tan delta factor.	Tan delta factor and capacitance not applicable for GIS	Kindly comply as per Tender Specification as the referred clause points to SF6 to Air Transiton Bushings (Please refer Vol III/Sec 3.6.2/Sheet 431/Clause 1.8.0/SF6 to Air Transition Bushings
3.6.2	E.1.0.0	Instrument transformers - codes and standards	IEC 60044 has been superseeded By IEC 61869-1&2 for CT & IEC 61869-1&3 for VT	Noted, Kindly comply as per latest IEC Standards
3.6.2	E.3.2.0	One minute power frequency withstand voltage between secondary terminal and earth - 5 kV	as per IEC this parameter is 3kV rms	Noted, Kindly comply as per latest IEC Standards

Project : ONGC Hazira CCCPP (1x51 MW)
Item : 66kV GIS

Section 2

Clarifications/ deviations to technical specifications

Sub section	clause no	Specification REQUIREMENT	BHEL Clarification
3.6.2	E.3.2.0	One minute power frequency withstand voltage between secondary terminal and earth - 5 kV	as per IEC

VOLUME - III

SECTION - 3

DETAILED TECHNICAL SPECIFICATION - ELECTRICAL

SUB-SECTION - 3.6.1

66 kV INDOOR GIS

3.2.0 **66 kV Indoor GIS System**

3.2.1 One no. 3 - Isolated phase, SF6 gas insulated metal enclosed busbars, each comprising of: (PART OF A1 TO A9)

a) Three numbers individual bus bar enclosures running the length of the switchgear to interconnect each of the circuit breaker bay modules in double main bus system.
b) Three numbers inductive type voltage transformers complete with isolator switch & safety ground switches
c) Three numbers inductive type voltage transformers, inside the GIS Compartment.
d) Interconnecting wiring and piping
e) Grounding support structures and platforms
f) GIS duct with gas monitoring devices, barriers, pressure switches etc as required

3.2.2 One no. Bus-coupler bay comprising of: (A7)

a) One number 3 phase SF6 insulated circuit breaker complete with operating mechanism
b) Single core single phase current transformers.
c) 3 phase, single pole group operated isolator switches, complete with manual and motor driven operating mechanism.
d) 3 phase, single pole group operated safety ground switches, complete with manual and motor driven operating mechanism.
e) GIS duct with gas monitoring devices, barriers, pressure switches etc as required
f) Bay marshalling boxes, Local Control panels

3.2.3 Three nos. Generator transformer circuit breaker bays, each comprising of: (A1, A6)

a) One number 3 phase SF6 insulated circuit breaker complete with operating mechanism
b) Single core single phase current transformers
c) 3 phase, single pole group operated isolator switches, complete with manual and motor driven operating mechanism
d) 3 phase, single pole group operated safety ground switches, complete with manual and motor driven operating mechanism
e) Three numbers inductive type voltage transformers, inside the GIS Compartment.
f) Three numbers out door type surge arresters (surge arresters inside transformer cable termination box can be accepted.)
g) Three numbers 1 phase SF6 Ducts to outdoor air bushings required for conductor termination. (required for existing GTG-3 transformer bay in case of OHL connection).
h) GIS duct with gas monitoring devices, barriers, pressure switches etc as required
i) Bay marshalling boxes, Local Control panels

3.2.4 Two nos. 66 kV transmission line circuit breaker bay modules, each comprising of: (A3)

a) One number 3 phase SF6 insulated circuit breaker complete with operating mechanism
b) Single core single phase current transformers
c) 3 phase, single pole group operated isolator switches, complete with manual and motor driven operating mechanism
d) 3 phase, single pole group operated safety ground switches, complete with manual and motor driven operating mechanism
e) One 3 phase single pole, high speed fault making ground switch, complete with manual and motor driven operating mechanism.
f) Three numbers inductive type voltage transformers, inside the GIS Compartment.
g) Three numbers 1 phase SF6 Ducts to outdoor air bushings required for conductor termination.
h) Three numbers Outdoor type surge arresters
i) GIS duct with gas monitoring devices, barriers, pressure switches etc as required
j) Bay marshalling boxes, Local Control panels

3.2.5 Four Station transformer circuit breaker bay (two nos. existing & two nos. new) comprising of: (A2, A4, A5)

a) One number 3 phase SF6 insulated circuit breaker complete with operating mechanism.
b) Single core single phase current transformers.
c) 3 phase, single pole group operated isolator switches, complete with manual and motor driven operating mechanism.
d) 3 phase, single pole group operated safety ground switches, complete with manual and motor driven operating mechanism.
e) Three numbers inductive type voltage transformers, inside the GIS Compartment.
f) Three numbers out door type surge arrestors (surge arresters inside transformer cable termination box can be accepted for new station transformers, existing Surge arresters can be used for existing transformers).
g) Three numbers 1 phase SF6 Ducts to outdoor air bushings required for conductor termination.
h) GIS duct with gas monitoring devices, barriers, pressure switches etc. as required./Cable
i) Bay marshalling boxes, Local Control panels

3.2.6 One spare Generator transformer circuit breaker bay, each comprising of:

a) One number 3 phase SF6 insulated circuit breaker complete with operating mechanism.
b) Single core single phase current transformers.
c) 3 phase, single pole group operated isolator switches, complete with manual and motor driven operating mechanism.
d) 3 phase, single pole group operated safety ground switches, complete with manual and motor driven operating mechanism.
e) Three numbers inductive type voltage transformers, inside the GIS Compartment.
f) Three numbers out door type surge arrestors (surge arresters inside transformer cable termination box can be accepted.).
h) GIS duct with gas monitoring devices, barriers, pressure switches etc. as required./Cable
i) Bay marshalling boxes, Local Control panels.

~~Refer the attached drawing 00-5111168-E-203 66kV GIS Key Single diagram for details.~~

3.3.0 ~~Balance of equipment~~ / accessories like ~~bus post~~ insulators, clamps & connectors, spacers, aluminum tubes, Conductors, ground wire, ~~insulators & hardware~~, gantry and equipment structures, ~~bay marshaling~~ kiosks as required to complete the 66kV GIS Substation ~~package~~.

3.4.0 SF6 Gas Filling.

3.5.0 Breaker operation analyzer with transducers.

3.6.0 All jumpers and connections to surge arrester and 66 kV Gantry is in Bidder's scope.

~~Each of the 66 kV overhead line circuits shall be protected with numerical line distance protection relay suitable for operation through OPGW cable as the main protection communication link. Any modification work required at GETCO end shall be in EPC contractor's scope. Approximate route length from ONGC 66kV switchyard to GETCO Ichhapore Substation is around 4 kM.~~

3.7.0 Protection & Relay panels shall consist of the following:

a) Bus bar Protection Relay panels for Main & Check zones for each 66 kV bus.
b) Islanding protection scheme with three channels of under frequency and df/dt functions.
c) Line Protection relay panels consisting of BPU's with Distance protection.
d) Generator transformer Protection relay panels consisting of BPU'.
e) One Portable dynamic Relay test kit, Phantom Load sets, Test plugs & Relay tool kits.
f) All necessary licensed software for communication with Numerical relays, BPU along with dedicated engineering work station.

3.8.0 Substation Automation system (SAS) consisting of following:

a) Bay controller units (BCU) for each 66kV GIS.
b) Fully dual redundant communication bus.
c) SAS I/O Cabinets, marshalling panels.
d) Transducers for transmitting electrical analog quantities (Voltage, Current, active & reactive Power, frequency etc.).
e) All necessary Remote Terminal units (RTU), HMI, engineering work stations at the GIS control room.
f) One Remote HMI at Central control room along with connectivity and printers. Remote HMI shall also be duplicated at new GIS control room. The new SAS system shall have provision to communicate with the proposed plant SCADA system of ONGC and also with the new DCS system for the new power plant.
g) All required printers, scanners and consumables like paper, toners, and printer ribbons shall be supplied.

Refer the attached 66 kV GIS SAS configuration Dwg No: 10-5111168-E-204 for details.

3.9.0 Existing Main Availability based tariff (ABT) metering kiosk (outdoor) for both 66kV line bays may be used with suitable relocation as per GETCO guidelines for GETCO & *DGVCL guidelines for their* metering purpose. *If it is required to replace these existing ABT meters with kiosk as per GETCO & DGVCL guidelines, contractor to provide new GETCO & DGVCL approved meters with their installation as per GETCO & DGVCL guidelines.* Additional requirement of Check Availability based tariff (ABT) meter shall be provided for each 66kV line bay for GETCO & *DGVCL* tariff metering, Standby ABT meter shall be provided for ONGC purpose in both 66kV Overhead lines. Trivector meter suitable for tariff metering for all outgoing bays shall be provided. *Suitable relocation / renewal provision as per GETCO & DGVCL provisions would need to be made.*

3.10.0 *Any additional requirement of CTs / PTs for GETCO & DGVCL approved ABT metering, same shall be provided by contractor as per GETCO & DGVCL guidelines.*

3.11.0 110 V DC System with Two (2) 100 % rated batteries and two (2) 100 % rated float cum boost chargers along with DC distribution boards for 66 kV GIS.

3.12.0 415 V AC Distribution boards required for complete 66kV GIS package.

3.13.0 Lightning protection for complete GIS building & existing switchyard area.

3.14.0 Design and supply of earthing material shall be in Bidders scope. Connections to Bidder's earth riser from embedded earth mesh is in Bidders Scope.

3.15.0 All necessary platforms, supports, ladders etc. for maintenance work.

3.16.0 Set of Special Tools & Tackles, Start-up & Commissioning spares.

3.17.0 ~~Recommended spares for 3 years of operation & maintenance.~~

3.18.0 Demolition / dismantling of existing 66kV switchyard equipment with their associated structures & foundations. Existing 66kV switchyard equipment after dismantling shall be dumped at the designated site as decided by ONGC.

3.19.0 Design of complete Civil works for the 66kV GIS system including that for GIS building, new Gantry structures, grading, gravel spreading, foundations, cable trenches, trench covers, drains, fencing, gates etc. to complete the installation . Bidder shall furnish all the civil drawings applicable as "Release for construction" for complete GIS building and switchyard area.

3.20.0 Required Documentation, Responsibility of calling State Electrical Inspector and getting statutory approval/certification of the GIS installation.

4.0.0 SCOPE OF SERVICES BY BIDDER (AS PER ANNEXURE - II)

4.1.0 Development of General arrangement drawings.

4.2.0 Development of detailed layout for 66kV GIS building & existing 66kV switchyard area.

4.3.0 Development of Single line drawings with parameters of equipment and details of metering & protection.

4.4.0 Development of protection & control philosophy, selection of protection, control and annunciation schemes.

4.5.0 Development of interlocking schemes.

4.6.0 Development of earthing system.

4.7.0 Insulation coordination and lightning protection design calculations.

4.8.0 Development of power & control cable laying and termination schedules.

4.9.0 Development of erection key diagrams with bill of material.

4.10.0 Design of foundation and release of civil construction drawings for complete GIS building.

4.11.0 Development cable trench layout and sections & release of construction drawings.

4.12.0 Relay setting calculations along with programming charts.

4.13.0 Shop inspection and testing procedures along with QAP.

4.14.0 Complete erection, testing commissioning of all the equipment required for complete 66 kV GIS substation package. The field testing equipment required for site testing shall be arranged by the Bidder.

4.15.0 Furnishing of all labor, skilled and unskilled, supervisory and administrative personnel, erection tools and tackles, testing equipment, implements, supplies, consumables, and hardware, for timely and efficient execution of the erection work.

4.16.0 Transport vehicles necessary for efficient transportation of equipment from stores to site of erection and of excess material back to stores.

4.17.0 Submission of engineering, manufacturing and erection schedules so as to carry out the works in a phased timely manner.

4.18.0 Training of Owner/Owner's representative's engineers.

5.0.0 CODES AND STANDARDS

5.1.0 All the equipment/system shall in general confirm to the latest addition of relevant National and International codes & Standards especially Indian Statutory Regulations.

5.2.0 The accompanying sections also indicates the applicable codes and standards.

5.3.0 The Equipment/material/systems confirming to other equivalent national and international standards shall also be considered provided the same ensures equal or better features compared to standards listed in the following section.

6.0.0 DETAILED TECHNICAL SPECIFICATIONS

6.1.0 The design and constructional requirements of 66 kV indoor GIS system is covered under clause 10.00.00 of this specification.

6.2.0 The detailed technical requirements of 66 kV GIS equipments like Circuit breakers, instrument transformers, disconnections switches are covered in Section 3.6.2. ~~This section also covers about the outdoor switchyard equipment like Surge arrestors, String insulators and all miscellaneous items. The detailed technical requirements of the OPGW are also covered in Section 3.6.2~~.

6.3.0 ~~The detailed technical requirements of Substation Automation system (SAS) & Protection panels of 66 kV GIS system is covered in Section 3.6.3 The Section 3.6.2 also covers requirements about~~ ABT metering ~~& Fault Disturbance recorders~~.

7.0.0 DESIGN & CONSTRUCTION REQUIREMENTS FOR 66 KV GIS SYSTEM

7.1.0 The GIS shall comply with IEC 62271-203/60694. The general requirements and special requirements for Gas insulated switchgear are given in this section. Materials and components not specifically stated in this specification but are necessary for the satisfactory operation of the equipment shall be deemed to be included unless specifically excluded and shall be supplied at no extra cost.

7.2.0 The switchgear assembly shall be suitable for installation in indoor area. Constructional features shall be selected not only to withstand satisfactorily the specified atmospheric conditions under Project Information but allow for thermal expansion during its normal use.

7.3.0 Gas enclosures shall be designed to withstand high vacuum by provision of suitable reinforcement(s) at all the required locations. The gas filled enclosures shall conform to relevant pressure vessel code of ANSI/IEC.

7.4.0 Equipment shall be complete with all necessary supports, platforms, ladders, staircases, catwalks, mechanism cabinets, internal cable raceways etc for each bay and it shall be of extensible design.

7.5.0 The GIS shall be modular in structure and shall be housed indoor. The modules shall be single phase encapsulation and provided with hooks for handling by overhead cranes to be provided in the building. The modular design shall be capable of extension on either side without any major dismantling.

7.6.0 The equipment and connections within each compartment shall be arranged so as to allow removal and replacement of any section both during normal and abnormal (fault) working conditions with minimum disturbance to adjacent pressurized sections.

7.7.0 The lines shall be terminated on take-off gantry. The take-off from GIS shall be through bushing and the surge arrestor & Line trap shall be outdoor type. The terminations of Generator transformer shall be underground cables. High speed earth switches shall be provided where ever required.

7.8.0 The bus bars shall be rated for the duty specified and current rating shall be derived considering maximum possibilities.

7.9.0 The metal enclosures for the GIS shall be made up of non-magnetic material and shall be suitable designed and fabricated from mechanical and electromagnetic aspects. The enclosure surface shall be painted suitably for deterioration due to corrosion, humidity, temperature ageing, and attack from fungus , rodents. Interior finishing shall not contain any substances which could contaminate the SF6 gas and its insulating properties over a period of time.

7.10.0 The enclosures shall be such as to eliminate dangerous electrostatic charges. The enclosures shall meet the pressure vessel requirement as per ASME or equivalent. The modular design shall offer maximum flexibility from the design, operation and maintenance point of view. The enclosures shall be sectionalized with gas tight barriers between sections or compartments. The wall thickness of the enclosure shall be based on the design pressure as well as considering a bum through duration of 0.1 sec.

7.11.0 The support insulators and section barriers shall be free from voids and shall be so designed so as to reduce the electrical stresses to the minimum. Gas barrier insulators and support insulators shall have the same basis of design. The support insulator shall have holes on both sides for proper flow of gas. The section barriers and enclosure walls shall be gas tight (permissible leakage rate of 0.5% per annum) and capable of withstanding the maximum pressure differential i.e. vacuum on one side and maximum gas pressure on other side.

7.12.0 Minimum assembly work is envisaged during installation. Each section shall have plug-in or easily removable connection pieces to allow easy replacement of any component with minimum disturbance to the remainder of the equipment.

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

7.14.0 The manufacturer shall guarantee that the pressure loss within each individual gas filled compartment shall not be more than half percent (0.5 %) per year.

7.15.0 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 vapor as well as any by products of SF6 during interruption.

7.16.0 Each gas compartment shall be fitted with separate non-return valve connectors for evacuating, gas filling, and for checking the gas pressure

7.17.0 The internal components shall be maintenance free for at least 10 years. Routine replacements of insulating gas shall not be required in intervals of less than ten years.

7.18.0 The thermal rating of all current carrying parts shall be minimum for three second for the rated symmetrical short circuit current.

7.19.0 The arrangement of individual switchgear bays shall be such so as to have optimum space saving, neat, logical arrangement and adequate accessibility to all external components.

7.20.0 It should be impossible to unwillingly touch live parts of the switchgear. All interlocks that will prevent potentially dangerous mal-operations shall be provided both electrical & mechanical.

7.21.0 The enclosure surface shall be smooth with no projection or irregularities which may cause visible corona. No corona shall be visible in complete darkness when the equipment is subjected to specified test voltage.

7.22.0 The enclosure shall be of continuous design and shall confirm to clause 10 of IEEE 80 Year 2000. The enclosure shall be sized for carrying induced current equal to the rated current of bus. The enclosure shall be designed to practically eliminate the external electromagnetic field. And there by electromagnetic stresses even under short circuit conditions.

7.23.0 The average intensity of electromagnetic field shall not be more than 50 micro tesla. The Bidder shall furnish all calculations and documents in support of above during detailed engineering.

7.24.0 The CT"s for GIS shall be of external or internal mounted type with SF6 Gas insulated or cast resin type. The secondary terminals shall be brought out in a dustproof enclosure.

7.25.0 The switchgear shall have provision for connection with ground mat risers. This shall consist of grounding pads to be connected the ground mat risers with in the vicinity of the equipment.

7.26.0 **Indication & Verification of Switch position:**

a) All circuit breakers, isolators and earth switches shall have externally mounted indicators to show clearly the 'open' and 'Close' positions. The indications shall be mechanically coupled directly to the main contact operating drive or linkage and shall be mounted in a position where they are clearly visible. The positions shall be designated as 'Open 'and 'Close '. Use of color code alone to differentiate position indication is not acceptable.

b) The Bidder shall offer equipment fitted with viewing ports on each isolator and earth switch for viewing and illuminating the position of switch. Viewing port shall be of a type whereby the open/close position can be checked without any danger to the eyes should a flashover occur at that time.

7.27.0 **Local Control Panel**

7.27.1 Individual local control panels for each circuit shall be supplied to facilitate local control of circuit breakers, isolators and earth switches. Theses panels shall also house the various relays, timers etc. to realise specified interlock requirement among circuit breakers, isolators and earth switches. The contacts, signals and conditions originating from/going to the switchgear, associated auxiliary, monitoring equipment and CT/VT wiring from the terminal boxes shall be wired up to the local control panels.

7.27.2 Completely separate and isolated circuit shall be used for operating mechanism control, tripping alarms and auxiliary devices. CLOSE and TRIP circuits shall be kept isolated to their final mechanical or electrical actuators. Trip circuits shall have individual monitoring facilities.

7.27.3 Mimic diagrams shall be provided on local control panels. The mimic strips shall be made of anodised aluminium and shall be screwed onto the panel. Colours of the various voltages of the mimic bus shall be subject to the approval of the Purchaser/comply with relevant IEC standard. The width of mimic strip shall not be less than 5 mm. Discrepancy switches and semaphore indicator shall be provided on the mimic diagram as applicable.

7.28.0 **Switches / MCBs**

7.28.1 Switches/MCBs shall be hand operated, air break, heavy duty, quick make, quick break type conforming to applicable IEC standards.

7.28.2 It shall be the responsibility of the Manufacturer to fully coordinate the overload and short circuit tripping of the MCBs with the sub circuit MCBs/fuses to provide satisfactory discrimination.

7.28.3 Switch handle shall have provision for locking in both fully open and fully closed positions. MCBs shall preferably be provided with suitable locking facility.

7.28.4 Single throw isolating switches for complete isolation of the DC control circuits shall be provided.

7.29.0 **Fuses**

7.29.1 Only HRC fuses shall be used.

7.29.2 Fuses shall be provided with visible operation indicators to show that they have operated.

7.30.0 **Control & Auxiliary Power Supply**

7.30.1 Control and selector switches shall be of the rotary type provided with properly designated escutcheon plates clearly marked to show the operating positions. Control switches shall have momentary contacts, spring return to normal, with pistol grip handle. Selector switches shall have stay put contacts. With oval handles. The local/remote selector switch shall be lockable in both positions. Colour of these switches shall be black. The number of contacts and their operation in each switch position shall be as per the requirements of the connected circuit. The switches shall be rated for minimum 10 A at 240 AC and 1 A inductive break at specified DC voltage.

7.30.2 All control equipment shall be suitable for operation on specified DC system.

7.30.3 Separate circuits with switches, fuses, etc. of adequate rating shall be provided for control of space heater, lighting and power receptacle. Theses shall be on 240 V, ph AC supply, unless specified otherwise.

7.30.4 D.C. & A.C. power supply shall be done in a manner which will enable isolation of individual equipment. Common supply bus shall be formed in the cubicle and then power supply shall be distributed to individual equipment through MCBS/fuses.

7.31.0 **Relays**

7.31.1 All relays excluding auxiliary relays shall be numerical microprocessor based only with IEC 61850 communications Protocol. Relays for various controls, monitoring and blocking functions of particular circuit element shall be of solid state design installed in associated local control panel. All relay shall have dust tight covers.

7.31.2 Necessary auxiliary relays for alarm, time-delay relays, voltage relays as required for control and protection shall be mounted inside the local control panel. Voltage operator relays shall have sufficient thermal capacity for continuous energisation, using external resistors, if necessary.

7.31.3 Auxiliary relays shall be rated to operate satisfactorily between 80% and 110% of the specified rated voltage.

7.31.4 Each relay shall be provided with at least 2 NO and 2 NC potential free contacts for external use.

7.31.5 Coils of all the relays shall be adequately rated to avoid spurious operation of relays on D.C. system ground or induced surges.

7.31.6 All relays shall be tropicalised and shall be suitable for maximum ambient temperature of 500C.

7.31.7 Make and type of relay shall be subject to approval of the Purchaser.

7.32.0 **Push Buttons**

All push buttons shall be of push to actuate type having 2 NO and 2 NC self-reset contacts. They shall be provided with integral escutcheon plates, engraved with functions. Push button contacts shall be rated for 10 A at 240 V AC and 1 A inductive breaking at specified DC voltage.

7.33.0 **Indicating Lamps**

Cluster LED type lamps are to be provided.

7.34.0 **Space Heater**

Strip type space heaters of adequate capacity shall be provided inside each cabinet/control panel. Heaters shall be complete with rotary type ON-OFF switch, HRC fuse on phase or a single-pole MCB with overload and short circuit protection, link on the neutral and a thermostat to cut off the heater at 45^0 C. The heaters shall be suitable for operation on a 240V, 1 phase 50 Hz supply.

7.35.0 **Internal Wiring**

Cabinets / Panels shall be supplied completely wired ready for external connections at the terminal blocks. All wiring shall be carried out with wires of 650 V grade, stranded copper conductors. The insulation shall be halogen free and flame retardant. Power circuits shall be wired with stranded *copper* conductors of adequate sizes to suit the rated current. Unless otherwise specified, control alarm and indication circuits shall be wired with stranded, tinned copper conductors of sizes not smaller than 1.5 sq.mm. CT and VT circuits shall be wired with stranded copper conductor of size, not smaller than 2.5 sq.mm.

7.35.1 Engraved identification ferrules, marked to correspond with the wiring diagram shall be fitted at both ends of each wire. All wiring shall be terminated on terminal blocks. Terminals shall be adequately rated for the circuit current, minimum rating shall be 10 A. Control wiring shall be protected against mechanical damage.

7.35.2 CT/PT terminals shall have disconnecting links for test purpose and other device terminals shall be of stud type.

7.35.3 The wire terminations shall be made with solder less crimping type of tinned copper lugs.

7.35.4 Wiring shall be colour coded and be firmly supported, neatly installed by lacing and taping, readily accessible and connected to equipment terminals and terminal blocks. Halogen free, flame retardant plastic wiring channels/throughs with strap on covers shall be used for this purpose.

7.36.0 **Local Alarm/Annunciation**

7.36.1 Window type alarm annunciation shall be provided on local control panels of each bay for the specified abnormal conditions. The alarm windows shall have provision for differentiating cleared and uncleared faults and flashing for new faults.

7.36.2 In addition to the above, the manufacturer may add any other condition, as felt necessary for annunciation. In case of auto reclosing feeders, all four stages breaker operation due to hydraulic pressures – pressure low, reclose blocked, closing blocked and tripping shall be provided.

7.36.3 All 66kV GIS transformer feeders shall have transformer annunciations / indications on metering panel.

7.37.0 **Labels and Diagram Plate**

7.37.1 Every GIS equipment and devices mounted in the cabinet/control panel shall be provided with individual labels with equipment designation/rating. Also, the cabinet/control panel shall be provided on the front with a non-rusting label engraved with the designation of the cabinet/control panel.

7.37.2 Inside the door, a metal pouch shall be provided along with as built drawings copy of the respective panel.

7.38.0 **EARTHING**

7.38.1 The BIDDER shall provide a "Main Ground Bus" for the specified short circuit current magnitude and duration to which all intentionally earthed parts of the assembly shall be bonded.

7.38.2 It shall be the responsibility of the Manufacturer to provide a sufficient number of earth connections so that dangerous voltages are not induced in the enclosure by the fault currents circulating in the inner conductor.

7.38.3 Provision shall be made for future extension and/or bonding to ground bus of other switchgear.

7.38.4 The Bidder shall furnish full details of the circulating currents expected to flow from the switchgear metal cladding to enable the Purchaser to design the main earthing grid.

7.38.5 Every section of the SF6 switchgear equipment including all panels, cubicles, kiosks and boxes shall be solidly bonded to the earthing system, by at least two independent leads.

7.38.6 The design of the earthing system shall be such as to ensure the safety and protection of all operating and maintenance personnel under all normal and fault conditions.

VOLUME - III

SECTION - 3

DETAILED TECHNICAL SPECIFICATION - ELECTRICAL

SUB-SECTION - 3.6.2

66 kV GIS SWITCHGEAR EQUIPMENT

VOLUME - III

SUB-SECTION - 3.6.2

66 kV GIS SWITCHGEAR EQUIPMENT

A. CIRCUIT BREAKERS

1.0.0 CODES & STANDARDS

i)	Gas Insulated Switchgear	:	IEC 62271-203 / IEC 60694
ii)	Circuit Breakers	:	IEC 62271-100, IS: 2516
iii)	SF6 Gas	:	IEC 60376
iv)	SF6 Cylinders	:	IS : 4379, IS : 7285 / IEC
v)	Air Receivers	:	BS : 5179, BS : 5500 / IEC
vi)	Air Piping	:	BS : 2871 / IEC

2.0.0 TYPE Indoor SF6, single pressure puffer type re-strike free and without opening resistors

3.0.0 RATING

3.1.0 **66 kV Circuit Breaker**

(a)	Voltage	:	66 kV
(b)	No. of poles	:	3
(c)	Rated Continuous Current	:	As required.
(d)	Rated Short	:	40 kA with percentage of DC component as per Circuit Breaking IEC 62271-100 corresponding to minimum opening current time under operating conditions specified.
(e)	Short Circuit making current	:	100 kAp
(f)	First Pole To Clear Factor		1.3
(g)	Rated Break Time		a) Not more than 40 ms under test duties 2, 3 & 4 at rated values. b) Not more than 45 ms under test duties 1 to 5 and short line fault test duties and combined variation of trip coil voltage, operating pressure and quenching media pressure, etc.

4.0.0 OPERATIONAL REQUIREMENTS

4.1.0	Rated Operating Duty Cycle O-0.3 sec.–CO-3 min-CO	
4.1.1	Re-Closing	Single and three phase high speed auto re-closing.
4.1.2	Trip and closing coil voltage	110V DC.
4.1.3	Auxiliary contacts	As required plus 12 NO and 12 NC contacts per pole as spare.
4.2.0	Controls	
4.2.1	Closing Circuits	Shall operate correctly at all values of supply voltage between 85% and 110% of rated voltage.
4.2.2	Trip Circuits	Two independent tripping circuits, valves, pressure switches and coils to be provided for connection to different set of relay. The circuits shall operate correctly under all operating conditions upto rated breaking capacity and at all values of supply voltage between 70% to 100% of rated supply voltage. However even at 50% of rated supply voltage the breaker shall be able to operate. Trip coil supervision to be provided in both open and close position.
4.2.3	Operation	Shall have both local and remote operation of breaker with local/remote lockable selector switch and close and trip control switch/push buttons shall be provided in the breaker control cabinet.
4.2.4	Pressure Switch Contacts	Shall have density meter and pressure switch contacts suitable for direct use as permissive in closing and tripping circuits. Separate contacts to be used for each of tripping and closing circuits. Fail safe logic/schemes to be employed if multiplying relays used.
4.2.5	Supply Voltage monitoring	DC supply voltage for all auxiliary circuits to be monitored. Provision to be made for remote annunciations and operation lockout in case of supply failure.
4.3.2	Operational requirement for PIR successive closing operation :	The resistor shall have thermal rating to the following duties with no allowance for heat dissipation between
4.3.5	Out of phase closing	One closing operation under phase opposition with twice rated voltage across terminals.
4.4.0	Safety aspect	Breaker position to be maintained on loss of operating media and/or quenching media pressure.
4.5.0	Central Control Cabinet	A central control cabinet shall be provided which shall house all the control equipment required for operation, indication, lockout and all requirements as per detailed list given below :

a) Local/remote changeover switch

b) Operation counter

c) Pneumatic/ hydraulic pressure gauges

d) SF6 pressure gauges

e) Power supply control switches

f) Fuses

g) Anti-pumping relay

h) Pole discrepancy relay

i) AC/DC supervision relays

4.6.0 The circuit breaker shall also be capable of:

a) Interrupting line charging current as per IEC without any restrikes and without use of opening resistors.

b) Clearing short line fault current with source impedance behind the bus equivalent to symmetrical fault current specified.

c) Breaking 25 % of the rated fault current at twice rated voltage under phase opposition condition.

5.0.0 DESIGN AND CONSTRUCTIONAL FEATURES

5.1.0	Interrupter	Shall be with adsorbing product box to minimize the effect of SF6 decomposing product and moisture.
5.2.0	SF6 Density Monitoring	(i) SF6 Density shall be monitored and regulated on each pole using individual pressure switches and pressure gauges. (ii) Density Monitor shall be adequately temperature compensated. (iii) It shall be possible to dismantle the monitor with out draining SF6 gas & also to remove SF6 gas from each pole separately for maintenance purpose.
5.3.0	D.C. Supply	Dual DC supply shall be provided for connection to independent trip circuits, monitoring & control circuits.
5.4.0	Aux. switch	Aux. switch of breaker to be positively driven by operating rod.
5.5.0	Operating Mechanism	
5.5.1	Type	Electro-hydraulic / spring charged or combination of these with Anti-pumping and trip free features.
5.5.2	Housing	Operating box / cabinet shall be accessible to man standing on ground and shall be hot dip galvanized.
5.5.3	Operation indicator	A mechanical indicator to show open/close position of breaker shall be provided which should be visible with housing closed.
5.5.4	Power supply	Dual DC power supply with changeover facility.

5.5.5 Spring Operated Mechanism

(i) Shall be complete with motor, opening and closing spring with limit switch for automatic charging and shall generally meet all the design and operation requirements for satisfactory and trouble free operation.

(ii) Motor shall be rated to fully charge the closing springs in less than 30 seconds and shall have adequate thermal rating for repeated sequence of closing and opening operations of breaker.

(iii) Closing action of mechanism shall compress/charge the opening spring so that it is ready for tripping. Closing springs shall be immediately charged after the closing operation. After failure of power supply, at least one CO operation should be possible. Breaker operation shall be prevented when spring is in partial charged condition. Indication of spring in charged condition shall be provided in local and remote cabinet.

5.5.6 Hydraulically Operated Mechanism

(i) Shall comprise of power cylinder, control valves, high & low pressure reservoir, motor, etc. Hydraulic oil used shall be fully compatible for the specified temperature range. Further it shall generally meet all the design and operation requirements for satisfactory and trouble free operation.

(ii) On failure of power supply and pressure equal to the lowest pressure of autoreclose duty, at least two CO operations should be possible. Also complete duty cycle of breaker to be possible meeting all parameters of break/opening time when oil is at lowest permissible pressure before make up.

(iii) Provision to be made to continuously monitor oil/nitrogen pressure both local and remote.

(iv) One hand operated pump shall be provided per station for emergency operation.

5.6.0 The gap between open contacts shall withstand at least rated phase to ground voltage for eight (8) hours at zero gauge pressure of SF6 gas. The breaker shall also withstand all dielectric stresses in open position at SF6 lockout pressure for 60 minutes.

5.7.0 Multi-break interrupters shall have uniform voltage distribution across them.

5.8.0 Breakers shall have provision for attaching operational analyzer.

5.9.0 Contractor shall supply spare SF6 gas equal to 20% of the total requirement for the station.

6.0.0 TESTS

In addition to the tests as per IEC, speed curve tests shall be conducted at works and site. Speed curves for each breaker pole to be obtained with the operational analyzer to determine the breaker contact movement during opening, closing, auto-reclosing and trip free operation under normal and limiting conditions of control voltage and operating medium. The tests shall show speeds of contacts at various stages of operation, travel of contacts, opening time, closing time, shortest time between separation and meeting of contacts at break make operation, pole discrepancy, etc.

7.0.0 MANDATORY MAINTENANCE EQUIPMENT

The following (1 no. each) shall be supplied along with circuit breakers.

7.1.0 SF6 gas handling equipment

Shall be of proven make and shall be supplied complete with all necessary pipes, plants, coupling, flexible tube and valves and shall comprise of the following:

(i) SF6 Gas filling and evacuating plant

Portable plants, shall evacuate SF6 to required vacuum and fill to required pressure in a complete three pole breaker within a reasonable time.

ii) SF6 gas filtering, drying, storage and recycling plant

a) Shall have a capacity to store and handling at least 300 liters of SF6 Gas & suitable to transfer SF6 gas directly from breaker to plant reservoir.

b) Shall include necessary equipment for purging the plant before filling SF6.

c) Shall be mounted on trolley or rollers.

d) Shall include devices to measure purity, moisture content (or dew point measurement), air content, decomposition products, etc. of SF6 gas. The devices shall have built-in calibration facility & the sensitivity shall not be affected by dust, humidity, heat, wind, etc.

7.2.0 SF6 gas leak detector

Shall have an accuracy of at least 5ppm. & shall reach leakages are possible. Shall be free from induced voltage effects.

7.3.0 Operational Analyzer

(i) Shall be one complete system of proven make for out-door use with necessary transducers (three to record speed and travel of 3 poles of breaker), cables, pickups, attachments, etc.

(ii) Shall have provision to record at least 12 function of breaker.

(iii) Shall be suitably shielded against induced charges.

(iv) shall record breaker contact movement during opening, closing, auto re-closing and make break operations, speed of contacts at various stages of operation, travel of contacts, opening time, closing time, make break time, etc.

(v) Shall have output on plain paper requiring no special storage facility.

(vi) Shall be suitable for outdoor use and shielded against induced charges.

Above features shall be demonstrated as site.

7.4.0 Nitrogen filling — Shall have capacity for nitrogen filling of one pole in device (applicable reasonable time and shall be complete with all for hydraulically operated mechanisms) accessories for nitrogen charging at site.

B. DISCONNECTING SWITCHES & EARTH SWITCHES

1.0.0 CODES AND STANDARDS

Disconnecting Switches And Earth Switches IEC : 62271-102, IS:9921

2.0.0 TYPE

Indoor, SF6 Gas Insulated

3.0.0 RATING

3.1.0 **Disconnecting Switches (DS)**

For 66 kV :

(i)	Rated continuous current	As required
(ii)	Short circuit making current	100 kAp
(iii)	Rated Mechanical Terminal Load	As per Table III of IEC
(iv)	Operating time	Not more than 12 seconds
(v)	Auxiliary contacts	As required plus 10 NO + 10 NC per DS as spare.
(vi)	Temperature Rise	As per Table V of IEC 60694 for specified ambient

3.2.0 **Earth Switch (ES)**

For 66 kV:

(i)	Short circuit making current	100 kAp
(ii)	Operating time	Not more than 12 seconds
(iii)	Auxiliary contacts	As required plus 8 NO + 8 NC per ES as spare

4.0.0 DESIGN AND CONSTRUCTIONAL FEATURES – DISCONNECTING SWITCHES

4.1.0 The three pole group operated disconnectors shall be operated by electric motor suitable for use on 110 V DC system and shall be equipped with a manual operating mechanism for emergency use. The motor shall be protected against over current and short circuit.

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

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

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

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

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

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

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

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

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

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

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

4.13.0 The auxiliary switches shall be capable of breaking at least 2 A in a 110 V DC circuit with a time constant of not less than 20 milliseconds.

4.14.0 The disconnectors and safety grounding switches shall have a mechanical key (pad locking key) and electrical inter-locks to prevent closing of the grounding switches when isolator switches are in the closed position and to prevent closing of the disconnectors when the grounding switch is in the closed position.

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

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

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

	SIGN	COLOUR
Open position	Open	Green
Closed position	Closed	Red

4.18.0 All the disconnecting switches shall have arrangement allowing easy visual inspection of the travel of the switch contacts in both open and close positions, from the outside of the enclosure.

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

4.20.0 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 10 mm 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.

5.0.0 DESIGN AND CONSTRUCTIONAL FEATURES FOR SAFETY EARTH SWITCHES

5.1.0 The three pole group operated disconnectors shall be operated by electric motor suitable for use on 110 V DC system and shall be equipped with a manual operating mechanism for emergency use. The motor shall be protected against over current and short circuit.

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

5.3.0 Each safety grounding switch shall have clearly identifiable local positive driven mechanical indicator together with position indicator on the bay module control cabinet and provision for taking the signal to control room.

5.4.0 The details of the inscriptions and colouring for the indicator are given as under :

	SIGN	COLOUR
Open position	Open	Green
Closed position	Closed	Red

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

5.6.0 Each earth switch shall be fitted with auxiliary switches having 6 NO & 6 NC contacts for use of Owner/Owner's representative over and above those required for local interlocking, position & indication purpose.

5.7.0 Provision shall be made for padlocking the earth switches in either the open position or closed position.

5.8.0 All portions of the Earth switch and operating mechanism required for grounding shall be connected together utilizing a flexible copper conductor having a minimum cross section area of 50 Sq.mm.

5.9.0 The main grounding connections 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 steel strap of adequate rating for connection to the grounding grid.

5.10.0 The Safety Earth switches shall confirm to the requirement of IEC 622271-102.

5.11.0 Mechanical position indication shall be provided locally at each switch and remotely at each bay module control cabinet / substation automation system.

C. HIGH SPEED EARTH SWITCHES

1.0.0 CODES AND STANDARDS

Disconnecting Switches And Earth Switches IEC : 62271-102, IS:9921

2.0.0 TYPE

Indoor, SF6 Gas Insulated

3.0.0 DESIGN & CONSTRUCTIONAL FEATURES

3.1.0 Earth switches located at the beginning of feeder module shall be of 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 be capable of interrupting the inductive currents and to withstand the associated TRV.

3.2.0 Single phase switches shall be provided with operating mechanism suitable for 110 V DC.

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

3.4.0 The short circuit making current rating of each ground switch shall be atleast equal to its peak withstand current rating of 100 kA. The switches shall have inductive/capacitive current switching capacity as per IEC-62271-102.

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

3.6.0 The details of the inscriptions and colouring for the indicator are given as under :

	SIGN	COLOUR
Open position	Open	Green
Closed position	Closed	Red

3.7.0 High speed earth switch operation should be possible locally from the bay module control cabinet, or remotely from the control room in conjunction with opening of the associated disconnector.

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

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

3.10.0 Each high speed earth switch shall be fitted with auxiliary switches having 6 NO & 6 NC auxiliary contacts for use by Owner/Owner's representative over and above those required for local interlocking, position & indication purpose. All contacts shall be wired to terminal blocks in the local bay control cabinet. Provision shall be made for padlocking the ground switches in their open or closed position.

3.11.0 The main grounding connections 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 steel strap of adequate rating for connection to the grounding grid.

3.12.0 The main grounding connections 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 steel strap of adequate rating for connection to the grounding grid.

3.13.0 The Safety Earth switches shall confirm to the requirement of IEC 622271-102.

D. SF6 TO AIR TRANSITION BUSHINGS

1.1.0 All bushings shall have an impulse and power frequency withstand level that is greater than or equal to the level specified for the switchgear.

1.2.0 Bushing shall be suitable for hot line washing and shall be provided with "water cut sheds".

1.3.0 Puncture strength of bushings shall be greater than the dry flash-over value. When operating at normal rated voltage, there shall be no electric discharge between the conductors and bushing which would cause corrosion or injury to conductors, insulators or supports by the formation of substances produced by chemical action. No radio interference shall be caused by the bushing when operating at the normal rated voltage.

1.4.0 All hardware used for current carrying parts shall be SS 304 and other iron parts shall be hot dip galvanized.

1.5.0 All joints shall be air tight. Surface of the joints shall be turned up; porcelain parts by grinding and metal parts by machining. Bushing design shall be so as to ensure uniform compressive pressure on the joints.

1.6.0 All current carrying contact surface shall be silver faced.

1.7.0 BIDDER shall furnish details of precaution taken to prevent bimetallic corrosion wherever dissimilar materials (such as Copper, Aluminium) are used, including the following:

a) Aluminium conductor in the bus duct and the current carrying part in the bushing.

b) Terminal clamp and the current carrying part in the bushing if bushing stud is not of Copper.

1.8.0 A test tap shall be provided for measurement of Capacitance & Tan delta factor.

E. INSTRUMENT TRANSFORMERS

1.0.0 CODES AND STANDARDS

Current Transformers	IEC 60044, BS:3938, IS: 2705
Voltage Transformers	IEC 186, IEC 186A, IEC 358, IS : 3156
Insulating Oil	IS : 335
Capacitive Voltage Transformers	IEC 60044-5

2.0.0 TYPE

Current Transformers	Single primary internal mounted type with SF6 insulated or Resin cast
Voltage Transformers	Shall be metal enclosed gas insulated capacitor voltage divider type or electromagnetic type.

3.0.0 RATING

3.1.0 Rated Insulation Levels for Instrument Transformers

i)	1.2/50 micro-sec. impulse withstand Voltage	325 kVp
(ii)	One minute power frequency withstand voltage.	140 kV rms.

3.2.0 **Current Transformers**

(i)	Rated primary current	-
(ii)	Rated dynamic current	100 kA peak
(iii)	One minute power frequency withstand voltage between secondary terminal and earth	5 kV
(v)	Temperature rise	----------As per IEC----------

3.3.0 **Voltage transformers**

(i)	Rated primary voltage	66 kV
(ii)	For secondary winding	2 kV rms

(iii)	Temp rise of electromagnetic unit	As per IEC:186
(iv)	Rated voltage factor	1.2 continuous ; 1.5 for 30 seconds
(v)	Phase angle error	+/- 20 minutes for metering

4.0.0 DESIGN AND CONSTRUCTION FEATURES

4.1.0 Current Transformers

4.1.1 The current transformers and accessories shall conform to IEC: 60044-1 and other relevant standards except to the extent explicitly modified in the specification.

4.1.2 The current transformers shall have class B type insulation and shall be suitable for high speed auto reclosure.

4.1.3 The particulars of the various cores may change within reasonable limits as per the requirements of protection relay supplier. The manufacturer is required to have these values confirmed from the purchaser before proceeding with design of the cores. The other characteristics of CTs shall be as given in TECHNICAL PARAMETER of Current Transformer.

4.1.4 The number, rating, ratios, accuracy class, etc. for the individual current transformer secondary cores shall be in accordance with IEC. Where multi-ratio current transformers are required the various ratios shall be obtained by changing the effective number of turns on the secondary winding.

4.1.5 Rating and diagram plates shall be as specified in the IEC specification incorporating the year of manufacture. The rated extended current rating voltage and rated thermal current shall also be marked on the name plate.

4.1.6 The diagram plates shall show the terminal markings and the relative physical arrangement of the current transformer cores with respect to the primary terminals (P1 & P2).

4.1.7 The position of each primary terminal in the current transformer SF6 gas section shall be clearly marked by two plates fixed to the enclosure at each end of the current transformer.

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

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

4.1.10 Current transformers guaranteed burdens and accuracy class are to be intended as simultaneous for all cores.

4.1.11 The rated extended primary current shall be 150% at all ratios and 200% at ratios other than highest ratios.

4.1.12 The instrument security factor at all ratios shall be less than five (5) for metering core. If any auxiliary CTs/reactor are used in the current transformers then all parameters specified shall have

to be met treating auxiliary CTs as an integral part of the current transformer. The auxiliary CTs/reactor shall preferably built in construction of the CTs.

4.1.13 The wiring diagram, for the interconnections of the three single phase CTs shall be provided inside the marshalling box.

4.1.14 Provisions shall be made for primary injection testing either within CT or outside.

4.2.0 VOLTAGE TRANSFORMERS

4.2.1 The voltage transformers shall conform to IEC 60044-2 and other relevant standards except to the extent explicitly modified in the specification.

4.2.2 Voltage transformers shall be of the electromagnetic type with SF6 gas insulated. The earth end of the high voltage winding and the ends of the secondary winding shall be brought out in the terminal box.

4.2.3 The rating, ratio, accuracy class, connection etc. for the voltage transformers shall be in accordance with IEC.

4.2.4 Rating and diagram plate shall be provided complying with the requirements of the IEC specification incorporating the year of manufacture and including turns ratio, voltage ratio, burden, connection diagram etc.

4.2.5 The beginning and end of each secondary winding shall be wired to suitable terminals accommodated in a terminal box mounted directly on the voltage transformer section of the SF6 switchgear.

4.2.6 All terminals shall be stamped or otherwise marked to correspond with the marking on the diagram plate. Provision shall be made for earthing of the secondary windings inside the terminal box.

4.2.7 The transformer shall be able to sustain full line to line voltage without saturation of transformer.

4.2.8 The accuracy class will be at maximum tap.

4. 2.9 The voltage transformers shall be located in a separate bay module on the bus and will be connected phase-to ground and shall be used for protection, metering and synchronization.

4.2.10 The voltage transformers shall be effectively shielded against high frequency electromagnetic transients. The voltage transformers shall have three secondary windings.

4.2.11 Voltage transformers secondary shall be protected by HRC cartridge type fuses for all the windings. In addition fuses shall be provided for the protection and metering windings for fuse monitoring scheme. The secondary terminals of the VT's shall be terminated to the stud type non-disconnecting terminal blocks in the secondary boxes via the fuse.

4.2.12 The voltage transformer should be thermally and dielectrically safe when the secondary terminals are loaded with the guaranteed thermal burdens.

4.2.13 The accuracy of 0.2 on secondary III should be maintained throughout the entire burden range up to 100 VA on all the three windings without any adjustments during operation.

4.2.14 The diagram for the interconnection of the VTs shall be provided inside the marshalling box.

~~OUTDOOR SWITCHYARD EQUIPMENT~~

F. SURGE ARRESTORS

1.0.0 ~~**CODES AND STANDARDS**~~ ~~IEC 60099, IS 3070~~

2.0.0 **TYPE** Heavy duty station class and Gapless type without any series or shunt gaps

3.0.0 **RATING**

3.1.0 For 66 kV Surge Arrestor

Nominal discharge current	10KA of 8/20 microsec. Wave
Discharge current at which insulation coordination is done	20 KA of 8/20 microsec. Wave.

4.0.0 **OPERATIONAL REQUIREMENTS**

4.1.0 Shall protect power transformers, circuit breakers disconnecting switches, instrument transformers, shunt reactors, etc. with insulation levels specified in this specification.

4.2.0 Shall be suitable for circuit breaker duty cycle in the given system.

4.3.0 The reference current shall be high enough to eliminate the influence of grading and stray capacitance on the measured reference voltage. Values and calculations shall be furnished with offer.

4.4.0 Discharge capabilities.

4.4.1 Shall be fully stabilized thermally to give a life expectancy of one hundred (100) years under site conditions and take care of effect of direct solar radiation.

4.4.2 Shall be capable of discharging over-voltages occurring due to switching of unloaded transformers, reactors and long lines.

5.0.0 **OTHER PARAMETERS**

5.1.0 For 66kV Class Surge Arrestor (APPLICABLE FOR GIS SURGE ARRESTERS)

a)	Minimum discharge capability	8 kJ/kV or corresponding to clause 5.01.02 at minimum discharge characteristics whichever is higher
b)	Long duration discharge class	II
c)	High current short duration test value (4/10 microsec.Wave)	100kAp
d)	Current for pressure relief test	40kA rms

FORMT9-P REV-A (MUM)

6.0.0 DESIGN AND CONSTRUCTIONAL FEATURES

6.1.0 **Insulation coordination**

6.1.1 The Bidder shall carry out the insulation coordination studies and design calculations for deciding the exact locate, energy capability, voltage levels of the SAs. The locations shown in the single line diagram is indicative only. If Bidder feels that at some more locations the surge arrestors are required same should be included in the offer.

6.1.2 The Bidder shall perform all necessary studies for insulation coordination and the report shall detail the characteristics of surge arrestor. The report shall also demonstrate that selected insulators comply with the requirements of the specification.

6.2.0 Construction

6.2.1 Shall be hermetically sealed single phase unit.

6.2.2 The non linear blocks shall be sintered metal oxide material.

6.2.3 Shall be robust with excellent mechanical and electrical properties.

6.2.4 Shall be capable of withstanding meteorological and short circuit forces under site conditions.

6.2.5 Each SA shall be complete with insulating base for mounting on structure.

6.2.6 SAs shall be provided with grading and/or corona rings as required.

6.3.0 Pressure relief device

6.3.1 Shall have pressure relief devices and arc diverting ports suitable for preventing shattering of porcelain housing and to provide path for flow of rated currents in the event of SA failure.

6.3.2 Shall not fail due to porcelain contamination.

6.3.3 Seals shall be effectively maintained even when SA discharges rated lightning current.

6.4.0 Porcelain

6.4.1 Porcelain shall be so coordinated that external flashover will not occur due to application of any impulse or switching surge voltage upto maximum design value for SA. The cantilever strength of the insulator shall be minimum 600kg.

6.4.2 The end fittings shall be non-magnetic and of corrosion proof material.

6.5.0 The Bidder shall furnish the following :

a) The heat treatment cycle details with necessary quality checks used for individual blocks along with insulation layer formed across each block.

b) Metalizing coating thickness for reduced resistance between adjacent discs along with procedure for checking the same.

c) Details of thermal stability test for uniform distribution of current on individual disc.

d) Detailed energy calculations to prove thermal capability of Discs.

e) The value of resistive current for each complete arrestor in factory test report and further suggest the values at which arrestor to be taken out of service.

6.6.0 Discharge counters

6.6.1 Self-contained discharge counters, suitably enclosed for outdoor use (IP-55 degree of protection) and requiring no auxiliary or battery supply shall be fitted with each SA along with necessary connection to SA and earth.

6.6.2 Suitable leakage current meters shall also be supplied in the same enclosure. The reading of milli - ammeter and counter shall be visible through an inspection glass panel to a man standing on ground. A pressure relief vent/suitable provision shall be made to prevent pressure build up.

6.6.3 The discharge counter shall be insulated from structure for measurement of resistive current.

6.7.0 ~~Maintenance Equipment~~

~~The Contractor shall also supply micro-processor based portable maintenance equipment for monitoring resistive current of SA which is of proven design & make for the intended purpose. The Bidder shall demonstrate the operation of the equipment at site~~.

G. INSULATORS

1.0.0 CODES AND STANDARDS

Support & Hollow column insulators	IEC 137. IEC 168, IEC 233, IEC 273, IEC 815
Bus post & Bushing Insulators	IEC 137. IEC 60168, IEC 233, IEC 273, IEC 60815
String Insulators	IS 731, IEC:60815
Composite Insulators	IEC 1109, IEC 507

2.0.0 TYPE Hollow/ Bushing / Bus post / String Insulators.

3.0.0 RATING

Dielectric Strength of Insulators

	Description	Hollow & Bushing Insulators	Buspost Insulators & string Insulators
(i)	Dry & wet lightning impulse withstand voltage	325 kVp	325 kVp
(iii)	Dry and wet one minute power frequency withstand voltage	140 kV	140 kV

4.0.0 OPERATIONAL REQUIREMENTS

4.1.0 There shall be no electric discharge between conductor and insulators, when operating at normal voltage, which would cause corrosion or injury to any of the material.

5.0.0 DESIGN AND CONSTRUCTIONAL FEATURES

5.1.0 Design of insulator shall avoid stresses due to expansion and contraction in any part of the insulator leading to deterioration.

5.1.1 All ferrous parts shall be hot dip galvanized. The associated metal part shall be permanently secured to the insulator, air tight and shall be designed to withstand all shocks and stresses to which they may be subjected to during operation and maintenance.

5.1.2 The design shall ensure uniform compressive pressure on the joints.

5.1.3 All insulators shall be of homogeneous glazed porcelain or composite type with silicon shed profile, free from laminations, cavities and other flaws or imperfections, and shall be thoroughly vitrified, tough and impervious to moisture.

5.1.4 Porcelain glazing shall be uniform brown in color, free from blisters, burns and other similar defects. Composite insulators can be of gray in color.

5.2.0 Hollow Bushing Insulators

5.2.1 Shall be provided for housing of various equipment i.e. circuit breakers, instrument transformer, surge arresters etc. & shall be robust and capable of withstanding internal pressures likely to occur in service.

5.3.0 Bus Post Insulators (BPI)

5.3.1 Shall be solid core type porcelain or composite insulators, and shall be used in disconnecting switches, support of bus conductor and line traps etc.

5.3.2 Parameters for BPI

(i)	Minimum cantilever strength	800 kg
(ii)	Minimum torsional moment	600 kg

5.4.0 Suspension and Tension Insulators

(a) Suspension and tension strings. Shall be interchangeable between any type of strings.

(b) Shall be wet process porcelain or composite with ball and socket connections.

(c) Composite insulator as well as string insulators shall have electro mechanical strength of 120 KN per string and shall meet all the dielectric requirements for porcelain indicated.

5.5.0 Disc Porcelain Insulators

5.5.1 Parameters

(i)	Type of each disc.	Anti-fog
(ii)	Size of each disc	255 x 145 mm
(iii)	Electro mechanical strength	120 kN for each disc .
(iv)	Number of discs per string	As required to meet total creepage distance
(v)	Leakage distance per disc	430 mm minimum
(vi)	Power freq. Withstand voltage for each disc	85 kV – dry ; 50 kV – wet

H. MISCELANEOUS EQUIPMENT

1.0.0 CODES AND STANDARDS

ALUMINIUM tubular Conductor	IS:5082 / IEC
ACSR conductor	IS : 398 / IEC
Clamps & connectors	IS : 617, IS : 5561 / IEC
Insulator string	IS : 731 / IEC
Hardware	IS : 2486, IEC : 433
Spacers	IS : 10162 / IEC
Earthing conductor	IS : 2141 / IEC
Cabinets, boxes, kiosks, panel etc.	IS:5039, IS:8623 and IEC: 439

2.0.0 OPERATIONAL REQUIREMENTS

2.1.0 **Cabinets, boxes, kiosks, panels etc.**

The size of enclosure and the layout of equipment inside shall provide generous clearances. Each cabinet/box/kiosk/panel shall be provided with a 15A, 240V AC, 2 pole, 3 pin industrial grade receptacle with switch. For incoming supply, MCB of suitable rating shall be provided. Illumination of each compartment shall be with door operated incandescent lamp. All control switches shall be of rotary type.

3.0.0 DESIGN AND CONSTRUCTIONAL FEATURES

3.1.0 Clamps and Connectors

(i) Shall be Aluminium alloy casting conforming to designation A6 of IS:617 for connecting to equipment terminals and conductors of ALUMINIUM. In case the terminals are of copper, the same clamps/ connectors shall be used with 2mm thick bimetallic liner.

(ii) Shall be Galvanised mild steel for connecting to shield wire.

(iii) Bolts, nuts and plain washers shall be hot dip galvanized mild steel for sizes M12 and above. For sizes below M12, they shall be electro-galvanized mild steel.

(iv) The spring washers shall be electro-galvanized mild steel.

(v) All castings shall be free from blow holes, surface blisters, cracks and cavities.

(vi) All sharp edges and corners shall be rounded off to meet specified corona and radio interference requirements.

(vii) Shall have same current rating as that of the connected equipment with temperature rise limited to 35 deg.C over 50 deg.C.

(viii) All current carrying parts shall be at least 10 mm thick.

(ix) Shall be manufactured to have minimum contact resistance.

(x) Flexible connectors, braids or laminated strips shall be made up of copper/ ALUMINIUM.

(xi) Current rating and size of terminal/conductor for which connector is suitable shall be embossed/punched on each component.

3.2.0 Insulator String Hardware

i) Shall be of bolted type and forged steel except for insulator cap, which can be of malleable cast iron.

ii) Shall also generally meet the requirements of clamps and connectors as specified above.

iii) In one span, Tension string assembly at one end shall be supplied with suitable turn buckle.

iv) Suitable sag compensating spring shall be supplied in case the design calculations show excessive variation of the sag over the temperature range of 0 to 80 deg. C.

3.3.0 ALUMINIUM ALLOY CONDUCTOR

(i)	Code & standard	IEC
(ii)	Name	J Power corporation, Japan or equivalent

3.4.0 Spacers

(i) Shall be non-magnetic material except nuts and bolts, which shall be of hot dip galvanized mild steel.

(ii) Shall generally meet the requirement of clamps and connectors specified above.

(iii) Design shall take care of fixing and removing during installation and maintenance.

(iv) Clamp slip test shall be conducted as follows :

In this test the sample shall be installed on test span of twin/quad bundle string at a tension of 44.2 kN (4500 kg.). One of the clamps when subjected to a longitudinal pull of 2.5 kN (250 kg) parallel to the axis of conductor shall not slip, i.e. permanent displacement between conductor and clamp after the test shall not exceed 1.0 mm.

This test shall be performed on all other clamps of the sample.

3.5.0 Gantry Structure

3.5.1 **Steel Structure**

Bidder shall furnish steel structure and other necessary materials like base plate/foundation bolts, anchor bolts etc. for all equipments supplied under this package.

3.5.2 **Gantry / LA, BPI Structures**

The steel structure shall be lattice truss construction made of Hot dip galvanized/shaped steel and assembled by bolts and nuts, except for a portion of welded parts.

3.6.0 Cabinets, Boxes, Kiosks, Panels, etc.

Control cabinets, junctions boxes, marshalling boxes, lighting panels, terminal boxes operating mechanism boxes, etc.

(i) Shall be of painted sheet steel or ALUMINIUM. However, the junction and switch boxes shall be of hot dip galvanized sheet steel of 1.6mm thickness.

(ii) Thickness of sheet steel shall be 2mm cold rolled or 2.5 mm hot rolled. The thickness of ALUMINIUM shall be 3mm and shall provide rigidity.

(iii) Top of the boxes shall be sloped towards rear.

(iv) The cabinets/ boxes / kiosks / panels shall be free standing or wall mounting or pedestal mounting type. They shall have hinged doors with padlocking arrangement. All doors, removable covers and plates shall be gasketed all around with neoprene gaskets.

(v) The cable entry shall be from bottom for which removable gasketed cable gland plates shall be provided. Suitable 240V, single phase 50Hz AC heaters with thermostats controlled by switch and fuse shall be provided to maintain inside temperature 10 deg. above the ambient.

(vi) Each cabinet / box / kiosk / panel shall be provided with two earthing pads to receive 75mmx 10mm GI flat. The connection shall be bolted type with two bolts per pad. The hinged door shall be connected to body using flexible wire.

(vii) The cabinets/boxes/kiosks/panels shall also be provided with danger plate, and internal wiring diagram shall be laminated and shall be installed inside of the door. The front label shall be on a 3 mm thick plastic plate with white letter engraved on black background.

4.0.0 OPGW (COMPOSITE FIBRE OPTIC OVERHEAD GROUND WIRE) OPTICAL GROUND WIRE:

4.1.0 General

The earth wire shall comprise a composite optical fibre cable and earth wire, with optical fibre cable links from each terminal support to the termination equipment installed in the sub-station buildings. Sectioning of aerial cable and jointing of optical fibres shall generally be arranged on tension supports or on suspension supports provided that such supports are designed for such condition.

The OPGW cable and its associated accessories shall be of a proven design with established satisfactory operating records / history.

The OPGW shall comprise an optical unit integral with the ground wire conductor. The OPGW design shall be mechanically and electrically compatible with the design of the transmission line. The OPGW shall be protected from Aeolian vibration by installation of vibration dampers.

The OPGW shall be earthed to the tower steel work at each tower. Approved clamps and bondings shall be used for earth connection.

The composite earthwire shall conform to the requirements of the earthwires specified in this specification. The construction shall be such that tension in the earth wire can impose only negligible strain on the optical fibres.

The outer layer of OPGW shall be aluminium clad steel wire of smooth bodied construction. Optical fibre shall be of silicon type suitable to withstand temperature of about 80^{0}C (Continuous) and upto 190 ^{0}C under specified short circuit current for specified short circuit duration. Each fibre shall be jacketed by heat resistant material and stranded around central spongy rubber core. Considerations should be made on OPGW design to provide superior reliability on thermal resistance water proof, strain reduction to fibres, mechanical strength and corrosion resistance.

The OPGW shall also withstand lightning currents without degradation of optical attenuation of the fibres or mechanical damage to the ground wire strands.

The wire forming the outer strands of the OPGW shall be right hand lay and designed to prevent bird caging, strand popping and unravelling during normal handling and installation.

The OPGW shall be delivered with approved water proof end seal which shall not be removed until immediately prior to optical jointing.

No mid-span joints shall be allowed in the OPGW. All joints shall be performed in a tower joint box located 5.0 metre above the ground level.

It is not envisaged that repeater stations are required. The Bidder / Contractor is to conduct necessary investigation to demonstrate that repeaters are not required.

The following standards shall generally be applicable.

a. Aluminium Clad Steel wire (ASTM B 415, B 416).

b. Optical fibre (CCITT recommendation G 652 for single mode).

The Contractor shall furnish recommended procedure for stringing the OPGW together with sketches.

4.2.0 **Optical Fibre Requirement**

Based on the system short circuit current level specified, the contractor shall evaluate the split of the total system earth fault current between the actual earth, the optical fibre cable and the outer layer of earth wire on the tower. Necessary calculations to this effect shall be provided for the approval of the Owner/Owner's representative. Accordingly the sizing of the composite OPGW and its individual components shall be established.

SECTION – 3
PROJECT DETAILS AND GENERAL SPECIFICATIONS

SL.NO.	DESCRIPTION	
1.	**PROJECT INFORMATION**	
	a) Customer	**ONGC Ltd.**
	b) Consultant	**FICHTNER Consulting Engineers (India) Pvt. Ltd.**
	b) Project	**66 KV GIS system for 1 X 51 MW CCCPP for ONGC , Hazira**
1.0	Location	ONGC Limited, Hazira
2.0	Elevation above mean sea level	RL 6.0 above, MSL
3.0	Nearest Railway Station	Surat, 20 KM
4.0	Nearest Airport	Surat, 10 KM
5.0	Nearest Harbour	Magdalla, 20 KM
6.0	Access Road	NH-8 (30 KM)
7.0	Atmospheric pressure at MSL	1.013 bar
8.0	Ambient Temperature	
a)	Max. average dry bulb temperature	45.6 oC
b)	Min. average dry bulb temperature	4.4 oC
c)	Design temperature for electrical equipment / device	50 oC
9.0	Relative Humidity	
a)	Max.	70%
b)	Min.	18%
c)	Average	64%
10.0	Seismic Zone	III (IS 1893)
11.0	Rainfall	
a)	Max. Intensity of rainfall in 24 hrs.	459.2 mm
b)	Period – Monsoon showers	June to September
c)	Average rainfall per annum	1203.5 mm
12.0	Wind data	
	Max. wind speed (as per IS:875) 20-61 kmph for 20 days in a year < 20 kmph for remaining period	62 kmph
	Most predominant wind direction	South -West
13.0	Land	
14.0	Tropicalisation	
	All equipment supplied against specification shall be given tropical and fungicidal treatment in view of the climatic conditions prevailing at site.	
	Tropical protection shall conform to BS: CP-1014-1965 "Protection of Electrical Power Equipment" against climatic conditions.	

Auxiliary Supply

Normal Voltage	Variation in Voltage	Frequency in Hz	Phase/Wire	Neutral Connection
415 Volts	± 10%	50 +3% to -5%	3 phase/ 4 wires	Solidly earthed
240 Volts	± 10%	50 +3% to -5%	1 phase/ 2 wires	One point earthed
110 Volts DC	± 10%	DC	1 phase/ 2 wires	Isolated 2 wire system

2. **General electrical requirement** as per Annexure A (Vol III, Section 3.1 of ONGC specification.(4 pages))

The discharge of pollution in water and air as well as noise levels shall meet with the stipulations of State Pollution Control Board as well as other Acts of the Government under the Ministry of Environment and Forestry. It is a pre-condition that irrespective of what is stated in statutory regulations or any other act or norms, the Specification stipulated environmental qualities standards are the minimum requirements and shall be fulfilled in all aspects.

For control room and offices, noise level shall not exceed 60 dB (A) near to the duct and at other places in the control room/offices noise levels shall not exceed 50 dB (A).

Equipment supplied and all work done including system design and detailed engineering shall also comply with the statutory requirements of the State/Central government and with the Indian Electricity Rules.

Unless otherwise specified, at least 10 % margin shall be considered in equipment sizing over and above the calculated load current/fault current/power requirements.
If not specified otherwise the electrical operational equipment must be designed to meet protection classes stated below.

- HT Switchgear (Indoor) - IP 4X
- LT Switchgear (Indoor) - IP 52
- Control panels (Indoor) - IP 42
- Relay panel - IP 42
- Motors (indoor) - IP 54
- Motors and other equipment located outdoor - IP 55
- Emergency DG (Indoor) - IP 23

Each individual enclosure accommodating electrical equipment which is liable to suffer from internal condensation due to atmospheric or load variations shall be fitted with heating

3. Standards and Codes of Practice

All equipment, systems and works covered under these specifications shall be in accordance with all the applicable statutes, regulations, codes and standard specified as well as all such standards, statutes, regulations and safety codes applicable in the locality where the equipment will be installed. Contractor may familiarize themselves with all such requirements.
Complete design including pressure parts, piping, valves and fittings shall meet or exceed all the latest requirements of the Indian Boiler Regulations (IBR), latest Indian Standards /ASME codes,

latest codes and standards as applicable. Any Indian/International standards shall be followed for any imported equipment. For plant layout aspects and area classification requirements OISD standards shall be followed.

The design, construction and testing of all equipment, facilities, components and systems shall be in accordance with relevant standards and codes issued by Bureau of Indian Standards (BIS) and/or reputed international standards and codes as on the date of Award of Contract. A non-exhaustive list of reputed international standards is given below:

a) American National Standards Institute (ANSI)
b) American Petroleum Institute (API)
c) American Society of Mechanical Engineers (ASME)
d) American Society of Testing and Materials (ASTM)
e) American Water Works Association (AWWA)
f) American Welding Society (AWS)
g) British Standards (BS)
h) Cooling Technology Institute (CTI)
i) Deutsches Institut fur Normung (DIN), Germany
j) Gosstandart of Russia (GOST) standards
k) Heat Exchange Institute (HEI), USA
l) Hydraulic Institute Standards (HIS), USA
m) International Electro-technical Commission (IEC)
n) Institute of Electrical and Electronics Engineers (IEEE)
o) International Organisation for Standardisation (ISO)
p) Japanese Industrial Standards (JIS)
q) National Electric Code (NEC), USA
r) National Electrical Manufacturers Association (NEMA), USA
s) Central Electricity Authority (Construction of Electrical Plants and Electric Lines) Regulations, Notification, 20th August 2010 and to those referred therein
t) National Fire Protection Association (NFPA), USA
u) Occupational Safety and Health Administration (OSHA)
v) Tubular Exchanger Manufacturers Association (TEMA), USA
w) VDE association for Electrical, Electronic and Information Technologies (VDE), Germany
x) OISD

Other international Standards, equivalent or superior to the above Standards can also be adopted. However, In the event of any conflict between the requirements of the international standards or codes and the requirements of the BIS standards or codes, the latter shall govern unless specified

elsewhere in the specifications. Any Indian/International standards shall be followed for imported equipment.

The Plants and Electric Lines (within the plant) shall also be designed to comply with the requirements stipulated in.

a) Central Electricity Authority (Installation and Operation of Meters) Regulations, 2006.

b) Central Electricity Authority (Technical Standards for Connectivity to the Grid) Regulations, 2007.

c) Central Electricity Authority (Measures relating to Safety and Electricity Supply),

Regulations as and when these are notified by the Authority.

d) Central Electricity Authority (Safety Requirements for Construction, Operation and

Maintenance of Electrical Plants and Electric Lines) Regulations as and when these are notified by the Authority.

e) Central Electricity Authority (Grid Standards) Regulations as and when these are notified by the Authority.

f) Central Electricity Authority (Construction of Electrical Plants and Electric Lines)

Regulations, Notification, 20th August 2010 and to those referred therein

g) Indian Electricity Grid Code issued by Central Electricity Regulatory Commission (CERC) and

h) Applicable State Grid Code issued by appropriate Regulatory Commission.

All material and equipment supplied and all work carried out as well as calculation sheets, drawings, quality and class of equipment, methods of inspection, constructional peculiarities of equipment and parts and acceptances of partial plants, as far as these are beyond the special requirements of the specifications, shall comply in every respect with the technical codes of the above listed codes and Standards.

It shall be the responsibility of the Contractor to take all approvals required and get the HRSG registered under the IBR. In all other cases where IBR does not govern, IS/ASME, Japanese, American, British, German or other international standards established to be equivalent or superior to IS/ASME shall be acceptable with the approval of the Owner/Owner's representative at the time of detailed engineering.

Where there are no standards or regulations, or the standard is not sufficient to meet the need of design and supply, for such items relating to the power plant, the Contractor shall carry out the design, manufacture, supply and installation on the basis of good engineering practice.

During the period of Contract execution, if any standards change, the Contractor shall be responsible to notify the Owner/Owner's representative and provide the basis for the prospect that it would not cause the lowering of quality, performance and service life of the power plant due to alteration of the standard and the latest standards shall be followed by the Contractor.

Further requirements about applicable standards and codes are specified in the detailed technical specifications.

4. SPECIAL TOOLS, TACKLES AND EQUIPMENT

One set of special tools and tackles required unit for the operation, maintenance, inspection and repair of the individual main equipment and auxiliary equipment shall be supplied by the Contractors in sufficient quantity to equip the shift personnel, maintenance personnel and workshop craftsman for commissioning, testing, calibration, modification and maintenance of the unit, List of such special tools, tackles and equipment shall be submitted in the EPC bid.

Special tools and tackles excludes conventional ones and those locally available normally (not those requiring a drawing and considered as those made to order).

The special tools and equipment for maintenance and repair shall be delivered by the Contractor in lockable steel boxes and they shall be marked in an approved manner for identification purposes and a corresponding tool chart shall be supplied with the steel boxes.

The following tools and appliances shall be supplied under this Contract for use by the Owner/Owner's representative:

- two sets of special tools and gauges required for the maintenance of the Plant
- one set of special lifting and handling tackles / appliances required for the maintenance of the Plant.

The tools, tackles and appliances supplied in general, shall not be used for erection purposes by the Contractor and shall be handed over in brand new condition. Damaged tools, tackles, and appliances shall be replaced before handing over.
The exception to this is the special lifting gear which may be used provided that when it is handed over to the Owner/Owner's representative it has not been subjected to more than normal wear and is still fully suitable for its intended use.
Each set of tools, gauges and appliances under category (a) above shall be suitably arranged in fitted boxes of mild steel construction, the number of boxes being determined in relation to the layout of the plant and equipment in question.

If the weight of any box and its contents should be such that it cannot conveniently be carried, it shall be supported on steerable rubber-tyred wheels.

Each cabinet and box shall be painted, fitted with a lock and clearly marked in white letters with the name of the item of equipment for which the tools and appliances contained are intended.

Suitable storage racks shall be provided for all portable lifting tackle supplied under this contract. Suitable lifting lugs, ears or ring bolts, or tapped holes for lifting rings shall be provided on all equipment items where the weight exceeds 15 kg.

All lifting tackle shall be stamped with a unique identification number and safe working load. A test certificate from an approved Authority shall be supplied for each item of lifting tackle.
The Contractor shall provide a schedule of all lifting tackle and tools and appliances being supplied, for the approval of the Owner/Owner's representative.

The Contractor shall provide all runway beams, trolleys, lifting blocks, special slings necessary for the safe and efficient handling and maintenance of the works. Particular attention shall be paid to handling of equipment located at higher elevations safety valves

The tools and appliances with the appropriate storage racks, cabinets and boxes shall be handed over to the Owner/Owner's representative at the time of Taking Over of the complete Plant.

Since the Contract includes site erection, any special tools or appliances required solely for erection shall be provided by the Contractor for his own use and shall remain the property of the Contractor.
Control and Instrumentation: Software with associated hardware required to access instruments or control systems to be provided.

5. CLEANING, PROTECTIVE COATING AND PAINTING

Refer Annexure-D (Vol III /Section 2/ Sub Section 2.15 Surface Preparation and Painting.)

6. INSPECTION, TESTING AND INSPECTION CERTIFICATE

Inspection testing shall be done as per customer specification as per Annexure – B.

7. DOCUMENTATION

Format of Documentation

All engineering documents and drawings shall be of international "A" series sizes, that is, A0, A1, A2, A3 and A4.
One set of CD containing all the drawings in Auto CAD (for final as built drawings) shall also be supplied in addition to hard copies.
Soft copy of all other documents shall be supplied in a CD in PDF or editable format. For review purpose pdf or editable version shall be considered.
Grouped documents shall be provided by size A4, with the inclusion of bigger size drawings which, however, have to be folded as Size A4.

Numbering and Identification of Documents

All the drawings shall be identified through a common way of numbering in accordance with the requirement of contracting. The numbering system of drawings and documents proposed by the Contractor shall be in compliance with the plant identification system and to be agreed with the Owner/Owner's representative. Apart from this, some drawings may also be numbered in the way which the contractor or subcontractors are used to do. But, there shall be a common title Block on all published drawings which include the following contents:

- Owner
- Owner's Engineer
- Project
- Contractor
- System
- Drawing No.
- Sheet No
- Revision No.

The measuring units and dimensions marked on the project engineering drawings shall be of SI system conforming to ISO 1000.
English words shall be used as descriptions on drawings.
In case dimensions are not marked in conformity with the scale of drawings and any dimension on the drawing does not conform to those dimensions and sizes measured through certain scale, the actual marked dimensions shall be applicable.
For revision of drawings, the revised part shall be clearly and definitely shown on the drawing.
For revision of documents which have been grouped together, a brief description shall be a perpendicular line with the margin of the revised copy closely following it.

Provision for Documents

Generally, copies of drawings or documents containing trade secret and drawings with patented nature need not be provided.
However, to know whether the Contractor has performed its obligations, the Owner/Owner's representative has the right to examine those drawings within the Contractor's working scope.
The Contractor shall meet the Owner/Owner's representative's reasonable demands to files and do the following to satisfy the Owner/Owner's representative:

- Contractor will work according to the requirements specified in the contract.
- Contractor's working has been arranged properly and developed according to the plan.
- The quality control system is reliable.
- After receiving all documents necessary for power plant operation and maintenance,

Contractor shall supply equipment and systems.

- Having received all necessary documents for Contractor to perform its legal obligations or other relevant responsibilities.

Distribution of documents
The source, distribution, no. of copies shall be as per the following document distribution schedule. Annexure –C.

Title block for the Project:

a) Customer	**ONGC**
b) Consultant:	**FICHTNER Consulting Engineers (India) Pvt. Ltd.**
c) Project:	**66 KV GIS system for 1 X 51 MW CCCPP for ONGC , Hazira**
d) Main Contractor	**BHEL**

DOCUMENTS TO BE SUBMITTED ALONGWITH OFFER

1) Drawings in 2D and 3D format.
2) Guaranteed Technical Particulars
3) Type Test Reports
4) Manufacturing Quality Plan

DOCUMENTATION SCHEDULE AT CONTRACT STAGE

No. of Copies	A: For Approval
5	Copies of GA drawings (2d and 3D) with projects details, dimension, equipment weight, fixing details, tolerances and terminal details etc.
5	Copies of type test reports
5	Copies of shipping list detailing the description & quantities of all items being dispatched separately, with shipping weights, number of cases and dimensions.
5	Copies of manufacturing and field quality plan.

5	Copies of installation, operation & Maintenance manual.
	B : After Approval and For Information/Distribution.
12	Copies of All drawings
12	Bound sets containing all drawings/manuals, type and routine test reports etc. along with sub-vendor's test reports for all bought out assemblies/components/parts including Internal wiring diagrams and exploded diagrams of assemblies/ parts, shall be furnished.
12	Copies of Installation, Operation & Maintenance manual.
	C: On Completion of Entire works
12	Bound sets of Installation, Operation & Maintenance manual and all as built drawings
12	Set of Computer CD-ROMs (with unbreakable CD Covers) containing all as-built drawings in Auto-Cad version 2008 or later with 2D and 3D drawings, Instruction Manual and GTP.

8. Package, storage

All materials and equipment should be packaged according to the typical environmental conditions during storage. In case of severe conditions, these materials and equipment should be packaged carefully by taking a full and appropriate preventive measure to protect from any damage or wear.

The Contractor and his appointed Subcontractor for installation should guarantee jointly that a good supplementary storage will be carried out within the equipment site controlled by them.
Three classes for storehouse are described as follows:

Storehouse class A items: Special measures are taken to protect the stored goods and the temperature, humidity are controlled within a specified range.

Storehouse class B items: Goods are stored with temperature uncontrolled.

Storehouse class C items: It is an outdoor storage with a drainage system on the ground.

For storehouses of class A and B they should be fireproof, heat resisting, waterproof and well ventilated. They should not be wet and should be provided with good drainage system and preferably with a brick laying or concrete ground. For storehouses of class C, they should not be wet and should be well drained, preferably with a brick laying or crushed stone ground, should be protected from rainfall, salt corrosion, ash and other adverse conditions with a temporary cover or tent if possible

Component surfaces should not be contacted directly with the ground or ground laying material. There should be a layer of oilcloth or wax or other similar materials between the machine surface and ground surface.

All components shall be inspected for their painting, storing, sealing and any damage or wear should be repaired during acceptance and storage periodically. The inspection interval is determined by the component function, applied protection measure and storehouse class.

Many components are provided with a drying agent or sealed in a coverage (polyethylene or insulating cover) containing drying agent. The drying condition shall be inspected during storage in an interval of every 4 weeks.

9. SPECIAL TOOLS, TACKLES AND EQUIPMENT

One set of special tools and tackles required unit for the operation, maintenance, inspection and repair of the individual main equipment and auxiliary equipment shall be supplied by the Contractors in sufficient quantity to equip the shift personnel, maintenance personnel and workshop craftsman for commissioning, testing, calibration, modification and maintenance of the unit, List of such special tools, tackles and equipment shall be submitted in the EPC bid.

Special tools and tackles excludes conventional ones and those locally available normally (not those requiring a drawing and considered as those made to order).

The special tools and equipment for maintenance and repair shall be delivered by the Contractor in lockable steel boxes and they shall be marked in an approved manner for identification purposes and a corresponding tool chart shall be supplied with the steel boxes.

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- One set of special lifting and handling tackles / appliances required for the maintenance of the Plant.

The tools, tackles and appliances supplied in general, shall not be used for erection purposes by the Contractor and shall be handed over in brand new condition. Damaged tools, tackles, and appliances shall be replaced before handing over.

The exception to this is the special lifting gear which may be used provided that when it is handed over to the Owner/Owner's representative it has not been subjected to more than normal wear and is still fully suitable for its intended use.

Each set of tools, gauges and appliances under category (a) above shall be suitably arranged in fitted boxes of mild steel construction, the number of boxes being determined in relation to the layout of the plant and equipment in question.

If the weight of any box and its contents should be such that it cannot conveniently be carried, it shall be supported on steerable rubber-tyred wheels.

Each cabinet and box shall be painted, fitted with a lock and clearly marked in white letters with the name of the item of equipment for which the tools and appliances contained are intended.

Suitable storage racks shall be provided for all portable lifting tackle supplied under this contract. Suitable lifting lugs, ears or ring bolts, or tapped holes for lifting rings shall be provided on all equipment items where the weight exceeds 15 kg.

All lifting tackle shall be stamped with a unique identification number and safe working load. A test certificate from an approved Authority shall be supplied for each item of lifting tackle.

The Contractor shall provide a schedule of all lifting tackle and tools and appliances being supplied, for the approval of the Owner/Owner's representative.

The Contractor shall provide all runway beams, trolleys, lifting blocks, special slings necessary for the safe and efficient handling and maintenance of the works. Particular attention shall be paid to handling of equipment located at higher elevations safety valves.

The tools and appliances with the appropriate storage racks, cabinets and boxes shall be handed over to the Owner/Owner's representative at the time of Taking Over of the complete Plant.

Since the Contract includes site erection, any special tools or appliances required solely for erection shall be provided by the Contractor for his own use and shall remain the property of the Contractor.

Control and Instrumentation: Software with associated hardware required to access instruments or control systems to be provided.

10. Painting, Insulation, Anti-dewing

Anti-corrosive coatings and painting shall be carried out as a pre-treatment to all equipment and parts. The paint system used should coordinate with the painted objects and surrounding conditions of project.

In multi-layer painting system, different painting layers should be selected to make the painting coordinate. If multi-layer painting system is used, various painting layers should have distinct colours so that the later layer can be distinguished from the former one.

After the equipment or apparatus finished preliminary or full painting, it can be supplied to field. After the installation is finished, ground coat must be painted.

Entire painting procedure should be supplied in order to repair the injures of painting coat after the equipment is delivered to field.

Colour strip indication system should be used for pipes. These strips should be painted on the joint of pipes, entrance, valves of pipe. This pipe without outside protection layer should be marked by some colour in whole length.

The principal colour of field equipment should be determined by Owner/Owner's representative and Contractor during execution stage. For Electrical equipment, paint shade shall be as mentioned in the equipment Specification.

Further requirements with regard to painting, insulation, and anti-dewing are specified in the relevant sections in the detailed technical specifications. The specified requirements shall be applied to the whole equipment and facilities of the Contract.

Insulation specification for MPP supplied equipment shall be as mentioned in detailed technical specification.

Language to be used

English shall be used as the general Contract language English translations shall be provided for any code and standards not in English language.
Name plates of equipment and instrument scale shall be marked in English.
Documents for training shall be provided in English.
Danger signs / Exit signs shall be in English, Hindi and Gujarati.

11. CONSUMABLES

12.1.0 Lubricants and greases

All lubricants proposed for the Plant operation shall be suitable for all operating and environmental conditions that will be met on site.
All oils and greases shall where possible be readily available in India.
The number of oils and greases shall be kept to a minimum to the extent feasible. For each type and grade of lubricant recommended the contractor shall list at least three equivalent lubricants manufactured by alternative companies. This will be in line with that suggested by OEM and outcome will be informed to the Owner/Owner's representative.
In case of imported oils, lubricants and other consumables, the contractor shall indicate the indigenous equivalents to enable the Owner/Owner's representative to arrange subsequent fills. Preference should be given to indigenous oils and lubricants during first filling itself. Short shelf life items if any may be supplied in a phased manner keeping in view of their actual use.
The Contractor shall supply the first fill lubricants and greases, and also shall provide at the Completion Certificate sufficient lubricants and greases necessary for the efficient operation and maintenance of the Plant at full load 24 hours per day for a period as mentioned in the relevant portion of Commercial Specification.

12.2.0 Chemicals and other consumables

Contract includes the supply (by the Contractor) of all chemicals, reagents, resins, and other consumables required for testing, commissioning and setting to work of each section of the Works.
The Contractor shall provide all chemicals and other consumables required for the efficient operation and maintenance of the plant at full load 24 hours per day for a period as mentioned in the relevant portion of Commercial Specification.
The Contractor shall prepare a list of these consumables giving quantities necessary for each section of the works and the recommended suppliers.
The Contractor shall deliver to site sufficient quantities of consumables in his supply to allow for 6 months running of the Works prior to the issue of the Completion Certificate. The delivery of the remainder of the consumables shall be programmed to suit the operational requirements and space availability within the various stores.

12. Plant and Equipment Identification

The contractor shall follow identification system for the whole plant equipment, instruments, facilities and systems as per the Annexure-4 **Guide for Coding Equipment, Documents & Drawings MPP generated drawings, identification system shall be based on MPP standard.**

Labelling

Name plates which are to be firmly fixed on all the equipment, instruments, buildings and structures shall be provided. For equipment of small size, these are to be fixed on the piping or structure adjacent to the equipment. The contents of nameplate are to include the designation and principal parameters of the equipment.

The nameplate within the field shall be made of a high temperature - resistant metallic sheets, with designation permanently engraved on them. Indoor installed equipment (e.g., panels, cabinets, switchgear) shall also be labelled by appropriate name plate.

The form, size, base colour and colour of contents of the name plates and prompting plates will be agreed between the Contractor and the Owner/Owner's representative. It shall be possible for these to be readily seen by the operator. The designation of warning tags shall be different from that of other tags. All buried pipes and cables routes shall be identified with permanent marker.

ANNEXURE - A

(40)

VOLUME - III

SUB-SECTION - 3.1

GENERAL ELECTRICAL REQUIREMENT

1.0.0 INTENT OF SPECIFICATION

1.1.0 This specification covers the design, manufacture, assembly, testing at manufacturer's works, packing, transportation to site including transit insurance, unloading, erection, testing & commissioning of Electrical Equipment complete with all accessories for efficient and trouble-free operation of combined cycle captive power project.

1.2.0 It is not the intent to specify completely herein all details of the equipment; nevertheless, the equipment shall be complete and operative in all respects and shall conform to the highest standarc of engineering, design and workmanship.

2.0.0 ELECTRICAL SYSTEM DESCRIPTION

2.1.0 The proposed Power plant consisting of one Gas Turbine Generator (GTG) & one Steam Turbine Generator (STG). GTG shall be connected to the new 66kV indoor type Gas Insulated Switchgear (GIS) through a Step-up Generator Transformer using phase segregated bus duct. STG shall be connected to the 66kV Outdoor type Gas insulated switchgear (GIS) through a Step-up Generator Transformer using phase segregated bus duct. Power shall be evacuated from 66kV GIS to the grid through the 66kVoutgoing line feeders. For commissioning of plant the start-up power shall be drawn from grid to the 66kV GIS.

2.2.0 Auxiliary Power supply is envisaged at 11kV & 415V level. Two numbers of Station Transformers are provided for supplying unit loads.

2.3.0 Required numbers of unit and station service transformer (11/0.415 kV) are provided for supplying 415V loads. Electrical Auxiliary power distribution arrangement & Power Evacuation Arrangement is shown in the enclosed **"Key Single Line diagram"(Drg. No. 00-5111168-E-201, 2 sheets).**

2.4.0 One number Black start cum Emergency DG set shall be considered for starting of Gas turbine and safe shutdown of units. During blackout condition Diesel Generator (DG) set shall feed essential loads, same Diesel generator set shall feed unit emergency loads for safe shut down of Units.

2.5.0 To provide uninterrupted power supply to DCS and other Control Panels, a dedicated 110 V AC UPS system shall be provided. To feed essential loads, such as the emergency oil pumps, Control Supply to Switchgears / Panels, Emergency DC lighting etc, 110 V DC supply backed by DC Batteries shall be provided. DC system shall include 66kV GIS control supply requirements also.

2.6.0 If 125V DC system is required by the Gas Turbine supplier as per manufacturer's standard the same shall also be provided.

2.7.0 Plant communication system shall be provided with Public address system & telephone system.

2.8.0 For all electrical MV/LV/Control panels, Local control panels and Junction boxes, Transformers, etc shall be painted with RAL 7032.

FORM19-P REV-A (MUM)

3.0.0 ELECTRICAL SYSTEM DESIGN

3.1.0 The plant shall be designed to operate in islanding mode of operation on tripping of all the grid incoming lines and Steam Turbine generator, so that the Gas Turbine generator unit can be made running with the available plant load under such condition.

3.2.0 The design, manufacture, assembly, shop testing, erection, testing & commissioning as well as performance of the equipment shall conform to the latest edition of relevant IS / IEC specifications.

3.3.0 Before starting manufacture of any equipment the Contractor shall have to take approval of relevant drawings and data from the Owner/Owner's representative.

3.4.0 All equipment supplied and all work carried out including design and detailed engineering shall comply with the statutory requirements local Government as well as Central Government and with the Indian Electricity Rules. The accuracy class of meters, CTs, PTs (inside GIS) for energy accountability shall be as per latest GETCO regulations.

3.5.0 Unless otherwise specified in the respective section, Electrical design ambient for all equipment sizing shall be considered as 50 Deg C dry bulb temperature and 95% RH. All the equipment are required to operate in a highly corrosive environment and highly humid (at costal area) atmosphere.

3.6.0 Unless otherwise specified, at least 20 % margin shall be considered in equipment sizing over and above the calculated load current/fault current/power requirements.

3.7.0 Makes of all Electrical equipment are subject to prior approval by the purchaser. Similar equipment and components shall be of same make. Equipment of same type and rating shall be interchangeable.

3.8.0 The 415V PCC & MCC panels shall be of minimum FORM 3B type of construction.

3.9.0 In respect to the above LV circuit breaker selection, following should be considered as per IEC:-

Utilisation Category	Application
Category A	Circuit-breakers with no assigned short-time rating (e.g Current limiting ACBs and MCCBs) cannot be used if coordination is required with downstream switchboard feeders. Applicable for the outgoing feeders
Category B	Circuit-breakers with assigned short-time rating (e.g ACBs and some Supplier's larger rated MCCBs) that shall be used if coordination is required with downstream switchboard / MCCs. Applicable for the incomer and outgoing feeders.

Outgoing feeders not requiring any coordination for example motor feeders Category "A" MCCB can be considered.

3.10.0 In switchgear for Motor feeders rated 15kW & above an ammeter & transducer shall be provided. All transducers will be of dual output type.

3.11.0 All LT motors rated 90 kW & above shall be controlled through Air Circuit Breakers. LT motors rated below 90 kW shall be controlled by fused contactor. In addition to the above ELCB shall be provided for all 415V motor feeder. Each feeder shall also provided with O/L relay and SPPR relay.

3.12.0 For the motor feeders, the essential auxiliaries shall have contactors with delayed drop out feature adjustable up to 3 sec and necessary auto reset facility and the relay should be of digital type. The

list of motors shall not be limited to BFP, AOP, JOP, lube oil pump, compressors, barring gear and any other drive recommended by GTG,STG & HRSG vendor.

3.13.0 The power cables upto and including 10 sq.mm should be copper conductor and above 10 Sqmm Aluminium conductor may be used. For CT circuits minimum cable size shall be 4sq.mm copper. Minimum size of control cables shall be 2.5sqmm. 20% spare cores shall be provided in all control cables. The maximum no. of cores shall be limited to 27.

3.14.0 The equipment supplied shall meet the requirement of state electricity and Indian grid code.

3.15.0 The Substation Automation System (SAS) shall have provision for interfacing with remote PLDC (Regional Load Dispatch Centre) through suitable gateways with adequate number of ports along with modems at substation level.

3.16.0 Voltage Levels shall be as follows:

- Power Evacuation : 66 kV (±10%), 3 phase, 3 wire 50 Hz, effectively earthed.
- Generation Voltage : Manufacturer's standard Voltage,3 phase,50 Hz
- Plant HT Auxiliary Supply : 11000V (±10%), 3-phase, 3W, 50 Hz, earthed through resistance.
- Plant LT Auxiliary Supply : 415V (±10%), 3 phase, 4 wire, solidly earthed.
- Plant LT Emergency Supply : 415V (±10%), 3 phase, 4 wire ungrounded.
- Plant DC Supply : 110V (+10% to –15%), DC 2 wire unearthed.
- Plant UPS Supply : 110V (±10%), 1 phase, 2 wires 50 Hz, A.C.
- Transducers : 110V DC (For LT boards 230V AC)
- Metering : 110V AC PT Voltage
- Control & protection : 110V, DC 2 wire unearthed
- Panel lighting and space heaters : 240V, 1-phase, 2wires 50 Hz, A.C. with one point earthed.
- Control Supply for Breaker feeders : 110V, DC 2 wire unearthed
- Control Supply for LV DOL modules : 110V, 1 phase, 2 wires
- Permissible Frequency variation for generator : +3% to – 5%
- Permissible Frequency variation for auxiliaries : +5% to – 5%
- Voltage level for AC Motors below 0.2 kW : 240 V, Single phase, 50 Hz, with DOL start.
- Voltage level for AC Motors from 0.2kW up to and including 160 kW : 415 V, 3 phase, 50 Hz, with DOL start.
- Voltage level for A.C Motors above 160 kW : 11000V, 3 phase, 50 Hz, with DOL start.

3.17.0 Design short circuit levels shall be at least the following and has to be supported by calculation:

- Three phase symmetrical short circuit ratings of 66kV System : 40 kA for 3 sec
- Three phase symmetrical short circuit ratings of 11kV System : 44 kA for 3 sec
- Earth fault current for 11kV System : 100A.
- Three phase symmetrical short circuit ratings of 415V System : 50 kA for 1sec
- Short circuit ratings of 110V DC System : 20 kA for 1 sec (min)

3.18.0 Insulation level at various voltages shall be as follows:

66kV System

One minute Power Frequency withstand voltage	: 140 kV (rms)
Switching Impulse withstand Voltage	: 325 kV (peak)

11kV System

One minute Power Frequency withstand voltage : 28 kV (rms)
1.2/50 Micro sec, impulse withstand voltage : 75 kV (peak)

415 V System

One minute Power Frequency withstand voltage : 3 kV (rms)

3.19.0 Sizing criteria for auxiliary transformers

Design Criteria for Auxiliary Transformer and Generator Transformer

i. The Contractor shall size the auxiliary transformer as per sizing criteria furnished below:

Min. Rating of each Auxiliary transformer (in kVA at p.f.0.8) = 1.2 x (Sum of total connected load + Max of (sum of 20% of total standby loads or the largest standby load) + max of (sum of 50% total intermittent loads or the largest intermittent load))

✓ The auxiliary transformers shall be sized for 2x100%

4.0.0 QUALITY ASSURANCE, TESTING & INSPECTION

4.1.0 All materials, components and equipment covered under this specification shall be procured, manufactured, erected, tested, and commissioned at all the stages, as per approved Quality Plan.

4.2.0 All tests shall be conducted as per relevant IS/IEC/IEEE standards and shall be performed in the presence of purchaser's representative, if so desired by the purchaser. The Bidder shall give at least 15 days advance notice of the date when the tests are to be carried out.

4.3.0 Equipment offered shall be of type tested and proven type. Type test certificates for test conducted earlier on similar rating shall be furnished. Type testing shall be conducted without any cost implication to the purchaser if type testing is not already carried out for any equipment supplied. For the various bought out items test certificates from equipment manufacturer shall be furnished. Routine tests shall be carried out for all the equipment as per applicable standards whether specifically mentioned or not. Specific type tests are to be carried out as specified in individual equipment specifications.

4.4.0 Copies of certified reports of all tests carried out at the works shall be furnished. The equipment shall be dispatched from works, only after receipt of Purchaser's written approval of the test reports.

The charges for carrying out all routine tests shall be deemed to be included in the Bid price. The charge of carrying out each type test/ special test if any shall be given separately in "Unit Price Schedule".

7.17.0 List of Approved Sub-vendors

Refer Volume IV/Annexure-1/ Section 8.

With full information substantiating the technical acceptability of the proposed change. The Owner/Owner's representative's decision shall be final. Concessions granted shall not absolve the Contractor from any of his responsibilities under the Contract.

8.0.0 QUALITY ASSURANCE, SHOP INSPECTION AND TESTING

8.1.0 General

This section contains general requirements for inspection of material, parts, equipment and workmanship of the plant during manufacture, assembling to demonstrate compliance with specification, codes and standards to ensure overall reliability of plant operation and performance.

The Owner/Owner's representative and/or authorised Representatives shall, at any time, be allowed free and ready access to the Contractor's premises and those of his suppliers as well as to the site installation and the Contractor has to make the plant items available for the purpose of inspecting the specified equipment components and obtaining information as to the progress of the work. Failure on the part of the Owner/Owner's representative, at this or any other time, to discover or reject materials or work which do not meet specified requirements shall not be deemed an acceptance thereof nor a waiver of defects therein.

The approval of the Owner/Owner's representative shall not prejudice the right to reject equipment if it does not give complete satisfaction in service.

8.2.0 Scope

All materials, components and equipments covered under this specification shall be tested at all stages of procurement, manufacturing, erection, commissioning as per a comprehensive quality assurance programme. The requirements of minimum quality plans to be followed by the Bidder in respect of various equipment are specified in detailed technical specification. The Bidder shall draw his own quality plans in line with these requirements and his standard practices and implement such programme after approval by the Owner/Owner's representative.The Owner/Owner's representative shall appoint a Third party inspection (TPI) agency for bought out items/outside inspection.The Owner/Owner's representative will carry out on-site supervision and inspection.

Manufacturing quality plan shall detail out, for all the components and equipments, various tests/inspection to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by contractor's quality control organization, the relevant reference document and standards, acceptance norms and inspection documents raised. during all stages of material procurement, manufacture, assembly and final testing/performance testing.

The Contractor has primary responsibility for ensuring the quality of items of equipment supplied under the contract and remains accountable when manufacture or erection is subcontracted. It is therefore a requirement of the specification that work is only subcontracted to companies with effective quality control organization and that the Contractor monitors the performance of these by the attendance at tests of experienced inspectors employed by the Contractor. The Contractor shall, at the appropriate time, prove that his

material and / or equipment comply with all the requirements of this Section, such proof being the successful completion of tests and inspections. Routine test and type test certificates shall be submitted for each item of equipment, wherever applicable.

All materials, components and equipment supplied under the contract shall be subject to inspection by the Owner/Owner's representative, his representative, Inspectors of Boilers (India) or his authorized Agency or any other Inspector of the Government, should they so require during manufacture, erection and after completion. The necessary inspection charges of the authorized agency of Inspection of Boilers (India) shall be borne by the contractor. The inspection and tests shall include but shall not be limited to the requirements of this section of the specification. Further requirements to be applied are specified in the detailed specification.

The Bidder along with quality plan, shall also furnish copies of the reference documents/plant standards/acceptance norms/test and inspection procedure referred by him in quality plans. These quality plans and reference documents/standards will be subject to Owner/ Owner's representative's approval and will form a part of the contract. In these approved quality plans, Owner/Owner's representative shall identify customer hold points (CHP), indicating tests/checks which shall be carried out in presence of the Owner/Owner's representative's or authorized representative and beyond which work will not proceed without consent of Owner/Owner's representative's in writing.

No materials/equipment shall be dispatched from the manufacturer's works before the same is either accepted subsequent to pre-dispatch final inspection including verification of records of all previous tests/inspections by Owner/Owner's representative or such pre-dispatch final inspection is waived by the Owner/Owner's representative and dispatch is authorized after review of test reports.

All materials used or supplied shall be accompanied by valid and approved material certificates and test and inspection reports duly approved by the Owner/Owner's representative. These certificates and reports shall indicate the acceptable identification number of the material they proposed to certify. The material certified shall also have the identification details stamped on it.

All material used for equipment construction including castings and forgings shall be of tested quality as per relevant codes/standards. Details of results of the test conducted to determine the mechanical properties, chemical analysis and details of heat treatment procedures 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 as specified in detailed specification.

All welding shall be carried out as per welding procedure drawn and qualified in accordance with requirements of ASME Section IX. Welding procedures shall be submitted to the Owner/Owner's representative for approval prior to carrying out qualification test in the presence of I/Owner/Owner's representative

All welders/welding operators employed on any part of the contract either in the Supplier's works or at site or elsewhere shall be qualified as per ASME Section-IX.

Test results of qualification tests and specimen testing shall be furnished to the Owner /Owner's representative for approval. However, wherever required by the Owner/ Owner's representative, tests shall be conducted in presence of Owner/Owner's representative

All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.

All the sub-vendors proposed by the Bidder for procurement of major bought out items including castings, forgings, pumps, heat exchangers, semi finished and finished components/equipment-(list of which shall be drawn up by the Bidder along with his offer and finalized with the Owner/Owner's representative) shall be subject to Owner/ Owner's representative's approval.

The type and extent of inspection of items shall be in accordance with the relevant International/Indian Standards/Indian Boiler Regulations and other standards approved by the Owner/Owner's representative, supplemented or amended by the requirements of this section of the specification or as specified elsewhere in the Specification.

8.3.0 Inspection Program and Test Notifications

Before manufacturing commences and not later than 45 days after award of contract, the Contractor shall submit an outline of his proposed inspection program, which shall include all major stages during manufacturing. The inspection and test program shall include for the various items the designation No., name of equipment, part of equipment, the kind of test, test standard, company which carries out the test, place, date and witnesses by the Contractor, third party or Owner/Owner's representative's .

The Owner/Owner's representative will return a copy of the Contractor's proposed inspection program indicating those inspection stages for which notification is required. Notification shall be by Fax or email in a format to be agreed and shall be sent at least 20 days prior to the intended test in accordance with 'Conditions of Contract'. If the Owner/Owner's representative intends to be represented at the test he will provide at least 24 hours' notice and if his representative does not attend on the notified date, the test may proceed unless an alternative date has been requested by the Owner/Owner's representative.

8.4.0 Test Certificate Documentation

The results of all tests shall be certified by the manufacturer, Contractor or independent agency as appropriate.

Document files containing material certificates, welding procedures, test report shall be compiled for each item of plant and shall be suitably identified (including equipment classification reference) and bound.

Three copies of each document file containing inspection reports and certificates of site erection testing activities of a particular item of plant or system shall be supplied to the Owner/Owner's representative prior to commissioning.

Copies of the performance and acceptance test reports shall be prepared and distributed as specified in Clause 'Performance and acceptance test data and reports' of this Section. All documentation as required by IBR shall also be prepared and submitted.

8.5.0 Certification of Equipment by Owner/Owner's representative's

The Personal and travelling costs in connection with the Owner/Owner's representative's inspection and witnessing of tests of equipment, components and material manufactured in India and abroad will be borne by the Owner/Owner's representative.

8.6.0 Codes and Standards

8.6.1 General

The type and extent of inspection shall generally be in accordance with that specified in the standard used for design and construction of the item of equipment supplemented or amended by the requirements of this section of the specification. The Contractor should provide the relevant codes and standard to the Owner/Owner's representative.

8.6.2 Reference to Codes and Standards

Reference to special codes and standards, where designated either directly or as "relevant", is intended to provide a measure of performance, safety, in-shop and on-site testing, and methods of construction and/or installation which must be equalled or exceeded in order to be considered acceptable for use under this specification. If more than a single degree of quality or accuracy is permitted within the scope of particular code or standard, the highest quality shall be applicable and the degree of accuracy commensurate with the intended function shall be selected, but with the understanding that the final decision will be made by the Owner/Owner's representative.

In all instances, the finally accepted applicable code or standard shall be the version last published.

8.6.3 Alternative Standards

Where no appropriate standard is available, tests shall be conducted in accordance with the manufacturer's standard practice, subject to the approval of the Owner/Owner's representative.

In such cases the Contractor shall submit to the Owner/Owner's representative, complete data and a suggested procedure for the testing to be performed. Commencement of manufacture before receipt of the Owner/Owner's representative's approval shall be at the Contractor's risk.

If the proposed procedures are accepted, the Contractor shall provide the Owner/Owner's representative with four additional copies in English before any test is performed.

8.6.4 Derating Standards

The Contractor's attention is drawn to the climatic conditions in the site area. Derating factors shall apply in accordance with the relevant and approved standards if not specified in the contract documents.

8.7.0 Services prior to and During Inspection and Testing

In accordance with and in addition to specified standards the Contractor shall submit procedures for material testing, manufacture, quality control and performance testing as they apply from the procurement phase of raw materials to the finished product. Manufacture commenced before receipt of the Owner/Owner's representative's approval of material specifications and testing procedures shall be at the Contractor's risk.

No inspection shall be valid unless the Contractor and manufacturer are in possession of relevant approved drawings and procedures for the item to be tested. The Contractor on

16.4.1 Document Distribution Schedule - After Placement of Order

Sl. No.	Document	Total Copies	Distribution		
			Owner		Owner's representative
			HQ	SITE	
1.	PERT Network, work schedules, Bar charts, Layout drawings	10	-	5	5
2.	Data, drawings, documents, write-ups, calculation				
	- Preliminary	10	-	5	5
	- Revised	10	-	5	5
3.	Approved drawings and documents.	10	-	5	5
4.	Instruction manuals for erection and O&M	10	-	8	2
5.	As built drawings including O &M manual				
	- Hard Copy	10	-	8	2
	- Soft Copy	-	-	-	-

ANNEXURE - D

(31)

SUB-SECTION – 2.15

SURFACE PREPARATION AND PAINTING

CONTENTS

SUB-SECTION – 2.15

SURFACE PREPARATION AND PAINTING

1.0.0 SURFACE PREPARATION

1.1.0 General

This specification covers the general requirements related to the cleaning protective coating and painting of equipment, component and system. The components and/or equipment shall be mechanically and / or chemically cleaned during the following stages of the Contract.

- Cleaning in workshop.
- Cleaning before painting and / or corrosion protection (application of prime coat).
- Cleaning before erection and during installation.

Cleaning of fabricated component items shall be carried out after fabrication and final heat treatment of welding at manufacturer's work or at site, as appropriate.

For cleaning in workshop and before painting mechanical cleaning as opposed to alternative chemical cleaning is the preferred method of for works cleaning except where this is precluded by design or access considerations.

Mechanical surfaces shall be protected during the cleaning operations.

In the event of the surfaces not being cleaned to the purchaser's satisfaction, such parts of the cleaning procedures or agreed alternatives as are deemed necessary to overcome the deficiencies shall be carried out at the supplier's sole expense.

For reclining small areas, hand cleaning by wire brushing may be permitted wire brushless used on austenitic steel bristles.

Austenitic stainless steels, copper and aluminium alloys, cast iron, bimetallic and metallic / plastic items, and components fabricated by spot welding or riveting shall not be chemically cleaned. All weld areas shall be suitably stress relieved before chemical cleaning.

various international standards equivalent to Swedish standard for surface preparation are given in Table-1.

The contractor shall arrange at his own cost, to keep a set of latest edition of the above standards and codes at site.

The paint manufacturer's instruction shall be followed as afar as practicable at all times. Particular attention shall be paid to the following.

a) Proper storage to avoid exposure as well as extremes of temperature.
b) Surface preparation prior to painting.
c) Mixing and thinning.
d) Application of paints and the recommended limit on the intervals between coats.
e) Shelf life for storage.

Any painting work (including surface preparation) on piping or equipment shall be commenced only after the system tests have been completed and clearance for taking up painting work is given by the Engineer, who may, however, at his discretion authorise in writing, the taking up of surface preparation of painting work in any specific location, even prior to completion of system test.

1.2.0 **Tools & Tackles**

All tools, brushes, rollers, spray guns, blast material, hand power tools for cleaning and all equipment, scaffolding materials, shot/sand blasting equipment and air compressor etc. shall be arranged by the contractor at the site in sufficient quantity at his own cost. He shall arrange to his own cost, for suitable paint thickness measuring instrument like Elkometers acceptable to the Engineer (with calibration facilities).

Mechanical mixing shall be used for paint mixing operation in case of two pack systems except that the Engineer may allow the hand mixing of small quantities at his discretion.

1.3.0 **Mechanical Cleaning at Manufacturer's Works**

Mechanical cleaning shall preferably be carried out by abrasive blasting. The Purchaser is prepared to consider alternative methods provided they achieve the necessary surface condition.

1.3.1 **Surface condition**

The Metal surfaces shall be clean and free of mill scale, rust dirt, grease and any other deleterious matter.

Where metal surfaces are to be painted the surface profiles shall conform with the painting specification requirements.

Where this does not apply surfaces shall have a surface texture not coarser than Grade 80 abrasive paper.

1.3.2 **Abrasives**

Abrasives containing silica, silicates of slag, residues shall not be used for water/steam side surfaces of plant except for cleaning sand castings, where hydro blasting with sand may be used.

For austenitic materials only abrasives containing 98% or more of aluminia, $Al_2 O_3$, shall be used.

1.3.3 **Removal of abrasive and debris**:

After cleaning abrasive and debris shall be thoroughly removed from components.

1.3.4 **Alternative Chemical Cleaning at Manufacturer's Works**

The procedure shall comprise of Pre-treatment and Acid treatment.

To achieve cleanliness equivalent to that specified for mechanical cleaning. The procedure to be adopted must meet with the purchaser's approval.

1.3.5 **Protection at Manufacturer's Works**

As soon as all items have been cleaned and within four hours of the subsequent drying, they shall be given suitable anti-corrosion protection.

All water, air and steam side surfaces shall be protected by the application of approved water soluble corrosion inhibitors, or vapour phase inhibitors that can be subsequently removed by site water washing or steam blowing.

The rate of application of volatile corrosion inhibitors shall be at least 10 grams per square metre or 35 grams per cubic metre, whichever is the greater, except for pipes up to 300 mm diameter for which the minimum application rates shall be 5 grams per square metre.

Immediately after the protective treatment has been applied all vessels and pipes shall be suitably sealed off by discs or caps or approved alternatives to prevent ingress from the surrounds Cylindrical plugs shall not be drive into the ends of pipes. These protective covers shall not be removed until immediately before final connection is made to the associated equipment.

1.4.0 **Weather Conditions**

Painting shall be done only when the surface temperature is above 5°C surface temperature must be at least 3°C above dewpoint to ensure that condensation does not occur on the surface.

Reasonable protection against precipitation, corrosive fumes and vapours shall be exercised for the painting of outdoor parts.

Precautions shall also be taken against solar radiation to ensure that the specified dry film thickness of priming of finish coats is obtained.

Any prime coat exposed to excess humidity, rain, dust etc. before drying, shall be permitted to dry & the damaged area of primer shall be removed and the surface prepared & primed again.

Sheltered or unventilated horizontal surfaces on which dew may collect require more protection, and to achieve this an additional top coat of paint shall be applied.

1.5.0 **Surface Preparation**

In preparing any surface to be coated, all loose paint, dirt, grease, rust, scale, weld slag or spatter or any other extraneous material shall be removed and defects repaired so as to obtain a clean, dry, even surface to receive the priming or finishing coat(s) as called for in the painting schedules. Sharp adges should be rounded especially when tank linings have to be applied.

All machined surfaces, including flange faces, shall be suitably covered to prevent damage during surface preparation.
All surface should be blast cleaned whenever possible.

1.5.1 **Surface preparation methods.**

Bare steel surfaces should be prepared by one of the methods described below in order of preference and in accordance with Swedish Standard SIS 05 5900 or Steel Structures Painting Council, SSPC, Vis1,or DIN 55928, section 4.

1.5.1.1 **White metal blast cleaning**: Sa 3 or SSPC - SP 5

Sa 3 Blast cleaning to bare metal, Mill scale, rust and foreign matter must be removed completely. Subsequently, the surface is cleaned with vacuum cleaner, clean dry compressed air or a clean brush. It must then have a uniform metallic colour & correspond in appearance to the prints designated Sa 3.

1.5.1.2 **Near white metal blast cleaning** Sa 2 1/2 or SSPC - SP 10

Sa 2 1/2. Very thorough blast cleaning. Mill scale, rust and foreign matter shall be removed to the extent that the only traces remaining are slight imperfections in the form of spots or stripes. Subsequently, the surface is cleaned with a vacuum cleaner, clean dry compressed air or a clean brush. It must then correspond in appearance to the prints designated Sa 2 1/2.

Mechanical cleaning should only be used when procedures (a) and (b) are not practicable.

1.5.1.3 **Commercial Blast Cleaning** Sa 2

Sa 2 Blast cleaning until atleast two-thirds of each element of surface area is free of all visible residues. This method of Blasting is suitable for steel required to be painted with conventional paints for exposure to mildly corrosive atmosphere for longer life of the paint system.

1.5.1.4 **Near white metal blast cleaning** P Sa 2 1/2 DIN 55928

Very thorough blast cleaning. Very adhesive coatings remain. From all other surface mill scale and rust are to be removed to such an extent that the only traces remaining are slight imperfections in the form of spots or stripes. Further treatment see Sub b).

1.5.1.5 **Very thorough mechanical scraping and wire brushing** St 3

St 3 very thorough scraping and wire-brushing - machine brushing - grinding - etc. are to be preferred. Surface preparation as for St 2. But much more thoroughly. After the removal of dust, the surface must have a pronounced metallic sheen and correspond to the prints designated St. 3.

1.5.1.6 **Thorough scraping and wire brushing**: St 2

St 2 Thorough scraping and wire-brushing - machine brushing - grinding - etc. The treatment shall remove loose mill scale, rust and foreign matter. Subsequently, the surface is cleaned with a vacuum cleaner, clean dry compressed air or a clean brush. It should then have a faint metallic sheen. The appearance must correspond to the prints designated St 2.

Table -1 (Surface Preparation Standards)

Surface preparation methods	SIS 055900	DIN 55928, Part-4	BS 4232 only for blasting	SSPC-Vis
Blasting ACC to item (a)	Sa 3		First quality	White metal SP 5
Blasting ACC to item (b)	Sa 2 1/2		Second near quality	White SP 10
Blasting ACC to item (c)	Sa 2		Third quality	Commercial blast SP 6
Hand / or power tool derusting ACC to item (f)	St 2		--	Hand tool cleaning SP 2
ACC to items (e)	St 3		--	Power tool cleaning SP 3
Flame jet cleaning		F1	--	Flame cleaning SP 4
Pickling		Be	--	Pickling

Steel structures to be blast cleaned have to be free of pitting and other severely corroded places in accordance with B.S. 4232 and SIS 055900.

The abrasives used for blast-cleaning shall be graded flint, grit, shot or silica sand and shall be such that they will produce an average keying profile on the blast-cleaned surface of not more than 40 microns.

An air pressure of 7 bar (g) at the nozzle shall be used.

After blast-cleaning all accumulated grit, sand, dust etc. must be removed leaving the surface clean, dry and free of mill scale, rust grease and other foreign matter.

In the event of rusting after completion of the surface preparation, the surface must be cleaned again in the manner specified.

Oil, grease, soil, cement, salts, acids or other corrosive chemicals shall be cleaned from steel surfaces, by the use of solvents, emulsions or cleaning compounds. The final wiping shall be with clean solvent and clean rags or brushes. There shall be no detrimental residue left on the surface.

Primed areas which suffer damage must be spot blasted on site to a degree of cleanliness P Sa 2 1/2 before touching up.

Protective coating must be applied as quickly as possible after the completion of surface preparation no matter what cleaning method has been used.

No blast-cleaned surface shall be allowed to remain uncoated overnight.

Steel work protected by shop primer after arrival on site must be cleaned of salt, sand, oil etc. before the coat of paint is applied on site. Shop primer damaged during transport must be rectified by blast-cleaning and coating before application of the site coats.

Wood surfaces shall be sanded clean. All nail holes shall be puttied and sanded before priming.

Concrete: If a protective coating is required, concrete shall be allowed to cure before painting.

1.5.2 **Rub Down and Touch up of Primer**

The shop coated surfaces shall be rubbed down thoroughly with emery paper to remove all dust, rust and other foreign matters, washed, degreased, then cleaned with warm fresh water and air dried. The portions, from where the shop coat has peeled off, shall be touched up and allowed to dry before applying a coat of primer. The compatibility between shop coat and field primer should be ascertained from the paint manufacturer. In case degreasing with white spirits is not effective, the surface should be finally wiped clean with aromatic solvent like xylol or light naphtha.

1.5.3 **Non Compatible Shop Primer**

The compatibility of finishing coat should be confirmed from the paint manufacturer. In the event of use of primer such as zinc rich epoxy, inorganic zinc silicate etc., the paint system shall depend on condition of shop coat. If the shop coat is in satisfactory condition showing no major defect, the shop coat shall not be removed. The touch up primer and finishing coat(s) shall be identified for application by Engineer.

Shop coated (coated with primer & finishing coat) equipment shall not be repainted unless paint is damaged.

Shop primed equipment and surfaces shall only be spot cleaned in damaged areas by means of power tool brush cleaning or hand tool cleaning and then spot primed before applying one coat of field primer unless otherwise specified. If shop primer is not compatible with field primer then shop coated primer shall be completely removed before application of selected paint system for particular environment.

For package units / equipment, shop primer shall be as per the paint system given for particular environment.

In case of existing paint, compatibility between finishing coat and new selected finish coat shall be ascertained before application of finish coat. In case the coat is selected for upgrading existing alkyd coating to high performance coating, then surface preparation can be by manual / mechanical means to remove loose rust, peeled off/damaged paint, but sound old coating need not be removed. It should be touched with red oxide zinc chromate primer wherever it has peeled of before application of the coat. The tie coat shall be applied after 7 days of curing of red oxide zinc chromate primer. If new paint system is not suitable to upgrade existing coating then complete paint shall be removed by mechanical or blast cleaning before application of new coating system.

2.0.0 SCHEDULE OF PRIMER & FINISH COATS

2.1.0 PRIMERS

P-1 Red Oxide zinc chromate primer
P-2 High build chlorinated rubber zinc phosphate primer
P-3 High build zinc phosphate primer
P-4 Etch primer/wash primer
P-5 Epoxy zinc chromate primer
P-6 Epoxy zinc phosphate primer
P-7 Epoxy high build mio paint
P-8 Epoxy red oxide zinc phosphate primer
P-9 Epoxy based tie coat finish coats
P-10 Inorganic zinc silicate coating.

2.2.0 FINISH COATS

F-1 Synthetic enamel
F-2 Acrylic polyurethane paint
F-3 Chlorinated rubber paint
F-4 High build chlorinated rubber mio paint
F-5 Chemical resistant phenolic based enamel
F-6 Epoxy high build coating
F-7 High build coal tar epoxy
F-8 Self priming epoxy high build coating
F-9 High build black
F-10 Heat resistant aluminium paint suitable upto 250°c
F-11 Heat resistant silicone paint suitable upto 400°c
F-12 Synthetic rubber based aluminium paint suitable upto 150°c
F-13 Heat resistant silicone paint suitable upto 600°c

2.3.0 PRIMER

a) Primer (P-1) Red oxide zinc chromate primer

Type and composition	:	Single pack modified phenolic alkyd medium pigmented with red oxide and zinc chromate
Volume solids	:	30 - 35%
DFT	:	20 ~ 40 microns/coat (min)
Covering capacity	:	11-13 sq. m/Lit/coat

b) Primer (P-2) High build chlorinated rubber zinc phosphate primer

Type and composition	:	Single pack Chlorinated rubber medium plasticised with unsaponifiable plasticiser pigmented with zinc phosphate
Volume solids	:	35-40%

DFT	:	50 microns/coat (min).
Covering capacity	:	7-8 sq. m/lit/coat

c) **Primer (P-3)** High build zinc phosphate primer

Type and composition	:	Single pack Synthetic medium, pigmented with zinc phosphate
Volume solids	:	40 - 45%
DFT	:	35 - 50 microns/coat
Covering capacity	:	10 - 12 sq. m/lit/coat
Heat resistant	:	Upto 100 ^{0}C (dry)

d) **Primer (P-4)** Etch primer / Wash primer

Type and composition	:	Two pack of Polyvinyl butyl resin medium cured with phosphoric acid solution pigmented with zinc tetroxy chromate
Volume solids	:	7 - 8%
DFT	:	8 - 10 microns/coat
Covering capacity	:	7 - 8 sq. m/lit/coat

e) **Primer (P-5)** Epoxy zinc chromate primer

Type and composition	:	Two pack of Polyamide cured epoxy resin medium pigmented with zinc chromate
Volume solids	:	40% (min.)
DFT	:	35 microns/coat
Covering capacity	:	11 - 12 sq. m/lit/coat

f) **Primer (P-6)** Epoxy zinc phosphate primer

Type and composition	:	Two pack of Polyamide cured epoxy resin medium pigmented with zinc phosphate
Volume solids	:	40% (min)
DFT	:	35 microns/coat (min)
Covering capacity	:	11 - 12 sq. m/lit/coat

g) **Primer (P-7)** Epoxy high build MIO paint (Intermediate coat)

Type and composition	:	Two pack of Polyamide cured epoxy resin medium pigmented with micaceous iron oxide
Volume solids	:	50% (min)
DFT	:	100 microns/coat (min)
Covering capacity	:	5.0 sq. m/lit/coat

h) **Primer (P-8)** Epoxy red oxide zinc phosphate primer

Type and composition	:	Two pack of Polyamide cured epoxy resin medium pigmented with red oxide and zinc phosphate
Volume solids	:	42% (min)
DFT	:	30 microns/coat (min)
Covering capacity	:	13 - 14 sq. m/lit/coat

i) **Primer (P-9)** Epoxy based tie coat

(Suitable for conventional alkyd based coating prior to application of acrylic polyurethane / epoxy finishing coat).

Type and composition	:	Two pack of Polyamide cured epoxy resin medium suitably pigmented
Volume solids	:	45-60%
DFT	:	40 microns/coat (min)
Covering capacity	:	10 - 12 sq. m/lit/coat

j) **Primer (P-10)** Inorganic Zinc silicate coating

Type and composition	:	Two pack of Self cured Ethyl - silicate solvent based Inorganic Zinc coating.
Volume solids	:	60% (min)
DFT	:	65-75 microns/coat
Covering capacity	:	8-9 sq.m./lit/coat

2.4.0 **FINISH COATS**

a) **Finish coat (F-1)** Synthetic Enamel

Type and composition	:	Single pack Alkyl medium pigmented with superior quality water & weather resistant pigments
Volume solids	:	30 - 40%
DFT	:	20 - 25 microns/coat (min)
Covering capacity	:	16 - 18 sq. m/lit/coat

b) **Finish coat (F-2)** Acrylic Polyurethane paint

Type and composition	:	Two pack Acrylic resin and isocyanate hardener suitably pigmented.
Volume solids	:	40 % (min)
DFT	:	30-40 microns/coat
Covering capacity	:	10-12 sq.m./lit/coat

c) **Finish Coat (F-3)** Chlorinated Rubber paint

Type and composition	:	Single pack Plasticised chlorinated rubber medium with chemical & weather resistant pigments.
Volume solids	:	30 % (min)
DFT	:	30 microns/coat (min)
Covering capacity	:	10 sq.m./lit/coat

d) Finish Coat (F-4) High build chlorinated rubber MIO paint.

Type and composition	:	Single pack Chlorinated rubber based high build pigmented with micaceous iron oxide.
Volume solids	:	40-50 %
DFT	:	65-75 microns/coat
Covering capacity	:	6-7 sq.m./lit/coat

e) Finish Coat (F-5) Chemical Resistant Phenolic based Enamel

Type and composition	:	Single pack Phenolic medium suitably pigmented.
Volume solids	:	30-40%
DFT	:	25 microns/coat (min)
Covering capacity	:	15 sq.m./lit/coat

f) Finish Coat (F-6) Epoxy High Building Coating

Type and composition	:	Two pack Polyamide cured epoxy resin medium suitably pigmented.
Volume solids	:	55-65%
DFT	:	100 microns/coat (min)
Covering capacity	:	6.0-6.5 sq.m./lit/coat

g) Finish Coat (F-7) High build coal tar Epoxy.

Type and composition	:	Two pack Polyamine cured epoxy resin blended with coal tar.
Volume solids	:	65 % (min)
DFT	:	80-125 microns/coat
Covering capacity	:	6.0-6.5 sq.m./lit/coat

h) Finish Coat (F-8) Self priming epoxy high build coating (complete rust control coating)

Type and composition	:	Two pack Polyamido-amine cured epoxy resin suitably pigmented. Capable of adhering to manual prepared surface and old coatings.
Volume solids	:	65-85%
DFT	:	100-125 microns/coat
Covering capacity	:	4-5 sq.m./lit/coat

i) Finish Coat (F-9) High build black.

Type and composition	:	Single pack Reinforced Bituminous composition phenolic based resin.
Volume solids	:	55 - 66 % (min)
DFT	:	100 microns/coat (min)
Covering capacity	:	5.5 – 6.0 sq.m./lit/coat

j) **Finish Coat (F-10)** Heat Resistant Aluminium Paint Suitable upto 250°C

Type and composition	:	Dual container (paste & medium) Heat resistant special Ole Ore resinous medium with leafing aluminium.
Volume solids	:	20 - 25 %
DFT	:	20 microns/coat (min)
Covering capacity	:	10 - 12 sq.m./lit/coat

k) **Finish Coat (F-11)** Heat Resistant Silicon paint suitable 250 - 400°C.

Type and composition	:	Single pack of Silicon resin based with aluminium flakes
Volume solids	:	15-25 %
DFT	:	20 microns/coat (min)
Covering capacity	:	7-12 sq.m./lit/coat

l) **Finish Coat (F-12)** Synthetic Rubber Based Aluminium Paint suitable upto 150°C.

Type and composition	:	Single pack of Synthetic rubber medium combined with leafing Aluminium.
DFT	:	20-25 microns/coat (min)
Covering capacity	:	9.5 sq.m./lit/coat

m) **Finish Coat (F-13)** Heat Resistant Silicon paint suitable 500 - 600°C

Type and composition	:	Single pack of Silicon resin based with aluminium flakes.
Volume solids	:	25-35%
DFT	:	20 - 25 microns/coat (min)
Covering capacity	:	12 - 14 sq.m./lit/coat

3.0.0 PAINT SYSTEM

SL. NO.	SURFACE/LOCATION	TEMP. °C	SURFACE PREPARATION	PAINT SYSTEM			PER COAT MICRONS Dft	APPLICATION	
				COAT	NO. OF COATS	GENERIC TYPE		IN SHOP	ON SITE
1	Structural steel work, piping (oil + water) tanks outside surface, transmission towers, cranes, steel floors, galleries, stairways, outdoor.	upto 130°C	Sa 2½	Prime	2	P6	35	x	
							35	x	
				Intermediate	1	P7	100		x
				Finish	1	F2	50		x
						Total DFT	**220**		
2	Structural steel work, piping, indoor and outdoor	130 to 200°C	Sa 2½	Prime	1	F9	75	x	
				Intermediate	1	F9	20		x
				Finish	2	F11	20		x
							20		x
						Total DFT	**135**		
3	Structural steelwork, piping, un-insulated carbon steel, indoor and outdoor	200 to 400°C	Sa 3	Prime	1	F9	75	x	
				Intermediate	1	F12	20		x
				Finish	1	F12	**20**		x
						Total DFT	**115**		
4	Structural steel work, piping (oil + water), tanks, indoor	upto 130°C	Sa 2½	Prime	2	P6	35	x	
							35	x	
				Finish	1	F6	100		x
						Total DFT	**170**		

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SL. NO.	SURFACE/LOCATION	TEMP. °C	SURFACE PREPARATION	PAINT SYSTEM			PER COAT MICRONS Dft	APPLICATION	
				COAT	NO. OF COATS	GENERIC TYPE		IN SHOP	ON SITE
5 (a)	Structural steel work in the battery rooms, Chlorination plant and water treatment plant (extreme aggressive atmosphere)	Ambient	Sa 3	Prime	2	P8	30	x	
							30	x	
				Finish	2	F6	100		x
							100		x
						Total DFT	**260**		
(b)	Un-insulated - equipment, tanks and piping etc.	upto 80°C	Sa 3	Prime	2	P3	35	x	
							35	x	
				Finish	2	F6	100		x
							100		x
						Total DFT	**270**		
6	Steel tanks inside surface (total) for oil storage	normal	Sa 2½	Prime	2	P3	35	x	
							35	x	
				Finish	2	F6	100		x
							100		x
						Total DFT	**270**		
7	Steel tanks inside surface (total) for water storage (potable and distilled water)	normal	Sa 2½	Prime	2	P2	50	x	
							50	x	
				Finish	2	F3	30		x
							30		x
						Total DFT	**160**		
8	Cast iron water pipe lines-outside surface, buried in the soil	upto 60°C	Sa 3	Prime	2	P8	30	x	
							30	x	
				Finish	3	F7	125		x
							125		x
							125		x
						Total DFT	**435**		

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SL. NO.	SURFACE/LOCATION	TEMP. °C	SURFACE PREPARATION	PAINT SYSTEM			PER COAT MICRONS Dft	APPLICATION	
				COAT	NO. OF COATS	GENERIC TYPE		IN SHOP	ON SITE
9	Steel pipes inside surface such as cooling water lines	upto 60°C	Sa 2½	Finish	4	F7	125		x
							125		x
							125		x
							125		x
						Total DFT	**500**		
10	Water pipelines - outside surface, indoor	upto 60°C	Sa 3	Prime	2	P2	50	x	
							50	x	
				Finish	3	F3	30		X
							30		X
							30		X
						Total DFT	**190**		
11	Oil pipelines - outside surface, above ground	upto 90°C	Sa 3	Prime	2	P3	50	x	
							50	x	
				Finish	2	F6	100		x
							100		x
						Total DFT	**300**		

3.1.0 Colour Code for Piping

The colour code scheme is intended for identification of the individual group of the pipeline. The system of colour coding consists of a ground colour and colour bands superimposed on it. The colour coding for the identification of pipelines should comply with the standard and shall submit for Owner/Owner's representative's approval. (For colour code for piping and fire equipment refer Annexure-1).

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Notes :

1. Covering capacity and DFT depends on method of application. Covering capacity specified above are theoretical. Allowing the losses during application, min specified DFT should be maintained.
2. All primers and finish coats should be cold cured and air dried unless otherwise specified.
3. Selected chlorinated rubber paint should have resistance to corrosive atmosphere and suitable for marine/saline environment.
4. All paints shall conform to relevant Indian Standard and shall be applied in accordance with manufacturer's instructions for surface preparation, intervals, curing and application. The surface preparation, quality and workmanship should be ensured.
5. Technical data sheets for all paints shall be supplied at the time of submission of quotations.
6. In case of use of epoxy tie coat, manufacturer should demonstrate satisfactory test for inter coat adhesion. In case of limited availability of epoxy tie coat (P-9) alternate system may be used taking into consideration the service requirement of the system.
7. All primers should be top coated immediately as per manufacturer's recommendations.
8. In ONGC Hazira complex no sand blasting or shot blasting shall be done. All equipment shall be protected with anti-corrosive coat and after final painting only shifted to project site for further erection. Touch – up painting for the damage area during transportation can be done at project site.

3.2.0 **Specific Requirement**

3.2.1 Following paint schedules shall be followed :

- Acid resistant paint for DM plant building / structure, neutralisation pit, battery room, other corrosive area.
- Synthetic enamel paint for Structural steel, structural sheds, window grills, hand railings, etc.
- Epoxy high build paint for DM plant equipment with piping valves.

3.2.2 All steel work not embedded in concrete to be given one coat of commercial grade zinc chromate primer before painting.

3.2.3 Synthetic enamel paint :

a) General building / structure :

• Surface preparation	:	ST – 2 according to Swedish standard SIS 055900
• Primer paint	:	Two coats of Zinc phosphate in phenolic alkyd medium (DFT = 35 microns / coat)
• Finish paint	:	Two coats of Synthetic enamel (DFT = 25 microns / coat) confirming IS 2932, 1974.

b) Part of steel structure embedded in concrete :

• Surface preparation	:	ST – 2 according to Swedish standard SIS 055900
		One coat of port land cement slurry.

c) Epoxy high building coating:

• Epoxy zinc phosphate primer	:	two coats of 35 DFT per coat.
• Epoxy high build coating	:	one coat of 100 DFT.

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SECTION – 4

Guaranteed technical particulars

ONGC format – 8 Pages

2.5.0 66KV GIS

Sl. No.	Description	Unit	Data
1.	General		
2.	Name of manufacturer		
3.	Country of origin		
4.	Delivery from		
5.	Type & designation		
6.	Type tested at		
i)	Name of Laboratory		
ii)	Address of Laboratory		
7.	Installation (Indoor / Outdoor)		
8.	Standards applicable		
9.	No. of Phases		
10.	Single or Three Phase design		
11.	**Configuration**		
i)	Number of Feeder bays		
ii)	Number of transformer bays		
iii)	Number of Bus coupler bay		
iv)	GIS to transformer connection		
v)	GIS to Feeder connection		
vi)	Number of VT		
vii)	Number of SA		
viii)	Future extension possibility		
12.	**Service conditions**		
i)	Ambient Air Temp. in Deg. C		
ii)	Max Temp. in Deg. C		
iii)	Min Temp. in Deg. C		
iv)	Creepage distance, in mm/kV		
v)	Vibration level		
vi)	Noise level		
13.	**Enclosure**		
i)	Type of manufacturing		
ii)	Design temperature in Deg.C		
iii)	Material		
iv)	Material grade & applicable standard		
v)	Outside diameter in mm		
vi)	Minimum Wall Thickness, in mm		
vii)	Painting Shade & Thickness		
	a) External		
	b) Internal		
viii)	Degree of Protection		
ix)	Inductance in H/mt		
x)	Capacitance in pF/mt		
xi)	Resistance in Ohm/mt		

Sl. No.	Description	Unit	Data
xii)	Expansion Bellow		
	a) Material		
	b) Min allowable adjustable displacement c) Longitudinal d) Transverse		
xiii)	Sealing system		
	a) Type		
xiv)	Estimated life in years		
xv)	Barrier		
	a) Material		
	b) Dielectric strength		
14.	**Support Structure**		
i)	Material		
ii)	Minimum thickness of galvanizing		
iii)	Foundation channels /Anchor bolts		
15.	**Grounding**		
i)	Grounding Material		
ii)	Grounding of complete GIS		
iii)	Grounding of individual compartment		
iv)	Grounding at flange joints		
16.	**System Parameters**		
i)	Rated voltage of System in kV		
ii)	Rated voltage of Equipment in kV		
iii)			
iv)	Rated Insulation level Phase to Earth and between Phases		
a)	One Min Power Frequency withstand voltage	kVrms	
b)	Switching impulse withstand voltage,	kVp	
	- Phase to Earth		
	- Between Phases		
c)	Lightning Impulse withstand voltage,	kVp	
i)	Rated Frequency		
ii)	Rated current	Amp	
iii)	Rated current at 50 °C (equipment) in Amp		
iv)	Rated current at 50 °C (bus bar) in Amp		
v)	Rated short circuit withstand current	kArms	
	a. Duration in sec		
	b. Peak, kAp		
vi)	Enclosure withstand time for an internal fault	sec.	
vii)	Estimated total energy loss at		

Sl. No.	Description	Unit	Data
	• 100 % of rated capacity		
	• 75 % of rated capacity		
	• 50 % of rated capacity		
	• 25 % of rated capacity		
viii)	Measures taken to minimize Over Voltage		
ix)	Phase labeling		
17.	**Bus Bar**		
i)	Configuration (Single / Double)		
ii)	Nos of Phases		
iii)	Material		
iv)	Size		
v)	Rating		
vi)	Current density adopted		
vii)	Short time current withstand rating in kA		
viii)	Duration		
ix)	Resistance per phase		
x)			
xi)	SF6 immersed insulator		
xii)	Material		
xiii)	Dielectric strength		
xiv)	Maximum Partial Discharges measured at HSV		
18.	**SF6 Gas**		
i)	Applicable standard		
ii)	Quantity of SF6 Gas of complete GIS at filling pressure, in kg		
iii)	Quantity of SF6 Gas of **largest** compartment		
iv)	GIS at filling pressure, in kg		
v)	Nos of Gas compartments		
vi)	Quantity of SF6 Gas of **individual** compartment		
vii)	GIS at filling pressure, in kg		
	PRESSURE	MPa	
viii)	Design pressure		
	a) Circuit breaker		
	b) Other compartments		
ix)	Rated filling pressure		
	a) Circuit breaker		
	b) Other compartments		
x)	Type tested pressure.		
	a) Circuit breaker		
	b) Other compartments		
xi)	Routine test pressure		
	a) Circuit breaker		

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Sl. No.	Description	Unit	Data
	b) Other compartments		
xii)	Operating pressure of PRD		
	a) Circuit breaker		
	b) Other compartments		
xiii)	Alarm Pressure		
	a) Circuit breaker		
	b) Other compartments		
	c) CB lock out Pressure		
	d) Over pressure signaling		
	Maximum SF6 Gas leakage rate, in % per year		
xiv)	Density Monitor to be provided for each		
xv)	Individual gas compartment.		
xvi)	**GIS to Line connection**		
xvii)	**GIS to Transformer connection**		
19.	**Circuit Breakers**		
i)	Applicable standards	-	
ii)	Rated Voltage	kV	
iii)	Type of circuit breaker	-	
iv)	Continuous current	-	
v)	Rated short-circuit breaking current	kA (rms)	
vi)	Rated duration of short circuit	s	
vii)	Rated short circuit making current	kA	
viii)	Maximum rise of temperature over ambient for continuous current rating	°C	
ix)	Rated operating duty	-	
x)	Total Interrupting Time		
	• Minimum	ms	
	• Maximum	ms	
xi)	Closing time	ms	
xii)	Rated transient recovery voltage for terminal	kV	
xiii)	First pole to clear factor	-	
xiv)	Rated transient recovery voltage for short-line faults	kV peak	
xv)	No. of breaks in series per pole	-	
xvi)	Insulation level of the breaker		
	• One minute power frequency withstand Voltage	kV (rms)	
	• Impulse withstand voltage	kV (rms)	
	• Switching surge withstand test voltage	kV (rms)	
xvii)	Radio interference voltage		
	• Test Voltage	kV	

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Sl. No.	Description	Unit	Data
	• RI level	Micro Volt	
xviii)	Visual discharge voltage for falling power frequency voltage	kV	
xix)	Minimum clearance in air parts	mm	
xx)	Between live parts and earth	mm	
xxi)	Centre to centre distance between phases	mm	
xxii)	Type of operating mechanism		
xxiii)	Method of tripping		
	• Normal	-	
	• Emergency	-	
	• Normal voltage of trip coil	V	
xxiv)	Pick-up range	V	
xxv)	Power for tripping mechanism	W	
xxvi)	Method of closing		
	• Normal voltage of closing coils	V	
	• Power for closing mechanism	W	
xxvii)	Rated line charging breaking current	A	
xxviii)	Rated cable charging breaking current	A	
xxix)	Rated (single) capacitor bank breaking current	A	
xxx)	Critical current (current giving the longest arc when a break takes place)		
xxxi)	Maximum over voltage to earth of the circuit breaker when breaking currents of :		
	• Unloaded transformers	kV peak	
	• Unloaded line	kV peak	
	• Capacitor banks	kV peak	
	• Cable charging	kV peak	
	When switching off a synchronous system:		
	• Maximum current	kA	
	• Maximum recovery voltage between contacts of one pole	kA	
xxxii)	Number of operations, the circuit breaker is capable of performing without inspection, replacement of contacts or other main parts at		
	• Rated interrupting capacity	-	
	• Rated continuous current	-	
xxxiii)	Overall dimension of complete 3-phase circuit breaker with structure	Dwg enclosed Yes/No	
xxxiv)	Weight of complete 3-phase circuit breakers	kg	
xxxv)	Whether all type test reports as per latest relevant standards are enclosed ?	Yes/ No	
xxxvi)	Whether literature enclosed giving details of arching chamber, main and arching	Yes/No	

Sl. No.	Description	Unit	Data
	contacts.		
xxxvii)	Air compressor		
	• Type	-	
	• Make	-	
	• Capacity	l/minute	
	• Rated pressure	kg/cm²	
xxxviii)	Safety valve opens on		
xxxix)	Compressor operations		
	• Start at	kg/cm²	
	• Stop at	kg/cm²	
xl)	Alarm switch closes on air receiver at	kg/cm²	
xli)	Permissible minimum pressure	kg/cm²	
xlii)	Lockout switch on air receiver operation, at pressure		
	• for closing	kg/cm²	
	• for opening	kg/cm²	
	• for autoreclosure duty	kg/cm²	
xliii)	Time for air compressor to charge the storage reservoirs		
	• from atmospheric to pressure specified	minutes	
xliv)	Number of stored close-open operations		
20.	**Disconnectors**		
i)	Type of Disconnector		
ii)	Rated Voltage	kV	
iii)	Current rating		
	• Continuous at site conditions	A	
	• Dynamic	kA	
	• One second	kA	
iv)	One minute power frequency wet withstand voltage		
	• Across the isolating distance	kV	
	• To earth and between poles	kV	
	1.2 x 50 □s impulse withstand voltage (+ polarity)		
	• Across the isolating distance	kV peak	
	• To earth and between poles	kV peak	
v)	Contacts and material of current carrying parts	-	
vi)	Type of main and arcing contacts	-	
vii)	Material of contacts (main & arcing)	-	
viii)	Whether contacts are silver faced	Yes/No	
ix)	Operating mechanism Manual/ pneumatic/ motor		
21.	**Insulator Data**		
i)	Type	-	
ii)	Number of units	mm	
iii)	Cantilever strength upright	kg	

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Sl. No.	Description	Unit	Data
iv)	Creepage distance (total & protected)		
22.	**Current Transformers**		
i)	Application	-	
ii)	Nominal system voltage & frequency	kV, Hz	
iii)	Highest System voltage	kV	
iv)	No. of cores	-	
v)	Current transformer ratio	A	
vi)	Secondary current	A	
vii)	Short time thermal rating	kA	
viii)	Class of Insulation	-	
ix)	Cantilever strength of CT at the terminal	kgm	
x)	Creepage distance total	mm	
23.	**Voltage Transformer**		
i)	Type		
ii)	Application	-	
iii)	Nominal/Highest System Voltage	kV	
iv)	Power frequency	Hz	
v)	Rated primary voltage	kV	
vi)	Rated secondary voltage	kV	
vii)	No. of secondary windings	-	
viii)	Rated burden	VA	
ix)	Accuracy class	-	
x)	Class of winding insulation	-	
xi)	Creepage distance (total)	mm	
xii)	1.2/50 □s impulse voltage withstand	kV peak	
xiii)	One minute power frequency voltage withstand	kV	
24.	**Surge Arresters**		
i)	Type of arrester	-	
ii)	Nominal System Voltage	kV	
iii)	Rating	kA	
iv)	Rated Arrester Voltage/ Continuous Operating Voltage	kV	
v)	Nominal Discharge current of 8/20 Micro second wave shape	kA	
vi)	Impulse current with stand		
	• Low current long duration discharge Class (as per IEC 99)	-	
	• High current short duration test value (4/10 □s Wave)	kA	
	• Low current long duration test value	kA	
	• Virtual duration of rectangular wave	□s	
	• Residual voltage corresponding to	-	
	• Steep current impulse	kV peak	
	• Lightning impulse	kV peak	
	• Switching impulse	kV peak	
	• Line Discharge class (As per IEC	kV peak	

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Sl. No.	Description	Unit	Data
	TC37 WG-4 1985)		
vii)	Arrester Housing withstand test voltages		
	• One minute power frequency dry & wet	kV (rms)	
	• 1.2/50 micro-second impulse	kV peak	
viii)	Creepage Distance	mm	
ix)	Minimum Cantilever strength of arrester Assembly		
x)	Pressure Relief Class (As per IEC-99)	-	
xi)	Minimum prospective symmetrical fault current	kA	
25.	**Bus Post Insulator for OHL Bushing**		
i)	Make and country of manufacturer	-	
ii)	Type	-	
iii)	Voltage class	kV	
iv)	Total creepage distance	mm	
v)	Cantilever strength	kg	
vi)	Withstand Voltages		
	• 1 min power frequency (Dry)	kV	
	• 1 min power frequency (wet)	kV	
	• 1.2/50 micro sec. Impulse (Dry)	kV peak	
	• 1.2/50 micro sec. Impulse (wet	kV peak	
vii)	Puncture voltage	kV peak	
26.	**Disc Insulator**		
i)	Voltage class	-	
ii)	Make and country of manufacturer	-	
iii)	Type	-	
iv)	Creepage distance	mm	
v)	Electromechanical strength	kg	
vi)	Withstand voltages		
	• 1 min power frequency (Dry)	kV	
	• 1 min power frequency (wet)	kV	
	• 1.2/50 micro sec impulse (Dry)	kV peak	
	• 1.2/50 micro sec. impulse (wet)	kV peak	
vii)	Puncture voltage	kV peak	
27.	**Protection Relays** (Shall be furnished for all relays)		
i)	Make and country of manufacturer		
ii)	Type		
iii)	Relay burden at rated voltage	VA	
iv)	Indication provided		

SECTION – 5

MANUFACTURING QUALITY PLAN

Bidder to follow approved quality plan of BHEL/Customer

SECTION – 6
CHECK LIST
FOR 66KV GIS

Sl.	Particulars	Reply by bidder.	
1	**TECHNICAL QUALIFYING REQUIREMENT**		
1.1	The Bidder to furnish relevant documents for meeting the qualifying requirement. Performance certificates shall be submitted in English. Translated pages should be attested by the ultimate customer, if attested only by the bidder it shall be notarised.	Confirmed	Yes/No
1.2	The bid shall be submitted by the Manufacturer of GIS. The bidder's scope includes supply and services like • supervision of installation, • Testing and commissioning. Bids submitted by agents will not be considered.	Confirmed	Yes/No
1.3	All the documents shall be submitted in English. Translated pages should be attested by the bidder.	Confirmed	Yes/No
2	**Un-priced Offer** –.		
2.1	Confirm that all items have been quoted. (If any item has not been quoted, the same shall be specifically brought out)	Confirmed	Yes/No
2.2	Any other item /service required for the execution for the complete job is deemed to be included in the offer, whether specifically mentioned in the specification or not. List of items along with their respective quantities required for completeness (Attach list, if required).	List of Additional items required attached	Yes/No
2.3	**Building** for GIS shall be constructed by Civil contractor based on the input (configuration, loads etc) provided by bidder. The supply of all structural material to be embedded like foundation bolts as well as consumables like grouting material shall be in scope of bidder shall be in scope of bidder. The erection of structure shall be done by BHEL.	Confirmed	Yes/No
2.4	**SF6 GIS to XLPE Cable Termination** - Interface for connecting XLPE cable, structures etc shall be provided by the bidder as per of section-2. Limit of supply, services between GIS manufactures and cable termination shall be as per 62271-209 for cable termination The typical arrangement drawing of interconnecting bus-duct from GIS bay module to XLPE cable termination end shall be submitted along with offer.	Confirmed, submitted along with offer.	Yes/No
2.5	Confirm that the consumables (list to be enclosed by bidder during contract stage) with shelf life of fewer than two years shall be supplied	Confirmed	Yes/No

Sl.	Particulars	Reply by bidder.	
	before erection after clearance from BHEL.		
2.6	Detailed list of Commissioning spares for testing & commissioning of GIS till handing over	Attached	Yes/No
2.7	Detailed list of Tools & tackle & Testing Equipment	Attached	Yes/No
2.8	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
2.9	The scope of supply shall also include all erection and mounting hardware and interconnecting cables within GIS.	Confirmed	Yes/No
2.10	Design philosophy of earthing submitted with the bid	Confirmed	Yes/No
2.11	Design of Earthing of GIS shall be in bidder scope. The items and accessories required for completeness of earthing shall be in bidder's scope. Mesh on floor shall be provided by BHEL as per bidder's design.	Confirmed	Yes/No
3	**Technical**		
3.1	Size of EOT crane , if required and GIS room size required submitted with the offer	Confirmed	Yes/Nc
3.2	Thermal rating for all current carrying parts shall be minimum 3 s for 40 kA.	Confirmed	Yes/Nc
3.3	Internal components maintenance free for at least 10 years	Confirmed	Yes/Nc
3.4	Material of enclosure – non-magnetic material	Confirmed	Yes/Nc
3.5	Requirement of AC and DC auxiliary loads	Enclosed with bid	Yes/Nc
3.6	Catalogues of GIS	Enclosed with bid	Yes/Nc
3.7	Catalogues of all Maintenance equipment. Bidder to confirm that offered equipment meets the requirements of specification.	Enclosed with bid	Yes/Nc
4	**Calculations**		
4.1	The design of the equipment shall be such that the agreed permitted movement of foundations and mechanical or thermal effects do not impair the assigned performance of the equipment.	Confirmed	Yes/Nc
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/Nc
4.3	Measures to limit external overvoltages (e.g. surge arresters) should be considered and detailed out based on the site conditions etc.	Enclosed with bid	Yes/N
5	**Technical Deviations**		
5.1	Confirm that the Complete systems have been offered as per the requirements of Technical Specification and Technical Deviation sheet has been submitted. Deviations mentioned elsewhere in the bid will not	Confirmed	Yes/N

Sl.	Particulars	Reply by bidder.	
	be considered.		
6	**Barchart**		
6.1	Bidder will submit detailed bar chart indicating all the milestones from Engineering till manufacturing/ testing, dispatch to site and commissioning based on the drawing & document schedule attached in section1.	Confirmed	Yes/No
7	**Conditions**		
7.1	Store shall be provided by BHEL for GIS and accessories. Confirm that the space required for the material being supplied, both indoor and outdoor has been indicated.	Details given with the bid.	Yes/No
8	**Site Test**		
8.1	Only special tools shall be in bidder's scope. Bidder to submit list of tools, tackle, slings, spanners, gauges, slings and other lifting devices, drills, instruments and appliances necessary for the complete assembly and erection at site of the GIS, required for installation, gas filling, maintenance, site testing of the GIS which shall be arranged by BHEL. HV Test kit shall be in scope of bidder. EOT cranes shall be provided by BHEL in GIS Hall as per size recommended by bidder.	Confirmed	Yes/No
8.2	Bidder to furnish detailed BOQ for non-returnable Tools and Tackles along with unit prices to be handed over to ultimate customer.	Details given with the bid.	Yes/No
8.3	All field tests including tests during installation, pre-commissioning, commissioning, field acceptance tests shall be conducted by the Contractor, in presence of representative of the Employer. No separate site test will be conducted by BHEL/Customer	Confirmed	Yes/No
9	**TYPE TESTS REQUIREMENTS**		
9.1	The 66kV 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 66 kV GIS shall be submitted alongwith the bid. Differences, if any, in the items offered and those which have been type tested shall be clearly brought out alongwith explanation for suitability.	Confirmed and enclosed with bid	Yes/No
9.3	In case the test reports are not found technically valid during contract stage by BHEL/ONGC, 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	Confirmed	Yes/No